NATIONAL GREENHOUSE GAS INVENTORY REPORT

1990-2012

TURKISH STATISTICAL INSTITUTE

NATIONAL GREENHOUSE GAS INVENTORY REPORT 1990-2012

Annual Report submission under the "Framework Convention on Climate Change"

TURKISH STATISTICAL INSTITUTE

Contact: **Turkish Statistical Institute (TurkStat)**

Aynur TOKEL (National Emission Inventory Focal Point)
Turkish Statistical Institute
Tel: +90-312-4100361
e-mail: aynur.tokel@tuik.gov.tr

Fatma Betül BAYGÜVEN
Turkish Statistical Institute
Tel: +90-312-4100362
e-mail: betul.bayguven@tuik.gov.tr

Erhan ÜNAL
Turkish Statistical Institute
Tel: +90-312-4100364
e-mail: erhan.unal@tuik.gov.tr

Turkish Statistical Institute is responsible for General, Energy Sector (except for 1.A.3 Transport and 1.A.1.a Public Electricity and Heat Production), Industrial Processes, solvent and Other Product Use, Agriculture and Waste.

Ministry of Energy and Natural Resources

Ergün KOÇ
Ministry of Energy and Natural Resources
Tel: +90-312-2126420/7610
e-mail: ekoc@enerji.gov.tr

Pelin HABERAL
Ministry of Energy and Natural Resources
Tel: +90-312-2126420/7610
e-mail: phaberal@enerji.gov.tr

Çınla DEMİRCİGİL AKKAŞOĞLU
Ministry of Energy and Natural Resources
Tel: +90-312-2126420/7584
e-mail: cdemircigil@enerji.gov.tr

Ministry of Energy and Natural Resources is responsible for energy balance tables and for the section 1.A.1.a Public Electricity and Heat Production.

Ministry of Food, Agriculture and Livestock

Hakan ERDEN, PhD
Ministry of Ministry of Food, Agriculture and Livestock
Tel: +90-312-2587801
e-mail: herden45@gmail.com

Assoc.Prof.Dr. Yusuf SERENGİL
İstanbul University, Faculty of Forestry
The Department of Watershed Management
Tel: +90-212-2261100/25339
e-mail: serengil@istanbul.edu.tr

Ministry of Food, Agriculture and Livestock is responsible for LUCF

Ministry of Transport, Maritime Affairs and Communications

Seda İSTANBULLU
Ministry of Transport, Maritime Affairs and Communications
Tel: +90-312-2032268
e-mail: seda.istanbullu@udhb.gov.tr

Lale KARAYAKA
Ministry of Transport, Maritime Affairs and Communications
Tel: +90-312-2031409
e-mail: lale.karayaka@udhb.gov.tr

Burak ÇİFTÇİ
Ministry of Transport, Maritime Affairs and Communications
Tel: +90-312-2031903
e-mail: Burak.ciftci@udhb.gov.tr

Rabia Betül KARADENİZ
Ministry of Transport, Maritime Affairs and Communications
Tel: +90-312-2031914
e-mail: betul.karadeniz@udhb.gov.tr

Ministry of Transport, Maritime Affairs and Communications is responsible for transport sector.

Ministry of Forest and Water Affairs

Çağlar BAŞSÜLLÜ, PhD
Ministry of Forest and Water Affairs-General Directorate of Forestry
Tel:+90-312-2481754
e-mail: caglarbassullu@ogm.gov.tr

Eray ÖZDEMİR
Ministry of Forest and Water Affairs-General Directorate of Forestry
Tel:+90-312-2481751
e-mail: erayozdemir@ogm.gov.tr

Ministry of Forest and Water Affairs is responsible for forestry sector.

Ministry of Environment and Urbanization

Şule ÖZKAL
Ministry of Environment and Urbanization
Tel: +90-312-5863168
e-mail: sule.ozkal@csb.gov.tr

Orhan SOLAK
Ministry of Environment and Urbanization
Tel: +90-312-5863292
e-mail: orhan.solak@csb.gov.tr

Tuba SEYYAH
Ministry of Environment and Urbanization
Tel: +90-312-5863167
e-mail: tuba.seyyah@csb.gov.tr

Ministry of Environment and Urbanization is responsible for F-gases.

Ministry of Food, Agriculture and Husbandry

Hakan ERDEN, PhD
Ministry of Ministry of Food, Agriculture and Husbandry
Tel: +90-312-2587801
e-mail: herden45@gmail.com

Prof.Dr. Yusuf SERENGİL
İstanbul University, Faculty of Forestry
The Department of Watershed Management
Tel: +90-212-2261100/25339
e-mail: serengil@istanbul.edu.tr

Ministry of Food, Agriculture and Husbandry is responsible for LULUC

Note: The sections pertaining to the related sectors in this report and the CRF tables are prepared by the related organizations described above. LULUCF NIR is prepared by “Ministry of Food, Agriculture and Livestock” and “Ministry of Forestry and Water Affairs”.

EXECUTIVE SUMMARY

ES.1 Background information on greenhouse gas inventories

Turkey, as a party to the United Nations Framework Convention on Climate Change (UNFCCC), reports annually on greenhouse gas (GHG) inventories. The National Inventory Report, 2012 contains national greenhouse gas emission estimates for the period 1990-2012.

The Turkish Statistical Institute (TurkStat) is the responsible agency for compiling the National Greenhouse Gases Inventory. Turkey's greenhouse gas emissions inventory is prepared by "Greenhouse Gas Emissions Inventory Working Group" which is set up by decision of the Coordination Board on Climate Change (CBCC). TurkStat is the responsible organization for the coordination of working group. Moreover, TurkStat has been designated as the focal point of National Emission Inventory by the decision taken by CBCC in 2009.

The Official Statistics Programme (OSP), based on the Statistics Law of Turkey No: 5429, has been prepared for a 5-year-period in order to determine the basic principles and standards dealing with the production and dissemination of official statistics and to produce reliable, timely, transparent and impartial data required at national and international level. The responsibility for compiling the National Greenhouse Gas Inventory has also been given to TurkStat by the Official Statistics Programme. The inventory preparation is a joint work of GHG emission inventory working group.

The main institutions involved in GHG inventory;

- Turkish Statistical Institute (TurkStat),
  (Environment, Energy and Transport Statistics Department)
- Ministry of Food, Agriculture and Livestock (MFAL),
  (General Directorate of Agrarian Reform)
- Ministry of Forestry and Water Affairs (MFWA),
  (General Directorate of Forest)
- Ministry of Environment and Urbanization (MoEU),
  (General Directorate of Environmental Management)
- Ministry of Transport, Maritime Affairs and Communications (MTMAC),
  (General Directorate of Foreign Affairs and European Union)
- Ministry of Energy and Natural Resources (MENR).
  (General Directorate of Energy Affairs)

The National Greenhouse Gas Emissions (GHG) are calculated by using Revised 1996 IPCC Guidelines, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. The Emission Inventory includes direct GHGs as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), F gases, and GHG precursors as nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and carbon monoxide (CO), and GHG precursor SO_2 emissions originated from energy, industrial processes, solvent and other product use, agricultural activities, and waste. The emissions and removals from land use, land use change and forestry are also included in the inventory

ES.2 Summary Of the national emission and removal related trends

Turkey's total greenhouse gas emissions, excluding the land use, land use change and forestry (LULUCF) sector, were estimated to be 439.9 million tonnes (Mt) of carbon dioxide equivalent (CO_2-eq) in 2012. This represents an increase of 15.8 Mt, or 3.72%, on emissions in 2011, and an increase of 133.4% above 1990 levels (Table ES.1).

ES.1 Greenhouse gas emissions (Excluding LULUCF), 1990-2012

	1990	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**
Total (Excluding LULUCF) million tonnes (CO_2 equivalent)	188.5	238.9	298.1	330.7	403.5	424.1	439.9
Change compared to 1990 (%)	-	26.7	58.2	75.5	114.1	125.0	133.4

Turkey's total greenhouse gas emissions, including the LULUCF sector, were 380.1 Mt CO_2-e in 2012. Overall, total emissions increased 4.6% as compared to 2011 emissions. There is 163.2% increase from 1990 to 2012 (Table ES.2).

ES.2 Overview of GHG emissions and removals, 1990-2012 in CO_2-equivalents

(million tonnes CO_2 equivalent)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2009	2010	2011	2012
CO_2 emissions including net CO_2 from LULUCF	97.49	126.52	175.55	210.06	243.32	269.00	284.91	297.68
CO_2 emissions excluding net CO_2 from LULUCF	141.56	174.09	225.61	259.79	299.67	326.85	345.73	357.50
CH_4	34.05	47.39	53.68	52.55	53.75	57.30	58.05	61.62
N_2O	12.22	16.82	17.14	14.67	13.91	14.15	13.73	14.79
HFCs	NA,NE	NA,NE	0.82	2.38	2.84	4.01	5.31	4.68
PFCs	0.60	0.52	0.52	0.49	0.17	0.31	0.32	0.31
SF6	NA,NE	NA,NE	0.32	0.86	0.80	0.88	0.95	0.97
Total (including LULUCF)	144.36	191.25	248.03	281.01	314.80	345.65	363.26	380.06
Total (excluding LULUCF)	188.43	238.82	298.09	330.74	371.15	403.49	424.09	439.87

Overall greenhouse gas (GHG) emissions as CO_2 equivalent for the year 2012 were 439.9 million tonnes (excluding LULUCF). In overall 2012 emissions, the energy sector had the largest portion with 70.2%. The energy sector was followed by the industrial processes with 14.3%, the waste with 8.2% and the agricultural activities with 7.3%. GHG emissions by sector are given in table ES.3.

ES.3 Greenhouse gas emissions by sectors, 1990 – 2012

(million tonnes CO_2 equivalent)

Year	Energy	Industrial processes	Agriculture	Waste	Total (Excluding LULUCF)
1990	132.9	15.5	30.4	9.7	**188.5**
1991	138.8	17.8	31.0	13.1	**200.7**
1992	145.1	19.0	30.9	16.7	**211.8**
1993	151.6	21.0	31.1	19.5	**223.1**
1994	149.4	19.3	29.8	20.1	**218.6**
1995	161.5	24.3	29.2	23.9	**238.9**
1996	179.7	24.4	29.7	26.3	**260.0**
1997	192.1	24.2	28.2	28.7	**273.2**
1998	191.3	24.8	28.9	30.2	**275.2**
1999	191.3	24.0	29.1	31.6	**276.0**
2000	213.2	24.4	27.8	32.6	**298.1**
2001	196.6	23.4	26.4	32.7	**279.1**
2002	204.6	25.6	24.9	32.0	**287.1**
2003	218.6	26.3	25.8	32.8	**303.6**
2004	228.0	28.6	25.4	31.1	**313.1**
2005	242.4	28.8	26.3	33.3	**330.7**
2006	259.2	31.0	27.0	33.7	**350.9**
2007	289.4	31.0	26.8	35.3	**382.4**
2008	278.4	31.7	25.5	33.2	**368.7**
2009	279.0	33.2	26.1	32.9	**371.1**
2010	285.1	55.7	27.1	35.6	**403.5**
2011	301.3	58.6	28.8	35.3	**424.1**
2012	308.6	62.8	32.3	36.2	**439.9**

In 2012, Turkey's total primary energy supply was 120.1 mtoe, a 4,9% increase compared to 2011. Oil had a share of 30.61 mtoe while coal and gas accounted for 20.32 mtoe and 37.37 mtoe respectively. Renewables accounted for 9.62 mtoe.

As shown in table ES.3, emissions from energy increased 2.4% to 308.6 million tonnes (Mt) CO_2 eq. in 2012 as compared to 2011. There is 132.26% increase as compared to 1990. Emissions in the Industrial Processes sector increased to 62.8 Mt CO_2 eq. in 2012 which is 7.1% higher than the emnissions in 2011. Emissions in the agriculture and waste sectors are 32.3 and 36.2 Mt CO_2 eq respectively in 2012.

ES.3 Overwiev of the source and sink category emission estimates and trends

The highest portion of total CO_2 emissions was originated from energy sector with 84.4%. The remaining 15.6% was originated from industrial processes in 2012. CO_2 emissions from energy increased 2.4 compared to 2011 137.8% as compared to 1990. CO_2 emissions industrial processes increased 9.5 compared to 2011, 279.9% as compared to 1990. Big change from 1990 is mainly due to the inclusion of coke used in iron and steel industry under the industrial process category after 2010.

The highest portion of CH_4 emissions was originated from waste with 55.7% while 34.8% was from agricultural activities, and 9.5% was from energy and industrial processes. CH_4 emissions from agriculture increased 12.6% compared to 2011. It increased 3.6% as compared to 1990. CH_4 emissions from waste increased 2.6% compared to 2011. However, it increased 311.7% as compared to 1990 depending on increase in the amount of managed waste.

While 73.4% of N_2O emission was from agricultural activities, 12.8% of that was from waste, 7.1% was from industrial processes, and 6.7% was from energy. There is a 7.7% and 21% increase in N_2O emissions as compared to 2011 and 1990 respectively. GHG emissions by sector are given in table ES.4.

ES.4 GHG emissions, 1990 - 2012

(thousand tonnes)

Greenhouse Gas Sources	1990	1995	2000	2005	2010	2011	2012
CO_2 Emissions							
Total	**141560.0**	**174087.1**	**225608.6**	**259791.0**	**326848.5**	**345734.3**	**357498.2**
Energy	126898.7	155534.4	207230.7	236540.9	277516.3	294860.5	301798.5
Industrial processes	14661.3	18552.7	18377.8	23250.1	49332.2	50873.7	55699.6
CH_4 Emissions							
Total	**1621.6**	**2256.8**	**2556.3**	**2502.5**	**2728.7**	**2764.2**	**2934.4**
Energy	237.6	231.2	223.6	207.3	286.9	260.8	276.8
Industrial processes	2.4	2.3	2.3	2.2	3.9	4.2	2.7
Agriculture	984.6	957.8	853.1	790.7	832.2	906.6	1020.4
Waste	397.0	1065.5	1477.3	1502.4	1605.7	1592.6	1634.6
N_2O Emissions							
Total	**39.4**	**54.3**	**55.3**	**47.3**	**45.6**	**44.3**	**47.7**
Energy	3.2	3.6	4.2	4.9	5.1	3.2	3.2
Industrial processes	0.4	16.4	13.8	5.7	3.4	3.4	3.4
Agriculture	31.3	29.4	32.0	31.2	31.1	31.6	35.0
Waste	4.5	4.8	5.2	5.5	5.9	6.0	6.1

ES.4 Indirect greenhouse gas emissions

Emissions of CO, NO_x, NMVOC are also included in the report because they influence climate change indirectly. Table ES 5 shows the indirect GHG emissions. CO emissions are 1.3 Mt in 2012 and 97% is from energy sector. NO_x emissions are about 3 Mt in 2012 and 93% of which is from energy. NMVOC emissions are 1.5 Mt in 2012. The largest portion is from industrial processes with, 65% and it is followed by energy with 29%.

ES.5 Indirect GHG emissions, 1990 - 2012

(thousand tonnes)

	1990	1995	2000	2005	2010	2011	2012
CO Emissions							
Total	**643.7**	**814.0**	**1036.9**	**1072.3**	**1287.7**	**1293.8**	**1283.7**
Energy	628.6	789.5	1009.7	1049.2	1256.3	1259.7	1249.8
Industrial processes	10.9	20.6	22.9	18.3	27.1	29.4	29.6
Agriculture	4.1	3.8	4.4	4.8	4.3	4.6	4.3
NO_x Emissions							
Total	**3643.9**	**4678.8**	**4297.4**	**3260.6**	**3483.9**	**2964.2**	**2988.3**
Energy	3445.5	4491.6	4090.5	3036.1	3287.6	2751.3	2792.4
Industrial processes	16.5	17.8	13.4	14.8	10.9	11.6	7.8
Agriculture	182.0	169.4	193.5	209.7	185.4	201.2	188.1
NMVOC Emissions							
Total	**543.9**	**1025.1**	**1109.3**	**1152.6**	**1566.7**	**1526.1**	**1474.4**
Energy	471.9	635.1	607.7	476.5	531.4	428.3	428.3
Industrial processes	39.8	352.5	456.8	613.7	963.2	1021.5	970.4
Solvent and other product use	32.2	37.5	44.8	62.4	72.1	76.3	75.7

Tables

Graphs

Symbol and Abbreviations

AD	Activity data
AMA	Automotive Manufacturers Association
BEF	Biomass Expansion Factor
BOD	Biochemical oxygen demand
C	Data pertaining to units which has less than three statistical units are not given by Law No:5429 which is indicated.
CO	Carbonmonoxide
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalent
COP	Conference of the Parties
CORINE	Coordination of Information on the Environment
CH_4	Methane
CRF	Common Reporting Format
EF	Emission Factor
FAO	Food and Agriculture Organization
FOD	First Order Decay
Gg	Gigagram
GDAR	General Directorate of Agricultural Reform
GDF	General Directorate of Forestry
GDP	Gross Domestic Product
GDSWA	General Directorate of State Water Affairs
GHG	Greenhouse Gas
GPG	Good Practice Guidance
GW	Gigawatt
GWh	Gigawatt Hour
HFC	Hydrofluorocarbon
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land Use, Land Use Change and Forestry
LTO	Landing and Takeoff Cycle
MCT	Ministry of Customs and Trade
MENR	Ministry of Energy and Natural Resources
MoEU	Ministry of Environment and Urbansation
MFAH	Ministry of Food, Agriculture and Husbandary
MFWA	Ministry of Forest and Water Affairs
Mt	Million tonnes
Mtoe	Million Tonnes Oil Equivalent
MTMAC	Ministry of Transport, Maritime Affairs and Communications
MW	Megawatt
N_2O	Nitrousoxide
NO_x	Nitrogenoxide
NMVOC	Non-Methane Volatile Organic Compounds
NSCR	Non-Selective Catalytic Reduction

OSD	Turkish Automotive Manufacturers Association
PETDER	Petroleum Manufacturers Association of Turkey
PFC	Perfluorocarbon
QA	Quality Assurance
QC	Quality Control
SF_6	Sulphurhexafluoride
SO_2	Sulphurdioxide
TCMA	Turkish Cement Manufacturer's Association
TLA	Turkish Lime Association
TPES	Total Primary Energy Supply
TL	Turkish Liras
TJ	Terajoule
TCMA	Turkish Cement Manufacturers' Association
TurkStat	Turkish Statistical Institute
TWh	Terawatt Hour
UNFCCC	United Nations Framework Convention on Climate Change
Note.	Figures in the table may not add up to the total due to rounding to the closest integer

1. INTRODUCTION

1.1 Background information on greenhouse gas inventories

In 2004, the United Nations Framework Convention on Climate Change (UNFCCC) and in 2009, The Kyoto Protocol were ratified by Turkey. As an Annex I party to Convention, Turkey is required to develop annual inventories on emissions and removals of greenhouse gases (GHG) not controlled by the Montreal Protocol using the Revised Intergovernmental Panel on Climate Change (IPCC) Guidelines and IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Inventory covers all emissions and removals sources described in IPCC Guidelines.

The National Greenhouse Gas Emissions (GHG) are calculated by using Revised 1996 IPCC Guidelines, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. The Emission Inventory includes Direct GHGs as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs), and GHG precursors as nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOC) and carbon monoxide (CO), and GHG precurser SO_2 emissions originated from energy, industrial processes, solvent and other product use, agricultural activities, and waste. The emissions and removals from land use, land use change and forestry are also included in the inventory

In this report, the national greenhouse gas (GHG) emissions from 1990 to 2012, emission sources, emission factors, difference between reference and sectoral approach, emission trends, fluctuations, changes, uncertainty estimations and key source categories were evaluated in detail.

1.2 Institutional arrangements

The Turkish Statistical Institute (TurkStat) is the responsible agency for compiling the National Greenhouse Gases Inventory. Turkey's greenhouse gas emissions inventory is prepared by "Greenhouse Gas Emissions Inventory Working Group" which is set up by decision of the Coordination Board on Climate Change (CBCC). Turkish Statistical Institute (TurkStat) is the responsible organization for the coordination of working group. Moreover, TurkStat has been designated as the focal point of National Emission Inventory by the decision taken by CBCC in 2009.

The Official Statistics Programme (OSP), based on the Statistics Law of Turkey No 5429, has been prepared for a 5-year-period in order to determine the basic principles and standards dealing with the production and dissemination of official statistics and to produce reliable, timely, transparent and impartial data required at national and international level. The responsibility for compiling the National Greenhouse Gas Inventory has also been given to TurkStat by the Official Statistics Programme. The inventory preparation is a joint work of GHG emission inventory working group.

The main institutions involved in GHG inventory;

- Turkish Statistical Institute (TurkStat),
  (Environment, Energy and Transport Statistics Department)
- Ministry of Food, Agriculture and Livestock (MFAL),
  (General Directorate of Agrarian Reform)
- Ministry of Forestry and Water Affairs (MFWA),
  (General Directorate of Forest)
- Ministry of Environment and Urbanization (MoEU),
  (General Directorate of Environmental Management)
- Ministry of Transport, Maritime Affairs and Communications (MTMAC),
  (General Directorate of Foreign Affairs and European Union)
- Ministry of Energy and Natural Resources (MENR).
  (General Directorate of Energy Affairs)

The emissions from energy sector were calculated by TurkStat using the energy-balance tables of Ministry of Energy and Natural Resources (MENR). The emissions from electricity generation were calculated on the basis of all power plants fuel consumption by the Ministry of Energy and Natural Resources and the emissions from the transportation sector is calculated by the Ministry of Transport, Maritime Affairs and Communications. Emissions and removals from land use, land-use change and forestry were provided by the Ministry of Food, Agriculture and Livestock and the Ministry of Forestry and Water Affairs. Emissions from F-gases are estimated by the Ministry of Environment and Urbanization. Emissions from fuel combustion except for public electricity and heat production, and transport, the fugitive emissions, emissions from industrial processes, solvent and other product use, agricultural activities, waste were calculated by

Turkish Statistical Institute. TurkStat compiles national emission inventory, and submits to the UNFCCC Secretariat.

1.3 Brief description of the process of inventory preparation

Main steps in the annual inventory preparation process are summurized below.

1.1 Time schedule for preparation of the "t-2" annual inventory submission

	Activity	**Start date**	**Deadline**
1.	Inventory planning by GHG Inventor Working Group (Creating Inventory Improvement Plan, recalculation, etc.)	01.05.XX-1	30.09.XX-1
2	Reviewing emission calculation methods, EFs, activity data sources, etc. by GHG Inventor Working Group	15.09.XX-1	30.11.XX-1
3.	Collection of activity data and quality control of the data by the institutions involved	01.11.XX-1	31.12.XX-1
4.	Calculation of all emissions from electricity production, transportation, F-gas, emissions and removal from LULUCF by the related Institutions, and transfer to TurkStat.	15.12.XX-1	15.02.XX
5.	Calculation of emissions under the responsibility of Turkstat	15.12.XX-1	15.02.XX
6.	Quality control of the calculated emissions (recalculation by TurkStat IT solution)	15.12.XX-1	15.02.XX
7.	Preparation of the CRF tables by TurkStat	15.02.XX	15.03.XX
8.	Performing key source, trend and uncertainty analysis by TurkStat	15.02.XX	15.03.XX
9.	Preparation of Emission Inventory Report by by the institutions involved and compilation by TurkStat	15.02.XX	31.03.XX
10.	Approval of National Greenhouse Gas Emission Inventory by Inventory Focal Point	01.04.XX	10.04.XX
11	Release of the National Greenhouse Gas Inventory as news release on Turkstat webpage.	01.04.XX	10.04.XX
12.	Reporting of Inventory to UNFCCC Secretariat by TurkStat	10.04.XX	15.04.XX
13.	Documentation and archiving processes	15.04.XX	30.05.XX

1.4 Brief general description of methodologies and data sources

The National Greenhouse Gas Emissions (GHG) are calculated by using Revised 1996 IPCC Guidelines, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Emissions from energy is calccculated by using tier 1 approach except public electricity and heat production and civil aviation for which tier 2 is used. Emissions from Industial process except iron and steel production for which tier 2 is used, solvent other product use, agriculture, and waste are calculated by using tier 1 approach.
Data sources of inventory are listed below.

1.2 Activity data sources for GHG emissions inventory

Sector	Category	Activity Data Source
Energy	Energy – 1 (excluding 1.A.1.a – Electricity and heat generation and 1.A.3 – Transportation)	MENR
	Electricity and Heat Generation – 1.A.1.a	MENR
	Transportation – 1.A.3	TurkStat MENR MTMAC
Industrial Process	Industrial Process – 2	TurkStat
	Cement Manufacturing - 2.A.1	TurkStat & TCMA
	Lime Manufacturing - 2.A.2 Lime Stone and Dolomite Use - 2.A.3	TurkStat & TLA
	Aluminum Manufacturing - 2.C.3	TurkStat & ETİ Aluminum Co. Inc.
	Halocarbon and SP6 consumption - 2.F	MCT, TurkStat
Solvent and other product use	Dye use – 3.A	TurkStat & Automobile Manufacturing Association
	Chemicals manufacturing and processing – 3.C	TurkStat
Agriculture	Agriculture – 4	TurkStat
Land Use, Land Use Change and Forestry	LULUCF - 5	MFWA, MFAL
Waste	Waste – 6	TurkStat

1.5 Brief description of key source categories

According to the IPCC Good Practice Guidance (GPG, 2000), emission sources that contribute to the 95% of the total emissions as CO_2 equivalent, are classified as a key source category. Based on the key source analysis including Land Use, Land-Use Change and Forestry (LULUCF) the followings are determined as key sources in 2012;

- 5. LULUCF (CO_2),
- 1.A.1.a Public electricity and heat production (CO_2),
- 1.A.3.b Road transportation (CO_2),
- 2.A.1 Cement production (mineral products) (CO_2),
- 1.A.4.b Residential (CO_2),
- 6.A.1 Solid waste disposal (managed) (CH_4),
- 2.C.1 Iron and steel production (CO_2),
- 4.A Enteric fermentation (CH_4),
- 6.A.2 Solid waste disposal (unmanaged) (CH_4),
- 1.A.2.f Cement production (CO_2),
- 1.A.2.f Other industries (CO_2),
- 2.F Emission of HFCs (HFC-134a),
- 4.D.1.1 Agricultural soil (synthetic fertilizer) (N_2O),
- 2.A.2 Lime production (mineral products) (CO_2),
- 1.A.3.a Civil aviation (CO_2),
- 1.A.2.a Iron and steel (CO_2),
- 1.A.4.c Agriculture/Forestry/Fisheries (CO_2),
- 4.B Manure management (N_2O),
- 1.A.1.b Petroleum refining (CO_2),
- 6.B.2 Domestic and commercial wastewater handling (N_2O),
- 4.D.1.2 Agricultural soil (animal manure applied) (N_2O),
- 1.A.2.c Chemicals (CO_2),
- 4.B Manure management (CH_4),
- 6.B.2 Domestic and commercial wastewater handling (CH_4),
- 1.A.2.f Fertilizer (CO_2),
- 1.A.3.d Navigation (CO_2),
- 1.A.2.f Ceramics (CO_2),
- 1.A.2.f Textile (CO_2),
- 1.B.1.a.2 Mining (surface) (CH_4)
- 4.D.1.4 Agricultural soil (crop residue) (N_2O).

1.6 Information on the quality assurance/quality control plan

Turkey's QA/QC plan is prepared by the GHG emission inventory working group in 2013. TurkStat coordinated the whole process. The QA/QC plan is at the stage of approval by the Climate Change and Air Management Coordination Board.

2012 inventoy is subjected to a more comprehensive quality control regardless of the approval of the plan.

For quality control of inventory, procedures listed below are applied for all categories by sector experts responsible for each category.

- Assumptions and criteria employed for selection of activity data and for other calculation parameters are checked.
- Data entry errors are checked.
- Calculations for emissions and removals are checked.
- Selection of parameters, units and conversion factors are checked.
- Completeness of database folders is checked.
- Consistency of data and parameters used in emission and removal calculations are checked.
- Consistency of time series is checked.

The data confidentiality is one of the important problems. Confidential data are included in the inventory by aggregating either in the upper categories or an "other" categories just created for this purposes.

2013 annual submission of Turkey was subjected to the centralized review. It is considered as quality assurance process. In formation about how to handle the Expert Review Team recommendations are given in annex 3.

1.7 General uncertainty evaluation

The general procedures for uncertainty analysis based on the expert judgment are as follows;

- Uncertainties of each activity are allocated by using emission factor and activity data uncertainties.

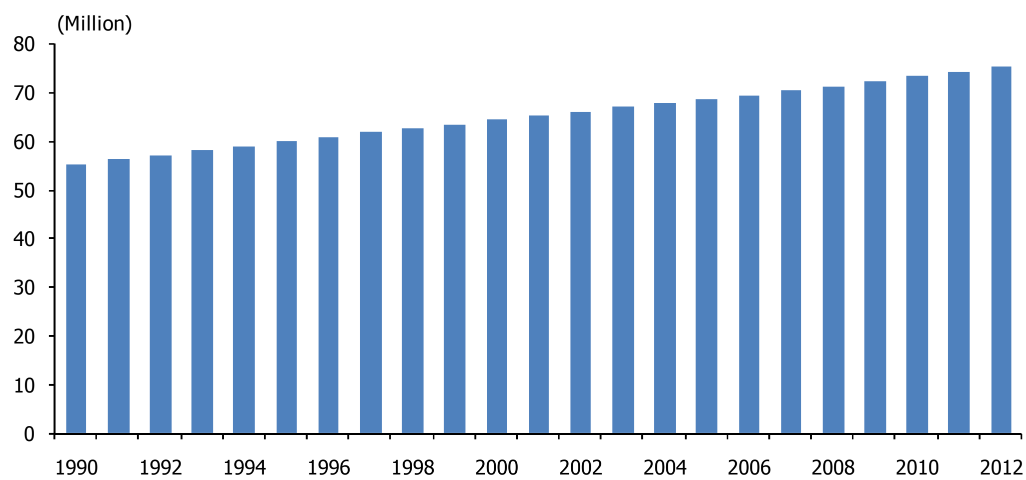
- Emissions are estimated for each (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) gases,
- The uncertainties for industrial processes data are estimated by TurkStat,
- The uncertainties of solvent and other product use data are estimated by TurkStat,
- The uncertainties of agricultural activities data are estimated by TurkStat,
- The uncertainties of waste data are estimated by TurkStat,
- The uncertainties for sectoral energy usage data are estimated by MENR,
- The uncertainties of transport sectors data are estimated by MTMAC.

Quantitative estimates of the uncertainties in the emissions are calculated using direct expert judgment. The total uncertainty is 5.9%, mainly caused by the high uncertain data of CO_2 uptake by forest.

1.8 General assessment of completeness

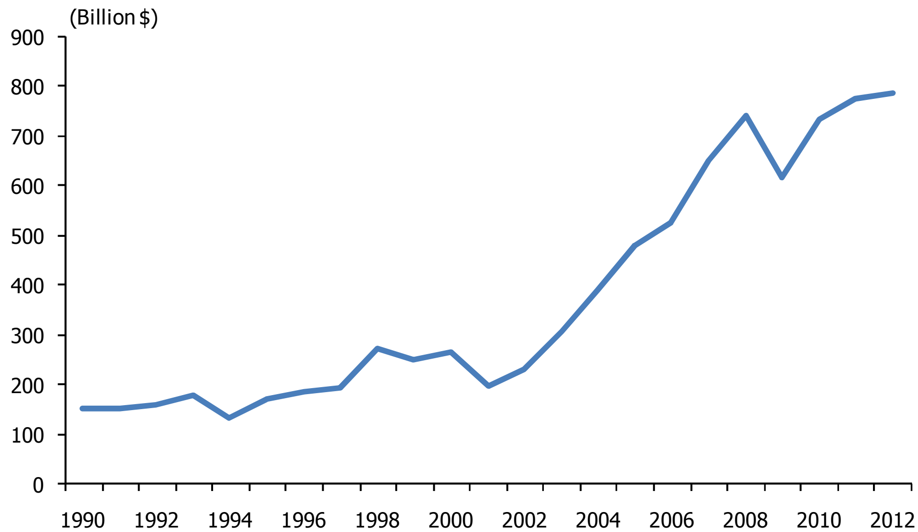
The inventory is considered to be largely complete with only a few minor sources not estimated, due to either a lack of available information. These sources are considered to be insignificant, when compared with the inventory as a whole. More information on completeness is available in Annex 5.

1.1 Population, 1990 - 2012



Population and Gross Domestic Product (GDP) data are regarded as the main indicators in evaluating emission inventories by the UNFCCC Secretariat. The population of Turkey was 75 million in 2012 and the GDP was 786 billion US dollars.

1.2 GDP, 1990 - 2012



2. GREENHOUSE GAS EMISSIONS

2.1 Emission trends for aggregated greenhouse gas emissions

Table 2.1 gives summary data for greenhouse gas emissions for the years 1990-2012. The inventory for the year 1990 and 2012 revealed that the overall GHG emissions expressed in CO_2 equivalent were correspondingly 188.43 and 439.87 million tonnes not taking into account the sector LULUCF. The emission trends (not taking into account the LULUCF) of the basic GHGs is also seen in the same table (1990=100%), the overall emission in 2012 increased by 133.44% compared to emission in 1990.

2.1 Aggregated GHG emissions by sectors

(Million tonnes CO_2 eq.)

Sector	1990	1995	2000	2005
Total (excluding LULUCF)	**188.43**	**238.82**	**298.09**	**330.74**
Energy	132.88	161.50	213.23	242.41
Industrial processes	15.44	24.21	24.37	28.78
Solvent and other product use	0	0	0	0
Agriculture	30.39	29.23	27.85	26.28
Waste	9.72	23.88	32.64	33.27
Compared to 1990 % (excluding LULUCF)	100.00	126.74	158.19	175.52
Land use, land-use change and forestry	-44.07	-47.57	-50.06	-49.73

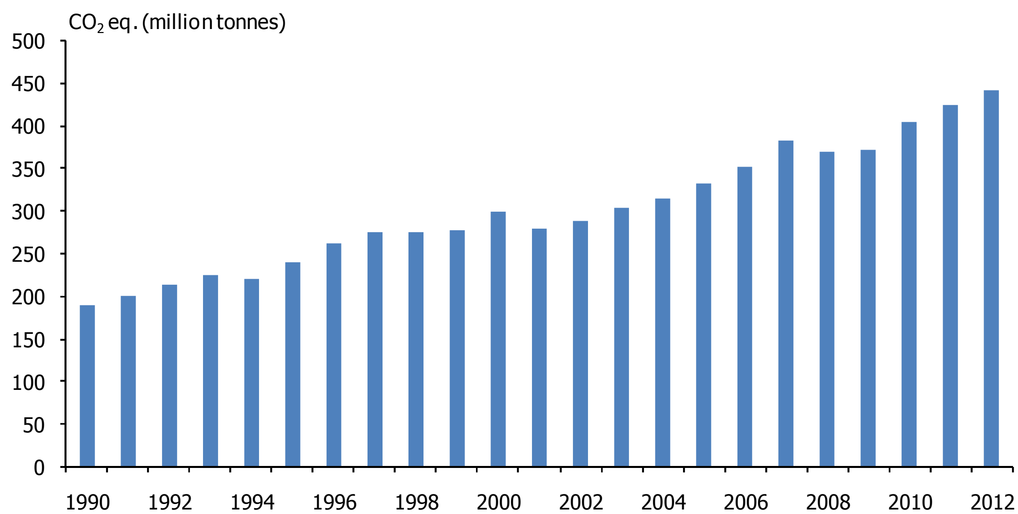
Sector	2009	2010	2011	2012
Total (excluding LULUCF)	**371.15**	**403.49**	**424.09**	**439.87**
Energy	279.01	285.14	301.34	308.60
Industrial processes	33.16	55.67	58.61	62.77
Solvent and other product use	0	0	0	0
Agriculture	26.10	27.13	28.83	32.28
Waste	32.88	35.56	35.31	36.22
Compared to 1990 % (excluding LULUCF)	196.96	214.13	225.06	233.44
Land use, land-use change and forestry	-56.35	-57.85	-60.83	-59.82

In overall 2012 emissions excluding LULUCF, the energy sector had the largest portion with 70.2%. The energy sector was followed by the industrial processes with 14.3%, the waste with 8.2% and the agricultural activities with 7.3%.

2.2 Emission trends by gas

Emissions of CO_2 increased by 152.5% from 1990 to 2012. CH_4 emissions increased by 81% and N_2O emissions increased by 21%. HFC emissions fell by 48.2 %.

2.1 GHGs emission trend, 1990 - 2012



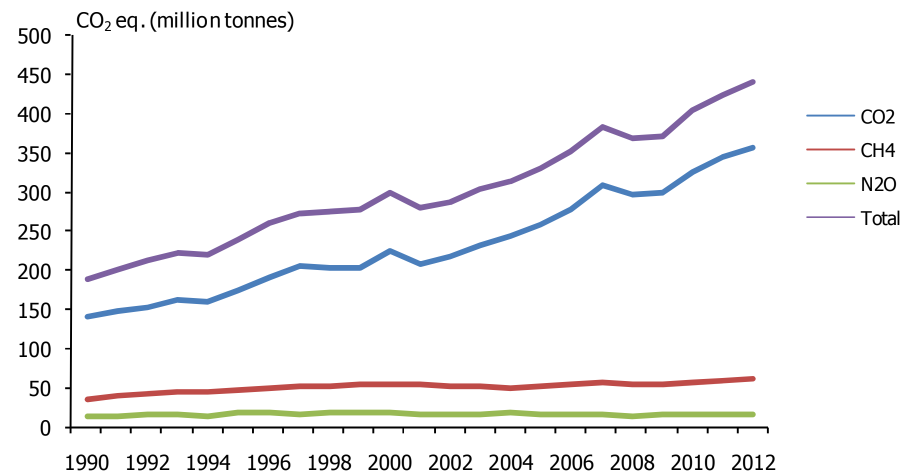
Graph 2.1 presents overall CO_2 equivalent emissions during the period 1990-2012.

2.2 Aggregated GHG emissions excluding LULUCF

(Million tonnes CO_2 eq.)

Gas	1990	1995	2000	2005	2009	2010	2011	2012
Total (excluding LULUCF)	**188.43**	**238.82**	**298.09**	**330.74**	**371.15**	**403.49**	**424.09**	**439.87**
CO_2	141.56	174.09	225.61	259.79	299.67	326.85	345.73	357.50
CH_4	34.05	47.39	53.68	52.55	53.75	57.30	58.05	61.62
N_2O	12.22	16.82	17.14	14.67	13.91	14.15	13.73	14.79
HFCs	0.00	0.00	0.82	2.38	2.84	4.01	5.31	4.68
PFCs	0.60	0.52	0.52	0.49	0.17	0.31	0.32	0.31
SF_6	0.00	0.00	0.32	0.86	0.80	0.88	0.95	0.97

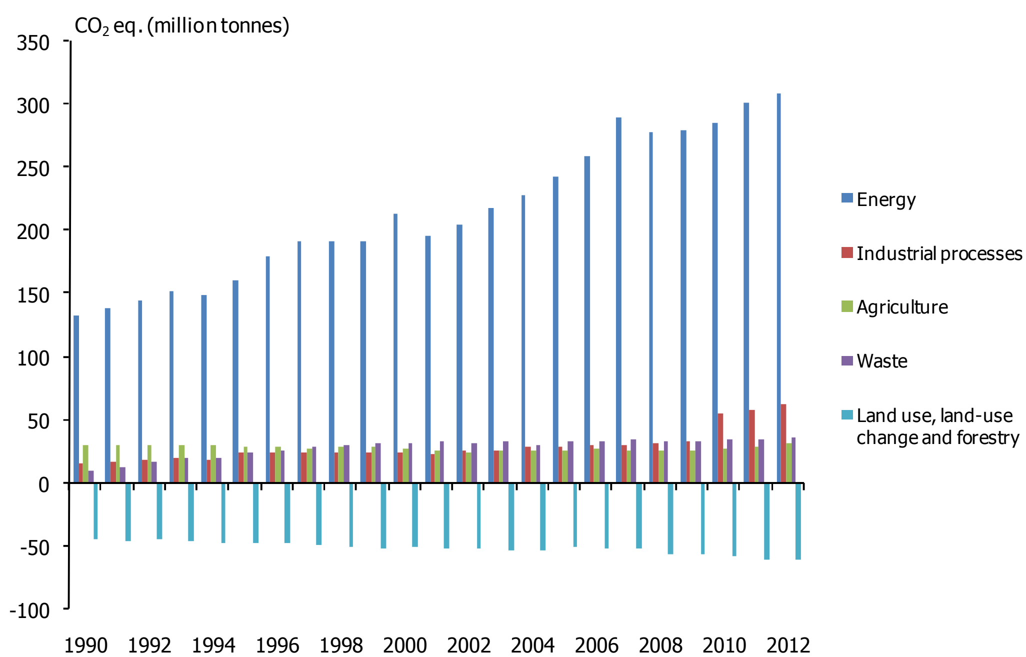
2.2 Emission trend of main GHGs, 1990 - 2012



As shown in graph 2.2, the CO_2 emissions show a general increasing trend, while N_2O and CH_4 emissions did not change considerably.

2.3 Emission trends by source

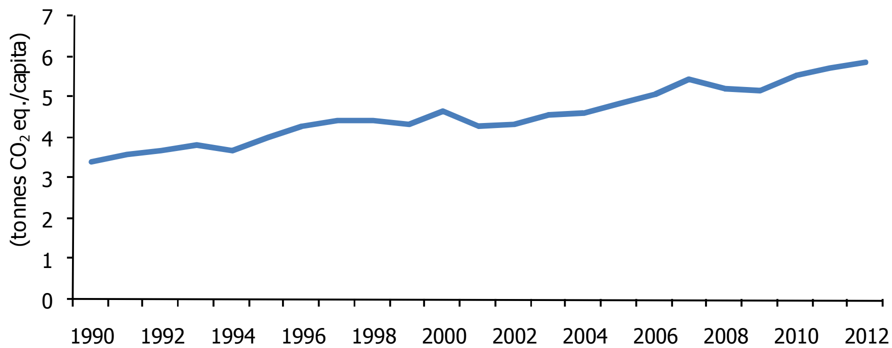
2.3 GHGs emission trend by sectors, 1990 - 2012



As shown in graph 2.3, the energy sector has the largest share in the overall emissions between the years 1990 and 2012.

As seen in graph 2.4, GHGs emission per capita shows an increasing trend and it is parallel to the Turkey's total emissions trend.

2.4 GHGs emission per capita, 1990 - 2012



2.3 Contribution of sectors to the total emission

(%)

	1990	1995	2000	2005	2009	2010	2011	2012
Energy	92.05	84.45	85.97	86.26	88.63	82.49	82.95	81.20
Industrial processes	10.70	12.66	9.83	10.24	10.53	16.11	16.13	16.52
Agriculture	21.05	15.29	11.23	9.35	8.29	7.85	7.94	8.49
Waste	6.73	12.48	13.16	11.84	10.44	10.29	9.72	9.53
LULUCF	-30.53	-24.87	-20.18	-17.70	-17.90	-16.74	-16.74	-15.74

2.4 Emission trends for indirect greenhouse gases

Emissions of CO, NO_x, NMVOC are also included in the report because they influence climate change indirectly. Table ES 5 shows the indirect GHG emissions. CO emissions are 1.3 Mt in 2012 and 97% is from energy sector. NOx emissions are about 3 Mt in 2012 and 93% of which is from energy. NMVOC emissions are 1.5 Mt in 2012. The largest portion is from industrial processes with, 65% and it is followed by energy with 29%.

3. ENERGY

3.1 Fuel combustion

The major source of GHGs in Turkey is the fossil fuel combustion. The emissions from fossil fuel combustion are calculated by TurkStat with cooperation with the Ministry of Energy and Natural Resources (MENR) and the Ministry of Transport, Maritime Affairs and Communications. The emissions from electricity generation were calculated by MENR and the emissions from transport were calculated by Ministry of Transport, Maritime Affairs and Communications, and the other energy sub-sectors were calculated by TurkStat.

According to the IPCC, the emissions from the energy sector mainly are released from the fuel combustion. As it can be seen almost in all countries, the energy sector in Turkey is also the key category for the emission of GHGs. Approximately 85% of the total CO_2 emission was from the fuel consumptions. In energy sector, the sub-sectors were categorized based on 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 and heat production" were estimated by IPCC Tier 1 approach. For those sectors, Tier 2 methodology has been used. For public electricity and heat production sector plant-specific net calorific values (NCVs) were used to calculate heat values that led to emissions. Every single unit reports a unique NCV. Therefore plant specific NCVs are numerous, as well. On the other hand, carbon contents and oxidation ratios are taken from IPCC guidelines

Energy balance tables were used to calculate emissions from fuel combustion for all the energy subsectors excluding public electricity and heat production. Energy balance tables are prepared by MENR, in both the original mass units and energy conversion units.

Transportation sector consists of road transportation, domestic civil aviation, railways and national navigation. Data availability in navigation sector and railways allows only Tier 1 methodology in the estimations. IPCC Tier 2 methodology was used for the calculation of emissions from civil aviation. For road transportation emissions were estimated by both Tier 1 and Tier 2 approaches. However Tier 1 results were included in the inventory.

In energy balance tables refinery feedstock and non-energy use of fuels are given separately and those consumption are not included in fuel consumptions. Naphta is given as refinery feedstock in energy balance table. Fuels used for non energy purposes are lubricants, bitumen, solvents etc. but they are not given separately in energy balance table, they are given as aggrageted form under "other petroleum products majority of which is bitumen. Therefore For the reference approach all non energy use data was assumed as bitumen. In the sectoral approach feedstock and non-energy use of fuel are not considered since they are not included in sectoral fuel consumption in energy balance table.

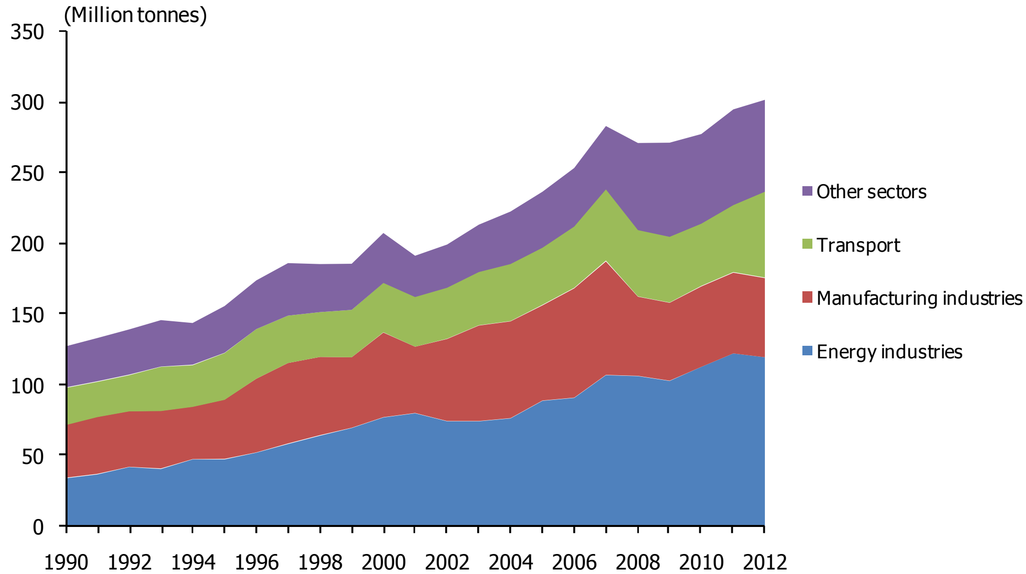
CO_2, CH_4, N_2O, NO_x, CO, NMVOC and SO_2 emissions from fuel combustion were calculated for the period 1990-2012.

3.1 Emissions from fuel combustion

(Gg)

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
1990	126 701.07	143.02	3.21	628.65	3 445.45	445.99
1991	132 470.80	146.04	3.25	634.17	3 422.75	445.61
1992	138 638.26	147.30	3.29	652.98	3 593.41	472.20
1993	145 246.92	143.04	3.44	723.75	3 891.86	515.23
1994	143 208.79	132.54	3.43	743.43	4 294.52	572.99
1995	155 347.54	137.27	3.59	789.51	4 491.64	610.59
1996	173 369.59	136.98	3.89	869.29	4 609.80	637.46
1997	185 600.38	142.03	3.94	897.78	4 723.85	654.21
1998	185 009.00	132.54	3.88	888.57	4 649.10	649.92
1999	185 214.00	124.05	3.93	920.20	4 438.16	634.04
2000	207 082.91	122.59	4.21	1 009.66	4 090.47	588.01
2001	190 906.52	109.13	3.97	969.21	3 691.24	538.27
2002	198 972.95	111.76	4.13	1 000.92	3 604.69	524.29
2003	212 999.68	114.24	4.36	1 061.18	3 511.87	516.27
2004	222 320.63	116.11	4.78	1 117.47	3 407.55	509.10
2005	236 416.94	114.57	4.89	1 049.19	3 036.11	459.78
2006	253 225.45	113.53	4.58	1 088.29	3 141.82	485.26
2007	282 901.10	116.11	5.12	1 175.51	3 093.49	489.98
2008	270 917.32	160.52	4.98	1 269.66	2 702.07	517.11
2009	271 163.83	176.81	4.89	1 410.41	3 276.37	519.77
2010	277 379.22	176.21	5.14	1 256.35	3 287.61	513.09
2011	294 728.91	147.89	3.23	1 259.71	2 751.33	410.65
2012	301 673.26	171.97	3.20	1 249.77	2 792.40	411.56

3.1 CO_2 emissions from fuel combustion, 1990 - 2012



Carbon Dioxide (CO_2): The main contributor to the enhanced (manmade) greenhouse effect is CO_2. Globally, it accounts for over 60% of the enhanced greenhouse gas effect. In industrialised countries, CO_2 makes up more than 80% of greenhouse gas emissions. As it can be seen from graph 3.1, the distribution of CO_2 emission from the fuel combustion by sectors is not changing considerably until the year 1994. There is a slight increase. However, between the years 1995 and 1997, the increase is sharp. The trend is steady for the period 1997-1999, it peaks in 2000 and 2007 and reaches the value as 301.7 Mt in 2012.

In Turkey, the highest CO_2 emission increase is observed in energy industries with 250.5%. Then it is followed by transport with 136.0%, other sectors (agriculture and residential sector) with 123.3% and manufacturing industries with 49.3%. The total CO_2 increase in fuel combustion activities in 2012 compared to 1990 is 138.1%.

3.2 CO_2 emissions from fuel combustion by sectors, 1990 - 2012

The highest proportion of CO_2 emissions from combustion is from manufacturing industries in 1990, while it is from energy industries in 2012.

The CO_2 emission and conversion factors which are used in calculations are given in table 3.2.

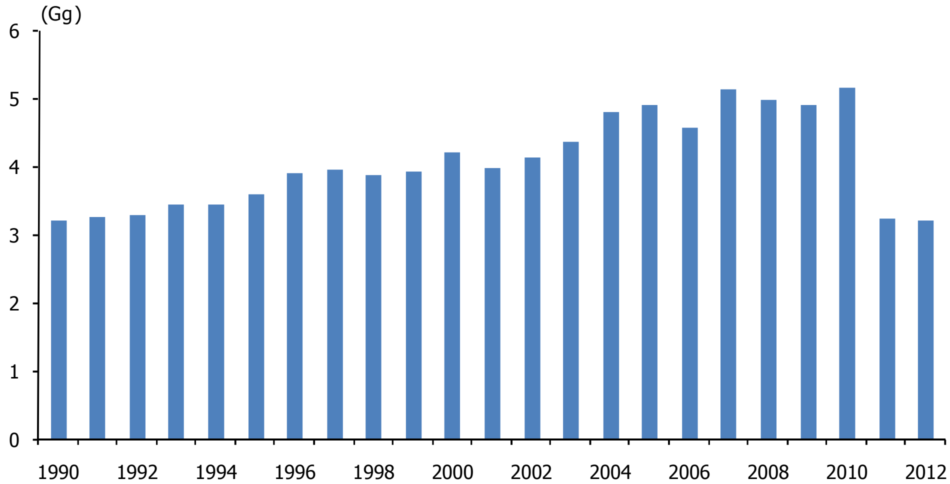
3.2 Emission and conversion factors for CO_2

Fuel	CO_2 EF (tC/TJ)	Efficiency	C-CO_2
Hard coal	25.80	0.98	3.67
Lignite	27.60	0.98	3.67
Asphalt	25.80	0.98	3.67
Secondary fuel	25.80	0.98	3.67
Petroleum coke	25.80	0.98	3.67
Natural gas	15.30	0.995	3.67
Petrol	20.00	0.99	3.67
Residual fuel oil	21.10	0.99	3.67
Gas/Diesel oil	20.20	0.99	3.67
Gasoline	18.90	0.99	3.67
LPG	17.20	0.99	3.67
Refinery gas	20.00	0.99	3.67
Jet Kerosene	19.50	0.99	3.67
Naphta	20.00	0.99	3.67

Nitrous Oxides (N_2O): N_2O emission from fuel combustion is decreased 0.14% during the period 1990-2012. However, a high increase is observed in energy industries with the value of

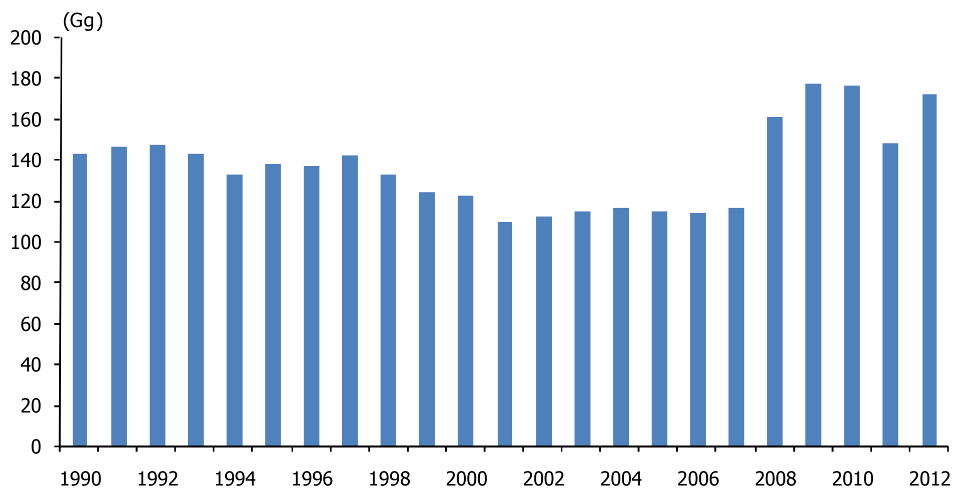
183.1%. The increase in manufacturing industries is 20.2%. There is a decreasing trend in transport and other sectors with 36.8% and 30.5%, respectively.

3.3 N_2O emissions from fuel combustion, 1990 - 2012



Methane (CH_4): CH_4 emission from fuel combustion doesn't change considerably till 2008. But it increases after 2008. The rate of change in 2012 emissions compared to 1990 is 20.2%.

3.4 CH_4 emissions from fuel combustion, 1990 - 2012



The emissions of other gases NO_x, CO and NMVOC from fuel combustion are also calculated for the period 1990-2012. While an increasing trend is observed for NO_x emission, declining trends are obtained for CO and NMVOC after 1997 (table 3.1).

Emissions from combustion are calculated on the basis of the following sub-categories of the IPCC.

3.1.1 Energy Industries (1.A.1)

Source Category Description: This source category includes the emission from the electricity generation and petroleum refining in Turkey. For this sector general fuel consumption data are taken from energy balance tables.

Methodological Issues: Revised 1996 IPCC guidelines are used for emission calculation. The fuel consumption data is multiplied by emission factors (EF) to give an estimation of the direct and indirect greenhouse gas emission. For thermal power plants T2 is applied. Emissions for each plant were calculated by Ministry of Energy and Natural Resources. Each power plant reported its net calorific values (NCVs) of the fuels used. The calorific values, in terms of Tj, of the fuel consumed are calculated by multiplying NCVs and fuel amounts. Carbon contents and oxidation rates, on the other hand, are directly taken from IPCC Guideline. The aggregated emission data are then compared with the emission estimated by simple multiplication of consumption and EF. The main aim is to verify the emissions.

Emissions from petroleum refining are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables. Also, data on waste incineration with energy recovery is taken from TurkStat environment statistics. The default IPCC emission factors in the guidelines are used.

Uncertainties and time-series consistency: The activity data for energy sectors are, completely taken from energy balance tables. Uncertainties in the emission factor and fuel used are determined by experts of MENR. After calculating the emissions from all sectors, the GWP weighted emission of CO_2, N_2O and CH_4 are multiplied by source specific data uncertainty to obtain overall uncertainty. The approach to produce quantitative uncertainty estimates is to use expert judgment as described in IPCC Good Practice Guidance and Uncertainty Management (2000). The combine uncertainties in emission factors and activity data are explained in annex 7 in detail.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance was used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. For the quality assurance purposes, GHGs emissions estimated by using Tier 2 approach were compared with emissions estimated by using Tier 1 approach to see whether the difference is reasonable. In addition, emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

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

Source category	Gas	Fuel type	Comments on time series consistency
1.A.1	CO_2	All Fuels	EF was not varying until 2004 for (1.A.1.a). Since 2004 PS NCVs were used for (1.A.1.a). All EFs are constant over the entire time series for Petroleum Refining (1.A.1.b).
1.A.1	N_2O, CH_4 and NO_X, CO, NMVOC	All Fuels	EF was not varying until 2004 for (1.A.1.a). Since 2004 PS NCVs were used for (1.A.1.a). All EFs are constant over the entire time series for Petroleum Refining (1.A.1.b).

Recalculation: There is recalculation in sector 1.A.1 for 1995-2012.

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 is a key category in terms of CO_2 emissions from the natural gas, lignite and secondary fuel. Under source category public electricity and heat production, the data includes electricity and heat production of all electricity generation installations in operation. For this sector fuel consumption data are gathered from every single plant via questionnaires.

In 2012, electricity production kept its major role in GHG emissions. The installed capacity reached to 57.06 GW with 7.8% increase from the previous year and about 3.5 times higher than the 1990 values. The total net electricity consumption has increased in 2012 compared to the previous year. In the year 2012, net consumption was 193.77 TWh meanwhile in 2011 this figure realized as 186.09 TWh. Natural gas had a very high share of 43.6% in electricity production, which was followed by coal (13.6%), hydro and geothermal (24.6%), other renewable (2.7%) and oil (0.7%).

Hydropower production has increased by 10.5% from 52.34 TWh in 2011 to 57.86 TWh in 2012, owing to the capacity additions. In 2012 thermal power plants produced 174.8 TWh of electricity with 0.1% increase from the previous year, meeting 71.3% of the total electricity demand with 63.7% share of total installed capacity.

There was an accelerated increase in wind installed capacity from 1728.71320.2 MW in 2011to 2260.5 MW in the year 2012. Renewable Law which came into force in 2005 later revised in 2011 providing some supporting mechanism for purchasing electricity from solar, biomass, geothermal, wind and hydraulic energy. 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.

Electricity generation from animal and vegetal waste has increased by 37% compared to the previous year, reaching to 158.5 MWs of installed power, generating 720.8 GWh of power in 2012.

In 2012, Turkey’s Total Primary Energy Supply (TPES) was 120.98 mtoe, a 5.66% increase compared to 2011. Oil had a share of 30.61 mtoe while coal and gas accounted for 20.32 mtoe and 37.37 mtoe respectively. Renewables accounted for 9.62 mtoe.

