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Management
Air Management Department

Turkey's

Informative Inventory Report

(IIR) 2017

TURKEY'S INFORMATIVE INVENTORY REPORT

MINISTRY OF ENVIRONMENT AND URBANIZATION

GENERAL DIRECTORATE for ENVIRONMENTAL MANAGEMENT

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DATA SHEET

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Contacts:

Canan Esin KOKSAL

Ministry of Environment and Urbanization

Tel.:+ 90 312 586 31 55

email: cesin.koksal@csb.gov.tr

Irde CETINTURK GURTEPE

Ministry of Environment and Urbanization

Tel.:+ 90 312 586 31 52

email: irde.gurtepe@csb.gov.tr

Content

ABBREVIATIONS

CLRTAP	Convention on Long Range Transboundary Air Pollution
EMEP	European Monitoring and Evaluation Programme
IEC	Improving Emission Control
NFR	Nomenclature for reporting
IIR	Informative Inventory Report
MoEU	Ministry of Environment and Urbanization
EU	European Union
IPPC	Integrated Pollution Prevention and Control
NECD	National Emission Ceilings Directive
TurkStat	Turkish Statistical Institute
EEA	European Environment Agency
GHG	Green House Gas
EF	Emissions factor
GAINS	Greenhouse Gas and Air Pollution Interactions and Synergies (see IIASA)
GB GDP	EMEP/EEA Emissions Inventory Guidebook Gross Domestic Product
GHG	Greenhouse gas
HGV	Heavy-Goods Vehicle
IE IEA	(Emissions) Included elsewhere Improving Emissions Control
IIASA	International Institute for Applied Systems Analysis
IPCC IT	Intergovernmental Panel on Climate Change Information Technologies
KCA	Key category assessment
LDV	Light-duty vehicle
LTO	Landing and take-off
N	Nitrogen
N_2O	Nitrous oxide
NE	Not estimated
NECD	National Emission Ceilings Directive
NFR	Nomenclature for Reporting
NH_3	Ammonia
NMVOCs	Non-methane volatile organic compounds
NO	Not occurring
NOx	Oxides of nitrogen
QA/QC	Quality assurance / quality control
SO_2	Sulphur dioxide
TA	Technical Assistance
UA	Uncertainty analysis
UK	United Kingdom
VKM	Vehicle-kilometres

Executive Summary

Turkey has ratified the United Nations Convention on the Long Range Transboundary Air Pollution (CLRTAP) in 1983 and EMEP Protocol in 1985 and as a such has to report emission data annually.

As a party to the Convention and EMEP Protocol the first submission of emission data for 2008 was made in 2011. Revised calculations for historical emissions 1990-2010 was completed by Technical Assistance (TA) Project[1] on Improving of Emission Control in 2011 and checked in cooperation with *IEC Twinning project*.[2] Emission data of 2010 was reported on 15th February 2012. NFR tables with complete time series were submitted in April 2012. Four NECD pollutants (SO_2, NO_x, NMVOC, NH_3) as well as CO and PM_{10} were covered in the emission data. Third Informative Inventory Report (IIR) was submitted on 8th May 2013. A week after the submission date of the 3rd IIR, the 2013 annual TFEIP/EIONET meeting was held on 14th and 15th May in Istanbul, Turkey and was kindly hosted by the Turkish Ministry of Environment and Urbanization. The main meeting was preceeded by a workshop on emission inventory compilers and users on 13th May.

Inventory Awards 2013 have been conferred in six categories: most comprehensive IIR (Finland), best small country IIR (Croatia and Estonia), most transparent/good looking IIR (Sweden), significant IIR improvements (Poland), most complete reporting in 2013 (Spain) and most improved inventory reporting within the last 3 years (Turkey).

4th IIR was submitted on December 2014 for the UNECE CLRTAP air pollutant emission inventory and was prepared to provide information on calculation methods of sectoral emissions, to documentate activity data and emission factors and to present emission trends. The report was prepared together with the calculation sheets according to the UNECE 2009 template. The 5th IIR for

[1] Technical Assistance for Improving Emissions Control , TR802.03-02/001; EuropeAid/128897/D/SER/TR, http://nec.cygm.gov.tr/nec/AnaSayfa/Teknik-Yardim/GenelBilgi.aspx?sflang=en

[2] EU Twinning Project TR08IBEN02 on "Improving Emissions Control"; http://nec.cygm.gov.tr/nec/AnaSayfa/Project-NEC/General_Information.aspx?sflang=en

the UNECE CLRTAP air pollutant emission inventory and was prepared under the reporting guidelines which were revised on 2013 and reported in due time. This is the 6th IIR for the UNECE CLRTAP air pollutant emission inventory and was prepared under the the reporting guidelines which were revised on 2013 and 2016.

Ministry of Environment and Urbanization is designated as responsible institution for national emission inventory of air pollutants in the Official Statistic Programme. Turkey's National Greenhouse Gas Emissions Inventory is prepared by TURKSTAT. There has been a substantial number of discussion meetings on how data handling and emission calculation in these two emission inventories can be aligned, to ensure consistency. However much of the input data to the two emission inventories (the national energy balance tables in particular) are common to both, and that the emission inventories generally use a simple Tier approach, a degree of consistency should result. In the beginning of 2015, meetings were held with TURKSTAT regarding inventorial topics and consistency controls between the datasets. The sectors were evaluated within the topics of activity data and emission factors separately one by one. The final decision to ensure the consistency between the inventories will be taken after the category and sub-category comparison from TURKSTAT. Before the next cycle the integration status of the inventories both will be clear.

The trends in the emissions calculated for the submission on 2016 were highlited below;

- In 1990 national total for NO_x emissions was 564 Gg and have increased 57% to 883 Gg. From 2014 to 2015 NO_x emissions increased by 12%.
- In 1990 national total for NMVOC emissions was 943 Gg and have increased 18% to 1115 Gg. From 2014 to 2015 the NMVOC emission decreased by 3%.
- In 1990 national total for SO_2 emissions was 1750 Gg and have increased 11% to 1939 Gg. From 2014 to 2015 the SO_2 emission decreased by 10,5%.
- In 1990 national total for NH_3 emissions was 778 Gg and have increased by 113 % to 907 Gg. From 2014 to 2015 the NH_3 emission decreased by 0,4%.
- In 1990 national total for CO emissions was 2023 Gg and have increased by 16% to 2351 Gg. From 2014 to 2015 the CO emission increased by 18%.

- In 1990 national total for PM_{10} emissions was 713 Gg and have increased 16% to 829 Gg. From 2014 to 2015 the PM_{10} emission increased by 4%.

Key category analysis was carried out to present major sources of national total for each pollutant. NFR 1A1a "Public Electricty and Heat Production" is the dominant key source for SO_2 and NO_x, "Road Transport- Heavy Duty Vehicles" is the second source of NO_x. All of the key sources for the NH_3 are belong to agriculture sector. "NFR 1A4b-Residential Heating" is the first category for NMVOCs after the first key source category of agriculture (3Da3) repeatedly together with CO. Industrial processes, agriculture and waste are also the contributing sectors for MNVOCs. "2B 10a Chemical Industry" is the first sector for the PM_{10} emissions together with residential combustion.

The emission inventory management task under the Ministry of Environment and Urbanization is developing parallel with the conditions of the knowledge within the air quality and related sectors regarding emission inventory compilation, improvement, data gap filling, data modeling, GIS integration, spatial/temporal distributions and emission abatement together with the projections. In the context of this developing field a national funded project was approved and started in May 2013 to establish the integrated national air pollution emission management system. Having the system established, the automatization will be secured and the inventory will be completed by the algorithyms of the system structure. Improvement plan for the inventory is still continuing and still being revised. Due to this requirement lots of meetings were held with the data providers and related institutions. Also plant specific data is planned within the prioritization between the sectors and sub-sectors.

The report provides summary information on legal institutional and procedural arrangements in Turkey. Furthermore the report describes calculation methods and documents activity data and emission factors. Emission trends and significant emission sources are highlighted in relevant chapters.

Chapter 1 includes general information on organizational structure of Ministry of Environment and Urbanization, institutional arrangements for data flow to the inventory and institutional responsibilities for the inventory planning, preparation and management. **Chapter 2** provides information on key trends of emissions in sectoral basis and also shares of NFR subcategories in air pollutants are presented as tables. **Chapter 3-9** involves emission trends, emission factors, calculation methods and emissions in NFR sectors energy, industry, product use, agriculture, waste, natural respectively.**Chapter 10** includes improvement plans for the inventory.

This report was prepared by Air Management Department under the General Directorate for Environmental Management on the behalf of MoEU.

Head of Air Management Department is Betül AYDIN and manager for the preparation of the Turkey’s Air Pollutant Inventory is Ülkü Füsun ERTÜRK (Head of Division). Specific responsibilities for the preparation IIR 2017 have been as follows:

- Energy Sector: Canan Esin KÖKSAL
- Transport Sector: Evrim ÖZTÜRK
- Industry-Solvent Use Sector: İrde ÇETİNTÜRK GÜRTEPE
- Agriculture Sector: Ağcagül YILMAZ
- Waste Sector: Şeyma UÇAR

1 INTRODUCTION

1.1 National Inventory Background

The central governmental environmental structure in Turkey is the MoEU. The main responsibilities of the Ministry relate to the development of environmental strategy, policies and legislation concerning:

- protection and improvement of the environment,
- prevention and monitoring of environmental pollution,
- bringing in sustainable development principles, clean production, use of renewable resources,
- permitting, licensing, auditing, monitoring of all kinds of activities in case there might be environmental impacts,

MoEU is also responsible for enforcing legislative tools it developed and for providing coordination among stakeholders in environmental issues.

MoEU organisation includes eight General Directorates and several Departments in coordination of the Undersecretary who is directly subordinated to the Minister. The structures are presented in www.csb.gov.tr

DG Environmental Management, which directly involves into preparation of this report through the Air Management Department, comprises seven Departments:

- Water and Soil Management Department
- Waste Management Department
- Climate Change Department
- Air Management Department
- Chemicals Management Department
- Marine and Coastal Management Department
- Administrative Affairs and Finance Department

Explicitly, the Air Management Department retains the following main responsibilities:

- To prepare national emission inventory for air pollutants,
- To determine emission ceilings,
- To prepare emission projections,
- To transpose and coordinate the implementation of all air related Directives,

- To give opinion regarding the legislation for air pollution.

By the way MoEU enacted the By-Law on Control of Air Pollution Caused by Industry Facilities (03.07.2009 O.J. 27277) amending the By-Law on Control of Air Pollution from Industrial Plants (BCAPIP) published in O.J.26236, dated on 22.07.2006, amended by 10/10/2011 and 28080, setting facilities classification according to their capacities, and the related permitting competencies shared between Ministry of Environment and Urbanization and Provisional Directorates.

Moroever, there is other 5 By-Laws besides BCAPIP regarding exhaust, heat, odor, fuel oil and gas issues.

In each of the 81 Provinces a Provincial Directorate subordinated to the MoEU is established. The Provincial Directorates have the responsibility to implement environmental legislation at local level by means of permitting and inspection for facilities falling under their competencies according to the law.

Many of the EU funded projects have been completed in MoEU. Air related projects are listed below:

"Air Pollution Measurement and Monitoring Systems": It is a national project, which has been finalized in 2002.

"Analysis of Environmental Legislation in Turkey": This project was completed in 2002. An analysis of Turkish environmental legislation and the gaps according to EU legislation were given.

"Strengthening of the implementation of the Council Directive 96/62/EC and Council Decision 97/101/EC on ambient air quality assessment and management, and reciprocal information exchange in the Refik Saydam Hygiene Centre (RSHC), MoH, Turkey": Project has been carried out in the period of January 2003-December 2004 within the framework of the MATRA Pre-Accession Projects Program (MAT02/TR/9/2).

"Capacity Building (Human Resources Aspect) on the adoption of Integrated Pollution Prevention and Control Directive (IPPC-96/61/EC)": The project was supported by the Dutch PSO Program. The objective of the project was to develop in-depth understanding of the IPPC Directive and design an action plan for adoption and implementation in Turkey. The project was finalised in 2004.

EU-Twinning Project **"Air Quality, Chemicals, Waste-Component 1: Air Quality"** was completed in 2006. The transpositions of the Council-Directive 96/62/EC (Air Quality Framework Directive) including the 4 Daughter Directives and the Directive 2001/80/ EC (Large Combustion Plant Directive) into Turkish Legislation were drafted and agreed. Under this Project a series of studies related to air quality management were completed.

"IPPC Implementation in Turkey" MATRA programme was started in January 2006. The project purpose was to assist the Ministry of Environment and Urbanization with the implementation of the IPPC Directive. More specifically, the project leads to the preparation of a roadmap towards full implementation of the IPPC Directive in Turkey. The project completed in January 2008.

Under the IPA-1 2007 Programme, the project on **"Institutional Building of Air Quality in Marmara Region"** was finalized in 2013 aiming to implement the Air Quality Framework Directive and daughter directives' requirements, building up technical and administrative capacity and assessment and management of air quality.

"Support for Implementation of IPPC Directive in Turkey" project was accepted in IPA-2008 NP and has been conducted between 2011-2014.

"Improving Emissions Control" Project that aims to transpose 2001/81/EC National Emission Ceiling Directive(NEC) Technical Assistance part and Twinning part were completed respectively in 2013.

"Control of Industrial Volatile Organic Compound Emissions" Project part of IPA 2009 NP has the overall objective to enhance the Control of Volatile Organic Compound (VOC) emissions to improve environmental quality in Turkey and to reduce or prevent the potential risks to human health and to prevent ground level ozone pollution Twinning component on VOC control. The project is structured in two components: a Twinning component and a Technical Assistance component. Project finalized in 2014.

This submission includes the reporting details of the NECD pollutants SO_2, NO_x, NMVOC and NH_3 as well as CO and PM_{10} for the period 1990 – 2015.

1.2 Institutional Arrangements

Inventory was prepared by Air Management Department staff. The department structure was reorganized in the beginning of 2014 which was ended up with the separation of the two departments; Climate Change and Air Management.

Before the separation of the previous department, the data provider connections, working group strategy of the related institutions on the air emissions inventory, data flow chart within the inventory compilation process and the inventory management cycle were assessed and the decision on the organizational chart of these stakeholders/data providers/institutions was taken to establish the Coordination Board (CoBoard) on Air Emissions. The board was established by the Prime Ministerial Circular which set up at least a meeting to be organized between the high level representatives of the ministries involved in the air emission related topics as a whole. After the Circular No:2012/22, the structure of the climate change and air management department was changed twice. The first annual meeting of the Coordination Board was held finally on 7th of May 2014 with the change of the establishing Circular (No: 2013/11) and the structure of the related departments which were separated before the mentioned meeting. The new CoBoard was named Climate Change and Air Management and was decided to establish a working group on air management (AMWG) whose study fields will be air pollutant emission inventory, air pollutant emission abatement and the evaluation of the effects related to air pollution and transportation of the pollutants. The first meeting of the Air Management WG was held on 2th December 2014 and the workplan of the WG was approved.

The national funded project (which will be written as EMISSION-111G037 here and after) will serve the strong basis and the structure of the whole chart of the air pollutant emission inventory. EMISSION-111G037 is the key for the continuous improvement only with the structure of itself. Data collection will be set with an agenda between the data providers and collected data will be integrated directly to the system as input files.

Together with the methodological revision under UNFCCC reporting guidelines, the air pollutant emission inventory could serve the calculation itself directly to the pollutants which are same in the GHG emission inventory. By 2015, IPCC 2006 Guidelines will be cited in the calculations and the emission inventory compilation of the emissions of pollutants in the GHG inventory which are mentioned under UNECE CLRTAP EMEP/EEA Guidebook. Therefore the unique air pollutant emission calculation and inventory structure is unavoidable. TurkSTAT is also aware of this situation and within the meetings which were held to understand the differences between the two inventories resulted in the agreed conclusion. Integrated working group studies were held in 2016 and 2017 with TURKSTAT and main categories were revised within the activity data checks and emission factor selections.

The 2nd Stage-3 review of Turkey was executed in 2016. The report will be used like the one in 2012 for continuous improvement under the reporting cycles.

1.3 Inventory Preparation Process

Inventory preparation includes three stages;

- inventory planning,
- inventory compilation and
- inventory management.

1.3.1 Inventory Planning

Inventory was prepared by Air Quality Assessment Division staff under Air Management Department.

Ministry of Energy and Natural Resources, Ministry of Transport, Maritime Affairs and Communication and Ministry of Food, Agriculture and Livestock were the main data providers.

Data flow for the upcoming years are planned to be achieved by EMISSION-111G037 project.

After the revision of the EMEP/EEA Guidebook, last year the update was done on the annexes of the reporting instructions by means of EF revisions, category changes, etc. This year both the NFR template and IIR template were revised by the 2013 versions mentioned under the EMEP/EEA Guidebook and Reporting Instructions on www.ceip.at

1.3.2 Inventory Preparation

For this inventory the calculations of all emissions for the whole period and all NFR sectors were carried out by national inventory experts from MoEU. Excel-based database (raw data, calculation sheets and output data) was prepared by the MoEU as well. "Raw data" folder consists of subfolders for each of the NFR sectors. Folders wre also consists of the reference documents, background documents, downloads, emails, etc. "Calculation sheets" folder includes excel spreadsheets for each NFR sector.

Spreadsheets also keep the emission factors used within the calculations of each sectors' emissions. "Outputs" folder involves revised (2013 NFR template) files that used for sumbission.

1.3.3 Inventory Management

The task and the responsibility of inventory compilation and management is given to the Air Quality Assessment Division under DG for Environmental Managament, MoEU.

Database folders with all relevant information (calcualtion sheets, documentation, activity data, downloaded documents, reference papers and other relevant information) are placed in one computer in the Ministry. All members of inventory team were defined as users of this computer. Data management and archive system were established.

Quality management system for the inventory will be configured and further implemented by Air Quality Assessment Division at MoEU.

1.4 Methods and Data Sources

Emission estimates were prepared in line with EMEP/EEA Emission Inventory Guidebook (2013 version). Mostly default factors were used for calculations while national factors are not available. Summary information on source of activity data and emission factors used are presented in Table 1.1. Different approach was used for the sectors below;

- Road transport – COPERT software was used for 2012, 2013 for the submission in 2016. This year the emissions for road transport were calculated with COPERT covering 2000-2015.

The national energy balance tables are key sources of information, in particular the use of fuel in different sectors. However there are some significant limitations with these data. For example the fuel used in the road transport sector is simply reported as "petroleum", with no petrol/diesel split. In 2013 format of National Energy Balance Tables were changed, some of the industrial sectors were resolved. Therefore calculation sheets were changed accordingly covering this year's calculations. The same situation was remained. The sub-sectors in the energy balance table were again reorganized. The petroleum split appointments and meetings with the Ministry of Energy and Natural Resources (MoENR) were resulted in success on 2014. The petroleum split will be used for the next cycles together with the recalculations due to the reconstruction of the web page for data sharing from the MoENR.

Source of activity data and methods that used in calculations are given in the Annex.

1.5 Key Category Analysis

The identification of key categories is described in the "Good Practice Guidance for LRTAP Emission Inventories" (see Chapter 2 of the EMEP/EEA emission inventory guidebook and IPCC Good Practice Guidance (IPCC-GPG, 2000), Chapter 7). It stipulates that "***a key category is one that is prioritised within the National System because its estimate has a significant influence on a country's total inventory of air emission in terms of the absolute level of emissions, the trend in emissions, or both."***

As stated in the "Good Practice Guidance for LRTAP Emission Inventories", it is good practice to identify the national key categories in a systematic and objective manner. This can be achieved by a quantitative analysis of the relationship between the magnitude of emission in any one year (level) and the change in emission year to year (trend) of each category's emissions compared to the total national emissions; to choose the parameter which is considered as key also depends on the application of the inventory; for compliance assessments the trend is essential, whereas in the case that emission reporting obligations are formulated as emission ceilings, the emission level uncertainty is relevant.

All notations, descriptions of identification and results for key categories included in this chapter are based on the Good Practice Guidance.

The identification includes all NFR categories and all reported gases:

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10}

5.3. Methodology – Approach 1

The methodology follows the IPCC approach to produce pollutant-specific key categories and covers for both level and trend assessments. In Approach 1, key categories are identified using a predetermined cumulative emissions threshold. Key categories are those which, when summed together in descending order of magnitude, cumulatively add up to 80% of the total level.

5.4. Identification of Source Categories

The revised EMEP/EEA Guidebook consists of combined and divided NFR categories which are directly addressing the codes and the sector connections.

EMEP/EEA GUIDEBOOK 2009 VERSION				EMEP/EEA GUIDEBOOK 2013 VERSION		
A_PublicPower	1 A 1 a	(a)	1 A 1 a Public electricity and heat production	A_PublicPower	1A1a	Public electricity and heat production
B_IndustrialComb	1 A 1 b	(a)	1 A 1 b Petroleum refining	B_Industry	1A1b	Petroleum refining
B_IndustrialComb	1 A 1 c	(a)	1 A 1 c Manufacture of solid fuels and other energy industries	B_Industry	1A1c	Manufacture of solid fuels and other energy industries
B_IndustrialComb	1 A 2 a	(a)	1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	B_Industry	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel
B_IndustrialComb	1 A 2 b	(a)	1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	B_Industry	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals
B_IndustrialComb	1 A 2 c	(a)	1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	B_Industry	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals
B_IndustrialComb	1 A 2 d	(a)	1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	B_Industry	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print
B_IndustrialComb	1 A 2 e	(a)	1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	B_Industry	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco
B_IndustrialComb	1 A 2 f i		1 A 2 f i Stationary combustion in manufacturing industries and construction: Other (Please specify in your IIR)	B_Industry	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals
I_OffRoadMob	1 A 2 f ii		1 A 2 f ii Mobile Combustion in manufacturing industries and construction: (Please specify in your IIR)	I_Offroad	1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)

EMEP/EEA GUIDEBOOK 2009 VERSION				EMEP/EEA GUIDEBOOK 2013 VERSION		
J_ AviLTO	1 A 3 a ii (i)		1 A 3 a ii (i) Civil aviation (Domestic, LTO)	B_Industry	1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)
J_AviLTO	1 A 3 a i (i)		1 A 3 a i (i) International aviation (LTO)	H_Aviation	1A3ai(i)	International aviation LTO (civil)
G_RoadRail	1 A 3 b i		1 A 3 b i Road transport: Passenger cars	H_Aviation	1A3aii(i)	Domestic aviation LTO (civil)
G_RoadRail	1 A 3 b ii		1 A 3 b ii Road transport:Light duty vehicles	F_RoadTransport	1A3bi	Road transport: Passenger cars
G_RoadRail	1 A 3 b iii		1 A 3 b iii Road transport:, Heavy duty vehicles	F_RoadTransport	1A3bii	Road transport: Light duty vehicles
G_RoadRail	1 A 3 b iv		1 A 3 b iv Road transport: Mopeds & motorcycles	F_RoadTransport	1A3biii	Road transport: Heavy duty vehicles and buses
G_RoadRail	1 A 3 b v		1 A 3 b v Road transport: Gasoline evaporation	F_RoadTransport	1A3biv	Road transport: Mopeds & motorcycles
G_RoadRail	1 A 3 b vi		1 A 3 b vi Road transport: Automobile tyre and brake wear	F_RoadTransport	1A3bv	Road transport: Gasoline evaporation
G_RoadRail	1 A 3 b vii		1 A 3 b vii Road transport: Automobile road abrasion	F_RoadTransport	1A3bvi	Road transport: Automobile tyre and brake wear
G_RoadRail	1 A 3 c	(a)	1 A 3 c Railways	F_RoadTransport	1A3bvii	Road transport: Automobile road abrasion
H_Shipping	1 A 3 d i (ii)		1 A 3 d i (ii) International inland waterways	I_Offroad	1A3c	Railways
H_Shipping	1 A 3 d ii	(a)	1 A 3 d ii National navigation (Shipping)	G_Shipping	1A3di(ii)	International inland waterways
B_IndustrialComb	1 A 3 e		1 A 3 e Pipeline compressors	G_Shipping	1A3dii	National navigation (shipping)
C_SmallComb	1 A 4 a i		1 A 4 a i Commercial / institutional: Stationary	I_Offroad	1A3ei	Pipeline transport
I_OffRoadMob	1 A 4 a ii		1 A 4 a ii Commercial / institutional: Mobile	I_Offroad	1A3eii	Other (please specify in the IIR)

EMEP/EEA GUIDEBOOK 2009 VERSION				EMEP/EEA GUIDEBOOK 2013 VERSION		
C_SmallComb	1 A 4 b i		1 A 4 b i Residential: Stationary plants	C_OtherStationaryComb	1A4ai	Commercial/institutional: Stationary
I_OffRoadMob	1 A 4 b ii		1 A 4 b ii Residential: Household and gardening (mobile)	I_Offroad	1A4aii	Commercial/institutional: Mobile
C_SmallComb	1 A 4 c i		1 A 4 c i Agriculture/Forestry/Fishing: Stationary	C_OtherStationaryComb	1A4bi	Residential: Stationary
I_OffRoadMob	1 A 4 c ii		1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	I_Offroad	1A4bii	Residential: Household and gardening (mobile)
H_Shipping	1A 4 c iii		1A 4 c iii Agriculture/Forestry/Fishing: National fishing	C_OtherStationaryComb	1A4ci	Agriculture/Forestry/Fishing: Stationary
C_SmallComb	1 A 5 a	(a)	1 A 5 a Other stationary (including military)	I_Offroad	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery
I_OffRoadMob	1 A 5 b	(a)	1 A 5 b Other, Mobile (including military, land based and recreational boats)	I_Offroad	1A4ciii	Agriculture/Forestry/Fishing: National fishing
E_Fugitive	1 B 1 a	(a)	1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	C_OtherStationaryComb	1A5a	Other stationary (including military)
E_Fugitive	1 B 1 b	(a)	1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	I_Offroad	1A5b	Other, Mobile (including military, land based and recreational boats)
E_Fugitive	1 B 1 c	(a)	1 B 1 c Other fugitive emissions from solid fuels	D_Fugitive	1B1a	Fugitive emission from solid fuels: Coal mining and handling
E_Fugitive	1 B 2 a i		1 B 2 a i Exploration, production, transport	D_Fugitive	1B1b	Fugitive emission from solid fuels: Solid fuel transformation
E_Fugitive	1 B 2 a iv		1 B 2 a iv Refining / storage	D_Fugitive	1B1c	Other fugitive emissions from solid fuels
E_Fugitive	1 B 2 a v		1 B 2 a v Distribution of oil products	D_Fugitive	1B2ai	Fugitive emissions oil: Exploration, production, transport
E_Fugitive	1 B 2 b	(a)	1 B 2 b Natural gas	D_Fugitive	1B2aiv	Fugitive emissions oil: Refining / storage
E_Fugitive	1 B 2 c	(a)	1 B 2 c Venting and flaring	D_Fugitive	1B2av	Distribution of oil products

EMEP/EEA GUIDEBOOK 2009 VERSION				EMEP/EEA GUIDEBOOK 2013 VERSION		
E_Fugitive	1 B 3		1 B 3 Other fugitive emissions from geothermal energy production , peat and other energy extraction not included in 1 B 2	D_Fugitive	1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)
D_IndProcess	2 A 1	(a)	2 A 1 Cement production	D_Fugitive	1B2c	Venting and flaring (oil, gas, combined oil and gas)
D_IndProcess	2 A 2	(a)	2 A 2 Lime production	D_Fugitive	1B2d	Other fugitive emissions from energy production
D_IndProcess	2 A 3	(a)	2 A 3 Limestone and dolomite use	B_Industry	2A1	Cement production
D_IndProcess	2 A 4	(a)	2 A 4 Soda ash production and use	B_Industry	2A2	Lime production
D_IndProcess	2 A 5	(a)	2 A 5 Asphalt roofing	B_Industry	2A3	Glass production
D_IndProcess	2 A 6	(a)	2 A 6 Road paving with asphalt	B_Industry	2A5a	Quarrying and mining of minerals other than coal
D_IndProcess	2 A 7 a		2 A 7 a Quarrying and mining of minerals other than coal	B_Industry	2A5b	Construction and demolition
D_IndProcess	2 A 7 b		2 A 7 b Construction and demolition	B_Industry	2A5c	Storage, handling and transport of mineral products
D_IndProcess	2 A 7 c		2A 7 c Storage, handling and transport of mineral products	B_Industry	2A6	Other mineral products (please specify in the IIR)
D_IndProcess	2 A 7 d		2 A 7 d Other Mineral products (Please specify the sources included/excluded in the notes column to the right)	B_Industry	2B1	Ammonia production
D_IndProcess	2 B 1	(a)	2 B 1 Ammonia production	B_Industry	2B2	Nitric acid production
D_IndProcess	2 B 2	(a)	2 B 2 Nitric acid production	B_Industry	2B3	Adipic acid production
D_IndProcess	2 B 3	(a)	2 B 3 Adipic acid production	B_Industry	2B5	Carbide production
D_IndProcess	2 B 4	(a)	2 B 4 Carbide production	B_Industry	2B6	Titanium dioxide production

EMEP/EEA GUIDEBOOK 2009 VERSION				EMEP/EEA GUIDEBOOK 2013 VERSION		
D_IndProcess	2 B 5 a		2 B 5 a Other chemical industry (Please specify the sources included/excluded in the notes column to the right)	B_Industry	2B7	Soda ash production
D_IndProcess	2 B 5 b		2 B 5 b Storage, handling and transport of chemical products (Please specify the sources included/excluded in the notes column to the right)	B_Industry	2B10a	Chemical industry: Other (please specify in the IIR)
D_IndProcess	2 C 1	(a)	2 C 1 Iron and steel production	B_Industry	2B10b	Storage, handling and transport of chemical products (please specify in the IIR)
D_IndProcess	2 C 2	(a)	2 C 2 Ferroalloys production	B_Industry	2C1	Iron and steel production
D_IndProcess	2 C 3	(a)	2 C 3 Aluminum production	B_Industry	2C2	Ferroalloys production
D_IndProcess	2 C 5 a		2 C 5 a Copper production	B_Industry	2C3	Aluminium production
D_IndProcess	2 C 5 b		2 C 5 b Lead production	B_Industry	2C4	Magnesium production
D_IndProcess	2 C 5 c		2 C 5 c Nickel production	B_Industry	2C5	Lead production
D_IndProcess	2 C 5 d		2 C 5 d Zinc production	B_Industry	2C6	Zinc production
D_IndProcess	2 C 5 e		2 C 5 e Other metal production (Please specify the sources included/excluded in the notes column to the right)	B_Industry	2C7a	Copper production
D_IndProcess	2 C 5 f		2 C 5 f Storage, handling and transport of metal products (Please specify the sources included/excluded in the notes column to the right)	B_Industry	2C7b	Nickel production
D_IndProcess	2 D 1	(a)	2 D 1 Pulp and paper	B_Industry	2C7c	Other metal production (please specify in the IIR)
D_IndProcess	2 D 2	(a)	2 D 2 Food and drink	B_Industry	2C7d	Storage, handling and transport of metal products (please specify in the IIR)
D_IndProcess	2 D 3		2 D 3 Wood processing	E_Solvents	2D3a	Domestic solvent use including fungicides

EMEP/EEA GUIDEBOOK 2009 VERSION				EMEP/EEA GUIDEBOOK 2013 VERSION		
D_IndProcess	2 E		2 E Production of POPs	E_Solvents	2D3b	Road paving with asphalt
D_IndProcess	2 F		2 F Consumption of POPs and heavy metals (e.g. electricial and scientific equipment)	B_Industry	2D3c	Asphalt roofing
D_IndProcess	2 G		2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded	B_Industry	2D3d	Coating applications
F_Solvents	3 A 1		3 A 1 Decorative coating application	E_Solvents	2D3e	Degreasing
F_Solvents	3 A 2		3 A 2 Industrial coating application	E_Solvents	2D3f	Dry cleaning
F_Solvents	3 A 3		3 A 3 Other coating application (Please specify the sources included/excluded in the notes column to the right)	E_Solvents	2D3g	Chemical products
F_Solvents	3 B 1		3 B 1 Degreasing	E_Solvents	2D3h	Printing
F_Solvents	3 B 2		3 B 2 Dry cleaning	E_Solvents	2D3i	Other solvent use (please specify in the IIR)
F_Solvents	3 C	(a)	3 C Chemical products	E_Solvents	2G	Other product use (please specify in the IIR)
F_Solvents	3 D 1		3 D 1 Printing	B_Industry	2H1	Pulp and paper industry
F_Solvents	3 D 2		3 D 2 Domestic solvent use including fungicides	B_Industry	2H2	Food and beverages industry
F_Solvents	3 D 3		3 D 3 Other product use	B_Industry	2H3	Other industrial processes (please specify in the IIR)
O_AgriLivestock	4 B 1 a	(a)	4 B 1 a Cattle dairy	B_Industry	2I	Wood processing
O_AgriLivestock	4 B 1 b	(a)	4 B 1 b Cattle non-dairy	B_Industry	2J	Production of POPs
O_AgriLivestock	4 B 2	(a)	4 B 2 Buffalo	B_Industry	2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)

EMEP/EEA GUIDEBOOK 2009 VERSION				EMEP/EEA GUIDEBOOK 2013 VERSION		
O_AgriLivestock	4 B 3	(a)	4 B 3 Sheep	B_Industry	2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)
O_AgriLivestock	4 B 4	(a)	4 B 4 Goats	K_AgriLivestock	3B1a	Manure management - Dairy cattle
O_AgriLivestock	4 B 6	(a)	4 B 6 Horses	K_AgriLivestock	3B1b	Manure management - Non-dairy cattle
O_AgriLivestock	4 B 7	(a)	4 B 7 Mules and asses	K_AgriLivestock	3B2	Manure management - Sheep
O_AgriLivestock	4 B 8	(a)	4 B 8 Swine	K_AgriLivestock	3B3	Manure management - Swine
O_AgriLivestock	4 B 9 a		4 B 9 a Laying hens	K_AgriLivestock	3B4a	Manure management - Buffalo
O_AgriLivestock	4 B 9 b		4 B 9 b Broilers	K_AgriLivestock	3B4d	Manure management - Goats
O_AgriLivestock	4 B 9 c		4 B 9 c Turkeys	K_AgriLivestock	3B4e	Manure management - Horses
O_AgriLivestock	4 B 9 d		4 B 9 d Other poultry	K_AgriLivestock	3B4f	Manure management - Mules and asses
O_AgriLivestock	4 B 13	(a)	4 B 13 Other	K_AgriLivestock	3B4gi	Manure mangement - Laying hens
P_AgriOther	4 D 1 a	(b)	4 D 1 a Synthetic N-fertilizers	K_AgriLivestock	3B4gii	Manure mangement - Broilers
P_AgriOther	4 D 2 a		4 D 2 a Farm-level agricultural operations including storage, handling and transport of agricultural products	K_AgriLivestock	3B4giii	Manure mangement - Turkeys
P_AgriOther	4 D 2 b		4 D 2 b Off-farm storage, handling and transport of bulk agricultural products	K_AgriLivestock	3B4giv	Manure management - Other poultry
P_AgriOther	4 D 2 c		4 D 2 c N-excretion on pasture range and paddock unspecified (Please specify the sources included/excluded in the notes column to the right)	K_AgriLivestock	3B4h	Manure management - Other animals (please specify in IIR)

EMEP/EEA GUIDEBOOK 2009 VERSION				EMEP/EEA GUIDEBOOK 2013 VERSION		
Q_AgriWastes	4 F	(a)	4 F Field burning of agricultural wastes	L_AgriOther	3Da1	Inorganic N-fertilizers (includes also urea application)
P_AgriOther	4 G	(a)	4 G Agriculture other(c)	L_AgriOther	3Da2a	Animal manure applied to soils
L_OtherWasteDisp	6 A	(a)	6 A Solid waste disposal on land	L_AgriOther	3Da2b	Sewage sludge applied to soils
M_WasteWater	6 B	(a)	6 B Waste-water handling	L_AgriOther	3Da2c	Other organic fertilisers applied to soils (including compost)
N_WasteIncin	6 C a		6 C a Clinical wasteincineration (d)	L_AgriOther	3Da3	Urine and dung deposited by grazing animals
N_WasteIncin	6 C b		6 C b Industrial waste incineration (d)	L_AgriOther	3Da4	Crop residues applied to soils
N_WasteIncin	6 C c		6 C c Municipal waste incineration (d)	L_AgriOther	3Db	Indirect emissions from managed soils
N_WasteIncin	6 C d		6 C d Cremation	L_AgriOther	3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products
N_WasteIncin	6 C e		6 C e Small scale waste burning	L_AgriOther	3Dd	Off-farm storage, handling and transport of bulk agricultural products
L_OtherWasteDisp	6 D	(a)	6 D Other waste(e)	L_AgriOther	3De	Cultivated crops
R_Other	7 A	(a)	7 A Other (included in national total for entire territory)	L_AgriOther	3Df	Use of pesticides
				L_AgriOther	3F	Field burning of agricultural residues
				L_AgriOther	3I	Agriculture other (please specify in the IIR)
				J_Waste	5A	Biological treatment of waste - Solid waste disposal on land
				J_Waste	5B1	Biological treatment of waste - Composting

EMEP/EEA GUIDEBOOK 2009 VERSION	EMEP/EEA GUIDEBOOK 2013 VERSION		
	J_Waste	5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities
	J_Waste	5C1a	Municipal waste incineration
	J_Waste	5C1bi	Industrial waste incineration
	J_Waste	5C1bii	Hazardous waste incineration
	J_Waste	5C1biii	Clinical waste incineration
	J_Waste	5C1biv	Sewage sludge incineration
	J_Waste	5C1bv	Cremation
	J_Waste	5C1bvi	Other waste incineration (please specify in the IIR)
	J_Waste	5C2	Open burning of waste
	J_Waste	5D1	Domestic wastewater handling
	J_Waste	5D2	Industrial wastewater handling
	J_Waste	5D3	Other wastewater handling
	J_Waste	5E	Other waste (please specify in IIR)
	M_Other	6A	Other (included in national total for entire territory) (please specify in IIR)

5.5. Results of the key category analysis (KCA)

NFR 1A1a "Public Electricty and Heat Production" is the dominant key source for SO_2 and NO_x, "Road Transport- Heavy Duty Vehicles" is the second source of NO_x. All of the key sources for the NH_3 are belong to agriculture sector. "NFR 1A4b-Residential Heating" is the first category for NMVOCs after the first key source category of agriculture (3Da3) repeatedly together with CO. Industrial processes, agriculture and waste are also the contributing sectors for MNVOCs. "2B 10a Chemical Industry" is the first sector for the PM_{10} emissions together with residential combustion. This situation is given in the Table 1.1.

Table 1.1 KCA for 2015 emissions

Key Category Analysis (KCA) for 2015								
SO_2								Total
	1 A 1 a	1 A 4 b i	1A2f					
	61,8%	14,3%	10,5%					86,7 %
NO_x								
	1 A 1 a	1 A 3 b iii	1A4ci	1A4bi	1A3bi	1A2f		
	30,5%	27,3%	7%	6,7%	6,3%	5%		83,2 %
NH_3								
	3 D a 3	3 B 1 a	3 Da1	3B1b				
	42,8%	16,9%	13,3%	10%				82,9 %
NMVOC	3Da3	1 A4bi	2 D 3 d	2 H 2	2 D 3 a	3B1a	3 B 1 b	
	17,9%	15,5%	9%	8,5%	8,5%	7,4%	5,6%	
	1A3bi	5A						
	3,9%	3,9%						80,2 %
PM_{10}								
	2 B 10 a	1 A4bi						
	67,1%	21,1%						88,1 %
CO								
	1 A 4 b i	1A3b i	1 A 2 f					
	61,9%	11,6%	9,4%					82,9 %

1.6 QA/QC and Verification Methods

General quality check regarding calculation sheets was performed. Quality control manager at Air Quality Assessment Division was nominated however quality management system is not established yet. By the mid of 2014 the system preparation was started and the studies for the management of the quality system are ongoing.

The best practice has been used in setting up QA/QC routines and several verification checks have been performed within the first submission and the content is still being used.

All of the calculation sheets used in the inventory have a QA/QC sheet. In addition, information on the colour coding convention that is used in the inventory is also included in the QA/QC sheet and presented in Figure 1-1.

QAQC COLOUR CODING	
Input Data	Extrapolated/Interpolated data
Calculation/Linked cells (internal)	Assumptions/Assumed values
Data from another spreadsheet	QA & cross checks
From the literature (emission factors)	General notes
Conversion factors & constants	Warnings or things to check
Final Emissions	

Figure 1-1: QA/QC Colour Coding

This colour coding convention is used throughout the entire inventory. It is a powerful tool in allowing a user to quickly interpret the data in complex spreadsheets. For example a time series of activity data that is blue, with sections of orange clearly indicate where the data is genuine input data, and where the data has been extrapolated/interpolated to address data gaps.

In addition to this, the calculation sheets are thoroughly commented, to include any additional explanation this is required. These comments all include a date, and an indication of the author. Calculation sheets also include a number of internal quality checks (colour coded in pink). These are usually difference checks (which should return a zero value) or ratio checks (which should return a value of 1).

A sheet called "***Notes and Explanations***" is included in the calculation sheets. Aim of these sheet is to record date and time worked on the sheet, problems and solutions that faced in the cycle which is important for the sustainability of the work.

1.7 General Assessment of Completeness

The 2nd Stage-3 review of our country underlined the situation under the Key Findings topic that *“Turkey has reported the emissions for NOx, NMVOCs, NH3, Sox, PM10 and CO. The Emission Review Team encourages Turkey to report the missing pollutants in the future submissions.”*

By the integration of the EMISSION Project, the missing pollutants will be added in the future submissions.

2 CHAPTER 2: EXPLANATION OF KEY TRENDS

Turkey has been reporting data about national total and sectoral emissions under LRTAP Convention since 2011. Total emissions between 1990 and 2015 are given in Table 2-1 and trends are illustrated in Figure 2-1.

Table 2-1 Emission trends of SO_2, NOx, NMVOC, NH_3, CO and PM_{10} for ther period 1990-2015

Year	Emissions	Totals in Gg				
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}
1990	1.750	562	943	778	2.023	713
1991	1.839	561	988	787	2.061	701
1992	1.878	594	1.007	799	2.092	715
1993	1.761	654	1.035	815	2.054	721
1994	1.798	648	1.029	784	1.926	679
1995	1.890	701	1.037	743	2.009	694
1996	2.024	756	1.065	765	2.083	706
1997	2.192	759	1.067	742	2.194	757
1998	2.266	755	1.067	787	2.069	757
1999	2.185	781	1.067	796	1.922	716
2000	2.244	673	1.110	779	2.876	701
2001	1.984	647	1.000	720	2.454	587
2002	1.873	630	1.002	694	2.455	689
2003	1.792	649	1.034	764	2.499	677
2004	1.782	675	1.034	746	2.501	656
2005	2.005	722	1.017	771	2.366	658
2006	2.162	756	1.017	794	2.395	666
2007	2.526	849	1.003	755	2.435	675
2008	2.561	808	1.000	718	2.743	742
2009	2.665	788	1.033	719	2.851	714
2010	2.561	771	1.048	752	2.835	805
2011	2.641	880	1.069	785	2.727	748
2012	2716	833	1.128	887	2.919	831
2013	1944	801	1.076	927	2.104	757
2014	2.148	787	1.081	932	1.993	798
2015	1.939	883	1.115	907	2.351	829
Trend 1990-2015	11%	57%	18%	16%	16%	16%
Trend 2014-2015	-10%	12%	3%	-3%	18%	4%

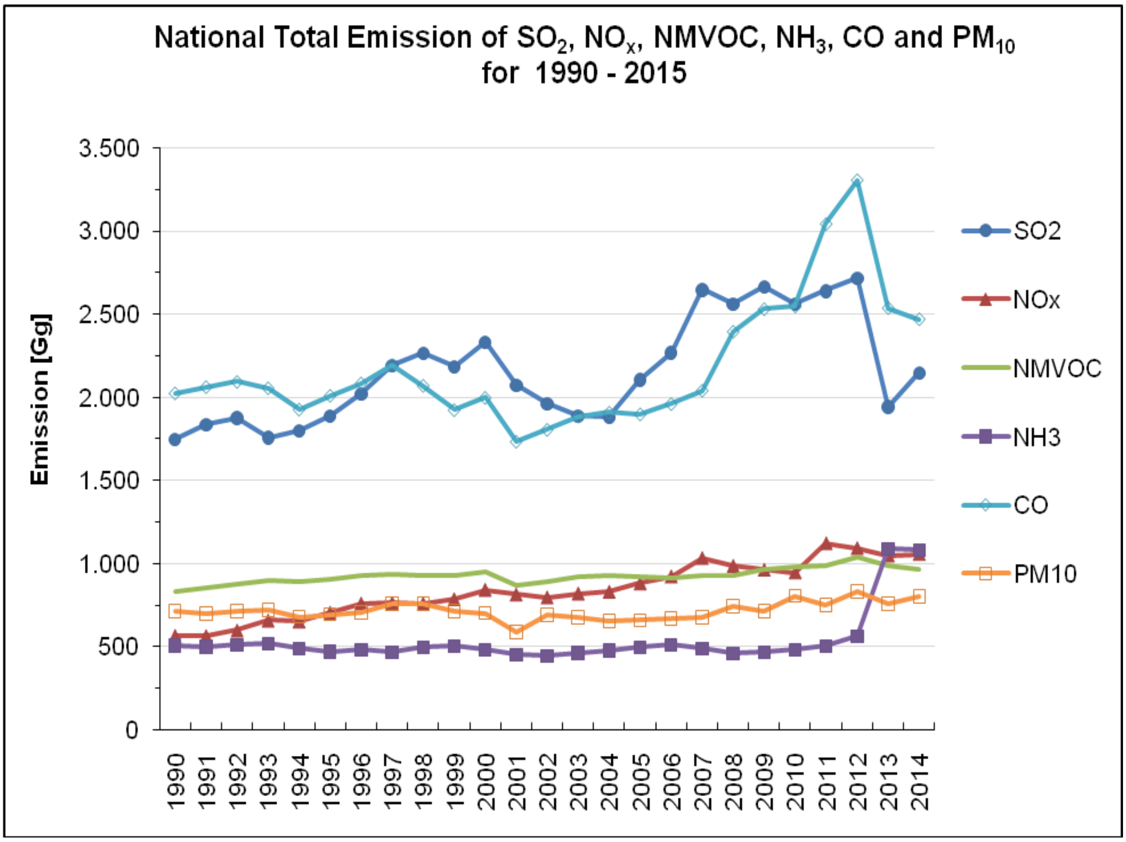


Figure 2-1: National Total Emission of SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} for 1990 - 2015

Due to the 2013 revision on the EMEP/EEA Guidebook, new emission factors caused some part of the emission changes directly. Additionally the energy balance components were changed a lot when compared with the previous year. The fuel usage shows a decline and the emission loads are also showing decline this year directly due to this numbers. From the emissions of Table 2-1, Figure 2-1 shows the 1990-2015 trends in total.

With respect to the information on the activity report of Ministry of Enegy and Natural Resources (MoEN), the figures which are given below shows respectively; the installed capacity distribution between the sources, installed capacity in MW between the sources of thermic, hydraulic and renewables, the electricity generation facilities which were activated year-by-year, installed capacity of the public and private sectors and the distribution between the public and private sector in the terms of electricity production.

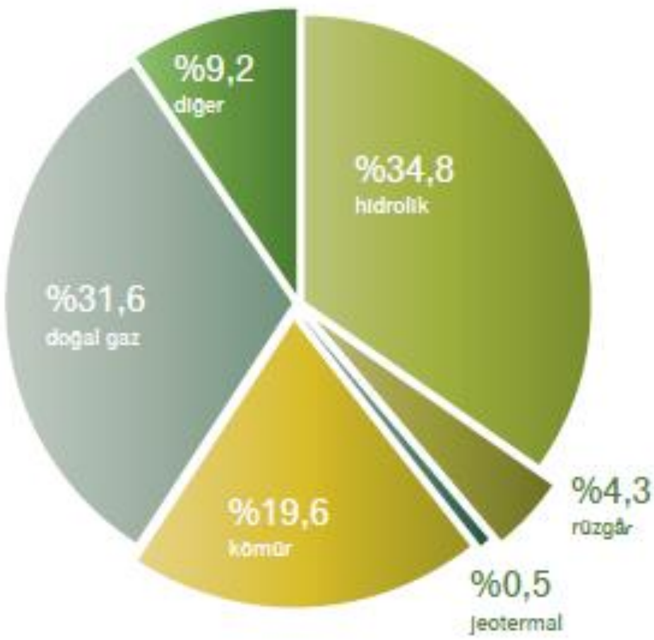


Figure 2-2: Explanatory Note: By the year of 2013 the installed capacity of electricity was distributed between the sources as %34,8: Hydraulic, %31,6: Natural Gas, %19,6 Coal, %9,2:Other, %4,3 Wind power, %0,5: Geothermal.

Figure 2-3: Turkey's installed capacity between the years 2003-2013 shows regular increase within the categories of thermic, hydraulic and wind power&geothermal.

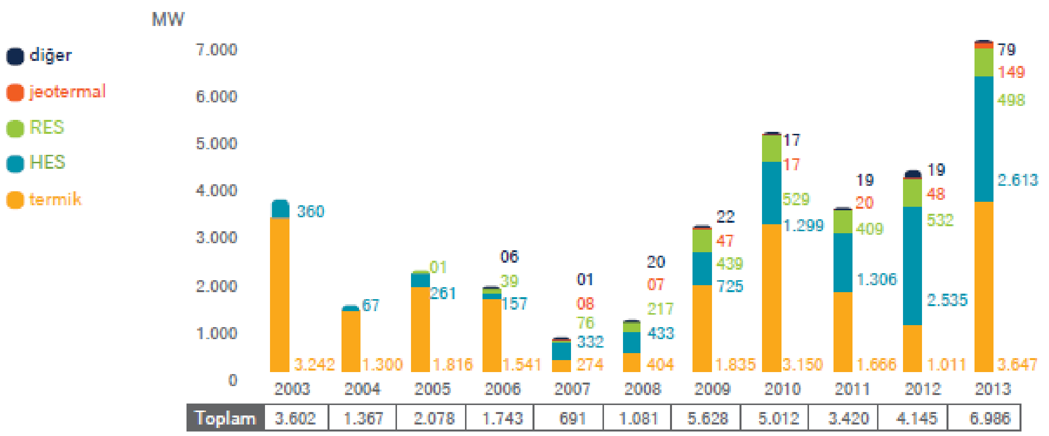


Figure 2-4: The activated energy production facilities showed steady increase after the year 2006. The bottom line shows the total in MW units. The color categorization is listed as orange:thermic, blue hydraulic power station, green: wind power station, red:geothermal power and black:others.

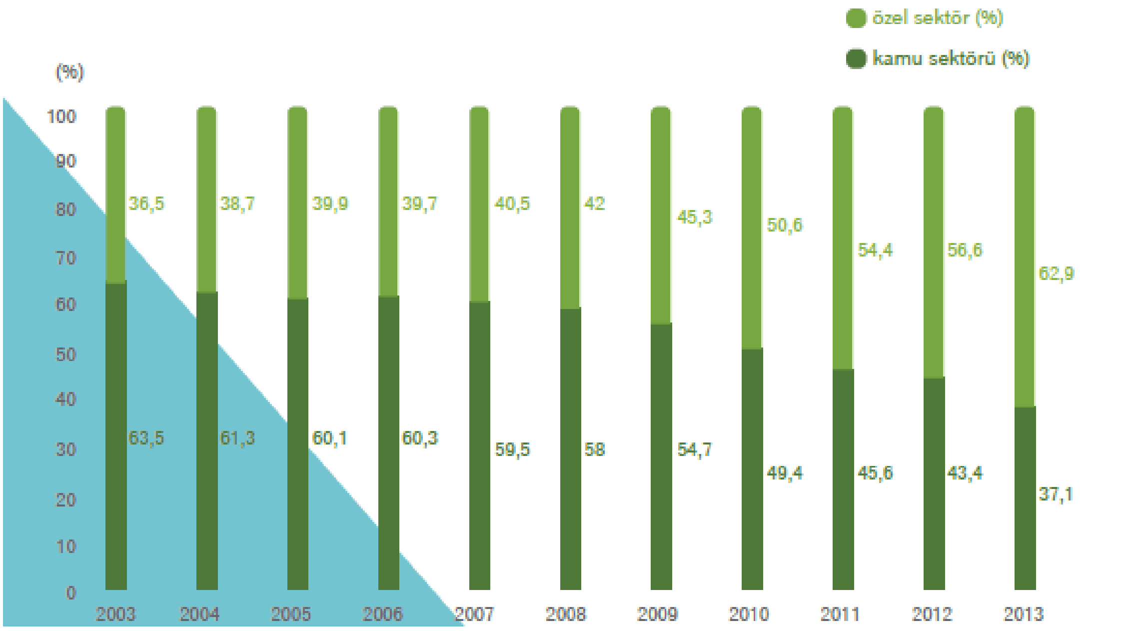


Figure 2-5: The distribution (%) between the public and private sectors within the terms of installed capacity (Public Power: Dark Green, Private Power:Light Green)

Figure 2-6: The distribution (%) between the public and private sectors within the terms of electricity production (Public Power: Blue, Private Power:Pink)

The information was kept as the same with the previous IIR which includes 2013 information on the energy perspective.

2.1 NO_x Emissions

In 1990 national total for NO_x emissions was 562 Gg and have increased to 883 Gg. As presented in

Figure 2-1-2 main source for NO_x emissions in Turkey is 1A3biii road transport activities from HDVs with a share of 35% and followed by the second sector of electricity generation sector with a share of 28%.

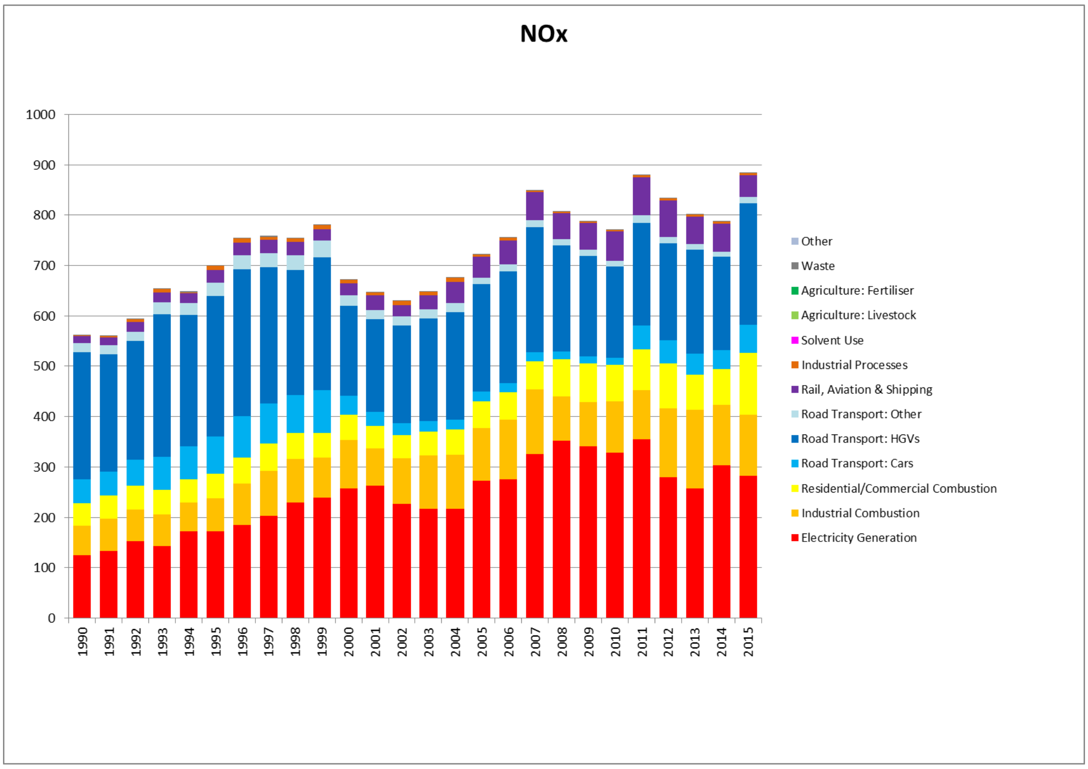


Figure 2-1-2NOx emissions in [Gg], 1990-2015, Sectoral Distributions

NOx emissions, especially from road transport (HGVs) and electricity generation indicates high percentage within the general total. Vehicle fleet and type of the fuel used are the main reasons of this coverage.

2.2 NMVOC Emissions

In 1990 national total for NMVOC emissions was 943 Gg and have increased to 1115 Gg. As presented in

Figure 2-1-23 main source for NMVOC emissions in Turkey is agriculture and followed by 1A4bi residential combustion activities with a share of about 15,5%.

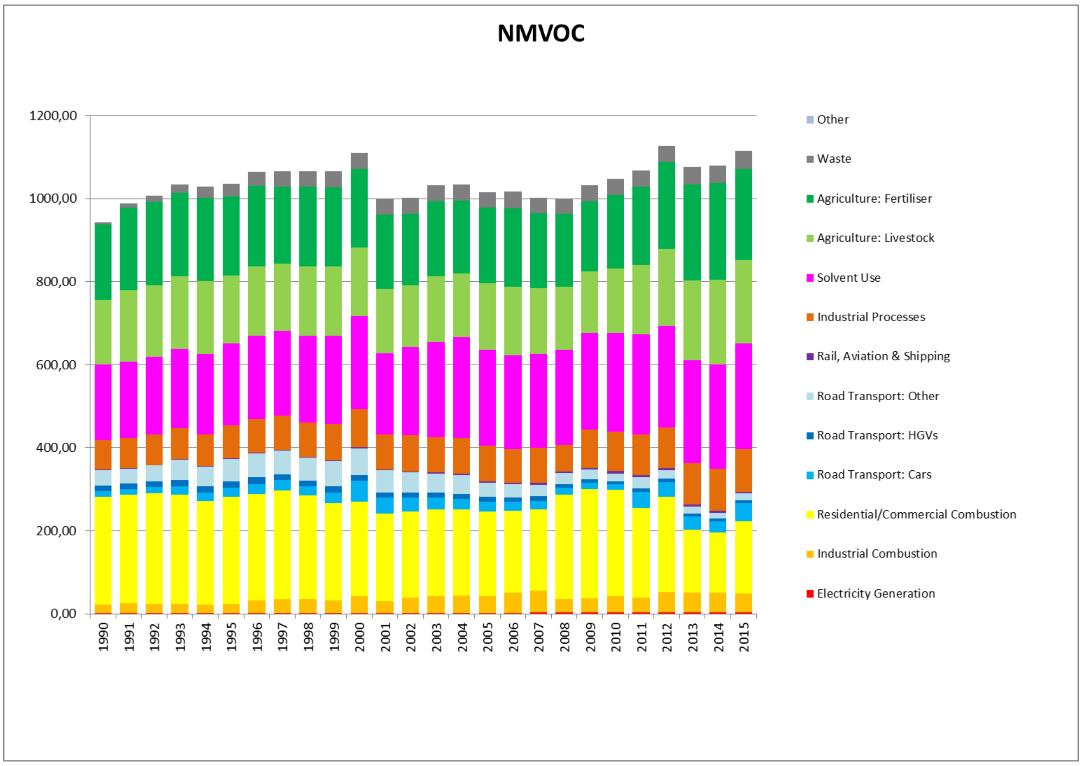


Figure 2-1-3: NMVOC emissions in [Gg], 1990-2015, Sectoral Distributions

2.3 SO_2 Emissions

In 1990 national total for SO_2 emissions was 1750 Gg and have decreased to 1939 Gg. As presented in Figure 2-1-4 main source for SO_2 emissions in Turkey is NFR sector 1A Fuel combustion activities with a share of 69% together with residential combustion with a share of 14%.

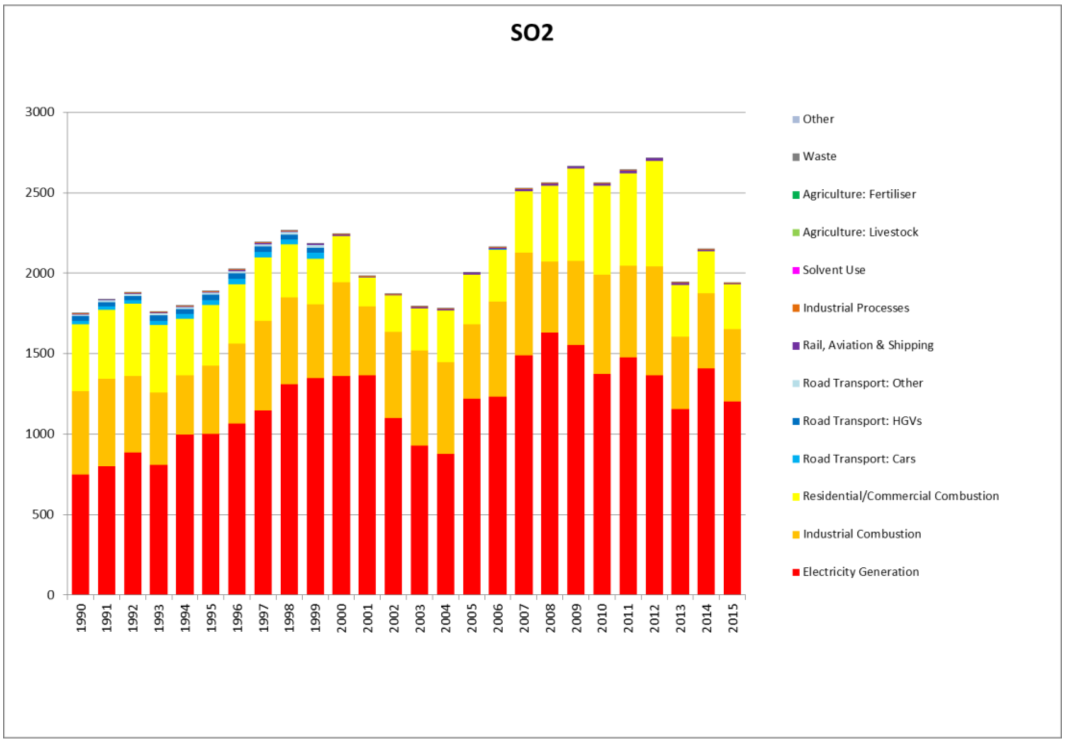


Figure 2-1-4SO_2 emissions in [Gg], 1990-2015, Sectoral Distributions

2.4 NH_3 Emissions

In 1990 national total for NH_3 emissions was 778 Gg and have increased to 907 Gg. As presented in Figure 2-1-5 the main source for NH_3 emissions in Turkey is 3DA1 fertiliser activities with a share of 53%.

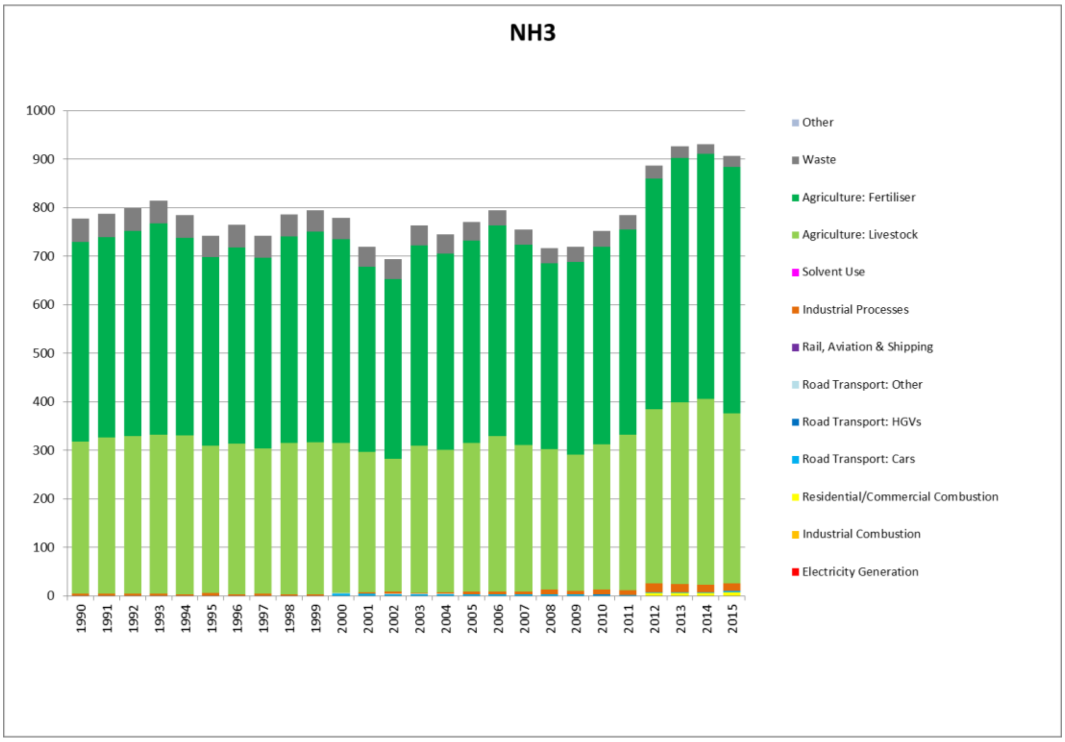


Figure 2-1-5:NH_3 emissions in [Gg], 1990-2015, Sectoral Distributions

Agricultural emission percentages show parallel leaning between 1990-2013. The emission factor revision and the EMEP/EEA GB revision is the main factor of the big increase in the sector of fertiliser. Waste sector also has an additive emission percentage on NH_3 totals.

2.5 PM_{10} Emissions

In 1990 national total for PM_{10} emissions was 713 Gg and have increased to 829 Gg. As presented in Figure 2-1-6 the main source for PM_{10} emissions in Turkey is 2B10a chemical industry activities categorized as other which includes production of fertilizer, sulphuric acid, ethylene, polythene PVC, propilen with a share of 67% together with residential combustion.

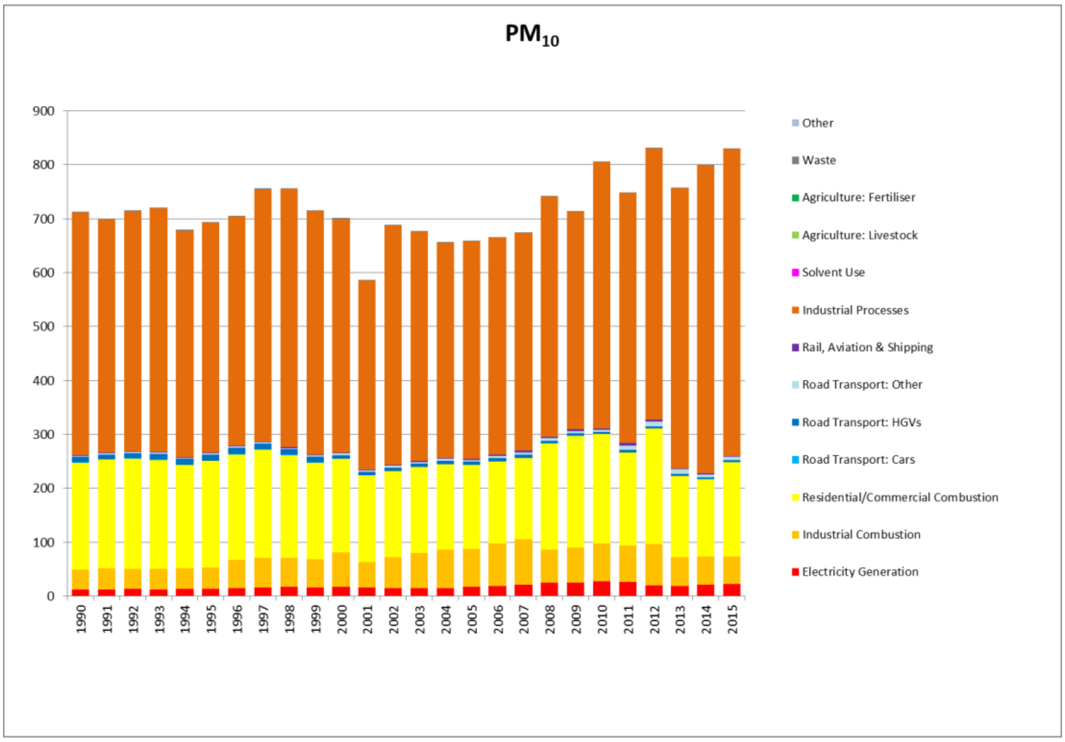


Figure 2-1-6 PM_{10} emissions in [Gg], 1990-2015, Sectoral Distributions

2.6 CO Emissions

In 1990 national total for CO emissions was 2023 Gg and have increased to 2351 Gg. As presented in Figure 2-1-7 the main source for CO emissions in Turkey is 1A4bi residential combustion activities with a share of 61%.

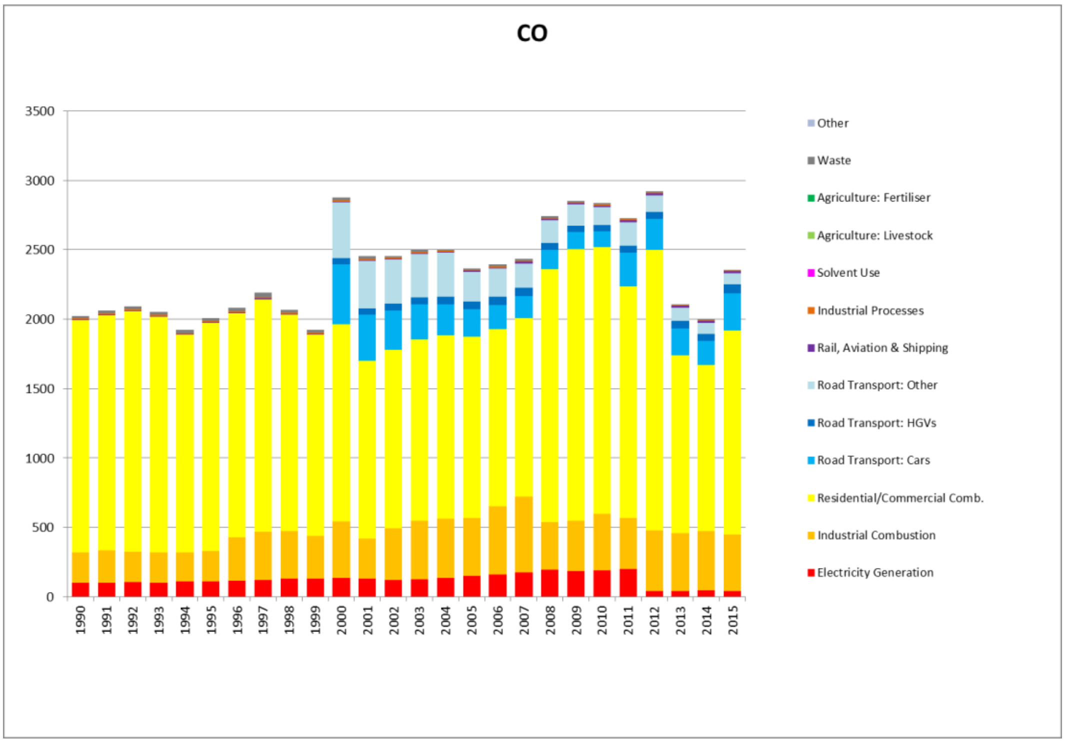


Figure 2-1-7 CO emissions in [Gg], 1990-2015, Sectoral Distributions

3 CHAPTER 3: ENERGY (NFR SECTOR 1)

NFR sector 1 energy includes subsectors below:

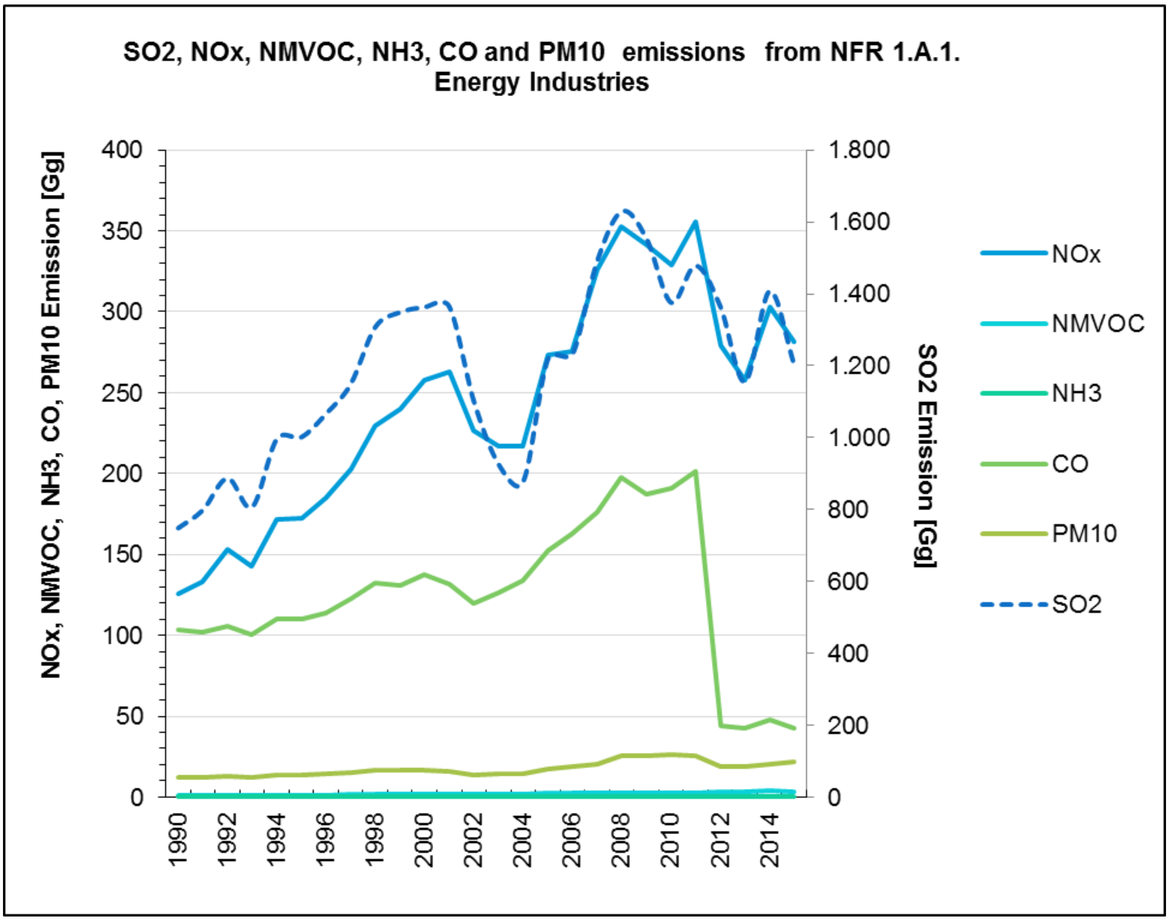
- 1.A Combustion
  - 1.A.1 Combustion in Energy Industries
  - 1.A.2 Combustion in Manufacturing Industries and Construction
  - 1.A.3 Transport
  - 1.A.4 Small Combustion
- 1.B Fugitive Emissions from Fuels
  - 1.B.1 Solid Fuels
  - 1.B.2 Oil and Gas Fuels

With the new version of new EMEP/EEA Guidebook (2013) the subsectors are integrated as given in the Table 3-1 : NFR Revision GB 2013

NFR CATEGORIES AND SECTOR CLARIFICATIONS	
1A1a	Public electricity and heat production
1A1b	Petroleum refining
1A1c	Manufacture of solid fuels and other energy industries
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals
1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)
1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)
1A3ai(i)	International aviation LTO (civil)
1A3aii(i)	Domestic aviation LTO (civil)
1A3bi	Road transport: Passenger cars
1A3bii	Road transport: Light duty vehicles
1A3biii	Road transport: Heavy duty vehicles and buses
1A3biv	Road transport: Mopeds & motorcycles
1A3bv	Road transport: Gasoline evaporation
1A3bvi	Road transport: Automobile tyre and brake wear
1A3bvii	Road transport: Automobile road abrasion
1A3c	Railways
1A3di(ii)	International inland waterways
1A3dii	National navigation (shipping)
1A3ei	Pipeline transport
1A3eii	Other (please specify in the IIR)
1A4ai	Commercial/institutional: Stationary
1A4aii	Commercial/institutional: Mobile
1A4bi	Residential: Stationary
1A4bii	Residential: Household and gardening (mobile)
1A4ci	Agriculture/Forestry/Fishing: Stationary
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery
1A4ciii	Agriculture/Forestry/Fishing: National fishing
1A5a	Other stationary (including military)
1A5b	Other, Mobile (including military, land based and recreational boats)
1B1a	Fugitive emission from solid fuels: Coal mining and handling
1B1b	Fugitive emission from solid fuels: Solid fuel transformation
1B1c	Other fugitive emissions from solid fuels
1B2ai	Fugitive emissions oil: Exploration, production, transport
1B2aiv	Fugitive emissions oil: Refining / storage
1B2av	Distribution of oil products
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)
1B2c	Venting and flaring (oil, gas, combined oil and gas)
1B2d	Other fugitive emissions from energy production