Primary energy (domestic) production increased by 6.9% from 32.23 Mtoe in 2011 to 34.47 Mtoe in 2012 and provided 28.4% of overall energy supply. Import dependency of the country increased to 81.57% from previous years’ 71.61%.

The production of solid fossil fuels, excluding animal & vegetal waste, has increased from 20.32 Mtoe in 2011 to 22.87 Mtoe in 2012. Decrease in indigenous oil production is 4.7%. There is a slight decrease in domestic natural gas production, from 0,652 Mtoe in 2011 to 0,533 Mtoe in 2012. The main domestic energy source remains as coal with a production increased by 4.9% from 75.98 million tonnes in 2011 to 79.68 million tonnes (Mt) in 2012.

The activity data for fuels are taken directly from the Energy Balance Sheets. More information on energy balance tables are presented in Annex 8.

Heat content of fuels for source category 1.A.1.a was calculated with the plant specific data collected from electricity generation installations, via questionnaires. The amount of main fuel used was multiplied by plant specific NCVs to obtain heat values in terms of Tj. The average NCV are given in the Table A4.3.

Recalculation: TurkStat performed comprehensive survey covering all Waste Disposal and Recovery Facilities Survey in 2013. This was the first covering all installations. Based on the information obtained from the survey a new waste incineration facility being started to operate after 2003 was determined. It is clarified that all the three installations have been energy recovery installations. Therefore historical activity data for those facilities from the beginning of the energy recovery operation was collected via official letter and activity data for estimation of waste incineration was updated. Emissions from waste incineration resulting electricity production are included in this category (1.A.1.a) under other fuels for the year 1995-2012.

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

Petroleum refining was a key category in terms of emissions level for CO_2 emissions from natural gas consumption. The contribution to total CO_2 emission from petroleum refining was ranging between 0.8% and 3.3% throughout the years. Fuel inputs in petroleum refineries were taken from energy balance tables. The emission factors were default from the 1996 Revised IPCC Guidelines. The uncertainty of activity data were estimated by MENR experts.

Recalculation: Based on the information obtained from TurkStat Waste Disposal and Recovery Facilities Survey in 2013, emissions from waste incineration resulting heat production are included in this category (1.A.1.b) under other fuels for the year 2003-2012.

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

This section was not evaluated under a separate category. It has been included in the Public Electricity and Heat Production and Coal Mining and Handling section.

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

Source Category Description: This source category consists of manufacturing industries sectors. IPCC categorizes manufacturing industry as iron and steel, nonferrous metal, chemicals, pulp, paper and print, food processing, beverages and tobacco. Based on the data availability pulp, paper and print and food processing were separated from 2012 on, beverages and tobacco can not be separated and still are considered under the section Other Industries (1.A.2.f). Moreover, cement production, sugar production, fertilizer industries and other industries were given separately since 2005. In addition to that road motor vehicles, porcelain and ceramic products, glass and glass products, and textile industry were given separately in tihs submission. Each of those mentioned sectors were included under the other industries before.

Since in the energy balance tables, fuel consumption for energy production of manufacturing industry can not be separated, emissions of manufacturing industry from energy production can not be separated, and included in the section Public Electricity and Heat Production (1.A.1.a)

Methodological Issues: GHG emissions from this sector were calculated by using Revised 1996 IPCC T1 approach. The fuel consumption data is multiplied by emission factors (EF) to give an estimation of the direct and indirect greenhouse gas emission. The emission factors are given in annex 2.

Uncertainties and time-series consistency: The activity data for manufacturing industry sector are, completely taken from energy balance tables. Uncertainties in the emission factor and fuel used are determined by experts of MENR. After calculating the emissions from all sectors, the GWP weighted emission of CO_2, N_2O and CH_4 are multiplied by source specific data uncertainty to obtain overall uncertainty. The approach to produce quantitative uncertainty estimates is to use expert judgment as described in IPCC Good Practice Guidance and Uncertainty Management (2000). The combine uncertainties in emission factors and activity data are explained in annex 7 in detail.

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

Source category	Gas	Fuel type	Comments on time series consistency
1.A.2	CO_2	All Fuels	All EFs are constant over the entire time series.
1.A.2	N_2O, CH_4	All Fuels	All EFs are constant over the entire time series.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance was used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation in sector 1.A.2 for 1990-2012.

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

The source category iron and steel industries under manufacturing industries and construction is a key category, in terms of CO_2 emissions from hard coal and natural gas. The emissions from the iron and steel industry are very high compared to other sectors due to high energy consumption.

There are two different technologies used in iron and steel industry; integrated facilities (BOF) and electric arc furnaces (EAF). Iron and steel industry consumes energy and raw materials intensively. Currently, 3 integrated facilities and 27 electric arc furnace mills are in operation in Turkey.

The fuel consumption amounts are taken from energy balance tables. Energy balance tables provided fuel consumptions of large scale iron and steel industry only till 2008, and fuel consumption of electric arc furnace mills is included in the section Other Industries (1.A.2.f). After 2008, the fuel consumption of electric arc furnace mills is separated and included in iron and steel production industries instead of other sector. For that reason, the emissions have increased since that year.

Process emissions and energy emissions from iron and steel industry are considered together under this section (1.A.2.a) for 1990-2009 periods. However, after 2010 inventory, process emissions and energy emissions from iron and steel industry are estimated separately. Only energy emissions given in this section, process emissions are given under section 2.C.1. In order to prevent double counting the entire quantity of coke used for iron and steel production is deducted from total coke consumption.

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

The source category non ferrous metal is not a key category. The CO_2 emission compared to total CO_2 emission from Manufacturing Industries and Construction is ranging between 0.47% and 12.39%. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables.

3.1.2.3 Chemicals (1.A.2.c)

The source category of chemicals is a key category in terms of CO_2 emissions from natural gas in 2012. Emissions from chemicals are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables. The default IPCC emission factors in the guidelines are used.

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

The fuel consumption for production of pulp, paper and printed products was separated in energy balance table in 2012. Therefore emissions from this sector are evaluated under the section 1.A.2.f-other before 2012. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat.

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

The fuel consumption for food processing sector was separated in 2012. Therefore emissions from those sectors were evaluated under the section 1.A.2.f before 2012. But, fuel comsumpion for beverages and tobacco industry can not be separated and still are considered under the section Other Industries (1.A.2.f). Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat.

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

The source category cement production was a key category in terms of CO_2 emissions from petroleum coke, lignite and hard coal. Emissions from cement production are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables. The default IPCC emission factors in the guidelines are used.

In Turkey, some of the cement plants co-incinerate waste via securing a license from the Turkish Ministry of Environment and Urbanization. The license 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 license are: waste plastics, used tyres, waste oils, industrial sludge, tank bottom sludge and biomass. For 2012 submission all cement plants with cofiring of waste were determined and waste amount by waste type were gathered. However, plant specific emission factor coludn't be obtained. Also in order to use IPCC defaults waste needs to be categorized. Therefore, emissions from waste cofired in cement industry are not included in this submission.

3.1.2.7 Other - Sugar (1.A.2.f)

This sector is not a key category. The energy consumption is taken from the energy balance tables. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables.

3.1.2.8 Other - Fertilizer (1.A.2.f)

This sector was a key category in terms of CO_2 emissions from natural gas in 2012. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables.

3.1.2.9 Other – Textile (1.A.2.f)

This sector was given separately for the first time in 2012 and it is a key category in terms of CO_2 emissions from natural gas in 2012. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables.

3.1.2.10 Other - Ceramics (1.A.2.f)

This sector was given separately for the first time in 2012 and it is a key category in terms of CO_2 emissions from natural gas in 2012. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables.

3.1.2.11 Other – Glass and glass products (1.A.2.f)

This sector was given separately for the first time in 2012 and is not a key category. The energy consumption is taken from the energy balance tables. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables.

3.1.2.12 Manufacture of road motor vehicles (1.A.2.f)

This sector was given separately for the first time in 2012 and is not a key category. The energy consumption is taken from the energy balance tables. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables.

3.1.2.13 Other Non-Specified (1.A.2.f)

The manufacturing industry sectors which are not specified above covered in this section. The source category other non-specified was a key category in terms of CO_2 emissions from natural gas, gas/diesel oil and petroleum coke. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat. Fuel data are taken from the energy balance tables.

3.1.3 Transport

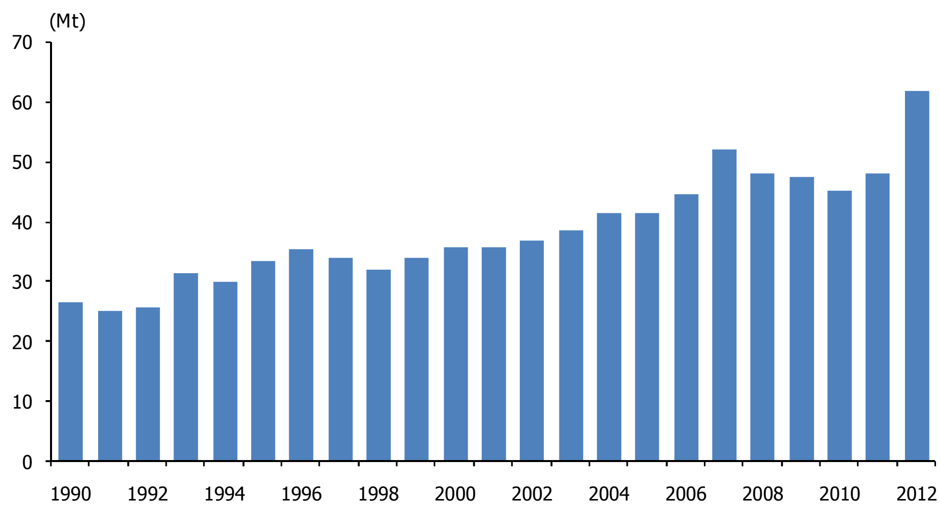
Estimation of emissions in Transport sector are carried out in sub-categories listed below:

- Civil Aviation (1.A.3.a)
- Road Transportation (1.A.3.b)
- Railways (1.A.3.c)
- Water-borne Navigation (1.A.3.d)

Emissions from this sector are 134.64% higher in 2012 than in 1990 (Graph 3.5), and on average emissions are increased by over 6.12% annually.

In 2012 transport sector contributed 61.68 Mt CO_2 equivalent emissions. The distributions and changes from the year 1990 to the year 2012 are given in Table 3.5. As shown the graph 3.6, road transportation is the major CO_2 source and contributing 90.50% of transport emissions. Contribution of the domestic aviation is 6.16%, domestic water-borne navigation is 2.62%, and railways is 0.72%.

3.5 CO_2 equivalent of emissions for transport sector, 1990 -2012



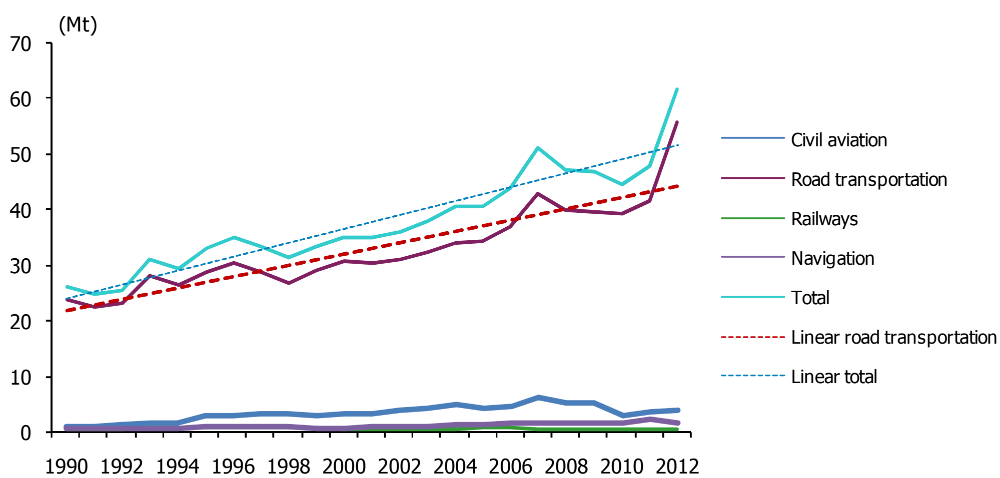
3.5 Transport GHG Contribution in CO_2 Equivalent

Modes of transport	CO_2EquivalentEmissions (Gg) 1990	2011	2012	Share in Transport Sector (%) 2012
Road transportation	24.350,70	41.742,53	55.817,39	90,50
Domesticaviation	914,98	3.404,39	3.801,67	6,16
Railways	521,52	482,12	443,70	0,72
Domesticnavigation	499,39	2.230,34	1.615,61	2,62

	Changebetween 2011-2012		Changebetween 1990-2012	
	CO_2Eq. (Gg)	(%)	CO_2 Eq. (Gg)	(%)
Road transportation	14.074,86	25,2	31.466,69	129,22
Domesticaviation	397,28	10,5	2.886,69	315,49
Railways	-38,42	-8,7	-77,82	-14,92
Domesticnavigation	-614,73	-38,0	1116,22	223,52

Source: Ministry of Transport, Maritime Affairs and Communications

3.6 CO_2 emission trend in modes of transport, 1990 - 2012



Source Category Description: The source category comprises GHG emissions resulted from transport sector as follows; aviation, railways, road transportation and navigation. In addition to these, international aviation and international navigation are also included in this category. Among these categories;

- Civil Aviation in terms of CO_2 emissions from jet fuel,
- Road transportation in terms of CO_2 emissions from diesel fuel, LPG and gasoline,
- Water-borne Navigation in terms of CO_2 emissions from diesel fuel and fuel oil,

are the key categories.

Emissions from civil aviation are covered as international aviation and domestic aviation under both (1.A.3.a.i) and (1.A.3.a.ii) categories.

Road transportation is the largest contributor to transport emissions and estimations are made under a wide variety of vehicle types using not only gasoline but also diesel fuel and LPG. It is covered under category (1.A.3.b).

Emissions from railways are reported under category (1.A.3.c).

Emission estimates from the navigation section cover international water-borne navigation (1.A.3.d.i) and domestic navigation-coastal shipping (1.A.3.d.ii).

Methodological Issues: Methodology used for the estimation of GHG emissions of mobile sources for time series 1990-2012 is the multiplication of fuel data with corresponding emission factors. All emission factors are taken from IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1996).

The IPCC methods used in transport sector calculations are listed in Table 3.6.

3.6 Method used in the calculation of GHG emissions by transport modes

Modes of transport	CO_2	CH_4	CO	N_2O	NOx	NMVOC	SO_2	TIER I	TIER II
Domestic aviation	√	√	√	√	√	√	√	X	X
International aviation	√	√	√	√	√	√	√	X	
Road transportation	√	√	√	√	√	√	√	X	X
Railways	√	√	√	√	√	√	√	X	
Domestic navigation	√	√	√	√	√	√	√	X	
International navigation	√	√	√	√	√	√	√	X	

Source: Ministry of Transport, Maritime Affairs and Communications

For the Transport source category (1.A.3), the following data sources are used to estimate and calculate emissions:

- Fuel consumption values for source categories (1.A.3.a.i), (1.A.3.a.ii), (1.A.3.b), (1.A.3.c), (1.A.3.d.i) and (1.A.3.d.ii) are provided by Ministry of Energy and Natural Resources in the form of the national energy balance tables.

- Air traffic data is provided by DG of State Airports Authority for National Aviation (1.A.3.a.ii). Emissions are estimated by using IPCC Tier 2 methodology explained in IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1996). The calculation methodology is based on the national energy consumption data and air traffic data for each airport in terms of aircraft type. For the activities, default emission factors are used. Air traffic data which consists of landing and take-off (LTO) cycles and cruise is processed for all 49 airports in Turkey. All activities 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 estimated individual fuel consumption values. The necessary emission factors for LTO and cruise for each type of aircraft have been chosen from IPPC reference manual.

- The emissions from road transportation are calculated by using IPCC Tier 2 methodology. Vehicle types and other important data necessary for calculations are provided from DG of Highways and Turkish Statistical Institute.

- Other values for database improvement are provided from DG of Highways, DG of Turkish State Railways and DG of Civil Aviation.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National Greenhouse Gases Emission Inventory. For the quality control purposes, GHG emissions, estimated by using Tier 2 approach, were compared with emissions estimated by using Tier 1 approach. If the difference between the emission values obtained by both methods is less than 5%, calculations are considered to be appropriate.

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

The civil aviation source category is a key category, in terms of CO_2 emissions from the jet fuel.

3.1.3.1.1 International Aviation (1.A.3.a.i)

The fuel type used in international aviation is jet fuel. Table 3.7shows the trend in emissions of CO_2, CH_4, N_2O, NO_x, CO, NMVOC and SO_2 from international aviation between 2011 and 2012.

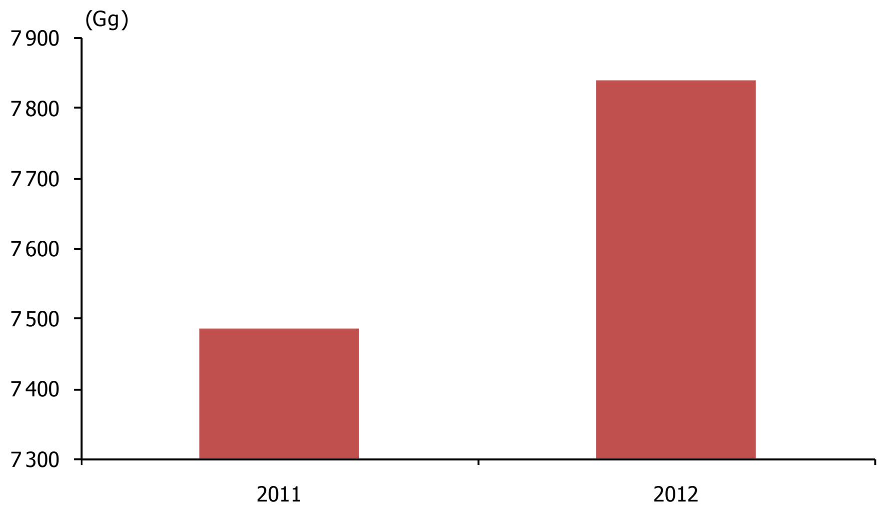
Due to increase in fuel consumption, all emissions increased in year 2012 compared to year 2011. Graph 3.7 and Graph 3.8 illustrate respectively the total GHG emissions and the emissions of N_2O and CH_4 increase trends as Gg CO_2 equivalents. According to Table 3.7, total CO_2 emission reached to 7.770 Gg. The emissions of nitrous oxide and methane reached 67.37 Gg CO_2 equivalents and 1.14 Gg CO_2 equivalents, respectively.

3.7 GHG emissions from international aviation

(Gg)

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2011	7 419.22	0.05	0.21	31.13	10.38	5.19	1.16
2012	7 769.61	0.05	0.22	32.6	10.87	5.43	1.22

3.7 CO_2 equivalent for international aviation, 2011-2012



3.8 CO_2 equivalent of CH_4 and N_2O emissions for international aviation, 2011-2012

Uncertainties and time-series consistency: It is necessary to study with all firms in this sector and Ministry of Energy and Natural Sources for determining international fuel usages.

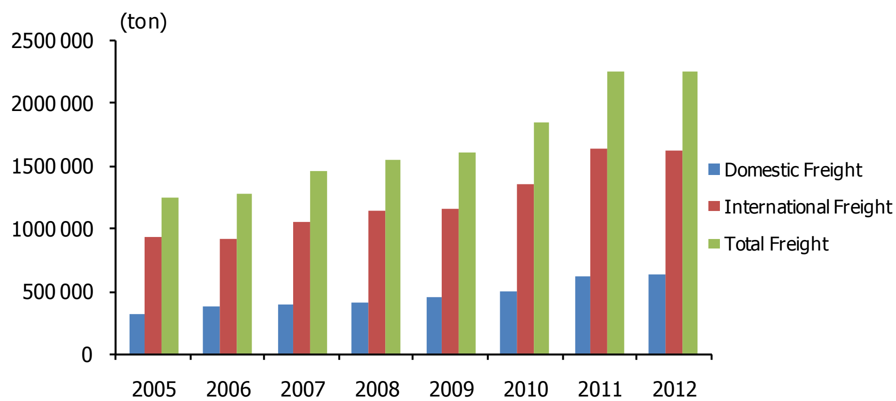
Recalculation: There is no recalculation in this sector.

3.1.3.1.2 Domestic Aviation (1.A.3.a.ii)

In domestic aviation only jet fuel is consumed. Air traffic data is provided by DG of State Airports Authority for all civil airports in Turkey. The number of LTO values for all aircraft types are provided for each airport. In the year 2012 total number of LTO's in domestic travel for all air craft types is 594.871. The increase in passenger and freight traffic from 2005 to 2012 is also given in Graph 3.9 and Graph 3.10respectively. Table 3.8 shows air traffic in Turkish airports in 2012.

3.9 Passenger traffic, 2005 - 2012

3.10 Freight traffic, 2005 - 2012



3.8 Airtraffic, 2012

Airports	Domestic		International		Total	
	Number of flight	Number of passengers	Number of flight	Number of passengers	Number of flight	Number of passengers
İstanbul Atatürk	127 013	15 279 655	237 309	29 812 307	364 322	45 091 962
Ankara Esenboğa	69 335	7 679 371	16 548	1 593 737	85 883	9 273 108
İzmir Adnan Menderes	55 013	6 945 044	18 139	2 410 858	73 152	9 355 902
Antalya	39 760	4 943 308	121 224	20 152 836	160 984	25 096 144
Muğla Dalaman	11 183	827 197	17 372	2 984 761	28 555	3 811 958
Muğla Milas-Bodrum	15 755	1 614 314	13 375	1 916 146	29 130	3 530 460
Adana	33 220	3 136 143	5 400	628 014	38 620	3 764 157
Trabzon	17 681	2 330 510	2 274	73 640	19 955	2 404 150
Isparta Süleyman Demirel	4 865		396	50 062	5 261	50 062
Nevşehir Kapadokya	1 848	153 776	204	20 202	2 052	173 978
Erzurum	7 121	772 700	210	16 520	7 331	789 220
Gaziantep	10 690	1 268 715	2 324	174 254	13 014	1 442 969
Adıyaman	1 237	100 522			1 237	100 522
Ağrı	1 409	154 035	2		1 411	154 035
Balıkesir Merkez	346	11 573			346	11 573
Balıkesir Koca Seyit	3 288	46 180	40	415	3 328	46 595
Batman	3 922	497 418			3 922	497 418
Bursa Yenişehir	6 041	54 161	330	25 595	6 371	79 756
Çanakkale	2 482	49 240	19		2 501	49 240
Denizli Çardak	2 970	187 337	55	4 771	3 025	192 108
Diyarbakır	11 031	1 270 613	130	15 211	11 161	1 285 824
Elazığ	5 578	642 819	291	38 598	5 869	681 417
Erzincan	2 511	233 580	2		2 513	233 580
Gökçeada	182	1 666			182	1 666
Hatay	4 344	506 433	1 514	157 459	5 858	663 892
Iğdır	526	55 225			526	55 225
Kahramanmaraş	1 638	102 046			1 638	102 046
Kars	3 209	376 147	5		3 214	376 147
Kayseri	9 133	1 096 883	1 844	232 943	10 977	1 329 826
Kocaeli Cengiz Topel	1 737	62 311	3		1 740	62 311
Konya	6 480	590 615	663	68 594	7 143	659 209
Malatya	6 842	572 599	167	16 864	7 009	589 463
Mardin	2 468	278 590	1		2 469	278 590
Amasya Merzifon	822	81 362	15	1 388	837	82 750
Muş	1 796	205 740	16	1 508	1 812	207 248
Samsun Çarşamba	9 750	1 151 368	912	86 323	10 662	1 237 691
Siirt	874	33 740			874	33 740
Sinop	855	67 404			855	67 404
Sivas Nuri Demirağ	2 410	237 120	81	6 890	2 491	244 010
Şanlıurfa Gap	3 307	332 306	119	15 020	3 426	347 326
Tekirdağ Çorlu	15 252	26 250	1 319	7	16 571	26 257
Tokat	823	25 425			823	25 425
Uşak	683	0	11	0	694	0
Van Ferit Melen	8 415	999 223	39	2 121	8 454	1 001 344
İstanbul Sabiha Gökçen	77 483	9 710 105	48 560	4 975 947	126 043	14 686 052
Eskişehir Anadolu	6 952	2 940	490	44 288	7 442	47 228
Zonguldak Çaycuma	171	572	251	27 139	422	27 711
Antalya Gazipaşa	309	3.854	575	75.886	884	79 740
Zafer	58	3.181			58	3 181

Source: Ministry of Transport, Maritime Affairs and Communications

Emission factors for all aircraft types are obtained from IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1996). Default values are applied for aircrafts where specific data is not available.

In the light of these explanations, the total fuel consumption for domestic aviation is 1.182 Mt. The calculated total LTO fuel consumption is 0.522 Mt and cruise fuel consumption is 0.6601 Mt, resulting CO_2 emission values of 1.639 Mt and 2.079 Mt for LTO and cruise respectively. CO_2, CH_4 and N_2O emission values and average emission factors are given in Table 3.9 for domestic aviation.

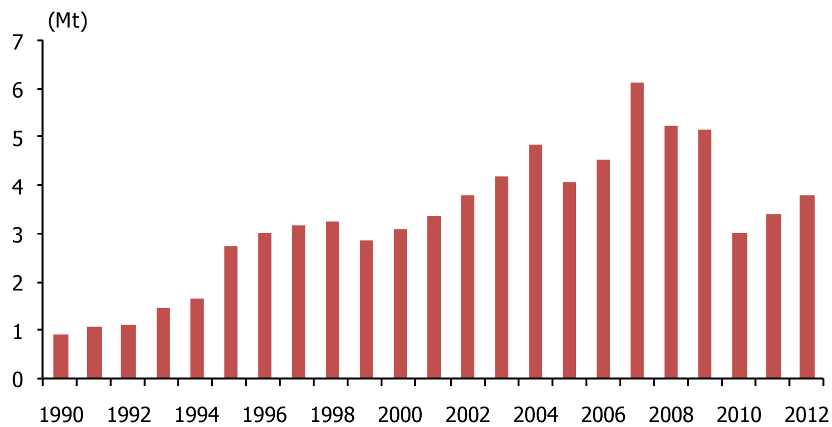
3.9 GHG emissions and average emission factors for LTO and cruise in domestic aviation

			(Gg)
	CO_2	**CH_4**	**N_2O**
Emissions			
Total emissions	3.718,79	0,05	0,13
LTO emissions	1.639,37	0,05	0,06
Cruiseemissions	2.079,42	-	0,07

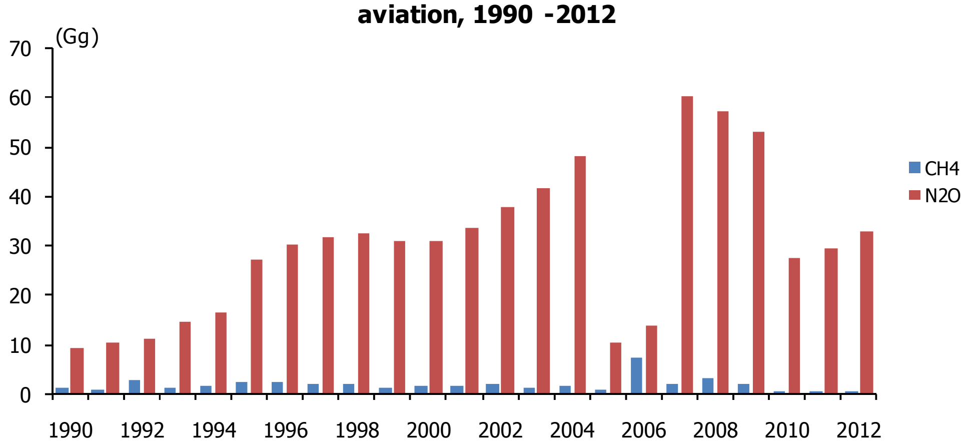
Source: Ministry of Transport, Maritime Affairs and Communications

Graph 3.11 and Graph 3.12 illustrate the total emissions and the emissions of N_2O and CH_4 increasing trends as CO_2 equivalents. CO_2 equivalent emissions have increased approximately 317.58% since 1990 and reached to 3.80 Mt CO_2 in 2012. The calculated amounts of N_2O and CH_4 emissions are 32.68 Gg CO_2 equivalents and 0.55 Gg CO_2 equivalents, respectively in 2012.

3.11 CO_2 equivalent for domestic aviation, 1990 - 2012



3.12 CO_2 equivalent of CH_4 and N_2O emissions for domestic aviation, 1990 -2012



Uncertainties and time-series consistency: Uncertainties arise from the lack of data concerning the types of aircraft which are evaluated with default values for fuel consumption and emission production. IPCC default values of 7% for the activities and 7% for the fuel consumption are accepted for domestic aviation sector.

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

The Road Transportation source category is a key category, in terms of CO_2 emissions from diesel fuel, LPG and gasoline.

The model method used for the estimation of emissions arising from road transportation was developed by Istanbul Technical University (ITU) in 2006. Road vehicles powered with internal combustion engines are one of the major sources of pollutant emissions such as CO, unburned HC's, NO_X and particulate matter (PM). CO_2 is also principal product of combustion and its production is directly related to the amount of fuel consumed by the vehicle and the carbon content of the fuel. Therefore CO_2 emissions can be precisely calculated knowing the type and the amount of fuel consumed by applying simple IPCC Tier 1 approch.

Other GHGs reported in this inventory such as CH_4 and N_2O are emitted into the atmosphere also through the combustion process. CH_4 is a hydrocarbon resulting from the incomplete combustion of fuel that is induced into the combustion chamber. N_2O is a product during the combustion process resulting from the partial oxidation of nitrogen present in the air and it is also produced by catalytic converters.
To estimate emissions from road vehicles, various parameters have to be considered such as vehicle and engine types, specifications of fuel consumed, operating characteristics, emission control systems, present maintenance conditions, fleet age, etc.

Energy based emission calculations are conducted according to IPCC Tier 1 approach initially to obtain CO_2 emissions for basis of model result comparisons. IPCC Tier 2 approach is subsequently conducted using the vehicle fleet and traffic activity data to calculate CO_2 emissions.

Both results are compared for consistency in an iterative approach. Further, the model is used to calculate other GHG emissions.

For the Tier 2 approach, initially vehicle fleet is seperated into the groups according to their classes, fuel types and model years, and then the vehicles are grouped by their emission control technologies. In doing this classification, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories are considered. For the emission factors, the default values of IPCC Guidelines are used. For gasoline vehicles, 4 emission standarts are used as uncontrolled, ECE 15/04, Euro I and EURO III-IV; and for diesel vehicles, only one emission technology classification is used (moderate control). Passenger cars with LPG are also considered.

Compiled data is then used in an equation;

Emission [kt] =Emission Factor [g/km] x Annual Vehicle Distance [km] x 10^{-9}

to compute emissions for each vehicle. To calculate total emissions, the emisson for one vehicle must be multiplied by number of vehicles in use in the year considered. When calculating the annual emissions, newly registered vehicles are added to the old fleet regarding their emission technologies and the old cars removed from the registers are subtracted from the total fleet. This data is validated with the total number of passenger cars reported by Turkish Statistical Institute.

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 tables and the estimated energy consumption. This is achieved by appropriately adjusting the covered mileage and the fuel consumption of each category (Table 3.10).

Annual mileages calculated are then used for obtaining GHG emissions from road transportation. 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 (Graph 3.13).

The predictions for the distance travelled are given in Table 3.10 for different vehicle categories. Improvements for the predictions of distance travelled for each vehicle category are in progress for future studies. Emission factors for vehicle categories are given in Table 3.11.

3.10 Yearly travelled distances by vehicle classes (predictions)

(km)

Year	Passenger cars Diesel	Passenger cars Gasoline	Passenger cars LPG	HD Trucks	LDV	Minibuses	Buses	Motorcyles
2012	11 580	4 700	24 000	19 400	12 500	18 500	69 000	1 200
2011	5 000	4 885	22 750	13 000	10 000	14 000	51 000	1 250
2010	6 580	6 580	27 930	15 000	10 055	16 000	70 000	1 350
2009	6 500	6 500	31 050	19 268	16 000	22 500	77 500	1 450
2008	7 540	7 540	26 400	19 500	14 000	14 750	53 000	1 550
2007	7 850	7 850	17 500	19 500	14 000	14 750	53 000	1 550
2006	8 400	8 400	16 970	15 000	13 250	14 250	52 500	1 650
2005	8 900	8 900	18 060	14 000	13 000	14 000	52 000	1 700
2004	9 400	9 400	19 230	18 000	11 800	12 400	51 000	1 750
2003	9 750	9 750	24 200	25 500	17 000	17 500	55 500	1 800
2002	10 400	10 400	24 500	25 500	14 750	15 250	55 000	1 800
2001	10 550	10 550	28 500	24 500	12 900	13 100	54 500	2 000
2000	12 400	12 400	28 200	22 500	11 700	12 600	53 500	2 250
1999	14 800	14 800	23 500	21 000	10 600	11 700	51 500	3 250
1998	16 000	16 000	23 200	18 000	8 400	9 450	43 500	3 250
1997	16 000	16 000	23 200	25 000	11 250	12 270	58 000	3 500
1996	15 600	15 600	-	33 000	15 100	15 930	80 000	3 700
1995	15 250	15 250	-	34 500	14 525	15 640	77 500	3 700
1994	14 400	14 400	-	33 000	14 030	14 975	76 000	3 350
1993	15 300	15 300	-	39 200	16 400	17 535	84 000	3 350
1992	15 200	15 200	-	34 200	14 200	15 135	76 000	3 350
1991	15 900	15 900	-	36 700	17 300	18 300	85 500	3 000
1990	18 400	18 400	-	44 000	22 500	22 500	89 000	3 000

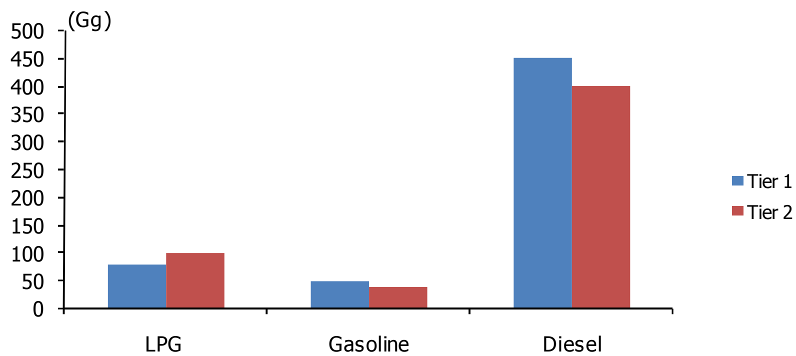
3.11 Emission factors for vehicle categories

								(g/km)
	Vehicleclasses							
	Passengercars							
Model Year	**Diesel**	**Gasoline**	**LPG**	**HD Trucks**	**LDV**	**Minibuses**	**Buses**	**Motorcyles**
				CH_4				
1990-2001	0.005	0.07	0.06	0.06	0.005	0.005	0.06	0.15
2002-2012	0.005	0.02	0.06	0.06	0.005	0.005	0.06	0.15
				N_2O				
1990-2001	0.01	0.005	0.0	0.03	0.02	0.02	0.03	0.002
2002-2012	0.01	0.05	0.0	0.03	0.02	0.02	0.03	0.002
				CO				
1990-1993	-	46	7.10	9	1.60	1.60	9.00	22.00
1994-2001	-	19	7.10	9	1.60	1.60	9.00	22.00
2002-2012	0.7	2.90	7.10	9	1.60	1.60	9.00	22.00
				NMVOC				
1990-1993	0.2	5.30	1.50	1.90	0.40	0.40	1.90	16.00
1994-2001	0.2	4.50	1.50	1.90	0.40	0.40	1.90	16.00
2002-2012	0.2	0.50	1.50	1.90	0.40	0.40	1.90	16.00
				Fuelconsumptions				**(l/100 km)**
1990-1993	7.30	11.20	-	-	-	-	-	-
1994-2001	7.30	8.30	-	-	-	-	-	-
2002-2009	7.30	8.50	-	-	-	-	-	-
2010-2012	7.30	8.50	11.20	29.90	10.90	10.90	29.90	8.50

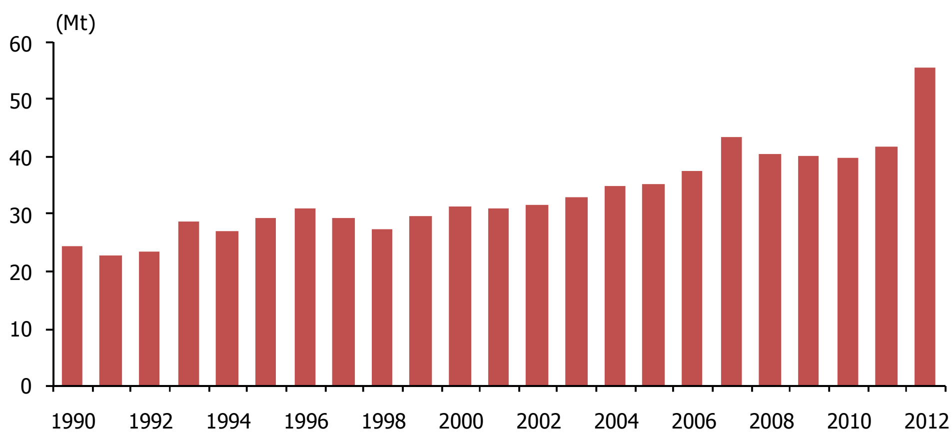
Source: Ministry of Transport, Maritime Affairs and Communications

In road transportation, gasoline, diesel, LPG, natural gas and biodiesel are used as fuel. Road transportation being the major source within transportation sector contributed 55.82 Mt of CO_2 equivalents in 2012 with 90.50% of the transport emission(Graph 3.14).The emissions of N_2O reached 0.12 Mt CO_2 equivalents and CH_4 reached 0.15 Mt CO_2 equivalents in 2012 (Graph 3.15). Emissions from the consumption of biofuels are taken into consideration for CH_4 and N_2O emissions.

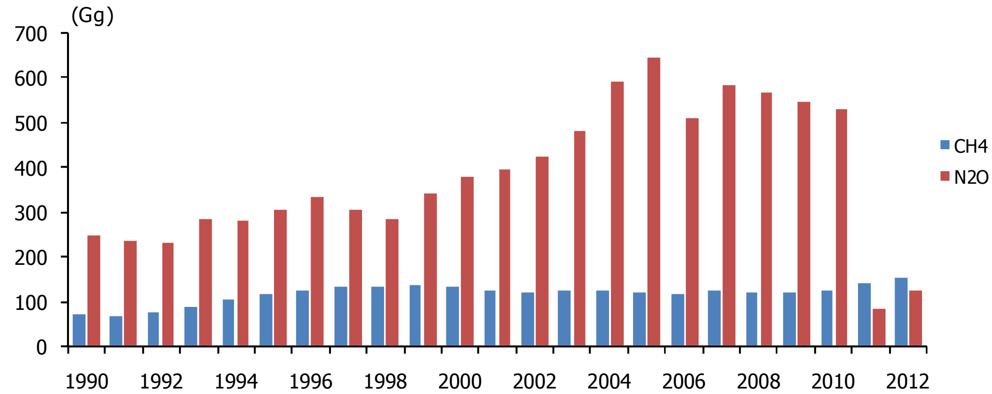
3.13 Comparison of NO_x emissions for validation, 2012



3.14 CO_2 equivalent for road transportation, 1990 - 2012

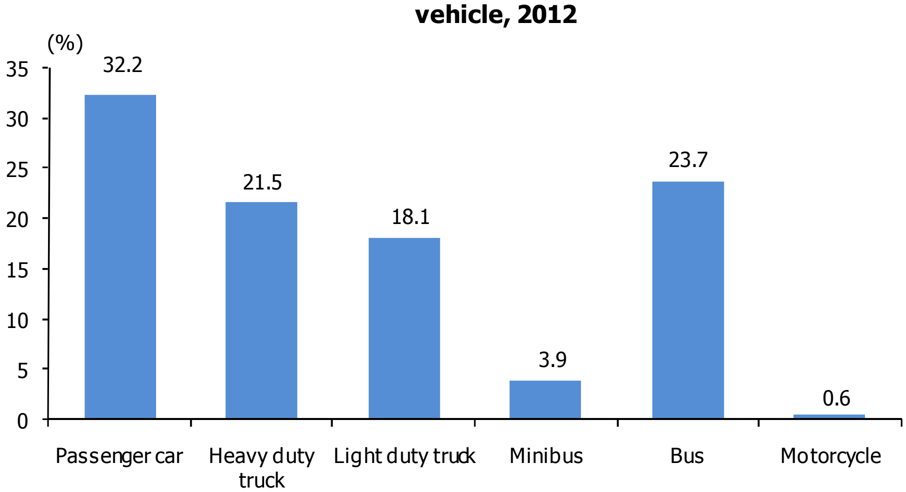


3.15 CO_2 equivalent of CH_4 and N_2O emissions for road transportation, 1990 - 2012

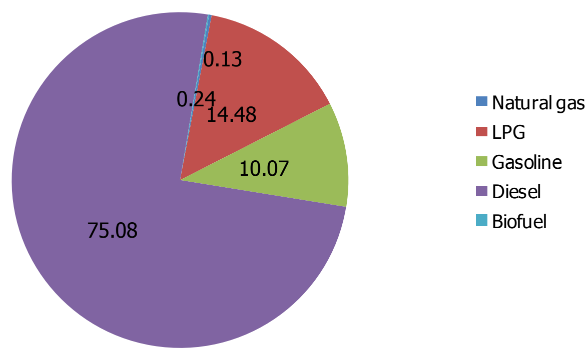


Emissions from road transportation are estimated using Tier 2 approach. According to the results, 32.20% (18.13 Mt CO_2 equivalents) of emissions is from passenger cars, 21.54% from Heavy Duty (HD) Truck, 18.07% from Light Duty Vehicle (LDV), 3.89% from Minibus, 23.72% from bus and 0.58% from motorcycles (Graph 3.16).CO_2 emissions according to fuel types are illustrated in Graph 3.17.Most important portion of CO_2 emission is occurred from diesel fuel consumption, which is about 75.08% of total emissions of road transportation.

3.16 CO_2 equivalent distributions with respect to types of vehicle, 2012



3.17 CO_2 emission distributions with respect to fuel types, 2012

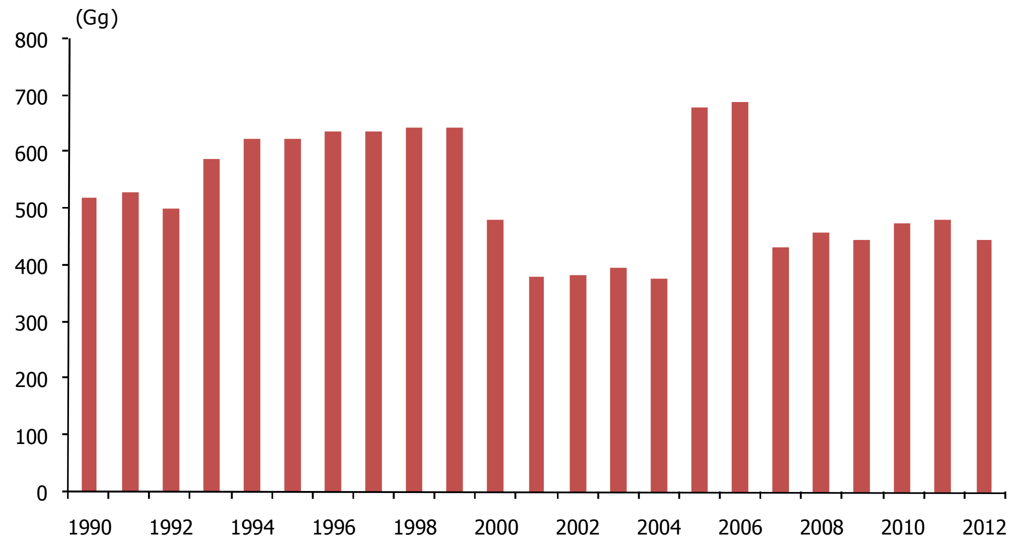


3.1.3.3 Railways (1.A.3.c)

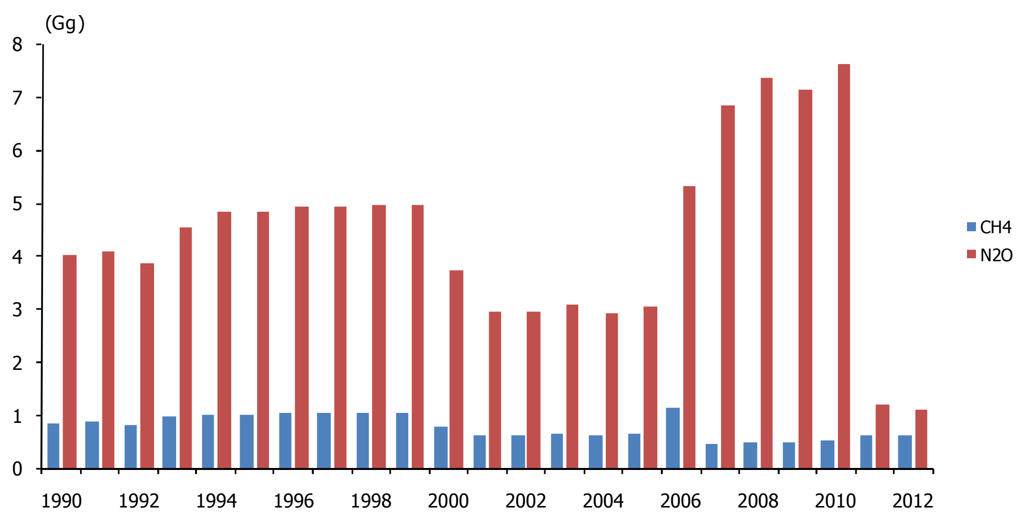
The data availability for railways is limited. Therefore IPCC Tier 1 approach has been used for this subsector. Diesel oil used in railways is taken into consideration.

Graph 3.18 and Graph 3.19 show the total emissions and the emissions of N_2O and CH_4 increase trends as CO_2 equivalents. CO_2 equivalent emissions have declined 14.75% since 1990. The amount of emissions calculated for railways is 0.44 Mt CO_2 in 2012. The emissions of N_2O decreased to 1.11 Gg CO_2 equivalents and CH_4 reached 0.63 Gg CO_2 equivalents in 2012 compared to 2011.

3.18 CO_2 equivalent for railways, 1990 - 2012



3.19 CO_2 equivalent of CH_4 and N_2O emissions for railways, 1990 - 2012



3.1.3.4 Water-borne Navigation (1.A.3.d)

3.1.3.4.1 International Water-borne Navigation (1.A.3.d.i)

Table 3.12 shows the trend in emissions of CO_2, CH_4, N_2O, NO_X, CO, NMVOC and SO_2 from international water-borne navigation for 2011 and 2012. Graph 3.20 and Graph 3.21 illustrate the total emissions and the emissions of N_2O and CH_4 trends as CO_2 equivalents. Total emission increased to 2.6 Mt CO_2 equivalents. The emissions of N_2O and CH_4 increased to 6.26 Gg CO_2 equivalents and 3.54 Gg CO_2 equivalents, respectively.

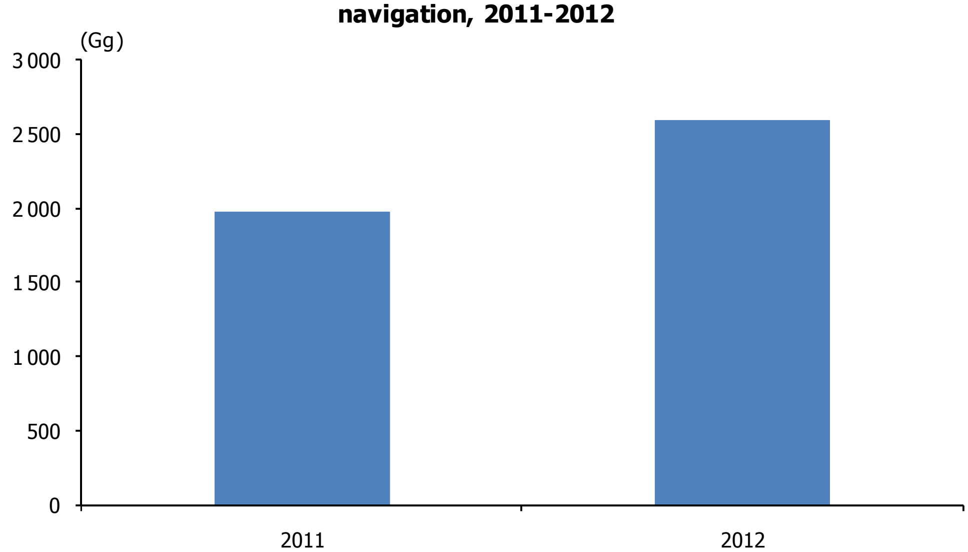
3.12 GHG emissions from marine bunker fuels

(Gg)

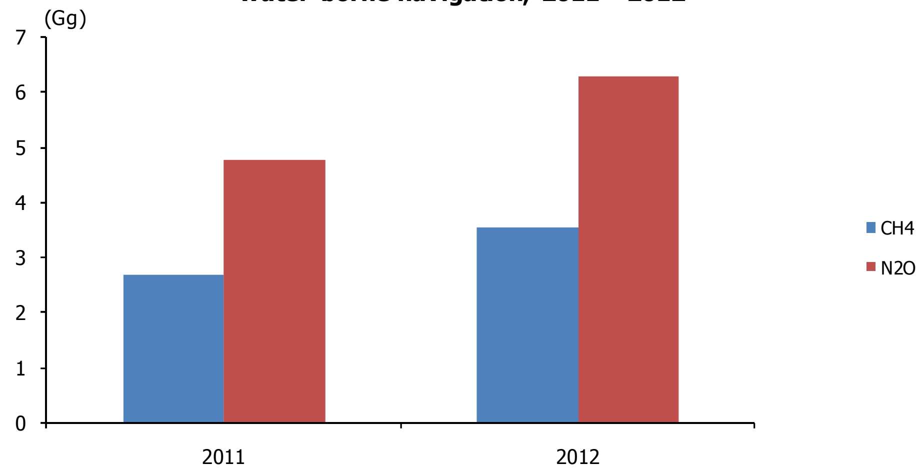
		CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	Diesel	256,57	0,02	0,00	5,20	3,47	0,69	0,24
2011	FuelOil	1713,26	0,11	0,01	33,22	22,14	4,43	16,53
	Total	1 969,83	0,13	0,02	38,42	25,61	5,12	16,77
	Diesel	369,07	0,02	0,00	7,47	4,98	1,00	0,35
2012	FuelOil	2220,09	0,14	0,02	43,04	28,70	5,74	21,42
	Total	2589,16	0,16	0,02	50,51	33,68	6,74	21,77

Source: Ministry of Transport, Maritime Affairs and Communications

3.20 CO_2 equivalent for international water-borne navigation, 2011-2012



3.21 CO_2 equivalent of CH_4 and N_2O emissions for international water-borne navigation, 2011 - 2012



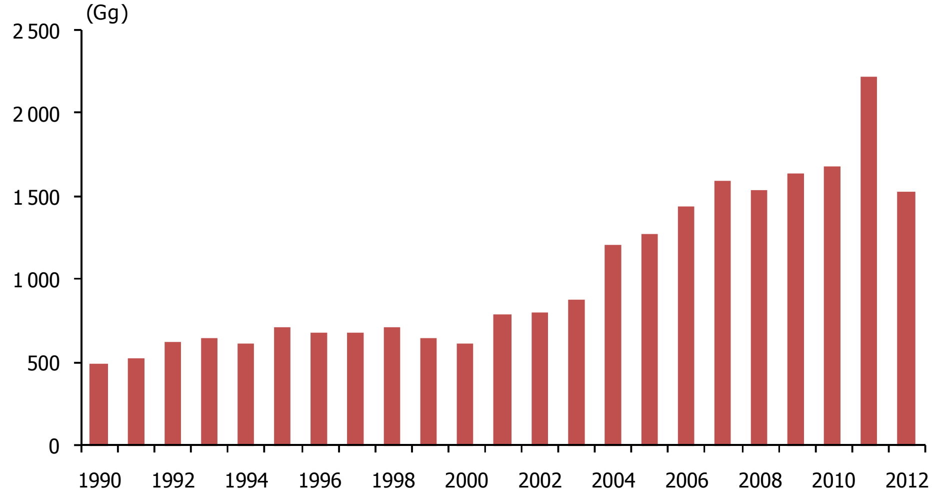
Recalculation: Recalculation has been made in this sub-sector according to improved fuel consumption data in 2011.

3.1.3.4.2 Domestic Water-borne Navigation (1.A.3.d.ii)

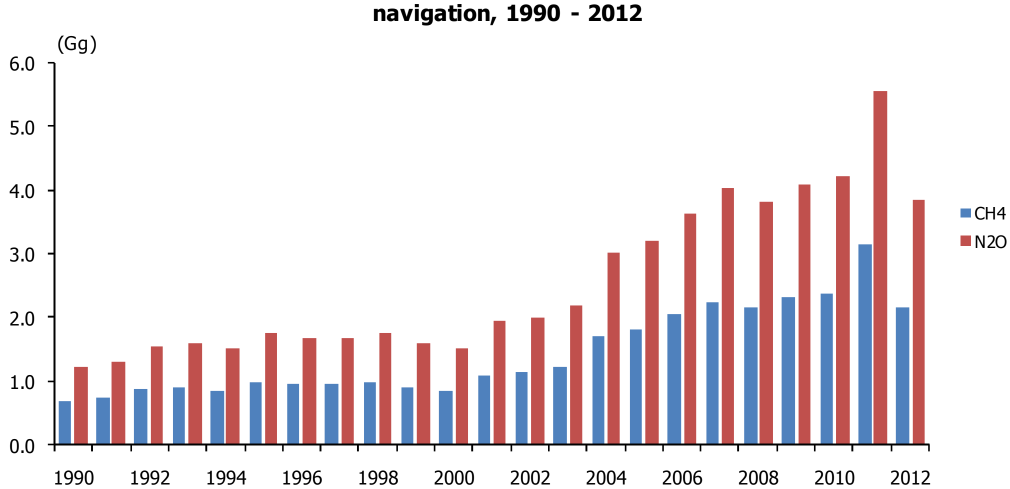
The data availability is limited in this sub-sector. In domestic water-borne navigation only, diesel and residual fuel oil are consumed as energy source. In emission calculation, IPCC Tier 1 approach is used.

Domestic water-borne navigation contributed 1.53 Mt of CO_2 in 2012 with 2.79% of the total transport emissions (Graph 3.22). The emissions of N_2O decreased to 3.84 Gg CO_2 equivalents and CH_4 decreased to 2.17 Gg CO_2 equivalents in 2012 compared to 2011 (Graph 3.23).

3.22 CO_2 equivalent for national domestic water-borne navigation, 1990 - 2012



3.23 CO_2 equivalent of CH_4 and N_2O emissions for domestic water-borne navigation, 1990 - 2012



3.1.4 Other Sectors (1.A.4)

Source Category Description: The emissions that are included in this category mainly arise from fuel consumption in heating of the sectors of commercial/institutional, residential and agriculture/forestry/fisheries. The source category (1.A.4.a) and (1.A.4.b) are considered together depend on the disaggregation of energy balance tables.

Methodological Issues: GHG emissions from this sector are calculated by using Revised 1996 IPCC T1 approach. The fuel consumption data is multiplied by emission factors (EF) to give an estimation of the direct and indirect greenhouse gas emission. The emission factors are given in annex 2.

Uncertainties and time-series consistency: The activity data for energy sectors are taken from energy balance tables. Uncertainties in the emission factor and fuel used are determined by experts of MENR. After calculating the emissions from all sectors, the GWP weighted emission of CO_2, N_2O and CH_4 are multiplied by source specific data uncertainty to obtain overall uncertainty. The approach to produce quantitative uncertainty estimates is to use expert judgment as described in IPCC Good Practice Guidance and Uncertainty Management (2000). The combine uncertainties in emission factors and activity data are explained in annex 7 in detail.

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

Source category	Gas	Fuel type	Comments on time series consistency
1.A.4	CO_2	All Fuels	All EFs are constant over the entire time series.
1.A.4	N_2O, CH_4	All Fuels	All EFs are constant over the entire time series.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance was used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation in sector 1.A.4.

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

The fuel consumption of commercial/institutional is not separated in the energy balance tables, and given together with residential sector. Therefore emissions are given under category (1.A.4.b).

3.1.4.2 Residential (1.A.4.b)

The source category residential is a key category in terms of CO_2 emissions from hard coal, natural gas, lignite and LPG. This source is also a key category in terms of CH_4 emissions from hard coal. Fuel consumption data are taken from the energy balance tables. Although, residential and commercial/institutional fuel consumptions are not separable in energy balance tables, the high percentage of fuel is consumed in households. Share of lignite and petroleum have been considerably decreasing in this sector. 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 is only including the emission from the consumption of fuel in agricultural activities. This source category is a key category in terms of CO_2 from gas/diesel oil.

3.1.5 Other Sectors (1.A.5)

Energy production from the recovered CH_4 gas in waste disposal sites is considered under this category. The collected CH_4 gas is used for the electricity production. Although, the resulting of emissions are so small that it is good practice to estimate CH_4 and N_2O emissions from this source. The emissions from the recovered CH_4 are calculated first time after the year 2002.

Recalculation: Based on the information obtained from TurkStat Waste Disposal and Recovery Facilities Survey in 2013, emissions from methane recovery resulting energy recovery are included in this category for the year 2010-2011.

3.2 Fugitive Emission from Fuels

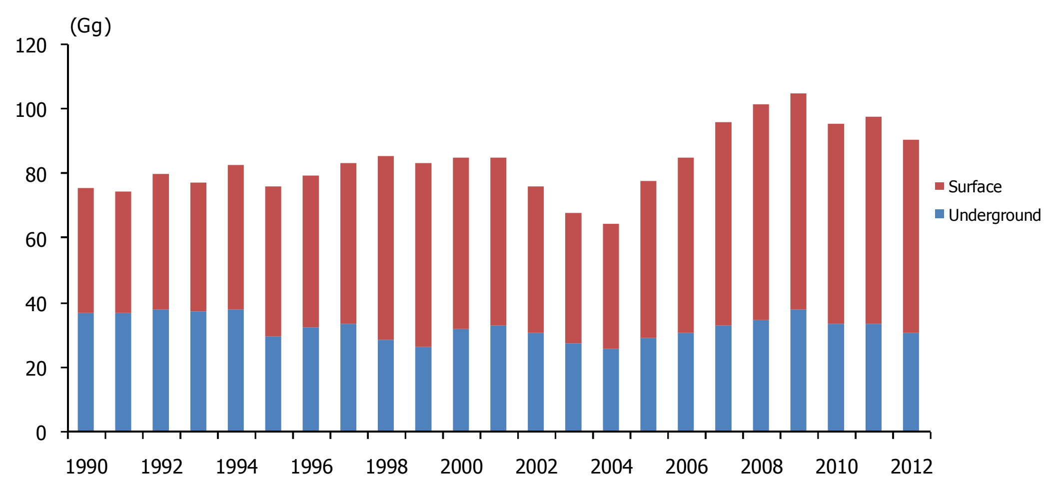
During all stages of fuel production and use, from extraction of fossil fuels to their final use, fuel components can be released as fugitive emissions. CH_4 emission is the most important emission within the source category solid fuels, especially coal mining and handling (1.B.1.a). The calculations of fugitive emissions that occur during the exploration, production (processing), transport (transmission), refining and storage of domestic oil and natural gas (1.B.2), are also calculated for the years 1990-2012.

Methane (CH_4): In Turkey, the main fugitive emissions are the CH_4 from the coal mining, especially the lignite and hard coal mining from underground and surface mines.

The emission factors of underground and surface mines differ considerably. Revised 1996 IPCC Tier 1 approach is used for the emission estimation. The emission from the coal mining is given in table 3.14 and graph 3.24. Moreover, the total amount of extracted coal is also given in graph 3.25.

As shown Table 3.14 and in graph 3.24, the CH_4 emission from coal mining changed between 64 776 tonnes and 105 112 tonnes. The highest CH_4 emission is observed in 2009 and the lowest emission is observed in 2004. CH_4 emission also consists of the emission from the post-mining activities in 2012.

3.24 CH_4 emissions from coal mining, 1990 - 2012

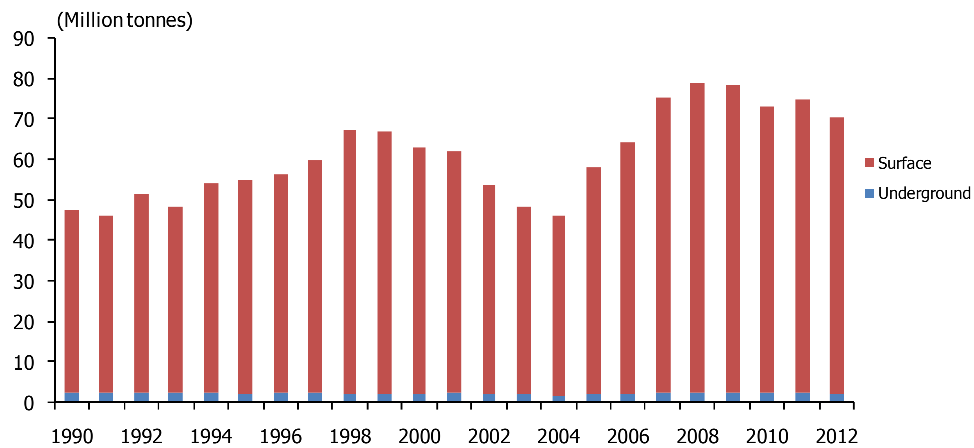


3.14 CH_4 emissions from coal mining

(Gg)

	1990	1995	2000	2005	2009	2010	2011	2012
Underground	36.78	30.12	32.05	29.07	38.36	33.82	33.88	30.72
Surface	38.92	46.01	53.02	48.92	66.75	61.73	63.97	60.25

3.25 Coal extraction, 1990 - 2012



The share underground coal mining in total coal minig decreased throughout the years. In 1990, approximately 5.8% of the total extracted coal was obtained from underground mining. However, this ratio in 2012 was 3.3%.

During surface and underground mining, methane escaping is not related to any specific conditions. Therefore, default Revised 1996 IPCC emission factors are used to calculate methane emissions. Activity data of the coal extraction is taken from the energy balance table.

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 inventory consists of only the CH_4 emission from the coal mining and handling.

Source Category Description: This source category covers CH_4 emissions which occur during the surface and underground extraction of solid fuels and post-mining activities. The emissions due to combustions of those fuels to support production activities is not included in this section. Under this category only methane emissions from coal mining and handling were calculated.

Methodological Issues: The methodology used for emissions calculation is Revised 1996 IPCC T1 method. Methane emission is estimated by multiplying coal production with methane emission factors. IPCC default emission factors are used in the calculation of emissions. The amount of coal extraction is taken from energy balance tables. All hard coal is produced in underground mining and lignite and asphaltite are produced on surface mining.

Uncertainties and time-series consistency: The activity data for this sectors are taken from energy balance tables. Uncertainties in the emission factor and fuel used are determined by experts of MENR. After calculating the emissions from all sectors, the GWP weighted emission of CH_4 is multiplied by source specific data uncertainty to obtain overall uncertainty. The approach to produce quantitative uncertainty estimates is to use expert judgment as described in IPCC Good Practice Guidance and Uncertainty Management (2000). The combine uncertainties in emission factors and activity data are explained in annex 7 in detail.

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

Source category	Gas	Fuel type	Comments on time series consistency
1.B.1	CH_4	Solid Fuels	All EFs are constant over the entire time series.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation in sector 1.B.1.

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

The amount of coal extraction is taken from energy balance tables. The average percent of extracted coal from underground mines is approximately 4.1% for the period 1990-2012. For year 2012, the percentage with a value of 3.3% is even lower than the average. Surface mining is a key category in terms of CH_4 emisiions in 2012.

3.2.2 Oil and Natural Gas (1.B.2)

This source category oil and natural gas (1.B.2) consists of three sub-source categories, oil (1.B.2.a), natural gas (1.B.2.b) and venting and flaring (1.B.2.c). The inventory consists of CO_2, N_2O, CH_4 emissions. The emissions from this section are calculated first time after the year 2010. The time series are submitted in the submission of 2012.

Source Category Description: This source category covers CO_2, N_2O, CH_4 emissions which occur during the exploration, production (processing), transport (transmission), refining and storage of domestic oil and natural gas.

Methodological Issues: The methodology used for emissions calculation is Revised 1996 IPCC T1 methodology. The emissions are estimated by multiplying extraction quantity of oil and natural gas with carbon dioxide, methane and nitrous oxide emission factors. IPCC default emission factors are used in the calculation of emissions. The amount of extraction data is taken from the energy balance tables.

Uncertainties and time-series consistency: The activity data for energy sectors are, completely taken from energy balance tables. Uncertainties in the emission factor and fuel used are determined by experts of MENR. After calculating the emissions from all sectors, the GWP weighted emission of CO_2, N_2O and CH_4 are multiplied by source specific data uncertainty to obtain overall uncertainty. The approach to produce quantitative uncertainty estimates is to use expert judgment as described in IPCC Good Practice Guidance and Uncertainty Management (2000). The combine uncertainties in emission factors and activity data are explained in annex 7 in detail.

3.16 Time series consistency of emission factor for (1.B.2)

Source category	Gas	Fuel type	Comments on time series consistency
1.B.2	CO_2, N_2O, CH_4	Oil and natural gas	All EFs are constant over the entire time series.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation.

3.2.2.1 Oil (1.B.2.a)

The data were gathered from energy balance tables. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat and is not a key category.

3.2.2.2 Natural gas (1.B.2.b)

The data is taken from the energy balance tables. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat and is not a key category.

3.2.2.3 Venting and Flaring (1.B.2.c)

The data is taken from the energy balance tables. Emissions from this category are calculated according to Revised 1996 IPCC T1 methodology by TurkStat and is not a key category.

4. INDUSTRIAL PROCESSES

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, emissions 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 inventory, data confidentiality is taken into account according to Law No. 5429. If the number of the statistical unit in any cell of the data table formed by aggregating the individual data is less than three or one or two of the statistical units are dominant even if the number of units is three or more, the data in the concerned cell is considered confidential. Confidential data can be published only as combined with other data so as not to allow any direct or indirect identification. For that reason, some emissions are given as aggregated into appropriate IPCC category in CRF tables and national inventory report.

Emission is usually obtained according to the IPCC T1 or CORINAIR methods by multiplying production quantity with emission factors. IPCC or CORINAIR default emission factors are used in the calculations. In this category, as well as CO_2, CH_4, N_2O, NO_x, CO, NMVOC and SO_2 emissions, HFC, PFC and SF_6 emissions are also calculated for the period 1990-2012.

Carbondioxide (CO_2): In industrial processes, 54.4% of the CO_2 emission is coming from the cement production (Table 4.1), which is also one of the key sources. The main emission source is clinker production. From the table, it might be concluded that the highest emission ratio is observed in 2012 with an approximate value of 30.3 million tonnes CO_2. In 2011, the other CO_2 emission source in industries is iron and steel production with 35.7%. In this inventory, process emissions from iron and steel industry are calculated under industrial process sector for the years 2010, 2011 and 2012. For the previous years, CO_2 emissions from iron and steel production are considered under energy sector. In order to prevent double counting, the amount of fuel used as a reducing agent is deducted from energy balance table. Because the studies on gathering activity data for the previous years are still in process, the time series will be submitted in the next submission.

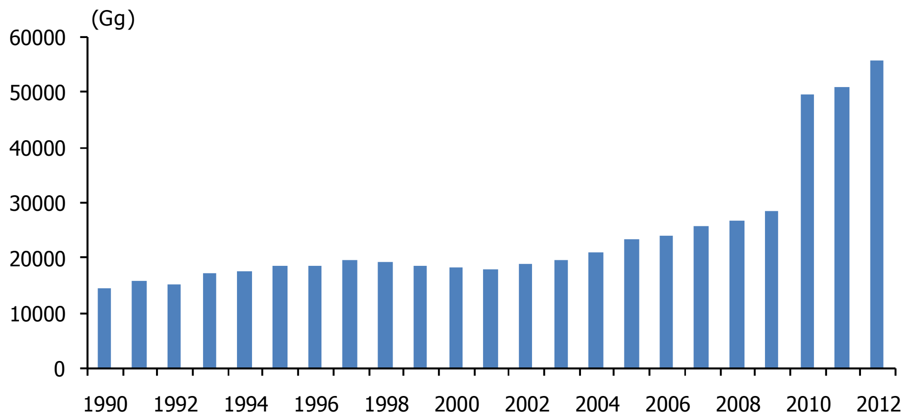
4.1 CO_2 emission contribution of cement production

							(%)
1990	**1995**	**2000**	**2005**	**2009**	**2010**	**2011**	**2012**
71.9	76	81.9	81.4	91.1	59.0	56.6	54.4

Emissions are calculated according to the IPCC T1 and T2 approach

The total CO_2 emission from the industrial processes which is given in graph 4.1 shows a steady increase till 2009. After 2010, sharp increase is observed since the process emission in iron and steel industry is included.

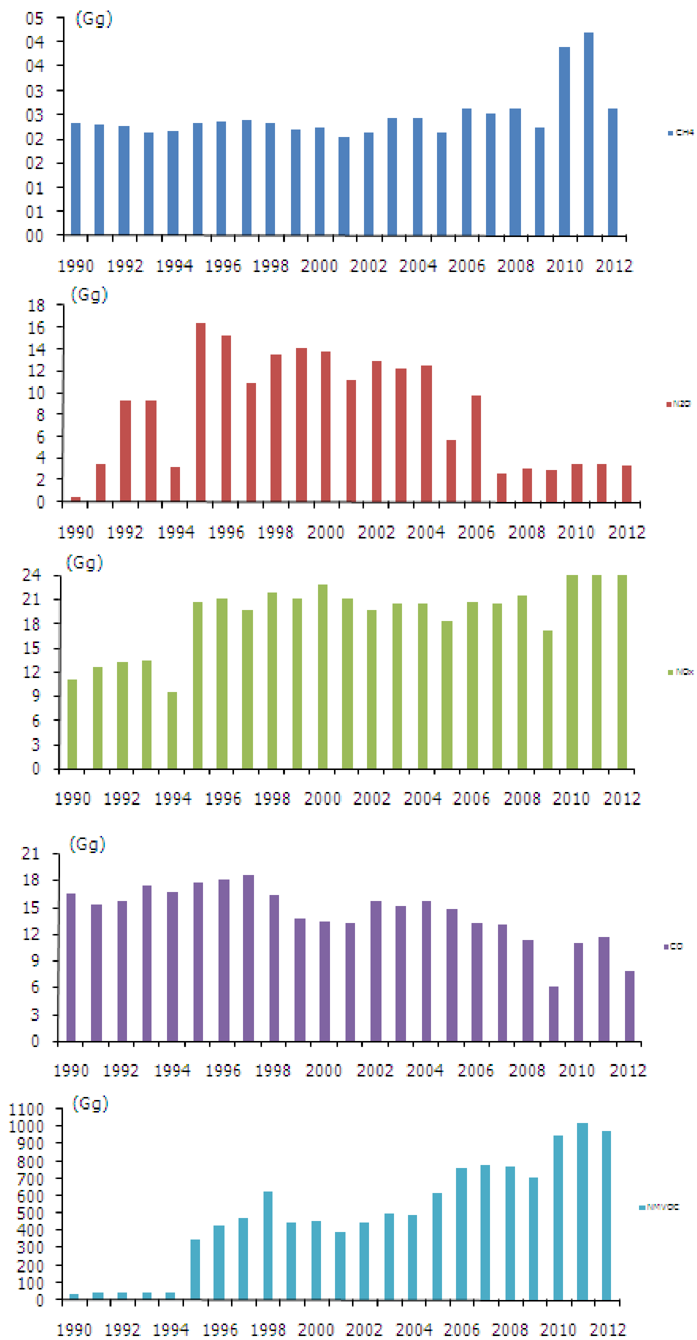
4.1 CO_2 emissions from industrial processes, 1990 - 2012



Nitrous Oxides (N_2O): The source of N_2O emission is 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 changes in nitric acid demands 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, and petroleum industry. The NO_X emission from glass production and petroleum industry is 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. After year 2006, Because the data is confidential due to Law No. 5429. emissions from nitric acid production is given under 2.G.CS 1.

Methane (CH_4): In Turkey, the main source of the industrial CH_4 emission is the chemical industry. The annual emissions from the industries are ranging between 2 062 and 4 220 tonnes. Amounts of methane and other GHG emissions can be seen in graph 4.2

4.2 CH_4, N_2O, NO_x, CO and NMVOC emissions from industrial processes, 1990 - 2012



The main sources of CO emissions are road paving with asphalt, asphalt roofing, other chemical productions and petroleum industry.

The CORINAIR methodology is 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 are the default from the IPCC. The total CO emission range is changing between 5 989 tonnes (in 2009) to 18 640 tonnes (in 1997).

The main sources of NMVOC emissions are road paving with asphalt, asphalt roofing, petroleum industry and food and drink industry. The highest NMVOC emission is coming from the food and drink industries. The emission trend shows fluctuations throughout the years. The CORINAIR methodology is 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 are given in the following Table 4.2.

4.2 CORINAIR emission factors

	(kg NO_X/tonnes production)
Glass production type	**EF**
Plain glass	10
Bottle	5
Others	6
Petroleum Industry	**EF**
NO_X	0.05 kg/m^3
CO	0.08 kg/m^3
NMVOC	0.25 g/kg

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. Emissions calculations have been based on the import data.

4.1 Mineral Products (2.A)

Source Category Description: This source category, mainly, includes the cement production, lime production, asphalt roofing, road paving with asphalt and glass production. Emissions of CO_2 from industrial processes are reported under (2.A). The industrial processes also include the emissions of NO_X, NMVOC, CO and SO_2. The main activity data is provided by TurkStat and Turkish Cement Manufacturers' Association.

Methodological Issues: The production data is multiplied by corresponding emission factors (EF) for the estimation of the direct and indirect greenhouse gas emissions.

Uncertainities and time-series consistency: The activity data for industrial processes are, gathered from industrial production statistics of TurkStat. Uncertainties in the emission factor and production data are determined by experts of TurkStat. Uncertainties in emission factors and activity data are given in annex 7 in detail.

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

Source category	Gas	Comments on time series consistency
2.A	CO_2	All EFs are constant over the entire time series.
2.A	NO_X, CO, NMVOC, SO_2	All EFs are constant over the entire time series.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is recalculation for industrial processes for the years 1990-2012 due to the change of EF for nitric acid production.

4.1.1 Cement Production (2.A.1)

In cement production, a mixture of raw materials containing calcium carbonate ($CaCO_3$), silica, alumina and iron oxides forms a by-product called as clinker. During the production of clinker, limestone is heated (calcined) to produce lime (CaO) and CO_2, then reacts with silica, aluminum and iron oxides in the raw materials. The clinker is then removed from the kiln, cooled and grinded. After addition of certain minerals to this grinded clinker, cement is produced as the final product.

The methodology used for estimating CO_2 emissions from calcinations is the IPCC Tier 1 approach (The Revised 1996 IPCC Guidelines, Good Practice Guidance 2000).

In Turkey, clinker production data is available. Aggregated country specific activity data (clinker production data) is received from Turkish Cement Manufacturers' Association (TCMA). Data for CaO content in clinker and Cement Kiln Dust (CKD) is IPCC defaults. Thus, weight fraction of 65% for CaO and CKD correction factor of 1.02 is used. The EF is consistent for the years between 1990 and 2012. This sector is a key category in terms of CO_2 emissions from kiln production.

4.4 CO_2 emissions from cement production

Year	Clinker Production	EF_{CO2}	CKD	Emission (Gg CO_2)
1990	20 252	0,51	1,02	10 535
1991	22 704	0,51	1,02	11 811
1992	23 153	0,51	1,02	12 044
1993	24 940	0,51	1,02	12 974
1994	25 880	0,51	1,02	13 463
1995	27 094	0,51	1,02	14 094
1996	27 852	0,51	1,02	14 489
1997	28 706	0,51	1,02	14 933
1998	29 148	0,51	1,02	15 163
1999	27 966	0,51	1,02	14 548
2000	28 950	0,51	1,02	15 060
2001	28 746	0,51	1,02	14 954
2002	29 499	0,51	1,02	15 345
2003	30 419	0,51	1,02	15 824
2004	32 779	0,51	1,02	17 052
2005	36 382	0,51	1,02	18 926
2006	38 198	0,51	1,02	19 870
2007	41 585	0,51	1,02	21 633
2008	44 732	0,51	1,02	23 269
2009	49 009	0,51	1,02	25 494
2010	55 600	0,51	1,02	28 923
2011	54 275	0,51	1,02	28 234
2012	58 300	0,51	1,02	30 328

There are 48 integrated cement plants in Turkey, which produce clinker and final product cement. There are also 19 cement plants in Turkey producing only cement from the clinker and final product cement. The clinker production was around 58.3 million tonnes and cement production was around 67 million tonnes in 2012 (data consist of TCMA Members & estimations for non-members). In Turkey, about 98% of the cement kilns (not the plants) are based on dry systems (with or without pre-calciner). The remaining 2% covers semi-wet (Lepol) or wet systems.

Sulphurdioxide is not a main emission item in cement sector. However, as given in the Revised 1996 IPCC Guidelines (Section 2.3.3.) SO_2 emission is also estimated.

4.1.2. Lime Production (2.A.2)

Lime (CaO) is manufactured by the calcinations. Until 2008, industrial lime production data were obtained from TurkStat. Later, the production data are collected from Turkish Lime Association. Therefore, the emission is recalculated due to change in activity data for the years 1990-2007. The IPCC T1 emission factors are used. The uncertainty for the activity data is estimated as 15%. This sector is a key category in terms of CO_2 emissions. Because the emissions from limestone and dolomite use are confidential, the emissions are included the emissions from lime production.

4.5. CO2 emissions from lime production, limestone and dolomite use

Yıl	CO_2 EF (kg CO_2 / tonnes produced CaO)	CO_2 EF (kg/tonnes used dolomite)	Emission (lime+ dolomite Use) (CO_2) Gg
1990	750	477	3 085
1991	750	477	3 091
1992	750	477	2 332
1993	750	477	3 045
1994	750	477	3 069
1995	750	477	3 250
1996	750	477	2 854
1997	750	477	3 315
1998	750	477	3 178
1999	750	477	3 252
2000	750	477	2 827
2001	750	477	2 678
2002	750	477	2 794
2003	750	477	2 895
2004	750	477	3 026
2005	750	477	3 291
2006	750	477	3 409
2007	750	477	3 449
2008	750	477	2 992
2009	750	477	2 503
2010	750	477	2 817
2011	750	477	3 742
2012	750	477	3 466

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

The emission from this category is confidential due to the Law No: 5429, For that reason, the CO_2 emission is aggregated to lime production category (2.A.2).

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

The emission from this category is confidential due to the Law No: 5429. Moreover, the calculated CO_2 emission is aggregated to 2.G.CS.1 Other and Undifferentiated Production

4.1.5 Asphalt Roofing (2.A.5)

CO and NMVOC are calculated in this category. The contribution from this source to total emission is extremely small. Emission for the year 2011 was recalculated due to the change of activity data.

4.6. Emissions from asphalt Roofing

Yıl	Production (tones)	EF (kg NMVOC / tonnes product)	Emission (Gg NMVOC)	EF (kg CO / tonnes product)	Emission (Gg CO)
1990	550 571	0,16	0,09	0,0095	0,005
1991	1382 464	0,16	0,22	0,0095	0,013
1992	1366 738	0,16	0,22	0,0095	0,013
1993	2015 045	0,16	0,32	0,0095	0,019
1994	1323 064	0,16	0,21	0,0095	0,013
1995	1398 641	0,16	0,22	0,0095	0,013
1996	2012 044	0,16	0,32	0,0095	0,019
1997	2485 342	0,16	0,40	0,0095	0,024
1998	3535 139	0,16	0,57	0,0095	0,034
1999	1945 344	0,16	0,31	0,0095	0,018
2000	2639 076	0,16	0,42	0,0095	0,025
2001	1553 842	0,16	0,25	0,0095	0,015
2002	2295 933	0,16	0,37	0,0095	0,022
2003	1858 438	0,16	0,30	0,0095	0,018
2004	2712 770	0,16	0,43	0,0095	0,026
2005	3031 365	0,16	0,49	0,0095	0,029
2006	4820 043	0,16	0,77	0,0095	0,046
2007	5371 335	0,16	0,86	0,0095	0,051
2008	4813 395	0,16	0,77	0,0095	0,046
2009	4194 266	0,16	0,67	0,0095	0,040
2010	4930 386	0,16	0,79	0,0095	0,047
2011	5020 610	0,16	0,80	0,0095	0,048
2012	4242 805	0,16	0,68	0,0095	0,040

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

NO_x, CO, NMVOC and SO_2 were calculated in this category. The contribution from this source to total emission is extremely small.

4.7. Emissions from road paving with asphalt

YIL	Asphalt used for road paving (tonnes)	NOx (kg/tonnes asphalt)	NOx (Gg)	CO (kg/tonnes asphalt)	CO (Gg)	EF NMVOC (kg/tonnes asphalt) asphalt plant	EF NMVOC (kg/tonnes asfalt) road surface	NMVOC (Gg)
1995	977 034	0,084	0,08	0,035	0,034	0,023	320	312,67
1996	1 187 902	0,084	0,10	0,035	0,042	0,023	320	380,16
1997	1 320 972	0,084	0,11	0,035	0,046	0,023	320	422,74
1998	1 797 305	0,084	0,15	0,035	0,063	0,023	320	575,18
1999	1 257 479	0,084	0,11	0,035	0,044	0,023	320	402,42
2000	1 281 162	0,084	0,11	0,035	0,045	0,023	320	410,00
2001	1 098 737	0,084	0,09	0,035	0,038	0,023	320	351,62
2002	1 245 479	0,084	0,10	0,035	0,044	0,023	320	398,58
2003	1 409 738	0,084	0,12	0,035	0,049	0,023	320	451,15
2004	1 390 587	0,084	0,12	0,035	0,049	0,023	320	445,02
2005	1 763 589	0,084	0,15	0,035	0,062	0,023	320	564,39
2006	2 225 337	0,084	0,19	0,035	0,078	0,023	320	712,16
2007	2 291 006	0,084	0,19	0,035	0,080	0,023	320	733,17
2008	2 241 852	0,084	0,19	0,035	0,078	0,023	320	717,44
2009	2 056 681	0,084	0,17	0,035	0,072	0,023	320	658,19
2010	2 789 029	0,084	0,23	0,035	0,098	0,023	320	892,55
2011	2 958 808	0,084	0,25	0,035	0,104	0,023	320	946,89
2012	2 807 278	0,084	0,24	0,035	0,098	0,023	320	898,39

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

NO_x emissions from glass production are calculated and reported under (2.A.7) category. The source category is not a key category. CO_2 emissions can not be estimated since the Revised 1996 IPPC Guidelines does not provide any information for CO_2 emissions from glass industry.

4.2 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 data source is TurkStat, the Industrial Production Statistics.

Methodological Issues: The direct and indirect greenhouse gas emissions are estimated by using IPCC T1 methodology.

Uncertainties and time-series consistency: The activity data for industrial processes are, gathered from industrial production statistics of TurkStat. Uncertainties in the emission factor and production data are determined by TurkStat experts. After calculating the emissions, the

GWP weighted emissions of gases are multiplied by source specific data uncertainty to obtain overall uncertainty. The approach to produce quantitative uncertainty estimates is to use expert judgment as described in IPCC Good Practice Guidance 2000. The combine uncertainties in emission factors and activity data are given in annex 7 in detail.

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

Source category	Gas	Comments on time series consistency
2.B	CO_2, CH_4, N_2O	All EFs are constant over the entire time series.
2.B	NO_X, CO, NMVOC, SO_2	All EFs are constant over the entire time series.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance 2000 is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation in chemical industry.

4.2.1. Ammonia Production (2.B.1)

The source category is not a key category. Ammonia is produced on the basis of hydrogen and nitrogen. The amount of production data is gathered from industrial production Statistics. The methodology used for emissions calculation is IPCC T1 methods by multiplying production quantity with emission factors. In IPCC guideline, the default emission factor is 1 600 kg CO_2/t NH_3.

Due to the confidentiality, after 2006, the CO_2 emissions from ammonia production is aggrageted under 2.G.CS.1 Other&Undifferentiated Products

4.2.2 Nitric Acid Production (2.B.2)

The activity data is confidential due to Law No: 5429 and the N_2O emissions from nitric acid production is aggrageted under 2.G.CS.1 Other&Undifferentiated Products. Considering the

2013 ERT recommendation, EF for N2O was changed from 19 to 6 by conducting a survey with 4 producers equipt with NSCR.

Basically, the nitric acid and ammonium productions are used for artificial fertilizers. - Market demand for agricultural activities (domestic markets) has determined the production quantity of fertilizers. Therefore the trends for either ammonia or nitric acid basis fertilizers produced according to the agricultural demand. The production data for NH_3 and HNO_3 are gathered from TurkStat industrial production survey results. This sector Nitric Acid Production is not key category in terms of N_2O emissions.

4.2.3 Adipic Acid Production (2.B.3)

There is no adipic acid plant in Turkey.

4.2.4 Carbide Production (2.B.4)

The activity data is confidential due to Law No: 5429. The production data are gathered from TurkStat industrial production statistics and the emissions from carpide production is aggrageted under 2.G.CS.1. Other & Undifferentiated Products.

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

This section includes carbon black, ethylene, dichloroethylene, styrene and methanol production. The production data are gathered from TurkStat industrial production statistics. The activity data is confidential due to Law No: 5429. For that reason, the emissions are not given as separately for each product and reported under 2.B.5

4.9. EF used for other chemicals

(kg/tonnes product)

	CH_4	SO_2	NO_x	NMVOC	CO
Carbon Black	11	3,1	0,4	40	10
Ethylene	1	-	-	1,4	-
Styrene	4	-	-	18	-
Methanol	2	-	-	-	-
Coke	0,5	-	-	-	-
Sulphuric Acid	-	17,5	-	-	-
Acrylonitrile	-	-	-	1	-
Propylene	-	-	-	1,4	-
Formaldehyde	-	-	-	5	-
Phtalic Anhydride	-	-	-	6	-
Polypropylene	-	-	-	12	-
Polystrene	-	-	-	5,4	-
Polythene-low	-	-	-	3	-
Polythene-high	-	-	-	6,4	-
Polyvinyl Chloride	-	-	-	8,5	-

There is no recalculation for other chemical production.

4.3 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 is TurkStat industrial production statistics.

Methodological Issues: The estimation of the direct and indirect greenhouse gas emissions, IPCC Tier 1 approach is used.

Uncertainties and time-series consistency: The activity data for industrial processes are, gathered from industrial production statistics of TurkStat. Uncertainties in the emission factor and production data are determined by TurkStat experts. The approach to produce quantitative uncertainty estimates is used as described in IPCC Good Practice Guidance 2000 for determining uncertainties of that category in total emissions. The combine uncertainties in emission factors and activity data are given in annex 7 in detail.

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

Source category	Gas	Comments on time series consistency
2.C	CO_2	All EFs are constant over the entire time series.
2.C	NO_X, CO, NMVOC, SO_2	All EFs are constant over the entire time series.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation in this sector.

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

Crude steel in iron and steel industry is produced by 2 different processes using different technologies: integrated facilities (BOF) and electric arc furnaces (EAF). Iron and steel industry consumes energy and raw materials intensively. Currently, 3 integrated facilities and 27 electric arc furnace mills are operating in Turkey.

Because of high energy consumption and slow operation, open hearth furnace (OHF) technology was replaced by basic oxygen furnace (BOF) and electric arc furnace (EAF) processes in 1999. Since then, steel production has been realized using latest technologies and under similar conditions of European steel production facilities.

Integrated iron and steel production process begins with the preparation of iron ores by crushing, screening and sintering process or direct charging of lump ore into the blast furnace. Iron ore reduced by the carbon monoxide formed as the coke burns with blast air and melted with the heat energy, turns into hot metal. During primary steelmaking process, a certain amount of scrap and alloying elements are added to hot metal in converter. In BOF technology, pure oxygen is blown on to the alloy and then the liquid steel is obtained. After refining process in ladle, liquid steel is transformed into the desired size of semi-finished products (billet, bloom, slab) at the continuous casting machine.

In electric arc furnaces, liquid steel is produced by melting the steel scrap with the help of graphite electrodes. After refining process, liquid steel transferred from the ladle to the continuous casting machine is solidified and finally shaped as the desired size of semi-finished products.

In iron and steel industry, crude steel production is realized both in integrated facilities and electric arc furnaces. In iron and steel sector where 3 integrated facilities and 27 electric arc furmaces are operating, energy and raw material are consumed intensively,

Process emissions and energy emissions from iron and steel industry are considered together under section (1.A.2.a) for 1990-2009 periods. However, since 2010 inventory, process emissions and energy emissions from iron and steel industry are estimated separately. Energy emissions are given under section (1.A.2.a), process emissions are given under this section 2.C.1. In order to prevent double counting the entire quantity of coke used for iron and steel production is deducted from total coke consumption. The studies on collecting the activity data to estimate the emissions for years before 2010 are still ongoing.

The source category iron and steel production is a key category, in terms of CO_2 emissions.

4.3.2. Ferroalloys Production (2.C.2)

This category is not a key category. The emissions from fuel consumption are reported under CRF category 1.A.2.

4.3.3. Aluminium Production (2.C.3)

The CO_2 emission from this sector is considerably small. The production data is confidential due to Law No: 5429 and emissions are aggrageted under 2.G.CS.1. Other & Undifferentiated Products

4.3.4. SF_6 used in Aluminium and Magnesium Foundries (2.C.4)

The production data is confidential due to Law No: 5429. Therefore, the emissions are aggrageted under 2.G.CS.1. Other & Undifferentiated Products

4.3.5. Other Metal production (2.C.5)

This category was not relevant to Turkey.

4.4 Other Production (2.D)

Source Category Description: This source category, mainly includes pulp and paper production and food and drink production. The main activity data is gathered from TurkStat industrial production statistics.

Methodological Issues: for the estimation of the direct and indirect greenhouse gas emissions, IPCC Tier 1 approach is used.

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

Source category	Gas	Comments on time series consistency
2.D	NO_X, CO, NMVOC, SO_2	All EFs are constant over the entire time series.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation in this sector.

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

There is no pulp production since 2011 in Turkey

4.12. Emissions from pulp production

Yıl	Kraft pulp (tonnes)	Sulphide pulp (tonnes)	EF (kg NOx/ tonnes pulp)	Emission (Gg NOx)	EF (kg NMVOC/ tonnes pulp)	Emission (Gg NMVOC)	EF (kg CO/ tonnes pulp)	Emission (Gg CO)
1990	175 190	56 415	1,5	0,26	3,7	0,65	5,6	0,98
1991	184 412	59 385	1,5	0,28	3,7	0,68	5,6	1,03
1992	194 118	62 510	1,5	0,29	3,7	0,72	5,6	1,09
1993	157 908	40 867	1,5	0,24	3,7	0,58	5,6	0,88
1994	225 449	34 694	1,5	0,34	3,7	0,83	5,6	1,26
1995	229 645	36 352	1,5	0,34	3,7	0,85	5,6	1,29
1996	201 931	25 139	1,5	0,30	3,7	0,75	5,6	1,13
1997	222 734	31 135	1,5	0,33	3,7	0,82	5,6	1,25
1998	209 362	33 587	1,5	0,31	3,7	0,77	5,6	1,17
1999	196 961	28 919	1,5	0,30	3,7	0,73	5,6	1,10
2000	208 587	23 962	1,5	0,31	3,7	0,77	5,6	1,17
2001	171 725	13 878	1,5	0,26	3,7	0,64	5,6	0,96
2002	183 108	15 028	1,5	0,27	3,7	0,68	5,6	1,03
2003	106 650	2 052	1,5	0,16	3,7	0,39	5,6	0,60
2004	92 516	3 000	1,5	0,14	3,7	0,34	5,6	0,52
2005	55 975	600	1,5	0,08	3,7	0,21	5,6	0,31
2006	72 188	0	1,5	0,11	3,7	0,27	5,6	0,40
2007	60 841	0	1,5	0,09	3,7	0,23	5,6	0,34
2008	50 864	0	1,5	0,08	3,7	0,19	5,6	0,28
2009	51 184	0	1,5	0,08	3,7	0,19	5,6	0,29
2010	59 871	0	1,5	0,09	3,7	0,22	5,6	0,34
2011	0	0	1,5	0,00	3,7	0,00	5,6	0,00
2012	0	0	1,5	0,00	3,7	0,00	5,6	0,00

4.4.2 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. is included in this category. The methodology used for NMVOC emissions calculation is IPCC T1 methods. This source category is not a key category.

4.5 Production of Halocarbons and SF_6 (2.E)

There is no production in Turkey and the demand is met by imports. For that reason, there is no emission.

4.6 Consumption of Halocarbons and SF_6 (2.F)

Source Category Description: Emissions from this category is estimated by the Ministry of Environment and Urbanization. There's no production of PFC, HFC and SF_6 in Turkey. All demand is met by imports. The methodology has been based on the IPCC Guidelines and the Good Practice Guidance. Inventory calculations have been based on the raw import data provided by TurkStat. This source category is a key category in terms of HFC-134a emission.

Methodological Issues: for the estimation of the direct greenhouse gas emissions, IPCC Tier 1 approach is used.

HFCs: HFCs are mostly consumed in the production processes. A major portion of HFCs are used in refrigeration and air conditoning sector. HFCs are being used as alternatives to CFCs since 1999 mainly in refrigeration air conditoning sector. There is an increase throughout the years. Table 4.13 and graph 4.3 show the HFC emission trends as CO_2 equivalents.

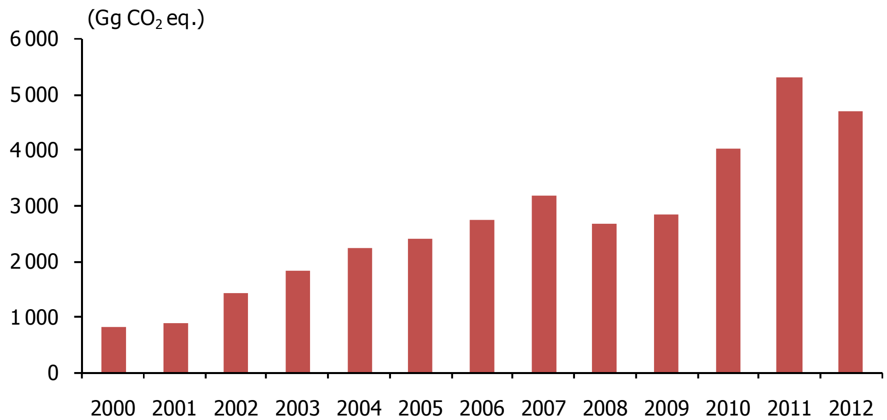
Import licenses until 2008 are registered by the Ministry of Environment and Urbanization. Import data for HFCs are gathered from TurkStat foreign trade statistics.

4.13 HFC emissions

(Gg CO_2 eq.)

2000	2001	2002	2003	2004	2005	2006
818.43	871.48	1 418.94	1 806.71	2 228.73	2 379.00	2 729.75
	2007	**2008**	**2009**	**2010**	**2011**	**2012**
	3 174.30	2 669.43	2 839.25	4 009.30	5 308.29	4 681.30

4.3 HFC emissions, 2000 - 2012



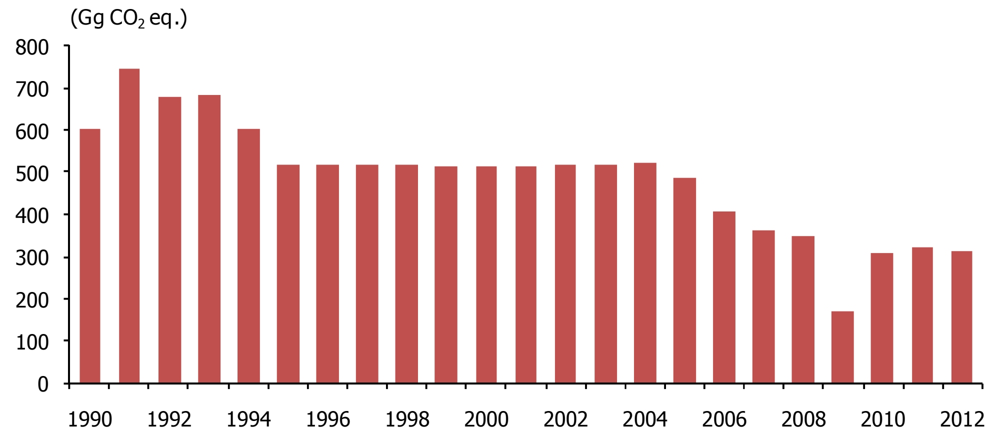
PFCs: Data is being collected from the aluminium production plant and metal foundries. For year 2006, PFC emissions from the aluminium production plant are estimated using Tier 3 methodology. Emissions from this plant for the years 2007 to 2011 could not be included in the inventory due to confidentiality. Table 4.14 and Figure 4.4 show the PFC emission trends resulting from aluminium production.

4.14 PFC emissions

(Gg CO_2 eq.)

1990	1995	2000	2005	2009	2010	2011	2012
603.43	516.43	515.12	487.76	170.56	308.01	320.76	312.75

4.4 PFC emissions, 1990 - 2012



Higher emissions observed between years 1990 and 1994 due to the low quality pitch used in the process. Starting from year 1995, high quality pitch began to be imported from France which resulted in an increase in process efficiency. In addition to this, there's an ongoing technology renewing project in the plant which will reduce the PFC emissions from electrolytic cell process considerably.

SF_6: There's no production of SF_6 in Turkey. All demand is met by imports. The methodology has been based on the IPCC Guidelines and the Good Practice Guidance. Inventory calculations have been based on the import data provided by TurkStat. Emissions are calculted from import data for 1990-2005. For year 2006, 2007, 2008 and 2009 emissions from SF_6 are estimated using annual growth rates of Turkey due to lack of import data.

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 Urbanization have worked 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 leads to high emission rates which is thought to be less in practice.

SF_6 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.

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.

SF_6 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. Therefore this assumption may contain some error. Emission factors have been taken as 60% and 35% for portable and fixed systems respectively.

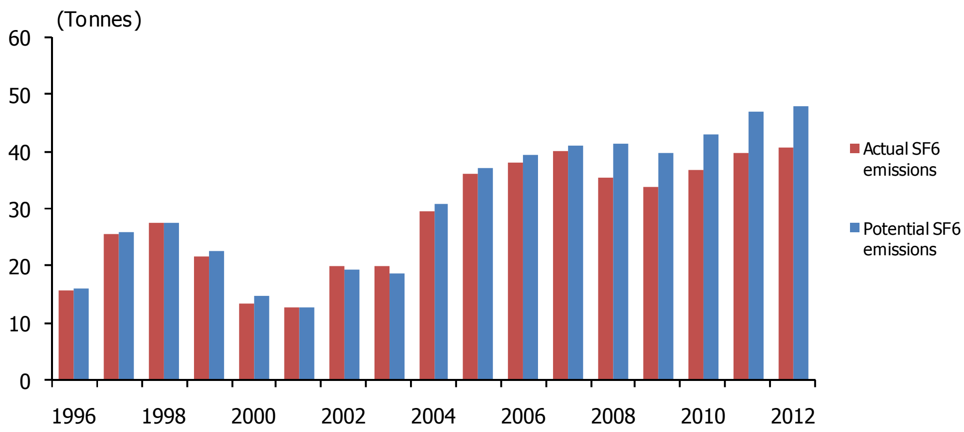
Table 4.15 and graph 4.5 show the SF_6 emission trends.

4.15 SF_6 emissions

(Gg CO_2 eq.)

	1996	**2000**	**2005**	**2009**	**2010**	**2011**	**2012**
Actual emissions	15.64	13.51	35.93	33.62	36.64	39.76	40.63
Potential emissions	15.94	14.60	37.00	39.53	43.08	46.74	47.77

4.5 SF_6 emissions, 1996 - 2012



Source Category Description: The consumption of PFC, HFC and SF_6 has been collected by by Ministry of Environment and Urbanization. Uncertainties in the emission factor and production data are determined by experts of the Ministry. After the HFC, PFC and SF_6 emissions are calculated, the approach to produce quantitative uncertainty estimates is used as described in IPCC Good Practice Guidance 2000 for determining uncertainties of that category in total emissions. The combine uncertainties in emission factors and activity data were given in annex 7 in detail.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Import data of HFCs are cross-checked between import data available in TurkStat and import licenses available in MoEU.

Recalculation: SF_6 emissions are assumed to increase by the same percentage with overall economic growth of Turkey. Overall economic growth data is taken from TurkStat. There was no recalculation. However, the empty cells in CRF are filled with appropriate notation keys.

4.7. Other (2.G)

Source Category Description: This source category includes petroleum industry and the aggragated confidential emission from production process. Production data is gathered from TurkStat industrial production statistics.

Methodological Issues: for the estimation of the NO_x, CO and NMVOC emissions, IPCC Tier 1 approach is used.

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

Source category	Gas	Comments on time series consistency
2.G	NO_X, CO, NMVOC	All EFs are constant over the entire time series.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation in this sector.

4.7.1 Petroleum Industry (2.G)

NO_x, CO, NMVOC emissions are calculated as process emissions from Petroleum Industry. IPCC Tier 1 approach is used. Production data is gathered from TurkStat industrial production statistics. The energy-related emissions are reported in the section (1.A.2.b). This source category is not a key category.

4.7.2 Other and Undifferantiated Products (2.G.CS.1)

This category includes confidential emission sourced from production process. Confidential emissions which are not included any other categories. These source categories are ammonia production, carpide production, soda ash production, aluminium production and nitric acid production.

5. SOLVENT AND OTHER PRODUCT USE

Source Category Description: This category includes paint application, chemical products, (cosmetics and toiletries, DIY/buildings, households products, car-care products), manufacture and processing. The main activity data provider is TurkStat and Automotive Manufacturers Association. The population and household numbers are provided by TurkStat and the annual automobile production is provided by Automotive Manufacturers Association.

Basically, it is very difficult to gather the information about solvent consumption by their usage purposes. For that reason, the usage of solvent was tried to be estimated based on average consumption of solvent per vehicle in the production stage of vehicles and the average consumption of cosmetics and toiletries, diy/buildings, household products and car care products per households. NMVOC emission is calculated for this category. The lack of data for solvent use hinders to estimate the CO_2 and N_2O emissions from this sector.

Methodological Issues: for the estimation of the NMVOC emission, CORINAIR methodology is used.

5.1 Time series consistency of emission factor for (3.A, 3.C)

Source category	Gas	Comments on time series consistency
3.A, 3.C	NMVOC	All EFs are constant over the entire time series.

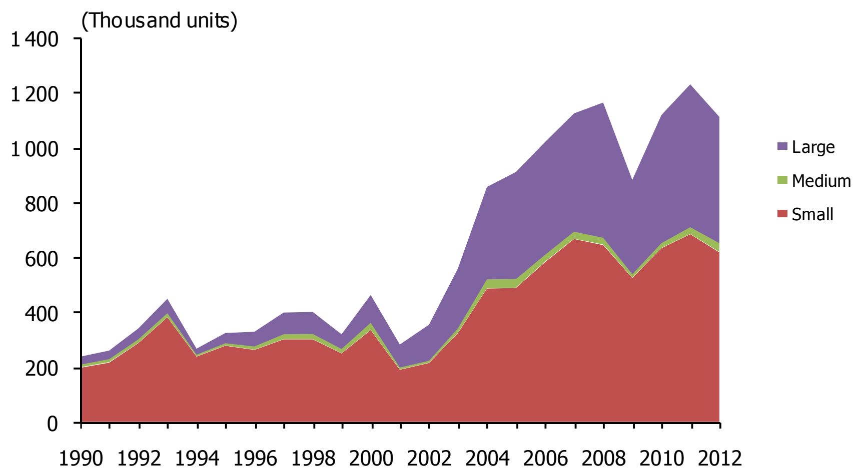
Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation in this sector.

5.1 Paint Application (3.A)

In this source category, only the paint applications for the production of vehicles are covered. CORINAIR methodology is used for the estimation of the NMVOC emission. Vehicles production data is taken from Automotive Manufacturers Association. The vehicles production is given in graph 5.1 according to its size. Automobile and tractor are considered as small size vehicles, minibuses and midibuses are considered as medium size vehicles and trucks and buses are considered as large size vehicles. The source category (3.A) is not a key source with regard to production of vehicles.

5.1 Total vehicle production, 1990 - 2012



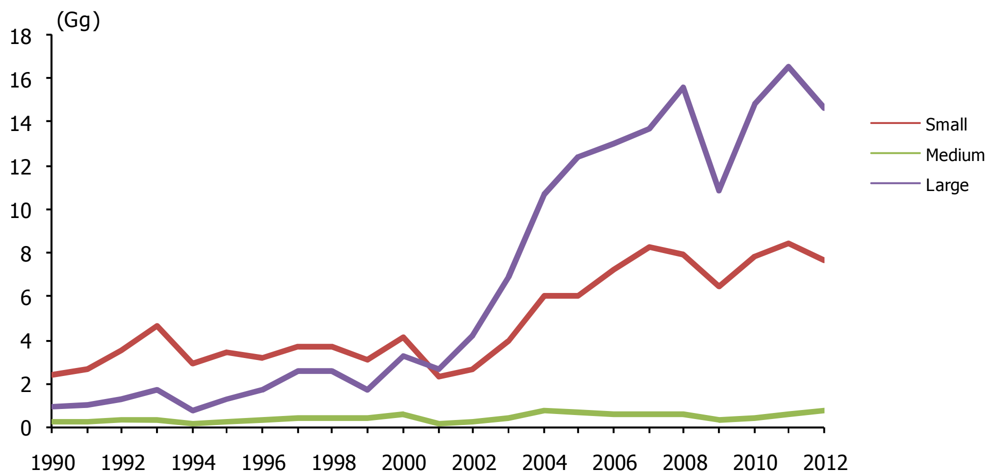
The emission factors for the production of vehicle are given in Table 5.2.

5.2 Emission factors for car size

	(Kg/car)
Paint (Vehicle production)	**NMVOC**
Small	12.30
Medium	21.95
Large	31.60

And the emission from this sector is given below in graph 5.2. After year 2002, there was a sharp increase in the emission due to increase in the automobile production.

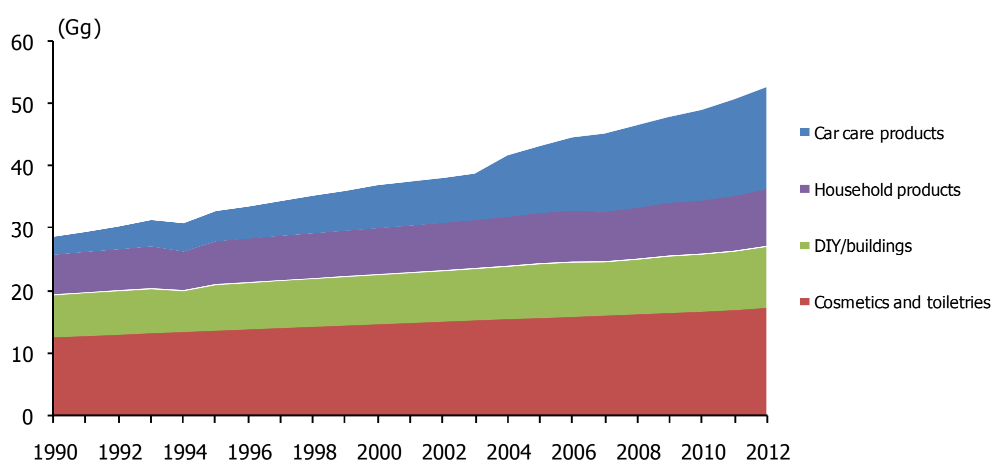
5.2 NMVOC emissions from vehicle production, 1990 - 2012



5.2. Chemical Products, Manufacture and Processing (3.C)

NMVOC emission from this source is basically from car care products, household products, DIY/buildings, cosmetics and toiletries. CORINAIR methodology is used for the estimation of the NMVOC emission. The NMVOC emission is tried to be estimated based on household number, and total vehicle numbers since consumption by usage purposes is not known. As seen in graph 5.3, the emission of NMVOC has been increasing.

5.3 NMVOC emissions from chemical products, manufacture and processing, 1990 - 2012



6. AGRICULTURE

In Turkey, the GHG emissions from agricultural activities are released as a result of the production and processing of agricultural crop, livestock (enteric fermentation, manure management), rice cultivation, agricultural soils and field burning of agricultural residues.

The agricultural activities are mainly sources of CH_4 and N_2O. Besides, the field burning of agricultural residues also emits CO and NO_X. CO_2 equivalent emissions from agriculture sector have inclined 6.23% since 1990 and reached to 32.28 Mt CO_2 equivalents in 2012.

In 2012 emissions of agriculture sector, enteric fermentation had the largest portion with 60.21%. Enteric fermentation was followed by agricultural soils with 24.57%, manure management with 13.68%, rice cultivation with 0.78% and field burning of agricultural residues with 0.76%.

The major GHG emissions from agriculture sector are CH_4 emissions, which represent 66.4% of total emissions from this sector in 2012, followed by N_2O with 33.6%.

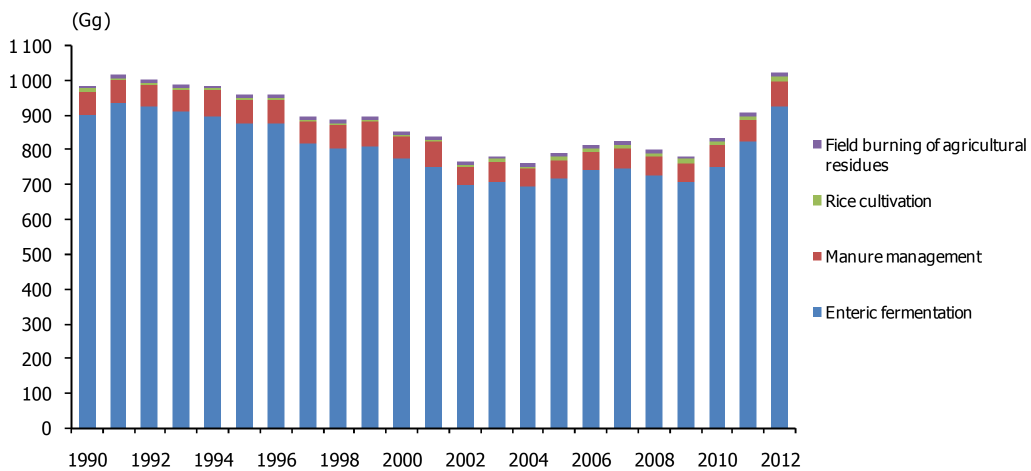
The activity data used for the compilation of the GHG inventory is provided by the TurkStat (http://www.turkstat.gov.tr/PreTabloArama.do?metod=search&araType=vt). The methodology for estimating the GHG emissions from this sector is the IPCC Tier 1.

In Turkey, there are two types of dairy cattle as culture cattle and domestic cattle. The emission factor for culture cattle is taken as the average of Eastern Europe and Asia EF, since based on the expert judgement the culture dairy cattle properties are assumed in between Eastern European and Asian cattle properties. The emission factor for domestic cattle is taken as Asia EF. Because, the domestic cattle is not as strong as cultural cattle and has low milk production yield and domestic dairy cattle has almost similar properties with Asian cattle.

Sheep is categorized as merinos and domestic sheep. For domestic sheep IPCC default EF for developing countries (5.0 kg CH_4/head/year) is used. The merinos are also a kind of domestic sheep breeded for its plumage. The weight is less compared to domestic sheep. Their feeding rate is less than domestic ones. For that reason its emission factor is chosen as a higher value (which is also recommended by the ERT) compared to domestic sheep. The EF of merinos sheep is taken as an average value (6.5 kg CH_4/head/year) from the IPCC default EF for developing countries (5.0 kg CH_4/head/year) and developed countries (8.0 kg CH_4/head/year).

Methane (CH_4): It includes the emissions from enteric fermentation, manure management, rice cultivation and field burning of agricultural residues. In agriculture sector, the highest methane emission was coming from enteric fermentation with 90.7%. Enteric fermentation was followed by manure management with 7.25%, rice cultivation with 1.17% and field burning of agricultural residues with 0.88%. As seen in graph 6.1, CH_4 emissions both from enteric fermentation and manure management had a decreasing trend until 2002, were steady for the years 2002-2009 and started to increase again after 2009. The trend for CH_4 emissions from field burning of agricultural residues was relatively stable for the period 1990-2012 while the trend for rice cultivation was showing an increase for the same period.

6.1 CH_4 emissions from agricultural activities, 1990 - 2012



There are differences between the size population (cattle, sheep and swine) between the numbers used for the estimations of GHG emissions and official numbers submitted to FAO (FAOSTAT). The FAO data is updated and used after one year later. Therefore the AD of GHG inventory is more accurate compared to FAO. Moreover FAO uses some assumptions and the main source is TurkStat. Although, the data is updated in each year by TurkStat, FAO has still continued to use their assumptions. Therefore the data sent by TurkStat which is also used for GHG inventory is the correct data.

The number of livestock is given in table 6.1.

6.1 Number of livestock

(Thousand)

	1990	1995	2000	2005
Dairy cattle	6 080	6 008	5 349	4 036
Other cattle	5 485	5 903	5 481	6 528
Buffalo	183	133	76	67
Sheep	40 553	33 791	28 492	25 304
Goats	10 926	9 111	7 201	6 517
Camels	2	2	1	1
Horse	513	415	271	208
Mules&Donkeys	1 187	900	588	423
Swine	12	5	3	2
Poultry	99 148	131 960	260 769	319 220
	2009	**2010**	**2011**	**2012**
Dairy cattle	4 166	4 397	4 801	5 478
Other cattle	6 591	7 008	7 625	8 484
Buffalo	55	49	57	60
Sheep	21 750	23 090	25 032	27 425
Goats	5 128	6 293	7 278	8 357
Camels	1	1	1	1
Horse	167	155	151	141
Mules&Donkeys	286	260	248	236
Swine	2	2	2	3
Poultry	234 082	238 973	241 499	257 505

Population size for sheep (domestic) and sheep (merinos) is given separately in table 6.2.

6.2 Population size for sheep

(Thousand)

	1990	1995	2000	2005
Sheep	40 553	33 791	28 492	25 304
Sheep (domestic)	39 711	32 985	27 719	24 552
Sheep (merinos)	842	806	773	752
	2009	**2010**	**2011**	**2012**
Sheep	21 750	23 090	25 032	27 425
Sheep (domestic)	20 722	22 003	23 811	25 893
Sheep (merinos)	1 028	1 086	1 221	1 533

Emissions from enteric fermentation and manure management are calculated by using IPCC Tier 1 approach. The annual average temperatures of the provinces are taken into account in order to select the emission factors for manure management. Temperature data are taken from the General Directorate of Meteorology (http://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=A). Considering the annual average air temperature, provinces are categorized as $0^{o}C$ - $14^{o}C$ or $15^{o}C$ - $25^{o}C$ climate region. The emission factors are used according to these two climate region. They are given in table 6.3.

Stubble burning is prohibited by the Ministry of Environment and Urbanization. Although most of the farmers obey this regulation, there are still some farmers burning residue. However, exact area of residual burning is not known. Therefore, all cultivated areas for grains are assumed as area of residual burning.

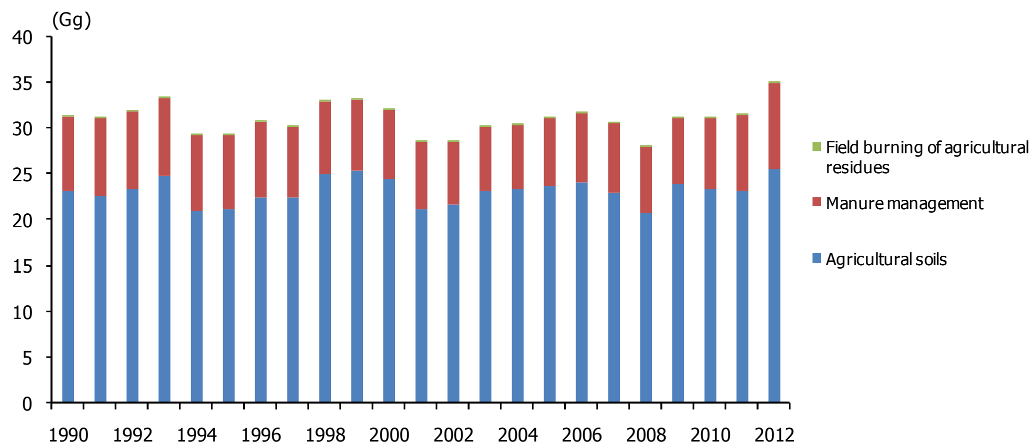
6.3 Emission factors of manure management and enteric fermentation, 2012

(kg CH_4/head/year)

	Cool EF	**Temperate EF**	**Enteric EF**
Cattle			
Dairy Cattle (Culture)	7.000	16.000	68.5
Dairy Cattle (Domestic)	7.000	16.000	56.0
Non-Dairy Cattle	1.000	1.000	44.0
Buffalo	1.000	2.000	55.0
Sheep			
Sheep (Domestic)	0.100	0.160	5.0
Sheep (Merinos)	0.110	0.170	6.5
Goats	0.110	0.170	5.0
Camels and lamas	1.300	1.900	46.0
Horse	1.100	1.600	18.0
Mules and asses	1.000	4.000	1.0
Swine	0.600	0.900	10.0
Poultry	0.120	0.018	.

Nitrous Oxide (N_2O): Includes emissions from the manure management, agricultural soils and field burning of agricultural residues. Agriculture sector had the biggest share in total N_2O emissions with 73.4% in 2012. In agricultural activities, the highest N_2O emission was coming from agricultural soils with 73.1%. It was followed by manure management with 26.4% and field burning of agricultural residues with 0.5%. As shown in graph 6.2, N_2O emissions show a fluctuation between the years 1990-2012.

6.2 N_2O emissions from agricultural activities, 1990 - 2012



Other gases: The NO_x and CO emissions from the field burning of agricultural residues are covered. The emission trend shows fluctuations between 1990 and 2012. The highest CO emission from field burning is seen in 2005 with a value of 209.7 Gg. The highest NO_X emissions are determined as 4.81 Gg again in 2005.