3.1. NFR 1.A.1 Combustion in Energy Industries

Emission totals are figured and given in the figure and table below:



Year		Emissions	Gg				
		SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}
1990		748,4	125,4	1,1	0,2	103,5	12,0
		798,5	133,4	1,1	0,1	101,7	12,0
1992		887,2	153,1	1,2	0,1	105,3	12,8
		806,8	142,7	1,1	0,1	100,4	12,0
1994		996,0	171,6	1,3	0,1	110,4	13,6
		1.001,5	172,6	1,3	0,1	109,7	13,5
1996		1.066,6	185,3	1,4	0,1	113,7	14,0
		1.148,8	202,9	1,5	0,1	122,8	15,2
1998		1.308,0	229,2	1,7	0,1	132,3	16,5
		1.348,4	239,7	1,8	0,1	131,2	16,4
2000		1.363,1	257,6	2,0	0,1	137,2	16,7
		1.364,4	262,7	2,0	0,1	131,4	16,1
2002		1.100,8	226,3	1,8	0,1	119,4	14,0
		926,4	216,8	1,9	0,1	126,8	14,2
2004		877,3	217,0	1,9	0,1	133,6	14,7
		1.218,3	272,9	2,2	0,1	152,3	17,6
2006		1.232,5	275,3	2,3	0,2	163,1	18,7
		1.490,4	325,7	2,7	0,1	176,3	20,6
2008		1.629,5	352,4	2,8	0,2	197,7	25,2
		1.554,1	341,6	2,8	0,2	187,2	25,3
2010		1.375,7	329,1	2,8	0,2	191,2	26,6
		1.478,3	355,6	2,7	0,2	201,5	25,7
2012		1.364,8	279,1	3,6	0,0	44,0	19,0
		1.154,8	257,8	3,4	0,0	42,9	18,6
2014		1.407,7	302,8	3,9	0,0	47,8	20,4
2015		1.202,3	281,7	3,5	0,0	42,6	21,9
Trend 1990-2015		60,7%	124,6%	221,1%	-100,0%	-58,9%	82,5%
Trend 2014-2015		-14,6%	-7,0%	-9,8%		-11,0%	7,2%

3.1.1. NFR 1.A.1.a Public electricity and heat production

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}

Key Source: Yes (SO_2,NO_x)

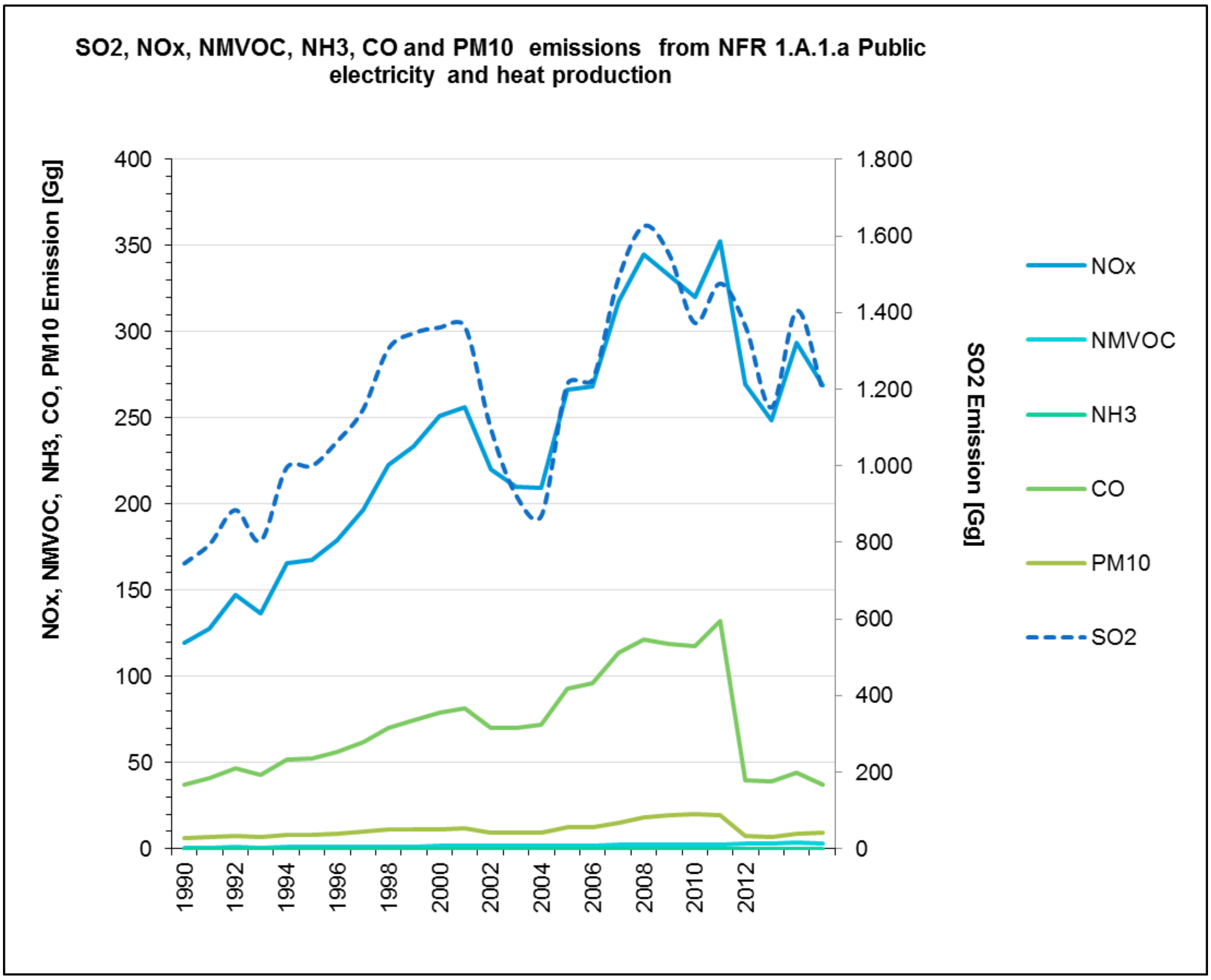


Figure 3-1-1 Emissions from NFR 1.A.1.a Public Electricity and Heat production

Table 3.1-2 Emissions from sector 1.A.1.a public electricity and heat production

Year		Emissions	Gg				
		SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}
1990		745	120	1	NA	37	6
		795	128	1	NA	41	6
1992		884	148	1	NA	46	7
		804	137	1	NA	43	7
1994		994	165	1	NA	52	8
		999	167	1	NA	52	8
1996		1.064	179	1	NA	56	9
		1.147	196	1	NA	62	10
1998		1.306	223	1	NA	70	11
		1.346	233	1	NA	74	11
2000		1.361	251	2	NA	79	11
		1.363	256	2	NA	81	12
2002		1.099	220	1	NA	70	10
		923	210	1	NA	70	9
2004		871	209	1	NA	72	9
		1.212	267	2	NA	93	12
2006		1.225	268	2	NA	96	13
		1.487	318	2	NA	114	15
2008		1.625	345	2	NA	121	18
		1.552	333	2	NA	119	19
2010		1.373	320	2	NA	117	20
		1.476	353	2	NA	132	19
2012		1.362	270	3	NA	40	8
		1.152	249	3	NA	39	7
2014		1.405	294	4	NA	44	8
2015		1.199,3	269,1	3,0	NA	36,9	9,2
Trend 1990-2015		61,0%	125,0%	362,9%		-0,6%	54,7%
Trend 2014-2015		-14,6%	-8,4%	-14,3%		-16,1%	9,5%

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables. (Source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1 in terms of energy balance table data and the emission factors of EMEP/EEA GB v.2013.

$$Emissionpollutant = \sum ADfuel * EFfuel$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Table 3.1-3 Emission factor (EF) used sector 1.A.1.a public electricity and heat production

Fuel	Unit	Ef	Reference	Table No.
NOx				
H. Coal	g/GJ	209	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using hard coal	Table 3-2
Lignite	g/GJ	247	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using brown coal	Tabel 3-3
Asphalite	g/GJ	247	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using brown coal,	*(assumption covers the brown coal from GB and NCVs from NIR)*

Fuel	Unit	Ef	Reference	Table No.
Wood (Biomass)	g/GJ	81	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using biomass	Table 3-7
Petroleum	g/GJ	89	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels	Table 3-4
N. Gas	g/GJ	89	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels	Table 3-4
SO_2				
H. Coal	g/GJ	820	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using hard coal	Tabel 3-2
Lignite	g/GJ	1680	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using brown coal	Tabel 3-3
Asphalite	g/GJ	1680	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using brown coal	page 16
Wood	g/GJ	11	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using biomass	Tabel 3-7
Petroleum	g/GJ	0,3	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels	Table 3-4
N. Gas	g/GJ	0,3	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels	Table 3-4

Fuel	Unit	Ef	Reference	Table No.
NMVOC				
H. Coal	g/GJ	1	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using hard coal	Table 3-2
Lignite	g/GJ	1,4	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using brown coal	Table 3-3
Asphalite	g/GJ	1,4	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using brown coal	Table 3-3
Wood	g/GJ	7,3	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using biomass	, page 19
Petroleum	g/GJ	2,6	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels	Table 3-4
N. Gas	g/GJ	2,6	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels	Table 3-4
CO				
H. Coal	g/GJ	8,7	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using hard coal	Table 3-2
Lignite	g/GJ	8,7	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using brown coal	Table 3-3
Asphalite	g/GJ	8,7	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using brown coal	Table 3-3

Fuel	Unit	Ef	Reference	Table No.
Wood	g/GJ	90	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using biomass	Table 3-7
Petroleum	g/GJ	39	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels	Table 3-4
N. Gas	g/GJ	39	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels	Table 3-4
PM_{10}				
H. Coal	g/GJ	7,7	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using hard coal	, page 15
Lignite	g/GJ	7,7	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using brown coal	, page 16
Asphalite	g/GJ	7,9	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using brown coal	, page 16
Wood	g/GJ	155	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using biomass	, page 19
Petroleum	g/GJ	0,89	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels	, page 17
N. Gas	g/GJ	0,89	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels	, page 17

Uncertainty

Estimation of uncertainties based on default values from GB.

Recalculations

No recalculations have been required for this version of the inventory.

Planned Improvements

Facility specific emission factors will be obtained and be used for further submissions together with the petroleum balance data.Production and consumption statistics will be used for next year including the data from the EMISSION Project.

3.1.2. NFR 1.A.1.b Petroleum Refining

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}

Key Source: No

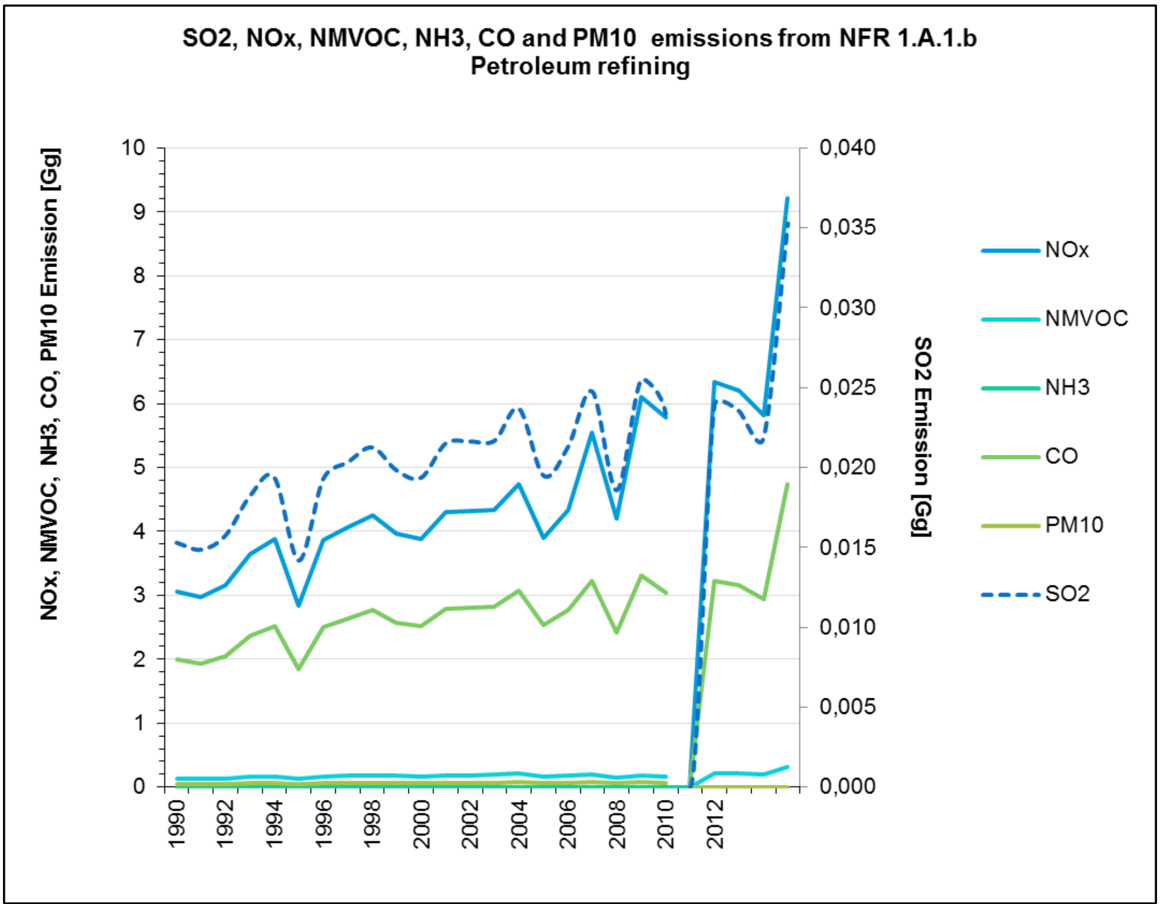


Figure 3-1-2 Emissions from petroleum refining

Emissions from sector are presented in Table 3-1-4

Years(1A1b)		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	**Gg**	0,02	3	0,133	NA	2	0,05
	Gg	0,01	3	0,129	NA	2	0,04
1992	**Gg**	0,02	3	0,137	NA	2	0,05
	Gg	0,02	4	0,158	NA	2	0,05
1994	**Gg**	0,02	4	0,168	NA	3	0,06
	Gg	0,01	3	0,123	NA	2	0,04
1996	**Gg**	0,02	4	0,167	NA	3	0,06
	Gg	0,02	4	0,176	NA	3	0,06
1998	**Gg**	0,02	4	0,184	NA	3	0,06
	Gg	0,02	4	0,172	NA	3	0,06
2000	**Gg**	0,02	4	0,168	NA	3	0,06
	Gg	0,02	4	0,186	NA	3	0,06
2002	**Gg**	0,02	4	0,187	NA	3	0,06
	Gg	0,02	4	0,188	NA	3	0,06
2004	**Gg**	0,02	5	0,205	NA	3	0,07
	Gg	0,02	4	0,169	NA	3	0,06
2006	**Gg**	0,02	4	0,181	NA	3	0,06
	Gg	0,02	6	0,192	NA	3	0,07
2008	**Gg**	0,02	4	0,142	NA	2	0,06
	Gg	0,03	6	0,183	NA	3	0,08
2010	**Gg**	0,02	6	0,161	NA	3	0,07
	Gg	IE	IE	IE	NA	IE	IE
2012	**Gg**	0,0	6,3	0,2	NA	3,2	IE
	Gg	0,0	6,2	0,2	NA	3,2	IE
2014	**Gg**	0,0	5,8	0,2	NA	2,9	IE
2015	**Gg**	0,0	9,2	0,3	NA	4,7	0,0
Trend 1990-2015		130,7%	201,3%	137,3%		138,2%	
Trend 2014-2015		61,5%	58,6%	61,0%		61,1%	

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables. (source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

Emissionpollutant = ∑ ADfuel * EFfuel

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Emission factors are presented in Table 3.1-5.

These are calculated in the Emission Factors sheet. EFs in energy terms are taken from the GB. These are then converted into EFs in mass terms by combining with calorific values (reference; NIR).

Table 3.1-5. Emission factor (EF) used sector 1.A.1.b petroleum refining

Fuel	Unit	Ef	Reference	Table No.
NOx				
Petroleum	g/GJ	63	EMEP/EEA (2016), Chapter 1.A.1.b Petroleum refining, Tier 1 emission factors for source category 1.A.1.b, refinery gas	Table 4-2
N. Gas	g/GJ	89	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using natural gas	Table 3-4
SO2				
Petroleum	g/GJ	0.3	EMEP/EEA (2016), Chapter 1.A.1.b Petroleum refining, Tier 1 emission factors for source category 1.A.1.b, refinery gas	Table 4-2

Fuel	Unit	Ef	Reference	Table No.
N. Gas	g/GJ	0,3	EMEP/EEA (2016), Chapter 1.A.1.a Stationary Combustion, Tier 1 emission factors for source category 1.A.1.a using natural gas	Table 3-4
NMVOC				
Petroleum	g/GJ	2.6	EMEP/EEA (2016), Chapter 1.A.1.b Petroleum refiningTier 1 emission factors for source category 1.A.1.b, refinery gas	Table 4-2
N. Gas	g/GJ	2,6	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using natural gas	Table 3-4
CO				
Petroleum	g/GJ	39	EMEP/EEA (2016), Chapter 1.A.1.b Petroleum refining, Tier 1 emission factors for source category 1.A.1.b, refinery gas	Table 4-2
N. Gas	g/GJ	39	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using natural gas	Table 3-4
PM10				
Petroleum	g/GJ	0.89	EMEP/EEA (2016), Chapter 1.A.1.b Petroleum refining, Tier 1 emission factors for source category 1.A.1.b, refinery gas	Table 4-2
N. Gas	g/GJ	0,89	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using natural gas	Table 3-4

Uncertainty

Estimation of uncertainties based on default values from GB.

Recalculations

No recalculations have been required for this version of the inventory.

Planned Improvements

Facility specific emission factors will be obtained and be used for the further submissions together with the petroleum balance data.

3.1.3. NFR 1.A.1.c Manufacture of solid fuels and other energy industries

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}, NH_3

Key Source: No

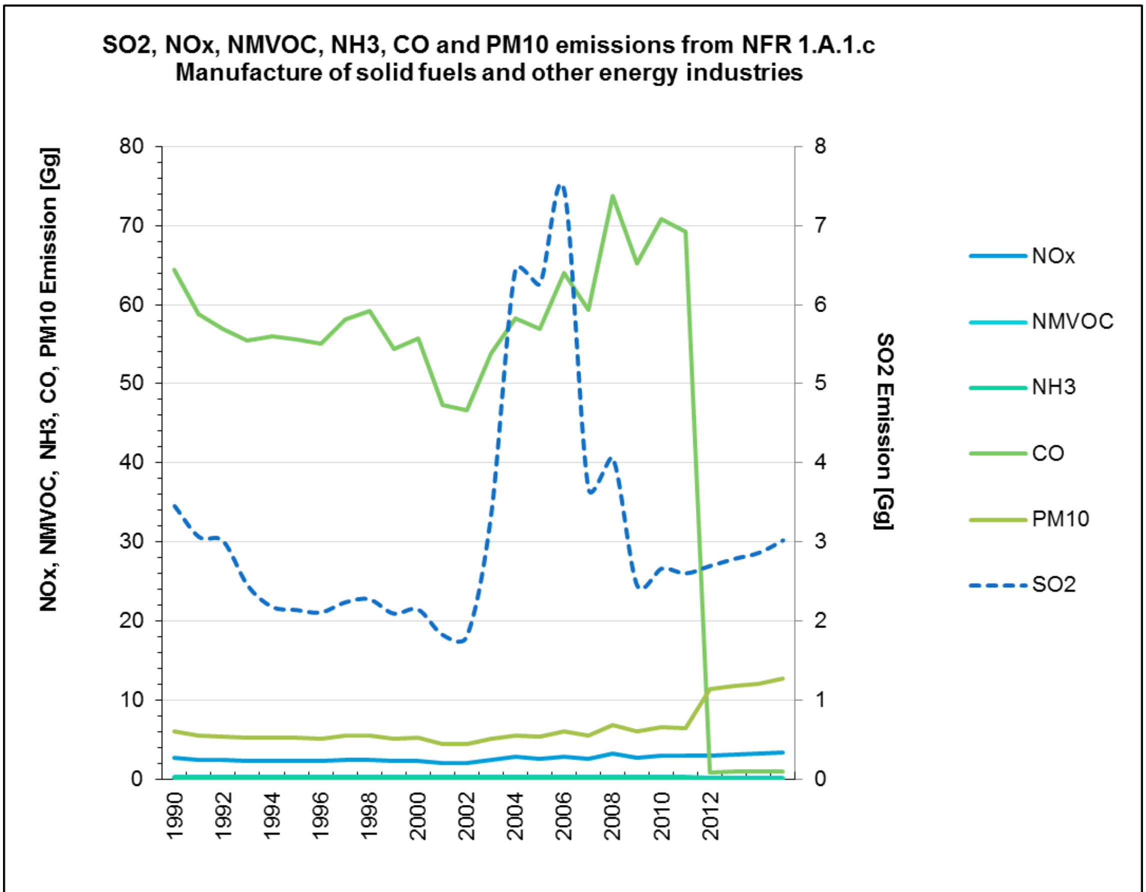


Figure 3-1-3 Emissions from manufacture of solid fuels and other energy industries

Emissions are presented in Table 3-1-6.

Years(1A1c)		Emissions	Gg				
1A1c		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	**Gg**	3,45	2,74	0,29	0,159	64,386	6,01
	Gg	3,06	2,48	0,27	0,146	58,793	5,49
1992	**Gg**	3,01	2,40	0,26	0,141	56,910	5,31
	Gg	2,45	2,33	0,25	0,137	55,420	5,17
1994	**Gg**	2,18	2,35	0,26	0,139	56,005	5,23
	Gg	2,14	2,33	0,25	0,138	55,667	5,20
1996	**Gg**	2,11	2,31	0,25	0,136	55,039	5,14
	Gg	2,23	2,44	0,27	0,144	58,129	5,43
1998	**Gg**	2,27	2,48	0,27	0,147	59,207	5,53
	Gg	2,09	2,28	0,25	0,135	54,389	5,08
2000	**Gg**	2,15	2,34	0,26	0,138	55,783	5,21
	Gg	1,83	1,98	0,22	0,117	47,273	4,41
2002	**Gg**	1,80	1,96	0,21	0,116	46,670	4,36
	Gg	3,33	2,37	0,25	0,133	53,878	5,03
2004	**Gg**	6,44	2,79	0,27	0,144	58,308	5,44
	Gg	6,26	2,50	0,26	0,141	56,919	5,31
2006	**Gg**	7,45	2,88	0,29	0,159	64,085	5,98
	Gg	3,68	2,57	0,27	0,147	59,383	5,54
2008	**Gg**	4,06	3,16	0,34	0,183	73,781	6,89
	Gg	2,45	2,73	0,30	0,161	65,211	6,09
2010	**Gg**	2,66	2,97	0,32	0,175	70,824	6,61
	Gg	2,60	2,90	0,32	0,171	69,216	6,46
2012	**Gg**	2,70	3,01	0,11	0,000	0,861	11,33
	Gg	2,79	3,11	0,12	0,000	0,889	11,71
2014	**Gg**	2,86	3,20	0,12	0,000	0,913	12,02
2015		3,02	3,37	0,13	0,000	0,964	12,69
Trend 1990-2015		-13%	23%	-56%	-100%	-99%	111%
Trend 2014-2015		37%	33%	867%		116%	9%

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables. (source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

$$Emission_{pollutant} = \sum AD_{fuel} * EF_{fuel}$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Emission factors for are in mass terms, and have been taken from the GB.Emission factors are presented in Table 3-1-7.

Table 3.1-7 Emission factor (EF) used sector 1.A.1.c manufacture of solid fuels and other energy industries

Fuel	Unit	Ef	Reference	Table No.
NOx				
H. Coal G	g/GJ	21	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Lignite	g/GJ	21	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Coke	g/GJ	21	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industriesTier 1 emission factors for source category 1.A.1.c	Table 5-1

Petroleum	g/GJ	89	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using gaseous fuels, page 17	Table 3-4
SO2				
H. Coal G	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Lignite	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Coke	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Petroleum	g/GJ	2,81	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using other liquid fuels	Table 3-4
NMVOC				
H. Coal G	g/GJ	0,8	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1

Lignite	g/GJ	0,8	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Coke	g/GJ	0,8	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Petroleum	g/GJ	2,6	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using other liquid fuels	Table 5-1
NH3				
H. Coal G	g/GJ	-	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	-
Lignite	g/GJ	-	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	-
Coke	g/GJ	-	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	-
CO				

H. Coal G	g/GJ	6	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Lignite	g/GJ	6	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Coke	g/GJ	6	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Petroleum	g/GJ	39	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using other liquid fuels	Table 3-4
PM10				
H. Coal G	g/GJ	79	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Lignite	g/GJ	79	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1

Coke	g/GJ	79	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy industries, Table 5-2 Tier 1 emission factors for source category 1.A.1.c	Table 5-1
Petroleum	g/GJ	0,89	EMEP/EEA (2016), Chapter 1.A.1.a, Tier 1 emission factors for source category 1.A.1.a using other liquid fuels	Table 3-4

Uncertainty

Estimation of uncertainties based on default values from GB.

Recalculations

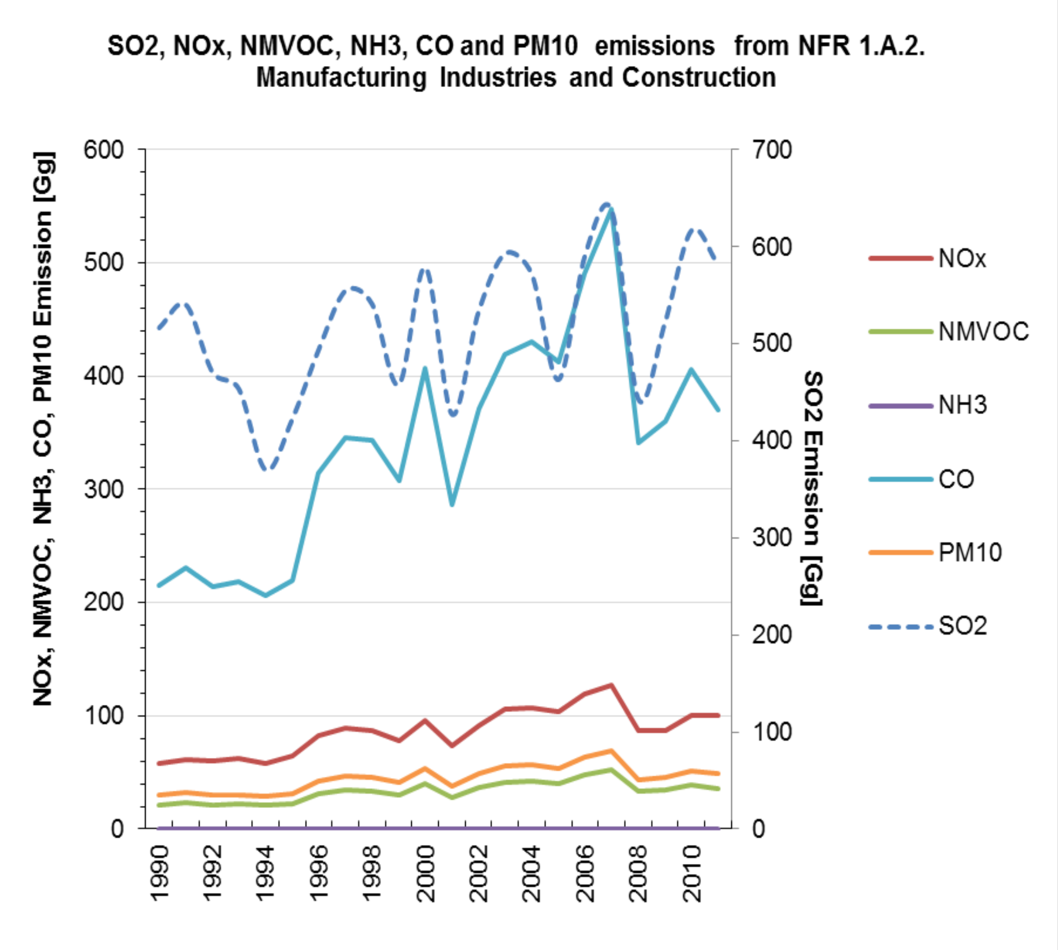
No recalculations have been required for this version of the inventory.

Planned Improvements

Facility specific emission factors will be obtained and be used for the further submissions together with the petroleum balance data.

3.2. NFR 1.A.2 Combustion in Manufacturing Industries and Construction

3.2.1. NFR 1.A.2.a Iron and Steel



General total emissions are illustrated above.

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}

Key Source: Yes (CO)

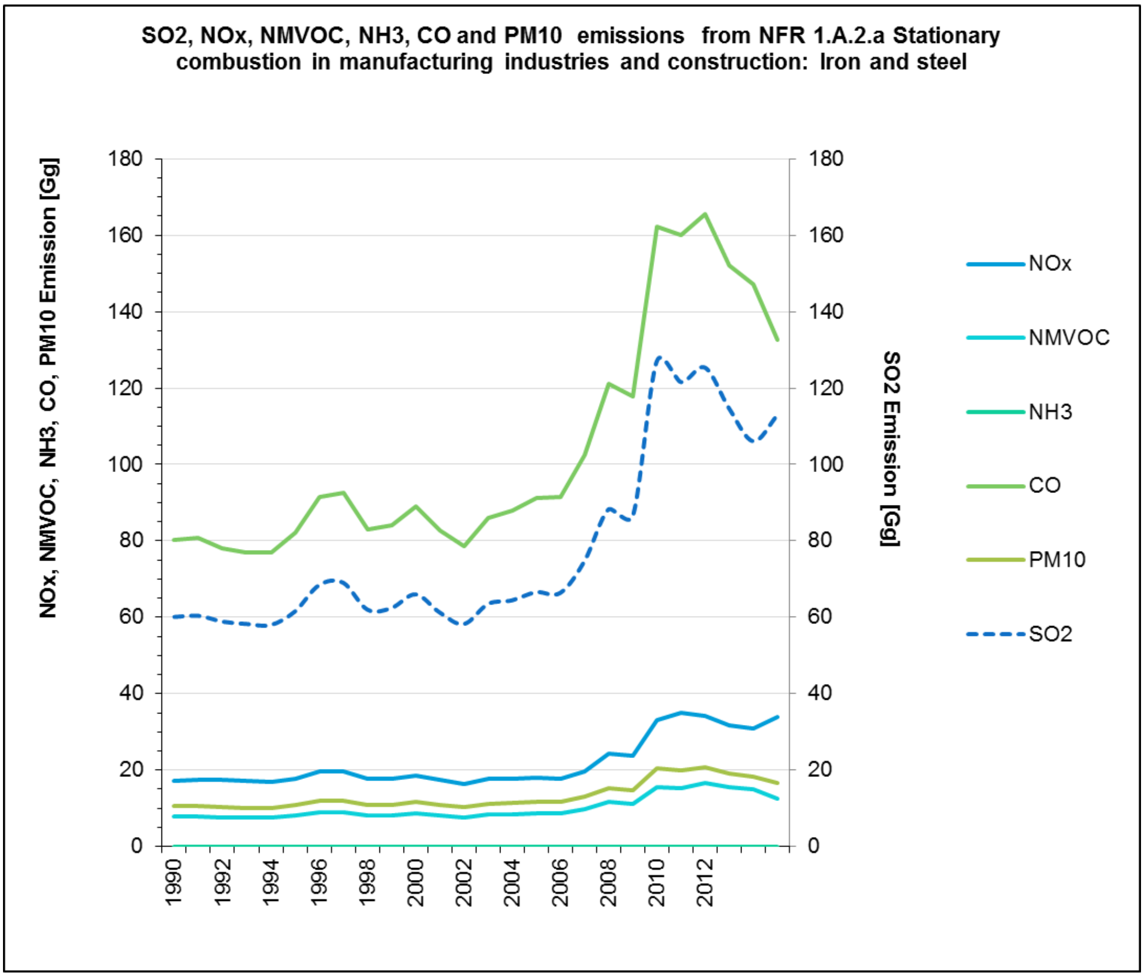


Figure 3-2-1 Emissions from Iron and Steel Manufacturing Industries

Table 3-2-1 Emission Totals from Iron and Steel

Year 1.A2.a Iron and steel		Emissions	Gg				
		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	**Gg**	60	17	8	NA	80	11
	Gg	60	18	8	NA	81	11
1992	**Gg**	59	17	8	NA	78	10
	Gg	58	17	8	NA	77	10
1994	**Gg**	58	17	8	NA	77	10
	Gg	62	18	8	NA	82	11
1996	**Gg**	68	20	9	NA	92	12
	Gg	69	20	9	NA	93	12
1998	**Gg**	62	18	8	NA	83	11
	Gg	62	18	8	NA	84	11
2000	**Gg**	66	19	9	NA	89	12
	Gg	61	17	8	NA	83	11
2002	**Gg**	58	16	8	NA	79	10
	Gg	63	18	8	NA	86	11
2004	**Gg**	64	18	8	NA	88	11
	Gg	67	18	9	NA	91	12
2006	**Gg**	66	18	9	NA	92	12
	Gg	75	20	10	NA	103	13
2008	**Gg**	88	24	12	NA	121	15
	Gg	86	24	11	NA	118	15
2010	**Gg**	127	33	16	NA	162	21
	Gg	122	35	15	NA	160	20
2012	**Gg**	125	34	17	NA	165	21
	Gg	115	32	15	NA	152	19
2014	**Gg**	106	31	15	NA	147	18
2015	**Gg**	113	34	13	NA	133	17
Trend 1990-2015		88%	96%	62%		65%	59%
Trend 2014-2015		6,5%	9,9%	-15,8%		-9,8%	-9,1%

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables (source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

Emissionpollutant = ∑ ADfuel * EFfuel

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

ADfuel = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Several assumptions are made in assuming that some fuels are equivalent to brown coal.

Emission factors are presented in Table 3.2.2

Table 3.2.2 Emission factor (EF) used sector 1.A.2.a Iron and Steel

Fuel	Unit	Ef	Reference	Table No.
NOx				
H. Coal	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	513	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	74	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3

AP Waste	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	81*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
SO_2				
H. Coal	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	47	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.67	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3

AP Waste	g/GJ	11*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	10,8*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
NMVOC				
H. Coal	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	25	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	23	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3

AP Waste	g/GJ	300	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	7,31*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
CO				
H. Coal	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	66	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	29	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas	Table 3-3

			or derived gases	
AP Waste	g/GJ	570	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	90*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
PM_{10}				
H. Coal	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	20	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.78	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3

AP Waste	g/GJ	143*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	155	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5

Uncertainty

Estimation of uncertainties based on default values from EMEP/EEA emission inventory guidebook 2013.

Recalculations

Recalculations were checked and applied due to the revision of the energy balance tables.

Planned Improvements

Facility specific emission factors will be obtained and be used for the further submissions together with the petroleum balance data.