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 is coming from the enteric fermentation. CH_4 emissions from enteric fermentation fluctuate over the time series. Due to governmental support, the number of animals has been increasing since 2009, thereby resulting in the inter-annual fluctuations. The main activity data (the population of animals) provider is TurkStat livestock statistics. This source category is a key category in terms of CH_4 emissions.

Methodological Issues: The provincial animal population is categorized according to the climate of province, for the selection of appropriate emission factors (EF). The methane emission factors are default IPCC Tier 1 factors. Although 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 detailed data required by Tier 2 approach can not be obtained. The CS emission factor estimation by experts is almost the same as IPCC Tier 1 factors.

Uncertainties and time-series consistency: The activity data for this sector are gathered from agricultural statistics of TurkStat. Uncertainties in the emission factor and production data are determined by TurkStat experts. The CH_4 emission is calculated and then it is converted to the CO_2 equivalent by multiplying the global warming potential. The approach to produce quantitative uncertainty estimates is used as described in IPCC Good Practice Guidance 2000 for determining uncertainties of that category in total emissions. The combine uncertainties in emission factors and activity data are given in annex 7 in detail.

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

Source category	Gas	Comments on time series consistency
4.A	CH_4	All EFs are constant over the entire time series as given in Table 6.3.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation.

6.2 Manure Management (4.B)

Source Category Description: This source contains the CH_4 and N_2O emissions. This source category is a key category in terms of N_2O and CH_4 emissions.

Methodological Issues: The provincial animal population data collected from TurkStat is categorized according to the climate of province, for the selection of appropriate emission factors (EF). CH_4 and N_2O emissions factors are default IPCC Tier 1 factors.

Uncertainties and time-series consistency: The activity data for this sector are gathered from agricultural statistics of TurkStat. Uncertainties in the emission factor and production data are determined by TurkStat experts. The CH_4 and N_2O emissions are calculated and then they are converted to the CO_2 equivalent by multiplying the global warming potential. The approach to produce quantitative uncertainty estimates was used as described in IPCC Good Practice Guidance 2000 for determining uncertainties of that category in total emissions. The combine uncertainties in emission factors and activity data are given in annex 7 in detail.

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

Source category	Gas	Comments on time series consistency
4.B	CH_4, N_2O	All EFs are constant over the entire time series as given in Table 6.3.

Source-specific QA/QC and verification: The IPCC Good Practice Guidance was used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation.

6.3 Rice Cultivation (4.C)

Source Category Description: This source contains the CH_4 emission. This source category is not a key category in terms of CH_4 emissions.

Methodological Issues: The CH_4 emission is calculated by using IPCC Tier 1 approach. The rice harvested area data are taken from agricultural statistics of TurkStat. The rice cultivation with intermittently flooded single aeration is applied In Turkey. The CH_4 emission factors are default IPCC Tier 1 factors.

Uncertainties and time-series consistency: The activity data for this sector are gathered from agricultural statistics of TurkStat. Uncertainties in the emission factor and production data were determined by TurkStat experts. The CH_4 emission is calculated and then it is converted to the CO_2 equivalent by multiplying the global warming potential. The approach to produce quantitative uncertainty estimates is used as described in IPCC Good Practice Guidance 2000 for determining uncertainties of that category in total emissions. The combine uncertainties in emission factors and activity data are given in annex 7 in detail.

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

Source category	Gas	Comments on time series consistency
4.C	CH_4, CO, N_2O, NO_x	All EFs are constant over the entire time series

Source-specific QA/QC and verification: The IPCC Good Practice Guidance was used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation.

6.4 Agricultural Soils (4.D)

Source Category Description: This source contains the N_2O emission from synthetic fertilizer, animal manure applied, N-fixing crop and crop residue. This source category is a key category in terms of N_2O emissions from synthetic fertilizer and animal manure applied. In this section the N_2O emissions from pasture, range and paddock manure (4.D.2) and indirect emission (4.D.3), which consists of atmospheric deposition (4.D.3.1) and nitrogen leaching and run-off (4.D.3.2), are also calculated first time after the year 2010. The complete time series of emissions are submitted in this submission.

Methodological Issues: The N_2O emission is calculated by using IPCC Tier 1 approach. The activity data used in emission calculation is taken from agricultural statistics of TurkStat. The N_2O emission factors are default IPCC Tier 1 factors.

The emission factors are given in annex 2. The the N_2O emissions from crop residues are calculated for plant species as given in table 6.7.

Uncertainties and time-series consistency: The activity data for this sector are gathered from agricultural statistics of TurkStat. Uncertainties in the emission factor and production data are determined by TurkStat expert. The N_2O emission is calculated and then it is converted to the CO_2 equivalent by multiplying the global warming potential. The approach to produce quantitative uncertainty estimates was used as described in IPCC Good Practice Guidance 2000 for determining uncertainties of that category in total emissions. The combine uncertainties in emission factors and activity data are given in annex 7 in detail.

6.7 Crop production data used for the crop residue

Major Crop Types	Grass-clover mixtures	Millet
Grains	**Individual Crops**	Sorghum
Beans & Pulses (N fix)	Maize	Soyabean
Beans & Pulses (non-N fix)	Wheat	Dry bean
Tubers	Winter wheat	Potato
Root crops and Other	Spring wheat	Peanut (w/pod)
N-fixing forages	Rice	Alfalfa
Non-N-fixing forages	Barley	Non-legume hay
Perennial grasses	Oats	

6.8 Time series consistency of emission factor for (4.D.1)

Source category	Gas	Comments on time series consistency
4.D.1	N_2O	All EFs are constant over the entire time series

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation.

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: This source contains the CH_4, CO, N_2O and NO_X emissions. Although the burning of agricultural residues is not considered as a net source of carbon dioxide, because, the carbon released to the atmosphere is reabsorbed during the growing season. This source category is not a key category.

Methodological Issues: Emissions are calculated by using IPCC Tier 1 approach. The estimates are derived from crop production including wheat, barley, maize, oat and rye. The emission factors are given in annex 2. The activity data used in emission calculation is taken from agricultural statistics of TurkStat.

Uncertainties and time-series consistency: The activity data for this sector were gathered from agricultural statistics of TurkStat. Uncertainties in the emission factor and production data are determined by TurkStat experts. After, CH_4 and N_2O emissions are calculated; they are converted to the CO_2 equivalent by multiplying the global warming potential. The approach to produce quantitative uncertainty estimates is used as described in IPCC Good Practice Guidance 2000 for determining uncertainties of that category in total emissions. The combine uncertainties in emission factors and activity data are given in annex 7 in detail.

6.9 Time series consistency of emission factor for (4.F)

Source category	Gas	Comments on time series consistency
4.F	CH_4, CO, N_2O, NO_X	All EFs are constant over the entire time series

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: There is no recalculation.

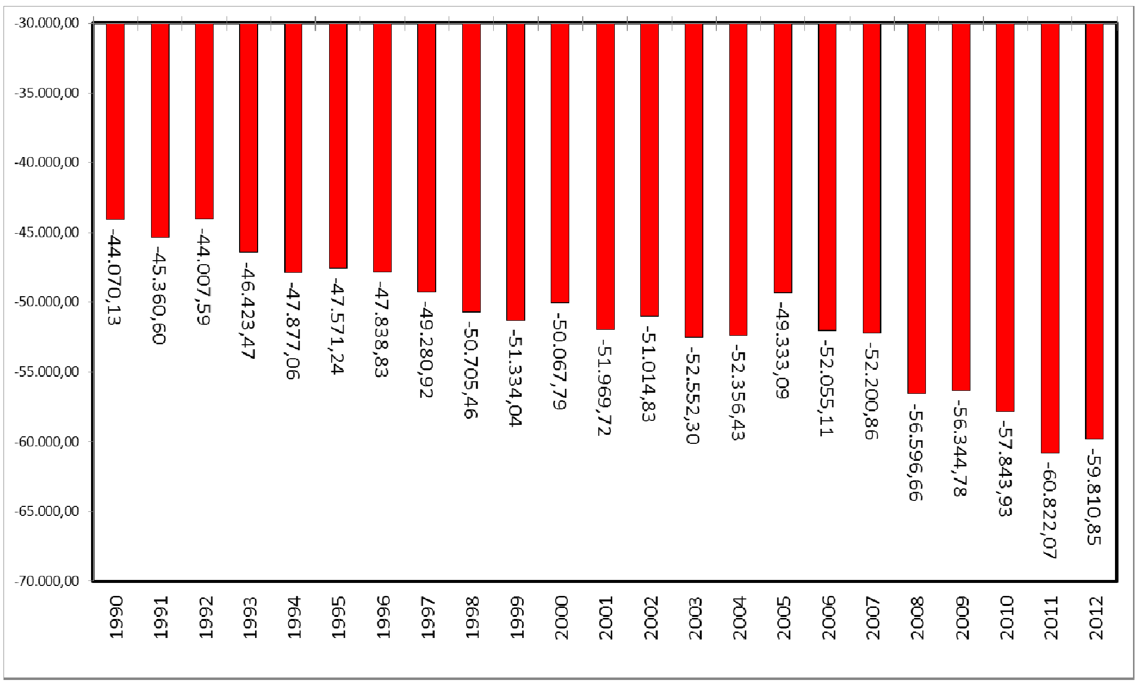
6.7 Other (4.G)

There are no other activities to be considered under this category.

7. LULUCF (CRF SECTOR 5)

7.1. Sector overview

This sector comprises GHG emissions and removals arising from land use, land use change and forestry. The following figure (Figure 7.1) presents net removals from this sector.

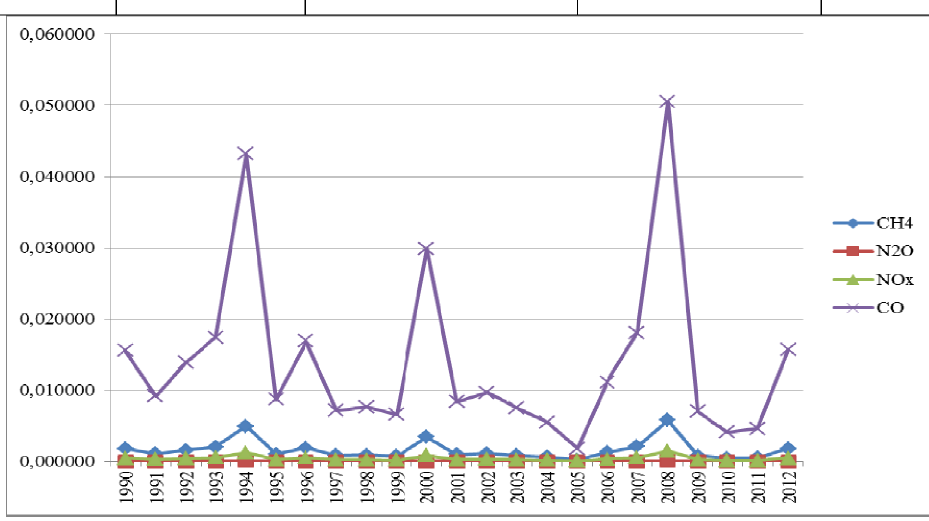


7.1. Net removals from LULUCF as Gg CO_2 equivalents

The figure shows that Land Use, Land Use Change and Forestry sector is a net sink in Turkey. The key driver for the rise in removals is related to improvements in sustainable forest management, afforestation, reforestation on forest land and conversion of coppices to productive forests in forest land remaining forest land. There has also been an increase of biomass removals in cropland and grassland categories due to good practices. Emissions from forest land arise from biomass burning as wildfire. Other greenhouse gasses amounts change depending on the burned forest areas and there is no definite and significant trend (Table 7.1 and Figure 7.2).

7.1. Changes in the other greenhouse gasses caused by forest fires between 1990 and 2012

Years	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)
1990	0,001780	0,000012	0,000442	0,015563
1991	0,001047	0,000007	0,000260	0,009147
1992	0,001580	0,000011	0,000393	0,013848
1993	0,001993	0,000014	0,000495	0,017430
1994	0,004933	0,000034	0,001226	0,043178
1995	0,000993	0,000007	0,000247	0,008692
1996	0,001933	0,000013	0,000480	0,016893
1997	0,000820	0,000006	0,000203	0,007152
1998	0,000873	0,000006	0,000218	0,007653
1999	0,000753	0,000005	0,000187	0,006568
2000	0,003413	0,000023	0,000847	0,029843
2001	0,000960	0,000007	0,000238	0,008377
2002	0,001100	0,000008	0,000274	0,009637
2003	0,000860	0,000006	0,000214	0,007525
2004	0,000633	0,000004	0,000157	0,005518
2005	0,000200	0,000001	0,000051	0,001785
2006	0,001272	0,000009	0,000316	0,011129
2007	0,002065	0,000014	0,000513	0,018066
2008	0,005768	0,000040	0,001433	0,050472
2009	0,000803	0,000006	0,000200	0,007026
2010	0,000469	0,000003	0,000116	0,004100
2011	0,000524	0,000004	0,000130	0,004586
2012	0,001789	0,000012	0,000445	0,015654



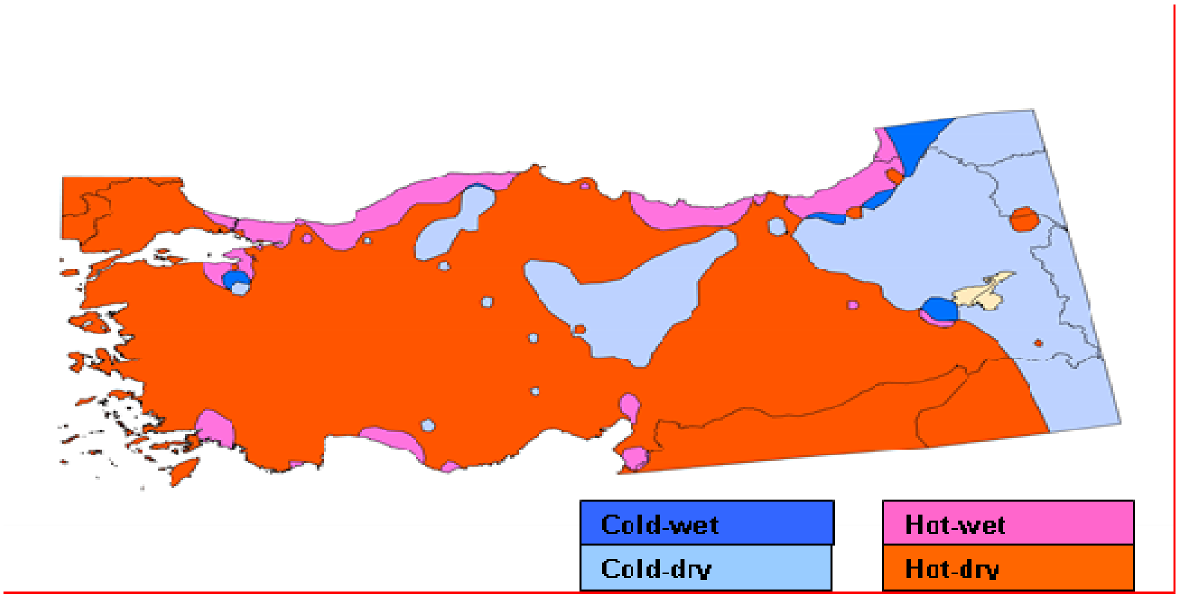
7.2. Other greenhouse gases from forest fires between 1990 and 2012

Due to accounted as a carbon lost from forest fires in the total carbon lost, CO_2emissions were not considered here to avoid double counting in the LULUCF inventory.The estimations for 1990-2012 were calculated according toformulas 3.2.19 and 3.2.20 in GPG. The parameters were chosen appropriate to method described in Section 3.2.1.4.2.1. The parameters have been used from Tables 3.A.1.13. and 3.A.1.14. Country specific data were used for the amount of burning biomass and burning efficiency data changes were entered into Table 5(5) of CRF.

7.2. Comparison of emissions and removals in 1990-2012 periods in Turkey

Year	Total greenhouse gases emissions (CO_2eq-Mtonnes)	Removals from LULUCF sector (CO_2eq-Mtonnes)	Removals from forestry category (CO_2eq-Mtonnes)	Share of LULUCF sector in total greenhouse gases emissions (%)
1990	188.483,62	-44 070,13	-44.870,57	-23,38
1991	200.702,86	-45.360,60	-46.014,77	-22,60
1992	211.777,30	-44.007,59	-46.499,52	-20,78
1993	223.125,05	-46.423,47	-46.884,70	-20,81
1994	218.575,62	-47.877,06	-48.464,07	-21,90
1995	238.869,51	-47.571,24	-48.084,17	-19,92
1996	259.989,26	-47.838,83	-48.418,68	-18,40
1997	273.223,23	-49.280,92	-50.295,78	-18,04
1998	275.242,73	-50.705,46	-51.283,27	-18,42
1999	275.952,17	-51.334,04	-52.077,49	-18,60
2000	298.138,22	-50.067,79	-51.967,26	-16,79
2001	279.118,20	-51.969,72	-53.766,17	-18,62
2002	287.097,13	-51.014,83	-53.338,26	-17,77
2003	303.588,76	-52.552,30	-54.290,58	-17,31
2004	313.122,73	-52.356,43	-54.116,75	-16,72
2005	330.740,34	-49.333,09	-51.264,38	-14,92
2006	350.881,15	-52.055,11	-53.689,04	-14,84
2007	382.378,40	-52.200,86	-53.318,81	-13,65
2008	368.734,42	-56.596,66	-57.575,67	-15,35
2009	371.149,35	-56.344,78	-57.364,76	-15,18
2010	403.494,70	-57.843,93	-58.832,76	-14,34
2011	424.090,95	-60.822,07	-61.795,59	-14,34
2012	439.873,72	-59.810,85	-60.787,51	-13,60

As shown in Table 7.2., however there was an increasing course in total GHG emissions, the average percentage of net removals from LULUCF was 10,74% during the 1990-2012 periods. The methodology advised in the IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry, 2003 was followed to estimate removals/emissions from LULUCF. According to the Guidance, a climate map of Turkey was firstly prepared and used a base for all land use category (Figure 7.3.).



7.3. The climate map of Turkey

Activity data

The land uses and land use changes for Forestland category is provided from ENVANIS database since 2004. The lands other than Forestland have been determined via Corine land use maps belonging to years 1990, 2000, 2006. These maps have been produced by different agencies of the government at different time frames but have the same legend and approach. The 1990 map was produced last year and has been used in this inventory for the first time. This enabled us to determine land uses and land use changes more consistent. In the previous inventory we could not determine the land uses and land use changes for all LULUCF land use types. The land use changes in these periods are given in Table 7.23. Linear interpolation was performed for the years between and linear extrapolation for the years after 2006. This procedure has been explained in 7.6.

Uncertainty

The uncertainty levels of the LULUCF inventory are stated in each land use section.

Completeness

As regards the inventory completeness, sinks and sources that could not be reported in the CRF tables are charted as follows:

Sink/source category	**GHG**	**Explanation**
Forest lands, soils	CO_2	Lack of adequate data on the carbon stocks in the soil organic matter
Forest lands, litter	CO_2	Lack of adequate data on the carbon stocks in the litter
Forest lands, soils	N_2O	N fertilization does not occur in the forestry activities
Forest lands, drained soils	Non-CO_2	Drainage does not occur in the forests
Drained wetlands	"	No available data
Limestone application in croplands and grasslands	CO_2	Limestone application does not occur in the agricultural lands and grasslands.
Croplands, grasslands, wetlands and settlements, biomass burning	CO_2, CH_4 and N_2O	No available data
Croplands, disturbance associated with land use conversion to cropland	N_2O	No available data
Settlements	CO_2	No available data after 2000 year

7.2. Forest land- Category 5A

The inventory studies in this category have been done by the LULUCF Working Group of GDF (Çağlar BAŞSÜLLÜ, Forest Engineer, Ph.D., and Eray ÖZDEMİR, Forest Industry Engineer, B.Sc.).

7.2.1. Definition of forest area

In Turkey forest areas are protected by constitution. According to the legislation (Forest Law No: 6831) (GDF, 1956),all natural woody and shrub areas and all plantations are accepted as forest with their lands. But, reed fields; steppes; bramble patches; parks; woody and shrub areas in cemeteries; areas which are in private ownership and covered with exotic tree species; wherever the areas in or next to or out of forest lands, all woody and shrub areas in private ownership which are using for agriculture; all the woody areas having less than 3 ha magnitudes; wherever the areas in or next to or out of forest lands, all fruit tree and shrub areas which are in the use of private ownership including alder trees, chestnut trees, stone pine trees and Turkish oak trees; olive groves in private ownership, wild olive groves separated from forests, areas covered with pistachio trees (*Pistaciavera* L.), mastic (*Pistacialentiscus* L.) and carob trees (*Ceratoniasiliqua* L.); scrubs and maquis are not accepted as forests.

In addition to that, according to IPCC GPG for LULUCF, areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest. Forests are not defined for reporting under the Convention. The IPCC Guidelines encourage countries to use detailed ecosystem classifications in the calculations and in reporting broad specified categories to ensure consistency and comparability of national data across countries.

7.2.2. Source/sink category description

According to the figures given by the Forest Management Planning Department of the GDF, Turkey has 21,67million ha forest area approximately with regard to its own forestry legislative. Since all the woody areas having more than 3 ha magnitudes are accepted in forest regime disregarding their crown closure, this figure differs with the figure given in FAO’s resources. FAO’s figures cover the woody areas having more than 40% crown closure only. Because of the forcing situation initiating from the protective rules of constitution and forestry regulations current in Turkey, the figures given by forestry organization were accepted and used during the estimation of net annual amount of carbon uptake or release in the forests of Turkey. The figures concerning forest resources in Turkey for 2012 year are given in table 7.3.

7.3. Forest inventory results of Turkey at the end of 2012

7.3.A. Area (GDF, 2012)

	Pure high forests (ha)		Mixed high forests (ha)	Total high forests (ha)	Coppices (ha)	Total forest area (ha)
	Coniferous	Deciduous				
Productive	6.792.336	2.156.746	1.332.646	10.281.728	1.276.940	11.558.668
Degraded	4.983.059	950.319	1.045.486	6.978.864	3.140.602	10.119.466
Total	**11.775.395**	**3.107.066**	**2.378.131**	**17.260.592**	**4.417.542**	**21.678.134**

7.3.B. Growing stock (GDF, 2012)

	Pure high forests (ha)		Mixed high forests (ha)	Total high forests (ha)	Coppices (ha)	Total forest area (ha)
	Coniferous	Deciduous				
Productive	825.750.787	313.485.436	225.950.016	1.365.186.239	52.296.445	1.417.482.684
Degraded	41.541.895	8.342.796	9.435.004	59.319.695	17.652.159	76971854
Total	**867.292.682**	**321.828.232**	**235.385.020**	**1.424.505.934**	**69.948.604**	**1.494.454.538**

7.3.C. Annual volume increment (GDF, 2012)

	Pure high forests (ha)		Mixed high forests (ha)	Total high forests (ha)	Coppices (ha)	Total forest area (ha)
	Coniferous	Deciduous				
Productive	22.937.367	8.616.137	5.747.210	37.300.713	2.719.466	40.020.179
Degraded	1.003.235	196.433	211.972	1.411.640	747.296	2.158.936
Total	**23.940.602**	**8.812.570**	**5.959.182**	**38.712.353**	**3.466.762**	**42.179.115**

Source: Forest Management Planning Department of General Directorate of Forestry.

1. Crown closure between 0,11-1,00.

2. Crown closure between 0,01-0,10.

3. 0,75 coefficient was used in order to convert the ster volume into m³ volume.

Pinusbrutia, Pinusnigra and, Pinussylvestris are the most important coniferous species among the other coniferous such as 4 kinds of *Abies, Piceaorientalis, Cedruslibani* etc. In portion of these three pine species is more than 80% as in totally volume of growing stock.

Fagusorientalis and 22 *Quercus spp.* have 80% ratio in total volume of the deciduous trees such as *Tilia, Ulmus, Alnus, Castanea* species.

Since 2004, ENVANIS System, a forest resources inventory based on forest management units is used. In this system total forest area changes, total annual increment changes and total growing stock changes can be calculated year by year. Therefore, comparison of forest area, annual increment and growing stock between two subsequent years has been possible since 2004. The comparison of removals by forestry sector, according to forest area, annual increment and growing stock changes since 2004 is given in Table 7.4.

7.4. Forest area changes between 2004 and 2012 (GDF, 2004; 2005; 2006; 2007; 2008a; 2009b; 2010a; 2011; 2012)

Forest area									
Year	High forests				Coppices				Total
	Normal (ha)	(%)	Degraded (ha)	(%)	Normal (ha)	(%)	Degraded (ha)	(%)	
2004	8.940.215,00	42,19	6.499.380,00	30,67	1.681.006,00	7,93	4.068.146,00	19,20	21.188.747,00
2005	9.031.446,97	42,50	6.579.111,67	30,96	1.641.230,50	7,72	3.985.516,43	18,76	21.248.495,00
2006	9.122.678,93	42,84	6.658.843,33	31,27	1.601.455,00	7,52	3.902.886,87	18,33	21.295.170,00
2007	9.213.910,90	43,19	6.738.575,00	31,59	1.561.679,50	7,32	3.820.257,30	17,91	21.334.422,70
2008	9.325.437,90	43,65	6.797.197,10	31,82	1.529.771,50	7,16	3.710.808,30	17,37	21.363.214,80
2009	9.494.322,40	44,39	6.810.887,70	31,84	1.478.186,50	6,91	3.606.386,30	16,86	21.389.782,90
2010	9.782.513,60	45,42	6.879.866,00	31,94	1.420.323,60	6,59	3.454.388,10	16,04	21.537.091,30
2011	10.281.728,00	47,43	6.978.864,20	32,19	1.276.940,40	5,89	3.140.601,90	14,49	21.678.134,50
2012	10.281.728,00	47,43	6.978.864,20	32,19	1.276.940,40	5,89	3.140.601,90	14,49	21.678.134,50

It can be seen from Table 7.4. totally489.387,50 ha areas have been converted to forest land between 2004 and 2012. Based on these data, the forest area is interpolated to be increasing by 54,38kha per year since 2004. The key driver for the rise in land converted to forest land is afforestation activities. Especially, in 2008, National Afforestation and Erosion Control Action Plan havebeen initiated in order to increase forest areas of Turkey. Various forestry activities (afforestation, reforestation, rehabilitation, erosion control, etc.) have done over 2,4Mha areas in the concept of National Afforestation and Erosion Control Action Plan between 2008 and 2012.

7.2.3. Databases to identify forests

There are only two documents concerning the national forest inventory results in Turkey. The first document showing the 1972 situation was presented in 1980, and the second was prepared at the end of 2004. Because of the absence of regular national forest inventory works in Turkey, both of the results were obtained based on the summaries of management plans data renewed in every 10 years' time interval. Forest data given in first document is shown in Tables 7.5 and 7.6.

7.5. Forest inventory results of Turkey at the end of 1972

7.5.A. Areas (GDF, 2006; 2011; 2012)

Type	Normal		Degraded		Total	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
High Forest	6.176.899,00	30,58	4.757.708,00	23,55	10.934.607,00	54,13
Coppice	2.679.558,00	13,27	6.585.131,00	32,60	9.264.689,00	45,87
Total	**8.856.457,00**	**43,85**	**11.342.839,00**	**56,15**	**20.199.296,00**	**100,00**

7.5.B. Growing stock (GDF, 2006; 2011; 2012)

Type	Normal		Degraded		Total	
	(m^3)	(%)	(m^3)	(%)	(m^3)	(%)
High	758.732.197,00	81,10	54.349.847,00	5,81	813.082.044,00	86,91
Coppice	88.300.818,00	9,44	34.129.288,00	3,65	122.430.106,00	13,09
Total	**847.033.015,00**	**90,54**	**88.479.135,00**	**9,46**	**935.512.150,00**	**100,00**

7.5.C. Annual volume increment (GDF, 2006; 2011; 2012)

Type	Normal		Degraded		Total	
	(m^3)	(%)	(m^3)	(%)	(m^3)	(%)
High Forest	20.791.672,00	74,09	1.343.744,00	4,79	22.135.416,00	78,88
Coppice	4.813.197,00	17,15	1.114.592,00	3,97	5.927.789,00	21,12
Total	**25.604.869,00**	**91,24**	**2.458.336,00**	**8,76**	**28.063.205,00**	**100,00**

Source: Forest Inventory of Turkey-Ankara, 1980 Bulletin.

1) Crown closure between 0,11–1,00.

2) Crown closure between 0,01–0,10.

3) 0,75 coefficient was used in order to convert the ster volume into m^3 volume.

7.6. Forest inventory results of Turkey at the end of 2004

7.6.A. Areas (GDF, 2006; 2011; 2012)

Type	Normal		Degraded		Total	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
High	8.940.215,00	42,19	6.499.380,00	30,67	15.439.595,00	72,87
Coppice	1.681.006,00	7,93	4.068.146,00	19,20	5.749.152,00	27,13
Total	**10.621.221,00**	**50,13**	**10.567.526,00**	**49,87**	**21.188.747,00**	**100,00**

7.6.B. Growing stock (GDF, 2006; 2011; 2012)

Type	Normal		Degraded		Total	
	(m^3)	(%)	(m^3)	(%)	(m^3)	(%)
High Forest	1.128.570.285,00	87,61	65.436.741,00	5,08	1.194.007.026,00	92,69
Coppice	70.463.902,00	5,47	23.653.844,00	1,84	94.117.746,00	7,31
Total	**1.199.034.187,00**	**93,08**	**89.090.585,00**	**6,92**	**1.288.124.772,00**	**100,00**

7.6.C. Annual volume increment (GDF, 2006; 2011; 2012)

Type	Normal		Degraded		Total	
	(m^3)	(%)	(m^3)	(%)	(m^3)	(%)
High	29.908.701,00	82,43	1.518.086,00	4,18	31.426.787,00	86,62
Coppice	3.926.196,00	10,82	929308,00	2,56	4.855.504,00	13,38
Total	**33.834.897,00**	**93,25**	**2.447.394,00**	**6,75**	**36.282.291,00**	**100,00**

Source: Forest Management Planning Department of General Directorate of Forestry.

1) Crown closure between 0,11–1,00.

2) Crown closure between 0,01–0,10.

3) 0,75 coefficient was used in order to convert the ster volume into m^3volume.

The changes and plus/minus differences among the forest forms and tree species between the years of 1972 and 2004 are outlined in Table 7.7.

7.7. Differences between forest inventory results of Turkey for the years of 1972 and 2004

7.7.A. Area changes among the forest forms and tree species (*10^6)

Tree Species	High Forests (Ha)			Coppices (Ha)			Total (Ha)		
	Normal[1]	Degraded[2]	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	2,023	1,464	3,487				2,023	1,464	**3,487**
Deciduous	0,740	0,278	1,018	-0,998	-2,517	-3,515	-0,258	-2,239	**-2,497**
Total	**2,763**	**1,742**	**4,505**	**-0,998**	**-2,517**	**-3,515**	**1,765**	**-0,775**	**0,990**

7.7.B. Growing stock changes among the forest forms and tree species (*10^6)

Tree Species	High Forests (m^3)			Coppices (m^3)[3]			Total (m^3)		
	Normal	Degraded	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	269,998	6,653	276,519				269,998	6,653	**276,519**
Deciduous	99,980	4,425	104,406	-23,783	-13,967	-37,750	76,198	-9,542	**66,656**
Total	**369,978**	**11,078**	**380,925**	**-23,783**	**-13,967**	**-37,750**	**346,196**	**-2,889**	**343,175**

7.7.C. Annual volume increment changes among the forest forms and tree species (*10^6)

Tree Species	High Forests (m^3)			Coppices (m^3)[3]			Total (m^3)		
	Normal	Degraded	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	6,642	0,072	6,714				6,642	0,072	**6,714**
Deciduous	2,475	0,102	2,577	-1,183	-0,247	-1,430	1,292	-0,145	**1,147**
Total	**9,117**	**0,174**	**9,291**	**-1,183**	**-0,247**	**-1,430**	**7,934**	**-0,073**	**7,861**

Source: Forest Management Planning Department of General Directorate of Forestry.

1) Crown closure between 0,11–1,00.

2) Crown closure between 0,01–0,10.

3) 0,75 coefficient was used in order to convert the ster volume into m^3volume.

The last columns of Tables 7.7.A., B, and C are compiled in Table 7.8.in order to find the average changes annually.

7.8. Total and average changes on forest resources between the years of 1972 and 2004

Tree Species	Change on Area (Ha)(*10^6)		Change on Growing Stock (m^3) (*10^6)		Change on Annual Increment (m^3) (*10^6)	
	Total	Average	Total	Average	Total	Average
Coniferous	3,487	0,109	276,519	8,641	6,714	0,210
Deciduous	-2,497	-0,078	66,656	2,083	1,147	0,036
Total	**0,990**	**0,031**	**343,175**	**10,724**	**7,861**	**0,246**

Evaluation of Table 7.7.and 7.8.can be outlined as below:

1. Total amount of areas, growing stocks and volume increments of the coppice forests reduced while high forests were increasing. Highest amount of decrease occurred in degraded coppices.
2. Total amount of growing stocks and annual volume increment of the coniferous and deciduous tree species increased. More than 80% of the increase occurred on coniferous tree species.
3. Total increase on area is 0,99Mha; on growing stock and volume increment are 343,175 and 7,861 Mm^3 respectively.
4. Although the reduction on the areas of deciduous tree species, total growing stock and current annual increment accrued because of conversion the coppices into high forests, and leaving of tree cuttings on some olden managed forests for nature protection.

According to the results of these two inventories, forest areas increased (0,99/20,199)= 5% while the growing stock volume (343,175/976,191) =35%, and annual volume increment (7,861/30,039) = 29% were getting high during the 32 years' time period between the years of 1972-2004.

Considerable reasons of these changes are:

1. Moving to province centers from the rural areas,
2. Giving up old fashion goat breeding and cattle grazing in the forests and the meadows adjacent to forests,
3. Abandonment of some forest lands occupying on steep slopes and having non-economic management conditions,
4. Changing considerations on forestry applications towards multi-functional use of forest resources in the framework of sustainable forest management concept,
5. Converting of coppices into high forests,
6. Afforestation activities on the bare lands and degraded forests accomplished by the Forestry Service.
7. National Afforestation and Erosion Control Action Plan has been initiated since 2008. In the scope of this action plan GDF has made afforestation, rehabilitation, erosion control activities, and artificial regeneration in degraded forests. By doing these activities GDF was aimed at sequestrating more carbon in the forests and converting degraded forests into high forests.

All the factors focused here played affecting roles on these increases. Almost whole of the Turkey's forests are natural forests and categorized under the temperate climate zone. In this zone, there are 4 sub-climate type are identified (Figure 7.3).

7.2.4. Assessment of land converted to forest land

According to forest inventory results 1972, 2011 and 2012 of GDF, forest areas of Turkey have increased 1.478.838,5 ha since 1972. All these areas have been converted from other lands. Especially, annual changes from lands to forests can be monitor by ENVANIS system. 1.067.958,50ha of these areas are considered as land converted to forest land since 1993.

7.2.5. Evaluation of normal and degraded forests of Turkey between 2004 and 2012

According to forest inventory data of GDF 2011 and 2012, 11.558.668 ha (53,32%) of forests are considered as normal forests and 10.119.466 ha (46,68%) of forests are considered as degraded forests. Despite the almost approximate distribution of normal and degraded forest land, growing stock and annual increment values are differs from forest area distribution.

7.9. Growing stock changes of Turkey's forests between 2004 and 2012

Year	High forests				Coppices				Total
	Normal (m^3)	(%)	Degraded (m^3)	(%)	Normal (m^3)	(%)	Degraded (m^3)	(%)	
2004	1.128.570.285,00	87,61	65.436.741,00	5,08	70.463.902,00	5,47	23.653.844,00	1,84	1.288.124.772,00
2005	1.139.882.061,23	87,93	64.691.084,67	4,99	68.848.853,79	5,31	22.908.187,67	1,77	1.296.330.187,35
2006	1.162.360.579,85	88,35	63.945.428,33	4,86	67.233.805,58	5,11	22.162.531,33	1,68	1.315.702.345,10
2007	1.172.288.504,20	88,58	63.199.772,00	4,78	65.618.757,38	4,96	22.321.371,38	1,69	1.323.428.404,95
2008	1.196.130.714,20	88,91	63.835.812,00	4,74	63.858.113,63	4,75	21.519.757,50	1,60	1.345.344.397,33
2009	1.228.748.234,10	89,41	63.163.647,00	4,60	61.701.880,88	4,49	20.627.164,13	1,50	1.374.240.926,10
2010	1.288.358.850,10	90,19	61.636.504,00	4,31	59.094.721,88	4,14	19.414.640,63	1,36	1.428.504.716,60
2011	1.365.186.239,28	91,35	59.319.694,90	3,97	52.296.445,13	3,50	17.652.158,63	1,18	1.494.454.537,93
2012	1.365.186.239,28	91,35	59.319.694,90	3,97	52.296.445,13	3,50	17.652.158,63	1,18	1.494.454.537,93

In Table 7.9.it can be seen that in 2012, 94.85% of growing stock belongs to normal forests. Only, 5.15% of growing stock belongs to degraded forests. According to Table 7.10., annual increment values are the same as well as growing stock values. 94.88% of annual increment belongs to normal forests. Only, 5.12% of annual increment belongs to degraded forests.

7.10. Annual increment of Turkey's forests between 2004 and 2012

Annual increment									
Year	High forests				Coppices				Total
	Normal (m^3)	(%)	Degraded (m^3)	(%)	Normal (m^3)	(%)	Degraded (m^3)	(%)	
2004	29.908.701,00	82,43	1.518.086,00	4,18	3.926.196,00	10,82	929.308,00	2,56	36.282.291,00
2005	30.349.123,93	83,01	1.507.326,95	4,12	3.787.284,26	10,36	917.958,04	2,51	36.561.693,18
2006	31.131.956,43	83,73	1.496.567,90	4,02	3.648.372,52	9,81	906.608,07	2,44	37.183.504,93
2007	31.514.552,69	84,25	1.485.808,85	3,97	3.509.460,78	9,38	895.258,11	2,39	37.405.080,43
2008	31.713.020,90	84,76	1.480.764,00	3,96	3.364.704,53	8,99	855.555,75	2,29	37.414.045,18
2009	32.904.372,90	85,57	1.481.335,00	3,85	3.252.615,53	8,46	816.591,75	2,12	38.454.915,18
2010	34.711.597,55	86,65	1.468.070,00	3,66	3.089.048,78	7,71	792.878,25	1,98	40.061.594,58
2011	37.300.713,05	88,43	1.411.640,00	3,35	2.719.465,80	6,45	747.296,25	1,77	42.179.115,10
2012	37.300.713,05	88,43	1.411.640,00	3,35	2.719.465,80	6,45	747.296,25	1,77	42.179.115,10

Carbon stock changes in normal forests and in degraded forests of Turkey are estimated separately since 2004 in Tables 7.11 and 7.12.Annual carbon stock changes are separated according to the total growing stock and annual biomass increment in normal and degraded forests. For example, 94,88% of total annual biomass increment occurred in normal forests. 5,12% of total annual biomass increment occurred in degraded forests. Also, growing stock values have very high percentage (% 94,55) in total. Due to low values of growing stock and annual biomass increment in degraded forests, percentage of annual carbon stock changes were low in degraded forests.

7.11. Carbon stock changes of Turkey’s normal forests between 2004 and 2012

Year	Carbon increases		Carbon losses			Net carbon sequestration	CO_2 equivalent
	Living biomass	Dead organic matter	Commercial cutting	Fuel wood gathering	Other *(Forest fires)		
	(Tons/year)	(Tons/year)	(Tons/year)	(Tons/year)	(Tons/year)	(Tons/year)	(Gg/year)
	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)
2004	18.115,73	828,46	4.047,67	1.369,12	30,07	13.497,34	-49.490,24
2005	17.000,10	798,69	3.897,60	1.392,47	9,50	12.499,22	-45.830,46
2006	17.638,48	839,10	4.091,83	1.204,64	60,43	13.120,69	-48.109,19
2007	18.057,11	963,86	4.262,95	1.292,70	98,09	13.367,23	-49.013,18
2008	18.095,74	2.223,02	4.686,33	865,14	291,48	14.475,80	-53.077,93
2009	17.996,43	2.302,74	4.768,64	1.058,25	38,92	14.433,37	-52.922,34
2010	18.533,20	2.402,20	5.009,91	1.040,84	21,01	14.863,63	-54.499,98
2011	19.379,88	2.490,08	5.161,51	950,85	24,21	15.733,39	-57.689,08
2012	19.319,56	2.565,49	5.428,39	898,58	84,98	15.473,11	-56.734,72

7.12. Carbon stock changes of Turkey’s degraded forests between 2004 and 2012

Year	Carbon increases		Carbon losses			Net carbon sequestration	CO_2 equivalent
	Living biomass	Dead organic matter	Commercia l cutting	Fuel wood gathering	Other *(Forest fires)		
	(Tons/year)	(Tons/year)	(Tons/year)	(Tons/year)	(Tons/year)	(Tons/year)	(Gg/year)
	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)
2004	1.310,37	59,93	0,00	99,03	9,49	1.261,77	-4.626,49
2005	1.538,72	72,29	0,00	126,04	3,00	1.481,98	-5.433,92
2006	1.573,46	74,85	0,00	107,46	19,07	1.521,78	-5.579,85
2007	1.227,59	65,53	0,00	87,88	30,97	1.174,26	-4.305,63
2008	1.205,25	148,06	0,00	57,62	69,03	1.226,66	-4.497,74
2009	1.143,75	146,35	0,00	67,26	11,27	1.211,57	-4.442,42
2010	1.108,52	143,68	0,00	62,26	8,27	1.181,67	-4.332,78
2011	1.045,47	134,33	0,00	51,29	8,55	1.119,96	-4.106,51
2012	1.042,22	138,40	0,00	48,47	26,83	1.105,31	-4.052,82

7.2.6. Data on forest fires

The information about the forest fires was received from the Department of Fighting Forest Fires of General Directorate of Forestry and written on the table 7.13.

7.13. Forest fires in 2012 (GDF, 2013)

Fire Number	Total area (ha)	Fire Types	
		Ground vegetation (ha)	Crown (ha)
2.450	10.454,64	2.844,67	7.609,97

These statistics contain forest area exposed to fire, fire type and standing volume with bark removed from forest because of the fire. Non-CO_2 greenhouse gasses emitted by wildfire were calculated based on the biomass burned with 45% burning productivity. This rate was taken from IPCC Guidance table 3A.1.12.

Existing document concerning the forest resources and forestry activities permitted to second level communication (Tier 2 methods) mainly during the calculation of carbon uptake and the other greenhouse gasses inventory. Since there was no adequate and baseline data on land use changes concerning the olden time, first level communication (Tier 1 methods) was applied for the estimation of carbon sequestrations and greenhouse gasses emissions between the years 1990–2012.

The required data on the dead organic matter cover the dead trees and felling residues (harvesting waste) for the forests older than 20 years old. Litter amounts were not included into calculations because of the absence of specific researches in this scope. Carbon contents in the forest soils were not considered too due to same reason. Thus, both of these carbon pools were not taken into account because of the lack of document suitable for these purposes. Due to the extraordinary peculiarities among the geographical regions in Turkey (southern and western parts of the country have Mediterranean forest conditions while the northern part looks like typical west European forests) default values for these pools given in the Guidance annexes tables could not be used.

7.2.7. Methodology

Carbon stock change in living biomass and net carbon stock change in dead organic matter in forest areas were evaluated as two categories divided into 5.A.1 Forest remaining Forest Land and 5.A.2 Land Converted to Forest Land (Table 7.14).

7.14. Annual changes carbon stocks in forest areas of Turkey in 2012

Greenhouse gas source and sink categories	Activity data	Changes in carbon stock				Net CO_2 emissions/ removals
Land-use category	Area (kha)	Carbon stock change in living biomass			Net carbon stock change in dead organic matter	
		Gains	Losses	Net change		
		(Gg C)				(Gg)
Total Forest Land	21.678,13	20.361,78	-	13.874,52	2.703,89	60.787,51
1. Forest Land remaining Forest	20.610,18	19.340,29	-	13.027,63	2.595,04	57.283,11
2. Land converted to Forest	1.067,96	1.021,49	-174,60	846,89	108,85	3.504,39

Net carbon sequestration and removals between 1990 and 2012 in the forests of Turkey are outlined in Table 7.15 and shown in Figure 7.4.

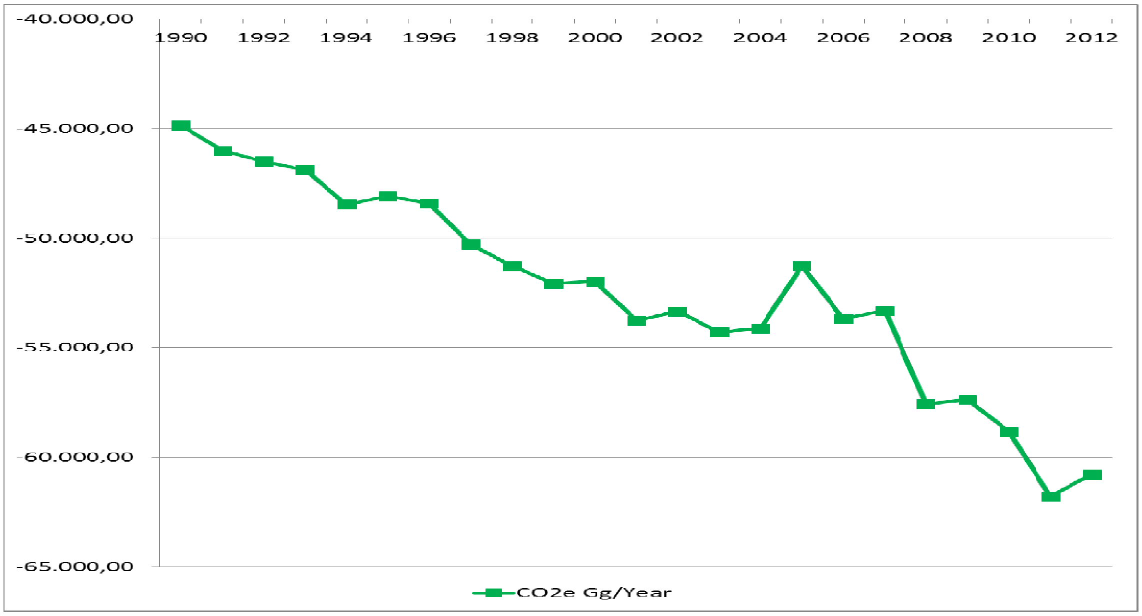
7.15. Net carbon sequestration and removals between 1990 and 2012 in the forests of Turkey

Years	Carbon increases		Carbon lost			Net carbon sequestration	CO_2 equivalent
	Living biomass	Dead organic matter	Commercial cutting	Fuel wood gathering	Other *(Forest fires)		
	(Tons/year)	(Tons/year)	(Tons/year)	(Tons/year)	(Tons/year)	(Tons/year)	(Gg/year)
	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)
1990	17.175,12	966,59	4.324,88	1.468,15	111,25	12.237,43	**-44.870,57**
1991	17.329,52	934,88	4.181,32	1.468,15	65,44	12.549,48	**-46.014,77**
1992	17.484,86	930,37	4.166,65	1.468,15	98,75	12.681,69	**-46.499,52**
1993	17.641,16	935,40	4.197,12	1.468,15	124,56	12.786,74	**-46.884,70**
1994	17.798,43	811,29	3.615,79	1.468,15	308,31	13.217,47	**-48.464,07**
1995	17.956,68	945,45	4.258,06	1.468,15	62,06	13.113,86	**-48.084,17**
1996	18.115,91	946,14	4.268,00	1.468,15	120,81	13.205,09	**-48.418,68**
1997	18.276,13	868,87	3.908,57	1.468,15	51,25	13.717,03	**-50.295,78**
1998	18.437,35	837,28	3.765,57	1.468,15	54,56	13.986,35	**-51.283,27**
1999	18.599,57	822,96	3.704,37	1.468,15	47,06	14.202,95	**-52.077,49**
2000	18.762,82	824,51	3.732,98	1.468,15	213,31	14.172,89	**-51.967,26**
2001	18.927,08	780,33	3.515,76	1.468,15	60,00	14.663,50	**-53.766,17**
2002	19.092,38	851,66	3.860,34	1.468,15	68,75	14.546,80	**-53.338,26**
2003	19.258,72	828,90	3.759,20	1.468,15	53,75	14.806,52	**-54.290,58**
2004	19.426,10	888,39	4.047,67	1.468,15	39,56	14.759,11	**-54.116,75**
2005	18.538,82	870,99	3.897,60	1.518,51	12,50	13.981,19	**-51.264,38**
2006	19.211,94	913,95	4.091,83	1.312,10	79,50	14.642,47	**-53.689,04**
2007	19.284,70	1.029,38	4.262,95	1.380,58	129,06	14.541,49	**-53.318,81**
2008	19.300,99	2.371,08	4.686,33	922,76	360,52	15.702,46	**-57.575,67**
2009	19.140,18	2.449,09	4.768,64	1.125,51	50,19	15.644,93	**-57.364,76**
2010	19.641,72	2.545,88	5.009,91	1.103,10	29,29	16.045,30	**-58.832,76**
2011	20.425,35	2.624,41	5.161,51	1.002,15	32,76	16.853,34	**-61.795,59**
2012	20.361,78	2.703,89	5.428,39	947,05	111,81	16.578,41	**-60.787,51**

*Other carbon lost from insect and fungus disturbances are not included.

**Fuel wood gathering data was taken from the GD of Forestry's Strategic plan for 2010-2014 (GDF, 2009a; 2010b).

Net carbon uptake was calculated by taking commercial cutting, fuel wood gathering and biomass lost from forest fires out the aboveground and belowground living biomass.



7.4. Net CO_2 removals between 1990 and 2012 in the forests of Turkey

Annual removals and emissions fromforest land remaining forest land were calculated by the following Equation 3.2.1 of IPCC GPG 2003.

Equation 3.2.1. $\Delta C_{FF} = (\Delta C_{FFLB} + \Delta C_{FFDOM} + \Delta C_{FFSoils})$

Annual increment in carbon stocks due to living biomass increment in forest land remaining forest land

Removals (average annual increase in carbon stocks due to biomass growth) were calculated according to the following 3.2.5 of IPCC GPG 2003.

Annual increment in biomass

Equation 3.2.5. $G_{TOTAL} = G_W * (1+R)$

$G_W = I_V * D * BEF_1$

$G_{TOTAL} = [(I_V * D * BEF_1) * (1+R)]$

For annual increase in carbon stocks, both the national and default data were used. National forestry data was mainly come from the General Directorate of Forestry.

- Area of forest land: It exists for each management class in the forest management plans (Tier 2).
- Average annual net increment in volume suitable for industrial processing (IV): It exists for each management class in the forest management plans (Tier 2).
- Basic wood density (D): It was determined for all fundamental tree species which form a stand in the Turkey's forests (Table 7.16)(Tier 2). This coefficient was determined as :

  -0,496 for largely coniferous mixed forests,

  -0,638 for largely deciduous mixed forests.

7.16. The oven dry weight of Turkey's fundamental tree species

Coniferous		**Oven dry weight (g/cm^3)**	**Deciduous**		**Oven dry weight (g/cm^3)**
Pinusbrutia	Turkish Pine	0,53	*Fagusorientalis*	The Oriental Beech	0.640
Pinusnigra	European Black Pine	0,516	*Quercusrobur*	The English Oak	0.650
Pinussylvestris	Scots Pine	0,496	*Carpinusbetulus*	European Hornbeam	0.790
Abiesbornmülleriana	Uludağ Fir	0,4	*Alnusbarbata*	Black Alder	0.490
Piceaorientalis	Oriental Spruce	0,401	*Populusnigra*	The Black Poplar	0.410
Cedruslibani	Taurus Cedar	0,48	*Castanea sativa*	Sweet Chestnut	0.590
Juniperusexcelsa	Greek Juniper	0,508	*Fraxinus excelsior*	The Ash	0,65
Pinuspinea	Stone Pine	0,465	*Tiliagrandiflora*	Linden	0.490
Cupressussempervirens	The Mediterranean Cypress	0,48	*Platanusorientalis*	The Oriental plane	0.580
Pinushalepensis	Aleppo Pine	0,514	*Eucalyptus rostrata*	Red Gum	0.547
Pinusmaritima	The Maritime Pine	0,43	*Liquidambar orientalis*	Turkish Sweetgum	0.680
Pinusradiata	The Monterey Pine	0,38	*Robiniapseudoacaccia*	The Black Locust	0.720

Source: As,*et al.,*2001.

Biomass expansion factor for conversion of annual net increment (including bark) to aboveground tree biomass increment (BEF_1 and BEF_2): Calculated for both coniferous and deciduous species separately (Table 7.17)(Tier 2).

7.17. Comparison of BEF_1 and BEF_2 coefficients between LULUCF Guidance and those calculated for Turkey to use for the natural and plantation forest located in the temperate zone

Tree Species	Data resource	BEF_2	Uncertainty %	BEF_1	Uncertainty %
Coniferous	In LULUCF Guidance	1,30 (1,15-	-	1,15 (1,05-1,20)	-
	Calculated for Turkey	1,24 (1,08-	12,27	1,22 (1,15-	14,72
Deciduous	In LULUCF Guidance	1,40 (1,15-3,40)	-	1,20 (1,10-	-
	Calculated for Turkey	1,26 (1,08-	10,94	1,24 (1,06-	5,69

Source: Asan, 2006.

- Root-to-shoot ratio (R): Default data used for temperate zone in the Guidance (Table 3A) and accounted distinctly for each management class based on the growing stock in hectare.
- Carbon fraction of dry matter (CF): Default value of Guidance (0.5) was used for carbon fraction of dry matter (CF).

Annual decrease in carbon stocks due to biomass loss in forest land remaining forest land

Annual biomass loss is a sum of losses from commercial round wood fellings, fuel wood gathering and other losses in forest land was calculated by using the following Equation 3.2.6 of LULUCF Guidance. In the estimations, biomass gains and biomass losses are calculated separately. For example, commercial round wood felling is being calculated in a different column as well as fuel wood gathering and other losses according to the Equation 3.2.7, Equation 3.2.8 and Equation 3.2.9, respectively. The calculations of biomass losses are consistent with the IPCC GPG for LULUCF.

Equation 3.2.6. $\Delta C_{FFL} = L_{fellings} + L_{fuelwood} + L_{other\ losses}$

Annual carbon loss due to commercial fellings

Equation 3.2.7. $L_{fellings} = H \bullet D \bullet BEF_2 \bullet (1 - f_{BL}) \bullet CF$

H: Wood harvesting data includes whole harvested woods as industrial harvesting including planned harvests (Tier 2).

Annual carbon loss due to fuelwood gathering

Equation 3.2.8. $L_{fuelwood} = FG \bullet D \bullet BEF_2 \bullet CF$

FG:Fuel wood gathering and illegal cutting data obtained from the General Directorate of Forestry and 8th Five Years Development Plan was used here (Tier 1).

Annual other losses of carbon

Equation 3.2.9. $L_{other\ losses} = A_{disturbance} \bullet B_W \bullet (1 - f_{BL}) \bullet CF$

$A_{disturbance}$= Forest areas burnt by fires were taken into account (Tear 1).
B_W= It was estimated that average biomass in the fired areas could be burned with 45% percent of burning productivity. This biomass did not cover the litter. Relevant burning rate was fixed to the Guidance (Tables 3A.1.12) (Tear 1).

Annual change in carbon stocks in dead organic matter in forest land remaining forest land

Equation 3.2.10. $\Delta C_{FFDOM} = \Delta C_{FFDW} + \Delta C_{FFLT}$

Dead organic matter as a carbon pool divided into dead wood and litter. Dead wood data in the "Forest Land Remaining Forest Land" was reached from forest management plans and added to the felling residues data.But there was no sufficient data on the litter in the Turkey's forests, the carbon stock change in the litter was assumed as zero according to the Guidance.

Annual change in carbon stocks in dead wood in forest land remaining forest land

Equation 3.2.11. $\Delta C_{FFDW} = [A \bullet (B_{into} - B_{out})] \bullet CF$

A = area of managed forest land remaining forest land, ha

B_{into} = Calculated from the forest management plans and the felling residues was added to it.

B_{out} = Decay period of dead wood in theforest was assumed as an average of 10 years. 1/10 of dead wood was decreased in each year.

CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonned.m.)$^{-1}$

Estimation of non-CO_2 emissions from C released

Equation 3.2.19.

CH_4 Emissions= (carbon released) ● (emission ratio) ● 16/12

CO Emissions= (carbon released) ● (emission ratio) ● 28/12

N_2O Emissions= (carbon released) ● (N/C ratio) ● (emission ratio) ● 44/28

NO_x Emissions= (carbon released) ● (N/C ratio) ● (emission ratio) ● 46/14

Estimation of GHGs directly released in fires

Equation 3.2.20. $L_{fire} = A \bullet B \bullet C \bullet D \bullet 10^{-6}$

Where:

L_{fire} = quantity of GHG released due to fire, tonnes of GHG

A= area burnt, ha

B= mass of "available" fuel, kg d.m. ha^{-1}

C= combustion efficiency (or fraction of the biomass combusted), dimensionless.

D= emission factor, g (kg d.m.)$^{-1}$

Calculations are made separately for each greenhouse gas, using the appropriate emission factor.

Annual removals and emissions from land converted to forest land were calculated by the following Equation 3.2.21 of IPCC GPG 2003.

Equation 3.2.21. $\Delta C_{LF} = (\Delta C_{LFLB} + \Delta C_{LFDOM} + \Delta C_{LFSoils})$

Annual increment in carbon stocks due to living biomass increment in land converted to forest land

Equation 3.2.22. $\Delta C_{LFLB} = \Delta C_{LFGROWTH} - \Delta C_{LFLOSS}$

Annual increment in biomass

Equation 3.2.5.

$$G_{TOTAL} = G_W * (1+R)$$

$$G_W = I_V * D * BEF_1$$

$$G_{TOTAL} = [(I_V * D* BEF_1) * (1+R)]$$

For annual increase in carbon stocks, both the national and default data were used. National forestry data was mainly come from the General Directorate of Forestry.

- Area of forest land: It exists for each management class in the forest management plans (Tier 2).
- Average annual net increment in volume suitable for industrial processing (IV): It exists for each management class in the forest management plans (Tier 2).
- Basic wood density (D): It was determined for all fundamental tree species which form a stand in the Turkey's forests (Table 7.18)(Tier 2). This coefficient was determined as :

  -0,496 for largely coniferous mixed forests,

  -0,638 for largely deciduous mixed forests.

7.18. The oven dry weight of Turkey's fundamental tree species

Coniferous		Oven dry weight (g/cm^3)	Deciduous		Oven dry weight (g/cm^3)
Pinus brutia	Turkish Pine	0,53	*Fagus orientalis*	The Oriental Beech	0.640
Pinus nigra	European Black Pine	0,516	*Quercus robur*	The English Oak	0.650
Pinus sylvetris	Scots Pine	0,496	*Carpinus betulus*	European Hornbeam	0.790
Abies bornmülleriana	Uludağ Fir	0,4	*Alnus barbata*	Black Alder	0.490
Picea orientalis	Oriental Spruce	0,401	*Populus nigra*	The Black Poplar	0.410
Cedrus libani	Taurus Cedar	0,48	*Castanea sativa*	Sweet Chestnut	0.590
Juniperus excelsa	Greek Juniper	0,508	*Fraxinus excelsior*	The Ash	0,65
Pinus pinea	Stone Pine	0,465	*Tilia grandiflora*	Linden	0.490
Cupressus sempervirens	The Mediterranean Cypress	0,48	*Platanus orientalis*	The Oriental plane	0.580
Pinus halepensis	Aleppo Pine	0,514	*Eucalyptus rostrata*	Red Gum	0.547
Pinus maritima	The Maritime Pine	0,43	*Liquidambar orientalis*	Turkish Sweetgum	0.680
Pinus radiata	The Monterey Pine	0,38	*Robinia pseudoacaccia*	The Black Locust	0.720

Source: As,*et al.,*2001.

Biomass expansion factor for conversion of annual net increment (including bark) to aboveground tree biomass increment (BEF_1 and BEF_2): Calculated for both coniferous and deciduous species separately (Tier 2) in Table 7.19.

7.19. Comparison of BEF_1 and BEF_2 coefficients between LULUCF Guidance and those calculated for Turkey to use for the natural and plantation forest located in the temperate zone

Tree Species	Data resource	BEF_2	Uncertainty %	BEF_1	Uncertainty %
Coniferous	In LULUCF Guidance	1,30 (1,15-	-	1,15 (1,05-1,20)	-
	Calculated for	1,24 (1,08-	12,27	1,22 (1,15-1,29)	14,72
Deciduous	In LULUCF Guidance	1,40 (1,15-	-	1,20 (1,10-1,30)	-
	Calculated for	1,26 (1,08-	10,94	1,24 (1,06-1,42)	5,69

Source: Asan, 2006.

- Root-to-shoot ratio (R): Default data used for temperate zone in the Guidance (Table 3A) and accounted distinctly for each management class based on the growing stock in hectare.
- Carbon fraction of dry matter (CF): Default value of Guidance (0.5) was used for carbon fraction of dry matter (CF).

Annual decrease in carbon stocks due to biomass losses in land converted to forest land

Annual biomass loss is a sum of losses from commercial round wood fellings, fuel wood gathering and other losses in forest land was calculated by using the following Equation 3.2.24 of LULUCF Guidance. In the estimations, biomass gains and biomass losses are calculated separately. For example, losses from forest fires are being calculated in a different column as according to the Equation 3.2.24 and Equation 3.2.9, respectively. The calculations of biomass losses are consistent with the IPCC GPG for LULUCF.

Equation 3.2.24. $\Delta C_{LFLOSS} = L_{fellings} + L_{fuelwood} + L_{other\ losses}$

Annual other losses of carbon

Equation 3.2.9. $L_{other\ losses} = A_{disturbance} \bullet B_W \bullet (1 - f_{BL}) \bullet CF$

$A_{disturbance}$= Forest areas burnt by fires were taken into account (Tear 1).
B_W= It was estimated that average biomass in the fired areas could be burned with 45% percent of burning productivity. This biomass did not cover the litter. Relevant burning rate was fixed to the Guidance (Tables 3A.1.12) (Tear 1).

Annual change in carbon stocks in dead organic matter in land converted to forest land

Equation 3.2.10. $\Delta C_{LFDOM} = \Delta C_{LFDW} + \Delta C_{LFLT}$

Dead organic matter as a carbon pool divided into dead wood and litter. Dead wood data in the "Land Converted to Forest Land" was reached from forest management plans and added to the felling residues data. But there was no sufficient data on the litter in the Turkey's forests, the carbon stock change in the litter was assumed as zero according to the Guidance.

Annual change in carbon stocks in dead wood in forest land remaining forest land

Equation 3.2.28. $\Delta C_{LFDW} = [(B_2 – B_1)/T] \bullet CF$

7.2.8. Uncertainty and time series consistency

To estimate the uncertainty levels in parameters and formulas, LULUCF Guidance recommends using the 5.2.1 and 5.2.2 equations:

Equation 5.2.1. $U_{toplam} = \sqrt{U_1^2 + U_2^2 + ... + U_n^2}$

Equation 5.2.2. $U_E = \dfrac{\sqrt{(U_1 \bullet E_1)^2 + (U_2 \bullet E_2)^2 + ... + (U_n \bullet E_n)^2}}{|E_1 + E_2 + ... + E_n|}$

Whole calculated uncertainty levels are expressed as follow in Table 7.20:

7.20. Uncertainty estimates of parameters

Parameters	Uncertainty (%)
Oven dry weight -Coniferous -Deciduous	 20 26
-BEF1 Coniferous Deciduous -BEF2 Coniferous Deciduous	 15 6 12 11
f_{BL}	43
Dead wood	44
Root the shoot (R)	30
CF	2
Aboveground biomass -Coniferous -Deciduous	 40 41

Uncertainty according to the expert view

For parameters related the forest areas from the GDF source 0,03%

For parameters related the volume " " " 10%

For parameters related the volume increment " " 10%

For parameters related the commercial wood volume from SPO 5%

For parameters related the fuel wood gathering " " 15%

For parameters related the burned forest areas " " 10%

7.21. Uncertainty of equations

Equations	Uncertainty (%)
Forest remaining forest land	
-Annual living biomass increment	
-Coniferous	40
-Deciduous	41
-Annual living biomass lost	
-Coniferous	73
-Deciduous	69
-Dead organic matter	44
-Forest fires	87

Time series consistency

Since there are two forest inventory carried out by the General Directorate of Forestry for 1972 and 2004 years, the data on the forest areas, growing stocks and annual volume increments during 1990-2003 period were calculated by interpolation between these two inventory data. Thus, the annual increase of forest areas were assumed as linear as well growing stocks and volume increments were accepted to increase with the compound interest basis. The data for the 2004-2012 were obtained annually from the Management and Planning Department of General Directorate of Forestry.

The statistics on the forest fires and commercial round wood production for the same period were taken from the same Directorate. Also, fuel wood gathering data was reached from utilizing the State Planning Organization's source and it was accepted as the same quantity for each year.

7.2.9. Planned improvements

It was seen during the preparation of GHG inventory of LULUCF, there is a need to improve the forest resources inventory studies, the quality assurance of relevant data and increase the researches to obtain the country specific data. Planned activities are:

- Integrated Approach to Management of Forests in Turkey, With Demonstration in High Conservation Value Forests in the Mediterranean Region Project was initiated in 2013. With this project sustainable forest management, establishment of policy and institutional framework GHG inventory estimation and carbon sequestration of forests issues will be studied more in detail.

- LULUCF Working Group will study AFOLU 2006 Guidance in 2014. GHG inventory and NIR will be prepared according to AFOLU guidance in 2015.

7.3 Croplands (5B)

7.3.1 Description

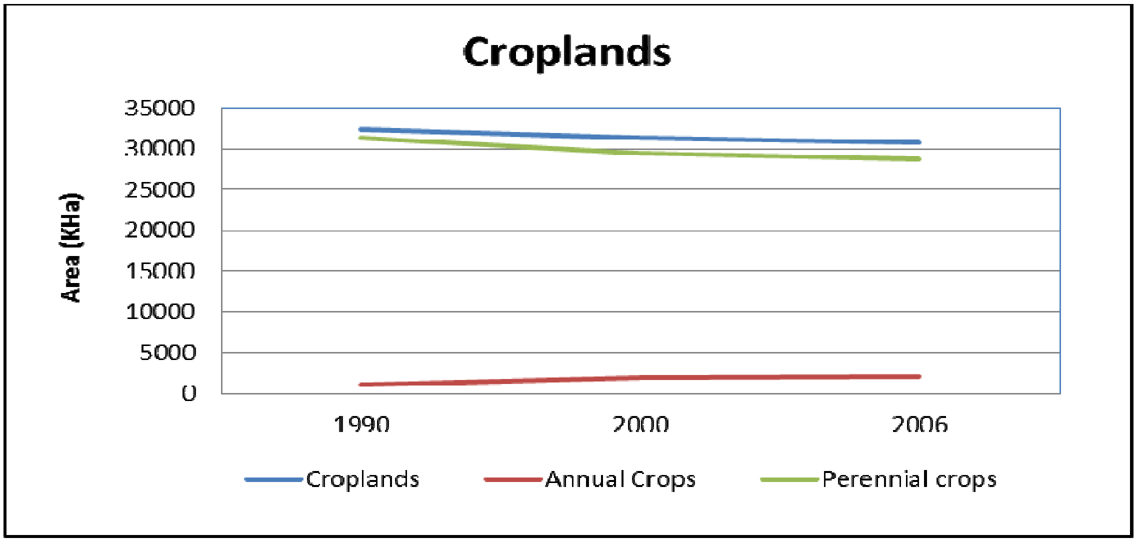
Cropland remaining Cropland and Land converted to Cropland has been reported under this category.

CSC in aboveground, belowground, organic and mineral soil pools have been calculated and reported. The Cropland category was a large source in the last submission but has diminished with the change in emission factors and activity data.

The Cropland covers all perennial and annual crops in agriculture lands. Orchards and poplars are included in this category.

7.3.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

As explained in the Activity data section database we have calculated land use changes based on 3 temporal time points: 1990, 2000 and 2006. We had a more compatible and consistent monitoring system with this methodology. In Turkey the cropland areas decreased between 1990 and 2006 as seen in Figure 7.5.



7.5 The temporal change in croplands in Turkey between 1990 and 2006.

The annual crops have a decreasing trend while the aerial distribution of perennial crops increases. The AD given in CRF table 5B is the cropland areas that are subject to changes in management. The total area of croplands in Turkey was 28774.21 ha in 2006. In 1990 it was 31259.93 ha.

7.3.3 Land-use definitions and the classification systems used and their correspondence to the LULUCF categories

Cropland areas have been determined as annual crops and perennial woody crops and disaggregated for IPCC climate and soil types.

7.22. Land use changes between 1990-2000 and 2000-2006 in Turkey

1990-2000										
ha	**FROM**	**Croplands**		**Wetlands**	**Grasslands**			**Settlements**	**Other lands**	
TO		**perennial**	**Annual**	**Artificial**	**Green areas**	**Pastures**	**Natural grasslands**	**Settlements**	**Other land**	**Mine areas**
Croplands	**Perennial**	856.689,75	198.708,98	1.582,76	381,92	2.602,32	22.432,36	14.531,96	5.060,92	387,34
	Annual	882.001,72	26.373.335,18	90.693,18	7.764,88	450.369,22	1.972.403,18	385.765,80	789.549,73	15.162,68
Wetlands	**Artificial**	2.243,78	54.479,14	1.029.089,77	142,72	10.059,02	19.257,97	864,16	22.341,42	217,05
Grasslands	**Green areas**	658,73	6.790,47	33,13	11.725,76	560,16	493,71	10.818,87	572,20	1,58
	Pastures	18.346,79	364.130,83	5.724,40	491,70	581.855,28	505.711,75	32.396,84	71.741,68	3.099,09
	Natural gr.	54.448,54	945.734,20	4.899,12	1.250,23	754.991,52	4.982.048,22	25.695,68	908.251,74	5.407,31
Settlements	**Settlements**	8.607,61	137.248,45	332,76	1.296,28	4.805,81	10.198,36	697.911,13	7.967,80	1.273,54
Other lands	**Other land**	49.599,06	961.362,32	35.568,48	1.737,02	162.085,98	4.225.350,71	15.073,51	6.726.439,73	162.085,98
	Mine areas	551,90	12.470,79	1.575,40	367,00	5.729,20	2.944,23	18.376,83	7.034,63	24.593,83
2000-2006										
ha	**FROM**	**Croplands**		**Wetlands**	**Grasslands**			**Settlements**	**Other land**	
TO		**Perennial**	**Annual**	**Artificial**	**Green areas**	**Pastures**	**Natural grasslands**	**Settlements**	**Other land**	**Mine areas**
Croplands	**Perennial**	853.417,33	194.964,97	2.275,62	2.706,39	14.993,51	56.268,59	12.054,36	49.113,43	1.741,38
	Annual	877.972,31	26.409.623,93	60.823,36	16.048,75	293.639,93	918.949,16	182.381,16	972.775,63	24.675,68
Wetlands	**Artificial**	160,41	17.178,87	1.132.367,75	67,03	1.643,64	1.480,69	451,23	17.899,54	677,45
Grasslands	**Green areas**	115,10	3.042,01	152,22	19.443,06	364,74	554,22	1.844,51	653,34	105,16
	Pastures	3.013,27	444.832,40	10.136,40	863,34	579.302,02	754.034,96	7.246,59	165.544,75	6.993,94
	Natural gr.	22.790,82	1.952.478,31	21.970,61	1.501,85	471.268,97	5.024.595,84	13.500,88	4.267.192,71	7.485,20
Settlements	**Settlements**	8.028,72	251.153,66	1.194,59	16.634,28	10.607,17	15.129,10	896.344,56	13.993,14	6.569,71
Other lands	**Other land**	4.418,77	767.649,99	20.883,51	2.200,32	62.428,44	879.351,63	9.840,46	6.823.610,72	13.296,10
	Mine areas	212,31	7.297,33	567,26	736,16	1.115,56	3.403,70	4.276,76	9.336,89	43.130,07

7.3.4 Methodological issues

Cropland remaining cropland

Cropland category includes all annual and perennial crops including orchards and poplar plantations; the change in biomass growth has been estimated only for perennial crops, since, for annual crops, the increase in biomass stocks in a single year is assumed equal to biomass losses from harvest and mortality in that same year. Activity data for cropland remaining cropland have been subdivided into annual and perennial crops.

The CSC in Cropland remaining Croplands have been estimated for the following pools;

- Biomass growth of perennial crops including Poplar plantations,
- Biomass gain/loss for conversions between annual and perennial croplands,
- CSC in mineral soils for conversions between annual and perennial croplands,
- Emissions from organic soils in croplands.

A combination of Tier 1 and 2 has been applied to calculate biomass increase for perennial croplands with Gain-Loss method. The areas of perennial woody cropland were multiplied by a net estimate of biomass accumulation from growth and subtract losses associated with harvest or gathering or disturbance (according to Equation 2.7 in Chapter 2 in IPCC).

A Tier 2 approach was used for the conversions between perennial and annual croplands. Tier 2 methods were used for CSC in organic and mineral soils (spatially explicit classification of these lands).

Concerning woody crops, estimates of carbon stocks changes in living biomass were applied to aboveground biomass (belowground was estimated just for poplars), according to the GPG (IPCC, 2003), as there is not sufficient information to estimate carbon stocks change in dead organic matter pools. To assess change in carbon in cropland biomass, the combination of Tier 1 and Tier 2 based on disaggregated aerial data for climate and soil types has been used; therefore a combination of default and country specific factors have been applied.

Biomass accumulation and harvesting

The gain-loss method of GPG 2003 was used (Eq 3.1.1). Biomass accumulation rate for perennial crops on Cropland remaining croplands have been taken as 1 tonnes C $ha^{-1}yr^{-1}$ based on values used by Italy inventory. The biomass accumulation rate we used in the last submission was the default 2.1 C $ha^{-1}yr^{-1}$ but based on expert discussions we decided to use the values used by neighboring countries for comparability reasons. Therefore biomass accumulation rate has been assumed to be 1 tonnes C $ha^{-1}yr^{-1}$ with a rotation period of 20 years and we also assume 10 years growth and 10 years stable (pruning and slow down of growth) periods similar to the mentioned inventory (NIR 2013 Italy, page 209).

For the estimation of CSC in polar plantations we used a database that covers the period 2003-2010. These values were extrapolated to 2011 and to the period before 2003. The poplar plantations were disaggregated for soil and default IPCC climate types.

The properties that were used to calculate CSC in poplars were a follows;

7.23. Properties of poplar species planted in Turkey (Gülbaba, 2010, Birler, 2010, Zabek and Prescott, 2006).

Tree	BWD (g/cm^3)	Plantation Pattern	# of trees per ha	Volume increment (m3/ha-yr)	Rotation period (years)	BEF	R
Common poplar species average (*P. tremula, P. nigra*)	0,40	5x6	333	28	12	1,24	0,21

BWD: Basic wood density, BEF: Biomass expansion factor, R: Root to shoot ratio.

In the calculation procedure we assumed that 12 percent of the poplar plantations are harvested every year considering the rotation period as 12 years.

Conversions between perennial and annual croplands

We used spatially explicit data to calculate conversions between perennial and annual croplands (Table 7.25).

7.25. Conversions between annual and perennial crops within cropland category for soil and climate types.

		Annual to perennial			Perennial to annual		
	(Ha)	**1990**	**2000**	**2006**	**1990**	**2000**	**2006**
HAC	W-D	17.661,76	9.8952,79	51.135,00	69.373,00	24.767,68	51.006,00
	W-W	606,35	11.374,78	5.040,40	8.136,99	851,78	5.137,20
	C-D	221,27	3.274,87	1.478,60	2.301,12	303,30	1.478,50
	C-W	52,47	72,85	60,90	51,00	74,96	60,90
LAC	W-D	667,37	2.625,85	1.473,80	1.838,30	901,69	1.452,60
	W-W	248,18	6.144,22	2.676,00	4.399,80	354,54	2.734,10
	C-D	1,38	0,00	0,80	0,00	1,98	0,80
	C-W	0,00	0,68	0,30	0,48	0,00	0,30
SANDY	W-D	366,78	2.901,40	1.410,40	2.045,47	531,45	1.422,00
	W-W	0,00	0,00	0,00	0,00	0,00	0,00
	C-D	0,00	0,15	0,10	0,00	0,00	0,00
	C-W	0,00	0,00	0,00	0,00	0,00	0,00
WET	W-D	45,33	77,00	58,40	53,91	64,76	58,40
	W-W	0,00	0,00	0,00	0,00	0,00	0,00
	C-D	0,00	0,00	0,00	0,00	0,00	0,00
	C-W	0,00	0,00	0,00	0,00	0,00	0,00

For the estimation of C stocks in biomass of perennial crops we had used country specific age and aerial distribution values in the last submission which resulted in very large C pools in aboveground biomass. The aboveground C stock of a perennial land was assumed to be 81.2 Mg C/ha in the last submission. This value has been considered as an overestimation by the group of experts and we used the value of 10 C $ha^{-1}yr^{-1}$ also used by Italy (NIR 2013 Italy, page 209).

2013 submission

38,7 * 2,1 = 81,2 Mg C/ha (IPCC GPG default is 30 years age and 63 MgC/ha)

2014 submission

20/2 * 1 = 10 Mg C/ha (20 years rotation period. 10 years growth 10 years stable)

The IPCC default value of 5 MgC/ha was used for the Carbon stocks for annual products.

The conversions between annual and perennial products and vice versa were calculated based on these CSC values.

We used IPCC GPG default EFs to estimate CSC in mineral and organic soils (GPG Table 3.3.5). In case of emissions from organic soils we assumed that all croplands are managed (conservative approach).

Land converted to cropland

Grassland converted to cropland

CSC in biomass and soil pools have been calculated in this category. CSC estimations for

- Grasslands converted to Perennial croplands
- Grasslands converted to Annual croplands

were estimated. We used gain-loss method of GPG 2003 (Eq 3.1.1).

The default C stock value of 5 Mg C/ha in aboveground biomass were used for annual crops while 10 Mg C/ha was taken for perennial crops.
The aboveground C stock for grasslands have been taken as 0,735 Mg C/ha, and belowground 2,94 Mg C/ha (Aydın and Uzun, 2005; Fırıncıoğlu et al., 2009; Sinoga et al., 2012).
In case of emissions from organic soils we assumed that all grasslands are managed (conservative approach).

7.4. Grasslands (5C)

7.4.1 Description

Grasslands are all lands with non woody vegetation subject to grazing.

Grassland remaining grassland

CSC in grasslands is assumed to be not changing if management is not changed. Actually, there are grassland rehabilitation projects implemented in the country but conservatively we assumed no change in biomass. We plan to report these projects as the grassland monitoring system becomes available.

Emissions from organic soils are reported assuming that all grasslands are managed. Default EFs are used in this procedure but the AD is disaggregated for climate types.

Croplands converted to grassland

CSC in biomass and soils are reported in this category.

CSC due to conversions from perennial and annual croplands are estimated in living biomass. The same C stocks determined for perennial (10 Mg C/ha) and annual crops (default value 5 Mg C/ha) were used.

7.5. Wetlands (5D)

7.5.1 Description

All human made reservoirs are included in the wetlands category. CSC in biomass due to conversions from croplands and grasslands has been reported in this category.

Croplands converted to wetlands

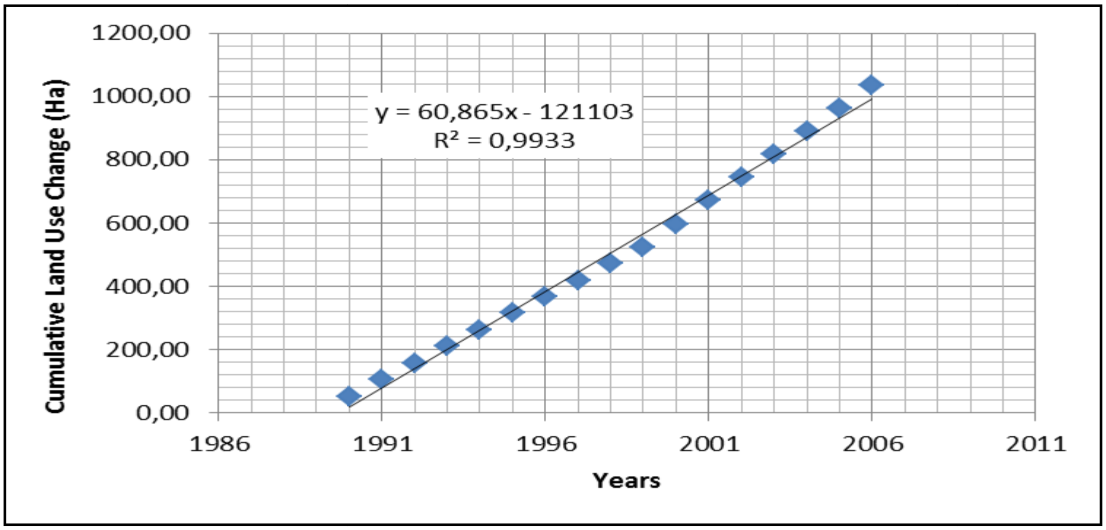
All perennial and annual croplands converted to wetlands have been reported. Gain-loss method of GPG 2003 (Eq 3.1.1) was used. The same C stock values were used as Croplands section.

Grasslands converted to wetlands

Emissions from above and below ground biomass have been reported in this category. Gain-loss method of GPG 2003 (Eq 3.1.1) was used. The same C stock values were used as Grasslands section.

7.6. Uncertainty and time series consistency

Data for some years or periods had to be interpolated or extrapolated to have a complete inventory that covers the whole reporting period. To extrapolate the data we used linear equations derived from cumulative values.



7.6. Interpolation and extrapolation approach for land use change data. Cumulative values are plotted and the trend line was extrapolated based on the linear equation.

Uncertainty estimates for the period 1990–2011 has been assessed based on IPCC GPG as explained below.

The IPCC GPG was used to estimate biomass growth. The error range has been accepted as ±75% for default values.

The uncertainty of the activity data is around 50% according to expert judgment considering that 3 different Land Use Maps have been used.

The overall uncertainty is calculated as;

$$Utotal = \sqrt{U1^2 + U1^2}$$

$$Utotal = \sqrt{75^2 + 50^2} = 90\%$$

7.7. Category-specific QA/QC and verification

A QA/QC mechanism has been established in the LULUCF working unit established under Ministry of Food, Agriculture and Livestock. The unit is responsible of complying, reporting, quality control, improving and quality assurance of the inventory. The responsibility of the unit is limited to 5 land use categories other than Forestland. The QA/QC mechanism of Forestlands is handled by OGM (General Directorate of Forestry).

7.8. Category-specific recalculations

The improvement of this category goes on so we anticipate making recalculations at least for the next 2-3 submissions. In 2012 submission we started to report categories other than Forestlands with explanations in the NIR. But completeness of the Inventory was very weak. In the 2013 submission we expanded the number of categories reported and incorporated management activities in categories (perennial-annual conversions, emissions from organic soils etc.). In this submission we gave the emphasis on QA/QC procedures. Therefore we focused on activity data generation process and calculations.

The activity data used in calculations are based on Corine Land Use maps (1990, 2000, 2006). The same data were used for land uses and land use types but some errors that have been determined by QA/QC team have been corrected. A systematic error was determined while land use matrices were prepared and was corrected. This has influences some changes in emission/removal estimates.

The change in emission factors for croplands had a serious influence on estimations. A more realistic time series have been realized in this way.

7.9. Category-specific planned improvements

The emphasis has been given to the QA/QC of the activity data in this submission. Some of the planned improvements from last year have been postponed to the next year as a collaborative work between OGM and TRGM has to be initiated. These results of the collaborative work can be seen in the next submission.

We plan to give the emphasis on compatibility of AD between land use categories and will try to increase the completeness and accuracy of the estimations in the next submission.

The new Corine map for 2012 has not been finalized yet. So we had to use the existing maps.

The scientific study we mentioned in the last submission to determine C stocks in settlements has not been resulted. The research project is supported by the Scientific and Technical Research Council of Turkey (TUBITAK) with a project number of 112Y096. We plan to use the outputs of this project if we get enough data until next submission. In this way we shall be able to report CSC during conversions from and to settlements. We consider this issue as very significant as urbanization and sprawl are common in many places of the country especially around Istanbul.

The General Directorate of Agriculture reform has started a GIS based land characterization project with the title of TARBIL (Agriculture Database System). We expect to use more accurate land and land use data especially on land use practices as this project advances. However as the current land uses should be linked with previous land uses we have to work on compatibility issues before using this system. The objective is to link ENVANIS with Corine Land Use maps for this year.
We are also working on a software that will ease our calculations but the system should be well established before software development. So this may take a few years.

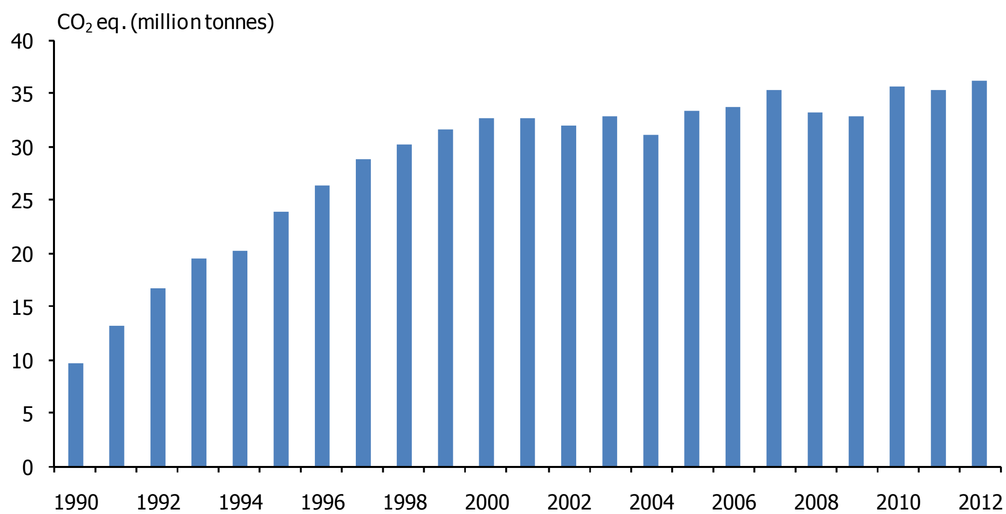
A cropland soil organic matter database is developed under TRGM. The country specific values will be disaggregated for climate and soil types and used in soil CSC estimations of the next submission.

8. WASTE

Emissions of GHGs from the waste sector are mainly released from the disposal of waste, wastewater handling and incineration of waste. The most important GHGs occured in this sector are CH_4 (methane) and N_2O (nitrous oxide). In addition to CH_4 and N_2O, incineration of waste produces CO_2 (carbon dioxide). The emissions from waste incineration are estimated but reported in the Energy Sector as other fuels since the purpose of waste incineration is energy recovery.

CO_2 equivalent emissions from waste sector excluding waste incineration have inclined 272.52% since 1990 and reached to 36.22 Mt CO_2 equivalents in 2012 as seen in graph 8.1.

8.1 Total GHG emissions of waste sector, 1990 - 2012



Waste disposal is the major GHG emission source and contributing 90.5% of total. Contribution of the wastewater handling is 9.5% in 2012.

The major GHG emissions from this sector are CH_4 emissions, which represent 94.8% of total emissions from this sector in 2012, followed by N_2O with 5.2%.

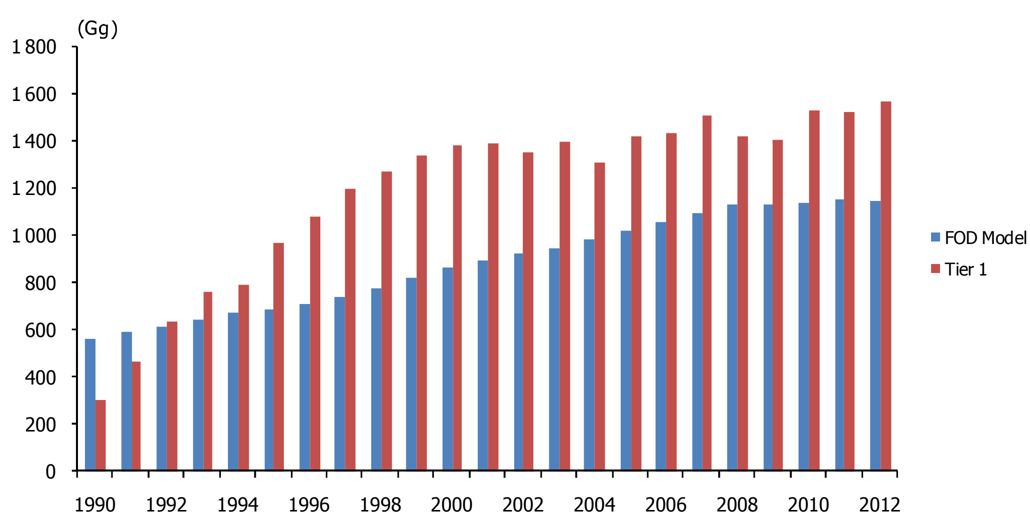
8.1 Solid Waste Disposal on Land (6.A)

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

Methodological Issues: CH_4 emissions released from waste disposal due to anaerobic and aerobic decomposition of organic matter in the waste. The default IPCC Tier 1 methodology recommended in the IPCC Guidelines is used for estimating the methane emissions.

Methane emissions from waste disposal sites are calculated by using both the Revised 1996 IPCC default emission factors and by using 2006 IPCC Guidelines First Order Decay (FOD) method. The emissions calculated by each method are given in graph 8.2. Since the results of FOD method are not compatible with the results of official statistics, the emissions are estimated according to the Revised 1996 IPCC Guidelines using the municipal waste disposal data provided by TurkStat environment statistics.

8.2 CH_4 emissions from waste disposal sites by Tier 1 methodology and FOD model, 1990 - 2012

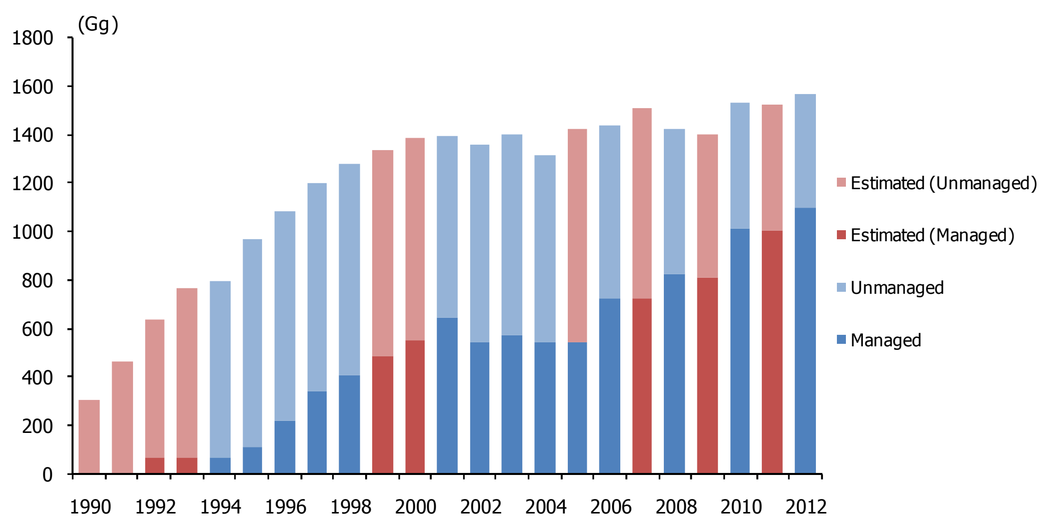


Both managed and unmanaged landfills are considered in the estimations. The annual data on municipal solid waste disposal on landfills are collected by TurkStat via Municipal Waste

Statistics Survey. The data are gathered from all municipalities. However, the annual survey has been done discontinuously. Only the data for years 1994-1998, 2001-2004, 2006, 2008, 2010 and 2012 are available. In 2005, managed landfill activity data is gathered via Waste Disposal and Recovery Facilities Statistics Survey by TurkStat. Missing data for the years not surveyed are estimated by regression analysis. In Turkey, there is only one managed waste disposal site for the years 1992 and 1993 but data on waste disposal amount for those years are not available, 1994 waste disposal amount is used for emission estimations of 1992 and 1993. The regression model is preferred to estimate the waste disposed in managed and unmanaged landfills in 1999 and 2000. Unmanaged landfill activity data for 2005, and managed and unmanaged landfill activity data for 2007 are also estimated. Managed and unmanaged landfill activity data for 2009 and 2011 are assumed the same as the previous year's survey data.

As seen in graph 8.3, CH_4 emissions from solid waste disposal increased from 304.12 Gg to 1561.25 Gg during the period 1990 - 2012. Since 2000, the emission is relatively stable.

8.3 CH_4 emissions from waste disposal, 1990 - 2012



Annual municipal solid waste (MSW) at the solid waste disposal sites (SWDS), CH_4 emissions, the amount of CH_4 recovered and the fraction of MSW disposed to SWDS are given in table 8.1 for solid waste disposal in distinction with managed and unmanaged disposal sites. Managed waste disposal started after 1992 in Turkey.

8.1 Solid waste disposal, 1990-2012

	Annual MSW at the SWDS (Gg)		CH_4 Emissions (Gg)		Recovery (Gg)	Fraction of MSW disposed to SWDS
	Managed	Unmanaged	Managed	Unmanaged	Managed	
1990	NA	6 582.62	NA	304.12	NA	100.00
1991	NA	10 040.91	NA	463.89	NA	100.00
1992	809.00	12 353.23	62.29	570.72	NA	93.85
1993	809.00	15 137.57	62.29	699.36	NA	94.93
1994	809.00	15 755.90	62.29	727.92	NA	95.12
1995	1 443.96	18 531.12	111.18	856.14	NA	92.77
1996	2 847.03	18 646.43	219.22	861.47	NA	86.75
1997	4 363.80	18 617.73	336.01	860.14	NA	81.01
1998	5 257.91	18 744.34	404.86	865.99	NA	78.09
1999	6 232.33	18 443.51	479.89	852.09	NA	74.74
2000	7 127.60	18 055.28	548.83	834.15	NA	71.70
2001	8 304.19	16 166.90	639.42	746.91	NA	66.07
2002	7 061.40	17 511.24	542.23	809.02	1.49	71.26
2003	7 431.80	17 872.80	569.73	825.72	2.51	70.63
2004	7 001.52	16 723.00	536.80	772.60	2.32	70.49
2005	7 078.18	18 869.22	543.35	871.76	1.67	72.72
2006	9 425.00	15 280.00	723.57	705.94	2.15	61.85
2007	9 425.00	17 119.64	717.46	790.93	8.26	64.49
2008	10 947.44	12 850.71	821.57	593.70	21.38	54.00
2009	10 947.44	12 850.71	806.48	593.70	36.47	54.00
2010	13 746.88	11 157.53	1 010.57	515.48	47.94	44.80
2011	13 746.88	11 157.53	1 001.79	515.48	56.72	44.80
2012	15 484.20	10 067.56	1 096.13	465.12	96.15	39.40

The recovery of methane and its subsequent utilization is also considered in the inventory. Methane recovery from landfill gas started to be implemented in Turkey after the year 2002. Therefore, the quantity of recovered methane is substracted from the methane produced after 2002. In 2013, Waste Disposal and Recovery Facilities Survey was applied to all waste disposal and recovery facilities having a licence or a temporary licence, and, regardless of licence, to controlled landfill sites, incineration plants and composting plants operated by or on behalf of municipalities for the year 2012. According to the survey results, new waste disposal facilities with methane recovery were determined. The amount of methane gas and electricity production for whole operating period of those facilities were collected via official letters. Thus, quantity of recovered methane was updated according to the activity data. Besides, the emissions of energy production from the recovered CH_4 gas in SWDS were includeded in the category of Public Electiricity and Heat Production.

As shown in Table 8.2, MCF is taken as 1.00 for managed waste disposal. Since, there is no seperation for the deep (>5) or shallow (<5 m) for unmanaged waste disposal sites, correction factor is used as 0.60. The Degradable Organic Carbon (DOC) value is taken as food waste's default value of 0.15 since the lack of waste composition data.

8.2 Parameters for CH_4 emissions of solid waste disposal sites

Methane Correction Factor (MCF)		Degradable Organic Carbon (DOC)	Fraction DOC Dissimilated (DOC_F)	Fraction of CH_4 in landfill gas (F)
Managed	**Unmanaged**			
1.00	0.60	0.15	0.77	0.50

Uncertainties and time-series consistency: The activity data for this sector are gathered from environmental statistics of TurkStat. Uncertainties in the emission factor and production data are determined by TurkStat experts. After, CH_4 emission is calculated; it is converted to the CO_2 equivalent by multiplying the global warming potential. The approach to produce quantitative uncertainty estimates is used as described in IPCC Good Practice Guidance 2000 for determining uncertainties of that category in total emissions. The combine uncertainties in emission factors and activity data are given in annex 7 in detail.

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

Source category	Gas	Comments on time series consistency
6.A	CH_4	All EFs are constant over the entire time series

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: Based on the information of Waste Disposal and Recovery Facilities Survey, 2012; there is recalculation in managed waste disposal on land (6.A.1) by taking into account the updated data for recovery of methane for the years of 2011 and 2012.

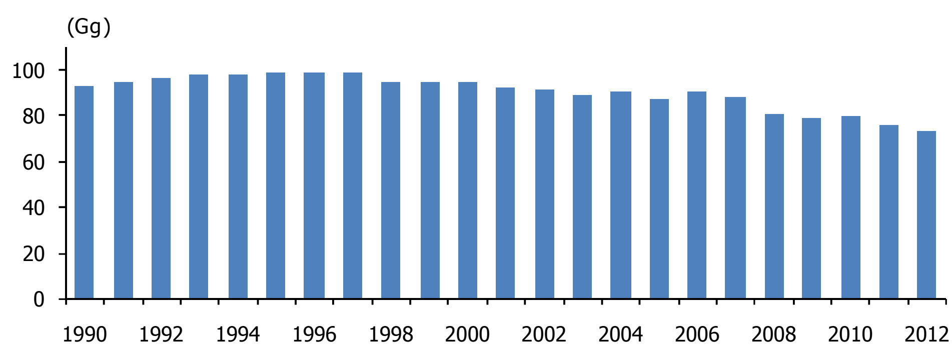
8.2 Wastewater Handling (6.B)

Source Category Description: This sector includes CH_4 and N_2O emissions from domestic wastewater. Domestic wastewater handling is a key category in terms of CH_4 and N_2O emissions.

Methodological Issues: The domestic wastewater emits CH_4 and N_2O as a result of the processes of anaerobic and aerobic decomposition of organic mater contained in the wastewater. The default Tier 1 methodology in the 2006 IPCC Guidelines is used for estimating CH_4 and N_2O emissions in Turkey. However, industrial wastewater has not been considered in the inventory due to lack of data.

As shown in graph 8.4, CH_4 emissions for domestic wastewater decrease from 92.89 Gg to 73.37 Gg during the period 1990 - 2012. CH_4 emissions show a decreasing trend after 1998 due to the recovery of methane.

8.4 CH_4 emissions from domestic wastewater, 1990 - 2012



Total organically degradable material in domestic wastewater (TOW), CH_4 emissions and the amount of CH_4 recovered are given in Table 8.4 for domestic wastewater.

8.4 CH_4 emissions from domestic wastewater, 1990-2012

	TOW (Gg BOD)	CH_4 Emissions (Gg)	Recovery (Gg)
1990	764.51	92.89	NA
1991	777.48	94.46	NA
1992	790.40	96.03	NA
1993	803.25	97.60	NA
1994	816.07	97.93	NA
1995	828.82	98.21	NA
1996	841.51	98.46	NA
1997	854.14	98.65	NA
1998	866.38	94.28	5.78
1999	878.86	94.70	5.49
2000	891.41	94.34	5.95
2001	903.85	92.10	8.23
2002	915.46	91.26	8.98
2003	926.45	88.82	11.24
2004	937.60	90.13	9.73
2005	949.19	87.25	12.41
2006	961.12	90.02	10.90
2007	973.09	87.70	14.48
2008	985.49	80.29	15.80
2009	999.18	79.17	16.75
2010	1 014.48	79.68	17.71
2011	1 029.49	75.32	21.96
2012	1 042.69	73.37	25.17

The recovery of methane and its subsequent utilization is also considered in the inventory. Methane recovery from biogas started to be implemented in Turkey after the year 1998. Therefore, the quantity of recovered methane is substracted from the methane produced after 1998. According to the results of Municipal Wastewater Statistics Survey which was applied to all municipalities for the year 2012, municipal wastewater treatment facilities with methane recovery were determined. The amount of methane gas and electricity production for whole operating period of those facilities were collected via official letters. Thus, quantity of recovered methane was taken into account, while the emissions of energy recovery from biogas were ignored in the Energy Sector.

For estimation of CH_4 from domestic wastewater, the total amount of organically degradable material in the wastewater (TOW) is used as activity data. TOW is calculated by multiplying population by the country-specific per capita Biochemical Oxygen Demand (BOD). The IPCC default estimated BOD_5 value for Turkey is used as 38 g/person/day. The urban and rural population is the primary determinant of the organic matter in terms of BOD. The emission factors are used as shown in table 8.5.

8.5 Parameters and CH_4 EFs for domestic wastewater

BOD (g/person/day)	EF	Weighted CH_4 EFs (kg CH_4/kg BOD)	
		Urban	Rural
38.00	1.00	0.06	0.21

The urban, rural and total population (mid-year) estimates are given in table 8.6. In 2013, the population estimates are updated from the year of 2000.

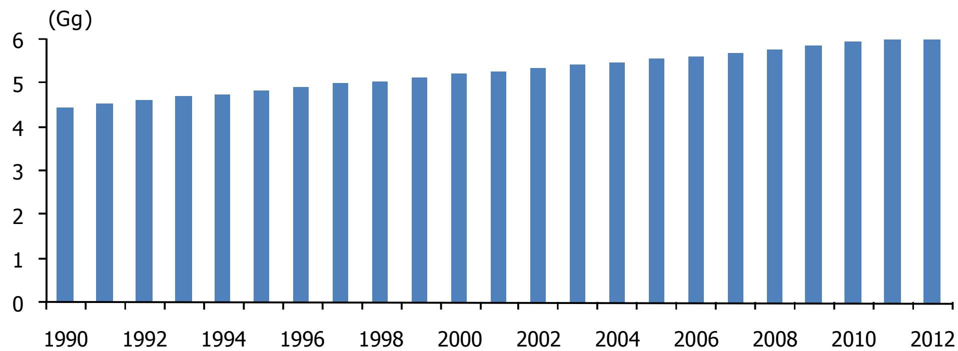
8.6 Urban, rural and total population, 1990-2012

(Thousand)

	Urban	Rural	Total (Mid-year)
1990	32 520.80	22 599.20	55 120.00
1991	33 072.45	22 982.55	56 055.00
1992	33 621.74	23 364.26	56 986.00
1993	34 168.67	23 744.33	57 913.00
1994	35 302.20	23 534.80	58 837.00
1995	36 451.16	23 304.84	59 756.00
1996	37 616.02	23 054.98	60 671.00
1997	38 796.66	22 785.34	61 582.00
1998	39 352.32	23 111.68	62 464.00
1999	40 552.96	22 811.04	63 364.00
2000	41 774.85	22 494.15	64 269.00
2001	43 009.56	22 156.44	65 166.00
2002	44 222.01	21 780.99	66 003.00
2003	45 420.60	21 374.40	66 795.00
2004	46 643.31	20 955.69	67 599.00
2005	47 904.50	20 530.50	68 435.00
2006	48 506.50	20 788.50	69 295.00
2007	49 110.60	21 047.40	70 158.00
2008	53 289.00	17 763.00	71 052.00
2009	54 749.64	17 289.36	72 039.00
2010	55 587.92	17 554.08	73 142.00
2011	57 152.48	17 071.52	74 224.00
2012	57 885.52	17 290.48	75 176.00

There has been a steady increase in N_2O emissions from domestic wastewater during the period 1990 - 2012, as shown in graph 8.5. N_2O emissions increase of 36.4% since 1990.

8.5 N_2O emissions from domestic wastewater, 1990 - 2012



For estimation of N_2O from domestic wastewater, total nitrogen in effluent is estimated by using the average of the available years of annual protein consumption data of the FAO (Food and Agriculture Organization) as 36.83 kg/person/year.

8.7 Parameters for estimation of nitrogen in effluent

Per capita protein consumption (Protein) (kg/person/year)	Fraction of nitrogen in protein (F_{NPR}) (kg N/kg protein)	Fraction of non-consumed protein ($F_{NON-CON}$)	Fraction of industrial and commercial co-discharged protein ($F_{IND-COM}$)	Nitrogen removed with sludge (N_{SLUDGE}) (kg)
36.83	0.16	1.40	1.25	0.00

Uncertainties and time-series consistency: The population data for this category are gathered from population statistics of TurkStat. Uncertainties in the emission factor and production data are determined by TurkStat experts. After, CH_4 and N_2O emissions are calculated; they are converted to the CO_2 equivalent by multiplying the global warming potential. The approach to produce quantitative uncertainty estimates is used as described in IPCC Good Practice Guidance 2000 for determining uncertainties of that category in total emissions. The combine uncertainties in emission factors and activity data are given in annex 7 in detail.

8.8 Time series consistency of emission factor for (6.B.2)

Source category	Gas	Comments on time series consistency
6.B.2	CH_4, N_2O	All EFs are constant over the entire time series

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: Based on the information of Municipal Wastewater Statistics Survey, 2012; there is recalculation in domestic and commercial wastewater (6.B.2) by taking into account the recovery of methane for the period of 1998 - 2012. Besides, there is also recalculation of the population data for the period of 2000 - 2012 depending on updating the population estimates for 2000 onwards.

8.3 Waste Incineration (6.C)

Source Category Description: This sector includes CO_2, CH_4 and N_2O emissions from incineration waste plants. This source category is reported in the Energy Sector.

Methodological Issues: The waste incineration emits CO_2, CH_4 and N_2O as a result of the combustion of solid and liquid waste in controlled incineration facilities. In 2013, Waste Disposal and Recovery Facilities Survey was applied to all waste disposal and recovery facilities having a licence or a temporary licence, and, regardless of licence, to controlled landfill sites, incineration plants and composting plants operated by or on behalf of municipalities for the year 2012. According to the survey results, energy recovery was determined for the waste incineration plants. Therefore, emissions from waste incineration were includeded in the Energy Sector in this inventory submission.

There are three waste incineration plants in Turkey. Types of waste incinerated include industrial, hazardous and clinical waste. In Turkey, municipal solid waste is not incinerated in the incineration plants. Clinical waste incineration started in 1995 and, industrial and hazardous waste incineration started in 1999. Thus, the activity data is available for clinical waste after

1995 and for industrial and hazardous waste after 1999. The default Tier 1 methodology in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories is used for estimating CO_2, CH_4 and N_2O emissions. CO_2, CH_4 and N_2O emissions as CO_2 equivalents are given in table 8.9 for waste incineration.

8.9 GHG emissions from waste incineration

(Gg CO_2 eq.)

	CO_2	**CH_4**	**N_2O**	**Total**
1995	0.233	0.036	0.004	0.273
1996	2.203	0.342	0.039	2.583
1997	3.909	0.606	0.069	4.584
1998	4.907	0.761	0.086	5.754
1999	10.827	1.119	0.200	12.147
2000	28.463	2.758	0.528	31.750
2001	27.782	2.646	0.516	30.944
2002	21.589	2.230	0.398	24.217
2003	35.411	3.299	0.659	39.370
2004	37.024	3.476	0.689	41.189
2005	43.299	3.965	0.807	48.071
2006	52.759	4.727	0.985	58.472
2007	50.485	4.611	0.941	56.038
2008	55.216	5.074	1.029	61.319
2009	54.784	4.775	1.025	60.584
2010	63.648	5.610	1.190	70.448
2011	79.774	6.969	1.493	88.237
2012	82.913	7.270	1.551	91.734

The major GHG emissions from waste incineration are CO_2 emissions, which represent 90.4% of total emissions from this sector in 2012, followed by CH_4 and N_2O as 7.9% and 1.7%, respectively.

Uncertainties and time-series consistency: The activity data for this category are gathered from the waste incineration plants. Uncertainties in the emission factor and production data are determined by TurkStat experts. After, CH_4 and N_2O emissions are calculated; they are converted to the CO_2 equivalent by multiplying the global warming potential. The approach to produce quantitative uncertainty estimates is used as described in IPCC Good Practice Guidance 2000 for determining uncertainties of that category in total emissions. The combine uncertainties in emission factors and activity data are given in annex 7 in detail.

8.10 Time series consistency of emission factor for (6.C)

Source category	Gas	Comments on time series consistency
6.C	CO_2, CH_4, N_2O	All EFs are constant over the time series after 1995

Source-specific QA/QC and verification: The IPCC Good Practice Guidance is used for the quality assurance and quality control (QA/QC) procedures of National greenhouse gases emission inventory. Emission trends are analysed. If there is a high fluctuation in the series then activity data and emission calculation re-examined.

Recalculation: Based on the information of Waste Disposal and Recovery Facilities Survey, 2012; a new waste incineration facility being started to operate after 2003 was determined. Historical activity data for this facility was collected via official letter and activity data for estimation of waste incineration was updated. There is recalculation in waste incineration (6.C) for the period of 2003-2012.

8.4 Other (6.D)

There are no other activities to be considered under this category.

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;

- 5. LULUCF (CO_2),
- 1.A.1.a Public electricity and heat production (CO_2),
- 2.A.1 Cement production (mineral products) (CO_2),
- 1.A.3.b Road transportation (CO_2),
- 1.A.4.b Residential usage of natural gas, hard coal, lignite, LPG (CO_2),
- 6.A.1 Solid waste disposal (managed landfill) (CH_4),
- 2.C.1 Iron and steel production (CO_2),
- 4.A Enteric fermentation (CH_4),
- 1.A.4.c Agriculture/Forestry/Fisheries (CO_2),
- 6.A.2 Solid waste disposal (unmanaged landfill) (CH_4),
- 1.A.2.f Other industries (CO_2),
- 1.A.2.f Cement production (CO_2),
- 2.F Emission of HFCs (HFC-134a),
- 1.A.2.a Iron and steel (CO_2),
- 4.D.1.1 Agricultural soil (synthetic fertilizer) (N_2O),
- 2.A.2 Lime production (mineral products) (CO_2),
- 1.A.2.c Chemicals (CO_2),
- 1.A.3.a Civil aviation (CO_2),
- 1.A.1.b Petroleum refining (CO_2),
- 4.B Manure management (N_2O),
- 1.A.3.d Navigation (CO_2),
- 6.B.2 Domestic and commercial wastewater handling (CH_4), (N_2O),
- 4.D.1.2 Agricultural soil (animal manure applied) (N_2O),
- 1.A.2.f Fertilizer (CO_2),
- 1.B.1.a.2 Mining (surface) (CH_4)

are determined as key sources in 2012.

The key source categories were determined by using Tier 1 level and trend assessment and it is also evaluated according to the qualitative criteria.

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

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

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 are computed, key source categories are 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.

A1.1 Tier 1 key source categories

Source category	Fuel	Gas	2011 Emission	Level Assessment (contribution)	Cumulative Total (%)
Example (1.A.1.a)	Fuel Oil	CO_2	Input Data		
			Gg	%	
			$\mathbf{\Sigma(E_{x,t})}$		100

A1.2 Key source categories (including LULUCF)

2012 KSA (with LULUCF)					
CATEGORY	FUEL	GAS	EMISSION	CONTRIBUTION(%	COMMUTATIVE CONTRIBUTION
5. LULUCF		CO2	59815	11.97	11.97
1.A.1.a. Public Electricity and Heat Production	Natural Gas	CO2	47592	9.52	21.49
1.A.3.b. Road Transportation	Gas / Diesel oil	CO2	41700	8.35	29.84
1.A.1.a. Public Electricity and Heat Production	Lignite	CO2	39996	8.00	37.84
2.A.1. Cement Production(Mineral Products)		CO2	30328	6.07	43.91
1.A.1.a. Public Electricity and Heat Production	Second Fuel Coal	CO2	27967	5.60	49.51
1.A.4.b. Residential	Hard Coal	CO2	25903	5.18	54.69
6.A.1. Solid Waste Disposal (Managed)		CH4	23019	4.61	59.30
1.A.4.b. Residential	Natural Gas	CO2	20644	4.13	63.43
2.C.1. Iron and Steel Production		CO2	19902	3.98	67.42

A1.2 Key source categories (including LULUCF) (cont.)

CATEGORY	FUEL	GAS	EMISSION	CONTRIBUTION (%)	COMMUTATIVE CONTRIBUTION
4.A. Enteric Fermentation		CH4	19436	3,89	71,30
1.A.4.b. Residential	Lignite	CO2	12802	2,56	73,87
6.A.2.1. Solid Waste Disposal (Unmanaged)		CH4	9768	1,95	75,82
1.A.2.f. Cement Production	Petroleum Coke	CO2	8422	1,69	77,51
1.A.3.b. Road Transportation	LPG	CO2	8171	1,64	79,14
1.A.2.f. Other Industries	Natural Gas	CO2	7039	1,41	80,55
1.A.2.f. Cement Production	Lignite	CO2	5691	1,14	81,69
1.A.2.f. Cement Production	Hard Coal	CO2	5636	1,13	82,82
1.A.3.b. Road Transportation	Gasoline	CO2	5595	1,12	83,94
2.F. Emission of HFCs		HFC-134a	4681	0,94	84,87
4.D.1.1. Agricultural Soil (Synthetic Fertilizer)		N2O	4439	0,89	85,76
2.A.2. Lime Production (Mineral Products)		CO2	4320	0,86	86,63
1.A.3.a. Civil Aviation	Jet Kerosene	CO2	3719	0,74	87,37
1.A.2.a. Iron and Steel	Hard Coal	CO2	3235	0,65	88,02
1.A.2.f. Other Industries	Gas / Diesel oil	CO2	3028	0,61	88,62
1.A.4.c. Agriculture Forestry Fisheries	Gas / Diesel oil	CO2	3018	0,60	89,23
4.B. Manure Management		N2O	2864	0,57	89,80
1.A.1.b. Petroleum Refining	Natural Gas	CO2	2434	0,49	90,29
1.A.2.a. Iron and Steel	Natural Gas	CO2	1945	0,39	90,68
1.A.4.b. Residential	LPG	CO2	1918	0,38	91,06
6.B.2. Domestic and Commercial Wastewater Handling		N2O	1888	0,38	91,44
1.A.2.f. Other Industries	Petroleum Coke	CO2	1825	0,37	91,81
4.D.1.2. Agricultural Soil (Animal Manure Applied)		N2O	1781	0,36	92,16
1.A.4.b. Residential	Hard Coal	CH4	1760	0,35	92,51
1.A.2.c. Chemicals	Natural Gas	CO2	1666	0,33	92,85
4.B. Manure Management		CH4	1553	0,31	93,16
6.B.2. Domestic and Commercial Wastewater Handling		CH4	1541	0,31	93,46
1.A.2.f. Fertilizer	Natural Gas	CO2	1531	0,31	93,77
1.A.3.d. Navigation	Gas / Diesel oil	CO2	1506	0,30	94,07
1.A.2.f. Ceramics	Natural Gas	CO2	1425	0,29	94,36
1.B.1.a.2. Mining (Surface)		CH4	1265	0,25	94,85
1.A.2.f. Textile	Natural Gas	CO2	1199	0,24	94,60
4.D.1.4. Agricultural Soil (Crop Residue)		N2O	1161	0,23	95,08
2.G.CS.1 Other and Undifferentiated Production	NA	CO2	1150	0,23	95,31
1.A.2.b. Non-Ferrous Metals	Natural Gas	CO2	1080	0,22	95,53
2.G.CS.1 Other and Undifferentiated Production	NA	N2O	1063	0,21	95,74
1.A.2.e. Food Processing, Beverages and Tobacco	Natural Gas	CO2	1028	0,21	95,95
1.A.2.f. Other Industries	Lignite	CO2	987	0,20	96,14
2.F. Emission of SF6		SF6	971	0,19	96,34
1.A.2.f. Sugar	Lignite	CO2	921	0,18	96,52
1.A.4.b. Residential	Lignite	CH4	813	0,16	96,68
1.A.2.c. Chemicals	Residual Fuel Oil	CO2	742	0,15	96,83
1.A.1.a. Public Electricity and Heat Production	Asphalt	CO2	691	0,14	96,97
1.B.1.a.1. Mining (underground)		CH4	645	0,13	97,45
1.A.2.f. Ceramics	Lignite	CO2	600	0,12	97,09
1.A.2.f. Glass and Glass Products	Natural Gas	CO2	592	0,12	97,21
1.A.4.b. Residential	Wood	CH4	579	0,12	97,33
1.A.2.f. Other Industries	Asphalt	CO2	559	0,11	97,57
1.A.2.a. Iron and Steel	Petroleum Coke	CO2	529	0,11	97,67
4.D.2. Pasture, Range and Paddock Manure		N2O	484	0,10	97,77
1.A.2.f. Sugar	Natural Gas	CO2	472	0,09	97,86
1.A.3.c. Railways	Gas / Diesel oil	CO2	443	0,09	97,95
1.A.1.a. Public Electricity and Heat Production	Residual Fuel Oil	CO2	431	0,09	98,04
1.A.2.c. Chemicals	LPG	CO2	426	0,09	98,12
1.A.4.b. Residential	Asphalt	CO2	419	0,08	98,21
1.A.2.f. Ceramics	LPG	CO2	377	0,08	98,28
1.A.2.f. Textile	Lignite	CO2	372	0,07	98,36
1.A.2.c. Chemicals	Lignite	CO2	366	0,07	98,43
1.A.2.f. Cement Production	Natural Gas	CO2	328	0,07	98,50
1.A.2.c. Chemicals	Hard Coal	CO2	322	0,06	98,56
1.A.2.d. Pulp, Paper and Print	Lignite	CO2	308	0,06	98,62
1.A.2.f. Road Motor Vehicles	Natural Gas	CO2	301	0,06	98,68
2.G.CS.1 Other and Undifferentiated Production	NA	CF4	294	0,06	98,74
1.A.2.d. Pulp, Paper and Print	Natural Gas	CO2	287	0,06	98,80
4.C.1.2.1. Rice Cultivation		CH4	251	0,05	98,85
1.A.4.c. Agriculture Forestry Fisheries	Hard Coal	CO2	240	0,05	98,90
1.A.2.b. Non-Ferrous Metals	Lignite	CO2	228	0,05	98,94
1.A.2.f. Ceramics	Hard Coal	CO2	224	0,04	98,99
1.A.2.e. Food Processing, Beverages and Tobacco	Hard Coal	CO2	216	0,04	99,03
1.B.2.a. Oil (fugitive)		CH4	197	0,04	99,07
4.F.1. Field Burning of Agricultural Residue		CH4	188	0,04	99,11
1.A.2.f. Textile	Hard Coal	CO2	180	0,04	99,14
1.A.1.a. Public Electricity and Heat Production	Lignite	N2O	164	0,03	99,18
1.A.2.c. Chemicals	Second Fuel Coal	CO2	160	0,03	99,21

A1.2 Key source categories (including LULUCF) (cont.)