3.2.2. NFR 1.A.2.b Non-ferrous Metals

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}

Key Source: No

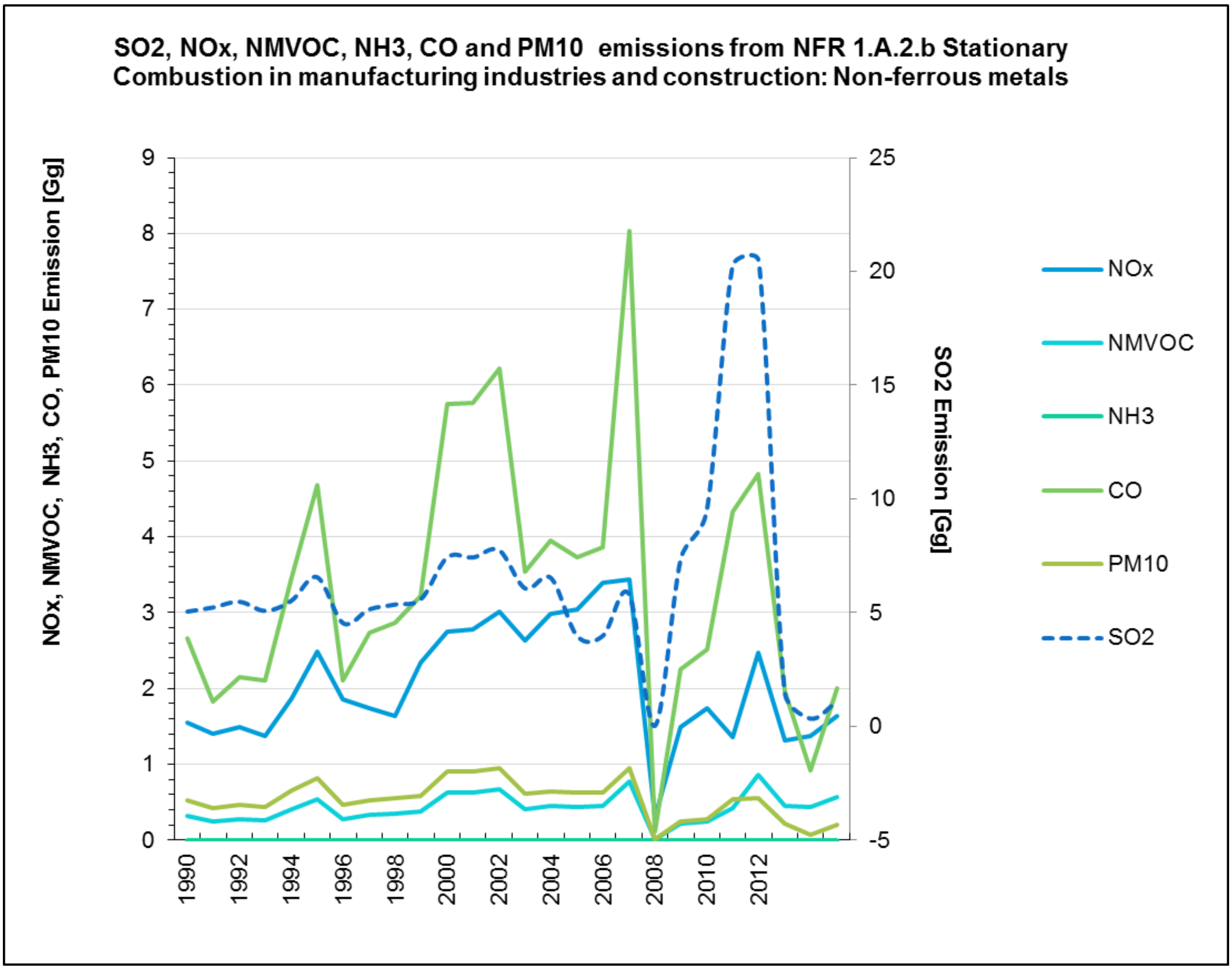


Figure 3-2-2 Emissions from Non-Ferrous Metals

Table 3-2-3 Emissions from non-ferrous metals industry

Year 1.A.2.b Non-ferrous metals		Emissions	Gg				
		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	Gg	5,04	1,55	0,32	NA	2,66	0,52
	Gg	5,23	1,41	0,25	NA	1,83	0,42
1992	Gg	5,48	1,48	0,28	NA	2,14	0,46
	Gg	5,08	1,37	0,27	NA	2,10	0,44
1994	Gg	5,52	1,87	0,41	NA	3,47	0,65
	Gg	6,56	2,49	0,54	NA	4,69	0,81
1996	Gg	4,53	1,86	0,28	NA	2,10	0,46
	Gg	5,14	1,73	0,33	NA	2,74	0,53
1998	Gg	5,35	1,64	0,35	NA	2,86	0,56
	Gg	5,60	2,34	0,38	NA	3,22	0,58
2000	Gg	7,42	2,75	0,62	NA	5,76	0,90
	Gg	7,42	2,78	0,62	NA	5,76	0,90
2002	Gg	7,74	3,01	0,67	NA	6,21	0,95
	Gg	6,07	2,63	0,41	NA	3,53	0,61
2004	Gg	6,52	2,99	0,45	NA	3,95	0,65
	Gg	3,98	3,05	0,43	NA	3,73	0,62
2006	Gg	3,98	3,39	0,45	NA	3,86	0,62
	Gg	5,81	3,43	0,77	NA	8,03	0,95
2008	Gg	0,03	0,30	0,01	NA	0,11	0,01
	Gg	7,37	1,49	0,22	NA	2,25	0,24
2010	Gg	9,51	1,74	0,24	NA	2,51	0,27
	Gg	20,29	1,36	0,42	NA	4,33	0,54
2012	Gg	20,43	2,47	0,86	NA	4,83	0,56
	Gg	1,48	1,32	0,45	NA	1,96	0,21
2014	Gg	0,34	1,37	0,43	NA	0,92	0,07
2015	Gg	1,08	1,64	0,57	NA	2,00	0,20
Trend 1990-2015		-79%	6%	75%		-25%	-61%
Trend 2014-2015		221,7%	19,7%	31,9%		118,7%	198,4%

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables (source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

$$Emission_{pollutant} = \sum AD_{fuel} * EF_{fuel}$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Several assumptions are made in assuming that some fuels are equivalent to brown coal.

Emission factors are presented in Table 3-2-4

Table 3-2-4 EFs for Non Ferrous Metals Industry

Fuel	Unit	Ef	Reference	Table No.
NOx				
H. Coal	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	513	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors	Table 3-4

			1.A.2 Combustion in industry using liquid fuels	
N. Gas	g/GJ	74	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	81*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
SO_2				
H. Coal	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or	Table 3-2

			brown coal, page 15	
Coke	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	47	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.67	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	11*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels, page 15	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	10,8*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*

NMVOC				
H. Coal	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	25	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	23	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in	Table 3-3

			industry using natural gas or derived gases	
AP Waste	g/GJ	300	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels, page 15	Table 3-5
Wood	g/GJ	7,31*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
CO				
H. Coal	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2	Table 3-2

			Combustion in industry using hard or brown coal	
Petroleum	g/GJ	66	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	29	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	570	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	90*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
PM_{10}				
H. Coal	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission	Table 3-2

			factors 1.A.2 Combustion in industry using hard or brown coal	
Lignite	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	20	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels, page 16	Table 3-4
N. Gas	g/GJ	0.78	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	143	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid	Table 3-5

			fuels, page 15	
Wood	g/GJ	155*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*

Uncertainty

Estimation of uncertainties based on default values from GB.

Recalculations

Recalsulations were checked and applied due to the revision of the energy balance tables.

Planned Improvements

Facility specific emission factors will be obtained and be used for the further submissions.

3.2.3. NFR 1.A.2.c Chemicals

Source Category Description

Emissions: NOx, SO2, NMVOC, CO, PM10

Key Source: No

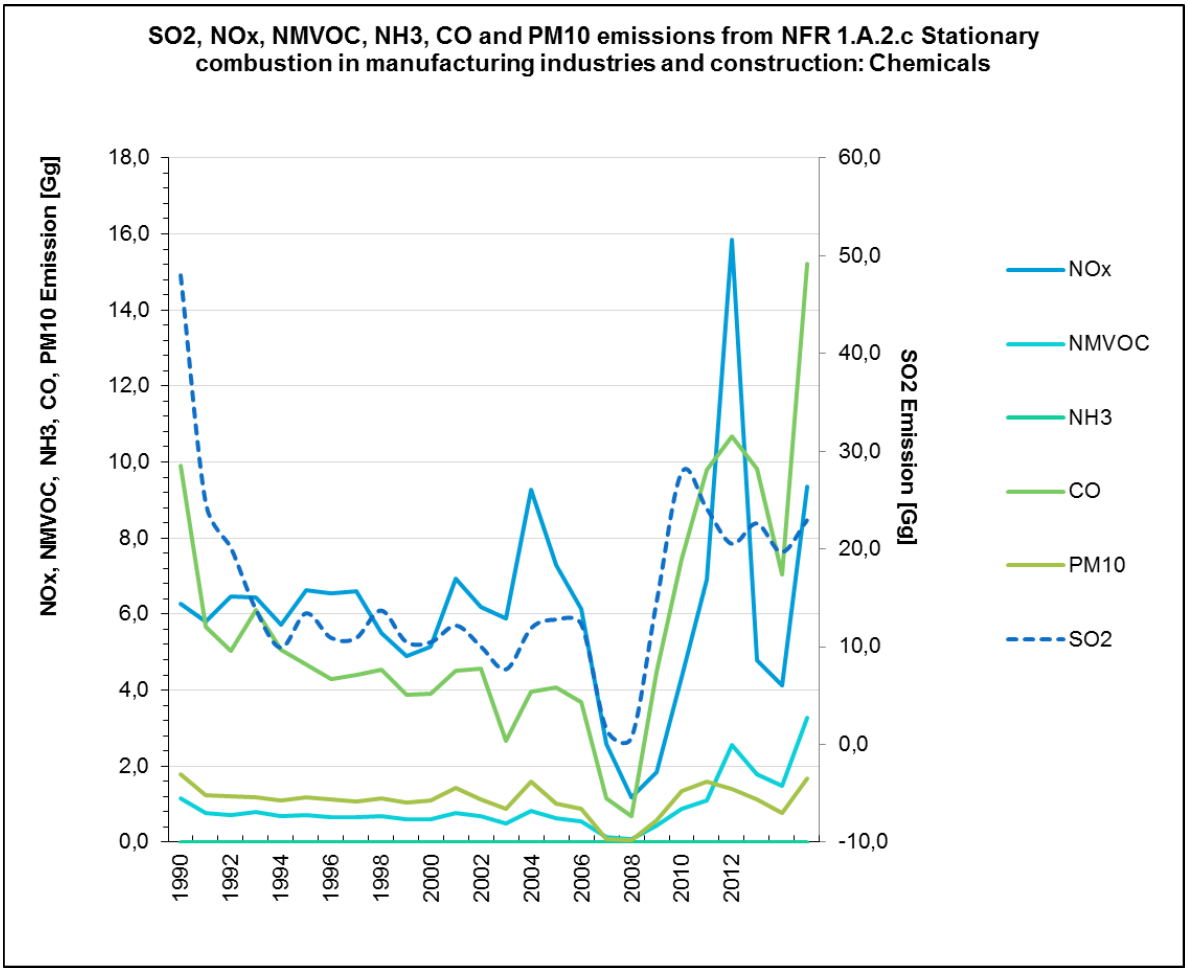


Figure 3-2-3 Emission trend of chemical manufacturing

Emission totals are presented in Table 3-2-5.

Table 3-2-5 Emissions from Chemicals

Year		Emissions	Gg				
1.A.2.c Chemicals		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	Gg	48,0	6,3	1,2	NA	9,9	1,8
	Gg	24,7	5,8	0,8	NA	5,7	1,2
1992	Gg	20,1	6,5	0,7	NA	5,0	1,2
	Gg	13,8	6,4	0,8	NA	6,1	1,2
1994	Gg	9,9	5,7	0,7	NA	5,1	1,1
	Gg	13,4	6,6	0,7	NA	4,7	1,2
1996	Gg	10,9	6,5	0,7	NA	4,3	1,1
	Gg	10,9	6,6	0,7	NA	4,4	1,1
1998	Gg	13,7	5,5	0,7	NA	4,5	1,2
	Gg	10,5	4,9	0,6	NA	3,9	1,0
2000	Gg	10,5	5,1	0,6	NA	3,9	1,1
	Gg	12,2	6,9	0,8	NA	4,5	1,4
2002	Gg	10,0	6,2	0,7	NA	4,6	1,1
	Gg	7,7	5,9	0,5	NA	2,7	0,9
2004	Gg	11,9	9,3	0,8	NA	4,0	1,6
	Gg	12,8	7,3	0,6	NA	4,1	1,0
2006	Gg	12,3	6,1	0,6	NA	3,7	0,9
	Gg	1,5	2,6	0,1	NA	1,2	0,1
2008	Gg	0,7	1,2	0,1	NA	0,7	0,1
	Gg	14,6	1,9	0,4	NA	4,5	0,6
2010	Gg	27,8	4,3	0,9	NA	7,5	1,3
	Gg	24,1	6,9	1,1	NA	9,8	1,6
2012	Gg	20,5	15,9	2,5	NA	10,7	1,4
	Gg	22,6	4,8	1,8	NA	9,8	1,1
2014	Gg	19,7	4,1	1,5	NA	7,1	0,8
2015	Gg	22,9	9,3	3,3	NA	15,2	1,7
Trend 1990-2015		-52%	49%	180%		54%	-6%
Trend 2014-2015		16,4%	125,9%	120,0%		115,7%	116,1%

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables (source: Ministry of Energy and Natural resources 2014).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

$$Emission_{pollutant} = \sum AD_{fuel} * EF_{fuel}$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Several assumptions are made in assuming that some fuels are equivalent to brown coal.Emission factors are presented in Table 3.2.6.

Table 3-2-6 Emission factors for 1A.2

Fuel	Unit	Ef	Reference	Table No.
NOx				
H. Coal	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	513	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid	Table 3-4

			fuels	
N. Gas	g/GJ	74	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	81*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
SO_2				
H. Coal	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2

Coke	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	47	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.67	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	11*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	10,8*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*

NMVOC				
H. Coal	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	25	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	23	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in	Table 3-3

			industry using natural gas or derived gases	
AP Waste	g/GJ	300	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	7,31*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
CO				
H. Coal	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction	Table 3-2

			(combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	
Petroleum	g/GJ	66	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	29	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	570	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	90*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
PM_{10}				
H. Coal	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and	Table 3-2

			construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	
Lignite	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	20	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.78	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	143	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1	Table 3-5

			emission factors 1.A.2 Combustion in industry using solid fuels	
Wood	g/GJ	155*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*

Uncertainty

Estimation of uncertainties based on default values from EMEP/EEA emission inventory GB.

Recalculations

Recalsulations were checked and applied due to the revision of the energy balance tables.

Planned Improvements

Facility specific emission factors will be obtained and be used for the further submissions.

3.2.4. NFR 1.A.2.d Pulp, paper and print

Source Category Description

Emissions: IE from 1990-2010, by 2011; NOx, SO2, NMVOC, CO, PM10

Key Source: No

Source of Activity Data

Fuel data were not resolved in the energy balance tables. Since it is not adequate for calculations, it is assumed that it is included in the fuel that has been allocated to stationary sources, so emissions were reported as IE this section from 1990-2010. By 2011, energy balance tables were configured by the subcategories under manufacturing industries. Therefore emissions were calculated separately under the topic of Pulp, Paper and Print.

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables (Source: Ministry of Energy and Natural resources 2015).

Emission trend is illustrated in the figure 3-2-4 a and b..

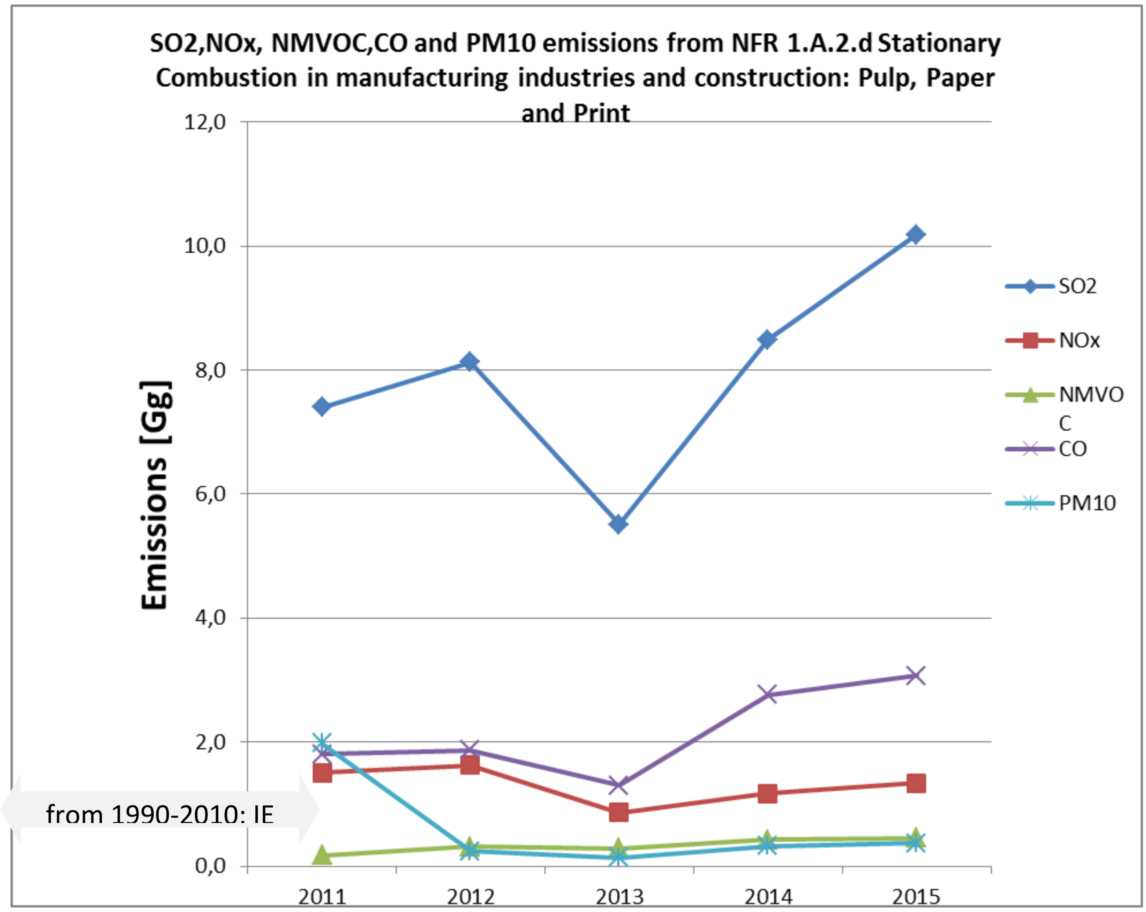


Figure 3-2-4.a Emissions from 1.A.2.d Pulp, Paper and Print, 1990-2015

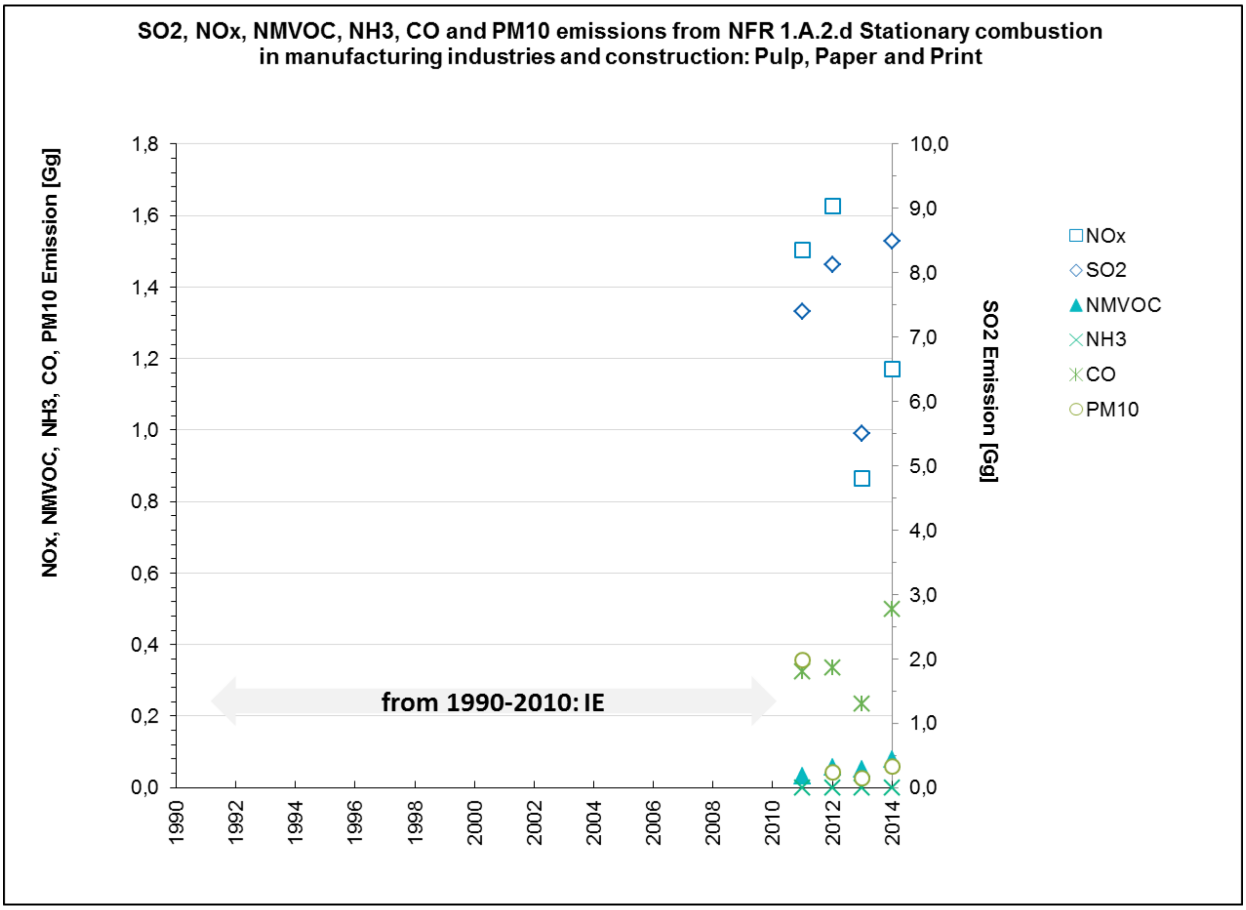


Figure 3-2-4.b Emissions from 1.A.2.d Pulp, Paper and Print, 1990-2015

Emission totals are presented in the Table 3-2-7.

Table 3-2-7 Emissions from 1.A.2.d Pulp, Paper and Print

Year 1.A.2.d Pulp, Paper and Print		Emissions	Gg				
		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	Gg	IE	IE	IE	NA	IE	IE
	Gg	IE	IE	IE	NA	IE	IE
1992	Gg	IE	IE	IE	NA	IE	IE
	Gg	IE	IE	IE	NA	IE	IE
1994	Gg	IE	IE	IE	NA	IE	IE
	Gg	IE	IE	IE	NA	IE	IE
1996	Gg	IE	IE	IE	NA	IE	IE
	Gg	IE	IE	IE	NA	IE	IE
1998	Gg	IE	IE	IE	NA	IE	IE
	Gg	IE	IE	IE	NA	IE	IE
2000	Gg	IE	IE	IE	NA	IE	IE
	Gg	IE	IE	IE	NA	IE	IE
2002	Gg	IE	IE	IE	NA	IE	IE
	Gg	IE	IE	IE	NA	IE	IE
2004	Gg	IE	IE	IE	NA	IE	IE
	Gg	IE	IE	IE	NA	IE	IE
2006	Gg	IE	IE	IE	NA	IE	IE
	Gg	IE	IE	IE	NA	IE	IE
2008	Gg	IE	IE	IE	NA	IE	IE
	Gg	IE	IE	IE	NA	IE	IE
2010	Gg	IE	IE	IE	NA	IE	IE
2011	Gg	7,4	1,5	0,2	NA	1,8	2,0
2012	Gg	8,1	1,6	0,3	NA	1,9	0,2
2013	Gg	5,5	0,9	0,3	NA	1,3	0,1
2014	Gg	8,5	1,2	0,4	NA	2,8	0,3
2015	Gg	10,2	1,3	0,5		3,1	0,4
Trend 2010-2015		38%	-11%	161%		70%	-81%
Trend 2014-2015		20,0%	14,4%	6,4%		11,0%	13,2%

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

$$Emission_{pollutant} = \sum AD_{fuel} * EF_{fuel}$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Several assumptions are made in assuming that some fuels are equivalent to brown coal.

Emission factors are presented in Table 3.2.8

Table 3.2.8 Emission Factors

Fuel	Unit	Ef	Reference	Table No.
NOx				
H. Coal	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	513	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	74	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5

Wood	g/GJ	81	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
SO_2				
H. Coal	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	47	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.67	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	11	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	10,8	EMEP/EEA (2016), Chapter 1.A.2Manufacturingindustries andconstruction(combustion)	*(*assumption covers the brown coal from GB and NCVs from NIR)*

			, Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	
NMVOC				
H. Coal	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	25	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	23	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	300	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	7,31	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*

CO				
H. Coal	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	66	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	29	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	570	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	90	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
PM_{10}				
H. Coal	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing	Table 3-2

			industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	
Lignite	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	20	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.78	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	143	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	155	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*

Planned Improvements

For further inventorial management, data info will be obtained from the sector groups.

3.2.5. NFR 1.A.2.e Food processing, beverages and tobacco

Source Category Description

Emissions: NOx, SO2, NMVOC, CO, PM10

Key Source: No

By 2011, sugar and food-drink were separately calculated. After the revision of the GB, food, beverages and tobacco were calculated under the same NFR category and therefore summed up. Emission trend of the food, beverages and tobacco manufacturing is presented in Figure 3-2-5.

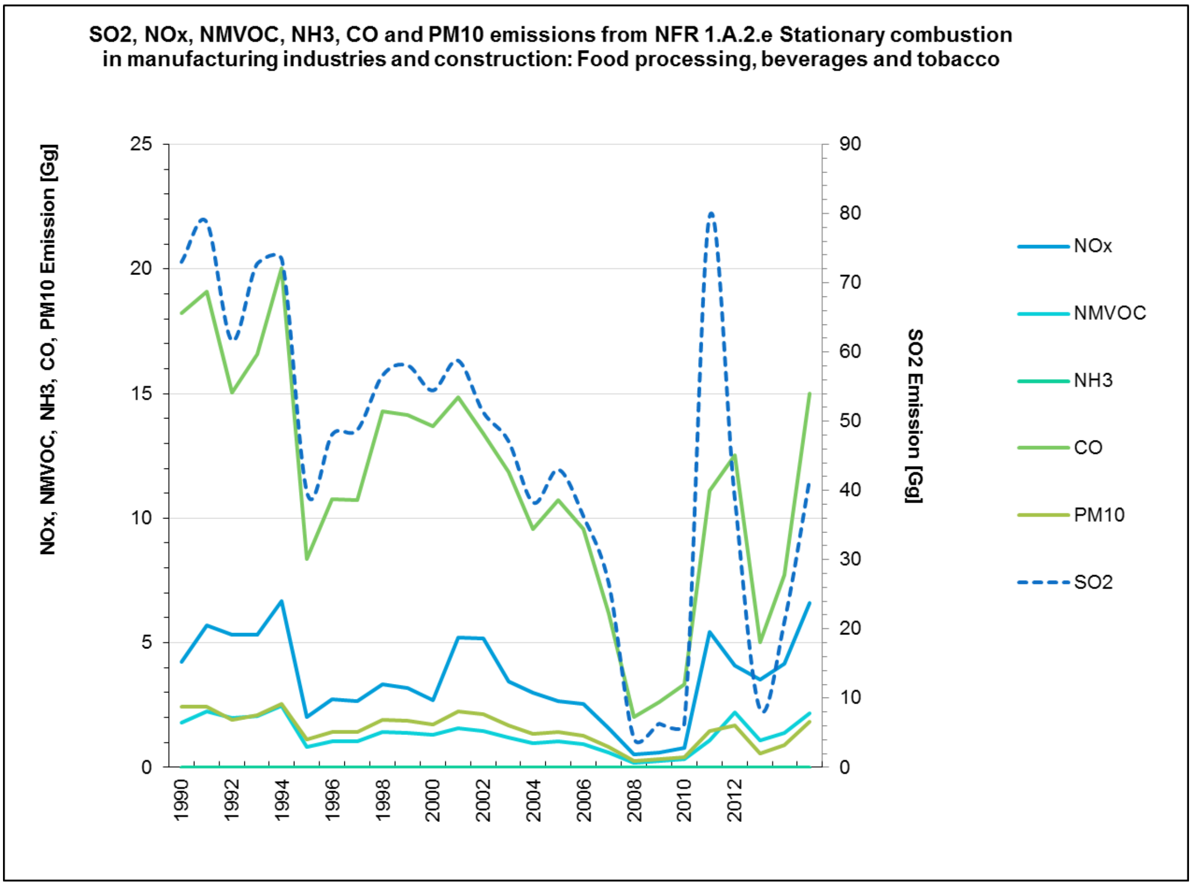


Figure 3-2-5 Emissions from NFR 1.A.2.e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco, 1990-2015.

Emission totals are given in the table 3-2-9.

Table 3-2-9 Emissions from NFR 1.A.2.e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco

Year		Emissions	Gg				
1.A2.e Food processing, beverages and tobacco		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	Gg	73,0	4,2	1,8	NA	18,2	2,4
	Gg	78,8	5,7	2,2	NA	19,1	2,4
1992	Gg	61,7	5,3	2,0	NA	15,0	1,9
	Gg	72,7	5,3	2,1	NA	16,6	2,1
1994	Gg	73,3	6,7	2,5	NA	20,0	2,5
	Gg	39,6	2,0	0,8	NA	8,4	1,1
1996	Gg	48,1	2,7	1,1	NA	10,8	1,4
	Gg	48,8	2,7	1,1	NA	10,7	1,4
1998	Gg	56,6	3,3	1,4	NA	14,3	1,9
	Gg	58,1	3,2	1,4	NA	14,2	1,9
2000	Gg	54,5	2,7	1,3	NA	13,7	1,7
	Gg	58,8	5,2	1,6	NA	14,9	2,3
2002	Gg	51,3	5,2	1,4	NA	13,4	2,1
	Gg	47,2	3,5	1,2	NA	11,8	1,7
2004	Gg	38,2	3,0	1,0	NA	9,6	1,4
	Gg	43,0	2,7	1,0	NA	10,7	1,4
2006	Gg	36,2	2,6	0,9	NA	9,5	1,3
	Gg	26,5	1,6	0,6	NA	6,2	0,8
2008	Gg	4,2	0,5	0,2	NA	2,0	0,3
	Gg	6,3	0,6	0,3	NA	2,6	0,3
2010	Gg	6,3	0,8	0,3	NA	3,3	0,4
	Gg	79,5	5,4	1,1	NA	11,1	1,4
2012	Gg	39,4	4,1	2,2	NA	12,5	1,7
	Gg	8,5	3,5	1,1	NA	5,0	0,6
2014	Gg	21,4	4,2	1,4	NA	7,7	0,9
2015	Gg	41,9	6,6	2,2	NA	15,0	1,8
Trend 2010-2015		-43%	56%	21%		-18%	-24%
Trend 2014-2015		96,1%	58,6%	57,6%		93,9%	101,4%

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables (source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

$$Emission_{pollutant} = \sum AD_{fuel} * EF_{fuel}$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Several assumptions are made in assuming that some fuels are equivalent to brown coal.

Emission factors are presented in Table 3.2.10.

Table 3.2.10 Emission Factors

Fuel	Unit	Ef	Reference	Table No.
NOx				
H. Coal	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	513	EMEP/EEA (2016), Chapter 1.A.2	Table 3-4

			Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	
N. Gas	g/GJ	74	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	81	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
SO_2				
H. Coal	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1	Table 3-2

			emission factors 1.A.2 Combustion in industry using hard or brown coal	
Petroleum	g/GJ	47	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.67	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	11	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	10,8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
NMVOC				
H. Coal	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or	Table 3-2

			brown coal	
Coke	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	25	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	23	EMEP/EEA(2016), Chapter1.A.2 Manufacturing industries andconstruction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	300	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	7,31	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
CO				
H. Coal	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2

Lignite	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	66	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	29	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	570	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	90	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*

PM_{10}				
H. Coal	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	20	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.78	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	143	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	155	EMEP/EEA (2016), Chapter 1.A.2	*(*assumption covers the brown coal from GB and NCVs from*

	Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*NIR)*

3.2.6. NFR 1.A.2.f Non-Metallic Minerals

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}

Key Source: Yes(SO_2,NO_x,CO)

After the revision of the GB, ceramics, glass and cement were calculated under the same NFR category and therefore summed up. Emission trend of non-metallic minerals is presented in Figure 3-2-6.

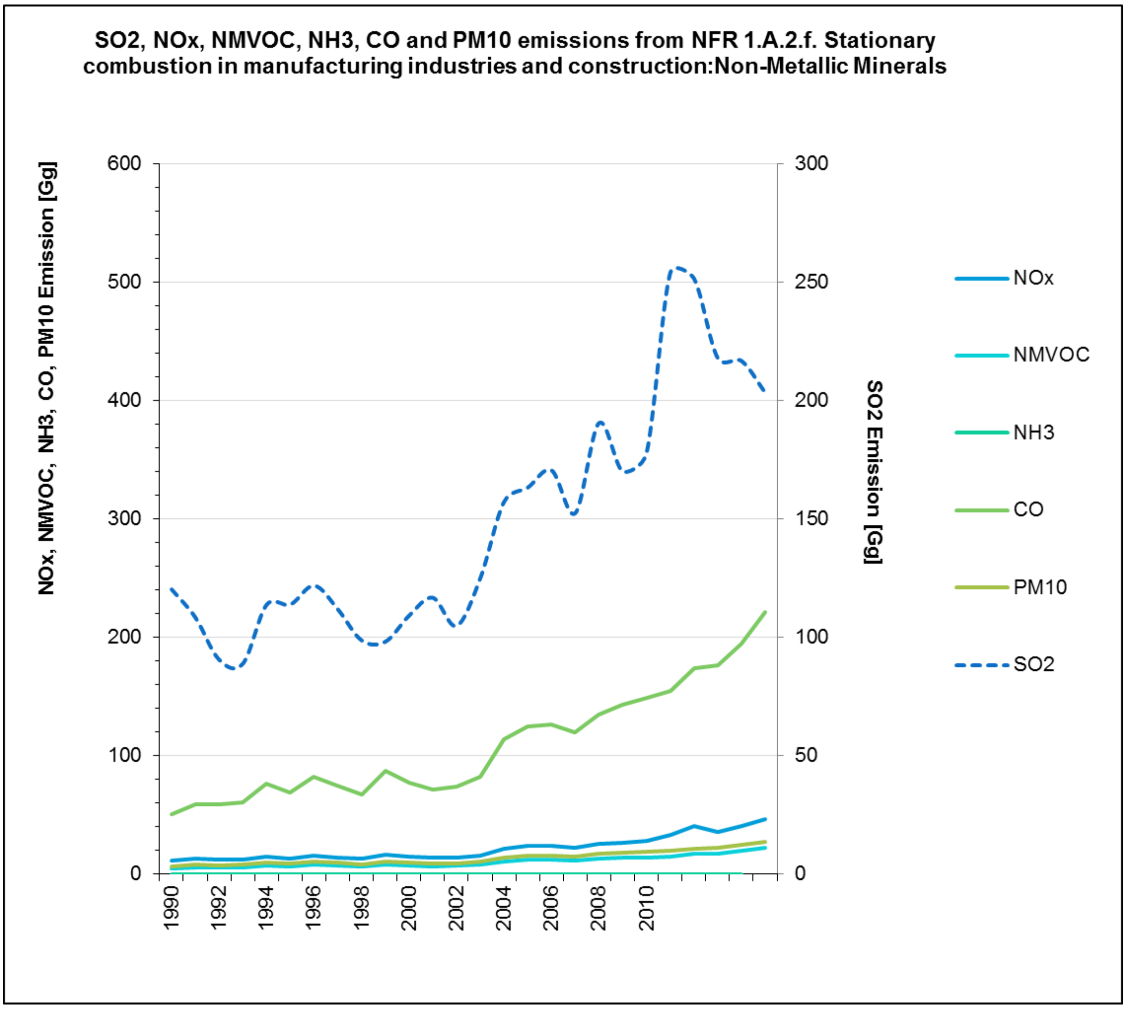


Figure 3-2-6 Emissions from NFR 1.A.2.f. Stationary combustion in manufacturing industries and construction:Non-Metallic Minerals, 1990-2014

Emission totals are given in Table 3-2-11.

Tabel 3-2-11 Emissions from NFR 1.A.2.f. Stationary combustion in manufacturing industries and construction:Non-Metallic Minerals

Year 1.A.2.f Non-metallic minerals		Emissions	Gg				
		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	Gg	120	11	5	NA	50	7
	Gg	108	13	6	NA	59	8
1992	Gg	91	12	6	NA	59	8
	Gg	89	12	6	NA	61	8
1994	Gg	114	15	7	NA	77	10
	Gg	114	13	7	NA	69	9
1996	Gg	122	16	8	NA	82	10
	Gg	112	14	7	NA	75	9
1998	Gg	99	13	6	NA	67	9
	Gg	98	17	8	NA	87	11
2000	Gg	109	15	7	NA	77	10
	Gg	117	14	7	NA	72	9
2002	Gg	105	14	7	NA	74	9
	Gg	125	16	8	NA	82	10
2004	Gg	157	21	11	NA	114	14
	Gg	163	24	12	NA	125	16
2006	Gg	171	24	12	NA	127	16
	Gg	152	23	11	NA	120	15
2008	Gg	191	25	13	NA	135	17
	Gg	170	27	14	NA	143	18
2010	Gg	178	28	14	NA	149	19
	Gg	254	33	15	NA	155	19
2012	Gg	252	40	18	NA	174	22
	Gg	218	36	18	NA	177	22
2014	Gg	216,8	40,8	19,7	NA	195,0	24,4
2015	Gg	203,5	46,3	22,4		221,3	27,6
Trend 1990-2015		69%	305%	354%		340%	313%
Trend 2014-2015		-6,2%	13,5%	13,6%		13,5%	13,4%

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables (source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

$$Emission_{pollutant} = \sum AD_{fuel} * EF_{fuel}$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Several assumptions are made in assuming that some fuels are equivalent to brown coal.

Emission factors are presented in Table 3.2.12.

Table 3.2.12 Emission Factors

fuel	unit	EF	Reference	Table No.
NOx				
H. Coal	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	513	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	74	EMEP/EEA (2016),	Table 3-3

			Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	
AP Waste	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	81	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
SO_2				
H. Coal	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	47	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction	Table 3-4

			(combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	
N. Gas	g/GJ	0.67	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	11	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	10,8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
NMVOC				
H. Coal	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors	Table 3-2

			1.A.2 Combustion in industry using hard or brown coal	
Petroleum	g/GJ	25	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	23	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	300	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	7,31	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
CO				
H. Coal	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors	Table 3-2

			1.A.2 Combustion in industry using hard or brown coal	
Coke	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	66	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	29	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	570	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	90	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
PM_{10}				
H. Coal	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors	Table 3-2

			1.A.2 Combustion in industry using hard or brown coal	
Lignite	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	20	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.78	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	143	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	155	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*

3.2.7. NFR 1.A.2.g vii Mobile Combustion in manufacturing industries and construction

Source Category Description: IE

Emissions: NOx, SO2, NMVOC, CO, PM10

Key Source: No

Emissions were assumed and calculated under the stationary other NFR category.

3.2.8. NFR 1.A.2.g viii Mobile Combustion in manufacturing industries and construction

Source Category Description

Emissions: NOx, SO2, NMVOC, CO, PM10

Key Source: No

By 2011, textile and motor vehicle manufacturing were separately given in the energy balance. By 2013, after the revision of the GB stationary other NFR category covers the textile, motor vehcle manufacturing and the 'other' manufacturing industry.

Emission trend is given in the figure 3-2-7.