CATEGORY	FUEL	GAS	EMISSION	CONTRIBUTION (%	COMMUTATIVE CONTRIBUTION
1.A.3.d. Navigation	Residual Fuel Oil	CO_2	103	0,02	99,47
1.A.2.d. Pulp, Paper and Print	Gas / Diesel oil	CO_2	103	0,02	99,49
1.B.2.c. Venting and Flaring (fugitative)		CO_2	101	0,02	99,51
1.A.2.a. Iron and Steel	LPG	CO_2	100	0,02	99,53
1.A.2.f. Ceramics	Petroleum Coke	CO_2	94	0,02	99,55
1.A.2.f. Other Industries	Hard Coal	CO_2	92	0,02	99,57
1.A.4.b. Residential	Residual Fuel Oil	CO_2	83	0,02	99,59
1.A.2.f. Textile	Gasoline	CO_2	65	0,01	99,60
1.A.1.a. Public Electricity and Heat Production	Industrial Waste	CO_2	61	0,01	99,61
1.A.3.b. Road Transportation	Gas / Diesel oil	CH_4	59	0,01	99,62
1.A.3.b. Road Transportation	LPG	CH_4	58	0,01	99,64
1.A.2.f. Glass and Glass Products	Gas / Diesel oil	CO_2	58	0,01	99,65
4.F.1. Field Burning of Agricultural Residue		N_2O	57	0,01	99,66
1.A.4.b. Residential	Lignite	N_2O	56	0,01	99,67
2.B.5. Other Chemicals Production (Chemical Industry)		CH_4	56	0,01	99,68
1.A.4.b. Residential	Waste of animal, plant	CH_4	56	0,01	99,69
1.B.2.b. Natural Gas (fugitative)		CH_4	51	0,01	99,70
1.A.2.e. Food Processing, Beverages and Tobacco	Residual Fuel Oil	CO_2	49	0,01	99,71
1.A.2.f. Ceramics	Gasoline	CO_2	48	0,01	99,72
1.A.2.e. Food Processing, Beverages and Tobacco	Lignite	CO_2	47	0,01	99,73
4.D.3.2. Nitrogen Leaching and Runoff (4.d3.2)		N_2O	46	0,01	99,74
1.A.2.f. Sugar	Gas / Diesel oil	CO_2	45	0,01	99,75
1.B.2.c. Venting and Flaring (fugitative)		CH_4	44	0,01	99,76
1.A.2.b. Non-Ferrous Metals	Hard Coal	CO_2	42	0,01	99,77
1.A.3.a. Civil Aviation	Jet Kerosene	N_2O	40	0,01	99,77
1.A.2.f. Cement Production	Petroleum Coke	N_2O	39	0,01	99,78
1.A.4.b. Residential	Natural Gas	CH_4	39	0,01	99,79
1.A.2.f. Glass and Glass Products	LPG	CO_2	38	0,01	99,80
1.A.3.b. Road Transportation	Gasoline	CH_4	34	0,01	99,80
1.A.4.c. Agriculture/Forestry/Fisheries	Natural Gas	CO_2	33	0,01	99,81
1.A.2.f. Sugar	Hard Coal	CO_2	33	0,01	99,82
1.A.2.f. Ceramics	Gas / Diesel oil	CO_2	32	0,01	99,82
1.A.2.f. Sugar	LPG	CO_2	31	0,01	99,83
1.A.2.d. Pulp, Paper and Print	Residual Fuel Oil	CO_2	29	0,01	99,84
1.A.4.b. Residential	Asphalt	CH_4	28	0,01	99,84
1.A.2.f. Textile	Gas / Diesel oil	CO_2	27	0,01	99,85
1.A.1.a. Public Electricity and Heat Production	Natural Gas	N_2O	27	0,01	99,85
1.A.2.f. Road Motor Vehicles	Lignite	CO_2	26	0,01	99,86
1.A.2.f. Cement Production	Hard Coal	N_2O	26	0,01	99,86
1.A.2.b. Non-Ferrous Metals	Residual Fuel Oil	CO_2	26	0,01	99,87
1.A.2.a. Iron and Steel	Gas / Diesel oil	CO_2	25	0,01	99,87
1.A.2.f. Road Motor Vehicles	Gas / Diesel oil	CO_2	25	0,01	99,88
1.A.2.f. Cement Production	Lignite	N_2O	25	0,00	99,88
1.B.2.a. Oil (fugitative)		CO_2	23	0,00	99,89
1.A.1.b. Petroleum Refining	Other Fuels	CO_2	22	0,00	99,89
4.D.1.3. Agricultural Soil (N-Fixing Crops)		N_2O	21	0,00	99,90
1.A.2.f. Cement Production	Petroleum Coke	CH_4	19	0,00	99,90
2.G.CS.1 Other and Undiffrentiated Production	NA	C_2F_6	18	0,00	99,90
1.A.1.b. Petroleum Refining	Other Fuels	CH_4	18	0,00	99,91
1.A.2.f. Other Industries	LPG	CO_2	18	0,00	99,91
1.A.1.a. Public Electricity and Heat Production	Natural Gas	CH_4	17	0,00	99,92
1.A.4.c. Agriculture/Forestry/Fisheries	Hard Coal	CH_4	16	0,00	99,92
1.A.2.f. Fertilizer	Residual Fuel Oil	CO_2	16	0,00	99,92
1.A.2.f. Textile	LPG	CO_2	16	0,00	99,93
1.A.2.a. Iron and Steel	Hard Coal	N_2O	15	0,00	99,93
1.A.3.b. Road Transportation	Gasoline	N_2O	15	0,00	99,93
1.A.2.f. Ceramics	Residual Fuel Oil	CO_2	14	0,00	99,93
1.A.2.f. Other Industries	Natural Gas	CH_4	13	0,00	99,94
1.A.2.f. Cement Production	Hard Coal	CH_4	13	0,00	99,94
1.A.2.f. Cement Production	Lignite	CH_4	12	0,00	99,94
1.A.4.b. Residential	Natural Gas	N_2O	11	0,00	99,94
1.A.4.b. Residential	Waste of animal, plant	N_2O	11	0,00	99,95
1.A.2.f. Cement Production	Gas / Diesel oil	CO_2	11	0,00	99,95
1.A.2.d. Pulp, Paper and Print	Hard Coal	CO_2	10	0,00	99,95
1.A.2.f. Other Industries	Petroleum Coke	N_2O	9	0,00	99,95
1.A.2.b. Non-Ferrous Metals	Gas / Diesel oil	CO_2	8	0,00	99,95
1.A.1.a. Public Electricity and Heat Production	Lignite	CH_4	8	0,00	99,96
1.A.2.f. Other Industries	Gas / Diesel oil	N_2O	8	0,00	99,96
1.A.1.a. Public Electricity and Heat Production	Biofuel	N_2O	8	0,00	99,96
1.A.4.c. Agriculture/Forestry/Fisheries	Gas / Diesel oil	N_2O	8	0,00	99,96
1.A.2.e. Food Processing, Beverages and Tobacco	Coke	CO_2	8	0,00	99,96
1.A.2.a. Iron and Steel	Hard Coal	CH_4	7	0,00	99,96
1.A.4.b. Residential	LPG	CH_4	6	0,00	99,96
1.A.2.f. Cement Production	Second Fuel Coal	CO_2	6	0,00	99,97

A1.2 Key source categories (including LULUCF) (cont.)

CATEGORY	FUEL	GAS	EMISSION	CONTRIBUTION (%	COMMUTATIVE CONTRIBUTION
1.A.1.a. Public Electricity and Heat Production	Second Fuel Coal	CH4	6	0,00	99,97
1.A.4.b. Residential	LPG	N2O	6	0,00	99,97
1.A.1.a. Public Electricity and Heat Production	Industrial Waste	CH4	5	0,00	99,97
1.A.2.f. Road Motor Vehicles	Gasoline	CO2	5	0,00	99,97
1.A.4.c. Agriculture/Forestry/Fisheries	Gas / Diesel oil	CH4	4	0,00	99,97
1.A.2.f. Other Industries	Lignite	N2O	4	0,00	99,97
1.A.2.f. Other Industries	Petroleum Coke	CH4	4	0,00	99,97
1.A.2.a. Iron and Steel	Residual Fuel Oil	CO2	4	0,00	99,97
1.A.2.f. Sugar	Lignite	N2O	4	0,00	99,97
1.A.2.f. Other Industries	Natural Gas	N2O	4	0,00	99,97
1.A.1.a. Public Electricity and Heat Production	Biofuel	CH4	4	0,00	99,98
1.A.3.d. Navigation	Gas / Diesel oil	N2O	4	0,00	99,98
1.A.2.a. Iron and Steel	Natural Gas	CH4	4	0,00	99,98
1.A.2.f. Sugar	Gasoline	CO2	4	0,00	99,98
1.A.2.f. Fertilizer	Gas / Diesel oil	CO2	3	0,00	99,98
1.A.2.c. Chemicals	Natural Gas	CH4	3	0,00	99,98
1.A.2.f. Fertilizer	Natural Gas	CH4	3	0,00	99,98
1.A.2.f. Ceramics	Natural Gas	CH4	3	0,00	99,98
1.A.2.f. Ceramics	Lignite	N2O	3	0,00	99,98
1.A.2.f. Other Industries	Asphalt	N2O	3	0,00	99,98
1.A.2.a. Iron and Steel	Petroleum Coke	N2O	2	0,00	99,98
1.A.2.f. Textile	Natural Gas	CH4	2	0,00	99,98
1.A.3.d. Navigation	Gas / Diesel oil	CH4	2	0,00	99,98
1.A.2.d. Pulp, Paper and Print	LPG	CO2	2	0,00	99,98
1.A.2.f. Other Industries	Lignite	CH4	2	0,00	99,98
1.A.2.b. Non-Ferrous Metals	Natural Gas	CH4	2	0,00	99,98
1.A.4.b. Residential	Asphalt	N2O	2	0,00	99,98
1.A.2.f. Sugar	Lignite	CH4	2	0,00	99,98
1.A.2.e. Food Processing, Beverages and Tobacco	Natural Gas	CH4	2	0,00	99,98
1.A.2.c. Chemicals	Residual Fuel Oil	N2O	2	0,00	99,99
1.A.3.d. Navigation	Gasoline	CO2	2	0,00	99,99
1.A.2.f. Other Industries	Gas / Diesel oil	CH4	2	0,00	99,99
1.A.2.f. Textile	Lignite	N2O	2	0,00	99,99
1.A.2.c. Chemicals	Lignite	N2O	2	0,00	99,99
1.A.1.a. Public Electricity and Heat Production	Asphalt	N2O	2	0,00	99,99
1.A.2.e. Food Processing, Beverages and Tobacco	Gas / Diesel oil	CO2	2	0,00	99,99
1.A.2.c. Chemicals	Hard Coal	N2O	2	0,00	99,99
1.A.1.b. Petroleum Refining	Natural Gas	N2O	1	0,00	99,99
1.A.2.d. Pulp, Paper and Print	Lignite	N2O	1	0,00	99,99
1.A.2.f. Ceramics	Lignite	CH4	1	0,00	99,99
1.A.2.c. Chemicals	LPG	N2O	1	0,00	99,99
1.A.2.f. Other Industries	Asphalt	CH4	1	0,00	99,99
1.A.2.a. Iron and Steel	Petroleum Coke	CH4	1	0,00	99,99
1.A.1.a. Public Electricity and Heat Production	Industrial Waste	N2O	1	0,00	99,99
1.A.2.f. Ceramics	LPG	N2O	1	0,00	99,99
1.A.4.c. Agriculture/Forestry/Fisheries	Hard Coal	N2O	1	0,00	99,99
1.A.2.f. Glass and Glass Products	Natural Gas	CH4	1	0,00	99,99
1.A.3.c. Railways	Gas / Diesel oil	N2O	1	0,00	99,99
1.A.1.a. Public Electricity and Heat Production	Residual Fuel Oil	N2O	1	0,00	99,99
1.A.2.a. Iron and Steel	Natural Gas	N2O	1	0,00	99,99
1.A.3.a. Civil Aviation	Jet Kerosene	CH4	1	0,00	99,99
1.A.2.f. Ceramics	Hard Coal	N2O	1	0,00	99,99
1.B.2.b. Natural Gas (fugitive)		CO2	1	0,00	99,99
1.A.2.e. Food Processing, Beverages and Tobacco	Hard Coal	N2O	1	0,00	99,99
1.A.2.b. Non-Ferrous Metals	Lignite	N2O	1	0,00	99,99
1.A.2.c. Chemicals	Natural Gas	N2O	1	0,00	99,99
1.A.1.b. Petroleum Refining	Natural Gas	CH4	1	0,00	99,99
1.A.2.f. Sugar	Natural Gas	CH4	1	0,00	99,99
1.A.2.f. Fertilizer	Natural Gas	N2O	1	0,00	99,99
1.A.2.f. Textile	Hard Coal	N2O	1	0,00	99,99
1.A.2.f. Ceramics	Natural Gas	N2O	1	0,00	99,99
1.A.2.f. Textile	Lignite	CH4	1	0,00	99,99
1.A.2.f. Road Motor Vehicles	LPG	CO2	1	0,00	99,99
1.A.2.c. Chemicals	Lignite	CH4	1	0,00	99,99
1.A.2.c. Chemicals	Second Fuel Coal	N2O	1	0,00	99,99
1.A.2.c. Chemicals	Hard Coal	CH4	1	0,00	99,99
4.D.3.1. Atmospheric deposition		N2O	1	0,00	99,99
1.A.2.f. Textile	Natural Gas	N2O	1	0,00	99,99
1.A.2.d. Pulp, Paper and Print	Lignite	CH4	1	0,00	99,99
1.A.3.c. Railways	Gas / Diesel oil	CH4	1	0,00	99,99
1.A.2.f. Cement Production	Natural Gas	CH4	1	0,00	99,99
1.A.2.b. Non-Ferrous Metals	Natural Gas	N2O	1	0,00	99,99
1.A.2.f. Sugar	Second Fuel Coal	N2O	1	0,00	99,99
1.A.2.e. Food Processing, Beverages and Tobacco	Natural Gas	N2O	1	0,00	99,99

A1.2 Key source categories (including LULUCF) (cont.)

CATEGORY	FUEL	GAS	EMISSION	CONTRIBUTION (%	COMMUTATIVE CONTRIBUTION
1.A.2.f. Other Industries	Hard Coal	N2O	0	0.00	100.00
1.A.1.b. Petroleum Refining	Other Fuels	N2O	0	0.00	100.00
1.A.2.c. Chemicals	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.f. Textile	Hard Coal	CH4	0	0.00	100.00
1.A.4.b. Residential	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.c. Chemicals	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.1.a. Public Electricity and Heat Production	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.c. Chemicals	Second Fuel Coal	CH4	0	0.00	100.00
1.A.4.b. Residential	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.2.f. Textile	Residual Fuel Oil	CO2	0	0.00	100.00
1.A.2.f. Glass and Glass Products	Natural Gas	N2O	0	0.00	100.00
1.A.2.a. Iron and Steel	LPG	N2O	0	0.00	100.00
1.A.2.f. Sugar	Second Fuel Coal	CH4	0	0.00	100.00
1.A.2.c. Chemicals	LPG	CH4	0	0.00	100.00
1.A.2.f. Sugar	Residual Fuel Oil	N2O	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	LPG	CO2	0	0.00	100.00
1.A.2.f. Sugar	Natural Gas	N2O	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.2.f. Cement Production	Residual Fuel Oil	N2O	0	0.00	100.00
1.A.2.f. Ceramics	LPG	CH4	0	0.00	100.00
1.A.3.d. Navigation	Residual Fuel Oil	N2O	0	0.00	100.00
1.A.2.a. Iron and Steel	Lignite	CH4	0	0.00	100.00
1.A.4.b. Residential	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.f. Ceramics	Petroleum Coke	CH4	0	0.00	100.00
1.A.2.f. Other Industries	Hard Coal	CH4	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	Lignite	N2O	0	0.00	100.00
1.A.4.b. Residential	Residual Fuel Oil	N2O	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	Hard Coal	N2O	0	0.00	100.00
1.A.2.f. Cement Production	Natural Gas	N2O	0	0.00	100.00
1.A.3.b. Road Transportation	Biofuel	N2O	0	0.00	100.00
1.A.2.f. Textile	Gasoline	N2O	0	0.00	100.00
1.A.2.f. Cement Production	LPG	CO2	0	0.00	100.00
1.A.2.f. Road Motor Vehicles	Natural Gas	N2O	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	Natural Gas	N2O	0	0.00	100.00
1.A.2.f. Sugar	Hard Coal	N2O	0	0.00	100.00
1.A.2.f. Glass and Glass Products	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.3.d. Navigation	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.f. Ceramics	Gasoline	N2O	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	Residual Fuel Oil	N2O	0	0.00	100.00
1.A.2.f. Road Motor Vehicles	Lignite	N2O	0	0.00	100.00
1.A.2.f. Glass and Glass Products	LPG	N2O	0	0.00	100.00
1.A.2.f. Sugar	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.3.b. Road Transportation	Biofuel	CH4	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	Lignite	CH4	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	Hard Coal	CH4	0	0.00	100.00
1.A.2.f. Sugar	LPG	N2O	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	Gasoline	CO2	0	0.00	100.00
1.A.2.f. Cement Production	Gasoline	CO2	0	0.00	100.00
1.A.2.c. Chemicals	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.f. Ceramics	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.2.f. Fertilizer	Gasoline	CO2	0	0.00	100.00
1.A.2.f. Sugar	Hard Coal	CH4	0	0.00	100.00
1.A.2.f. Other Industries	Gasoline	CO2	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	Residual Fuel Oil	N2O	0	0.00	100.00
1.A.2.f. Textile	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.2.a. Iron and Steel	LPG	CH4	0	0.00	100.00
1.A.3.b. Road Transportation	LPG	N2O	0	0.00	100.00
1.A.2.f. Glass and Glass Products	Gasoline	CO2	0	0.00	100.00
1.A.2.a. Iron and Steel	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.2.f. Road Motor Vehicles	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.2.f. Sugar	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	Residual Fuel Oil	N2O	0	0.00	100.00
1.A.4.c. Agriculture/Forestry/Fisheries	Natural Gas	CH4	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.f. Cement Production	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.f. Road Motor Vehicles	Lignite	CH4	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	LPG	CO2	0	0.00	100.00
1.A.2.f. Other Industries	LPG	N2O	0	0.00	100.00
1.B.2.a. Oil (fugitive)		N2O	0	0.00	100.00
1.A.2.f. Textile	LPG	N2O	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	Hard Coal	N2O	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	Gasoline	CO2	0	0.00	100.00
1.A.2.f. Textile	Gasoline	CH4	0	0.00	100.00
1.A.2.f. Fertilizer	Residual Fuel Oil	N2O	0	0.00	100.00

A1.2 Key source categories (including LULUCF) (cont.)

CATEGORY	FUEL	GAS	EMISSION	CONTRIBUTION (%)	COMMUTATIVE CONTRIBUTION
1.A.2.f. Fertilizer	LPG	CO2	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	Coke	N2O	0	0.00	100.00
1.A.2.f. Ceramics	Residual Fuel Oil	N2O	0	0.00	100.00
1.A.2.f. Glass and Glass Products	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.5.a. Other (Stationary)		N2O	0	0.00	100.00
CH4 from Waste Disposal		N2O	0	0.00	100.00
1.A.2.f. Ceramics	Gasoline	CH4	0	0.00	100.00
1.A.2.f. Cement Production	Second Fuel Coal	N2O	0	0.00	100.00
1.A.2.f. Cement Production	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.f. Glass and Glass Products	LPG	CH4	0	0.00	100.00
1.A.2.f. Sugar	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.a. Iron and Steel	Gasoline	CO2	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	Hard Coal	CH4	0	0.00	100.00
1.A.5.a. Other (Stationary)		CH4	0	0.00	100.00
CH4 from Waste Disposal		CH4	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.2.f. Sugar	LPG	CH4	0	0.00	100.00
1.A.4.c. Agriculture/Forestry/Fisheries	Natural Gas	N2O	0	0.00	100.00
1.A.2.c. Chemicals	Gasoline	CO2	0	0.00	100.00
1.A.2.f. Ceramics	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	Coke	CH4	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.f. Textile	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.a. Iron and Steel	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.f. Road Motor Vehicles	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.f. Cement Production	Second Fuel Coal	CH4	0	0.00	100.00
1.A.2.f. Road Motor Vehicles	Gasoline	N2O	0	0.00	100.00
1.A.2.f. Other Industries	LPG	CH4	0	0.00	100.00
1.A.3.d. Navigation	Gasoline	CH4	0	0.00	100.00
1.A.2.f. Textile	LPG	CH4	0	0.00	100.00
1.A.2.a. Iron and Steel	Residual Fuel Oil	N2O	0	0.00	100.00
1.A.2.f. Sugar	Gasoline	N2O	0	0.00	100.00
1.A.2.f. Fertilizer	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.f. Fertilizer	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.2.f. Ceramics	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	LPG	N2O	0	0.00	100.00
1.A.2.f. Cement Production	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.3.d. Navigation	Gasoline	N2O	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	Gas / Diesel oil	N2O	0	0.00	100.00
1.A.2.f. Road Motor Vehicles	Gasoline	CH4	0	0.00	100.00
1.A.2.f. Road Motor Vehicles	LPG	N2O	0	0.00	100.00
1.A.2.a. Iron and Steel	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.f. Sugar	Gasoline	CH4	0	0.00	100.00
1.A.2.f. Fertilizer	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	LPG	CH4	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	Gas / Diesel oil	CH4	0	0.00	100.00
1.A.2.f. Textile	Residual Fuel Oil	N2O	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	LPG	N2O	0	0.00	100.00
1.A.2.f. Road Motor Vehicles	LPG	CH4	0	0.00	100.00
1.A.2.f. Cement Production	LPG	N2O	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	Gasoline	N2O	0	0.00	100.00
1.A.2.f. Cement Production	Gasoline	N2O	0	0.00	100.00
1.A.2.f. Fertilizer	Gasoline	N2O	0	0.00	100.00
1.A.2.f. Other Industries	Gasoline	N2O	0	0.00	100.00
1.A.2.f. Textile	Residual Fuel Oil	CH4	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	LPG	CH4	0	0.00	100.00
1.A.2.f. Glass and Glass Products	Gasoline	N2O	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	LPG	N2O	0	0.00	100.00
1.A.2.f. Cement Production	LPG	CH4	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	Gasoline	N2O	0	0.00	100.00
1.A.2.f. Fertilizer	LPG	N2O	0	0.00	100.00
1.A.2.e. Food Processing, Beverages and Tobacco	Gasoline	N2O	0	0.00	100.00
1.A.2.a. Iron and Steel	Gasoline	N2O	0	0.00	100.00
1.A.2.d. Pulp, Paper and Print	Gasoline	CH4	0	0.00	100.00
1.A.2.f. Cement Production	Gasoline	CH4	0	0.00	100.00
1.A.2.c. Chemicals	Gasoline	N2O	0	0.00	100.00
1.A.2.f. Fertilizer	Gasoline	CH4	0	0.00	100.00
1.A.2.f. Other Industries	Gasoline	CH4	0	0.00	100.00
1.A.2.f. Glass and Glass Products	Gasoline	CH4	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	LPG	CH4	0	0.00	100.00
1.A.2.b. Non-Ferrous Metals	Gasoline	CH4	0	0.00	100.00

A1.3 Key source categories (excluding LULUCF)

2012 KSA (without LULUCF)					
CATEGORY	FUEL	GAS	EMISSION	CONTRIBUTION (%)	COMMULATIVE CONTRIBUTION
1.A.1.a. Public Electricity and Heat Production	Natural Gas	CO2	47592	10.82	10.82
1.A.3.b. Road Transportation	Gas / Diesel oil	CO2	41700	9.48	20.30
1.A.1.a. Public Electricity and Heat Production	Lignite	CO2	39996	9.09	29.39
2.A.1. Cement Production (Mineral Products)		CO2	30228	6.89	36.29
1.A.1.a. Public Electricity and Heat Production	Second Fuel Coal	CO2	27967	6.36	42.64
1.A.4.b. Residential	Hard Coal	CO2	25903	5.89	48.53
6.A.1. Solid Waste Disposal (Managed)		CH4	23019	5.23	53.77
1.A.4.b. Residential	Natural Gas	CO2	20644	4.69	58.46
2.C.1. Iron and Steel Production		CO2	19902	4.52	62.98
4.A. Enteric Fermentation		CH4	19436	4.42	67.40
1.A.4.b. Residential	Lignite	CO2	12802	2.91	70.31
6.A.2.1. Solid Waste Disposal (Unmanaged)		CH4	9768	2.22	72.53
1.A.2.f. Cement Production	Petroleum Coke	CO2	8422	1.91	74.45
1.A.3.b. Road Transportation	LPG	CO2	8171	1.86	76.31
1.A.2.f. Other Industries	Natural Gas	CO2	7039	1.60	77.91
1.A.2.f. Cement Production	Lignite	CO2	5691	1.29	79.20
1.A.2.f. Cement Production	Hard Coal	CO2	5636	1.28	80.48
1.A.3.b. Road Transportation	Gasoline	CO2	5595	1.27	81.75
2.F. Emission of HFCs		HFC-134a	4651	1.06	82.82
4.D.1.1. Agricultural Soil (Synthetic Fertilizer)		N2O	4439	1.01	83.83
2.A.2. Lime Production (Mineral Products)		CO2	4220	0.96	84.81
1.A.3.a. Civil Aviation	Jet Kerosene	CO2	3719	0.85	85.65
1.A.2.a. Iron and Steel	Hard Coal	CO2	3235	0.74	86.39
1.A.2.f. Other Industries	Gas / Diesel oil	CO2	3036	0.69	87.08
1.A.4.c. Agriculture/Forestry/Fisheries	Gas / Diesel oil	CO2	3015	0.69	87.76
4.B. Manure Management		N2O	2864	0.65	88.42
1.A.1.b. Petroleum Refining	Natural Gas	CO2	2434	0.55	88.97
1.A.2.a. Iron and Steel	Natural Gas	CO2	1945	0.44	89.41
1.A.4.b. Residential	LPG	CO2	1915	0.44	89.85
6.B.2. Domestic and Commercial Wastewater Handling		N2O	1885	0.43	90.28
1.A.2.f. Other Industries	Petroleum Coke	CO2	1825	0.41	90.69
4.D.1.2. Agricultural Soil (Animal Manure Applied)		N2O	1781	0.40	91.10
1.A.4.b. Residential	Hard Coal	CH4	1760	0.40	91.50
1.A.2.c. Chemicals	Natural Gas	CO2	1656	0.38	91.87
4.B. Manure Management		CH4	1553	0.35	92.23
6.B.2. Domestic and Commercial Wastewater Handling		CH4	1541	0.35	92.58
1.A.2.f. Fertilizer	Natural Gas	CO2	1531	0.35	92.92
1.A.3.d. Navigation	Gas / Diesel oil	CO2	1506	0.34	93.27
1.A.2.f. Seramics	Natural Gas	CO2	1425	0.32	93.59
1.A.2.f. Textile	Natural Gas	CO2	1199	0.27	93.86
1.B.1.a.2. Mining (Surface)		CH4	1265	0.29	94.15
4.D.1.4. Agricultural Soil (Crop Residue)		N2O	1161	0.26	94.41
2. G.C.5.1 Other and Undifferentiated Production	NA	CO2	1150	0.26	94.68
1.A.2.b. Non-Ferrous Metals	Natural Gas	CO2	1080	0.25	94.92
2. G.C.5.1 Other and Undifferentiated Production	NA	N2O	1053	0.24	95.16
1.A.2.e. Food Processing, Beverages and Tobacco	Natural Gas	CO2	1025	0.23	95.39

ANNEX 2

A2. METHODOLOGY

Turkey’s greenhouse gas emission inventory is in accordance with the IPCC Guidelines. The emission factors are given in the following Table A2.1.

A2.1 Emission factors used for national emission inventory

Sector	Gas	Unit	Emission Factor	Sector	Gas	Unit	Emission Factor
Energy				**Energy - Industry**			
Hard Coal	CO_2	tC/TJ	25.8	Natural Gas	N_2O	KG/TJ	0.1
Lignite	CO_2	tC/TJ	27.6	**Energy - Other**			
Asphalt	CO_2	tC/TJ	25.8	Hard Coal	N_2O	KG/TJ	1.4
Secondary Fuel Coal	CO_2	tC/TJ	25.8	Lignite	N_2O	KG/TJ	1.4
Petroleum Coke	CO_2	tC/TJ	25.8	Asphalt	N_2O	KG/TJ	1.4
Petroleum	CO_2	tC/TJ	20.0	Secondary Fuel Coal	N_2O	KG/TJ	1.4
Natural Gases	CO_2	tC/TJ	15.3	Petroleum Coke	N_2O	KG/TJ	1.4
Jet Kerosene	CO_2	tC/TJ	19.5	Petroleum (Residential)	N_2O	KG/TJ	0.6
Energy - Electricity Production				Petroleum (Agriculture)	N_2O	KG/TJ	0.6
Hard Coal	CH_4	KG/TJ	1.0	Natural Gas	N_2O	KG/TJ	0.1
Lignite	CH_4	KG/TJ	1.0	Biomass (Residential)	N_2O	KG/TJ	4.0
Asphalt	CH_4	KG/TJ	1.0	**Energy - Transport**			
Secondary Fuel Coal	CH_4	KG/TJ	1.0	Hard Coal	N_2O	KG/TJ	1.4
Petroleum Coke	CH_4	KG/TJ	1.0	Lignite	N_2O	KG/TJ	1.4
Petroleum	CH_4	KG/TJ	3.0	Asphalt	N_2O	KG/TJ	1.4
Natural Gas	CH_4	KG/TJ	1.0	Secondary Fuel Coal	N_2O	KG/TJ	1.4
Energy - Industry				Petroleum Coke	N_2O	KG/TJ	1.4
Hard Coal	CH_4	KG/TJ	10.0	Petroleum	N_2O	KG/TJ	0.6
Lignite	CH_4	KG/TJ	10.0	Natural Gas	N_2O	KG/TJ	0.1
Asphalt	CH_4	KG/TJ	10.0	Jet Kerosene	N_2O	KG/TJ	2.0
Secondary Fuel Coal	CH_4	KG/TJ	10.0	Fuel-oil	N_2O	KG/TJ	0.6
Petroleum Coke	CH_4	KG/TJ	10.0	Diesel	N_2O	KG/TJ	0.6
Petroleum	CH_4	KG/TJ	2.0	Gasoline	N_2O	KG/TJ	0.6
Natural Gas	CH_4	KG/TJ	5.0	**Energy - Electricity Production**			
Energy - Other				Hard Coal	NO_X	KG/TJ	300.0
Hard Coal	CH_4	KG/TJ	300.0	Lignite	NO_X	KG/TJ	300.0
Lignite	CH_4	KG/TJ	300.0	Asphalt	NO_X	KG/TJ	300.0
Asphalt	CH_4	KG/TJ	300.0	Secondary Fuel Coal	NO_X	KG/TJ	300.0
Secondary Fuel Coal	CH_4	KG/TJ	300.0	Petroleum Coke	NO_X	KG/TJ	300.0
Petroleum Coke	CH_4	KG/TJ	300.0	Petroleum	NO_X	KG/TJ	200.0
Petroleum (Residential)	CH_4	KG/TJ	10.0	Natural Gas	NO_X	KG/TJ	150.0
Petroleum (Agriculture)	CH_4	KG/TJ	5.0	**Energy - Industry**			
Natural Gas	CH_4	KG/TJ	5.0	Hard Coal	NO_X	KG/TJ	300.0
Biomass (Residential)	CH_4	KG/TJ	300.0	Lignite	NO_X	KG/TJ	300.0
Energy - Transport				Asphalt	NO_X	KG/TJ	300.0
Hard Coal	CH_4	KG/TJ	10.0	Secondary Fuel Coal	NO_X	KG/TJ	300.0
Lignite	CH_4	KG/TJ	10.0	Petroleum Coke	NO_X	KG/TJ	300.0
Asphalt	CH_4	KG/TJ	10.0	Petroleum	NO_X	KG/TJ	200.0
Secondary Fuel Coal	CH_4	KG/TJ	10.0	Natural Gas	NO_X	KG/TJ	150.0
Petroleum Coke	CH_4	KG/TJ	10.0	**Energy - Other**			
Petroleum	CH_4	KG/TJ	5.0	Hard Coal	NO_X	KG/TJ	100.0
Natural Gas	CH_4	KG/TJ	50.0	Lignite	NO_X	KG/TJ	100.0
Jet Kerosene	CH_4	KG/TJ	0.5	Asphalt	NO_X	KG/TJ	100.0
Fuel-oil	CH_4	KG/TJ	5.0	Secondary Fuel Coal	NO_X	KG/TJ	100.0
Diesel	CH_4	KG/TJ	5.0	Petroleum Coke	NO_X	KG/TJ	100.0
Gasoline	CH_4	KG/TJ	20.0	Petroleum (Residential)	NO_X	KG/TJ	100.0
Energy - Electricity Production				Petroleum (Agriculture)	NO_X	KG/TJ	1,200.0
Hard Coal	N_2O	KG/TJ	1.4	Natural Gas	NO_X	KG/TJ	50.0
Lignite	N_2O	KG/TJ	1.4	Biomass (Residential)	NO_X	KG/TJ	100.0
Asphalt	N_2O	KG/TJ	1.4	**Energy - Transport**			
Secondary Fuel Coal	N_2O	KG/TJ	1.4	Hard Coal	NO_X	KG/TJ	300.0
Petroleum Coke	N_2O	KG/TJ	1.4	Lignite	NO_X	KG/TJ	300.0
Petroleum	N_2O	KG/TJ	0.6	Asphalt	NO_X	KG/TJ	300.0
Natural Gas	N_2O	KG/TJ	0.1	Secondary Fuel Coal	NO_X	KG/TJ	300.0
Energy - Industry				Petroleum Coke	NO_X	KG/TJ	300.0
Hard Coal	N_2O	KG/TJ	1.4	Natural Gas	NO_X	KG/TJ	600.0
Lignite	N_2O	KG/TJ	1.4	Jet Kerosene	NO_X	KG/TJ	300.0
Asphalt	N_2O	KG/TJ	1.4	Fuel-oil (Railway)	NO_X	KG/TJ	1,200.0
Secondary Fuel Coal	N_2O	KG/TJ	1.4	Diesel (Railway)	NO_X	KG/TJ	1,200.0
Petroleum Coke	N_2O	KG/TJ	1.4	Gasoline	NO_X	KG/TJ	600.0
Petroleum	N_2O	KG/TJ	0.6	Fuel-oil (Navigation)	NO_X	KG/TJ	1,500.0

A2.1 Emission factors used for national emission inventory (cont.)

Sector	Gas	Unit	Emission Factor
Energy - Transport			
Diesel (Navigation)	NO_X	KG/TJ	1 500.0
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	2 000.0
Lignite	CO	KG/TJ	2 000.0
Asphalt	CO	KG/TJ	2 000.0
Secondary Fuel Coal	CO	KG/TJ	2 000.0
Petroleum Coke	CO	KG/TJ	2 000.0
Petroleum (Residential)	CO	KG/TJ	20.0
Petroleum (Agriculture)	CO	KG/TJ	1 000.0
Natural Gas	CO	KG/TJ	50.0
Biomass (Residential)	CO	KG/TJ	5 000.0
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	1 000.0
Natural Gas	CO	KG/TJ	400.0
Jet Kerosene	CO	KG/TJ	100.0
Fuel-oil	CO	KG/TJ	1 000.0
Diesel	CO	KG/TJ	1 000.0
Gasoline	CO	KG/TJ	8 000.0
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
Biomass (Residential)	NMVOC	KG/TJ	600.0
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	1 500.0
Energy - Fugitive Emission			
Coal Mining			
Underground mining	CH_4	m^3/tonnes	17.5
Surface mining	CH_4	m^3/tonnes	1.2
Industrial Processes			
Cement Production			
Clinker (CKD is 1,02)	CO_2	tonne CO_2/tonne	0.51
Lime Production			
CaO Production	CO_2	Kg CO_2/tonne	0.75
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	SO_2	Kg/tonne	0.120
Asphalt plant	CO	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
Nitric Acid Production			
Nitric Acid	N_20	Kg/tonne	19.0
Nitric Acid	NO_X	Kg/tonne	12.0
Nitric Acid	NH_3	G/tonne	10.0
Calcium Carbid Production			
Limestone	CO_2	Kg/tonne	760.0
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	SO_2	Kg/tonne	3.1
Sulfuric Acid	SO2	Kg/tonne	17.5
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
Styrene butadiene	NMVOC	Kg/tonne	5.8
Carbon Black	CO	Kg/tonne	10.0

A2.1 Emission factors used for national emission inventory (cont.)

Sector	Gas	Unit	Emission Factor
Iron and Steel			
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	1,330.0
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	68.5
Other Cattle	CH_4	Kg/head/year	56.0
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&Donkeys	CH_4	Kg/head/year	10.0
Manure Mangement			
Dairy Cattle (C.R. Temp.)	CH_4	Kg/head/year	16.0
Other Cattle (C.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	0.16
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_2O	Emission Ratios*	0.007
Wheat, Barley, Maize, Oat, Rye	NO_X	Emission Ratios*	0.121
Note: Dry Matter fraction (arithmetic mean)			

Direct N_2O Manure		N Excretion/animal kg N/head/year	Waste manage type (%)
Dairy Cattle		82.581	0.003
Other Cattle		45.088	0.006
Buffalo		44.384	0.007
Sheep		13.502	0.000
Goats		16.494	0.002
Camels		33.266	0.000
Horse		37.869	0.002
Swine		6.800	0.007
Mules&Dankeys		37.869	0.002
Poultry		-	-
Chicken		0.409	0.001
Duck&Gees		0.818	0.000
Turkey		1.837	0.001
Indirect N_2O Manure		**Fraction of Total N lost**	**Emission Factor**
Dairy Cattle		0.2096	0.01
Other Cattle		0.15975	0.01
Buffalo		0.132	0.01
Sheep		0	0.01
Goats		0	0.01
Camels		0	0.01
Horse		0.05	0.01
Swine		0.150225	0.01
Mules&Dankeys		0.05	0.01
Poultry		-	-
Chicken		0.2375	0.01
Duck&Gees		0	0.01
Turkey		0.2375	0.01
Fr. of manure used as fertilizer			**Fr. of Total N lost (CS)**
Dairy Cattle			0.8
Other Cattle			0.5
Buffalo			0.5
Sheep			0.0
Goats			0.0
Camels			0.0
Horse			0.1
Swine			0.0
Mules&Dankeys			0.1
Poultry			-
Chicken			0.2
Duck&Gees			0.0
Turkey			0.2
Crop Residue Burning	**Residue/Crop**	**Dry matter**	**% Burned**
Wheat	1.30	0.83	0.10
Barley	1.20	0.83	0.10
Maize	1.00	0.40	0.10
Oat	1.30	0.83	0.10
Rye	1.60	0.83	0.10
Nitrogen Fixation			
	Dry Matter Fraction	**% 100=1**	**$Frac_{NCRBF}$ (EF) (kg N/kg)**
Peas	0.91	0.10	0.03
Lentil (Red)	0.91	0.10	0.03
Lentil (Green)	0.91	0.06	0.03
Chick Peas	0.91	0.12	0.03
Soya	0.91	0.03	0.03
Dry Bean	0.90	0.08	0.03

EF for synthetic N applied as fertilizers is 0,01 kg N_2O/kg N

A2.1 Emission factors used for national emission inventory (cont.)

Crop residues	Dry matter fraction	Above ground residue DM relationship with DM yield: Slop	Intercept	Above ground residue N	Below residue/ above biomass	Below ground residue N	Combustion factor	Area burnt	Renewal fraction	Fraction removed
Major crop types										
Grains	0,88	1,09	0,88	0,01	0,22	0,01	0,80	0,10	1,00	0,50
Beans & Pulses (N fix)	0,91	1,13	0,85	0,01	0,19	0,01	0,80	0,10	1,00	0,50
Beans & Pulses (non-N fix)	0,91	1,13	0,85	0,01	0,19	0,01	0,80	0,10	1,00	0,50
Tubers	0,22	0,10	1,06	0,02	0,20	0,01	0,80	0,00	1,00	1,00
Root crops and Other	0,94	1,07	1,54	0,02	0,20	0,01	0,80	0,00	1,00	1,00
N-fixing forages	0,90	0,30	0,00	0,03	0,40	0,02	0,80	0,00	1,00	1,00
Non-N-fixing forages	0,90	0,30	0,00	0,02	0,54	0,01	0,80	0,00	1,00	1,00
Perennial grasses	0,90	0,30	0,00	0,02	0,80	0,01	0,80	0,00	1,00	1,00
Grass-clover mixtures	0,90	0,30	0,00	0,03	0,80	0,02	0,80	0,00	1,00	1,00
Individual Crops										
Maize	0,87	1,03	0,61	0,01	0,22	0,01	0,80	0,10	1,00	0,50
Wheat	0,89	1,51	0,52	0,01	0,24	0,01	0,80	0,10	1,00	0,50
Winter wheat	0,89	1,61	0,40	0,01	0,23	0,01	0,80	-	-	-
Spring wheat	0,89	1,29	0,75	0,01	0,28	0,01	0,80	-	-	-
Rice	0,89	0,95	2,46	0,01	0,16	0,00	0,80	0,10	1,00	0,50
Barley	0,89	0,98	0,59	0,01	0,22	0,01	0,80	0,10	1,00	0,50
Oats	0,89	0,91	0,89	0,01	0,25	0,01	0,80	0,10	1,00	0,50
Millet	0,90	1,43	0,14	0,01	0,00	0,00	0,80	0,10	1,00	0,50
Sorghum	0,89	0,88	1,33	0,01	0,00	0,01	0,80	0,10	1,00	0,50
Soyabean	0,91	0,93	1,35	0,01	0,19	0,01	0,80	0,10	1,00	0,50
Dry bean	0,90	0,36	0,68	0,01	0,00	0,01	0,80	0,10	1,00	0,50
Potato	0,22	0,10	1,06	0,02	0,20	0,01	0,80	0,00	1,00	1,00
Peanut (w/pod)	0,94	1,07	1,54	0,02	0,00	0,00	0,80	-	-	-
Alfalfa	0,90	0,29	0,00	0,03	0,40	0,02	0,80	0,10	1,00	0,50
Non-legume hay	0,90	0,18	0,00	0,15	0,54	0,01	0,80			

CH_4 emission from waste disposal sites

*= (MSWT*MSWF*MCF*DOC*D*	*Collected*	*Gg/year*	-
MSWT	*Collected*	*Gg/year*	-
MSWF	*Fraction*	-	*1.0*
MCF (Uncont. Landfill)	*Corr. Fact.*	-	*0.6*
MCF (Cont. Landfill)	*Corr. Fact.*	-	*1.0*
DOC	*Deg.Org.C*	-	*0.15*
DOCF	*Fraction*	-	*0.77*
F	*Fra.in land.*	-	*0.5*
R	*Recovered*	*Gg/year*	-
OX	*Oxi. Fact.*	-	*0.0*

Solvent and Other Product Use

Paint (Vehicle Production)	Gas	Unit	EF
Small	NMVOC	Kg/car	12.3
Medium	NMVOC	Kg/car	21.95
Large	NMVOC	Kg/car	31.6
Chemical Products Manufacture and Processing			
Cosmetics and toiletries	NMVOC	Kg/person	0.23
DIY/Buildings	NMVOC	Kg/Household	0.49
Household Products	NMVOC	Kg/Household	0.46
Car Care Products	NMVOC	Kg/Car	0.97

Wastewater

Annual Protein Consumption (FAO) (kg/person/year)	36.83
Fraction of Nitrogen in Protein (kg N/kg)	0.16
Factor Non-consumed Protein added to WW	1.40
Factor for industrial and commercial co-discharged protein into the server system	1.25
Nitrogen removed with sludge (kg N/year)	0.00
Domestic WW EF (kg N_2O-N/kg	0.01

Wastewater

Domestic Wastewater	BOD g/person/day	EF
Organics in Wastewater	38.0	1.0
	kg CH4/kg BOD	
	urban	rural
	0.06	0.21

Waste Incineration

CF (industrial waste)	CO_2	(fraction)	0.50
FCF (industrial waste)	CO_2	(fraction)	0.90
OF (industrial waste)	CO_2	(fraction)	1.00
CF (clinical waste)	CO_2	(fraction)	0.60
FCF (clinical waste)	CO_2	(fraction)	0.40
OF (clinical waste)	CO_2	(fraction)	1.00
EF (industrial, clinical waste)	CH_4	kg CH_4/Gg Wet Waste	6500
EF (industrial waste)	N_2O	kg N_2O/Gg Wet Waste	100
EF (clinical waste)	N_2O	kg N_2O/Gg Wet Waste	50

Note: Weighted CH_4 Efs (kg CH_4/kg COD) is taken as 0.03

The EF for new sectors added to the inventory

Sector	Gas	Unit	Emission Factor
Fugitative Emissions			
Well Drilling	CO_2	ktonne/m³	0.000100
Well Testing	CO_2	ktonne/m³	0.009000
Well Servicing	CO_2	ktonne/m³	0.000002
Gas Production (1)	CO_2	ktonne/m³	0.000082
Gas Production (2)	CO_2	ktonne/m³	0.001200
Gas processing (1)	CO_2	ktonne/m³	0.000320
Gas processing (2)	CO_2	ktonne/m³	0.001800
Gas transmission&storage(1)	CO_2	ktonne/m³	0.000001
Gas transmission&storage(2)	CO_2	ktonne/m³	0.000003
Gas transmission&storage(3)	CO_2	ktonne/m³	0.000000
Oil Production	CO_2	ktonne/m³	0.000260
Oil Production	CO_2	ktonne/m³	0.000000
Oil Production	CO_2	ktonne/m³	0.000095
Oil Production	CO_2	ktonne/m³	0.041000
Oil transport	CO_2	ktonne/m³	0.000000
Tanker, trucks, rail cars	CO_2	ktonne/m³	0.000002
Well Drilling	CH_4	ktonne/m³	0.000033
Well Testing	CH_4	ktonne/m³	0.000051
Well Servicing	CH_4	ktonne/m³	0.000110
Gas Production (1)	CH_4	ktonne/m³	0.002300
Gas Production (2)	CH_4	ktonne/m³	0.000001
Gas processing (1)	CH_4	ktonne/m³	0.001030
Gas processing (2)	CH_4	ktonne/m³	0.000001
Gas transmission&storage(1)	CH_4	ktonne/m³	0.000480
Gas transmission&storage(2)	CH_4	ktonne/m³	0.000320
Gas transmission&storage(3)	CH_4	ktonne/m³	0.000025
Oil Production	CH_4	ktonne/m³	0.003600
Oil Production	CH_4	ktonne/m³	0.000001
Oil Production	CH_4	ktonne/m³	0.000720
Oil Production	CH_4	ktonne/m³	0.000025
Oil transport	CH_4	ktonne/m³	0.000005

Sector	Gas	Unit	Emission Factor
Tanker, trucks, rail cars	CH_4	ktonne/m³	0.000025
Oil Refining	CH_4	ktonne/m³	0.000041
Well Testing	N_20	ktonne/m³	0.000000
Gas Production - Flaring	N_20	ktonne/m³	0.000000
Gas processing - Flaring	N_20	ktonne/m³	0.000000
Oil Production	N_20	ktonne/m³	0.000001
Well Drilling	NMVOC	ktonne/m³	0.000001
Well Testing	NMVOC	ktonne/m³	0.000012
Well Servicing	NMVOC	ktonne/m³	0.000017
Gas Production (1)	NMVOC	ktonne/m³	0.000550
Gas Production (2)	NMVOC	ktonne/m³	0.000001
Gas processing (1)	NMVOC	ktonne/m³	0.000470
Gas processing (2)	NMVOC	ktonne/m³	0.000001
Gas transmission&storage(1)	NMVOC	ktonne/m³	0.000007
Gas transmission&storage(2)	NMVOC	ktonne/m³	0.000005
Gas transmission&storage(3)	NMVOC	ktonne/m³	0.000000
Oil Production	NMVOC	ktonne/m³	0.004500
Oil Production (1)	NMVOC	ktonne/m³	0.000430
Oil Production (2)	NMVOC	ktonne/m³	0.000021
Oil transport	NMVOC	ktonne/m³	0.000054
Tanker, trucks, rail cars	NMVOC	ktonne/m³	0.000250
Oil Refining	NMVOC	ktonne/m³	0.001300
Post Mining activities			
Underground	CH_4	m³/tonne	2.5
Surface Mining	CH_4	m³/tonne	0.1
Agriculture - Indirect losses			
Leaching & Run-off	N_20	kg N_2O-N/kg N input	0.0075
Atmospheric Deposition	N_20	kg N_2O-N/kg N input	0.0100
Agriculture - Pasture, Range, Paddock			
Cattle, Poultry and Pigs	N_20	kg N_2O-N/kg N input	0.02
Sheep and Other	N_20	kg N_2O-N/kg N input	0.01

Note:

Gas Production (1) - Production	Gas transmission and storage (1) - Transmission
Gas Production (2) - Exploration	Gas transmission and storage (2) - Venting
Gas processing (1) - Processing	Gas transmission and storage (3) - Storage
Gas processing (2) - Flaring	Oil Production (1) - Venting
	Oil Production (2) - Flaring
	Tanker, trucks, rail cars - Venting

ANNEX 3

A3. QUALITY ASSURANCE AND QUALITY CONTROL

Turkey's QA/QC plan is prepared by the GHG emission inventory working group in 2013. TurkStat coordinated the whole process. The QA/QC plan is at the stage of approval by the Climate Change and Air Management Coordination Board.

2012 inventoy is subjected to a more comprehensive quality control regardless of the approval of the plan. Chech lists for quality kontrol covered in the plan is given below.

GENERAL QUALITY CONTROL CHECK LIST

Data gathering, input, and handling activities: quality checks

1. Check data entry errors for activity data
2. Review spreadsheets for the accuracy of the formula

Data documentation: quality checks

4. Check inventory files for completeness
5. Check that activity data are documented according to the references
6. Check that references stated in calculation tables are also present in inventory document
7. Check completeness of calculation tables and inventory (i.e., include all relevant information)
8. Check that assumptions and criteria for selection of activity data, emission factors and other estimation parameters are in line with IPCC Guidance
9. Check that changes in data or methodology are documented along with their reasons
10. Check that information in calculation tables and inventory document is acceptable.

Calculating emissions and checking calculations:

12. Check that all calculations are included in archive
13. Check whether units, parameters, and conversion factors are presented appropriately
14. Check if units are properly labelled and correctly carried through from beginning to end of calculation
15. Check that conversion factors are correct
16. Check that temporal and spatial adjustment factors are used correctly
17. Check the data relationships (comparability) and data processing steps (e.g., equations) in calculation tables
18. Check that input data for calculation tables and calculated data are clearly differentiated
19. Check a representative sample of calculations, by hand or electronically
20. Check the aggregation of emission results within a category

21. When methods or data have changed, check consistency of time series inputs and calculations
22. Check for any unexplained or unusual trends for activity data or other calculation parameters in time series
23. Check value of implied emission/removal factors across time series and investigate unexplained outliers
24. Check for any unexplained or unusual trends for activity data or other calculation parameters in time series
25. Check for consistency with IPCC inventory guidelines and good practices, particularly if changes occur

CATEGORY SPECIFIC CHECK LIST

Emission data quality control

1. Check historical data for emission comparisons, sources and significant sub sources
2. Check with independent calculations or calculations made with alternative methods
3. Check with reference calculations
4. Check completeness

Emission factor quality control

6. Check the suitability of emission factors to national conditions and similar emission data
7. Check by comparing with alternative factors (factor assumptions of IPCC, factors of other countries, literature)
8. Search for more representative data options

Activity data quality control: activity data on national level

10. Check trends
11. Compare with different reference sources
12. Check the applicability of data
13. Check methodology for filling in time series for data that are not available annually

Activity data quality control: site specific activity data

15. Check inconsistencies for different sites
16. Compare aggregated data with national data

For quality control purpose, almost all procedures listed above are applied for all categories by sector experts.

2013 annual submission of Turkey was subjected to the centralized review. It is considered as quality assurance process. Information about how to handle the Expert Review Team recommendations are given in below.