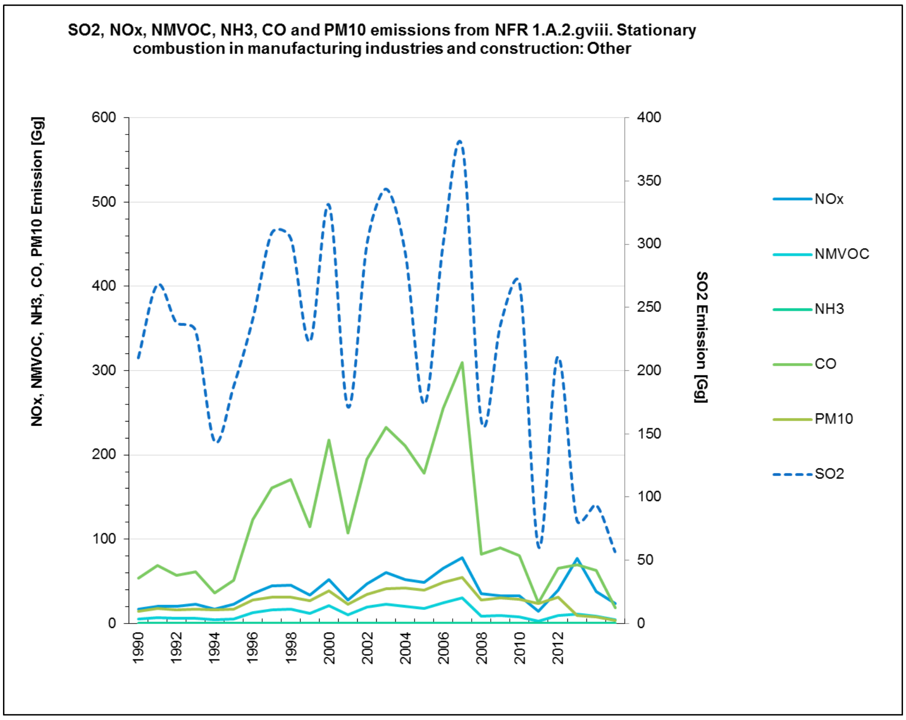


Figure 3-2-7 SO2, NOx, NMVOC, NH3, CO and PM10 emissions from NFR 1.A.2.gviii. Stationary combustion in manufacturing industries and construction: Other from 1990-2015

Emission totals are given in the table 3-2-13.

Table 3-2-13 Emissions from NFR 1.A.2.gviii. Stationary combustion in manufacturing industries and construction: Other

Year		Emissions	Gg				
1.A2.gviii Other		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	Gg	210	17	6	NA	54	15
	Gg	268	20	7	NA	68	18
1992	Gg	238	20	6	NA	57	16
	Gg	232	23	6	NA	61	17
1994	Gg	144	17	4	NA	36	16
	Gg	188	22	6	NA	51	17
1996	Gg	241	35	12	NA	123	27
	Gg	309	44	16	NA	161	31
1998	Gg	304	46	17	NA	171	32
	Gg	223	34	12	NA	115	27
2000	Gg	331	52	21	NA	217	39
	Gg	171	28	10	NA	107	23
2002	Gg	301	47	19	NA	195	35
	Gg	344	60	23	NA	233	41
2004	Gg	293	52	21	NA	211	42
	Gg	174	49	18	NA	178	39
2006	Gg	302	65	25	NA	255	49
	Gg	377	78	30	NA	310	55
2008	Gg	160	36	8	NA	83	28
	Gg	237	33	9	NA	90	30
2010	Gg	268	33	8	NA	81	29
	Gg	60	15	3	NA	25	23
2012	Gg	211	39	10	NA	66	31
	Gg	82	77	11	NA	70	10
2014	Gg	93,9	37,6	8,8	NA	63,0	8,1
2015	Gg	56,7	23,4	4,0	NA	18,3	3,5
Trend 1990-2015		-73%	37%	-27%		-66%	-76%
Trend 2014-2015		-39,6%	-37,8%	-54,2%		-70,9%	-56,6%

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables (source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

$$Emission_{pollutant} = \sum AD_{fuel} * EF_{fuel}$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Several assumptions are made in assuming that some fuels are equivalent to brown coal.

Emission factors are presented in Table 3.2.14.

Table 3.2.14 Emission Factors

Fuel	Unit	Ef	Reference	Table No.
NOx				
H. Coal	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	513	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	74	EMEP/EEA (2016),	Table 3-3

			Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	
AP Waste	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	81*	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
SO_2				
H. Coal	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	47	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction	Table 3-4

			(combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	
N. Gas	g/GJ	0.67	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	11	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	10,8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
NMVOC				
H. Coal	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-2 Tier 1 emission factors	Table 3-2

			1.A.2 Combustion in industry using hard or brown coal	
Petroleum	g/GJ	25	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-4 Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	23	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),Table 3-3 Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	300	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	7,31	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
CO				
H. Coal	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry	Table 3-2

			using hard or brown coal	
Coke	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	66	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	29	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	570	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	90	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
PM_{10}				
H. Coal	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2	Table 3-2

			Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	
Coke	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	20	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.78	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	143	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	155	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels, page 15	*(*assumption covers the brown coal from GB and NCVs from NIR)*

3.3. NFR 1.A.3 Transport

3.3.1. NFR 1.A.3.a Civil aviation

3.3.1.1. NFR 1A3aii(i) Civil Aviation, Domestic, LTO and NFR 1A3ai(i) International Aviation, LTO

Source Category Description

Emissions: NOx, CO, NMVOC, SO2

Key Source: No

Emission Trend

NOx emissions increased from 1,92 Gg in 1990 to 20,86 Gg in 2015.

SO2 emissions increased from 0,12 Gg in 1990 to 1,36 Gg in 2015.

NMVOC emissions increased from 0,45 Gg in 1990 to 4,41 Gg in 2015.

CO emissions increased from 0,89 Gg in 1990 to 10,43 Gg in 2015.

Emission trends are presented in **Hata! Başvuru kaynağı bulunamadı.**2-15 and **Hata! Başvuru kaynağı bulunamadı.**-16.

Table 3.2-15: Emissions from sector NFR 1.A.3.a.ii (i) Civil Aviation, Domestic (LTO) for the period 1990 to 2015

Years	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1990	0.12	1.92	0.45	NA	0.89	NE
1991	0.13	2.17	0.50	NA	1.00	NE
1992	0.14	2.30	0.53	NA	1.07	NE
1993	0.19	3.07	0.71	NA	1.42	NE
1994	0.21	3.42	0.79	NA	1.58	NE
1995	0.35	5.69	1.32	NA	2.63	NE
1996	0.38	6.27	1.46	NA	2.90	NE
1997	0.41	6.63	1.54	NA	3.07	NE
1998	0.42	6.81	1.58	NA	3.15	NE
1999	0.36	5.90	1.37	NA	2.73	NE

2000	0.39	6.37	1.48	NA	2.95	NE
2001	0.42	6.92	1.61	NA	3.20	NE
2002	0.14	2.24	0.52	NA	1.03	NE
2003	0.34	5.58	1.30	NA	2.58	NE
2004	0.61	10.02	2.33	NA	4.64	NE
2005	0.52	8.43	1.96	NA	3.90	NE
2006	0.57	9.30	2.16	NA	4.30	NE
2007	0.76	12.41	2.88	NA	5.74	NE
2008	0.66	10.77	2.50	NA	4.98	NE
2009	0.65	10.60	2.46	NA	4.91	NE
2010	0.83	13.43	3.17	NA	6.30	NE
2011	0.93	14.97	3.44	NA	7.19	NE
2012	0.98	13.20	0.25	NA	8.20	NE
2013	1.11	17.73	3.72	NA	8.46	NE
2014	1.24	16.51	0.34	NA	9.80	NE
2015	1.36	20.86	4.41	NA	10.43	NE
Trend1990 - 2015	1033.3 %	986.5%	880%	NA	1071.9 %	NE
Trend 2014 - 2015	9.7%	26.3%	1197.1 %	NA	6.4%	NE

Table 3-2-16: Emissions from sector NFR 1.A.3.a.i (i) International Aviation (LTO) for the period 1990 to 2015

Years	SO_2	NOx	NMVOC	NH_3	CO	PM_{10}
	ktonnes	**ktonnes**	**ktonnes**	**ktonnes**	**ktonnes**	**ktonnes**
1990	0.03	0.43	0.10	NA	0.20	NE
1991	0.03	0.48	0.11	NA	0.22	NE
1992	0.03	0.51	0.12	NA	0.24	NE
1993	0.04	0.68	0.16	NA	0.32	NE
1994	0.05	0.76	0.18	NA	0.35	NE
1995	0.08	1.27	0.29	NA	0.59	NE
1996	0.09	1.40	0.32	NA	0.65	NE
1997	0.09	1.48	0.34	NA	0.68	NE
1998	0.09	1.52	0.35	NA	0.70	NE
1999	0.08	1.31	0.31	NA	0.61	NE
2000	0.09	1.42	0.33	NA	0.66	NE
2001	0.09	1.54	0.36	NA	0.71	NE
2002	0.03	0.50	0.12	NA	0.23	NE
2003	0.08	1.24	0.29	NA	0.58	NE
2004	0.14	2.23	0.52	NA	1.03	NE
2005	0.12	1.88	0.44	NA	0.87	NE
2006	0.13	2.07	0.48	NA	0.96	NE
2007	0.17	2.76	0.64	NA	1.28	NE

2008	0.15	2.40	0.56	NA	1.11	NE
2009	0.14	2.36	0.55	NA	1.09	NE
2010	0.18	2.99	0.71	NA	1.40	NE
2011	0.21	3.33	0.77	NA	1.60	NE
2012	0.22	2.94	0.17	NA	1.83	NE
2013	0.25	3.95	0.83	NA	1.89	NE
2014	0.28	3.68	0.03	NA	2.18	NE
2015	0.30	4.65	0.98	NA	2.32	NE
Trend 1990 - 2015	900%	981.4%	880%	NA	1060%	NE
Trend 2014 - 2015	7.1%	26.4%	3166.7 %	NA	6.4%	NE

Source of Activity Data

Domestic LTO

For domestic aviation the number of LTO per aircraft type is available for the years 2009-2015. To complete the whole time series, the existing 2009 data are extrapolated using the total fuel sales for aviation form the energy balance. Each LTO per aircraft type was multiplied with an ordinary fuel use per LTO.

International LTO

These are calculated by taking the domestic LTO emissions and rescaling by the fuel used for International LTO vs. Domestic LTO.

Source of Emission Factors

The LTO emission factors by aircraft type are taken from the existing emissions model from the Ministry of Transport (which agree with literature values in the EMEP/EEA Guidebook 2013 and IPCC Guidance). These are emissions per LTO cycle, except for SO_2 which is calculated throughout this sector on a fuel basis. For 2015 calculation EMEP/EEA Guidebook 2013 is used. Emission factors are presented in **Hata! Başvuru kaynağı bulunamadı.**2-17 and 3-2-18.

Table 3-2-17: Emission factor (EF) used sector 1.A.3.a Aviation LTO

EF	NOx	CO	NMVOC
	kg/LTO	kg/LTO	kg/LTO
median (min – max)	10.2 (0.74 - 65)	8.1 (2.33 - 45)	2.6 (0.26 - 75.9)

Table 3-2-18: Emission factor (EF) used sector 1.A.3.a Aviation LTO, EMEP 2016

EF	NOx	CO	NMVOC
	kg/LTO	kg/LTO	kg/LTO
median (min – max)	10.8 (10.8- 38.20)	5.5 (5.5 -82.9)	0.10 (0.10 – 13.20)

Uncertainty

Estimation of uncertainties based on default values from EMEP/EEA emission inventory guidebook 2013.

The uncertainty may however lie between 20–30 % for LTO factors.

Recalculations

Recalculations have been done for year 1990-2015 with the activity data obtained from Ministry of Transport, Maritime and Communication.

Planned Improvements

International LTO

It is currently assumed that the LTO: Cruise fuel use for international is the same as domestic. This is a significant assumption and is not likely to be accurate, because international flights are longer than domestic flights. So the cruise component will account for a higher percentage of the total fuel use. However, without any data this has been the only sensible approach, and it is not expected to have a particular large impact on the total emissions (because the total fuel use is still the same).

There are several steps needed to improve these emission estimates. The first and most important is to obtain international (bunker) aviation fuel data for the entire time series. This issue will be handled for next submissions between the Ministry of Transport and MoEU.

If the numbers of international LTOs are available, then an estimate of the International LTO fuel use can be estimated, and hence the total split into LTO and cruise components.

3.3.1.2. NFR 1.A.3.a.ii (ii) Civil Aviation, Domestic Cruise (Memo Items) and NFR 1.A.3.a i (ii) International Aviation Cruise (Memo Items)

Source Category Description

Emissions: NO_x, NMVOC, SO_2, CO

Key Source: No

Emission Trend

NO_x emissions increased from 2.25 Gg in 1990 to 0.54 Gg in 2015.

SO_2 emissions increased from 0.17 Gg in 1990 to 0.29 Gg in 2015.

NMVOC emissions increased from 0.12 Gg in 1990 to 0.03 Gg in 2015.

CO emissions increased from 1.22 Gg in 1990 to 0.04 Gg in 2015.

Source of Activity Data

The total fuel used for cruise is split into the different aircraft types by assuming that the fuel used in the cruise phase is in proportion to that used for LTO (i.e. for each aircraft type, the fraction of total fuel used in cruise is assumed to be the same as the fraction for LTO).

The total fuel used for domestic aviation is available from the energy balance tables. The fuel used for the LTO component has been estimated (above) from the number of LTO movements, it is therefore possible to estimate the fuel used for domestic cruise by difference.

$$\text{Fuel}_{\text{domestic cruise}} = \text{Fuel}_{\text{domestic total}} - \text{Fuel}_{\text{domestic LTO}}$$

Source of Emission Factors

The emission factors are taken from the existing emissions model from the Ministry of Transport (which agrees with literature values in the GB and IPCC Guidance). For cruise the emission factors are fuel based emissions factors (which is different to the LTO based emission factors). For 2015 calculation EMEP/EEA Guidebook 2013 is used. Emission factor is presented in Table 3-2-19.

Table 3-2-19: Emission factor (EF) used sector 1.A.3.a Aviation (Domestic Cruise)

EF	kg/tonne	kg/tonne	kg/tonne	kg/tonne
	NOx	CO	NMVOC	SO_2
median (min – max)	11 (7,2 - 16,1)	7 (7 - 7)	0,7 (0,7 - 0,7)	1 (1 - 1)

Uncertainty

Estimation of uncertainties based on default values from GB.

The uncertainty may however lie between 20–45 % for the cruise factors.

Recalculations

Recalculations have been done for year 1990-2015 with the activity data obtained from Ministry of Transport, Maritime and Communication.

Planned Improvements

The availability of LTO data by aircraft type is going to be obtained yearly from Ministry of Transport.

International LTO

It is currently assumed that the LTO: Cruise fuel use for international is the same as domestic. This is a significant assumption and is not likely to be accurate, because international flights are longer than domestic flights. So the cruise component will account for a higher percentage of the total fuel use. However, without any data this has been the only sensible approach, and it is not expected to have a particular large impact on the total emissions (because the total fuel use is still the same).

There are several steps needed to improve these emission estimates. The first and most important is to obtain international (bunker) aviation fuel data for the entire time series. This issue will be handled for next submissions between the Ministry of Transport and MoEU.

If the numbers of international LTOs are available, then an estimate of the International LTO fuel use can be estimated, and hence the total split into LTO and cruise components.

3.3.2. NFR 1.A.3.b Road Transportation

COPERT Calculation

Source Category Description

Emissions: NOx, SO2, NMVOC, NH3, CO, PM10

Key Source: Yes(NOx,NMVOC)

Emission Trends

NOx emissions increased by about 338.8% from 236.8 Gg in 2000 to 310.7 Gg in 2015.

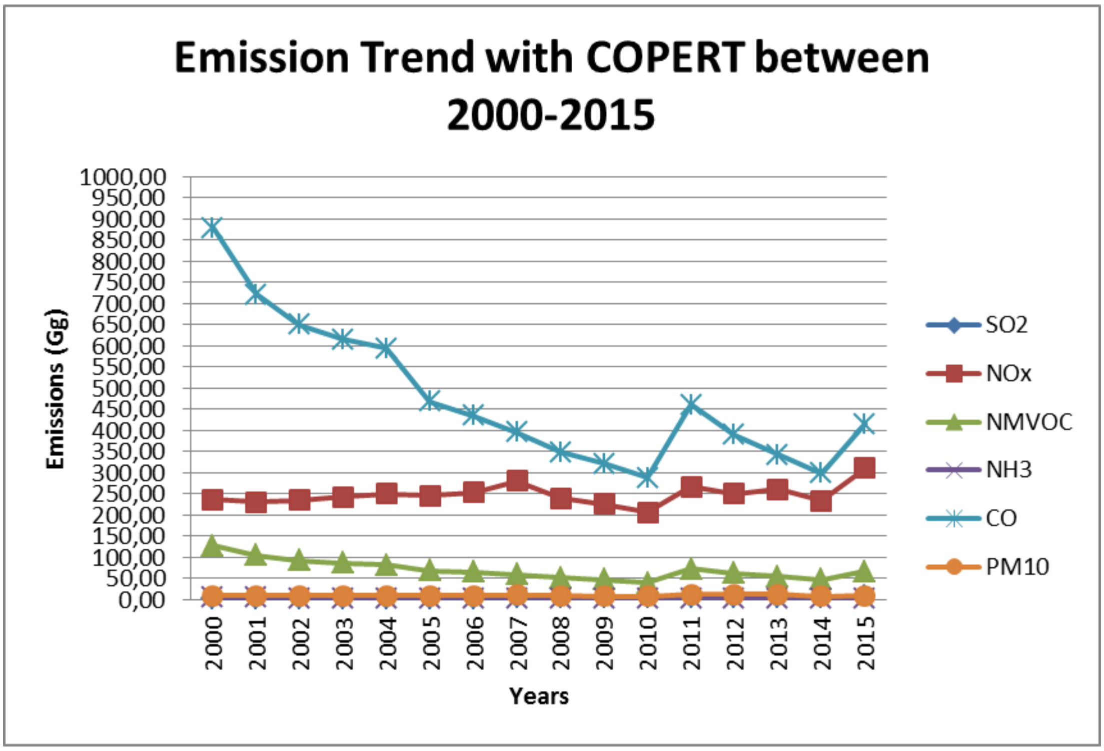
SO2 emissions increased by about 31.2% from 1.72 Gg in 2000 to 7.54 Gg in 2015.

NMVOC emissions decreased by about 47.5% from 127,9 Gg in 2000 to 67.2 Gg in 2015.

NH3 emissions decreased by about 42,2% from 4.59 Gg in 2000 to 2.65 Gg in 2015.

CO emissions decreased by about 52.8% from 880 Gg in 2000 to 415 Gg in 2015.

PM10 emissions decreased by about 1.5% from 9.89 Gg in 2000 to 9.75 Gg in 2015.

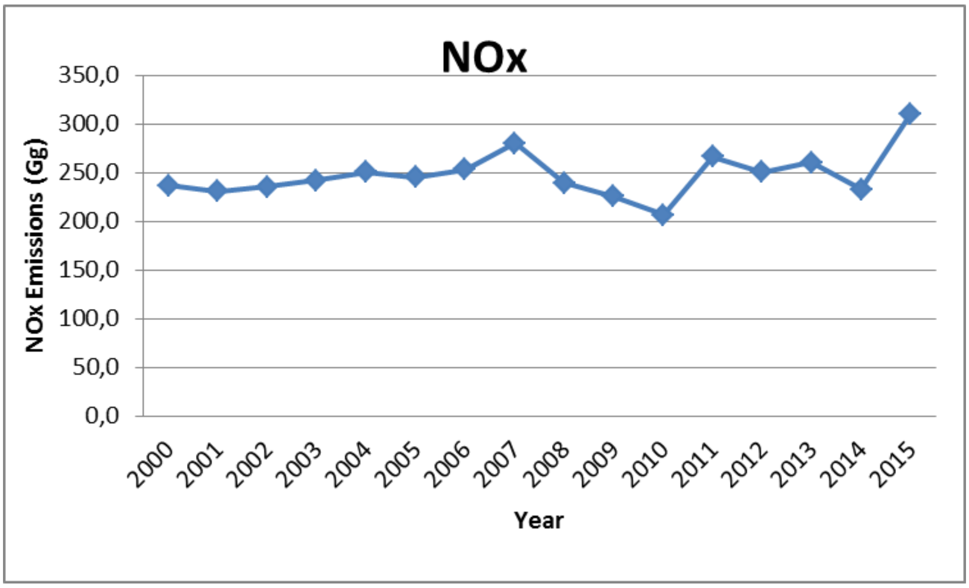


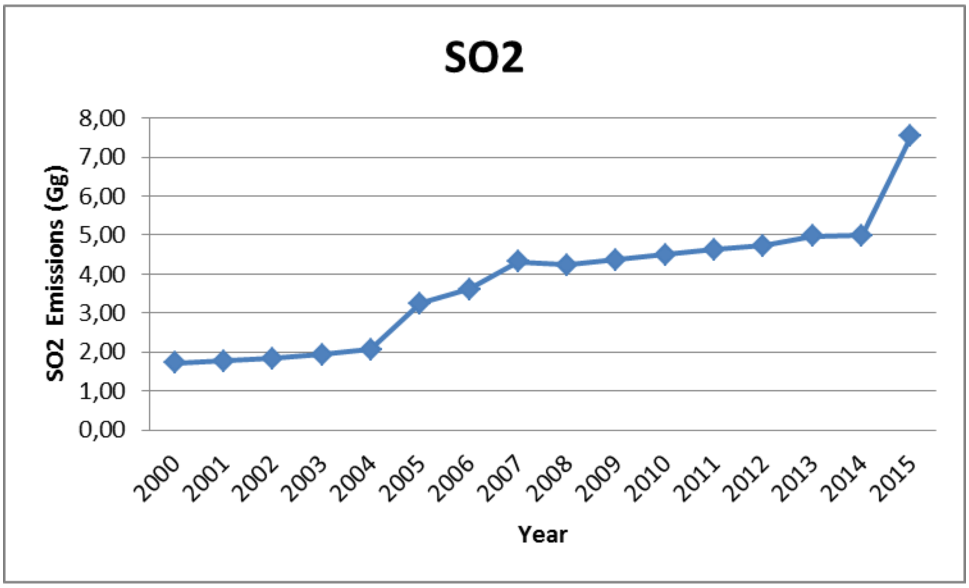
Figures 3-2-13 – Emissions with COPERT

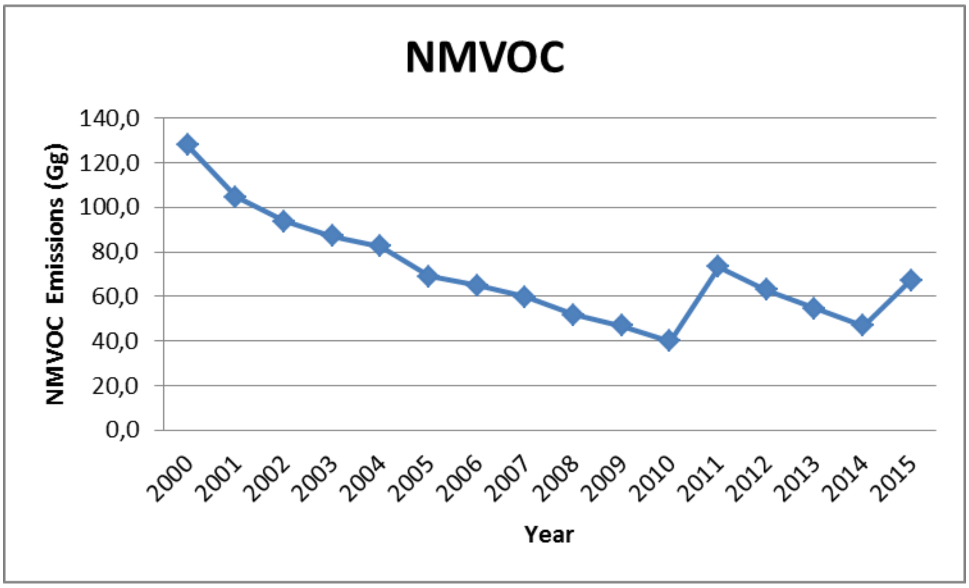
Emissions trend from road transport are presented only for 2000-2015, since COPERT was run only for these years. The submission on 2017 also includes the road transport emissions including 2000-2015 years COPERT calculation.

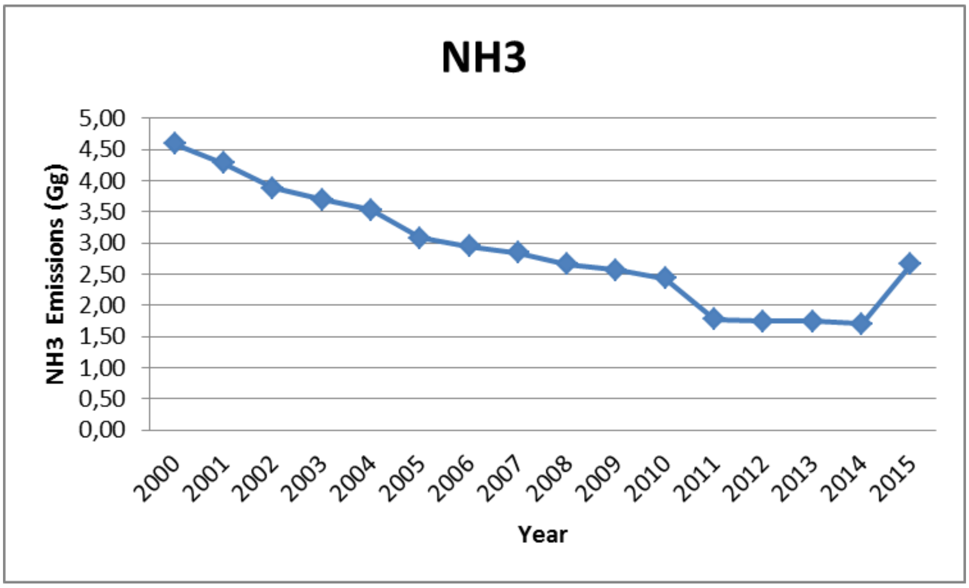
After the recalculation of emissions from sector 1.a.3.b Road transport with COPERT for the years before 2000, the trend can be compared between 1990 and 2015. After the time series completed including 1990-2015, road transportation emissions will be submitted under recalculations topic.

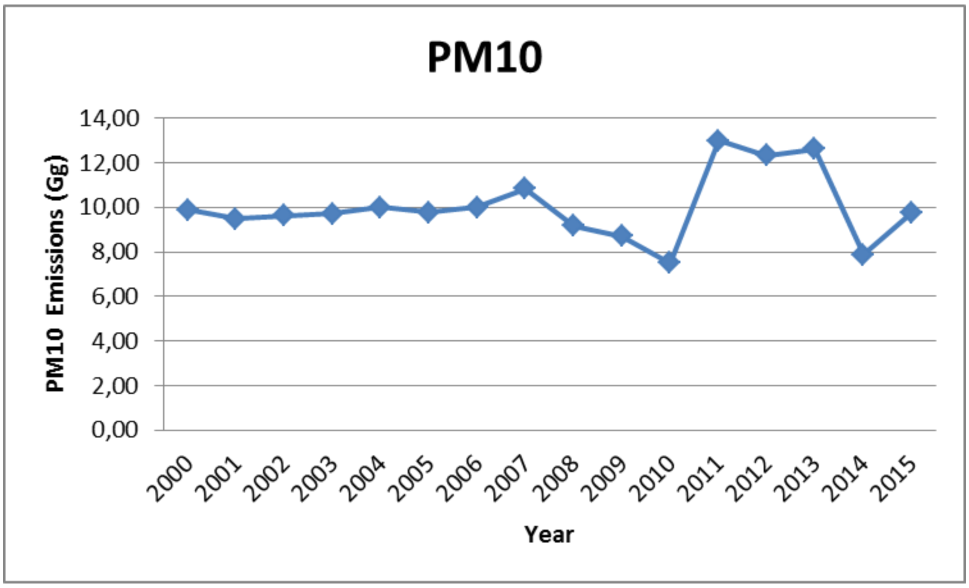
Here, emission trends with COPERT calculation are also presented.

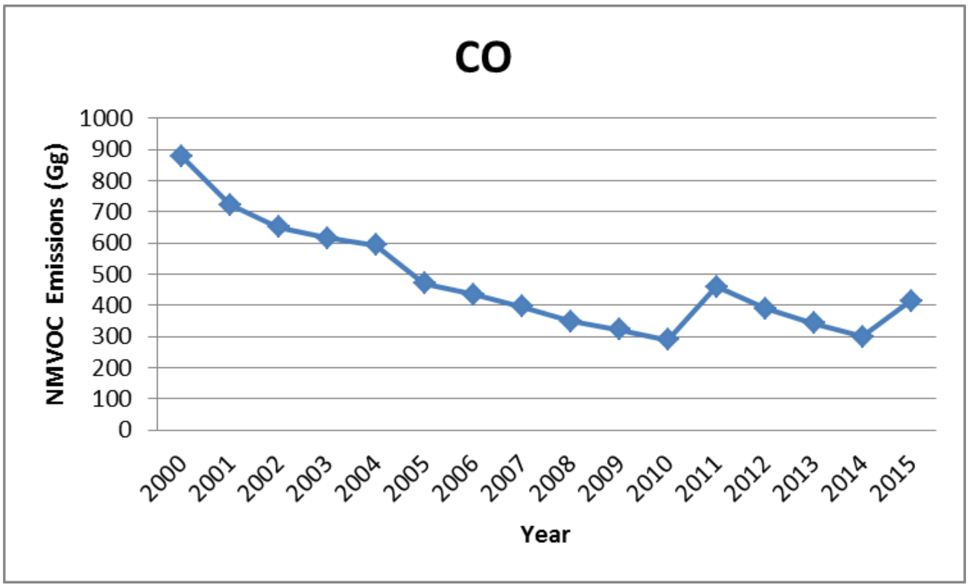

NOx
NOx Emissions (Gg)
350,0
300,0
250,0
200,0
150,0
100,0
50,0
0,0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year


SO2
SO2 Emissions (Gg)
8,00
7,00
6,00
5,00
4,00
3,00
2,00
1,00
0,00
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year


NMVOC
NMVOC Emissions (Gg)
140,0
120,0
100,0
80,0
60,0
40,0
20,0
0,0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year


NH3
NH3 Emissions (Gg)
5,00
4,50
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year


PM10
PM10 Emissions (Gg)
14,00
12,00
10,00
8,00
6,00
4,00
2,00
0,00
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year


CO
NMVOC Emissions (Gg)
1000
900
800
700
600
500
400
300
200
100
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year

Figures 3-2-14, 3-2-15, 3-2-16, 3-2-17, 3-2-18, 3-2-19 – Emissions from COPERT

Source of Activity Data

Activity data are in the form of the amount of fuels used in this sector and are taken from the energy balance tables (source: Ministry of Energy and Natural resources 2015).

Fleet number

The data in the model are vehicle numbers for each year, split into vehicle type and fuel type (assumptions are made regarding the petrol/diesel split for LDVs).

The petrol/diesel split for annual car sales were taken directly from the emissions calculation method used by the Ministry of Transport.

This information on the petrol and diesel cars and LDVs entering the fleet each year were applied to the vehicle numbers in a stepwise approach through the years. It was therefore possible to have a figure for e.g. 2000 that accounted for the petrol and diesel sales in each of the ten previous years.

This is how total vehicle numbers, split by type and petrol/diesel were generated for each year in the time series.

Age Distribution of Vehicle Fleet and Technology

The fraction of the fleet complying with the different emission standards were calculated for each year in the time series. This was done by using annual data on sales and removals from the vehicle fleet, allowing the age profile of the vehicle fleet to be determined for each year in the time series.

For example, to create the 1991 vehicle fleet by age, the vehicle removals in 1991 were subtracted from the previous year (1990), and the sales were added. This provides the total number of vehicles in 1990 and indicates whether they were new in 1990 or 1991. This process is then repeated, stepping through the entire time series, removing cars (assumed to be distributed uniformly through the fleet by age) and adding in the sales figures, to generate a total for the next year.

In this way, it is possible to construct vehicle numbers for each year of the time series broken down by their age.

As the years at which the different Euro standards were introduced in Turkey are known, the ages of the vehicles were then translated into Euro standards.

This enabled, for each year of the time series, the vehicle fleet to be broken down into defined technology standards for each vehicle type.

Annual kilometers by Road class

Data on the use of different road types by different vehicles were provided by Istanbul Technical University. It was necessary to split the rural roads into single- and dual-carriageways. It was assumed that 75% of vehicle kilometers (vkm) on rural roads were undertaken on single carriageway roads, with the remaining 25% on dual carriageway.

Fraction of vehicles on different roadways

In the year 2015 Turkey has about 2159 km of toll roads, 31213 km of state highways, and 33065 km of provincial roads and in total 66437 km.

Annual kilometers by Vehicle Type

It was not possible to obtain annual vehicle km data from official sources. So the data had to be generated with information that was available. A large dataset of vehicle data was obtained from the TUVTURK studies. This provided the odometer reading from a very large sample of vehicles, as well as the vehicle type and age. Theoretically, it would then be possible to use these data to deduce information about the typical annual vehicle kms driven by different vehicle types in different years. However, it was clear that the output would be very variable and that some assumptions would need to be made about smoothing the data so as to arrive at some sensible estimates. Hence the dataset was sorted so that results could be expressed according to different vehicle types. For each vehicle type, the following analysis was undertaken:

The data were screened for outliers, and where possible these were removed.

The odometer readings for vehicles originating in the same year were then averaged. For example, by 2010 a heavy goods vehicle originating in 1998 had undertaken an average of 408,500 kms; these vehicles had been on the road for 13 years and had been driven an average of 31,423 kms/year (Note: no account was taken of the fact that newer vehicles do more kms/year than older ones; hence vkms in earlier years are likely to be underestimated whilst vkms in more recent years are likely to be overestimated).

These data were plotted, and it was clear that there was substantial noise in the sample. So simple straight line fits were applied to the plots to represent the changing annual vehicle kms across the time series.

It is recognised that there is a large degree of subjectivity in deciding on these best fits, and it is important that improvements be made – not by making small improvements to the existing method, but by sourcing alternative (preferably official) datasets on the annual vehicle-kms of the different vehicle types.

PM10 Brake & Tyre Wear

PM10 emissions from brake and tyre wear were calculated by combining international default emission factors with vehicle-km data.

Evaporative Emissions

Emissions of NMVOC arise from evaporation from petrol vehicles as well as exhaust emissions.

Emissions are estimated from different evaporative components: diurnal losses, hot soak and running losses using a standard approach from the EMEP/EEA Guidebook.

Cold Start Emissions

There are increased emissions of NOx and PM10 from vehicles which start cold, as opposed to vehicles which already have a warm engine.

A method from the EMEP/EEA Guidebook is used to calculate the ratio of emissions including cold start over the emissions excluding cold start (Ecold/Ehot). This ratio is combined with the emissions already estimated to adjust the emission total to include the impact of cold start emissions.

Emission calculations

The vehicle-kms and corresponding EFs were combined to give emissions for each year in some detail. Carbon emissions are also calculated for reasons given in later sections.

Total emission estimates are obtained by collating the calculated emissions, on a vehicle-km basis, for the following:

Exhaust emissions for NOx, NMVOC, NH3 and PM10

NOx and PM10 cold start emissions

NMVOC evaporative emissions (reported as a specific NFR category)

PM10 tyre and brake wear emissions (reported as a specific NFR category)

Carbon emissions (calculated on a vkm basis)

SO2 emissions (calculated by combining the fuel use and S content of fuels).

Adjusting Emission Estimates using Fuel Consumption

The emissions calculated on a vehicle-km basis are accompanied by a calculation of the fuel use. This is compared with the actual fuel use data from the national energy balance tables. Emissions are rescaled by: fuel used/calculated fuel use. This is so that the final emissions are completely consistent with the national fuel data from the energy balance tables and, presumably, with the emission estimates in the GHG emissions inventory.

The following figure shows the impact of rescaling emissions by the fuel use. It is noticeable that the rescaling has the largest impact on HGV vehicles in the most recent years. This may be partly due to tank tourism: Turkey has one of the highest fuel prices in Europe. But is it also likely to be caused by some of the uncertainties in the methodology. In particular it should be noted that the energy balance tables do not provide information on petrol and diesel use – merely total petroleum. Also, there is a high level of uncertainty associated with the annual vehicle kms that have been assigned to HGVs across the time series.

Source of Emission Factors

The emission factors are taken from a road transport model that is used in the UK (called the 'Emission Factor Toolkit'). It is based on the most currently available information on EFs from sources such as COPERT. EFs for NOx are currently undergoing rather frequent revisions, and will need to be reviewed.

The EFs are dependent on speed, and set speeds are assumed for each vehicle type travelling on different road classes. The speeds that are assumed are given in Table 3.24

Table 3-2-20: Speed per street and vehicle type used sector 1.A.3.b road transport

km/hr	Within Residential Areas	Inter-city	Inter-city, separated roads	Highway
Passenger Cars	50	90	110	120
Minibus	50	80	90	100
Buses and Coaches	50	80	90	100
Light Duty Vehicles	50	80	85	95
Heavy Goods Vehicles, Rigid	50	80	85	90
Heavy Goods Vehicles, Articulated	50	80	85	90
Motorcycles	50	90	110	120

Uncertainty

Estimation of uncertainties based on default values from GB.

Recalculations

No recalculations have been required for this version of the inventory. This is the first reporting to emission data of sector 1.A.3.b road transport.

Planned Improvements

The national energy balance tables do not split the road fuel use into petrol and diesel. So assumptions had to be made about the use of these two different types of fuel. Improvements need to be made by obtaining real data on the use of petrol and diesel individually.

Compressed natural gas has not been included in the emissions inventory. It is known that taxis and other vehicles use this fuel. Emissions per km may not be large for this fuel type, but it seems that the data may be available to allow its inclusion in the inventory in future.

Improvements are needed to reduce the uncertainties associated with the annual vehicle km data by vehicle type that are used across the time series.

PM10 emissions from road abrasion have not been estimated yet.

3.3.3. NFR 1.A.3.c Railways

EPA Method

Source Category Description

Emissions: NOx, HC, CO, PM10

Key Source: No

Exhaust emissions from railways arise from Diesel-powered engines used in freight and passenger rail, line-haul and switch locomotives.

Emission Trends

NOx emissions decreased by about 6,69% from 1,5913 Gg in 2011 to 1,4848 Gg in 2015,

HC emissions decreased by about 7,89% from 0,8395 Gg in 1990 to 0,7733 Gg in 2015,

CO emissions decreased by about 24,98% from 0,0578 Gg in 1990 to 0,0434 Gg in 2015,

PM10 emissions decreased by about 22,31% from 0,2048 Gg in 1990 to 0,1591 Gg in 2015.

Emission trends are illustrated in Figure 3.2-20. The decreases of all emissions in this sector were mainly due to Hard coal rails were not be used after 2000.