A3.1 Recommendations identified by the expert review team

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
Cross-cutting	**Completeness**	Include emissions from the categories currently reported using the notation keys —C" and —NE"	Table 3	For confidential data which were reported as C flag in previous submissions, were included in 2012 inventory by included either in the upper categories or an "other" categories just created for this purposes.
	General	Make concerted efforts to address the recommendations made in the previous review reports, and provide information on the progress made, including the planned improvement measures	14, 15, 20	ERT recomendations were tired to be taken into account as much as possible. Related information was given under the categories.
Energy	**Sector overview**	Provide a clear explanation in a separate section at the subcategory level for the recalculations in the NIR	18	recalculations was given separately under the related category
		Improve the documentation on the inventory for the energy sector	19	Archiving is a priority issue for Turkey. Archiving and documantation was detailed in QA/QC plan. And it is under concern of all institutions involved in the inventory.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
	Comparison of the reference approach with the sectoral approach and international statistics	Conduct additional analysis to understand the reasons for the differences between the fuel consumption data reported to the IEA and to the secretariat	23	The reasons for the differences between data reported to the mentioned bodies. arise from the methodology, questionairre format and time period of the reporting.
	International bunker fuels	Determine a data source to obtain accurate fuel consumption data, ensure time-series consistency and estimate and report the emissions for all years ensuring time-series consistency Ensure the consistency of the information reported in CRF table 1.A(b) for CO2 emissions from fuel combustion activities - reference approach, and CRF table 1.C for international bunkers		Considered
	Feedstocks and non-energy use of fuels	Collect more disaggregated data on the amount of feedstocks and non-energy use of fuels, or revise the notation keys, as appropriate, and provide the relevant information in the additional information boxes in CRF table 1.A(d) Explain in the NIR the allocation of fuels used as feedstock and for non-energy purposes between the energy and the industrial processes sectors	26	Studies for more disaggregated data on the amount of feedstocks and non-energy use of fuels are continuing.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
	Stationary combustion: solid, liquid and gaseous fuels - CO2	Collect the necessary data and apply a tier 2 method for all key categories Ensure consistency between the information provided in the CRF tables and in the NIR	27	GHG emissions from energy have been calculated by using energy balance tables which is the only data source for energy statistics. For apllying higher tier specific surveys should be conducted in key kategory installation. For the next submission, it is planned to conduct specific surveys in at least the biggest installations (eg. iron and steel, cement) to increase tier.
		When country-specific EFs and parameters are used, include information on the data sources and methodologies used for calculating the EFs at the plant level, and compare those to the default EFs	28	In the public electricity and heat production sector plant specific NCVs were used. Information about these data sources were explained in NIR.
		Provide information where the emissions from the incineration of waste fuels in cement kilns are reported	29	In cooperation with Turkish Cement Manufacturers' Association, data on waste incineration in cement plants were collected since the beginning of waste incineration for each cement plants. Wastes are catogoriezed in line with Waste chapter of 2006 IPCC guideline, so related emissions were estimated. However, It is thought that the categorization of waste need to be discussed with the sectoral experts. Therefore, emissions from waste incineration in cement industry were not included in this submission.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
	Road transportation: liquid fuels - CO2, N2O and CH4	Improve the documentation on the methods applied and provide information on all EFs, assumptions and AD used in developing the country-specific model	30	Activity data used for transport-sourced GHG emissions was collected from MTMAC's related and affiliated bodies; while fuel consumption data was provided by the Ministry of Energy and Natural Resources; and the emission factors were derived from the IPCC guidelines. Likewise, our calculations are based on the methods suggested in the IPCC Guidelines. Detailed explanation on our calculation methodology can be found in the NIR report.
	Oil and natural gas - CO2, CH4 and N2O	Collect the relevant AD, and estimate and report the emissions from the subcategories currently reported as ―NE‖ using the country-specific data or default EFs provided in the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*	31	Not covered in this submission.
		Estimate and report CH4 emissions from natural gas distribution	32	Not covered in this submission.
		Explain the expert judgement used for the uncertainties for the EFs and AD	32	Uncertainties will be held throughout again and expert judgement will be explained in detail in next submissions.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
Industrial processes and solvent and other product use	**Sector overview**	Report emissions from the categories with confidential data	35	For confidential data which were reported as C flag in previous submissions, were included in 2012 inventory by included either in the upper categories or an "other" categories just created for this purposes.
		Improve documentation on the methods, EFs, and AD applied for all categories, especially for the key categories, and on sector-specific QA/QC activities	36	Necessary documentation were given under related categories.
	Cement production - CO2	Develop a country-specific EF by using plant-specific data	37	For the next submission it is planned to collect plant specific fuel and production data and increase the tiers.
		Improve the documentation on the emissions, EFs and clinker (AD) for the entire time series using a tabular format	38	Necessary documentation were given under related categories.
	Lime production - CO2	Provide information on the EFs used, including the respective types of lime produced to improve transparency	39	Necessary documentation were given under related categories.
		Correct the error in the units used for the EF in the NIR	39	Necessary correction was made.
		Provide the reason for the fluctuation in the IEFs including the uses of limestone and dolomite, such as glass production Include an explanation of how time-series consistency is ensured	40	Necessary documentation were given under related categories.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
	Iron and steel production - CO2	Recalculate the emissions from iron and steel production for the entire time series and provide an analysis of the emissions trend	41	It is not possible to calculate CO_2 emissions from iron and steel production before 2010 due to lack of activity data.
		Reallocate CO2 emissions from coke consumption to iron production	42	There is no off-site coke production in Turkey.
	Consumption of halocarbons and SF6 and HFCs	Use a higher-tier method, using data on the annual sales of HFC-134a, or by collecting equipment data to apply specific EFs representing each equipment type	43	There is a project related to 'Support to Mechanism for Monitoring Turkey's Greenhouse Gas Emissions' . Main beneficiary of this project is Ministry of Environmenet and Urbanization. Within the scope of this project , a fully functioning monitoring mechanism of greenhouse gas emissions in Turkey is to be established in line with EU Monitoring Mechanism Decision 280/2004/EC and revised version of Monitoring Mechanism Decision 280/2004/EC called as 525/2013/EC. With this project all activity data related to greenhouse gases is to be collected in a detailed way. The quality of the data collected will increase with the aid of this project which will start at the end of 2014. Regarding to specifically F gases, there is also another project that is conducting by Ministry of Environment and Urbanization. One of the aim of this project to develop a methodology for data collection on equipment containing ODSs and F-gases in linewith the EC Regulation 842/2006.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
		Include more detailed information on the AD and method used	44	Necessary documentation were given under related categories.
	Soda ash production and use - CO2	Estimate the emissions from the categories that are subject to confidentiality restrictions and report them at an aggregated level	45	For confidential data which were reported as C flag in previous submissions, were included in 2012 inventory by included either in the upper categories or an "other" categories just created for this purposes.
		Ensure the consistency of the reporting within the NIR and between the NIR and the CRF tables	46	Done
	Ammonia production - CO2	Report the emissions at an aggregated level, in cases where the production data are confidential	47	For confidential data which were reported as C flag in previous submissions, were included in 2012 inventory by included either in the upper categories or an "other" categories just created for this purposes.
	Nitric acid production - N2O	Report the emissions at an aggregated level, in cases where the production data are confidential	48	For confidential data which were reported as C flag in previous submissions, were included in 2012 inventory by included either in the upper categories or an "other" categories just created for this purposes.
		Provide an explanation for the choice of EF used to estimate N2O emissions from nitric acid production and provide a description of the number of plants that have NSCR technology	48	Plant specific data on NSCR technology were collected. Necessary documentation were given under the category
	Calcium carbide production - CO2	Report the emissions at an aggregated level, in cases where the production data are confidential, and provide descriptions of the methods and data used in the NIR	49	For confidential data which were reported as C flag in previous submissions, were included in 2012 inventory by included either in the upper categories or an "other" categories just created for this purposes.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
	Other (chemical industry) - CH4	Report the emissions separately under each subcategory and describe the EFs and AD used in the calculations	50	Necessary documentation were given under related categories.
	Ferroalloys production - CO2	Describe where combustion and process related emissions are reported, and the method, EFs and AD used	51	Necessary documentation were given under related categories.
	Aluminium production - CO2 and PFCs	Estimate and reallocate the PFC emissions from consumption of halocarbons and SF6 to aluminium production for the entire time series, and report both PFC and CO2 emissions from aluminium production under this category	52	Necessary documentation were given under related categories.
		Describe the methods, EFs, and AD used both for CO2 and PFC emissions	52	For confidential data which were reported as C flag in previous submissions, were included in 2012 inventory by included either in the upper categories or an "other" categories just created for this purposes.
	SF6 used in aluminium and magnesium foundries - SF6	Estimate and report the emissions from SF6 used in aluminium and magnesium foundries separately, or at an aggregated level	54	For confidential data which were reported as C flag in previous submissions, were included in 2012 inventory by included either in the upper categories or an "other" categories just created for this purposes.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
Agriculture	**Sector overview**	Elaborate on the contribution of gases and subcategories within the agriculture sector to total sectoral emissions	56	Contribution of gases and subcategories within the agriculture sector was elaborated.
		Improve the information on the AD providers and provide information on the data sources for the agricultural statistics by source category	57	The website references for AD providers were included in the NIR.
		Explain the reasons for the differences between the AD used for the GHG inventory and the FAO data	58	It was explained in the NIR.
		Update the AD and recalculate the emissions in the relevant categories	59	The correct aggregated number of cattle was used in the estimations.
		Improve the transparency of the reporting, and provide tables showing the time series for the EFs, AD and emissions by source category, as well as detailed documentation supporting the choice of EFs	61	Necessary documentation were given under related categories.
	Enteric fermentation - CH4	Provide information on category-specific planned improvements	62	It was provided in the improvement chapter in the NIR.
		Provide information on the inter-annual fluctuations in the animal population	63	It was provided in the related category.
		Provide documentation that supports the expert judgement used	64	Uncertainties will be handled in the detailed manner for the next submission.
		Use a tier 2 method with country-specific EFs for the emissions from significant livestock categories	64	There is no CS EFs in Turkey.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
		Provide national data on the milk productivity of dairy cattle	65	It is planned to be studied with the experts of agricultural statistics.
		Provide disaggregated time-series data for sheep (domestic, merinos), and relevant documentation supporting the choice of EFs	66	It was provided in the NIR.
	Manure management - CH4 and N2O Direct soil emissions - N2O Rice cultivation - CH4	Include background information on the AD to explain the fluctuations in the CH4 IEF Estimate the CH4 emissions using a tier 2 method with country-specific EFs for the animal species/categories Include documentation on the N2O emissions per manure management system, or information on the distribution of manure management systems used for the different animal groups Complete the evaluation of the accuracy of the N2O emission estimates and recalculate the N2O emissions, if appropriate Estimate the N2O emissions using a tier 2 method Provide documentation on the information/assumption used to determine the harvested area data	67 67 68 69 69 70	Necessary documentation were given under related categories.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
LULUCF	**Sector overview**	Estimate the carbon stock changes in all mandatory land-use categories, and provide further information, including on the estimation methods, AD and assumptions used, if any, in the NIR Ensure the appropriate use of the notation keys in the CRF tables, and provide justification for the notation keys used in a consistent manner in the NIR Re-examine the land-use data source, and explore the possibility of obtaining a more consistent time series of land-use and land-use change data Improve the transparency of the documentation on the estimation methodologies used for the different land-use categories by including transparent information on the AD, EFs, other parameters and underlying assumptions used in the inventory methodologies Provide a complete set of annual land-use change matrices for the period 1990-2012	72 72 73 74 75	The land use matrix has not been prepared yet. It is planned for the next submission. AD and EF have been checked and revised based on ERT recommendations. The transperancy has been improved with further explanations in NIR.
		Include detailed information on the sector-specific QA/QC activities for the LULUCF sector	75	The QA/QC improvements are on the way. A QA/QC prepared by TUIK has been filled. Will be considered in the next submission.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
	Forest land remaining forest land - CO2	Consistently use the same subcategories in both the NIR and the CRF tables and explain the methods and factors used for the estimation of the carbon stock changes in degraded forests	77	Same subgategories were used both in NIR and CRF tables in this submission. Carbon stock changes in degraded forests were estimated according to IPCC LULUCF Guidance by using biomass, annual increment and growing stock datas.
		Provide clear and transparent documentation on the estimation of the carbon stock changes in living biomass	78	Not realized in this submission. Planned for the next one.
		Provide complete and transparent documentation on how the carbon stock changes in the dead organic matter pool are calculated by presenting the equations, parameters and other data used in the calculation	79	Not realized in this submission. Planned for the next one.
	Land converted to forest land - CO2	Estimate the carbon stock changes in soils	81	Not realized in this submission. Planned for the next one.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
	Cropland remaining cropland - CO2	Estimate the carbon stock changes in soils	82	It is estimated in the last submission based on conversions between perennial and annual crops. Also for organic soils.
		Include further detail on the data and methodologies used in the NIR, such as on the types of annual crop, the basis for the value of the carbon stocks in living biomass applied for annual crops, and the carbon stocks, EFs and AD used for mineral and organic soils	83	These issues already exist in the NIR report.
		Include transparent information on the losses in the living biomass pool due to harvesting and replanting of perennial crops in the estimation methodology, and on all losses in the living biomass pool in perennial crops, and explain how the issue on the losses in the living biomass pool due to harvesting and replanting of perennial crops has been addressed in the estimation methodology	84	It is explained for poplars in the NIR. 12 years rotation is assumed and 1/12 of poplar areas are assumed to be cleared every year.
	Land converted to cropland - CO2	Develop a methodology and report the carbon stock changes in organic soils	85	Not realized in this submission. Planned for the next one.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
	Land converted to grassland - CO2	Estimate and report the carbon stock changes in land converted to grassland	86	CL-GL is estimated already. Other conversions will be addressed in the next submission.
		Use the appropriate notation keys and provide transparent information on the choice of the notation keys	86	Some NK are modified based on ERT recommendations.
		Increase the transparency of the inventory by including information on the areas, methods, factors and parameters used for the emission and removal estimates	87	The NIR will be revised and will be improved for more transperancy in the next submission.
	Grassland remaining grassland - CO2	Increase the transparency of the information on the areas, methods, factors and parameters used for the emission and removal estimates	88	Only emissions from organic soils are reported in this category. All grasslands with organic soils are assumed to be managed.
		Estimate and report the carbon stock changes in all carbon pools	88	There is no information about management practices and grassland conditions in Turkey . Not possible in the next 2-3 years.
	Forest land converted to other land-use categories - CO2	Ensure the correct use of the notation keys	89	This issue will be assessed this year and will be explained in the next submission. The NK has not been changed in this submission.

Sector	Category	ERT Recommendations	Paragraph cross-references	Explanations
	Waste Sector overview Solid waste disposal on land - CH4 Wastewater handling - CH4 and N2O Waste incineration - CO2, CH4 and N2O	Develop country-specific EFs and use a higher-tier method for the emission estimates for the key categories Provide more detailed information on the QA/QC plan Use the FOD method to estimate emissions Provide a justification for the use of the DOC value of 0.15 Provide a justification for the use of the notation key ― NA" to report emissions Correct the AD and estimate the emissions from sludge Estimate and report the CH4 and N2O emissions from industrial wastewater and sludge Correct the error in CRF table 6.B Collect AD on waste incineration for the entire time series and estimate the emissions	91 93 94 95 97 97 98 99 100	Necessary documentation were given under related categories.

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)

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

A4.1 Conversion factors (Reference Approach)

(TJ/Gg)

	1990	1995	2000	2005	2007	2008	2009	2010	2011	2012
Hard coal	31,43	28,92	26,79	26,98	25,42	26,13	26,09	25,35	26,60	27,04
Lignite	8,91	8,47	8,14	6,9	7,78	8,35	8,67	9,30	9,30	9,44
Petroleum	44,08	43,98	43,52	43,43	43,39	43,27	42,88	43,14	43,98	43,73

Country specific emission factors are used for comparative estimation of CO_2 emissions. The differences tend to be less than 10% except for 2008, which was around 11%. 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.

A4.2 Comparison of CO2 from fuel combustion (Sectoral and Reference Approach difference)

(%)

1990	1995	2000	2005	2007	2008	2009	2010	2011	2012
10,55	4,67	2,55	6,83	7,82	11,5	9,39	5,16	4,27	9,23

A4.2 Sectoral approach

The Sectoral Approach requires detail fuel consumption data in each sectors. The biggest advantage of this method is the possibility of analyzing sectoral emissions. The calculations by using sectoral approach results in more accurate estimation, since the calorific values and carbon content are specific for each type of consumed fuel.

The GHG emissions from fuel combustion are released 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 categories reflected in CRF tables. The GHG emissions are estimated by grouping the fuel types into 4 categories - liquid, solid, gaseous and biomass.

The GHGs emissions in the energy sector are the main key sources in the inventory. The GHGs emissions in the energy sector are the main key sources in the inventory. However The heat content of fuels for each plant shows a great variations in source category 1.A.1.a. The average NCV are given in the Table A4.3.

A4.3 Average NCVs of fuels

Fuels	NCV	Unit	Fuels	NCV	Unit
Natural Gas	8250	(kcal/Sm^3)	Coke	7200	(kcal/kg)
Fuel oil	9600	(kcal/kg)	Petroleum Coke	7600	(kcal/kg)
Hard Coal	6100	(kcal/kg)	Wood	3000	(kcal/kg)
Lignite	2200	(kcal/kg)	Animal and Vegetal Waste	2300	(kcal/kg)
LPG	10527	(kcal/Sm^3)			
Asphaltite	4300	(kcal/kg)	Crude Oil	10500	(kcal/kg)

Emissions from International Bunkers has been included in the inventory since 2008.

ANNEX 5

A5. COMPLETENESS

The following sources are not estimated owing to the reasons listed below;

A5.1 GHGs and sources not considered in emission inventory

GHG	Sector	Source/sink category	Explanation
CH4	1 Energy	1.B.1.B Solid Fuel Transformation	The methodology is not clear
CH4	1 Energy	1.B.2.A.5 Distribution of oil products	The methodology is not clear
CO2	1 Energy	1.B.2.A.5 Distribution of oil products	The methodology is not clear
CH4	1 Energy	1.B.2.B.4 Distribution	The methodology is not clear
CO2	1 Energy	1.B.2.B.4 Distribution	The methodology is not clear
CH4	1 Energy	1.B.2.C.1.3 Combined	The methodology is not clear
CO2	1 Energy	1.B.2.C.1.3 Combined	The methodology is not clear
CH4	1 Energy	1.B.2.C.2.3 Combined	The methodology is not clear
CO2	1 Energy	1.B.2.C.2.3 Combined	The methodology is not clear
N2O	1 Energy	1.B.2.C.2.3 Combined	The methodology is not clear
SF6	2 Industrial Processes	2.C.4 Aluminium and Magnesium Foundries	There is no activity data
SF6	2 Industrial Processes	2.C.4.1 Aluminium Foundries	There is no activity data
HFCs	2 Industrial Processes	2.F.1 Refrigeration and Air Conditioning Equipment	There is no activity data
PFCs	2 Industrial Processes	2.F.1 Refrigeration and Air Conditioning Equipment	There is no activity data
SF6	2 Industrial Processes	2.F.1 Refrigeration and Air Conditioning Equipment	There is no activity data
SF6	2 Industrial Processes	2.F.3 Fire Extinguishers	There is no activity data
HFCs	2 Industrial Processes	2.F.4 Aerosols/ Metered Dose Inhalers	There is no activity data
PFCs	2 Industrial Processes	2.F.4 Aerosols/ Metered Dose Inhalers	There is no activity data
SF6	2 Industrial Processes	2.F.4 Aerosols/ Metered Dose Inhalers	There is no activity data
HFCs	2 Industrial Processes	2.F.5 Solvents	There is no activity data
PFCs	2 Industrial Processes	2.F.5 Solvents	There is no activity data
SF6	2 Industrial Processes	2.F.5 Solvents	There is no activity data
HFCs	2 Industrial Processes	2.F.6 Other applications using ODS substitutes	There is no activity data
PFCs	2 Industrial Processes	2.F.6 Other applications using ODS substitutes	There is no activity data
SF6	2 Industrial Processes	2.F.6 Other applications using ODS substitutes	There is no activity data
HFCs	2 Industrial Processes	2.F.7 Semiconductor Manufacture	There is no activity data
PFCs	2 Industrial Processes	2.F.7 Semiconductor Manufacture	There is no activity data
SF6	2 Industrial Processes	2.F.7 Semiconductor Manufacture	There is no activity data
SF6	2 Industrial Processes	2.F.P2.2 In products	There is no activity data
SF6	2 Industrial Processes	2.F.P3.1 In bulk	There is no activity data
CO2	3 Solvent and Other Product Use	3.A Paint Application	There is no activity data
CO2	3 Solvent and Other Product Use	3.B Degreasing and Dry Cleaning	There is no activity data
N2O	3 Solvent and Other Product Use	3.B Degreasing and Dry Cleaning	There is no activity data
CO2	3 Solvent and Other Product Use	3.C Chemical Products, Manufacture and Processing	There is no activity data
N2O	3 Solvent and Other Product Use	3.D.1 Use of N2O for Anaesthesia	There is no activity data
N2O	3 Solvent and Other Product Use	3.D.2 Fire Extinguishers	There is no activity data
N2O	3 Solvent and Other Product Use	3.D.3 N2O from Aerosol Cans	There is no activity data
N2O	3 Solvent and Other Product Use	3.D.4 Other Use of N2O	There is no activity data
Carbon	5 LULUCF	5.A.1 Forest Land remaining Forest Land	-
CH4	5 LULUCF	5.A.2 Land converted to Forest Land	-
CO2	5 LULUCF	5.A.2 Land converted to Forest Land	-
N2O	5 LULUCF	5.A.2 Land converted to Forest Land	-
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	-
Carbon	5 LULUCF	5.B.1 Cropland remaining Cropland	The methodology will be revised
CO2	5 LULUCF	5.B.1 Cropland remaining Cropland	The methodology will be revised
Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	-
N2O	5 LULUCF	5.B.2.2 Grassland converted to Cropland	-
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	-
N2O	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	-
Carbon	5 LULUCF	5.B.2.4 Settlements converted to Cropland	-
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	-
N2O	5 LULUCF	5.B.2.5 Other Land converted to Cropland	-

A5.1 GHGs and sources not considered in emission inventory (cont.)

GHG	Sector	Source/sink category	Explanation
Carbon	5 LULUCF	5.C.1 Grassland remaining Grassland	The database is not adequate to differentiate grasslans type
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	-
Carbon	5 LULUCF	5.C.2.5 Other Land converted to Grassland	The methodology and activity data will be revised.
Carbon	5 LULUCF	5.D.1 Wetlands remaining Wetlands	-
Carbon	5 LULUCF	5.D.2.1 Forest Land converted to Wetlands	-
Carbon	5 LULUCF	5.D.2.2 Cropland converted to Wetlands	-
Carbon	5 LULUCF	5.D.2.3 Grassland converted to Wetlands	-
Carbon	5 LULUCF	5.E.1 Settlements remaining Settlements	-
Carbon	5 LULUCF	5.E.2.1 Forest Land converted to Settlements	
Carbon	5 LULUCF	5.E.2.2 Cropland converted to Settlements	
Carbon	5 LULUCF	5.E.2.3 Grassland converted to Settlements	
CO2	5 LULUCF	5.G Harvested Wood Products	A harvested wood products database has not been established yet
CH4	6 Waste	6.B.1 Industrial Wastewater	There is no activity data
N2O	6 Waste	6.B.1 Industrial Wastewater	There is no activity data

ANNEX 6

A6. TREND ANALYSIS

One of the major component part of the inventories is the determination of chnges from base year in national emission.

In the Following Table A6.1., the annual trend analysis compared to year 1990 are given.

$$T_x^t = L_x^t * [((E_x^t - E_x^o)/ E_x^t) - ((E^t_{tot} – E^o_{tot})/ E^t_{tot})] \qquad (A6.1)$$

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

A6.1 Trend analysis

2012 VS. 1990 TREND ANALYSIS									
CATEGORY	FUEL	GAS	EMISSION 2012	CONTRIBUTION (%)	EMISSION 1990	TREND ASSESMENT	CONTRIBUTION	CUMULATIVE TOTAL	TREND
1.A.1.a. Public Electricity and Heat Production	Natural Gas	CO2	47591.8	11.1	5403.3	3.5601	11.1%	11.1%	88.6%
1.A.3.b. Road Transportation	Gas / Diesel oil	CO2	41700.4	9.7	15742.6	0.5556	1.7%	1.7%	62.2%
1.A.1.a. Public Electricity and Heat Production	Lignite	CO2	39996.4	9.3	20538.5	0.7338	2.3%	2.3%	48.6%
2.A.1. Cement Production (Mineral Products)		CO2	30327.7	7.1	10534.9	0.6171	1.9%	1.9%	65.3%
1.A.1.a. Public Electricity and Heat Production	Second Fuel Coal	CO2	27967.2	6.5	0.0	2.8316	8.9%	8.9%	100.0%
1.A.4.b. Residential	Hard Coal	CO2	25902.5	6.0	3936.8	1.7057	5.3%	5.3%	84.8%
6.A.1. Solid Waste Disposal (Managed)		CH4	23018.8	5.4	NA	-	-	-	-
1.A.4.b. Residential	Natural Gas	CO2	20644.0	4.8	106.7	2.0653	6.5%	6.5%	99.5%
2.C.1. Iron and Steel Production		CO2	19902.2	4.6	IE	-	-	-	-
4.A. Enteric Fermentation		CH4	19435.6	4.5	18955.6	2.4469	7.7%	7.7%	2.5%
1.A.4.b. Residential	Lignite	CO2	12802.1	3.0	9496.2	0.9155	2.9%	2.9%	25.8%
6.A.2.1. Solid Waste Disposal (Unmanaged)		CH4	9767.6	2.3	6386.5	0.4985	1.6%	1.6%	34.6%
1.A.2.f. Cement Production	Petroleum Coke	CO2	8422.1	2.0	929.2	0.6363	2.0%	2.0%	89.0%
1.A.3.b. Road Transportation	LPG	CO2	8170.8	1.9	0.0	0.8273	2.6%	2.6%	100.0%
1.A.2.f. Other Industries	Natural Gas	CO2	7039.4	1.6	669.9	0.5567	1.7%	1.7%	90.5%
1.A.2.f. Cement Production	Lignite	CO2	5690.9	1.3	2422.2	0.0121	0.0%	0.0%	57.4%
1.A.2.f. Cement Production	Hard Coal	CO2	5636.1	1.3	2619.9	0.0395	0.1%	0.1%	53.5%
1.A.3.b. Road Transportation	Gasoline	CO2	5594.6	1.3	8293.3	1.3651	4.3%	4.3%	-48.2%
2.F. Emission of HFCs		HFC-134a	4681.3	1.1	NA				
4.D.1.1. Agricultural Soil (Synthetic Fertilizer)		N2O	4439.0	1.0	3719.0	0.4167	1.3%	1.3%	16.2%
2.A.2. Lime Production (Mineral Products)		CO2	4320.2	1.0	3084.8	0.2810	0.9%	0.9%	28.6%
1.A.3.a. Civil Aviation	Jet Kerosene	CO2	3718.8	0.9	904.6	0.1658	0.5%	0.5%	75.7%
1.A.2.a. Iron and Steel	Hard Coal	CO2	3235.1	0.8	0.0	0.3275	1.0%	1.0%	100.0%
1.A.2.f. Other Industries	Gas / Diesel oil	CO2	3028.4	0.7	302.2	0.2362	0.7%	0.7%	90.0%
1.A.4.c. Agriculture/Forestry/Fisheries	Gas / Diesel oil	CO2	3018.3	0.7	5795.4	1.0441	3.3%	3.3%	-92.0%
4.B. Manure Management		N2O	2864.0	0.7	2497.3	0.2917	0.9%	0.9%	12.8%
1.A.1.b. Petroleum Refining	Natural Gas	CO2	2434.4	0.6	0.0	0.2465	0.8%	0.8%	100.0%
1.A.2.a. Iron and Steel	Natural Gas	CO2	1945.4	0.5	0.0	0.1970	0.6%	0.6%	100.0%
1.A.4.b. Residential	LPG	CO2	1917.8	0.4	4596.4	0.8763	2.7%	2.7%	-139.7%
6.B.2. Domestic and Commercial Wastewater Handling		N2O	1888.2	0.4	1384.5	0.1313	0.4%	0.4%	26.7%
4.D.1.2. Agricultural Soil (Animal Manure Applied)		N2O	1780.5	0.4	1679.8	0.2109	0.7%	0.7%	5.7%
1.A.4.b. Residential	Hard Coal	CH4	1760.2	0.4	261.3	0.1174	0.4%	0.4%	85.2%
1.A.2.c. Chemicals	Natural Gas	CO2	1656.2	0.4	0.0	0.1677	0.5%	0.5%	100.0%
4.B. Manure Management		CH4	1552.6	0.4	1428.8	0.1756	0.5%	0.5%	8.0%
6.B.2. Domestic and Commercial Wastewater Handling		CH4	1540.7	0.4	1950.7	0.2983	0.9%	0.9%	-26.6%
1.A.2.f. Fertilizer	Natural Gas	CO2	1530.9	0.4	1035.3	0.0861	0.3%	0.3%	32.4%
1.A.3.d. Navigation	Gas / Diesel oil	CO2	1506.0	0.4	219.1	0.1015	0.3%	0.3%	85.5%
1.B.1.a.2. Mining (Surface)		CH4	1265.2	0.3	817.3	0.0623	0.2%	0.2%	35.4%
4.D.1.4. Agricultural Soil (Crop Residue)		N2O	1160.8	0.3	1115.2	0.1422	0.4%	0.4%	3.9%
1.A.2.b. Non-Ferrous Metals	Natural Gas	CO2	1079.7	0.3	0.0	0.1093	0.3%	0.3%	100.0%

A6.1 Trend analysis (cont.)

CATEGORY	FUEL	GAS	EMISSION 2012	CONTRIBUTION (%)	EMISSION 1990	TREND ASSESMENT	CONTRIBUTION	CUMULATIVE TOTAL	TREND
1.A.2.b. Non-Ferrous Metals	Natural Gas	N2O	1079,7	0,3	0,0	0,1093	0,3%	0,3%	100,0%
1.A.2.f. Other Industries	Lignite	CO2	987,0	0,2	5022,2	1,0697	3,3%	3,3%	-408,8%
2.F. Emission of SF6		SF6	971,1	0,2	NA	-	-	-	-
1.A.2.f. Sugar	Lignite	CO2	920,8	0,2	1752,8	0,3150	1,0%	1,0%	-90,4%
1.A.4.b. Residential	Lignite	CH4	813,2	0,2	589,3	0,0549	0,2%	0,2%	27,5%
1.A.2.c. Chemicals	Residual Fuel Oil	CO2	742,2	0,2	2006,3	0,3921	1,2%	1,2%	-170,3%
1.A.1.a. Public Electricity and Heat Production	Asphaltite	CO2	690,6	0,2	0,0	0,0699	0,2%	0,2%	100,0%
1.B.1.a.1. Mining (underground)		CH4	645,0	0,2	772,4	0,1146	0,4%	0,4%	-19,8%
1.A.4.b. Residential	Wood	CH4	578,8	0,1	1414,1	0,2707	0,8%	0,8%	-144,3%
1.A.2.f. Other Industries	Asphaltite	CO2	558,9	0,1	24,7	0,0508	0,2%	0,2%	95,6%
1.A.2.f. Other Industries	Petroleum Coke	CO2	528,8	0,1	0,0	0,0535	0,2%	0,2%	100,0%
1.A.2.a. Iron and Steel	Petroleum Coke	CO2	528,8	0,1	0,0	0,0535	0,2%	0,2%	100,0%
4.D.2. Pasture, Range and Padock Manure		N2O	484,5	0,1	565,0	0,0825	0,3%	0,3%	-16,6%
1.A.2.f. Sugar	Natural Gas	CO2	472,4	0,1	0,0	0,0478	0,1%	0,1%	100,0%
1.A.3.c. Railways	Gas / Diesel oil	CO2	442,9	0,1	405,2	0,0495	0,2%	0,2%	8,5%
1.A.1.a. Public Electricity and Heat Production	Residual Fuel Oil	CO2	431,0	0,1	3469,5	0,7644	2,4%	2,4%	-705,0%
1.A.2.c. Chemicals	LPG	CO2	425,8	0,1	0,0	0,0431	0,1%	0,1%	100,0%
1.A.4.b. Residential	Asphaltite	CO2	419,2	0,1	399,8	0,0507	0,2%	0,2%	4,6%
1.A.2.c. Chemicals	Lignite	CO2	366,0	0,1	507,4	0,0811	0,3%	0,3%	-38,6%
1.A.2.f. Cement Production	Natural Gas	CO2	325,8	0,1	2,1	0,0325	0,1%	0,1%	99,4%
1.A.2.c. Chemicals	Hard Coal	CO2	321,7	0,1	0,0	0,0326	0,1%	0,1%	100,0%
4.C.1.2.1. Rice Cultivation		CH4	251,4	0,1	111,3	0,0005	0,0%	0,0%	55,7%
1.A.2.b. Non-Ferrous Metals	Lignite	CO2	228,4	0,1	57,5	0,0097	0,0%	0,0%	74,8%
1.A.2.b. Non-Ferrous Metals	Lignite	N2O	228,4	0,1	0,3	0,0231	0,1%	0,1%	99,9%
1.B.2.a. Oil (fugitative)		CH4	196,8	0,0	314,7	0,0534	0,2%	0,2%	-59,9%
4.F.1. Field Burning of Agricultural Residue		CH4	187,9	0,0	181,8	0,0233	0,1%	0,1%	3,2%
1.A.1.a. Public Electricity and Heat Production	Lignite	N2O	164,1	0,0	90,4	0,0044	0,0%	0,0%	44,9%
1.A.2.c. Chemicals	Second Fuel Coal	CO2	160,2	0,0	0,0	0,0162	0,1%	0,1%	100,0%
1.A.2.c. Chemicals	Gas / Diesel oil	CO2	152,1	0,0	0,0	0,0154	0,0%	0,0%	100,0%
1.A.4.b. Residential	Gas / Diesel oil	CO2	135,8	0,0	603,2	0,1267	0,4%	0,4%	-344,3%
1.A.2.f. Sugar	Second Fuel Coal	CO2	127,1	0,0	147,6	0,0215	0,1%	0,1%	-16,1%
1.A.1.a. Public Electricity and Heat Production	Second Fuel Coal	N2O	122,8	0,0	0,0	0,0124	0,0%	0,0%	100,0%
1.A.4.b. Residential	Hard Coal	N2O	121,3	0,0	18,0	0,0081	0,0%	0,0%	85,2%
1.A.2.a. Iron and Steel	Lignite	CO2	116,1	0,0	0,0	0,0118	0,0%	0,0%	100,0%
1.A.2.f. Sugar	Residual Fuel Oil	CO2	115,5	0,0	413,4	0,0846	0,3%	0,3%	-257,9%
1.A.4.b. Residential	Wood	N2O	113,9	0,0	278,3	0,0533	0,2%	0,2%	-144,3%
1.A.2.f. Cement Production	Residual Fuel Oil	CO2	106,6	0,0	1519,9	0,3432	1,1%	1,1%	-1325,4%
1.A.3.b. Road Transportation	Gas / Diesel oil	N2O	104,7	0,0	157,9	0,0262	0,1%	0,1%	-50,8%
1.A.3.d. Navigation	Residual Fuel Oil	CO2	103,3	0,0	275,3	0,0537	0,2%	0,2%	-166,6%
1.B.2.c. Venting and Flaring (fugitative)		CO2	101,4	0,0	160,8	0,0272	0,1%	0,1%	-58,5%
1.A.2.a. Iron and Steel	LPG	CO2	100,2	0,0	0,0	0,0101	0,0%	0,0%	100,0%
1.A.2.f. Other Industries	Hard Coal	CO2	92,5	0,0	1250,6	0,2819	0,9%	0,9%	-1252,5%
1.A.4.b. Residential	Residual Fuel Oil	CO2	82,9	0,0	3616,6	0,8339	2,6%	2,6%	-4262,2%
1.A.4.b. Residential	Second Fuel Coal	CO2	82,9	0,0	650,0	0,1430	0,4%	0,4%	-684,0%
1.A.1.a. Public Electricity and Heat Production	Industrial Waste	CO2	60,7	0,0	NA	-	-	-	-
1.A.3.b. Road Transportation	LPG	CH4	59,1	0,0	0,0	0,0060	0,0%	0,0%	100,0%
1.A.3.b. Road Transportation	Gas / Diesel oil	CH4	58,5	0,0	20,9	0,0011	0,0%	0,0%	64,3%
4.F.1. Field Burning of Agricultural Residue		N2O	57,1	0,0	54,2	0,0068	0,0%	0,0%	5,1%
1.A.4.b. Residential	Lignite	N2O	56,0	0,0	40,6	0,0038	0,0%	0,0%	27,5%
2.B.5. Other Chemicals Production (Chemical Industry)		CH4	55,8	0,0	49,4	0,0059	0,0%	0,0%	11,5%
1.A.4.b. Residential	Waste of animal, plant	CH4	55,7	0,0	487,2	0,1078	0,3%	0,3%	-775,3%
1.B.2.b. Natural Gas (fugitative)		CH4	50,9	0,0	17,1	0,0012	0,0%	0,0%	66,5%
4.D.3.2. Nitrogen Leaching and Runoff (4.d.3.2)		N2O	45,9	0,0	45,3	0,0059	0,0%	0,0%	1,2%
1.A.2.f. Sugar	Gas / Diesel oil	CO2	44,5	0,0	0,0	0,0045	0,0%	0,0%	100,0%
1.B.2.c. Venting and Flaring (fugitative)		CH4	43,7	0,0	64,5	0,0106	0,0%	0,0%	-47,5%
1.A.2.b. Non-Ferrous Metals	Hard Coal	CO2	42,1	0,0	0,0	0,0043	0,0%	0,0%	100,0%
1.A.2.b. Non-Ferrous Metals	Hard Coal	N2O	42,1	0,0	0,0	0,0043	0,0%	0,0%	100,0%
1.A.3.a. Civil Aviation	Jet Kerosene	N2O	40,0	0,0	9,1	0,0019	0,0%	0,0%	77,3%
1.A.2.f. Cement Production	Petroleum Coke	N2O	39,4	0,0	4,4	0,0030	0,0%	0,0%	88,8%
1.A.4.b. Residential	Natural Gas	CH4	38,9	0,0	0,2	0,0039	0,0%	0,0%	99,5%
1.A.3.b. Road Transportation	Gasoline	CH4	33,9	0,0	47,0	0,0075	0,0%	0,0%	-38,7%
1.A.4.c. Agriculture/Forestry/Fisheries	Natural Gas	CO2	33,5	0,0	0,0	0,0034	0,0%	0,0%	100,0%
1.A.2.f. Sugar	Hard Coal	CO2	32,8	0,0	245,3	0,0538	0,2%	0,2%	-648,9%
1.A.2.f. Sugar	LPG	CO2	31,2	0,0	0,0	0,0032	0,0%	0,0%	100,0%
1.A.4.b. Residential	Asphaltite	CH4	28,5	0,0	26,5	0,0033	0,0%	0,0%	6,8%
1.A.1.a. Public Electricity and Heat Production	Natural Gas	N2O	26,9	0,0	3,0	0,0020	0,0%	0,0%	88,8%
1.A.2.f. Cement Production	Hard Coal	N2O	26,4	0,0	12,4	0,0002	0,0%	0,0%	52,9%
1.A.2.b. Non-Ferrous Metals	Residual Fuel Oil	CO2	26,0	0,0	739,9	0,1697	0,5%	0,5%	-2741,7%
1.A.2.b. Non-Ferrous Metals	Residual Fuel Oil	N2O	26,0	0,0	1,9	0,0022	0,0%	0,0%	92,8%
1.A.2.a. Iron and Steel	Gas / Diesel oil	CO2	25,3	0,0	19,5	0,0020	0,0%	0,0%	23,0%

A6.1 Trend analysis (cont.)

1.A.2.f. Cement Production	Lignite	N2O	24,9	0,0	10,7	0,0000	0,0%	0,0%	56,9%
1.B.2.a. Oil (fugitative)		CO2	22,8	0,0	36,5	0,0062	0,0%	0,0%	-59,9%
4.D.1.3. Agricultural Soil (N-Fixing Crops)		N2O	20,9	0,0	33,8	0,0058	0,0%	0,0%	-61,9%
1.A.2.f. Cement Production	Petroleum Coke	CH4	19,1	0,0	2,1	0,0014	0,0%	0,0%	88,8%
1.A.2.f. Other Industries	LPG	CO2	17,8	0,0	133,8	0,0294	0,1%	0,1%	-652,5%
1.A.1.a. Public Electricity and Heat Production	Natural Gas	CH4	17,1	0,0	2,0	0,0013	0,0%	0,0%	88,1%
1.A.2.f. Fertilizer	Residual Fuel Oil	CO2	16,1	0,0	0,0	0,0016	0,0%	0,0%	100,0%
1.A.2.a. Iron and Steel	Hard Coal	N2O	15,1	0,0	0,0	0,0015	0,0%	0,0%	100,0%
1.A.3.b. Road Transportation	Gasoline	N2O	15,0	0,0	88,9	0,0192	0,1%	0,1%	-492,2%
1.A.2.f. Other Industries	Natural Gas	CH4	13,2	0,0	1,3	0,0010	0,0%	0,0%	90,4%
1.A.2.f. Cement Production	Hard Coal	CH4	12,8	0,0	6,0	0,0001	0,0%	0,0%	52,9%
1.A.2.f. Cement Production	Lignite	CH4	12,1	0,0	5,2	0,0000	0,0%	0,0%	56,9%
1.A.4.b. Residential	Natural Gas	N2O	11,5	0,0	0,1	0,0011	0,0%	0,0%	99,5%
1.A.4.b. Residential	Waste of animal, plant	N2O	11,0	0,0	95,9	0,0212	0,1%	0,1%	-775,3%
1.A.2.f. Cement Production	Gas / Diesel oil	CO2	11,0	0,0	78,4	0,0172	0,1%	0,1%	-616,2%
1.A.2.f. Other Industries	Petroleum Coke	N2O	8,5	0,0	0,0	0,0009	0,0%	0,0%	100,0%
1.A.2.b. Non-Ferrous Metals	Gas / Diesel oil	CO2	8,3	0,0	43,4	0,0093	0,0%	0,0%	-422,1%
1.A.2.b. Non-Ferrous Metals	Gas / Diesel oil	N2O	8,3	0,0	0,1	0,0008	0,0%	0,0%	98,6%
1.A.1.a. Public Electricity and Heat Production	Lignite	CH4	7,9	0,0	4,4	0,0002	0,0%	0,0%	44,9%
1.A.2.f. Other Industries	Gas / Diesel oil	N2O	7,7	0,0	0,8	0,0006	0,0%	0,0%	89,9%
1.A.1.a. Public Electricity and Heat Production	Biofuel	N2O	7,7	0,0	0,0	0,0008	0,0%	0,0%	100,0%
1.A.4.c. Agriculture/Forestry/Fisheries	Gas / Diesel oil	N2O	7,7	0,0	14,8	0,0027	0,0%	0,0%	-93,9%
1.A.2.a. Iron and Steel	Hard Coal	CH4	7,3	0,0	0,0	0,0007	0,0%	0,0%	100,0%
1.A.4.b. Residential	LPG	CH4	6,5	0,0	15,1	0,0029	0,0%	0,0%	-134,1%
1.A.1.a. Public Electricity and Heat Production	Second Fuel Coal	CH4	5,9	0,0	0,0	0,0006	0,0%	0,0%	100,0%
1.A.4.b. Residential	LPG	N2O	5,7	0,0	13,4	0,0025	0,0%	0,0%	-134,1%
1.A.1.a. Public Electricity and Heat Production	Industrial Waste	CH4	5,4	0,0	NA	-	-	-	-
1.A.4.c. Agriculture/Forestry/Fisheries	Gas / Diesel oil	CH4	4,3	0,0	8,4	0,0015	0,0%	0,0%	-93,9%
1.A.2.f. Other Industries	Lignite	N2O	4,3	0,0	22,3	0,0047	0,0%	0,0%	-415,3%
1.A.2.f. Other Industries	Petroleum Coke	CH4	4,1	0,0	0,0	0,0004	0,0%	0,0%	100,0%
1.A.2.a. Iron and Steel	Residual Fuel Oil	CO2	4,1	0,0	1777,3	0,4135	1,3%	1,3%	-43571,0%
1.A.2.f. Sugar	Lignite	N2O	4,0	0,0	7,8	0,0014	0,0%	0,0%	-92,8%
1.A.2.f. Other Industries	Natural Gas	N2O	3,9	0,0	0,4	0,0003	0,0%	0,0%	90,4%
1.A.1.a. Public Electricity and Heat Production	Biofuel	CH4	3,9	0,0	0,0	0,0004	0,0%	0,0%	100,0%
1.A.3.d. Navigation	Gas / Diesel oil	N2O	3,8	0,0	0,6	0,0003	0,0%	0,0%	85,4%
1.A.2.a. Iron and Steel	Natural Gas	CH4	3,7	0,0	0,0	0,0004	0,0%	0,0%	100,0%
1.A.2.f. Sugar	Gasoline	CO2	3,6	0,0	0,0	0,0004	0,0%	0,0%	100,0%
1.A.2.f. Fertilizer	Gas / Diesel oil	CO2	3,1	0,0	0,0	0,0003	0,0%	0,0%	100,0%
1.A.2.c. Chemicals	Natural Gas	CH4	3,1	0,0	0,0	0,0003	0,0%	0,0%	100,0%
1.A.2.f. Fertilizer	Natural Gas	CH4	2,9	0,0	2,0	0,0002	0,0%	0,0%	31,5%
1.A.2.f. Other Industries	Asphaltite	N2O	2,6	0,0	0,1	0,0002	0,0%	0,0%	95,5%
1.A.2.a. Iron and Steel	Petroleum Coke	N2O	2,5	0,0	0,0	0,0003	0,0%	0,0%	100,0%
1.A.3.d. Navigation	Gas / Diesel oil	CH4	2,1	0,0	0,3	0,0001	0,0%	0,0%	85,4%
1.A.2.f. Other Industries	Lignite	CH4	2,1	0,0	10,8	0,0023	0,0%	0,0%	-415,3%
1.A.2.b. Non-Ferrous Metals	Natural Gas	CH4	2,0	0,0	0,0	0,0002	0,0%	0,0%	100,0%
1.A.4.b. Residential	Asphaltite	N2O	2,0	0,0	1,8	0,0002	0,0%	0,0%	6,8%
1.A.2.f. Sugar	Lignite	CH4	1,9	0,0	3,8	0,0007	0,0%	0,0%	-92,8%
1.A.2.c. Chemicals	Residual Fuel Oil	N2O	1,8	0,0	5,1	0,0010	0,0%	0,0%	-182,0%
1.A.2.f. Other Industries	Gas / Diesel oil	CH4	1,7	0,0	0,2	0,0001	0,0%	0,0%	89,9%
1.A.2.c. Chemicals	Lignite	N2O	1,6	0,0	2,3	0,0004	0,0%	0,0%	-44,7%
1.A.1.a. Public Electricity and Heat Production	Asphaltite	N2O	1,6	0,0	0,0	0,0002	0,0%	0,0%	100,0%
1.A.2.c. Chemicals	Hard Coal	N2O	1,5	0,0	0,0	0,0002	0,0%	0,0%	100,0%
1.A.2.c. Chemicals	LPG	N2O	1,3	0,0	0,0	0,0001	0,0%	0,0%	100,0%
1.A.2.f. Other Industries	Asphaltite	CH4	1,3	0,0	0,1	0,0001	0,0%	0,0%	95,5%
1.A.2.a. Iron and Steel	Petroleum Coke	CH4	1,2	0,0	0,0	0,0001	0,0%	0,0%	100,0%
1.A.1.a. Public Electricity and Heat Production	Industrial Waste	N2O	1,1	0,0	NA	-	-	-	-
1.A.3.c. Railways	Gas / Diesel oil	N2O	1,1	0,0	2,9	0,0006	0,0%	0,0%	-164,1%
1.A.1.a. Public Electricity and Heat Production	Residual Fuel Oil	N2O	1,1	0,0	8,5	0,0019	0,0%	0,0%	-679,2%
1.A.2.a. Iron and Steel	Natural Gas	N2O	1,1	0,0	0,0	0,0001	0,0%	0,0%	100,0%

A6.1 Trend analysis (cont.)

CATEGORY	FUEL	GAS	EMISSION 2012	CONTRIBUTION (%)	EMISSION 1990	TREND ASSESMENT	CONTRIBUTION	CUMULATIVE TOTAL	TREND
1.A.3.a. Civil Aviation	Jet Kerosene	CH4	1,1	0,0	1,3	0,0002	0,0%	0,0%	-21,3%
1.B.2.b. Natural Gas (fugitative)		CO2	1,0	0,0	0,3	0,0000	0,0%	0,0%	66,5%
1.A.2.c. Chemicals	Natural Gas	N2O	0,9	0,0	0,0	0,0001	0,0%	0,0%	100,0%
1.A.1.b. Petroleum Refining	Natural Gas	CH4	0,9	0,0	0,0	0,0001	0,0%	0,0%	100,0%
1.A.2.f. Sugar	Natural Gas	CH4	0,9	0,0	0,0	0,0001	0,0%	0,0%	100,0%
1.A.2.f. Fertilizer	Natural Gas	N2O	0,9	0,0	0,6	0,0000	0,0%	0,0%	31,5%
1.A.2.c. Chemicals	Lignite	CH4	0,8	0,0	1,1	0,0002	0,0%	0,0%	-44,7%
1.A.2.c. Chemicals	Second Fuel Coal	N2O	0,8	0,0	0,0	0,0001	0,0%	0,0%	100,0%
1.A.2.c. Chemicals	Hard Coal	CH4	0,7	0,0	0,0	0,0001	0,0%	0,0%	100,0%
4.D.3.1. Atmospheric deposition		N2O	0,7	0,0	0,6	0,0001	0,0%	0,0%	16,0%
1.A.3.c. Railways	Gas / Diesel oil	CH4	0,6	0,0	0,6	0,0001	0,0%	0,0%	-1,4%
1.A.2.f. Cement Production	Natural Gas	CH4	0,6	0,0	0,0	0,0001	0,0%	0,0%	99,3%
1.A.2.f. Sugar	Second Fuel Coal	N2O	0,6	0,0	0,7	0,0001	0,0%	0,0%	-17,5%
1.A.1.a. Public Electricity and Heat Production	Asphaltite	CH4	0,5	0,0	0,0	0,0001	0,0%	0,0%	100,0%
1.A.2.a. Iron and Steel	Lignite	N2O	0,5	0,0	0,0	0,0001	0,0%	0,0%	100,0%
1.B.2.c. Venting and Flaring (fugitative)		N2O	0,5	0,0	0,8	0,0001	0,0%	0,0%	-57,6%
1.A.2.b. Non-Ferrous Metals	Lignite	CH4	0,5	0,0	0,1	0,0000	0,0%	0,0%	73,8%
1.A.2.c. Chemicals	Residual Fuel Oil	CH4	0,4	0,0	1,1	0,0002	0,0%	0,0%	-182,0%
1.A.4.b. Residential	Gas / Diesel oil	CH4	0,4	0,0	1,7	0,0004	0,0%	0,0%	-334,0%
1.A.2.c. Chemicals	Gas / Diesel oil	N2O	0,4	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.1.a. Public Electricity and Heat Production	Residual Fuel Oil	CH4	0,4	0,0	2,9	0,0006	0,0%	0,0%	-679,2%
1.A.2.c. Chemicals	Second Fuel Coal	CH4	0,4	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.4.b. Residential	Gas / Diesel oil	N2O	0,3	0,0	1,5	0,0003	0,0%	0,0%	-334,0%
1.A.2.a. Iron and Steel	LPG	N2O	0,3	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Sugar	Second Fuel Coal	CH4	0,3	0,0	0,3	0,0000	0,0%	0,0%	-17,5%
1.A.2.c. Chemicals	LPG	CH4	0,3	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Sugar	Residual Fuel Oil	N2O	0,3	0,0	1,0	0,0002	0,0%	0,0%	-262,5%
1.A.2.f. Sugar	Natural Gas	N2O	0,3	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Cement Production	Residual Fuel Oil	N2O	0,3	0,0	3,7	0,0008	0,0%	0,0%	-1343,6%
1.A.3.d. Navigation	Residual Fuel Oil	N2O	0,2	0,0	0,7	0,0001	0,0%	0,0%	-167,8%
1.A.2.a. Iron and Steel	Lignite	CH4	0,2	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.4.b. Residential	Residual Fuel Oil	CH4	0,2	0,0	9,7	0,0022	0,0%	0,0%	-4161,3%
1.A.2.f. Other Industries	Hard Coal	CH4	0,2	0,0	2,9	0,0006	0,0%	0,0%	-1269,7%
1.A.4.b. Residential	Residual Fuel Oil	N2O	0,2	0,0	8,6	0,0020	0,0%	0,0%	-4161,3%
1.A.2.f. Cement Production	Natural Gas	N2O	0,2	0,0	0,0	0,0000	0,0%	0,0%	99,3%
1.A.3.b. Road Transportation	Biofuel	N2O	0,2	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Cement Production	LPG	CO2	0,2	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Sugar	Hard Coal	N2O	0,2	0,0	1,2	0,0003	0,0%	0,0%	-658,4%
1.A.3.d. Navigation	Residual Fuel Oil	CH4	0,1	0,0	0,4	0,0001	0,0%	0,0%	-168,3%
1.A.2.f. Sugar	Gas / Diesel oil	N2O	0,1	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.3.b. Road Transportation	Biofuel	CH4	0,1	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.b. Non-Ferrous Metals	Hard Coal	CH4	0,1	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Sugar	LPG	N2O	0,1	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Cement Production	Gasoline	CO2	0,1	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.c. Chemicals	Gas / Diesel oil	CH4	0,1	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Sugar	Hard Coal	CH4	0,1	0,0	0,6	0,0001	0,0%	0,0%	-658,4%
1.A.2.f. Other Industries	Gasoline	CO2	0,1	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.a. Iron and Steel	LPG	CH4	0,1	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.3.b. Road Transportation	LPG	N2O	0,1	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.a. Iron and Steel	Gas / Diesel oil	N2O	0,1	0,0	0,0	0,0000	0,0%	0,0%	22,2%
1.A.2.f. Sugar	Residual Fuel Oil	CH4	0,1	0,0	0,2	0,0000	0,0%	0,0%	-262,5%
1.A.4.c. Agriculture/Forestry/Fisheries	Natural Gas	CH4	0,1	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Cement Production	Residual Fuel Oil	CH4	0,1	0,0	0,8	0,0002	0,0%	0,0%	-1343,6%
1.A.2.f. Other Industries	LPG	N2O	0,1	0,0	0,4	0,0001	0,0%	0,0%	-662,0%
1.B.2.a. Oil (fugitative)		N2O	0,1	0,0	0,1	0,0000	0,0%	0,0%	-59,9%
1.A.2.f. Fertilizer	Residual Fuel Oil	N2O	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Fertilizer	LPG	CO2	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.5.a. Other (Stationary)		N2O	0,0	0,0	NA	-	-	-	-
1.A.2.f. Cement Production	Gas / Diesel oil	N2O	0,0	0,0	0,2	0,0000	0,0%	0,0%	-625,3%
1.A.2.f. Sugar	Gas / Diesel oil	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.a. Iron and Steel	Gasoline	CO2	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Sugar	LPG	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.4.c. Agriculture/Forestry/Fisheries	Natural Gas	N2O	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.c. Chemicals	Gasoline	CO2	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.a. Iron and Steel	Gas / Diesel oil	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	22,2%
1.A.2.b. Non-Ferrous Metals	Residual Fuel Oil	CH4	0,0	0,0	0,4	0,0001	0,0%	0,0%	-2855,8%
1.A.2.f. Other Industries	LPG	CH4	0,0	0,0	0,1	-	-	-	-
1.A.2.a. Iron and Steel	Residual Fuel Oil	N2O	0,0	0,0	4,4	0,0010	0,0%	0,0%	-44006,6%
1.A.2.f. Sugar	Gasoline	N2O	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Fertilizer	Residual Fuel Oil	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Fertilizer	Gas / Diesel oil	N2O	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Cement Production	Gas / Diesel oil	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	-625,3%
1.A.2.b. Non-Ferrous Metals	Gas / Diesel oil	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	-443,1%
1.A.2.a. Iron and Steel	Residual Fuel Oil	CH4	0,0	0,0	1,0	0,0002	0,0%	0,0%	-44006,6%
1.A.2.f. Sugar	Gasoline	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Fertilizer	Gas / Diesel oil	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Cement Production	LPG	N2O	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Cement Production	Gasoline	N2O	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Other Industries	Gasoline	N2O	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Cement Production	LPG	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Fertilizer	LPG	N2O	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.a. Iron and Steel	Gasoline	N2O	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Cement Production	Gasoline	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.c. Chemicals	Gasoline	N2O	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Other Industries	Gasoline	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.f. Fertilizer	LPG	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.a. Iron and Steel	Gasoline	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%
1.A.2.c. Chemicals	Gasoline	CH4	0,0	0,0	0,0	0,0000	0,0%	0,0%	100,0%

A6.1 Trend analysis (cont.)

CATEGORY	FUEL	GAS	EMISSION 2012	CONTRIBUTION (%)	EMISSION 1990	TREND ASSESMENT	CONTRIBUTION	CUMULATIVE TOTAL	TREND
1.A.1.b. Petroleum Refining	Refinery Gas	CO2	0,0	0,0	1402,9	-	-	-	-
1.A.1.a. Public Electricity and Heat Production	Hard Coal	CO2	0,0	0,0	846,3	-	-	-	-
1.A.2.f. Other Industries	Residual Fuel Oil	CO2	0,0	0,0	4344,0	-	-	-	-
1.A.2.a. Iron and Steel	Naphta	CO2	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Other Industries	Second Fuel Coal	CO2	0,0	0,0	520,5	-	-	-	-
1.A.1.a. Public Electricity and Heat Production	LPG	CO2	0,0	0,0	0,0	-	-	-	-
1.A.1.a. Public Electricity and Heat Production	Hard Coal	N2O	0,0	0,0	4,0	-	-	-	-
1.A.1.a. Public Electricity and Heat Production	Gas / Diesel oil	CO2	0,0	0,0	67,7	-	-	-	-
1.A.1.b. Petroleum Refining	Refinery Gas	CH4	0,0	0,0	1,3	-	-	-	-
1.A.1.b. Petroleum Refining	Gas / Diesel oil	CO2	0,0	0,0	5,6	-	-	-	-
1.A.2.f. Other Industries	Hard Coal	N2O	0,0	0,0	5,9	-	-	-	-
1.A.2.f. Other Industries	Waste of animal, plant	N2O	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Other Industries	Waste of animal, plant	CH4	0,0	0,0	0,0	-	-	-	-
1.A.1.a. Public Electricity and Heat Production	Hard Coal	CH4	0,0	0,0	0,2	-	-	-	-
1.A.2.f. Other Industries	Residual Fuel Oil	N2O	0,0	0,0	10,7	-	-	-	-
1.A.1.b. Petroleum Refining	Gasoline	CO2	0,0	0,0	1,9	-	-	-	-
1.A.2.f. Cement Production	Naphta	CO2	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Other Industries	Residual Fuel Oil	CH4	0,0	0,0	2,4	-	-	-	-
1.A.1.b. Petroleum Refining	Petroleum & Other	CO2	0,0	0,0	2,6	-	-	-	-
1.A.2.f. Other Industries	Second Fuel Coal	N2O	0,0	0,0	2,5	-	-	-	-
1.A.2.a. Iron and Steel	Naphta	N2O	0,0	0,0	0,0	-	-	-	-
1.A.1.a. Public Electricity and Heat Production	Naphta	N2O	0,0	0,0	0,0	-	-	-	-
1.A.1.a. Public Electricity and Heat Production	Gas / Diesel oil	N2O	0,0	0,0	0,2	-	-	-	-
1.A.2.f. Sugar	Naphta	CO2	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Other Industries	Second Fuel Coal	CH4	0,0	0,0	1,2	-	-	-	-
1.A.1.a. Public Electricity and Heat Production	Gas / Diesel oil	CH4	0,0	0,0	0,1	-	-	-	-
1.A.2.b. Non-Ferrous Metals	Wood	N2O	0,0	0,0	0,0	-	-	-	-
1.A.2.a. Iron and Steel	Naphta	CH4	0,0	0,0	0,0	-	-	-	-
1.A.2.b. Non-Ferrous Metals	Wood	CH4	0,0	0,0	0,0	-	-	-	-
1.A.5.a. Other (Stationary)		CH4	0,0	0,0	NA	-	-	-	-
1.A.2.f. Sugar	Waste of animal, plant	N2O	0,0	0,0	0,0	-	-	-	-
1.A.1.a. Public Electricity and Heat Production	Naphta	CH4	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Other Industries	Wood	N2O	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Sugar	Waste of animal, plant	CH4	0,0	0,0	0,0	-	-	-	-
1.A.1.b. Petroleum Refining	Gas / Diesel oil	CH4	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Other Industries	Wood	CH4	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Cement Production	Naphta	N2O	0,0	0,0	0,0	-	-	-	-
1.A.1.b. Petroleum Refining	Gasoline	CH4	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Sugar	Naphta	N2O	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Cement Production	Naphta	CH4	0,0	0,0	0,0	-	-	-	-
1.A.1.b. Petroleum Refining	Petroleum & Other	CH4	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Sugar	Naphta	CH4	0,0	0,0	0,0	-	-	-	-
1.A.3.c. Railways	Hard Coal	CO2	0,0	0,0	29,3	-	-	-	-
1.A.3.d. Navigation	Hard Coal	CO2	0,0	0,0	3,1	-	-	-	-
1.A.2.f. Fertilizer	Lignite	CO2	0,0	0,0	626,1	-	-	-	-
1.A.3.c. Railways	Lignite	CO2	0,0	0,0	21,6	-	-	-	-
1.A.2.f. Cement Production	Asphaltite	CO2	0,0	0,0	62,6	-	-	-	-
1.A.2.a. Iron and Steel	Second Fuel Coal	CO2	0,0	0,0	7605,2	-	-	-	-
1.A.2.b. Non-Ferrous Metals	Second Fuel Coal	CO2	0,0	0,0	70,5	-	-	-	-
1.A.2.f. Fertilizer	Second Fuel Coal	CO2	0,0	0,0	2,7	-	-	-	-
1.A.2.b. Non-Ferrous Metals	Petroleum Coke	CO2	0,0	0,0	99,3	-	-	-	-
1.A.1.b. Petroleum Refining	Residual Fuel Oil	CO2	0,0	0,0	2276,2	-	-	-	-
1.A.3.c. Railways	Residual Fuel Oil	CO2	0,0	0,0	60,6	-	-	-	-
1.A.1.b. Petroleum Refining	LPG	CO2	0,0	0,0	0,1	-	-	-	-
1.A.2.f. Other Industries	Refinery Gas	CO2	0,0	0,0	1,1	-	-	-	-
1.A.2.f. Fertilizer	Naphta	CO2	0,0	0,0	478,0	-	-	-	-
1.A.3.c. Railways	Hard Coal	CH4	0,0	0,0	0,1	-	-	-	-
1.A.3.d. Navigation	Hard Coal	CH4	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Fertilizer	Lignite	CH4	0,0	0,0	1,3	-	-	-	-
1.A.3.c. Railways	Lignite	CH4	0,0	0,0	0,1	-	-	-	-
1.A.2.f. Cement Production	Asphaltite	CH4	0,0	0,0	0,1	-	-	-	-
1.A.2.a. Iron and Steel	Second Fuel Coal	CH4	0,0	0,0	17,4	-	-	-	-
1.A.2.b. Non-Ferrous Metals	Second Fuel Coal	CH4	0,0	0,0	0,2	-	-	-	-
1.A.2.f. Fertilizer	Second Fuel Coal	CH4	0,0	0,0	0,0	-	-	-	-
1.A.4.b. Residential	Second Fuel Coal	CH4	0,0	0,0	43,2	-	-	-	-
1.A.2.b. Non-Ferrous Metals	Petroleum Coke	CH4	0,0	0,0	0,2	-	-	-	-
1.A.1.b. Petroleum Refining	Residual Fuel Oil	CH4	0,0	0,0	1,9	-	-	-	-
1.A.3.c. Railways	Residual Fuel Oil	CH4	0,0	0,0	0,1	-	-	-	-
1.A.1.b. Petroleum Refining	LPG	CH4	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Other Industries	Refinery Gas	CH4	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Fertilizer	Naphta	CH4	0,0	0,0	0,3	-	-	-	-
1.A.3.c. Railways	Hard Coal	N2O	0,0	0,0	0,4	-	-	-	-
1.A.3.d. Navigation	Hard Coal	N2O	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Fertilizer	Lignite	N2O	0,0	0,0	2,8	-	-	-	-
1.A.3.c. Railways	Lignite	N2O	0,0	0,0	0,3	-	-	-	-
1.A.2.f. Cement Production	Asphaltite	N2O	0,0	0,0	0,3	-	-	-	-
1.A.2.a. Iron and Steel	Second Fuel Coal	N2O	0,0	0,0	36,0	-	-	-	-
1.A.2.b. Non-Ferrous Metals	Second Fuel Coal	N2O	0,0	0,0	0,3	-	-	-	-
1.A.2.f. Fertilizer	Second Fuel Coal	N2O	0,0	0,0	0,0	-	-	-	-
1.A.4.b. Residential	Second Fuel Coal	N2O	0,0	0,0	3,0	-	-	-	-
1.A.2.b. Non-Ferrous Metals	Petroleum Coke	N2O	0,0	0,0	0,5	-	-	-	-
1.A.3.c. Railways	Residual Fuel Oil	N2O	0,0	0,0	0,4	-	-	-	-
1.A.2.f. Other Industries	Refinery Gas	N2O	0,0	0,0	0,0	-	-	-	-
1.A.2.f. Fertilizer	Naphta	N2O	0,0	0,0	1,2	-	-	-	-
1.A.1.b. Petroleum Refining	Refinery Gas	N2O		0,0	3,7	-	-	-	-
1.A.1.b. Petroleum Refining	Natural Gas	N2O		0,0	0,0	-	-	-	-

A6.1 Trend analysis (cont.)