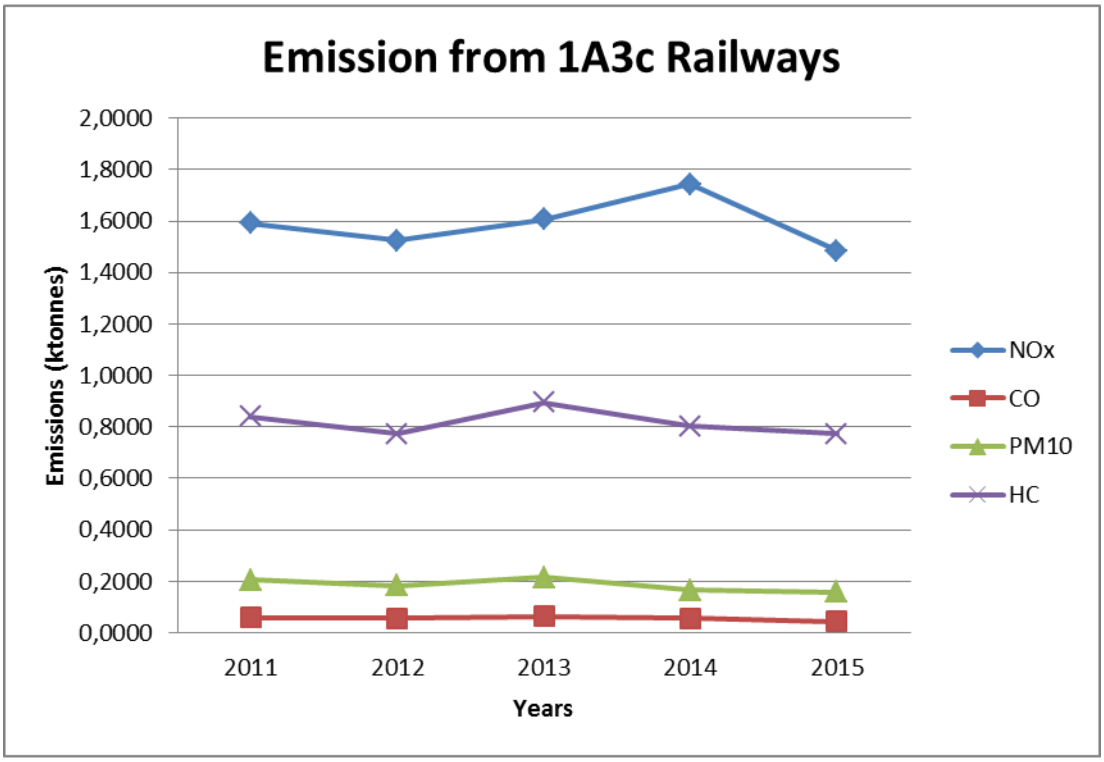


Figure 3-2-20 Emissions from NFR 1.A.3.c for the period 2011 to 2015

Table 3-2-21 Emissions from sector 1.A.3.c.Railway

Years	NOX	HC	CO	PM10
	ktonnes	ktonnes	ktonnes	ktonnes
2011	1,5913	0,8395	0,0578	0,2048
2012	1,5241	0,7723	0,0563	0,1842
2013	1,6060	0,8945	0,0626	0,2157
2014	1,7441	0,8027	0,0563	0,1666
2015	1,4848	0,7733	0,0434	0,1591

Source of Activity Data

Activity data are in the form of the number and types of locomotives used in this sector and are taken from Turkish State Railways Annual Statistics (TSRAS) 2008-2012 (source: web site of Turkish State Railways http://www.tcdd.gov.tr/files/istatistik/20082012yillik.pdf). Only locomotives with diesel engines are included to the calculations.

Table 3-2-22 Number and Types of locomotives available and in-operation (Turkish State Railways Annual Statistics 2008-2012)

	Lokomotif tipi	Motor üreticisi	Faal lokomotif sayısı	Mevcut lokomotif
Anahat Dizel Lokomotif	DE 11000	Krauss-Maffei	38	63
	DE 18000	SMTE	1	1
	DE 18100	SMTE	5	9
	DE 22000	General Motors	69	86
	DE 24000	SMTE	218	248
	DE 33000	General Motors	64	79
	DE 33000	General Motors	10	10
	Toplam		405	496
Manevra Dizel Lokomotif	DH 6500	Shunters	1	1
	DH 3600	MaK	2	2
	DH 7000	Tulomsas	11	17
	DH 9500	Tulomsas	24	26
	Toplam		38	46
Dizel dizi	MT 5500	Fiat	6	7
	MT 5600	Tuvasas and Fiat	3	9
	MT 5700	Fiat	23	28
	MT 15000	Cummıns QSK	9	12
	MT 30000	Cummıns SK 19R	8	11
	Toplam		49	67

Methodological Issues

The applied methodology is TIER 3, which is a specific locomotive usage methodology and uses the algorithm below:

Ei=N x HP x LF x HRS x EFi, j, m

Ei= total emissions of pollutant i for the period concerned in the inventory (ktonnes/year)

HP=power of engine

N=number of engines of locomotive used

LF=typical operational load of engines according to the average engine power (0.26)

HRS=average yearly operation time per engine

EFi, j, m= emission factor of pollutant i for each unit of fuel type m used by category j (kg/tonnes)

m = fuel type (diesel, gas oil)

j = locomotive category (shunting, rail-car, line-haul)

Source of Emission Factors

Emission factors for each type of locomotive are in gram/bhp-hr terms, and have been taken from the EPA Guidebook. Emission factors are presented in Table 3-2-24 and Table 3-2-25.

Table 3-2-23 Technical Specifications and Emission Standards according to type of locomotives (Turkish State Railways Annual Statistics 2008-2012)

	Lokomotif tipi	Motor üreticisi	Lokomotif başına düşen güç (hp)	Lokomotif yaşı	Emisyon standartı
Anahat Dizel Lokomotif	**DE 11000**	Krauss-Maffei	1065	20-29	Seviye 0
	DE 18000	SMTE	1500	>40	Kontrolsüz
	DE 18100	SMTE	1500	30-39	Seviye 0
	DE 22000	General Motors	2000	20-29	Seviye 0
	DE 24000	SMTE	1900	20-29 30-39	Seviye 0
	DE 33000	General Motors	3000	0-9	Seviye 2
	DE 33000	General Motors	3000	10-19	Seviye 1
Manevra Dizel Lokomotif	**DH 6500**	Shunters	650	>40	Kontrolsüz
	DH 3600	MaK	360-450	>40	Kontrolsüz
	DH 7000	Tulomsas	700	10-19	Seviye 1
	DH 9500	Tulomsas	950	10-19	Seviye 1
Dizel dizi	**MT 5500**	Fiat	4x145	>40	Kontrolsüz
	MT 5600	Tuvasas and Fiat	2x225	20-29	Seviye 0
	MT 5700	Fiat	2x280	20-29	Seviye 0
	MT 15000	Cummıns QSK 19R	2x750	0-9	Seviye 2
	MT 30000	Cummıns SK 19R	2x750	0-9	Seviye 2

Table 3-2-24 Line-Haul Locomotive Emission Factors, g/bhp·hr (EPA, 2009)

Seviye	*Yıl*	*HC*	*CO*	*NOx*	*PM10*
Kontrolsüz	-1973	1	1.28	13	0.32
Seviye 0	1973-1992	1	5	8	0.22
Seviye 1	1993-2004	0.55	2.2	7.4	0.22
Seviye 2	2005-2011	0.3	1.5	5.5	0.1
Seviye 3	2012-2014	0.3	1.5	5.5	0.1
Seviye 4	2015 ve sonrası	0.14	1.5	1.3	0.03

Table 3-2-25 Switch Locomotive Emission Factors, g/bhp·hr (EPA, 2009)

Seviye	*Yıl*	*HC*	*CO*	*NOx*	*PM10*
Kontrolsüz	-1973	2.1	8	17.4	0.44
Seviye 0	1973-2001	2.1	8	11.8	0.26
Seviye 1	2002-2004	1.2	2.5	11	0.26
Seviye 2	2005-2010	0.6	2.4	8.1	0.13
Seviye 3	2011-2014	0.6	2.4	5	0.1
Seviye 4	2015 or later	0.14	2.4	1.3	0.03

Uncertainty

Estimation of uncertainties based on default values from GB.

Recalculations

No recalculations have been required for this version of the inventory. This is the first reporting to emission data of sector 1.A.3.c Railways with Tier 3 Method.

Planned Improvements

No improvement is planned.

3.3.4. NFR 1.A.3.d Navigation

3.3.4.1. NFR 1.A.3.d.i (ii) International inland waterways

Source Category Description

Emissions: NE

Source of Activity Data

The national energy balance tables do not include bunker fuel, and therefore international shipping in inland waters was not included in the emissions inventory.

So this source is reported as NE (not estimated).

Planned Improvements

If bunker fuel can be obtained, then it will be possible to include the international component of shipping. However, it is likely that all of this will be assigned to international shipping (reported in the memo items), unless this could be split into marine and inland waterways components.

3.3.4.2. NFR 1.A.3.d.ii National navigation (Shipping)

Source Category Description

Emissions: NOx, SO2, NMVOC, CO, PM10

Key Source: Yes (NOx)

For national navigation, emission estimates have been made, although it has not been possible to resolve the emissions from fishing boats (so the latter is reported as IE). Exhaust emissions from shipment arise from the combustion of petroleum in diesel engines.

Emission Trends

NOx emissions increased by about 14.79% from 12.64 Gg in 1990 to 14.51 Gg in 2015.

SO2 emissions increased by about 14.73% from 3.19 Gg in 1990 to 3.66 Gg in 2015.

NMVOC emissions increased by about 13.95% from 0.43 Gg in 1990 to 0.49 Gg in 2015.

CO emissions increased by about 14.4% from 1.18 Gg in 1990 to 1.35 Gg in 2015.

PM10 emissions increased by about 14.14% from 0.99 Gg in 1990 to 1.13 Gg in 2015.

Emission trends are illustrated in Figure 3-2-21. The increases of all emissions in this sector were mainly due to higher activity.

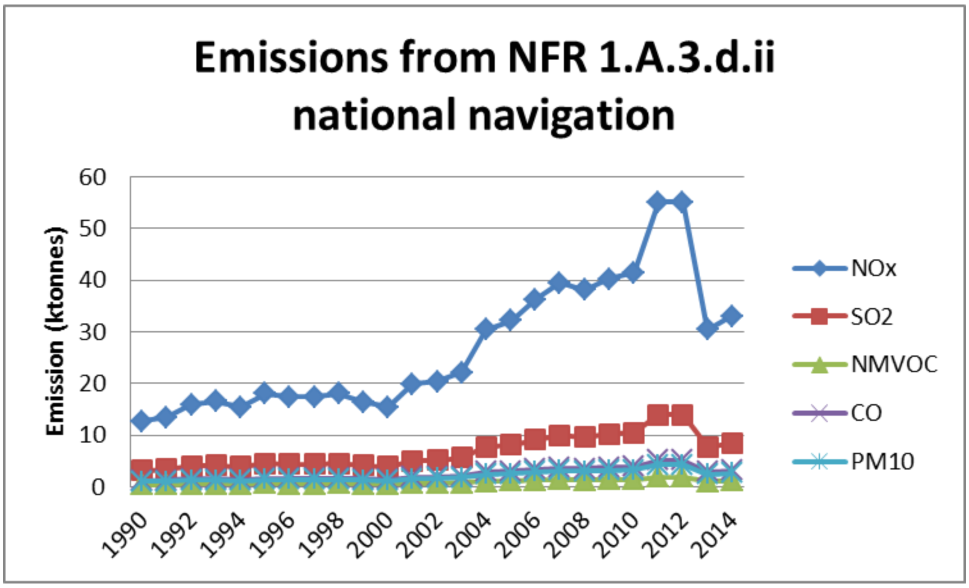


Figure 3-2-21 Emissions from NFR 1.A.3.d.ii national navigation for the period 1990 to 2015

Emissions from this sector are presented in Table 3.2-23

Table 3-2-23 Emissions from sector 1.A.3.d.ii national navigation

Years	NOx	SO2	NMVOC	CO	PM10
	ktonnes	**ktonnes**	**ktonnes**	**ktonnes**	**ktonnes**
1990	12.64	3.19	0.43	1.18	0.99
1991	13.48	3.40	0.46	1.26	1.05
1992	15.86	4.00	0.54	1.48	1.24
1993	16.49	4.16	0.56	1.54	1.29
1994	15.47	3.90	0.53	1.44	1.21
1995	18.05	4.55	0.61	1.68	1.41
1996	17.38	4.38	0.59	1.62	1.36
1997	17.34	4.37	0.59	1.62	1.36
1998	18.02	4.55	0.61	1.68	1.41
1999	16.34	4.12	0.56	1.52	1.28
2000	15.46	3.90	0.53	1.44	1.21
2001	19.83	5.00	0.68	1.85	1.55
2002	20.36	5.14	0.69	1.90	1.59
2003	22.07	5.57	0.75	2.06	1.73
2004	30.40	7.67	1.03	2.84	2.38
2005	32.16	8.11	1.09	3.00	2.51
2006	36.21	9.13	1.23	3.38	2.83
2007	39.52	9.97	1.35	3.69	3.09
2008	38.14	9.62	1.30	3.56	2.98
2009	40.26	10.15	1.37	3.76	3.15
2010	41.48	10.46	1.41	3.87	3.24
2011	55.03	13.88	1.87	5.14	4.30
2012	55.03	13.88	1.87	5.14	4.30
2013	30.45	7.68	1.04	2.84	2.38
2014	33.07	8.34	1.13	3.09	2.59
2015	14.51	3.66	0.49	1.35	1.13

Source of Activity Data

Activity data are in the form of amount petroleum used in this sector and are taken from the energy balance tables (source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

Emissionpollutant = ∑ ADfuel * EFfuel

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

ADfuel = fuel consumption of fuel type (tonnes)

EFfuel = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Emission factors for are in mass terms and have been taken from the GB. Emission factors are presented in Table 3.2-24.

Table 3-2-24 Emission factor (EF) used sector 1.A.3.d.ii national navigation

Fuel	Unit	Ef	Reference
NOx			
petroleum	kg/tonne	79.3	EMEP/EEA (2016), Chapter 1.A.3.d shipping, Tier 1 emission factors for ships using bunker fuel oil, page 13
SO2			
petroleum	kg/tonne	20	EMEP/EEA (2016), Chapter 1.A.3.d shipping, Tier 1 emission factors for ships using bunker fuel oil, page 13
NMVOC			
petroleum	kg/tonne	2.7	EMEP/EEA (2016), Chapter 1.A.3.d shipping, Tier 1 emission factors for ships using bunker fuel oil, page 13
CO			
petroleum	kg/tonne	7.4	EMEP/EEA (2016), Chapter 1.A.3.d shipping, Tier 1 emission factors for ships using bunker fuel oil, page 13
PM10			
petroleum	kg/tonne	6.2	EMEP/EEA (2016), Chapter 1.A.3.d shipping, Tier 1 emission factors for ships using bunker fuel oil, page 13

Uncertainty

Estimation of uncertainties based on default values from GB.

Activity data uncertainty: ±10%%

Emission factor uncertainty: NOx ±20%, SOx ±10%, NMVOC ±25% and PM ±25%

Recalculations

No recalculations have been required for this version of the inventory. This is the first reporting to emission data of sector 1.A.3.d.ii national navigation.

Planned Improvements

It would be a considerable improvement if the petroleum from the energy balance tables could be split into different types of petroleum. This is true for all of the petroleum fuels being reported by the energy balance tables.

3.3.5. NFR 1.A.3.e.i pipeline compressors

Source Category Description

Emissions: NOx, SO2, NMVOC, PM10, CO

Key Source: No

This chapter covers the emissions of pipeline compressors, which is mainly important for greenhouse gases (methane leaks). Emissions occur from combustion in gas driven compressor in compressor stations.

Emission Trends

Emissions in this sector were reported since 2006. Before, there is no activity data available. Emissions from pipeline compressors have only minor importance to the total emissions in Turkey.Emission trends are illustrated in Figure 3-2-22.

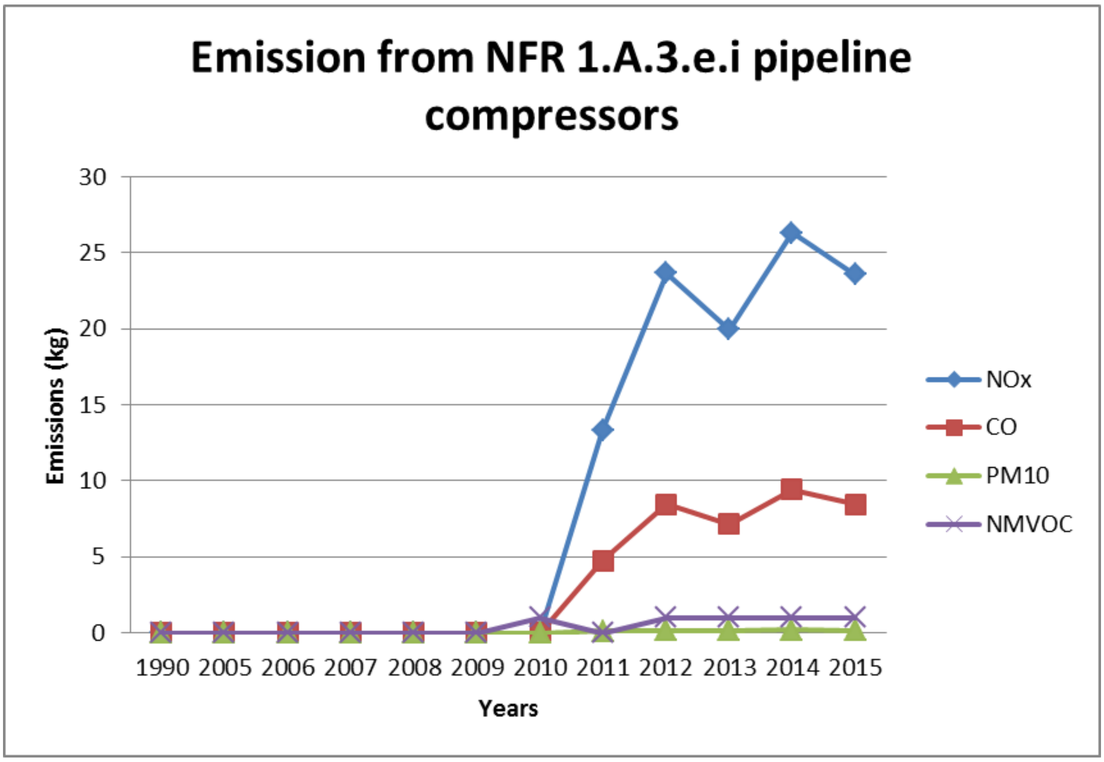


Figure 3-2-22 Emissions from NFR 1.A.3.e for the period 1990 to 2015

Emissions from this sector are presented in Table 3.29.

Years	NOx	SO2	NMVOC	CO	PM10
	kg	kg	kg	kg	kg
1990		0	0	0	0
2005		0	0	0	0
2006	.	0	0	3.43.	0.07.
2007	13.28.	0	0	4.74.	0.09.
2008	13.36.	0	0	4.77.	0.10.
2009	13.13.	0	0	4.69.	0.09.
2010	17.01.	0	1	6.08.	0.12.
2011	13.32	0	0	4.76	0.10
2012	23.66	0	1	8.45	0.17
2013	19.95	0	1	7.13	0.14
2014	26.32	0	1	9.40	0.19
2015	23.59	0	1	8.43	0.17

Source of Activity Data

Activity data are in the form of the amount of gas used in this sector and are taken from the energy balance tables. The original units are in m3. These are converted into an energy term (using a calorific values from the literature), to match the available emission factors (source: Ministry of Energy and Natural resources 2015). Before 2006 there is no activity data available.

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

Emissionpollutant = ∑ ADfuel * EFfuel

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

ADfuel = fuel consumption of fuel type (tonnes)

EFfuel = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Emission factors are taken from the GB and are in energy terms. Emission factors are presented in Table 3-2-26.

Table 3-2-26 Emission factor (EF) used sector 1.A.3.e.i pipeline compressors

fuel	unit	EF	Reference
NOx			
Natural Gas	g/GJ	74	EMEP/EEA (2016), Chapter 1.A.4.a/c, 1.A.5.a Small Combustion, Table 3-8 Tier 1 emission factors for NFR source category 1.A.4.a/c, 1.A.5.a, using gaseous fuels, page 29
SO2			
Natural Gas	g/GJ	0.67	EMEP/EEA (2016), Chapter 1.A.4.a/c, 1.A.5.a Small Combustion, Table 3-8 Tier 1 emission factors for NFR source category 1.A.4.a/c, 1.A.5.a, using gaseous fuels, page 29
NMVOC			
Natural Gas	g/GJ	23	EMEP/EEA (2016), Chapter 1.A.4.a/c, 1.A.5.a Small Combustion, Table 3-8 Tier 1 emission factors for NFR source category 1.A.4.a/c, 1.A.5.a, using gaseous fuels, page 29
CO			
Natural Gas	g/GJ	29	EMEP/EEA (2016), Chapter 1.A.4.a/c, 1.A.5.a Small Combustion, Table 3-8 Tier 1 emission factors for NFR source category 1.A.4.a/c, 1.A.5.a, using gaseous fuels, page 29
PM10			
Natural Gas	g/GJ	0.78	EMEP/EEA (2016), Chapter 1.A.4.a/c, 1.A.5.a Small Combustion, Table 3-8 Tier 1 emission factors for NFR source

	category 1.A.4.a/c, 1.A.5.a, using gaseous fuels, page 29

Uncertainty

Estimation of uncertainties based on default values from GB.

Recalculations

No recalculations have been required for this version of the inventory.

3.3.6. NFR 1.A.4 Small Combustion

3.3.6.1.NFR 1.A.4.a.i Commercial/Institutional (Stationary)

Source Category Description: IE

No emission estimates have been made for this sector. This is because the energy balance tables do not resolve the fuel used for the Commercial/Institutional sector. It is assumed that the fuel used in this sector has been included in either Other Industry or Residential ("Housing and Services"). This assumption needs to be confirmed. Emissions are reported as IE.

The energy balance tables split on the petroleum still isn't available on the web under the topic of statistics. The meeting results which were succeeded on the petroleum split will be used in the future submissions.

3.3.6.2.NFR 1.A.4.a.ii Commercial/Institutional (Mobile)

Source Category Description:IE

No emission estimates have been made for this sector. This is because the energy balance tables do not resolve the fuel used for mobile machinery in this sector from other sources.Emissions are reported as IE due to energy balance split.

The 1st alternative is to improve the detail of the fuel data from the energy balance tables to allow fuel for this sector be resolved, then these fuel data could be combined with either emission factors from the GB. The 2nd alternative would be use a bottom-up approach. It might be possible to make some very approximate estimates of the number of different types of machinery being used in Turkey, and their hours of operation. This approach is outlined in the GB. The results from this would give emission estimates for mobile machinery, as well as an estimate of the fuel that is consumed each year (presumably diesel and petrol).

It would be necessary to subtract this amount of fuel from the fuel that is currently assigned to stationary combustion in the various categories above.

These alternatives will be assessed fo future submissions.

3.3.6.3. NFR 1.A.4.b.i Residential (Stationary)

Source Category Description

Emissions: NOx, SO_2, NMVOC, PM_{10}, CO,NH_3

Key Source: Yes (CO, PM_{10}, NMVOC, SO_2, NO_x)

Emission trend is given in the Figure 3-2-22.

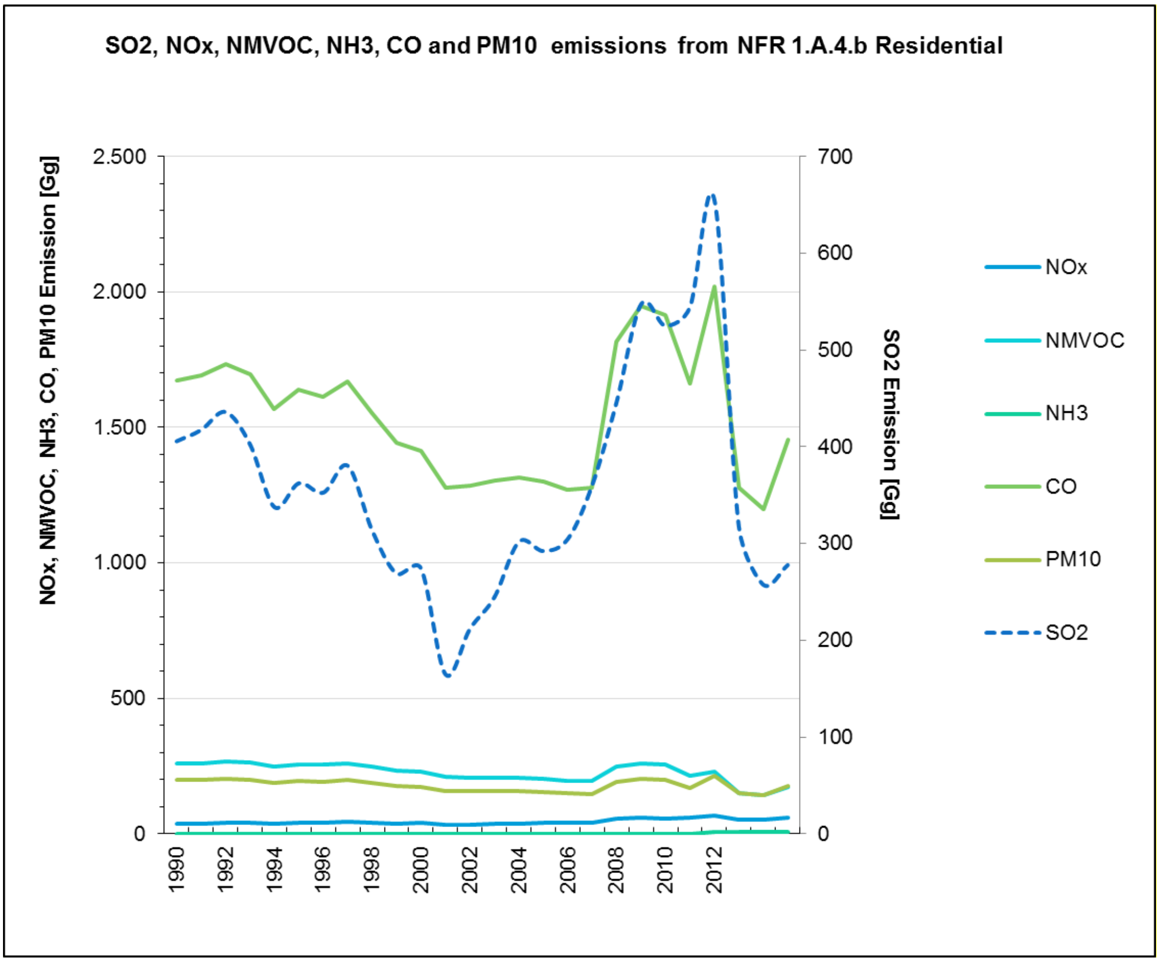


Figure 3-2-22 Emission trend for residential combustion

Emission totals are given in the table 3-2-26.

Table 3-2-26 Emission totals for residential combustion.

Year		Emissions	Gg				
1.A.4.b Residential		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	Gg	405,8	36,9	258,0	0,9	1.671,6	197,2
	Gg	417,3	37,8	260,5	0,9	1.690,6	199,1
1992	Gg	436,0	39,8	265,5	0,9	1.732,9	203,1
	Gg	402,7	39,5	262,2	0,9	1.696,0	200,2
1994	Gg	337,7	36,3	249,1	0,9	1.567,0	189,1
	Gg	362,3	39,9	257,3	0,9	1.638,0	195,6
1996	Gg	352,7	40,5	254,7	0,9	1.611,6	193,2
	Gg	380,4	42,8	261,0	0,9	1.670,7	198,4
1998	Gg	313,4	39,8	248,5	0,9	1.552,2	187,9
	Gg	268,7	37,7	233,8	0,8	1.444,2	176,4
2000	Gg	274,2	39,0	227,6	0,8	1.413,7	171,7
	Gg	164,8	33,5	209,8	0,8	1.276,7	157,8
2002	Gg	211,7	34,0	207,6	0,7	1.284,4	156,6
	Gg	244,5	36,3	207,1	0,7	1.304,8	156,6
2004	Gg	301,7	38,2	205,7	0,7	1.315,3	155,8
	Gg	292,3	41,0	202,0	0,7	1.301,2	152,8
2006	Gg	304,7	40,9	196,1	0,6	1.269,0	148,3
	Gg	360,4	42,0	194,6	0,6	1.276,8	147,5
2008	Gg	446,3	55,4	249,0	0,6	1.815,8	193,4
	Gg	547,4	58,2	260,8	0,6	1.950,0	203,8
2010	Gg	525,0	55,4	254,7	0,6	1.915,4	199,5
	Gg	544,4	59,7	214,8	0,5	1.660,5	167,9
2012	Gg	655,1	67,0	228,1	6,4	2.019,5	213,6
	Gg	317,3	52,9	150,3	6,5	1.276,8	149,3
2014	Gg	257,45	50,61	141,22	6,26	1.196,49	140,73
2015	Gg	277,82	59,52	173,30	8,20	1.454,98	174,65
Trend 1990-2015		-31,5%	61,3%	-32,8%	844,9%	-13,0%	-11,4%
Trend 2014-2015		7,9%	17,6%	22,7%	31,0%	21,6%	24,1%

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables (source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

$$Emission_{pollutant} = \sum AD_{fuel} * EF_{fuel}$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Several assumptions are made in assuming that some fuels are equivalent to brown coal.

Asphalite has the same EFs as the h.coal, lignite and coke.

Emission factors are presented in Table 3-2-27.

Table 3-2-27 EFs for residential combustion

Fuel	Unit	Ef	Reference	Table No.
NOx				
H. Coal	g/GJ	110	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Lignite	g/GJ	110	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Coke	g/GJ	110	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Petroleum	g/GJ	51	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-4
N. Gas	g/GJ	51	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-4
AP Waste	g/GJ	80	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-6
Wood	g/GJ	80	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-6
SO_2				
H. Coal	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Lignite	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Coke	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Petroleum	g/GJ	70	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-5
N. Gas	g/GJ	0,3	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-4

AP Waste	g/GJ	11	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-6
Wood	g/GJ	11	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-6
NMVOC				
H. Coal	g/GJ	484	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Lignite	g/GJ	484	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Coke	g/GJ	484	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Petroleum	g/GJ	0,69	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-5
N. Gas	g/GJ	1,9	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-4
AP Waste	g/GJ	600	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-6
Wood	g/GJ	600	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-6
CO				
H. Coal	g/GJ	4600	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Lignite	g/GJ	4600	EMEP/EEA (2016), Chapter 1.A.4.b Residential combustion, Tier 1 emission factors	Table 3-3
Coke	g/GJ	4600	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-3
Petroleum	g/GJ	57	EMEP/EEA (2016), Chapter 1.A.4.b Residential combustion, Tier 1 emission factors	Table 3-4
N. Gas	g/GJ	26	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-5
AP Waste	g/GJ	4000	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-6
Wood	g/GJ	4000	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	Table 3-6

PM_{10}				
H. Coal	g/GJ	117*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Lignite	g/GJ	117*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Coke	g/GJ	117*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Petroleum	g/GJ	20*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
N. Gas	g/GJ	0.78*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
AP Waste	g/GJ	143*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	155*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
NH_3				
H. Coal	g/GJ	117*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Lignite	g/GJ	117*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Coke	g/GJ	117*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Petroleum	g/GJ	20*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
N. Gas	g/GJ	0.78*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
AP Waste	g/GJ	143*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	155*	EMEP/EEA (2016), Chapter 1.A.4.bResidential combustion, Tier 1 emission factors	*(*assumption covers the brown coal from GB and NCVs from NIR)*

3.3.6.4. NFR 1.A.4.b.ii Residential Household and Gardening (Mobile)

Source Category Description:IE

No emission estimates have been made for this sector. Emissions are reported as IE due to the energy balance structure.

3.3.6.5. NFR 1.A.4.c.i Agriculture/Forestry/Fishing (Stationary)

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}

Key Source: Yes (NOx)

Emission trend is given in the figure 3 -2-17.

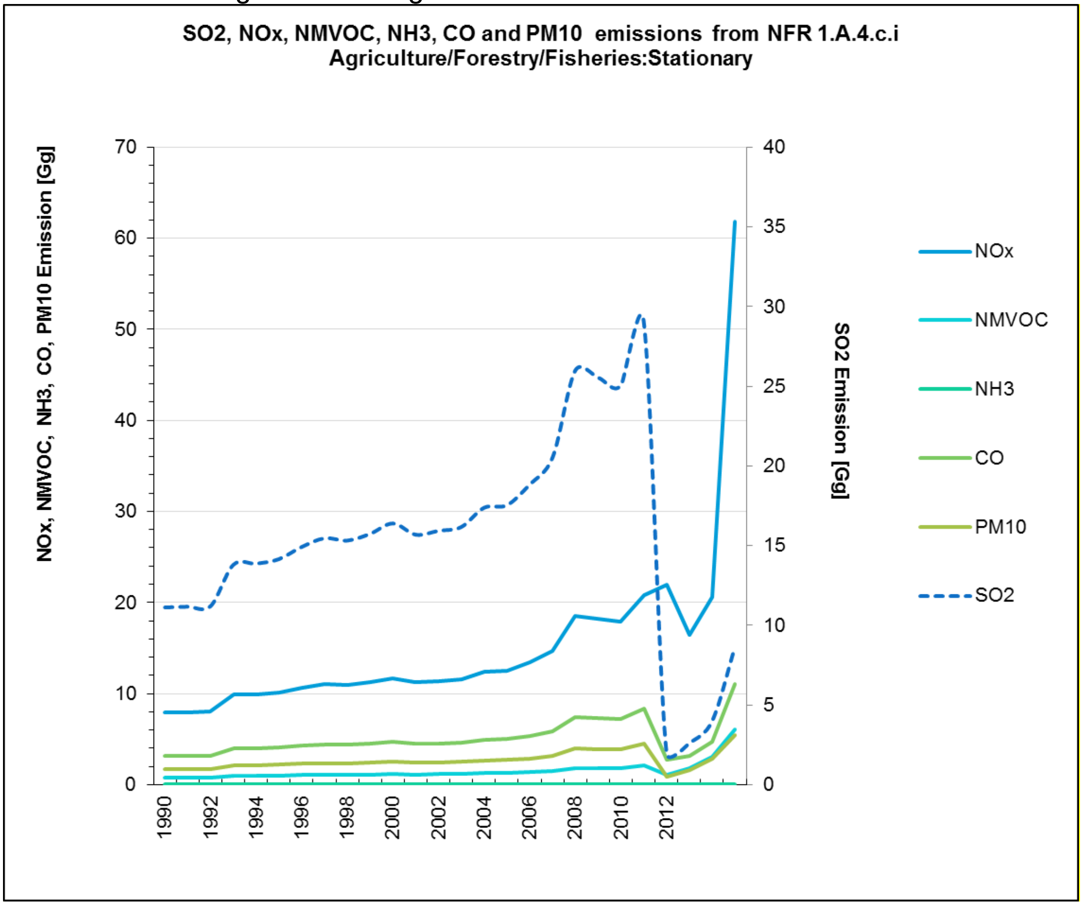


Figure 3-2-17 Emission trend for 1A4ci

Emission totals are given in the table 3-2-28.

Table 3-2-28 Emissions from 1.A.4.c Agriculture/Forestry/Fisheries.

Year		Emissions	Gg				
1.A.4.c Agriculture/Forestry /Fisheries		SO_2	NO_x	NMVOC	NH_3	CO	PM10
1990	Gg	11,1	7,9	0,8	NA	3,2	1,7
	Gg	11,2	8,0	0,8	NA	3,2	1,7
1992	Gg	11,2	8,0	0,8	NA	3,2	1,7
	Gg	13,8	9,9	1,0	NA	3,9	2,1
1994	Gg	13,9	9,9	1,0	NA	4,0	2,1
	Gg	14,2	10,1	1,0	NA	4,0	2,2
1996	Gg	14,9	10,7	1,1	NA	4,3	2,3
	Gg	15,5	11,0	1,1	NA	4,4	2,4
1998	Gg	15,3	10,9	1,1	NA	4,4	2,4
	Gg	15,7	11,2	1,1	NA	4,5	2,4
2000	Gg	16,4	11,7	1,2	NA	4,7	2,5
	Gg	15,7	11,2	1,1	NA	4,5	2,4
2002	Gg	15,9	11,4	1,1	NA	4,6	2,4
	Gg	16,2	11,6	1,2	NA	4,6	2,5
2004	Gg	17,4	12,4	1,2	NA	5,0	2,7
	Gg	17,5	12,5	1,3	NA	5,0	2,7
2006	Gg	18,8	13,5	1,3	NA	5,4	2,9
	Gg	20,5	14,7	1,5	NA	5,9	3,2
2008	Gg	26,0	18,6	1,9	NA	7,4	4,0
	Gg	25,5	18,2	1,8	NA	7,3	3,9
2010	Gg	25,1	17,8	1,8	NA	7,2	3,8
	Gg	29,0	20,8	2,1	NA	8,3	4,5
2012	Gg	2,0	22,0	1,1	NA	2,8	0,8
	Gg	2,6	16,4	1,8	NA	3,2	1,6
2014	Gg	4,0	20,6	3,1	NA	4,7	2,8
2015	Gg	8,6	61,9	6,1	NA	11,0	5,4
Trend 1990-2015		-22,3%	678,5%	668,1%		247,6%	216,2%
Trend 2014-2015		116,6%	200,6%	97,7%		132,6%	93,4%

Source of Activity Data

Activity data are in the form of the amount of different type of fuels used in this sector and are taken from the energy balance tables (source: Ministry of Energy and Natural resources 2015).

Methodological Issues

The applied methodology is TIER 1, which is a fuel-based methodology and uses the general equation:

$$Emission_{pollutant} = \sum AD_{fuel} * EF_{fuel}$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD_{fuel} = fuel consumption of fuel type (tonnes)

EF_{fuel} = emission factor of pollutant i for each unit of fuel type m used (kg/tonnes)

Source of Emission Factors

Several assumptions are made in assuming that some fuels are equivalent to brown coal.

Asphalite has the same EFs as the h.coal, lignite and coke.

Emission factors are presented in Table 3-2-29.

Fuel	Unit	Ef	Reference	Table No.
NOx				
H. Coal	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	173	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	513	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	74	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3

AP Waste	g/GJ	91	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	81	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
SO_2				
H. Coal	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	900	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	47	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	0.67	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	11	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
Wood	g/GJ	10,8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2	*(*assumption covers the brown coal from GB and NCVs from NIR)*

			Combustion in industry using solid fuels	
NMVOC				
H. Coal	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	88.8	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	25	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	23	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors	Table 3-3
AP Waste	g/GJ	300	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	7,31	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
CO				
H. Coal	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion),	Table 3-2

			Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	
Coke	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	66	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	Table 3-4
N. Gas	g/GJ	29	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	570	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	90	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*
PM_{10}				
H. Coal	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Lignite	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Coke	g/GJ	117	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2
Petroleum	g/GJ	20	EMEP/EEA (2016), Chapter	Table 3-4

			1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using liquid fuels	
N. Gas	g/GJ	0.78	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using natural gas or derived gases	Table 3-3
AP Waste	g/GJ	143	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	Table 3-5
Wood	g/GJ	155	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combustion), Tier 1 emission factors 1.A.2 Combustion in industry using solid fuels	*(*assumption covers the brown coal from GB and NCVs from NIR)*

3.3.6.6. NFR 1A4cii Agriculture/Forestry/Fishing (Off-Road Vehicles and other machinery)

Source Category Description

Emissions: IE

3.3.6.7. NFR 1A4ciii Agriculture/Forestry/Fishing :National Fishing

Source Category Description

Emissions: IE

3.3.6.8. NFR 1A5a and 1A5b

Source Category Description

Emissions: IE

3.3.7. NFR 1.B Fugitive Emissions from Fuels

3.3.7.1.NFR 1 B 1 a Fugitive emission from solid fuels: Coal mining and handling

Emission estimates were not made for this source. The main pollutant emitted from this activity is PM10. However emissions of NMVOC also arise and it would be good to include these estimates in the emissions inventory.

By the EMISSION project mentioned in the introduction sections of the IIR, the total mass of coal produced by underground mining will be obtained in the mid of 2016 and fort he submissions afterwards, this NFR category also will be integrated tot he inventory and the IIR.

3.3.7.2.NFR 1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation

Source Category Description

Emissions: NE

An example of a source included in this sector is the coke oven gas leaking through the coke oven doors, or a similar source during the manufacture of other solid fuels. This is not a particularly large source. Coke production and fuel sonsumption data will be integrated for next submissions.

3.3.7.3. NFR 1 B 1 c Other fugitive emissions from solid fuels

Source Category Description

Emissions: NE

The EMISSION Project will allow the activity data to be collected for the calculations to be added.

3.3.7.4. NFR 1 B 2 a i Fugitive Emissions oil: Exploration, production, transport

Source Category Description

Emissions: NE

This can be a large source of NMVOC where countries are significant producers of oil. In Turkey it was thought that this was not a large source, so no particular efforts were made to arrive at an emission estimate. EMISSION project will be used for further data compilation.

Planned Improvements

When information is available on the amounts of petroleum that are produced, then it would be sensible to make an emissions estimate for this source for further submissions.

3.3.7.5. NFR 1 B 2 a iv Fugitive Emissions oil: Refining / storage

Source Category Description

Emissions: NE

This can be a large source of NMVOC depending on the volumes of oil stored in refineries, and whether there is good management in ensuring that emissions of NMVOCs are minimised. Refining emissions are reported as NE.

The volumes of oil products held by refineries would need to be determined to allow an emission estimate to be made. This has not yet been done because no activity data were sourced. However, it would be sensible to include, at least, an initial estimate of what the emissions might be from this source to determine the amount of effort that should be spent on improving the current situation – which is no information at all. By the EMISSION project mentioned in the introduction sections oft he IIR, the storage emissions will be obtained in the mid of 2016 and for the submissions afterwards, this NFR category also will be integrated tot he inventory and the IIR.

3.3.7.6.NFR 1 B 2 a v Distribution of oil products

Source Category Description

Emissions: NE

This source can amount to several percent of the NMVOC emissions in total but not yet calculated under the category. The category is reported as NE.

An emission estimate has not yet been made, because no activity data were sourced. However, it would be sensible to include, at least, an initial estimate of what the emissions might be from this source. This would determine the amount of effort that should be spent on improving the current lack of information.

A simple emissions estimate is possible by considering the amount of petrol consumed by road transport (although this would require the petroleum data from the energy balance tables to be split), the number of tanker deliveries that this would equate to, and the number of car refills that this would equate to. A simple NMVOC emission estimate for each of the different transport or delivery stages could then be calculated.

By the EMISSION project mentioned in the introduction sections oft he IIR, the service stations' emissions together with the data for amount of gasoline sold and pipeline storage will be obtained in the mid of 2016 and for the submissions afterwards, this NFR category also will be integrated to the inventory and the IIR.

3.3.7.7. NFR 1 B 2 b Fugitive Emissions from Natural gas (exploration, production, processing, transmission, storage, distribution and other)

Source Category Description

Emissions: NE

This source is not trivial, but is not expected to be particularly large because, in comparison to many other European countries, there is little use of natural gas. As a result, there is not an extensive network of gas mains pipes.

Making a simple estimate of gas leakage (and hence the NMVOC emission from this source) can be difficult without information on the number of kms of gas mains pipe.

3.3.7.8. NFR 1 B 2 c Venting and flaring (oil, gas, combined oil and gas)

Source Category Description

Emissions: NE

This can be a significant source of NMVOC where gas is being extracted. However, for Turkey this is not expected to be a particularly large source. Therefore adding in emission estimates for this source is not considered to be a particularly high priority.
By the EMISSION project mentioned in the introduction sections oft he IIR, data based under this category will be obtained in the mid of 2016 and for the submissions afterwards, this NFR category also will be integrated tot he inventory and the IIR.

4 CHAPTER INDUSTRIAL PROCESSES AND PRODUCT USE (NFR SECTOR 2)

NFR sector 2 includes below subsectors

- 2.A Mineral Industry
    - 2.A.1 Cement production
    - 2.A.2 Lime production
    - 2.A.3 Glass production
    - 2.A.5.a Quarrying and mining of minerals other than coal
    - 2.A.5.b Construction and demolition
    - 2.A.5.c Storage, handling and transport of mineral products
    - 2.A.6 Other mineral products
- 2.B Chemical Industry
    - 2.B.1 Ammonia production
    - 2.B.2 Nitric acid production
    - 2.B.3 Adipic acid production
    - 2.B.5 Carbide production
    - 2.B.6 Titanium dioxide production
    - 2.B.7 Soda ash production
    - 2.B.10.a Other chemical industry
    - 2.B.10.b Storage, handling, transport of chemical products
- 2.C Metal Industry
    - 2.C.1 Iron and Steel Production
    - 2.C.2 Ferroalloys production
    - 2.C.3 Aluminium production
    - 2.C.4 Magnesium production
    - 2.C.5 Lead Production
    - 2.C.6 Zinc Production
    - 2.C.7.a Copper Production
    - 2.C.7.b Nickel production

        - 2.C.7.c Other metal production
        - 2.C.7.d Storage, handling and transport of metal products
- 2.D Solvent Use
    - 2.D.3.a Domestic solvent use including fungicides
    - 2.D.3.b Road paving with asphalt
    - 2.D.3.c Asphalt roofing
    - 2.D.3.d Coating applications
    - 2.D.3.e Degreasing
    - 2.D.3.f Dry cleaning
    - 2.D.3.g Chemical Products
    - 2.D.3.h Printing
    - 2.D.3.i Other Solvent Use
- 2.G&H Other Production Industry
    - 2.G Other product use
    - 2.H.1 Pulp and paper industry
    - 2.H.2 Food and beverages industry
    - 2.H.3 Other industrial processes

4.1 NFR 2.A Mineral Industry

5.6. NFR 2.A.1 Cement Production

Source Category Description

Emissions: NE

Emissions from Cement production are estimated from fuel consumption data and reported aggregated under NFR 1A2fi.

Process emissions from Cement production are not estimated.

There are 48 integrated cement plants with 75 rotary kilns in Turkey. 15 plants are grinding and packing facilities. All cement plants are subject to the environmental permit. Clinker production capacity is 39 million tones and grinding capacity is 68 million tones by 2005. (Development plan 2007-2013)
Regarding the production technology, most of wet furnaces had been converted to the dry technology since 1974. There are 2 small wet furnaces in Turkey.

Planned improvements

It is planned to report process emissions on particles separately from emissions related to combustion in the coming years. Annual cement production data is available but due to limited time process emissions cannot be calculated. It will be calculated next year.

4.1.1 NFR 2.A.2 Lime Production

Source Category Description

Emissions: NE

Emissions from lime production are estimated from fuel consumption data and in the present inventory included under NFR 1A2fi.
Process emissions from lime production are not estimated.

Total annual production volume was determined as 4.700.000 tonnes in 1998, out of which 58% belongs to private lime production plants, 42 % belongs to sugar, iron and steel, paper plants. (Development plan 2007-2013)

Planned improvements

It is planned to estimate separately particle emissions from lime production process. To perform the estimation, lime production volumes are needed, emission factors for particle emissions are available in the GB.

4.1.2 NFR 2.A.3 Glass Production

Source Category Description

Emissions: NE

Emissions from glass production are not included in the inventory at the moment.

Planned improvements

It is planned to include emission estimates from glass production in Turkey in the inventory after more information on the activity in Turkey is collected.

4.1.3 NFR 2.A.5a Quarrying and mining of other minerals than coal

Source Category Description

Emissions: NE

Emissions from quarrying and mining of other minerals than coal are not included in the inventory at the moment.

Quarrying and mining is a source of TSP, PM_{10}, $PM_{2.5}$, heavy metals (Pb, Cd, As, Cr, Ni, Zn) emissions. Emission factors for particle emissions exist in the GB.
Quarrying and mining of minerals can be classified metal ores (copper, iron,lead,zinc etc.) and ores that are raw materials for industry.

Data for mineral production of copper,lead and zinc is available but can not be used due to limited time. Next year emissions from this activity will be calculated.

Graphite, calsite, fluorite, titanium are quarried for general industry. Phosphate, sulphur,alunite, boron salt, sodium sulphate are quarried for chemical industry. Manyezite, dolomite, cement raw materials are quarried for soil industry. Gypsum, aggregate, sand, paint soils are quarried for construction.

Planned improvements

It is planned to include emission estimates for at least particle emissions from quarrying and mining of minerals in Turkey after information on the volume of mined mineral ores in Turkey has been collected. The methodology to be used for estimating particle emissions is available in GB and emission factors for the other pollutants in the IIR reports of other countries.

4.1.4 NFR 2.A.5b Construction and Demolition

Source Category Description

Emissions: NE

Emissions from construction and demolition are not included in the inventory at the moment.
Construction and demolition is a source of particle (TSP, PM_{10}, $PM_{2.5}$) emissions. Emission factors for these are available in the GB.

No information is available for sector in Turkey.

Planned improvements

It is planned to include emission estimates from construction and demolition activities in Turkey after related activity data to estimate emissions has been collected (area of constructed and demolished buildings). The methodology to be used for estimating these emissions is available in GB.

4.1.5 NFR 2.A.5c Storage, handling and transport of mineral products

Source Category Description

Emissions: NE

Emissions from storage, handling and transport of mineral products are not included in the inventory at the moment.

Storage, handling and transport of mineral products is a source of particle (TSP, PM_{10}, $PM_{2.5}$) emissions. Emission factors for these are available in the GB.

No information is available for sector in Turkey.

Planned improvements

It is planned to include emission estimates from activities related to storage, handling and transport of mineral products in Turkey after information of these activities in Turkey has been obtained. The methodology to be used for estimating these emissions is available in the GB.

4.1.6 NFR 2.A.6 Other Mineral Products (e.g. Glass Industry falls under this category)

Source Category Description

Emissions: NE

Emissions from this source category are not included in the inventory at the moment.

In Turkey, emissions under this category are at least occurring from the following industries:
Glass industry (typical emissions include NO_X, NMVOC, SO_X, TSP, PM_{10}, $PM_{2.5}$, PCDD/F, heavy metals (Pb, Cd, Cu, Se, Zn) which has 1.6 million ton production capacity (National Development plan 2001)

Fiberglass, Mineral wool and rock wool industry: 3 facilities in Turkey which have approximately 0.08 million ton production capacity in 2001.

Planned improvements

It is planned to include emission estimates from activities related to other mineral products in Turkey after information of these activities in Turkey has been obtained. The methodologies to be used for estimating these emissions are available in GB.

4.2 NFR 2.B.Chemical Industry

Figure 4.1 and Table 4.1 presents the emissions, trend and share within NFR 2.B.Chemical Industry.

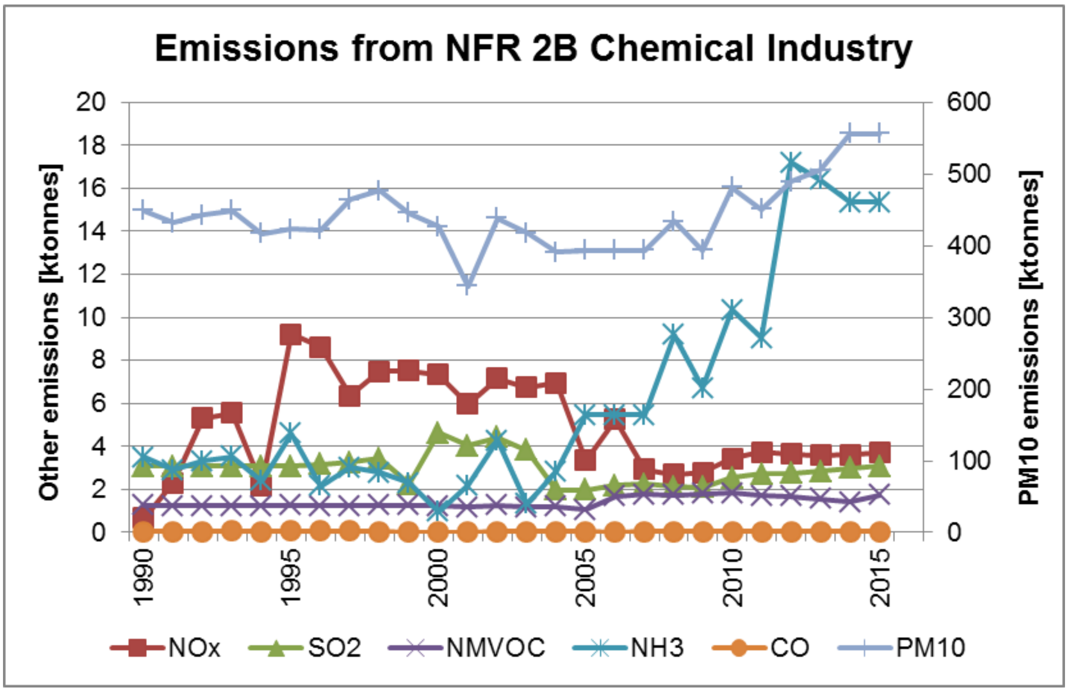


Figure 3.1: **Emissions from NFR 2.B.Chemical Industry.**

Table 3.3: **Emissions from NFR 2.B.Chemical Industry.**

	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1990	3.1	0.7	1.3	3.5	0.045	448.5
1991	3.1	2.3	1.2	2.9	0.042	431.5
1992	3.1	5.3	1.2	3.3	0.040	442.9
1993	3.1	5.5	1.2	3.5	0.064	448.6
1994	3.1	2.2	1.2	2.4	0.050	416.9
1995	3.1	9.2	1.3	4.6	0.059	422.9
1996	3.2	8.6	1.2	2.2	0.060	422.2
1997	3.3	6.4	1.2	3.0	0.062	463.8

1998	3.4	7.5	1.2	2.8	0.036	476.2
1999	2.2	7.5	1.3	2.3	0.010	445.0
2000	4.6	7.4	1.2	1.0	0.007	427.0
2001	4.0	6.0	1.2	2.2	0.008	343.4
2002	4.4	7.2	1.3	4.3	0.037	438.0
2003	3.8	6.7	1.2	1.3	0.035	417.7
2004	2.0	7.0	1.2	2.8	0.040	390.7
2005	2.0	3.4	1.0	5.5	0.037	393.6
2006	2.2	5.3	1.7	5.5	0.011	393.6
2007	2.3	2.9	1.8	5.5	0.032	393.6
2008	2.1	2.7	1.7	9.2	0.030	434.2
2009	2.1	2.8	1.8	6.7	0.031	393.5
2010	2.5	3.4	1.8	10.3	0.038	480.8
2011	2.7	3.7	1.7	9.0	0.041	450.3
2012	2.8	3.6	1.7	17.2	0.040	489.0
2013	2.9	3.6	1.6	16.4	0.040	505.0
2014	3.0	3.6	1.4	15.3	0.040	556.1
2015	3.1	3.7	1.7	15.3	0.041	556.1
Trend 1990 – 2015	0%	460%	37%	337%	-8%	24%
Trend 2014 - 2015	4%	3%	24%	0%	3%	0%

4.2.1 NFR 2.B.1 Ammonia Production

Source Category Description

Emissions: NO_x, NH_3, CO

Key Source: No

Emission Sources

Ammonia is produced reaction of nitrogen and hydrogen basically. Hydrogen is derived from natural gas with steam reforming reaction and nitrogen is derived from air. Simplified process scheme in the GB is illustrated in Figure 4.2

There are two facilities for ammonia production with total capacity of 0.07 million tonnes/year. Detailed information about production and abatement technologies will be collected next coming years.

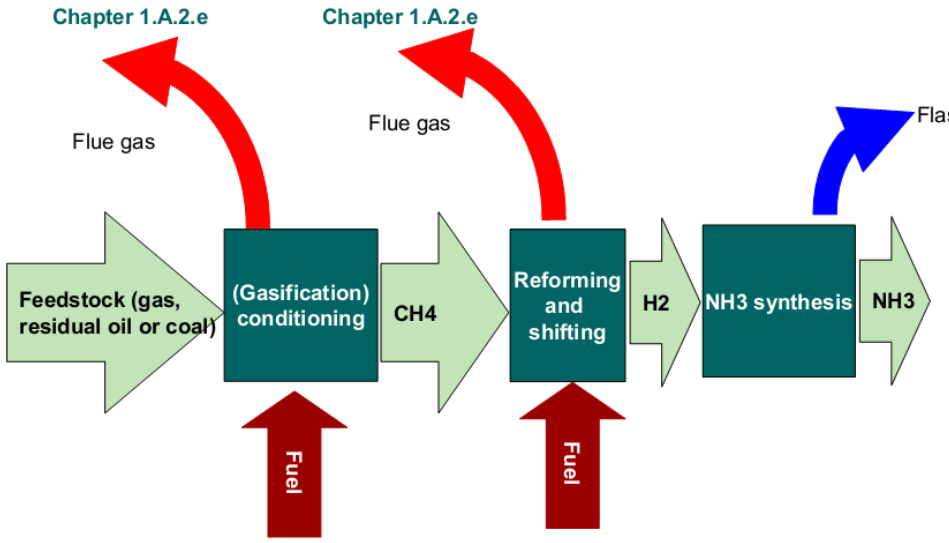


Figure 4.2: Process scheme of Ammonia production

Emission Trends

NO_x emissions decreased by about 8 % from 0.446 Gg in 1990 to 0.410 Gg in 2015, which is a share of less than 1% in total NO_x emissions in 2015.

NH_3 emissions decreased by about 8 % from 0.0045 Gg in 1990 to 0.0041 Gg in 2015, which is a share of less than 1% in total NH_3 emissions in 2015.

CO emissions decreased by about 11 % from 0.045 Gg in 1990 to 0.041 Gg in 2015, which is a share of less than 1% in total CO emissions in 2015.

Emission trends are illustrated in Figure 4.3 and emissions and activity data are presented in Table 4.2

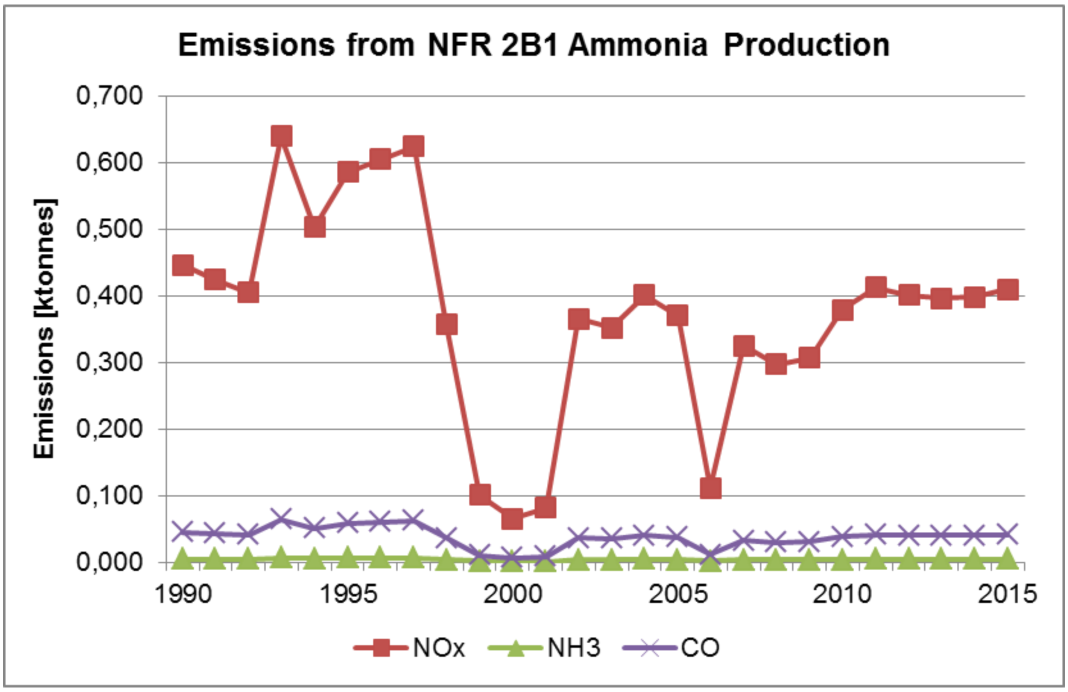


Figure 4.3: Emissions from NFR 2.B.1 ammonia production for the period 1990 to 2015

Production of ammonia decreases due to high operation while imported ammonia is preferred as a raw material of fertiliser industry. That is the reason for the decreases of emissions after 2005.

Table 4.2: Emissions from NFR sector 2.B.1 Ammonia production and activity data

Years	NOx	NH_3	CO	NH_3 Production
	ktonnes	ktonnes	ktonnes	ktonnes
1990	0.446	0.004	0.045	445.92
1991	0.424	0.004	0.042	423.79
1992	0.405	0.004	0.040	404.66
1993	0.639	0.006	0.064	639.46
1994	0.503	0.005	0.050	503.26
1995	0.586	0.006	0.059	585.64
1996	0.605	0.006	0.060	604.76
1997	0.624	0.006	0.062	624.02
1998	0.357	0.004	0.036	356.66
1999	0.100	0.001	0.010	100.25
2000	0.065	0.001	0.007	65.01

2001	0.082	0.001	0.008	81.64
2002	0.366	0.004	0.037	365.65
2003	0.352	0.004	0.035	351.96
2004	0.401	0.004	0.040	400.78
2005	0.371	0.004	0.037	370.58
2006	0.112	0.001	0.011	111.52
2007	0.324	0.003	0.032	324.45
2008	0.297	0.003	0.030	297.40
2009	0.307	0.003	0.031	307.06
2010	0.379	0.004	0.038	378.80
2011	0.412	0.004	0.041	412.40
2012	0.401	0.004	0.040	400.88
2013	0.396	0.004	0.040	395.88
2014	0.398	0.004	0.040	398.34
2015	0.410	0.004	0.041	409.82
Trend 1990 - 2015		-8%		
Trend 2014 - 2015		1%		

Source of Activity Data

Production data was available in CRF tables for 1990-2006. 2007-2015 data is extrapolated according to Eurostat Turkey Industry Production Index-Manufacture of Fertiliser and Nitrogen Compounds. 2005 is used as base year for extrapolation.

Methodological Issues

The applied methodology is TIER 1 uses the general equation:

$$\text{Emissionpollutant} = \sum AD * EF$$

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (Gg)

i = NO_x, CO, NH_3

AD = annual national ammonia production (Gg)

EF = emission factor of pollutant i for ammonia production (kg/tonnes NH_3)

Source of Emission Factors

Default emission factors (Tier 1) for ammonia production are taken from the EMEP/EEA Emission Inventory Guidebook 2016.

Emission factors are presented in Table 4.3.

Table 4.3: Emission factor (EF) used sector 2.B.1 Ammonia production

	Unit	EF	Reference
NO_x	kg/tonne NH_3	1	EMEP/EEA (2016), Chapter 2.B Chemical Industry, Table 3-2 , page 15,Tier 1
NH_3	kg/tonne NH_3	0.01	
CO	kg/tonne NH_3	0.1	

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

No recalculations have been done for this inventory.

Planned Improvements

It is planned to use plant specific data in next coming years. 1990-2006 data will be checked and 2007-2014 data will be completed. To improve the emission estimation, more information needs to be received on the process and abatement techniques used by plants in Turkey. It is possible to improve the methodology by obtaining information on the performance of production processes, i.e. data on possible emission measurements from which calculation of typical emission levels (kg/tonnes of product) could be carried out.

These improvements are scheduled to be carried out in next coming years.

4.2.2 NFR 2.B.2 Nitric Acid Production

Source Category Description

Emissions: NO_x

Key Source: No

Emission Sources

Nitric acid production involves the catalytic oxidation of ammonia by air yielding nitrogen oxide then oxidized in to nitrogen dioxide and absorbed in the water. This process results weak acid, for strong acid nitrogen dioxide absorbed in nitric acid. Simplified process scheme in the GB is illustrated in Figure 4.4 This process is a source of NO_x emissions at least.

One plant produces both high and low concentration nitric acid in Turkey.

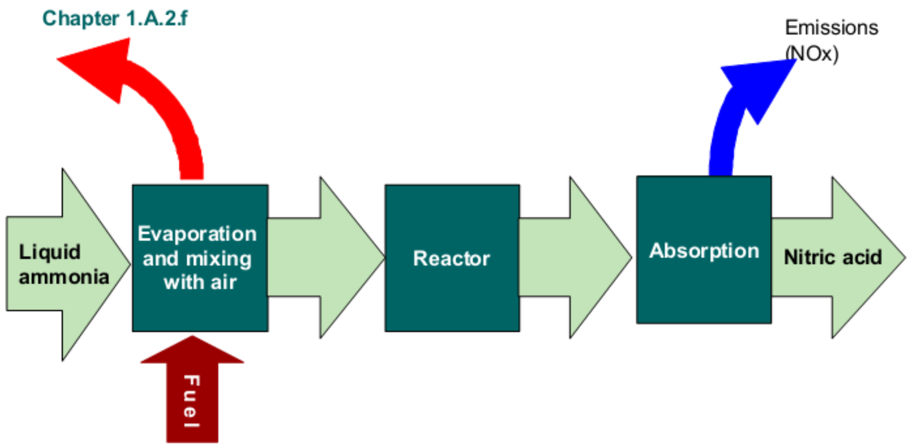


Figure 4.4: Process scheme of nitric acid production

Emission Trends

NO_x emissions increased by about 1420 % from 0.217 Gg in 1990 to 3.304 Gg in 2015, which is a share of less than 1% in total NO_x emissions in 2015.

Emission trends are illustrated in Figure 4.5 and emissions and activity data are presented in Table 4.4

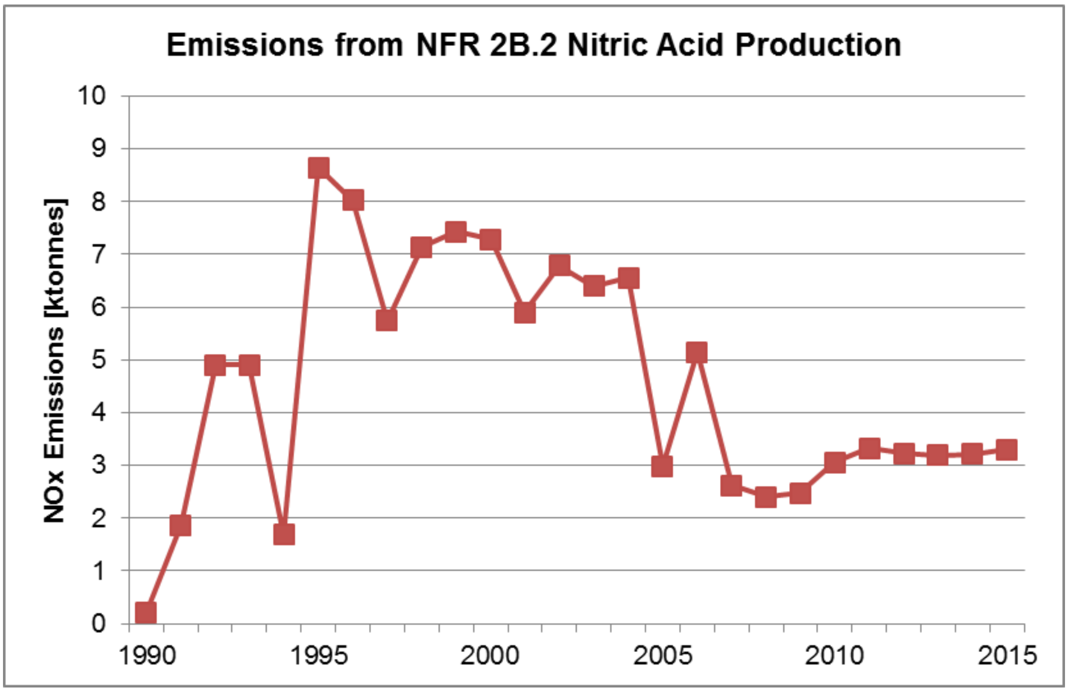


Figure 4.5: Emissions from NFR 2.B.2 nitric acid production for the period 1990 to 2015

Table 4.4: Emissions from NFR sector 2.B.2 Nitric Acid production and activity data

	NO_x	HNO_3 Production
	ktonnes	ktonnes
1990	0.217	21.75
1991	1.867	186.73
1992	4.905	490.50
1993	4.898	489.85
1994	1.680	167.96
1995	8.639	863.89
1996	8.029	802.89
1997	5.737	573.70
1998	7.136	713.64
1999	7.428	742.76
2000	7.287	728.73
2001	5.896	589.62
2002	6.786	678.63

2003	6.391	639.07
2004	6.558	655.76
2005	2.988	298.81
2006	5.141	514.06
2007	2.616	261.61
2008	2.398	239.80
2009	2.476	247.59
2010	3.054	305.43
2011	3.325	332.52
2012	3.232	323.24
2013	3.192	319.21
2014	3.212	321.19
2015	3.304	330.45
Trend 1990 - 2015	1420%	
Trend 2014 - 2015	3%	

Source of Activity Data

Production data was available in CRF tables for 1990-2006. 2007-2015 data is extrapolated according to Eurostat Turkey Industry Production Index-Manufacture of Fertiliser and Nitrogen Compounds. 2005 is used as base year for extrapolation.

Methodological Issues

The applied methodology is TIER 1 uses the general equation:

$$\text{Emission pollutant} = \sum AD * EF$$

Where:

Emission pollutant = emissions of pollutant i for the period concerned in the inventory (Gg)

i = NO_x,

AD = annual national nitric acid production (Gg)

EF = emission factor of pollutant i for nitric acid production(kg/tonnes NH_3)

Source of Emission Factors

Default emission factors (Tier 1) for nitric acid production are taken from the EMEP/EEA Emission Inventory Guidebook 2013 .

Emission factors are presented in Table 4.5.

Table 4.5: Emission factor (EF) used sector 2.B.2 Nitric Acid production

	Unit	EF	Reference
NOx	kg/Mg HNO_3	10	EMEP/EEA Guidebook(2016) Chapter 2B.Chemical Industry Table 3-3, page 15, Tier 1

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

No recalculations have been done for this inventory.

Planned improvements

Plant specific information will be collected to better emission estimates.

These improvements are scheduled to be carried out in next coming years.

4.2.3 NFR 2.B.3 Adipic Acid Production

Source Category Description

Emissions: NO

No emission from adipic acid production is estimated in this inventory.

Emission Sources

Adipic acid is raw material for nylon, polyurethane and polyester manufacturing. Adipic acid production involves oxidizing of cyclohexane to cyclohexanol and cyclohexanon mixture. Then mixture oxidized with nitric acid to produce adipic acid.

Adipic acid production is a source for at least NO_x and CO emissions but major pollutant is nitrous oxide(N_2O) which is greenhouse gas.

Adipic acid production does not occur in Turkey and emission estimates were not included to greenhouse gas emission inventory.

4.2.4 NFR 2.B.5 Carbide Production

Source Category Description

Emissions: NO_x, CO, PM10

Key Source : No

Emission Sources

Production of calcium carbide involves heating lime and carbon mixture in an electrical arc furnace up to 2100 ^{0}C.Calcium carbide and carbon monoxide occurs in the reaction. Carbide production is a source for NO_x and CO emissions. Simplified process scheme in the GB is illustrated in Figure 4.6

Carbide production occurs in Turkey, but accurate information on the volume of the industry, nor on the production processes has been available for the work.

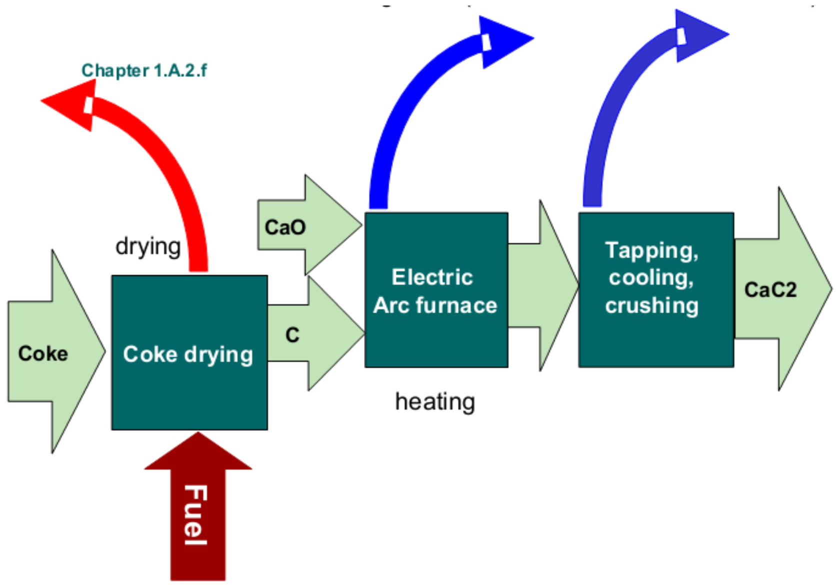


Figure 4.6: Process scheme for carbide production

Emission Trends

PM_{10} emissions decreased by about 14 % from 0.003 Gg in 1990 to 0.0026 Gg in 2015, which is a share of less than 1% in total PM_{10} emissions in 2015.

Emission trends are illustrated in Figure 4.7 and emissions and activity data are presented in Table 4.6

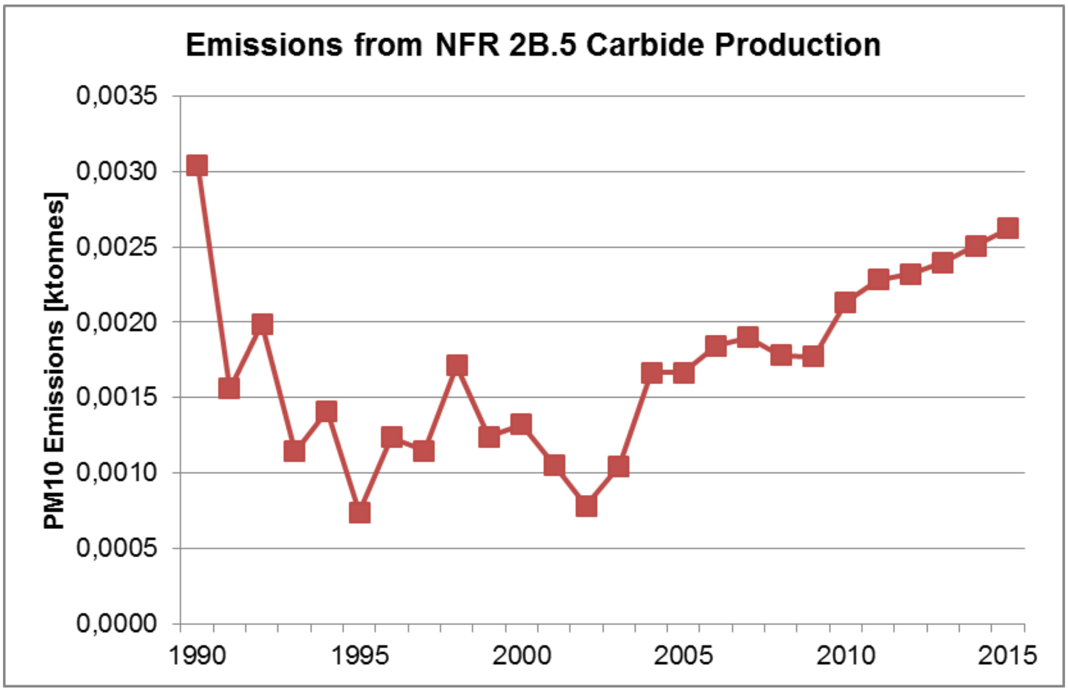


Figure 4.7: Emissions from NFR 2.B.5 carbide production for the period 1990 to 2015

Table 4.6: Emissions from NFR sector 2.B.5 Carbide production and activity data

Years	PM_{10}	Carbide Production
	ktonnes	**ktonnes**
1990	0.0030	38.05
1991	0.0016	19.50
1992	0.0020	24.85
1993	0.0011	14.29
1994	0.0014	17.61
1995	0.0007	9.20
1996	0.0012	15.44
1997	0.0011	14.35
1998	0.0017	21.42
1999	0.0012	15.49
2000	0.0013	16.49
2001	0.0011	13.15
2002	0.0008	9.77
2003	0.0010	13.05

2004	0.0017	20.81
2005	0.0017	20.81
2006	0.0018	23.02
2007	0.0019	23.74
2008	0.0018	22.25
2009	0.0018	22.13
2010	0.0021	26.67
2011	0.0023	28.54
2012	0.0023	29.02
2013	0.0024	29.96
2014	0.0025	31.35
2015	0.0026	32.45
Trend 1990 - 2015	-14%	
Trend 2014 - 2015	4%	

Source of Activity Data

Production data was available in CRF tables for 1990-2004. 2005 is assumed same as 2004 data. 2006-2014 data is extrapolated according to Eurostat Turkey Industry Production Index-Manufacture of Chemicals and chemical products. 2005 is used as base year for extrapolation.