CATEGORY	FUEL	GAS	EMISSION 2012	CONTRIBUTION (%)	EMISSION 1990	TREND ASSESMENT	CONTRIBUTION	CUMULATIVE TOTAL	TREND
6.C. Waste Incineration		N2O		0,0	NA	-	-	-	-
1.A.1.b. Petroleum Refining	Gas / Diesel oil	N2O		0,0	0,0	-	-	-	-
1.A.1.b. Petroleum Refining	Gasoline	N2O		0,0	0,0	-	-	-	-
1.A.1.b. Petroleum Refining	Petroleum & Other	N2O		0,0	0,0	-	-	-	-
1.A.1.b. Petroleum Refining	Residual Fuel Oil	N2O		0,0	5,7	-	-	-	-
1.A.1.b. Petroleum Refining	LPG	N2O		0,0	0,0	-	-	-	-
6.C. Waste Incineration		CO2	IE	-	NA	-	-	-	-
6.C. Waste Incineration		CH4	IE	-	NA	-	-	-	-
1.A.3.b. Road Transportation	Natural Gas	CO2	IE	-	-	-	-	-	-
1.A.3.b. Road Transportation	Natural Gas	CH4	IE	-	-	-	-	-	-
1.A.3.b. Road Transportation	Natural Gas	N2O	IE	-	-	-	-	-	-
2.C.2. Ferroalloys Production		CO2	IE	-	-	-	-	-	-
2.A.3. Limestone and Dolomite Use (Mineral Products)		CO2	IE	-	-	-	-	-	-
2.C.3. Aluminium Production		CO2	C	-	109,6	-	-	-	-
2.B.1. Ammonia Production		CO2	C	-	713,5	-	-	-	-
2.B.4.2. Carbide Production		CO2	C	-	112,2	-	-	-	-
2.B.2. Nitric Acid Production (Chemical Industry)		N2O	C	-	128,1	-	-	-	-
2.C.3. Aluminium Production		CF4	C	-	568,0	-	-	-	-
2.C.3. Aluminium Production		C2F6	C	-	35,5	-	-	-	-
2.A.4.1. Soda Ash Production and Use (Mineral Products)		CO2	C	-	106,3	-	-	-	-

ANNEX 7

A7. UNCERTAINTY ANALYSIS

Uncertainties are calculated by multiplying by sectoral uncertainty values after conversion to the CO_2 equivalent according to the global warming potential equivalent of the direct GHG emissions and sinks of CO_2, N_2O, CH_4, HFCs, PFCs and SF_6. Quantitative estimates of the uncertainties in the emissions are calculated using direct expert judgement. It can be concluded that the total uncertainty is 5.2% according to the high uncertain data of LULUCF. The general procedure for uncertainty analysis is:

- Uncertainties of each activity are allocated by using emission factor and activity rate uncertainties.
- A calculation is set up to estimate the emission of each CO_2, CH_4, N_2O, HFCs and SF_6 gases.
- The uncertainties used for the industrial processes data are estimated from the statistical difference between supply and demand.
- The uncertainties for sectorial energy usage are estimated by MENR experts.
- The uncertainties of agricultural activities are estimated by TurkStat experts.
- The uncertainties of transport sectors are estimated by MTMAC experts.

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

Uncertainty estimates are an essential element of a complete emissions inventory. Uncertainties of the inventories are, mainly derived from measured data. However, it is not practical to measure every sources in this way. 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. The following Table A7.1 is used for calculating Tier 1 uncertainty analysis of the emission inventory.

A7.1 Tier 1 uncertainty calculation

A	B	C	D	E	F	G	H	I
Source Category	**Fuel**	**Gas**	**1990 Emission**	**2011 Emission**	**Activity Data Uncert. (%)**	**Emission Factor Uncert. (%)**	**Combined Uncertainty**	**Combined uncertainty of total national emissions in year 2011 (%)**
			Input Data	Input Data	Input Data	Input Data	$\sqrt{F^2 + G^2}$	$\frac{H * E}{\sum E}$
			(Gg CO_2 eq.)	(Gg CO_2 eq.)	%	%	%	&
Example (1.A.1.a)	Hard coal	CO_2						Total Uncertainty
				$\sum D$	$\sum E$			$\sqrt{\sum I^2}$

A7.2 Uncertainty analysis

CATEGORY	FUEL	GAS	2012	Activity data Unc. (%)	Emis fact. Unc. (%)	Combined Unc. (%)	Combined uncertainty as % of total national emissions in year 2011
5. LULUCF		CO2	59815,013	40,0	10,0	41,2	5,60806
1.A.1.a. Public Electricity and Heat Production	Natural Gas	CO2	47591,799	0,0	3,0	3,0	0,32466
1.A.3.b. Road Transportation	Gas / Diesel oil	CO2	41700,425	0,0	5,0	5,0	0,47412
1.A.1.a. Public Electricity and Heat Production	Lignite	CO2	39996,442	5,3	3,0	6,1	0,55390
2.A.1. Cement Production (Mineral Products)		CO2	30327,660	0,0	5,0	5,0	0,34482
1.A.1.a. Public Electricity and Heat Production	Second Fuel Coal	CO2	27967,156	7,00	3,0	7,6	0,48433
1.A.4.b. Residential	Hard Coal	CO2	25902,521	7,0	3,0	7,6	0,44857
6.A.1. Solid Waste Disposal (Managed)		CH4	23018,766	15,00	19,0	24,2	1,26709
1.A.4.b. Residential	Natural Gas	CO2	20643,958	0,0	3,0	3,0	0,05745
2.C.1. Iron and Steel Production		CO2	19902,155	0,00	1,0	1,0	0,04526
4.A. Enteric Fermentation		CH4	19435,551	6,30	1,0	6,4	0,28192
1.A.4.b. Residential	Lignite	CO2	12802,088	5,3	3,0	6,1	0,17729
6.A.2.1. Solid Waste Disposal (Unmanaged)		CH4	9767,551	15,00	19,0	24,2	0,53767
1.A.2.f. Cement Production	Petroleum Coke	CO2	8422,122	0,0	3,0	3,0	0,05745
1.A.3.b. Road Transportation	LPG	CO2	8170,831	2,5	5,0	5,6	0,10387
1.A.2.f. Other Industries	Natural Gas	CO2	7039,372	0,0	3,0	3,0	0,04802
1.A.2.f. Cement Production	Lignite	CO2	5690,949	5,3	3,0	6,1	0,07881
1.A.2.f. Cement Production	Hard Coal	CO2	5636,081	7,0	3,0	7,6	0,14585
1.A.3.b. Road Transportation	Gasoline	CO2	5594,561	3,0	3,0	4,2	0,05397
2.F. Emission of HFCs		HFC-134a	4681,300	40,00	20,0	44,7	0,47606
4.D.1.1. Agricultural Soil (Synthetic Fertilizer)		N2O	4439,032	1,00	9,0	9,1	0,09141
2.A.2. Lime Production (Mineral Products)		CO2	4320,167	15,0	1,0	15,0	0,14768
1.A.3.a. Civil Aviation	Jet Kerosene	CO2	3718,792	0,0	3,0	3,0	0,02537
1.A.2.a. Iron and Steel	Hard Coal	CO2	3235,063	7,0	3,0	7,6	0,05602
1.A.2.f. Other Industries	Gas / Diesel oil	CO2	3028,428	0,0	5,0	5,0	0,03443
1.A.4.c. Agriculture/Forestry/Fisheries	Gas / Diesel oil	CO2	3018,304	0,0	5,0	5,0	0,03432
4.B. Manure Management		N2O	2863,951	1,00	9,0	9,1	0,05897
1.A.1.b. Petroleum Refining	Natural Gas	CO2	2434,380	0,0	3,0	3,0	0,01661
1.A.2.a. Iron and Steel	Natural Gas	CO2	1945,420	0,0	3,0	3,0	0,01327
1.A.4.b. Residential	LPG	CO2	1917,781	2,5	5,0	5,6	0,02438
6.B.2. Domestic and Commercial Wastewater Handling		N2O	1888,198	15,00	19,0	24,2	0,10394
4.D.1.2. Agricultural Soil (Animal Manure Applied)		N2O	1780,528	1,00	9,0	9,1	0,03666
1.A.4.b. Residential	Hard Coal	CH4	1760,214	7,0	16,0	17,5	0,06990
1.A.2.c. Chemicals	Natural Gas	CO2	1656,209	0,0	3,0	3,0	0,01130
4.B. Manure Management		CH4	1552,615	6,30	1,0	6,4	0,02252
6.B.2. Domestic and Commercial Wastewater Handling		CH4	1540,673	15,00	19,0	24,2	0,08481
1.A.2.f. Fertilizer	Natural Gas	CO2	1530,885	0,0	3,0	3,0	0,01044
1.A.3.d. Navigation	Gas / Diesel oil	CO2	1506,026	0,0	5,0	5,0	0,01712
1.A.2.f. Ceramics	Natural Gas	CO2	1424,841	0,0	3,0	3,0	0,00972
1.B.1.a.2. Mining (Surface)		CH4	1265,167	5,00	20,0	20,6	0,05931
1.A.2.f. Textile	Natural Gas	CO2	1199,258	0,0	3,0	3,0	0,00818
4.D.1.4. Agricultural Soil (Crop Residue)		N2O	1160,752	1,00	9,0	9,1	0,02390
2. G.CS.1 Other and Undiffrentiated Production	NA	CO2	1149,631	3	5	5,8	0,01524
1.A.2.b. Non-Ferrous Metals	Natural Gas	CO2	1079,717	0,0	3,0	3,0	0,00737
1.A.2.b. Non-Ferrous Metals	Natural Gas	N2O	1079,717	0,0	20,0	20,0	0,04910
2. G.CS.1 Other and Undiffrentiated Production	NA	N2O	1052,888	3	5	5,8	0,01396
1.A.2.e. Food Processing, Beverages and Tobacco	Natural Gas	CO2	1027,660	0,0	3,0	3,0	0,00701
1.A.2.f. Other Industries	Lignite	CO2	987,012	5,3	3,0	6,1	0,01367
2.F. Emission of SF6		SF6	971,130	40,00	20,0	44,7	0,09876
1.A.2.f. Sugar	Lignite	CO2	920,826	5,3	3,0	6,1	0,01275
1.A.4.b. Residential	Lignite	CH4	813,233	5,3	16,0	16,9	0,03117
1.A.2.c. Chemicals	Residual Fuel Oil	CO2	742,250	2,50	3,0	3,9	0,00659
1.A.1.a. Public Electricity and Heat Production	Asphaltite	CO2	690,562	20,0	20,0	28,3	0,04441
1.B.1.a.1. Mining (underground)		CH4	645,042	5,00	20,0	20,6	0,03024
1.A.2.f. Ceramics	Lignite	CO2	599,877	5,3	3,0	6,1	0,00831
1.A.2.f. Glass and Glass Products	Natural Gas	CO2	591,917	0,0	3,0	3,0	0,00404
1.A.4.b. Residential	Wood	CH4	578,840	16,00	16,0	22,6	0,02978
1.A.2.f. Other Industries	Asphaltite	CO2	558,936	20,0	20,0	28,3	0,03595
1.A.2.f. Other Industries	Petroleum Coke	CO2	528,814	0,0	3,0	3,0	0,00361
1.A.2.a. Iron and Steel	Petroleum Coke	CO2	528,814	0,0	3,0	3,0	0,00361
4.D.2. Pasture, Range and Padock Manure		N2O	484,464	6,30	1,0	6,4	0,00703
1.A.2.f. Sugar	Natural Gas	CO2	472,376	0,0	3,0	3,0	0,00322
1.A.3.c. Railways	Gas / Diesel oil	CO2	442,885	0,0	5,0	5,0	0,00504
1.A.1.a. Public Electricity and Heat Production	Residual Fuel Oil	CO2	430,994	2,50	3,0	3,9	0,00383
1.A.2.c. Chemicals	LPG	CO2	425,790	2,5	5,0	5,6	0,00541
1.A.4.b. Residential	Asphaltite	CO2	419,202	20,0	20,0	28,3	0,02696
1.A.2.f. Ceramics	LPG	CO2	377,390	2,5	5,0	5,6	0,00480
1.A.2.f. Textile	Lignite	CO2	371,667	5,3	3,0	6,1	0,00515
1.A.2.c. Chemicals	Lignite	CO2	365,987	5,3	3,0	6,1	0,00507

A7.2 Uncertainty analysis (cont.)

CATEGORY	FUEL	GAS	2012	Activity data Unc. (%)	Emis fact. Unc. (%)	Combined Unc. (%)	Combined uncertainty as % of total national emissions in year 2011
1.A.2.f. Cement Production	Natural Gas	CO2	325,843	0,0	3,0	3,0	0,00222
1.A.2.c. Chemicals	Hard Coal	CO2	321,657	7,0	3,0	7,6	0,00557
1.A.2.d. Pulp, Paper and Print	Lignite	CO2	308,380	5,3	3,0	6,1	0,00427
1.A.2.f. Road Motor Vehicles	Natural Gas	CO2	300,778	0,0	3,0	3,0	0,00205
2. G.CS.1 Other and Undiffrentiated Production	NA	CF4	294,371	3	5	5,8	0,00390
1.A.2.d. Pulp, Paper and Print	Natural Gas	CO2	287,282	0,0	3,0	3,0	0,00196
4.C.1.2.1. Rice Cultivation		CH4	251,422	10,00	20,0	22,4	0,01278
1.A.2.b. Non-Ferrous Metals	Lignite	CO2	228,417	5,3	3,0	6,1	0,00316
1.A.2.b. Non-Ferrous Metals	Lignite	N2O	228,417	5,3	20,0	20,7	0,01075
1.A.2.f. Ceramics	Hard Coal	CO2	224,263	7,0	3,0	7,6	0,00388
1.A.2.e. Food Processing, Beverages and Tobacco	Hard Coal	CO2	216,139	7,0	3,0	7,6	0,00374
1.B.2.a. Oil (fugitative)		CH4	196,798	2,5	16,0	16,2	0,00725
4.F.1. Field Burning of Agricultural Residue		CH4	187,888	25,00	14,0	28,7	0,01224
1.A.2.f. Textile	Hard Coal	CO2	179,533	7,0	3,0	7,6	0,00311
1.A.1.a. Public Electricity and Heat Production	Lignite	N2O	164,066	5,3	20,0	20,7	0,00772
1.A.2.c. Chemicals	Second Fuel Coal	CO2	160,237	7,00	3,0	7,6	0,00277
1.A.2.c. Chemicals	Gas / Diesel oil	CO2	152,064	0,0	5,0	5,0	0,00173
1.A.4.b. Residential	Gas / Diesel oil	CO2	135,769	0,0	5,0	5,0	0,00154
1.A.2.f. Sugar	Second Fuel Coal	CO2	127,135	7,00	3,0	7,6	0,00220
1.A.1.a. Public Electricity and Heat Production	Second Fuel Coal	N2O	122,765	7,00	20,0	21,2	0,00592
1.A.4.b. Residential	Hard Coal	N2O	121,259	7,0	20,0	21,2	0,00584
1.A.2.a. Iron and Steel	Lignite	CO2	116,071	5,3	3,0	6,1	0,00161
1.A.2.f. Sugar	Residual Fuel Oil	CO2	115,497	2,50	3,0	3,9	0,00103
1.A.4.b. Residential	Wood	N2O	113,930	45,00	45,0	63,6	0,01649
1.A.2.f. Cement Production	Residual Fuel Oil	CO2	106,630	2,50	3,0	3,9	0,00095
1.A.3.b. Road Transportation	Gas / Diesel oil	N2O	104,720	0,0	5,0	5,0	0,00119
1.A.3.d. Navigation	Residual Fuel Oil	CO2	103,274	2,50	3,0	3,9	0,00092
1.A.2.d. Pulp, Paper and Print	Gas / Diesel oil	CO2	102,912	0,0	5,0	5,0	0,00117
1.B.2.c. Venting and Flaring (fugitative)		CO2	101,426	1,0	3,0	3,2	0,00073
1.A.2.a. Iron and Steel	LPG	CO2	100,164	2,5	5,0	5,6	0,00127
1.A.2.f. Ceramics	Petroleum Coke	CO2	94,130	0,0	3,0	3,0	0,00064
1.A.2.f. Other Industries	Hard Coal	CO2	92,469	7,0	3,0	7,6	0,00160
1.A.4.b. Residential	Residual Fuel Oil	CO2	82,908	2,50	3,0	3,9	0,00074
1.A.4.b. Residential	Second Fuel Coal	CO2	82,908	7,00	3,0	7,6	0,00144
1.A.2.f. Textile	Gasoline	CO2	65,180	3,0	3,0	4,2	0,00063
1.A.1.a. Public Electricity and Heat Production	Industrial Waste	CO2	60,712	10,0	10,0	14,1	0,00195
1.A.3.b. Road Transportation	LPG	CH4	59,116	2,5	10,0	10,3	0,00139
1.A.3.b. Road Transportation	Gas / Diesel oil	CH4	58,500	0,0	5,0	5,0	0,00067
1.A.2.f. Glass and Glass Products	Gas / Diesel oil	CO2	58,024	0,0	5,0	5,0	0,00066
4.F.1. Field Burning of Agricultural Residue		N2O	57,130	25,00	20,0	32,0	0,00416
1.A.4.b. Residential	Lignite	N2O	56,023	5,3	20,0	20,7	0,00264
2.B.5. Other Chemicals Production (Chemical Industry)		CH4	55,812	60,00	1,0	60,0	0,00762
1.A.4.b. Residential	Waste of animal, plant	CH4	55,655	0,00	16,0	16,0	0,00202
1.B.2.b. Natural Gas (fugitative)		CH4	50,938	0,0	16,0	16,0	0,00185
1.A.2.e. Food Processing, Beverages and Tobacco	Residual Fuel Oil	CO2	48,773	2,50	3,0	3,9	0,00043
1.A.2.f. Ceramics	Gasoline	CO2	47,655	3,0	3,0	4,2	0,00046
1.A.2.e. Food Processing, Beverages and Tobacco	Lignite	CO2	46,974	5,3	3,0	6,1	0,00065
4.D.3.2. Nitrogen Leaching and Runoff (4.d.3.2)		N2O	45,862	5,0	5,0	7,1	0,00074
1.A.2.f. Sugar	Gas / Diesel oil	CO2	44,535	0,0	5,0	5,0	0,00051
1.B.2.c. Venting and Flaring (fugitative)		CH4	43,739	1,0	16,0	16,0	0,00159
1.A.2.b. Non-Ferrous Metals	Hard Coal	CO2	42,106	7,0	3,0	7,6	0,00073
1.A.2.b. Non-Ferrous Metals	Hard Coal	N2O	42,106	7,0	20,0	21,2	0,00203
1.A.3.a. Civil Aviation	Jet Kerosene	N2O	39,954	0,0	10,0	10,0	0,00091
1.A.2.f. Cement Production	Petroleum Coke	N2O	39,427	0,0	20,0	20,0	0,00179
1.A.4.b. Residential	Natural Gas	CH4	38,894	0,0	16,0	16,0	0,00142
1.A.2.f. Glass and Glass Products	LPG	CO2	38,268	2,5	5,0	5,6	0,00049
1.A.3.b. Road Transportation	Gasoline	CH4	33,906	10,0	10,0	14,1	0,00109
1.A.4.c. Agriculture/Forestry/Fisheries	Natural Gas	CO2	33,492	0,0	3,0	3,0	0,00023
1.A.2.f. Sugar	Hard Coal	CO2	32,755	7,0	3,0	7,6	0,00057
1.A.2.f. Ceramics	Gas / Diesel oil	CO2	32,051	0,0	5,0	5,0	0,00036
1.A.2.f. Sugar	LPG	CO2	31,196	2,5	5,0	5,6	0,00040
1.A.2.d. Pulp, Paper and Print	Residual Fuel Oil	CO2	28,818	2,50	3,0	3,9	0,00026
1.A.4.b. Residential	Asphaltite	CH4	28,487	20,0	20,0	28,3	0,00183
1.A.2.f. Textile	Gas / Diesel oil	CO2	27,345	0,0	5,0	5,0	0,00031
1.A.1.a. Public Electricity and Heat Production	Natural Gas	N2O	26,901	0,0	20,0	20,0	0,00122
1.A.2.f. Road Motor Vehicles	Lignite	CO2	26,444	5,3	3,0	6,1	0,00037
1.A.2.f. Cement Production	Hard Coal	N2O	26,385	7,0	20,0	21,2	0,00127
1.A.2.b. Non-Ferrous Metals	Residual Fuel Oil	CO2	26,038	2,50	3,0	3,9	0,00023
1.A.2.b. Non-Ferrous Metals	Residual Fuel Oil	N2O	26,038	2,50	16,0	16,2	0,00096
1.A.2.a. Iron and Steel	Gas / Diesel oil	CO2	25,261	0,0	5,0	5,0	0,00029

A7.2 Uncertainty analysis (cont.)

CATEGORY	FUEL	GAS	2012	Activity data Unc. (%)	Emis fact. Unc. (%)	Combined Unc. (%)	Combined uncertainty as % of total national emissions in year 2011
1.A.2.f. Road Motor Vehicles	Gas / Diesel oil	CO2	25,174	0,0	5,0	5,0	0,00029
1.A.2.f. Cement Production	Lignite	N2O	24,904	5,3	20,0	20,7	0,00117
1.B.2.a. Oil (fugitative)		CO2	22,846	2,5	3,0	3,9	0,00020
1.A.1.b. Petroleum Refining	Other Fuels	CO2	22,201	7	3,0	7,6	0,00038
4.D.1.3. Agricultural Soil (N-Fixing Crops)		N2O	20,880	1,00	9,0	9,1	0,00043
1.A.2.f. Cement Production	Petroleum Coke	CH4	19,078	0,0	16,0	16,0	0,00069
2. G.CS.1 Other and Undiffrentiated Production	NA	C2F6	18,382	3	5	5,8	0,00024
1.A.1.b. Petroleum Refining	Other Fuels	CH4	18,366	7	16,0	17,5	0,00073
1.A.2.f. Other Industries	LPG	CO2	17,777	2,5	5,0	5,6	0,00023
1.A.1.a. Public Electricity and Heat Production	Natural Gas	CH4	17,122	0,0	16,0	16,0	0,00062
1.A.2.f. Fertilizer	Residual Fuel Oil	CO2	16,088	2,50	3,0	3,9	0,00014
1.A.2.f. Textile	LPG	CO2	15,942	2,5	5,0	5,6	0,00020
1.A.2.a. Iron and Steel	Hard Coal	N2O	15,145	7,0	20,0	21,2	0,00073
1.A.3.b. Road Transportation	Gasoline	N2O	15,016	16,0	16,0	22,6	0,00077
1.A.2.f. Ceramics	Residual Fuel Oil	CO2	13,715	2,50	3,0	3,9	0,00012
1.A.2.f. Other Industries	Natural Gas	CH4	13,242	0,0	16,0	16,0	0,00048
1.A.2.f. Cement Production	Hard Coal	CH4	12,767	7,0	16,0	17,5	0,00051
1.A.2.f. Cement Production	Lignite	CH4	12,050	5,3	16,0	16,9	0,00046
1.A.4.b. Residential	Natural Gas	N2O	11,483	0,0	20,0	20,0	0,00052
1.A.4.b. Residential	Waste of animal, plant	N2O	10,954	45,00	45,0	63,6	0,00159
1.A.2.f. Cement Production	Gas / Diesel oil	CO2	10,953	0,0	5,0	5,0	0,00012
1.A.2.d. Pulp, Paper and Print	Hard Coal	CO2	10,134	7,0	3,0	7,6	0,00018
1.A.2.f. Other Industries	Petroleum Coke	N2O	8,543	0,0	20,0	20,0	0,00039
1.A.2.b. Non-Ferrous Metals	Gas / Diesel oil	CO2	8,315	0,0	5,0	5,0	0,00009
1.A.2.b. Non-Ferrous Metals	Gas / Diesel oil	N2O	8,315	0,0	5,0	5,0	0,00009
1.A.1.a. Public Electricity and Heat Production	Lignite	CH4	7,939	5,3	16,0	16,9	0,00030
1.A.2.f. Other Industries	Gas / Diesel oil	N2O	7,682	0,0	5,0	5,0	0,00009
1.A.1.a. Public Electricity and Heat Production	Biofuel	N2O	7,662	16,0	16,0	22,6	0,00039
1.A.4.c. Agriculture/Forestry/Fisheries	Gas / Diesel oil	N2O	7,656	0,0	5,0	5,0	0,00009
1.A.2.e. Food Processing, Beverages and Tobacco	Coke	CO2	7,530	7,0	3,0	7,6	0,00013
1.A.2.a. Iron and Steel	Hard Coal	CH4	7,328	7,0	16,0	17,5	0,00029
1.A.4.b. Residential	LPG	CH4	6,450	2,5	10,0	10,3	0,00015
1.A.1.a. Public Electricity and Heat Production	Second Fuel Coal	CH4	5,940	7,0	16,0	17,5	0,00024
1.A.4.b. Residential	LPG	N2O	5,713	2,5	16,0	16,2	0,00021
1.A.1.a. Public Electricity and Heat Production	Industrial Waste	CH4	5,433	16,0	16,0	22,6	0,00028
1.A.2.f. Road Motor Vehicles	Gasoline	CO2	4,961	3,0	3,0	4,2	0,00005
1.A.4.c. Agriculture/Forestry/Fisheries	Gas / Diesel oil	CH4	4,322	0,0	5,0	5,0	0,00005
1.A.2.f. Other Industries	Lignite	N2O	4,319	5,3	20,0	20,7	0,00020
1.A.2.f. Other Industries	Petroleum Coke	CH4	4,134	0,0	16,0	16,0	0,00015
1.A.2.a. Iron and Steel	Residual Fuel Oil	CO2	4,070	2,50	3,0	3,9	0,00004
1.A.2.f. Sugar	Lignite	N2O	4,030	5,3	20,0	20,7	0,00019
1.A.2.f. Other Industries	Natural Gas	N2O	3,909	0,0	20,0	20,0	0,00018
1.A.1.a. Public Electricity and Heat Production	Biofuel	CH4	3,893	16,0	16,0	22,6	0,00020
1.A.3.d. Navigation	Gas / Diesel oil	N2O	3,782	0,0	5,0	5,0	0,00004
1.A.2.a. Iron and Steel	Natural Gas	CH4	3,659	0,0	16,0	16,0	0,00013
1.A.2.f. Sugar	Gasoline	CO2	3,574	3,0	3,0	4,2	0,00003
1.A.2.f. Fertilizer	Gas / Diesel oil	CO2	3,149	0,0	5,0	5,0	0,00004
1.A.2.c. Chemicals	Natural Gas	CH4	3,115	0,0	16,0	16,0	0,00011
1.A.2.f. Fertilizer	Natural Gas	CH4	2,880	0,0	16,0	16,0	0,00010
1.A.2.f. Ceramics	Natural Gas	CH4	2,680	0,0	16,0	16,0	0,00010
1.A.2.f. Ceramics	Lignite	N2O	2,625	5,3	20,0	20,7	0,00012
1.A.2.f. Other Industries	Asphaltite	N2O	2,617	20,0	20,0	28,3	0,00017
1.A.2.a. Iron and Steel	Petroleum Coke	N2O	2,476	0,0	20,0	20,0	0,00011
1.A.2.f. Textile	Natural Gas	CH4	2,256	0,0	16,0	16,0	0,00008
1.A.3.d. Navigation	Gas / Diesel oil	CH4	2,135	0,0	5,0	5,0	0,00002
1.A.2.d. Pulp, Paper and Print	LPG	CO2	2,127	2,5	5,0	5,6	0,00003
1.A.2.f. Other Industries	Lignite	CH4	2,090	5,3	16,0	16,9	0,00008
1.A.2.b. Non-Ferrous Metals	Natural Gas	CH4	2,031	0,0	16,0	16,0	0,00007
1.A.4.b. Residential	Asphaltite	N2O	1,962	20,0	20,0	28,3	0,00013
1.A.2.f. Sugar	Lignite	CH4	1,950	5,3	16,0	16,9	0,00007
1.A.2.e. Food Processing, Beverages and Tobacco	Natural Gas	CH4	1,933	0,0	16,0	16,0	0,00007
1.A.2.c. Chemicals	Residual Fuel Oil	N2O	1,802	2,50	16,0	16,2	0,00007
1.A.2.f. Other Industries	Gas / Diesel oil	CH4	1,735	0,0	5,0	5,0	0,00002
1.A.2.f. Textile	Lignite	N2O	1,626	5,3	20,0	20,7	0,00008
1.A.2.c. Chemicals	Lignite	N2O	1,602	5,3	20,0	20,7	0,00008
1.A.1.a. Public Electricity and Heat Production	Asphaltite	N2O	1,600	20,0	20,0	28,3	0,00010
1.A.2.e. Food Processing, Beverages and Tobacco	Gas / Diesel oil	CO2	1,551	0,0	5,0	5,0	0,00002
1.A.2.c. Chemicals	Hard Coal	N2O	1,506	7,0	20,0	21,2	0,00007
1.A.2.d. Pulp, Paper and Print	Lignite	N2O	1,349	5,3	20,0	20,7	0,00006
1.A.2.f. Ceramics	Lignite	CH4	1,270	5,3	16,0	16,9	0,00005

A7.2 Uncertainty analysis (cont.)

CATEGORY	FUEL	GAS	2012	Activity data Unc. (%)	Emis fact. Unc. (%)	Combined Unc. (%)	Combined uncertainty as % of total national emissions in year 2011
1.A.2.c. Chemicals	LPG	N2O	1,268	2,5	16,0	16,2	0,00005
1.A.2.f. Other Industries	Asphaltite	CH4	1,266	20,0	20,0	28,3	0,00008
1.A.2.a. Iron and Steel	Petroleum Coke	CH4	1,198	0,0	16,0	16,0	0,00004
1.A.1.a. Public Electricity and Heat Production	Industrial Waste	N2O	1,134	45,0	45,0	63,6	0,00016
1.A.2.f. Ceramics	LPG	N2O	1,124	2,5	16,0	16,2	0,00004
1.A.2.f. Glass and Glass Products	Natural Gas	CH4	1,113	0,0	16,0	16,0	0,00004
1.A.3.c. Railways	Gas / Diesel oil	N2O	1,112	0,0	5,0	5,0	0,00001
1.A.1.a. Public Electricity and Heat Production	Residual Fuel Oil	N2O	1,088	2,50	16,0	16,2	0,00004
1.A.2.a. Iron and Steel	Natural Gas	N2O	1,080	0,0	20,0	20,0	0,00005
1.A.3.a. Civil Aviation	Jet Kerosene	CH4	1,077	0,0	10,0	10,0	0,00002
1.A.2.f. Ceramics	Hard Coal	N2O	1,050	7,0	20,0	21,2	0,00005
1.B.2.b. Natural Gas (fugitative)		CO2	1,014	0,0	3,0	3,0	0,00001
1.A.2.e. Food Processing, Beverages and Tobacco	Hard Coal	N2O	1,012	7,0	20,0	21,2	0,00005
1.A.2.c. Chemicals	Natural Gas	N2O	0,920	0,0	20,0	20,0	0,00004
1.A.1.b. Petroleum Refining	Natural Gas	CH4	0,916	0,0	16,0	16,0	0,00003
1.A.2.f. Sugar	Natural Gas	CH4	0,889	0,0	16,0	16,0	0,00003
1.A.2.f. Fertilizer	Natural Gas	N2O	0,850	0,0	20,0	20,0	0,00004
1.A.2.f. Textile	Hard Coal	N2O	0,840	7,0	20,0	21,2	0,00004
1.A.2.f. Ceramics	Natural Gas	N2O	0,791	0,0	20,0	20,0	0,00004
1.A.2.f. Textile	Lignite	CH4	0,787	5,3	16,0	16,9	0,00003
1.A.2.f. Road Motor Vehicles	LPG	CO2	0,780	2,5	5,0	5,6	0,00001
1.A.2.c. Chemicals	Lignite	CH4	0,775	5,3	16,0	16,9	0,00003
1.A.2.c. Chemicals	Second Fuel Coal	N2O	0,750	7,00	20,0	21,2	0,00004
1.A.2.c. Chemicals	Hard Coal	CH4	0,729	7,0	16,0	17,5	0,00003
4.D.3.1. Atmospheric deposition		N2O	0,710	5,0	5,0	7,1	0,00001
1.A.2.f. Textile	Natural Gas	N2O	0,666	0,0	20,0	20,0	0,00003
1.A.2.d. Pulp, Paper and Print	Lignite	CH4	0,653	5,3	16,0	16,9	0,00003
1.A.3.c. Railways	Gas / Diesel oil	CH4	0,628	0,0	5,0	5,0	0,00001
1.A.2.f. Cement Production	Natural Gas	CH4	0,613	0,0	16,0	16,0	0,00002
1.A.2.f. Sugar	Second Fuel Coal	N2O	0,595	7,00	20,0	21,2	0,00003
1.A.2.e. Food Processing, Beverages and Tobacco	Natural Gas	N2O	0,571	0,0	20,0	20,0	0,00003
1.A.2.f. Road Motor Vehicles	Natural Gas	CH4	0,566	0,0	16,0	16,0	0,00002
1.A.1.a. Public Electricity and Heat Production	Asphaltite	CH4	0,542	20,0	20,0	28,3	0,00003
1.A.2.d. Pulp, Paper and Print	Natural Gas	CH4	0,540	0,0	16,0	16,0	0,00002
1.A.2.f. Ceramics	Hard Coal	CH4	0,508	7,0	16,0	17,5	0,00002
1.A.2.a. Iron and Steel	Lignite	N2O	0,508	5,3	20,0	20,7	0,00002
1.B.2.c. Venting and Flaring (fugitative)		N2O	0,493	1,0	20,0	20,0	0,00002
1.A.2.e. Food Processing, Beverages and Tobacco	Hard Coal	CH4	0,490	7,0	16,0	17,5	0,00002
1.A.2.b. Non-Ferrous Metals	Lignite	CH4	0,484	5,3	16,0	16,9	0,00002
1.A.2.f. Ceramics	Petroleum Coke	N2O	0,441	0,0	20,0	20,0	0,00002
1.A.1.b. Petroleum Refining	Other Fuels	N2O	0,417	7	20,0	21,2	0,00002
1.A.2.c. Chemicals	Residual Fuel Oil	CH4	0,407	2,50	10,0	10,3	0,00001
1.A.2.f. Textile	Hard Coal	CH4	0,407	7,0	16,0	17,5	0,00002
1.A.4.b. Residential	Gas / Diesel oil	CH4	0,389	0,0	5,0	5,0	0,00000
1.A.2.c. Chemicals	Gas / Diesel oil	N2O	0,386	0,0	5,0	5,0	0,00000
1.A.1.a. Public Electricity and Heat Production	Residual Fuel Oil	CH4	0,368	2,50	10,0	10,3	0,00001
1.A.2.c. Chemicals	Second Fuel Coal	CH4	0,363	7,00	16,0	17,5	0,00001
1.A.4.b. Residential	Gas / Diesel oil	N2O	0,344	0,0	5,0	5,0	0,00000
1.A.2.f. Textile	Residual Fuel Oil	CO2	0,332	2,50	3,0	3,9	0,00000
1.A.2.f. Glass and Glass Products	Natural Gas	N2O	0,329	0,0	20,0	20,0	0,00001
1.A.2.a. Iron and Steel	LPG	N2O	0,298	2,5	16,0	16,2	0,00001
1.A.2.f. Sugar	Second Fuel Coal	CH4	0,288	7,0	20,0	21,2	0,00001
1.A.2.c. Chemicals	LPG	CH4	0,286	2,5	10,0	10,3	0,00001
1.A.2.f. Sugar	Residual Fuel Oil	N2O	0,280	2,50	16,0	16,2	0,00001
1.A.2.e. Food Processing, Beverages and Tobacco	LPG	CO2	0,263	2,5	5,0	5,6	0,00000
1.A.2.f. Sugar	Natural Gas	N2O	0,262	0,0	20,0	20,0	0,00001
1.A.2.d. Pulp, Paper and Print	Gas / Diesel oil	N2O	0,261	0,0	5,0	5,0	0,00000
1.A.2.f. Cement Production	Residual Fuel Oil	N2O	0,259	2,50	16,0	16,2	0,00001
1.A.2.f. Ceramics	LPG	CH4	0,254	2,5	10,0	10,3	0,00001
1.A.3.d. Navigation	Residual Fuel Oil	N2O	0,248	2,50	16,0	16,2	0,00001
1.A.2.a. Iron and Steel	Lignite	CH4	0,246	5,3	16,0	16,9	0,00001
1.A.4.b. Residential	Residual Fuel Oil	CH4	0,227	2,50	10,0	10,3	0,00001
1.A.2.f. Ceramics	Petroleum Coke	CH4	0,213	0,0	16,0	16,0	0,00001
1.A.2.f. Other Industries	Hard Coal	CH4	0,209	7,0	16,0	17,5	0,00001
1.A.2.e. Food Processing, Beverages and Tobacco	Lignite	N2O	0,206	5,3	20,0	20,7	0,00001
1.A.4.b. Residential	Residual Fuel Oil	N2O	0,201	2,50	16,0	16,2	0,00001
1.A.2.f. Cement Production	Natural Gas	N2O	0,181	0,0	20,0	20,0	0,00001
1.A.3.b. Road Transportation	Biofuel	N2O	0,179	16,0	16,0	22,6	0,00001
1.A.2.f. Textile	Gasoline	N2O	0,177	16,0	16,0	22,6	0,00001
1.A.2.f. Cement Production	LPG	CO2	0,174	2,5	5,0	5,6	0,00000

A7.2 Uncertainty analysis (cont.)

CATEGORY	FUEL	GAS	2012	Activity data Unc. (%)	Emis fact. Unc. (%)	Combined Unc. (%)	Combined uncertainty as % of total national emissions in year 2011
1.A.2.f. Road Motor Vehicles	Natural Gas	N2O	0,167	0,0	20,0	20,0	0,00001
1.A.2.d. Pulp, Paper and Print	Natural Gas	N2O	0,160	0,0	20,0	20,0	0,00001
1.A.2.f. Sugar	Hard Coal	N2O	0,153	7,0	20,0	21,2	0,00001
1.A.2.f. Glass and Glass Products	Gas / Diesel oil	N2O	0,147	0,0	5,0	5,0	0,00000
1.A.3.d. Navigation	Residual Fuel Oil	CH4	0,140	2,50	10,0	10,3	0,00000
1.A.2.f. Ceramics	Gasoline	N2O	0,129	16,0	16,0	22,6	0,00001
1.A.2.e. Food Processing, Beverages and Tobacco	Residual Fuel Oil	N2O	0,118	2,50	16,0	16,2	0,00000
1.A.2.f. Road Motor Vehicles	Lignite	N2O	0,116	5,3	20,0	20,7	0,00001
1.A.2.f. Glass and Glass Products	LPG	N2O	0,114	2,5	16,0	16,2	0,00000
1.A.2.f. Sugar	Gas / Diesel oil	N2O	0,113	0,0	5,0	5,0	0,00000
1.A.3.b. Road Transportation	Biofuel	CH4	0,101	16,0	16,0	22,6	0,00001
1.A.2.e. Food Processing, Beverages and Tobacco	Lignite	CH4	0,099	5,3	16,0	16,9	0,00000
1.A.2.b. Non-Ferrous Metals	Hard Coal	CH4	0,095	7,0	16,0	17,5	0,00000
1.A.2.f. Sugar	LPG	N2O	0,093	2,5	16,0	16,2	0,00000
1.A.2.d. Pulp, Paper and Print	Gasoline	CO2	0,092	3,0	3,0	4,2	0,00000
1.A.2.f. Cement Production	Gasoline	CO2	0,089	3,0	3,0	4,2	0,00000
1.A.2.c. Chemicals	Gas / Diesel oil	CH4	0,087	0,0	5,0	5,0	0,00000
1.A.2.f. Ceramics	Gas / Diesel oil	N2O	0,081	0,0	5,0	5,0	0,00000
1.A.2.f. Sugar	Hard Coal	CH4	0,074	7,0	16,0	17,5	0,00000
1.A.2.f. Other Industries	Gasoline	CO2	0,074	3,0	3,0	4,2	0,00000
1.A.2.d. Pulp, Paper and Print	Residual Fuel Oil	N2O	0,070	2,50	16,0	16,2	0,00000
1.A.2.f. Textile	Gas / Diesel oil	N2O	0,069	0,0	5,0	5,0	0,00000
1.A.2.a. Iron and Steel	LPG	CH4	0,067	2,5	10,0	10,3	0,00000
1.A.3.b. Road Transportation	LPG	N2O	0,066	2,5	16,0	16,2	0,00000
1.A.2.f. Glass and Glass Products	Gasoline	CO2	0,065	3,0	3,0	4,2	0,00000
1.A.2.a. Iron and Steel	Gas / Diesel oil	N2O	0,064	0,0	5,0	5,0	0,00000
1.A.2.f. Road Motor Vehicles	Gas / Diesel oil	N2O	0,064	0,0	5,0	5,0	0,00000
1.A.2.f. Sugar	Residual Fuel Oil	CH4	0,063	2,50	10,0	10,3	0,00000
1.A.4.c. Agriculture/Forestry/Fisheries	Natural Gas	CH4	0,063	0,0	16,0	16,0	0,00000
1.A.2.d. Pulp, Paper and Print	Gas / Diesel oil	CH4	0,059	0,0	5,0	5,0	0,00000
1.A.2.f. Cement Production	Residual Fuel Oil	CH4	0,058	2,50	10,0	10,3	0,00000
1.A.2.f. Road Motor Vehicles	Lignite	CH4	0,056	5,3	16,0	16,9	0,00000
1.A.2.f. Other Industries	LPG	N2O	0,053	2,5	16,0	16,2	0,00000
1.B.2.a. Oil (fugitive)		N2O	0,051	2,5	20,0	20,2	0,00000
1.A.2.f. Textile	LPG	N2O	0,047	2,5	16,0	16,2	0,00000
1.A.2.d. Pulp, Paper and Print	Hard Coal	N2O	0,047	7,0	20,0	21,2	0,00000
1.A.2.f. Textile	Gasoline	CH4	0,040	10,0	10,0	14,1	0,00000
1.A.2.f. Fertilizer	Residual Fuel Oil	N2O	0,039	2,50	16,0	16,2	0,00000
1.A.2.e. Food Processing, Beverages and Tobacco	Gasoline	CO2	0,037	3,0	3,0	4,2	0,00000
1.A.2.f. Fertilizer	LPG	CO2	0,035	2,5	5,0	5,6	0,00000
1.A.2.e. Food Processing, Beverages and Tobacco	Coke	N2O	0,035	7,0	20,0	21,2	0,00000
1.A.2.f. Ceramics	Residual Fuel Oil	N2O	0,033	2,50	16,0	16,2	0,00000
1.A.2.f. Glass and Glass Products	Gas / Diesel oil	CH4	0,033	0,0	5,0	5,0	0,00000
1.A.5.a. Other (Stationary)		N2O	0,033	0,00	16,0	16,0	0,00000
1.A.2.f. Ceramics	Gasoline	CH4	0,029	10,0	10,0	14,1	0,00000
1.A.2.f. Cement Production	Gas / Diesel oil	N2O	0,028	0,0	5,0	5,0	0,00000
1.A.2.e. Food Processing, Beverages and Tobacco	Residual Fuel Oil	CH4	0,027	2,50	10,0	10,3	0,00000
1.A.2.f. Glass and Glass Products	LPG	CH4	0,026	2,5	10,0	10,3	0,00000
1.A.2.f. Sugar	Gas / Diesel oil	CH4	0,026	0,0	5,0	5,0	0,00000
1.A.2.a. Iron and Steel	Gasoline	CO2	0,025	3,0	3,0	4,2	0,00000
1.A.2.d. Pulp, Paper and Print	Hard Coal	CH4	0,023	7,0	16,0	17,5	0,00000
1.A.2.f. Sugar	LPG	CH4	0,021	2,5	10,0	10,3	0,00000
1.A.4.c. Agriculture/Forestry/Fisheries	Natural Gas	N2O	0,019	0,0	20,0	20,0	0,00000
1.A.2.c. Chemicals	Gasoline	CO2	0,018	3,0	3,0	4,2	0,00000
1.A.2.f. Ceramics	Gas / Diesel oil	CH4	0,018	0,0	5,0	5,0	0,00000
1.A.2.e. Food Processing, Beverages and Tobacco	Coke	CH4	0,017	7,0	16,0	17,5	0,00000
1.A.2.d. Pulp, Paper and Print	Residual Fuel Oil	CH4	0,016	2,50	10,0	10,3	0,00000
1.A.2.f. Textile	Gas / Diesel oil	CH4	0,016	0,0	5,0	5,0	0,00000
1.A.2.a. Iron and Steel	Gas / Diesel oil	CH4	0,014	0,0	5,0	5,0	0,00000
1.A.2.f. Road Motor Vehicles	Gas / Diesel oil	CH4	0,014	0,0	5,0	5,0	0,00000
1.A.2.b. Non-Ferrous Metals	Residual Fuel Oil	CH4	0,014	2,50	10,0	10,3	0,00000
1.A.2.f. Road Motor Vehicles	Gasoline	N2O	0,013	16,0	16,0	22,6	0,00000
1.A.2.f. Other Industries	LPG	CH4	0,012	2,5	10,0	10,3	0,00000
1.A.2.f. Textile	LPG	CH4	0,011	2,5	10,0	10,3	0,00000
1.A.2.a. Iron and Steel	Residual Fuel Oil	N2O	0,010	2,50	16,0	16,2	0,00000
1.A.2.f. Sugar	Gasoline	N2O	0,010	16,0	16,0	22,6	0,00000
1.A.2.f. Fertilizer	Residual Fuel Oil	CH4	0,009	2,50	10,0	10,3	0,00000
1.A.2.f. Fertilizer	Gas / Diesel oil	N2O	0,008	0,0	5,0	5,0	0,00000
1.A.2.f. Ceramics	Residual Fuel Oil	CH4	0,008	2,50	10,0	10,3	0,00000
1.A.2.d. Pulp, Paper and Print	LPG	N2O	0,006	2,5	16,0	16,2	0,00000

A7.2 Uncertainty analysis (cont.)

CATEGORY	FUEL	GAS	2012	Activity data Unc. (%)	Emis fact. Unc. (%)	Combined Unc. (%)	Combined uncertainty as % of total national emissions in year 2011
1.A.2.f. Cement Production	Gas / Diesel oil	CH4	0,006	0,0	5,0	5,0	0,00000
1.A.2.b. Non-Ferrous Metals	Gas / Diesel oil	CH4	0,005	0,0	5,0	5,0	0,00000
1.A.2.e. Food Processing, Beverages and Tobacco	Gas / Diesel oil	N2O	0,004	0,0	5,0	5,0	0,00000
1.A.2.f. Road Motor Vehicles	Gasoline	CH4	0,003	10,0	10,0	14,1	0,00000
1.A.2.f. Road Motor Vehicles	LPG	N2O	0,002	2,5	16,0	16,2	0,00000
1.A.2.a. Iron and Steel	Residual Fuel Oil	CH4	0,002	2,50	10,0	10,3	0,00000
1.A.2.f. Sugar	Gasoline	CH4	0,002	10,0	10,0	14,1	0,00000
1.A.2.f. Fertilizer	Gas / Diesel oil	CH4	0,002	0,0	5,0	5,0	0,00000
1.A.2.d. Pulp, Paper and Print	LPG	CH4	0,001	2,5	10,0	10,3	0,00000
1.A.2.e. Food Processing, Beverages and Tobacco	Gas / Diesel oil	CH4	0,001	0,0	5,0	5,0	0,00000
1.A.2.f. Textile	Residual Fuel Oil	N2O	0,001	2,50	16,0	16,2	0,00000
1.A.2.e. Food Processing, Beverages and Tobacco	LPG	N2O	0,001	2,5	16,0	16,2	0,00000
1.A.2.f. Road Motor Vehicles	LPG	CH4	0,001	2,5	10,0	10,3	0,00000
1.A.2.f. Cement Production	LPG	N2O	0,001	2,5	16,0	16,2	0,00000
1.A.2.d. Pulp, Paper and Print	Gasoline	N2O	0,000	16,0	16,0	22,6	0,00000
1.A.2.f. Cement Production	Gasoline	N2O	0,000	16,0	16,0	22,6	0,00000
1.A.2.f. Other Industries	Gasoline	N2O	0,000	16,0	16,0	22,6	0,00000
1.A.2.f. Textile	Residual Fuel Oil	CH4	0,000	2,50	10,0	10,3	0,00000
1.A.2.e. Food Processing, Beverages and Tobacco	LPG	CH4	0,000	2,5	10,0	10,3	0,00000
1.A.2.f. Glass and Glass Products	Gasoline	N2O	0,000	16,0	16,0	22,6	0,00000
1.A.2.f. Cement Production	LPG	CH4	0,000	2,5	10,0	10,3	0,00000
1.A.2.f. Fertilizer	LPG	N2O	0,000	2,5	16,0	16,2	0,00000
1.A.2.e. Food Processing, Beverages and Tobacco	Gasoline	N2O	0,000	16,0	16,0	22,6	0,00000
1.A.2.a. Iron and Steel	Gasoline	N2O	0,000	16,0	16,0	22,6	0,00000
1.A.2.d. Pulp, Paper and Print	Gasoline	CH4	0,000	10,0	10,0	14,1	0,00000
1.A.2.f. Cement Production	Gasoline	CH4	0,000	10,0	10,0	14,1	0,00000
1.A.2.c. Chemicals	Gasoline	N2O	0,000	16,0	16,0	22,6	0,00000
1.A.2.f. Other Industries	Gasoline	CH4	0,000	10,0	10,0	14,1	0,00000
1.A.2.f. Glass and Glass Products	Gasoline	CH4	0,000	10,0	10,0	14,1	0,00000
1.A.2.f. Fertilizer	LPG	CH4	0,000	2,5	10,0	10,3	0,00000
1.A.2.e. Food Processing, Beverages and Tobacco	Gasoline	CH4	0,000	10,0	10,0	14,1	0,00000
1.A.2.a. Iron and Steel	Gasoline	CH4	0,000	10,0	10,0	14,1	0,00000
1.A.2.c. Chemicals	Gasoline	CH4	0,000	10,0	10,0	14,1	0,00000
6.C. Waste Incineration		CO2	IE	16,0	16,0	22,6	-
6.C. Waste Incineration		CH4	IE	16,0	16,0	22,6	-
1.A.3.b. Road Transportation	Natural Gas	CO2	IE	-	-	-	-
1.A.3.b. Road Transportation	Natural Gas	CH4	IE	-	-	-	-
1.A.3.b. Road Transportation	Natural Gas	N2O	IE	-	-	-	-
2.C.2. Ferroalloys Production		CO2	IE	0,00	1,0	1,0	-
2.A.3. Limestone and Dolomite Use (Mineral Products)		CO2	IE	15,0	1,0	15,0	-
2.C.3. Aluminium Production		CO2	C	0,00	1,0	1,0	-
2.B.1. Ammonia Production		CO2	C	24,00	1,0	24,0	-
2.B.4.2. Carbide Production		CO2	C	45,00	1,0	45,0	-
2.B.2. Nitric Acid Production (Chemical Industry)		N2O	C	9,00	1,0	9,1	-
2.C.3. Aluminium Production		CF4	C	0,00	1,0	1,0	-
2.C.3. Aluminium Production		C2F6	C	0,00	1,0	1,0	-
2.A.4.1. Soda Ash Production and Use (Mineral Products)		CO2	C	45,0	1,0	45,0	-
Total							5,9

References

EMEP, 1999, EMEP / CORINAIR – Emission Inventory Guidebook.

ETKB, 1990 - 2011. Enerji ve Tabii Kaynaklar Bakanlığı – Enerji ve petrol denge tabloları.

IPCC, 1996. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (volume 3.) – Greenhouse Gas Inventory Reference Manual.

IPCC, 2000. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories - Intergovernmental Panel on Climate Change.

IPCC, 2002. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories - Intergovernmental Panel on Climate Change.

IPCC. 2003. Good Practice Guidance for Land Use, Land Use Change and Forestry. Available at<http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

Kırnak H., Küsek G., 2006. Enabling Activities For The Preparation Of Turkey's initial National Communication to the UNFCCC - Under the UNDP-GEF Project.

NIR, 2006. TURKEY Greenhouse Gas Inventory,1990 to 2004. Annual Report for submission under the Framework Convention on Climate Change.

NIR, 2007. TURKEY Greenhouse Gas Inventory,1990 to 2005. Annual Report for submission under the Framework Convention on Climate Change.

NIR, 2008. TURKEY Greenhouse Gas Inventory,1990 to 2006. Annual Report for submission under the Framework Convention on Climate Change.

NIR, 2009. TURKEY Greenhouse Gas Inventory,1990 to 2007. Annual Report for submission under the Framework Convention on Climate Change.

NIR, 2010. TURKEY Greenhouse Gas Inventory,1990 to 2008. Annual Report for submission under the Framework Convention on Climate Change.

NIR, 2011. TURKEY Greenhouse Gas Inventory,1990 to 2009. Annual Report for submission under the Framework Convention on Climate Change.

NIR, 2012. TURKEY Greenhouse Gas Inventory,1990 to 2010. Annual Report for submission under the Framework Convention on Climate Change.

NIR, 2013. TURKEY Greenhouse Gas Inventory,1990 to 2011. Annual Report for submission under the Framework Convention on Climate Change.

Soruşbay C., Ergeneman M., 2006. Greenhouse Gas Emissions Resulting from transport sector in Turkey (Inventory Analysis and Projections) – Final Report.

TTGV, 2006. Greenhouse Gas Emissions resulting from HFCs, PFCs and SF6 emissions (Under the UNDP-GEF project) – Final Report (Demirkol M.K. and Dündar A.K).

Ünal A., 2006. Final Report for the LULUCF Forestry Group Concerning the Estimation of Net Annual Amount of Carbon Uptake or Release in the Forests of Turkey.

Alemdağ, I.S., 1983. Mass Equations and Merchantability Factors for Ontario Softwoods. Canadian Forestry Service, Petawawa National Forestry Institute, Chalk River, Ontario. Information Report PI-X-23.

Alemdağ, I.S., 1984. Total Tree and Merchantable Stem Biomass Equations For Ontario Hardwoods.Agriculture Canada, Ministry of State for Forestry, Petawawa National Forestry Institute, Chalk River ON. Information Report PI-X-046.

Asan, Ü., 1999. Climate Change, Carbon Sinks and the Forests of Turkey. Proceedings of the International Conference on Tropical Forests and Climate Change: Status, Issues and Challenges (TFCC'98). pp.157-170.

Asan, Ü., 2006. Final Report for the LULUCF Forestry Group Concerning the Estimation of Net Annual Amount of Carbon Uptake or Release in the Forests of Turkey.

As, N., Koç, H., Doğu, D., Atik, C., Aksu, B., Erdinler, S., 2001: Türkiye'deYetişenEndüstriyelÖnemeSahipAğaçlarınAnatomik, Fiziksel, MekanikveKimyasalÖzellikleri. İ.Ü. OrmanFakültesiDergisi, Seri B, Sayı: 1, p.71-88.

Birler, S., 2010. Türkiye'de Kavak Yetiştirme.

GDF, 1956. Forest Legislation (Law No: 6831)

GDF, 2004.Turkish Forest Inventory.

GDF, 2005.Turkish Forest Inventory.

GDF, 2006. Turkey's Forest Existence. 160p.

GDF, 2008a.Turkish Forest Inventory.

GDF, 2008b. Sürdürülebilir Orman Yönetimi Kriter ve Göstergeleri 2008 Yılı Raporu. 147pp.

GDF, 2009a. GDF Strategic Plan (2010-2014).

GDF, 2009b.Turkish Forest Inventory.

GDF, 2010a.Turkish Forest Inventory.

GDF, 2010b. GENERAL DIRECTORATE OF FORESTRY STRATEGIC PLAN 2010-2014. 138pp, http://web.ogm.gov.tr/birimler/merkez/StratejiGelistirme/Dokumanlar/Stratejik_Planlama/STRATEJİK%20PLAN_İNG_20_06_2011.pdf, access Date: 25.12.2012.

GDF, 2011.Turkish Forest Inventory.

GDF, 2012a.Turkish Forest Existance-2012.GDF Forest Management and Planning Department, 26p.

GDF, 2012b.Forest Fires in 2012b.GDF Fighting with Forest Fires Department.

GDF, 2013. Forest Fires in 2012b. GDF Fighting with Forest Fires Department.

Guneş, Y., Coşkun, A.A., 2008.Trends in Forest Ownership, Forest Resources Tenure and Institutional Arrangements: Are They Contributing to Better Forest Management and Poverty Reduction? A Case Study from Turkey. 20pp, http://www.fao.org/forestry/16407-0c0665eddd86a68c9fbbc87cdde52501c.pdf, Access Date: 14.12.2012.

Gülbaba, G., 2010. DOA Dergisi. Doğu Akdeniz ormancılık araştırma Müdürlüğü.

Küçük, Ö.,Bilgili, E., 2007. Crown Fuel Load for Young Calabrian Pine (*Pinusbrutia*Ten.) Trees.Vol.7, No.2, ISSN 1303-2399, Journal of Forestry Faculty, Kastamonu University, Kastamonu.

MEF, 2009. Forestry Statistics 2007. 59pp, Publication Number: 371.

MEF, 2010. Forestry Statistics 2008. 65pp, Publication Number: 384,ISBN 978-605-393-047-1.

MFWA, 2012. Forestry Statistics 2010. 84pp, Publication Number: 01, ISBN 978-605-4610-00-6.

MENR, 2006.Ministry of Energy and Natural Resources, Energy and Petroleum Balance Tables.

Raev, I., Asan, Ü.,Grozev, O., 1997. Accumulation of CO_2 in the Aboveground Biomass of the Forests In Bulgaria And Turkey In The Recent Decades. Proceedings of the XI world Forestry Congress.Vol.1, pp.131-138.

Tolunay, D., 2011. Total carbon stocks and carbon accumulation in living tree biomass in forest ecosystems of Turkey. Turk J Agric For, Volume: 35, http://scholar.googleusercontent.com/scholar?q=cache:oaKpfY--8DAJ:scholar.google.com/+Total+carbon+stocks+and+carbon+accumulation+in+living+tree+biomass+in+forest+ecosystems+of+Turkey&hl=tr&as_sdt=0&as_vis=1, doi:10.3906/tar-0909-369, pp.265-279, Access Date: 22.12.2011.

TRGM, 1980. Digitized Land Cover Map of 1980.

TRGM, 2000. Corine 2000.

TRGM, 2006. Corine 2006.

TRGM, 2010. STATIP 2010.

TTGV, 2006.Greenhouse Gas Emissions Resulting from HFCs, PFCs and SF_6 emissions (Under the UNDP-GEF project) – Final Report (Demirkol M.K. and Dündar A.K).

Zabek, L.M., Prescott, C.E., 2006. Forest Ecology and Management Volume 223, Issues 1–3, pp.291–302.