Methodological Issues

The applied methodology is TIER 1 uses the general equation:

Emission pollutant = ∑ AD * EF

Where:

Emission pollutant = emissions of pollutant i for the period concerned in the inventory (Gg)

i = NOx,CO

AD = annual national carbide production (Gg)

EF = emission factor of pollutant i for carbide production (kg/tonnes NH3)

Source of Emission Factors

Default emission factors (Tier 1) for carbide production are taken from the EMEP/EEA Emission Inventory Guidebook 2016.

Emission factors are presented in Table 4.7.

Table 4.7: Emission factor (EF) used sector 2.B.5 Carbide production

	Unit	EF	Reference
TSP	g/Mg Product	100	EMEP/EEA Guidebook(2016) Chapter 2B.Chemical Industry Table 3-5, page 16, Tier1
PM_{10}	g/Mg Product	80	

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

No recalculation has been done for this inventory.

Planned improvements

To make more country-specific estimates, information on the process and abatement techniques for plants in Turkey, as well as information on emission measurements needs to be collected.

These improvements are scheduled to be carried out in next coming years.

4.2.5 NFR 2.B.6 Titanium dioxide production

Source Category Description

Emissions: NE

No emission from titanium dioxide production is estimated in this inventory.

4.2.6 NFR 2.B.7 Soda ash production

Source Category Description

Emissions: NE

Emissions from soda ash production and use are not included in the inventory at the moment.

There is one facility in Turkey which produce soda ash. By production capacity it is the third largest supplier in Europe, and eight in the world.
There is also another facility which was established for natural soda ash production in 2002 and had started production.
Solvay method is used for synthetic soda ash production in Turkey. Remote control system is used in all production steps.

Planned improvements

It is planned to include emission estimates from soda ash production and use in Turkey after data on the production and use volumes is collected. Emission factors to estimate emissions of CO, ammonia and TSP are available in the GB.

4.2.7 NFR 2.B.10.a Other chemical industry

4.2.7.1 Fertiliser Production

Source Category Description

Emissions: NH_3, PM_{10}

Key Source: No

In Turkey, there are seven fertilizer production facilities. Five facilities produce fertilizer as by-product. Information about production and abatement technologies will be collected next coming years.

Emission Trends

NH_3 emissions increased by about 338 % from 4 Gg in 1990 to 15 Gg in 2015, which is a share of 1 % in total NH_3 emissions in 2015.

PM_{10} emissions increased by about 9% from 448 Gg in 1990 to 556 Gg in 2015, which is a share of 8 % in total PM_{10} emissions in 2015.

Emission trends are illustrated in Figure 4.8 while emissions are presented in Table 4.8. Activity data are given in Annex C.23.

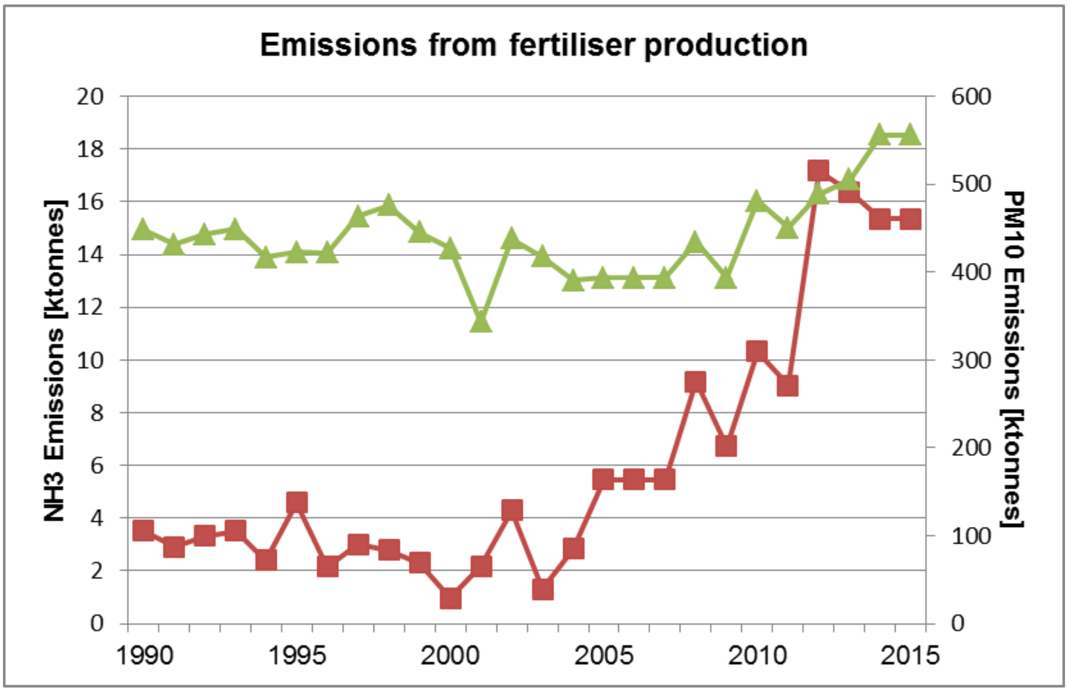


Figure 4.8: Emissions from NFR 2.B.10.a fertiliser production for the period 1990 to 2015

The annual changes in emissions reflect the changes in production volumes.

Table 4.8: Emissions from sector 2.B.10.a Fertiliser Production

Years	NH_3	PM_{10}
	ktonnes	**ktonnes**
1990	4	448
1991	3	431
1992	3	443
1993	4	449
1994	2	417
1995	5	423
1996	2	422
1997	3	464
1998	3	476
1999	2	445
2000	1	427
2001	2	343
2002	4	438
2003	1	418
2004	3	391
2005	5	394
2006	5	394
2007	5	394
2008	9	434
2009	7	393
2010	10	481
2011	9	450

2012	17	489
2013	16	505
2014	15	556
2015	15	556
Trend 1990 - 2015	338%	24%
Trend 2014 - 2015	-6%	10%

Source of Activity Data

Production data was available from international website http://www.fertilizer.org/ifa/ifadata in terms of nitrogen for 1990-2009. More reliable data in product unit was found National Development Reports and Annual Activity Reports of Gubretas. Production amounts of ammonium nitrate, calcium ammonium nitrate, ammonium sulphate, urea, diammonium phosphate and NPK was available in the reports. Therefore 1995-2005 data was taken from national development reports, 2005-2014 data from activity reports of Gubretas and Ministry of Food,Agriculture,Livestock. 2015 data was assumed same as 2014. Due to lack of prior data IFA data was used for 1990-1995 with an assumption which includes total nitrogen amount, average nitrogen contents of fertiliser types and production shares of fertiliser types in 1995.

Methodological Issues

The applied methodology is TIER 2 uses the general equation:

Emission pollutant = ∑ ADproduction * EFpollutant

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (Gg)

i = NH_3,PM_{10}

ADfert = activity rate for fertiliser production by type (Gg)

- Nitrogen - Ammonium nitrate
- Nitrogen - Ammonium phosphate (N)
- Nitrogen - Ammonium sulphate
- Nitrogen - Calc.amm. nitrate
- Nitrogen - N K compound (N)
- Nitrogen - N P K compound (N)

- Nitrogen - Other N straight
- Nitrogen - Other NP (N)
- Nitrogen - Urea

EF = emission factor of pollutant i for fertilizer production by type (kg/tonnes)

- Amonium Sulphate
- Ammonium Nitrate
- Ammonium Phosphate &NPK
- Urea

ADfert = Total N Manufacture Fert * Consumption / Total N Consumption

Where:

Total N ManufactureFert = Total N Fertiliser Manufacture by type (Gg nutrients)

Consumption = Consumption of fertilizer (Gg nutrients)

Total N Consumption = Total N Consumption (Gg nutrients)

Source of Emission Factors

Emission factors (Tier 2) for ammonium sulphate ammonium nitrate, ammonium phosphate and urea production are taken from the EMEP/EEA Emission Inventory Guidebook 2016.

Emission factors are presented in Table 4.9, 4.10, 4.11 and 4.12

Table 4.9: Emission factor (EF) used sector 2.B.10.a other chemical industry, ammonium sulphate production

	Unit	EF	Reference
TSP	kg/tonne	60	EMEP/EEA (2016), Chapter 2.B Chemical Industry, Table 3-26 , page 27,Tier2
PM_{10}	*kg/tonne*	*48*	Since PM10 EF is not given in the guidebook, it is assumed PM10 is 80% of TSP

Table 4.10: Emission factor (EF) used sector 2.B.10.a other chemical industry, ammonium nitrate production

	Unit	EF	Reference
NH_3	kg/tonne	30	EMEP/EEA (2016), Chapter 2.B Chemical Industry, Table 3-27 , page 28
TSP	kg/tonne	200	
PM_{10}	*kg/tonne*	*160*	Since PM10 factor is not given in the guidebook, it is assumed PM10 is 80% of TSP.

Table 4.11: Emission factor (EF) used sector 2.B.10.a other chemical industry, ammonium phosphate production

	Unit	EF	Reference
TSP	kg/tonne	300	EMEP/EEA (2016), Chapter 2.B Chemical Industry, Table 3-28 , page 29 EMEP/EEA
PM_{10}	kg/tonne	240	

Table 4.12: Emission factor (EF) used sector 2.B.10.a other chemical industry, urea production

	Unit	EF	Reference
NH_3	kg/Mg	2.5	EMEP/EEA (2016), Chapter 2.B Chemical Industry, Table 3-29 , page 29
PM_{10}	kg/Mg	1.2	

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

No recalculation has been done in this inventory.

Planned Improvements

National datasets were available for recent years but for historic data international data was used. It is aimed to obtain national historic data from sector.

It is possible to improve the methodology by obtaining information on the process technique and abatement technique used for each plant in the sector, as well as information on emission measurements to enable calculation of specific emissions for each plant.

These improvements are scheduled to be carried out in next coming years.

4.2.7.2 Sulphuric Acid Production

Source Category Description

Emissions: SO_2

Key Source: No

Five facilities produce sulphuric acid production in Turkey, but not enough accurate information on the volume of the industry or on the production processes has been available for the work.

Emission Trends

SO_2 emissions has not been changed between 1990-2015, 3.09 Gg which is a share of less than 1% in total SO_2 emissions in 2015.

Emission trends are illustrated in Figure 4.9 and emissions and activity data are presented in Table 4.13

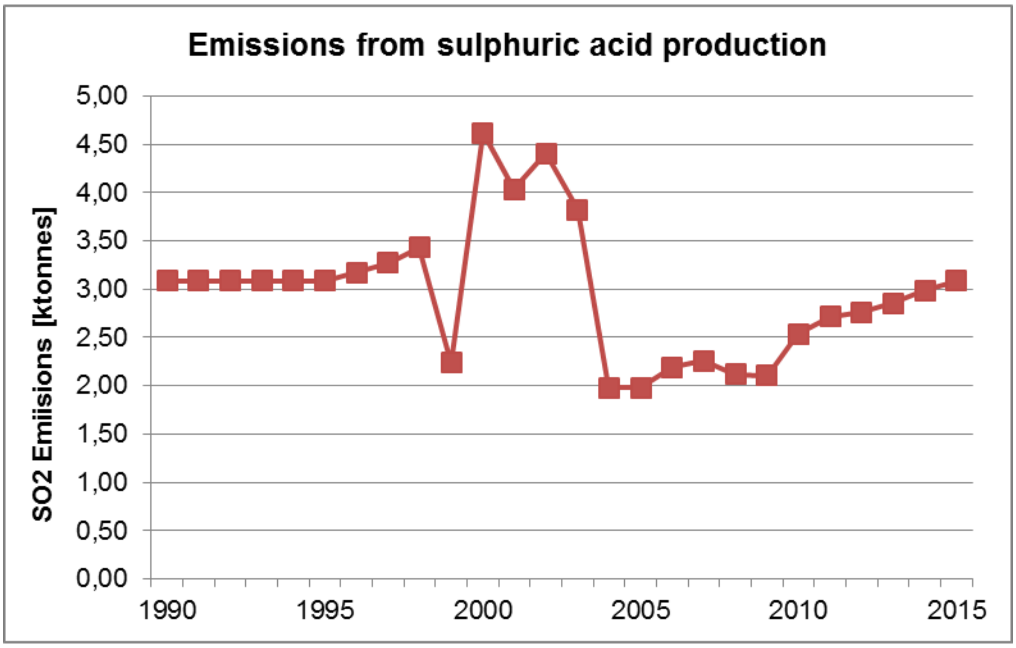


Figure 4.9: Emissions from NFR 2.B.10.a sulphuric acid production for the period 1990 to 2015

Table 4.13: Emissions from NFR sector 2.B.10.a Sulphuric Acid production and activity data

Years	SO_2	H_2SO_4 Production
	ktonnes	**ktonnes**
1990	3.09	441
1991	3.09	441
1992	3.09	441
1993	3.09	441
1994	3.09	441
1995	3.09	441
1996	3.17	453
1997	3.27	467
1998	3.43	490
1999	2.24	320
2000	4.61	659
2001	4.03	576
2002	4.41	630
2003	3.82	546
2004	1.98	283
2005	1.98	283
2006	2.19	313
2007	2.26	323
2008	2.12	303
2009	2.11	301
2010	2.54	363
2011	2.72	388
2012	2.76	394
2013	2.85	407
2014	2.98	426
2015	3.09	441
Trend 1990 - 2015	0	
Trend 2014 - 2015	4%	

Source of Activity Data

Production data was available in National Development Reports for 1995-2004. 2005 is assumed same as 2004 data. 2005-2015 data is extrapolated according to Eurostat Turkey Industry Production Index-Manufacture of Chemical and Chemical Products. 2005 is used as base year for extrapolation.1990-1994 are assumed same as 1995 data.

Methodological Issues

The applied methodology is TIER 2 uses the general equation:

Emission pollutant = ∑ AD * EF

Where:

Emission pollutant = emissions of pollutant i for the period concerned in the inventory (Gg)

i = SO_2,

AD = annual national sulphuric acid production (Gg)

EF = emission factor of pollutant i for sulphuric acid production (kg/tonnes NH3)

Source of Emission Factors

Default emission factors (Tier 2) for sulphuric acid production are taken from the EMEP/EEA Emission Inventory Guidebook 2016.

Emission factors are presented in Table 4.14.

Table 4.14: Emission factor (EF) used sector 2.B.10.a Sulphuric Acid production

	Unit	EF	Reference
SO_2	kg/Mg H_2SO_4	7	EMEP/EEA Guidebook(2016) Chapter 2B.Chemical Industry Table 3-20, page 24,Tier 2

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

No recalculation has been done for this inventory.

Planned improvements

Plant specific information will be collected to better emission estimates.

These improvements are scheduled to be carried out in next coming years.

4.2.7.3 Ethylene Manufacture

Source Category Description

Emissions: NMVOC

Key Source: No

Turkey has 3 companies in petrochemical industry one of which produces high density and low density polyethylene. Information about production and abatement technology will be collected next coming years.

Emission Trends

NMVOC emissions decreased by about 31 % from 0.256 Gg in 1990 to 0.335 Gg in 2015, which is a share of less than 1% in total NMVOC emissions in 2015.

Emission trends are illustrated in Figure 4.10 and emissions and activity data are presented in Table 4.15

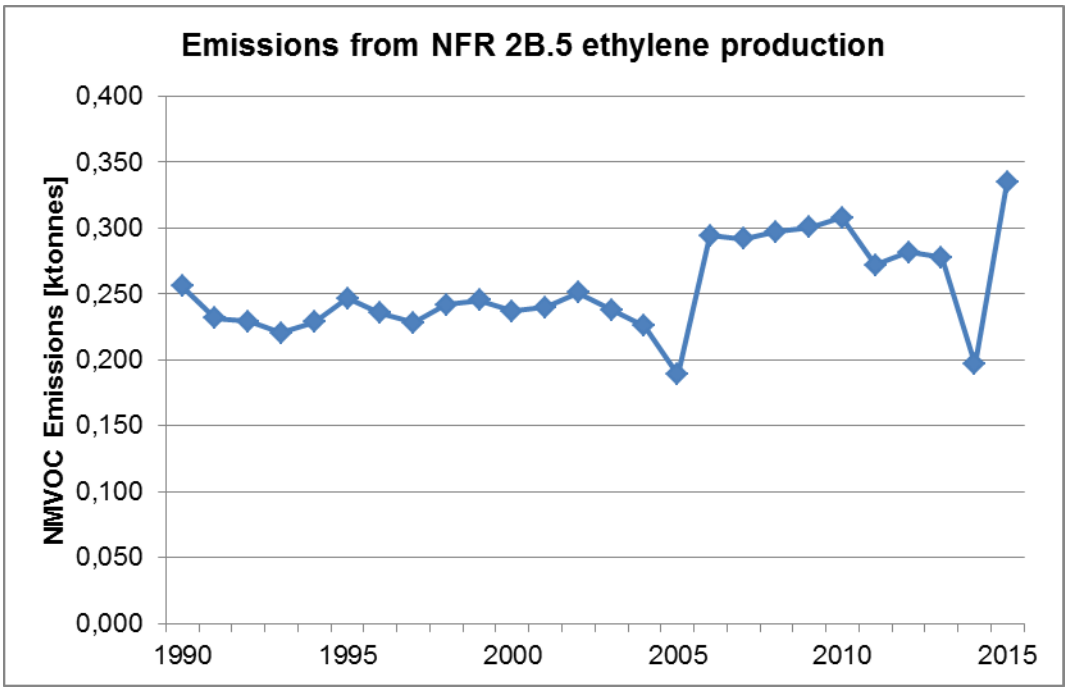


Figure 4.10: Emissions from NFR 2.B.5 ethylene production for the period 1990 to 2015

Table 4.15: Emissions from NFR sector 2.B.10.a ethylene production and activity data

Years	NMVOC	Ethylene Production
	ktonnes	**ktonnes**
1990	0.256	426
1991	0.232	386
1992	0.229	382
1993	0.220	367
1994	0.229	381
1995	0.247	411
1996	0.235	392
1997	0.228	380
1998	0.242	403
1999	0.245	409
2000	0.237	395
2001	0.240	400
2002	0.251	419
2003	0.238	396
2004	0.226	376
2005	0.189	314
2006	0.294	490
2007	0.292	486
2008	0.297	495
2009	0.301	501
2010	0.308	513
2011	0.272	454
2012	0.281	469
2013	0.278	463
2014	0.197	328
2015	0.335	559
Trend 1990 - 2015	31%	
Trend 2014 - 2015	70%	

Source of Activity Data

Production data was available in CRF tables for 1990-2004. Activity data for 2005-2015 were taken from PETKİM activity reports.

Methodological Issues

The applied methodology is TIER 2 uses the general equation:

Emission pollutant = ∑ AD * EF

Where:

Emission pollutant = emissions of pollutant i for the period concerned in the inventory (Gg)

i = NMVOC,

AD = annual national ethylene production (Gg)

EF = emission factor of pollutant i for ethylene production(kg/tonnes ethylene)

Source of Emission Factors

Default emission factors (Tier 2) for ethylene production are taken from the EMEP/EEA emission inventory guidebook 2016.

Emission factors are presented in Table 4.16

Table 4.16: Emission factor (EF) used sector 2.B.10.a Ethylene production

	Unit	EF	Reference
NMVOC	kg/tonne	0.6	EMEP/EEA Guidebook(2016) Chapter 2B.Chemical Industry Table 3-36, page 34

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

No recalculations have been done.

Planned improvements

Plant specific information will be collected to better emission estimates.

These improvements are scheduled to be carried out in next coming years.

4.2.7.4 Polyethene Manufacture

Source Category Description

Emissions: NMVOC

Key Source: No

Emission Trends

NMVOC emissions increased by about 31 % from 0.687 Gg in 1990 to 0.898 Gg in 2015, which is a share of less than 0.01 % in total NMVOC emissions in 2015.

Emission trends are illustrated in Figure 4.11 while emissions are presented in Table 4.17

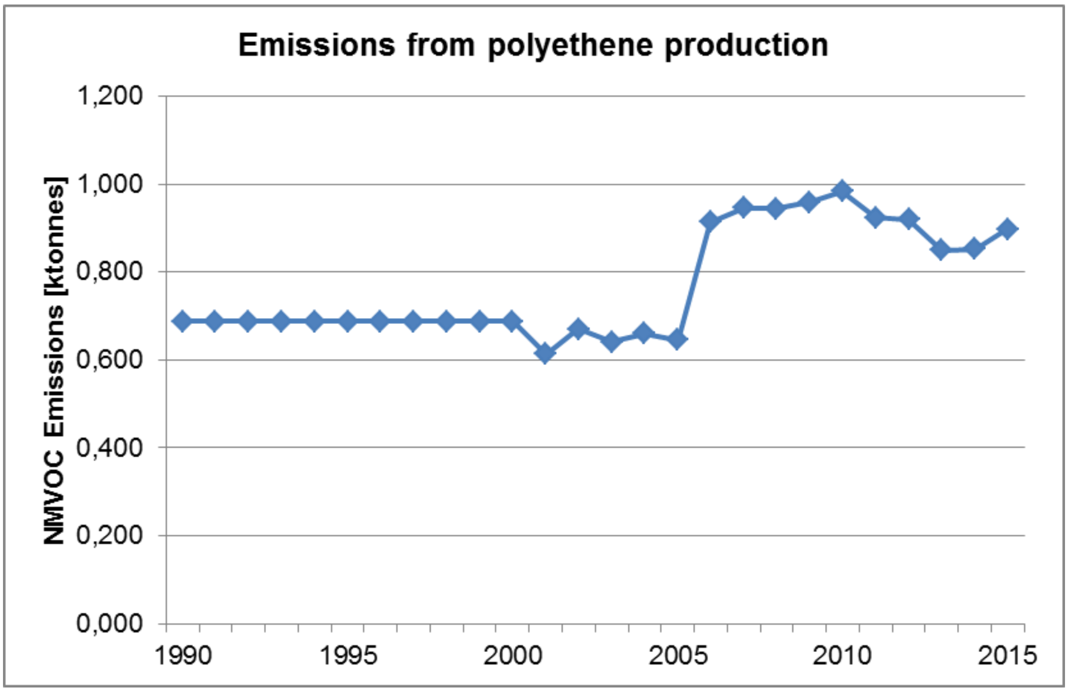


Figure 4.11: Emissions from NFR 2.B.5 Polyethene Manufacture for the period 1990 to 2015

Table 4.18: Emission factor (EF) used sector 2.B.10.a Polyethene Low density

	Unit	EF	Reference
NMVOC	kg/tonne	2.4	EMEP/EEA (2016), Chapter 2.B.5 Polyethene Productions, Table 3-38, page 36

It was assumed all polythene production is low density.

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

No recalculation has been done in this part of the inventory.

Planned Improvements

Activity data for recent years were available but it is assumed production remains same for historic data.

It will be tried to find historic data for this sector.

It is possible to improve the methodology by obtaining information on the process and abatement techniques for plants in Turkey, as well as information on emission measurements.

In addition to NMVOC, also particles are emitted from polyethylene production.

For particle emissions, fraction factors to calculate PM_{10} and $PM_{1.2}$ emissions are available at http://www.air.sk/tno/cepmeip/ but to use those data on TSP emissions needs to be available from plants.

These improvements are scheduled to be carried out within coming years.

4.2.7.5 PVC Production

Source Category Description

Emissions: NMVOC, PM_{10}

Key Source: No

Emission Trends

NMVOC emissions decreased by about 28 % from 0.017 Gg in 1990 to 0.012 Gg in 2015, which is a share of less than 0.01 % in total NMVOC emissions in 2015.

PM_{10} emissions decreased by about 28 % from 0.018 Gg in 1990 to 0.013 Gg in 2015, which is a share of less than 0.01 % in total PM_{10} emissions in 2015.

Emission trends are illustrated in Figure 4.12

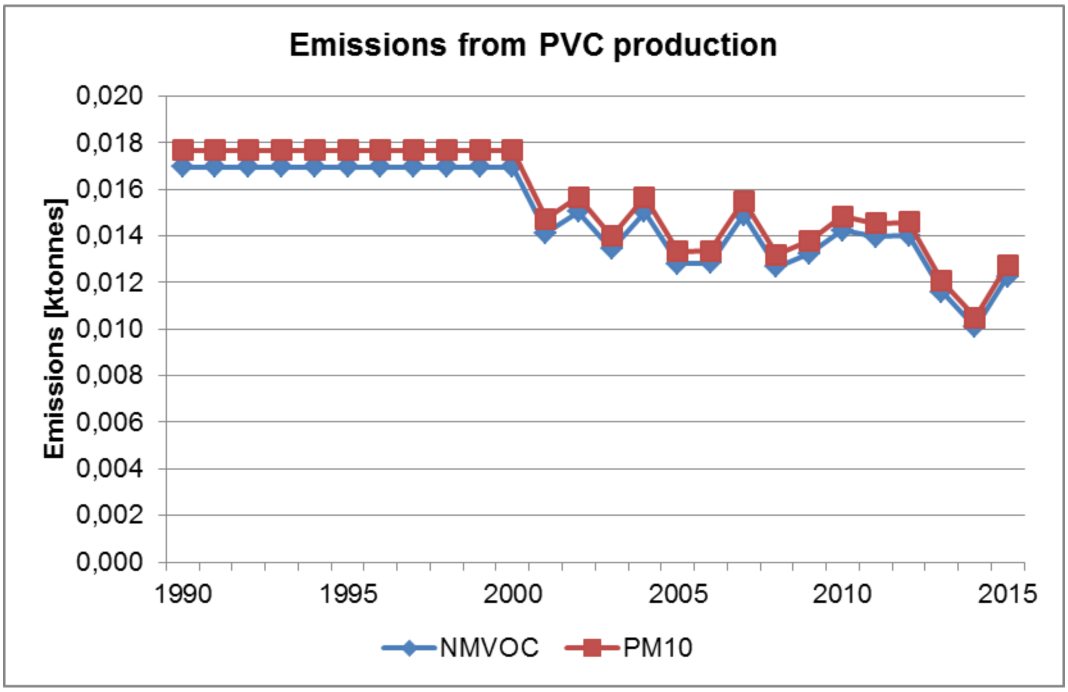


Figure 4.12: Emissions from NFR 2.B.5 PVC production for the period 1990 to 2015

Emissions and activity data from PVC production are presented in Table 4.19

Table 4.19: Emissions and activity data from sector 2.B.10.a PVC Production

Years	NMVOC	PM_{10}	PVC Production
	ktonnes	**ktonnes**	**ktonnes**
1990	0.017	0.018	177
1991	0.017	0.018	177
1992	0.017	0.018	177
1993	0.017	0.018	177
1994	0.017	0.018	177
1995	0.017	0.018	177
1996	0.017	0.018	177
1997	0.017	0.018	177
1998	0.017	0.018	177
1999	0.017	0.018	177
2000	0.017	0.018	177
2001	0.014	0.015	147
2002	0.015	0.016	157
2003	0.013	0.014	140
2004	0.015	0.016	157
2005	0.013	0.013	133
2006	0.013	0.013	134
2007	0.015	0.016	155

2008	0.013	0.013	132
2009	0.013	0.014	138
2010	0.014	0.015	148
2011	0.014	0.015	145
2012	0.014	0.015	146
2013	0.012	0.012	121
2014	0.010	0.011	105
2015	0.012	0.013	128
Trend 1990– 2015	-28%	-28%	
Trend 2014 - 2015	21%	21%	

Source of Activity Data

Production data was taken from annual activity reports of Petkim which is available on website. Due to lack of data for 1990-1999 , 2000 data was used.

Methodological Issues

The TIER 2 approach for process emissions from PVC productions uses the general equation:

Emissionpollutant = ∑ AD * EF

Where:

Emissionpollutant (ktonnes) =emissions of pollutant i for the period concerned in the inventory

i = NMVOC,PM_{10}

AD = the activity rate for the PVC production (ktonnes)

EF = emission factor of pollutant i for PVC production (g/tonne)

Source of Emission Factors

Default emission factors (Tier 2) for PVC production is taken from the GB.

Emission factors are presented in Table 4.20.

Table 4.20: Emission factor (EF) used sector 2.B.10.a PVC production

	Unit	EF	Reference
NMVOC	g/tonne	96	EMEP/EEA (2016), Chapter 2.B.5 PVC Productions, Table 3-40 , page 38
PM_{10}	g/tonne	100	

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

No recalculation has been done in this part of the inventory.

Planned Improvements

It would be preferable to use official national datasets or plant specific data.

It is possible to improve the methodology by obtaining information on the use of production processes and abatement techniques for plants in Turkey, as well as information on emission measurements.

These improvements are scheduled to be carried out in next coming years

4.2.7.6 Polypropylen Manufacture

Source Category Description

Emissions: NMVOC

Key Source: No

Emission Trends

NMVOC emissions increased by about 61 % from 0.304 Gg in 1990 to 0.490 Gg in 2015, which is a share of less than 1% in total NMVOC emissions in 2015.

PM_{10} emissions increased by about 61 % from 0.091 Gg in 1990 to 0.147 Gg in 2015, which is a share of less than 1% in total PM_{10} emissions in 2015.

Emission trends are illustrated in Figure 4.13 and emissions and activity data are presented in Table 4.21

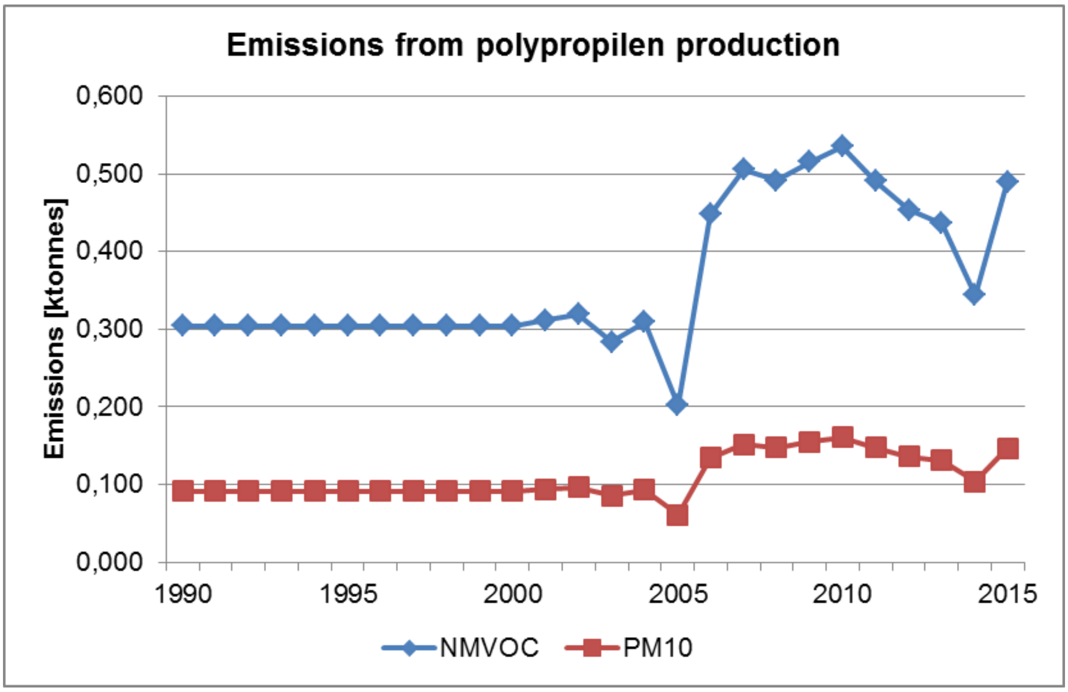


Figure 4.13: Emissions from NFR 2.B.10.a polypropylene production for the period 1990 to 2015

Table 4.21: Emissions from NFR sector 2.B.10.a polypropylene production and activity data

Years	**NMVOC**	**PM_{10}**	**Polypropylene** Production
	ktonnes	**ktonnes**	**ktonnes**
1990	0.304	0.091	76
1991	0.304	0.091	76
1992	0.304	0.091	76
1993	0.304	0.091	76
1994	0.304	0.091	76
1995	0.304	0.091	76
1996	0.304	0.091	76
1997	0.304	0.091	76
1998	0.304	0.091	76
1999	0.304	0.091	76
2000	0.304	0.091	76
2001	0.312	0.094	78
2002	0.319	0.096	80
2003	0.284	0.085	71
2004	0.309	0.093	77

2005	0.202	0.061	50
2006	0.447	0.134	112
2007	0.505	0.152	126
2008	0.491	0.147	123
2009	0.515	0.155	129
2010	0.535	0.160	134
2011	0.491	0.147	123
2012	0.453	0.136	113
2013	0.436	0.131	109
2014	0.344	0.103	86
2015	0.490	0.147	122
Trend 1990 - 2015	61%	61%	
Trend 2014 - 2015	42%	42%	

Source of Activity Data

Production data was taken from annual activity reports of Petkim which is available on website. Due to lack of data for 1990-1999, 2000 data was used.

Methodological Issues

The applied methodology is TIER 2 uses the general equation:

Emission pollutant = ∑ AD * EF

Where:

Emission pollutant = emissions of pollutant i for the period concerned in the inventory (Gg)

i = NMVOC,

AD = annual national polypropylene production (Gg)

EF = emission factor of pollutant i for polypropylene production (kg/tonnes polypropylene)

Source of Emission Factors

Default emission factors (Tier 2) for polyproplyene production are taken from the EMEP/EEA Emission Inventory Guidebook 2016.

Emission factors are presented in Table 4.22.

Table 4.22: Emission factor (EF) used sector 2.B.10.a Polypropylene production

	Unit	EF	Reference
NMVOC	kg/tonne	4	EMEP/EEA Guidebook(2016) Chapter 2B.Chemical Industry Table 3-42, page 39
PM10	kg/tonne	1.2	EMEP/EEA Guidebook(2016) Chapter 2B.Chemical Industry Table 3-42, page 39 (assumed 80% of TSP emission factor)

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

No recalculation has been done in this part of the inventory.

Planned improvements

Plant specific information will be collected to better emission estimates.

These improvements are scheduled to be carried out in next coming years.

4.2.8. NFR 2.B.10.b Storage, handling, transport of chemical products

Source Category Description

Emissions: NE

No emissions from storage, handling and transport of chemical products are estimated in this inventory.

Storage, handling and transport of chemical products is a source of e.g. particles, ammonia and NMVOC emissions.

Planned improvements

Particle emissions from storage and handling of fertilizers can be included in the inventory using emission factors from e.g. TNO. 2002. The Co-ordinated European Programme on Particulate Matter Emission Inventories. Projections and Guidance (CEPMEIP). http://www.air.sk/tno/cepmeip/ and by using fertilizer production as activity data. Production data needs to be collected.

These improvements are scheduled to be carried out in next coming years.

4.3 NFR 2.C Metal Industry

NFR 2.C Metal Industry includes following subsectors;

- Iron and steel production
- Ferroalloys production
- Aluminium production
- Non-Ferrous Metals production

The shares of subcategories to PM_{10} emissions in 2015 from Metal Industry are presented in Figure 4.14 below. The largest share of emissions came from iron-steel production which contributed to 97.7 % (5.67 kt) of emissions. Ferroalloys contributed to 0.9 % (0.05 kt), aluminium production contributed to 1.1% (0.06 kt) and non-ferrous metal production to 0.3% (0.015 kt). Nickel, magnesium and zinc production emissions were not included in the calculations due to lack of production data.

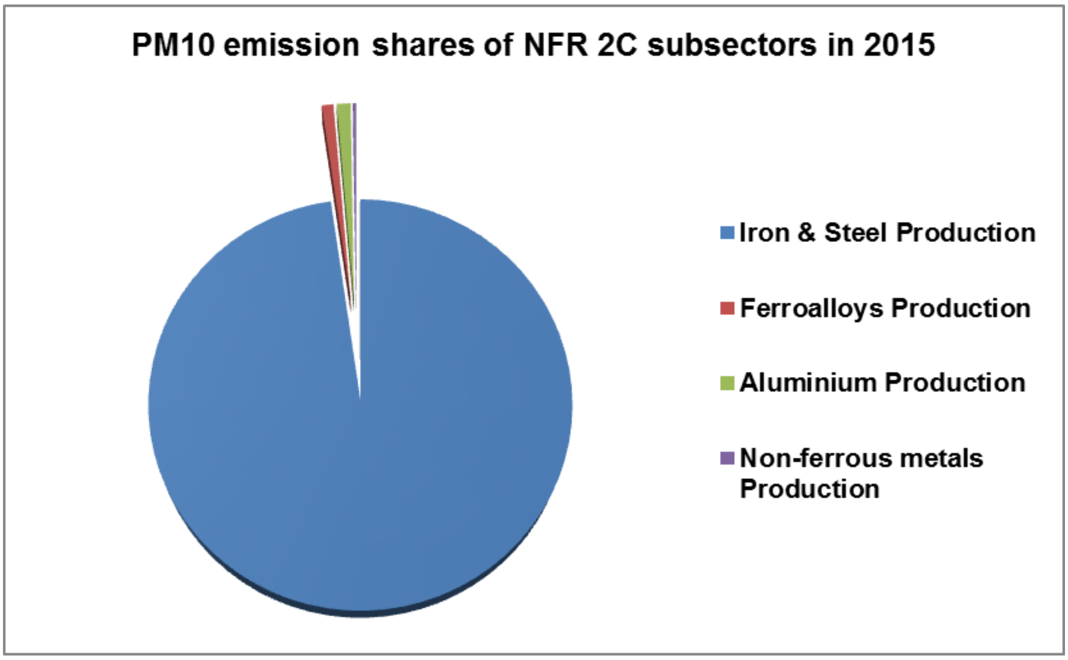


Figure 4.14: Contributions of subsectors to metal industry

4.3.1 NFR 2.C.1 Iron and Steel Production

Source Category Description

Emissions: NMVOC, PM_{10}

IE: SO_2, NO_x, CO included in NFR 1.A.2.b

Key Source: No

Emission Sources

Iron and steel production is a large scale industry which involves many process for instance coke production, sinter production, pellet production, iron making, steel making etc. Main processes scheme according to the GB is illustrated in Figure 4.15

In Turkey, there are 17 facilities with electrical arc oven and 3 integrated plant. Annual steel production capacity has increased from 9 million tonnes in 1990 to 34 million tonnes in 2014 (World Steel Organization). Information about production and abatement technology will be collected next coming years.

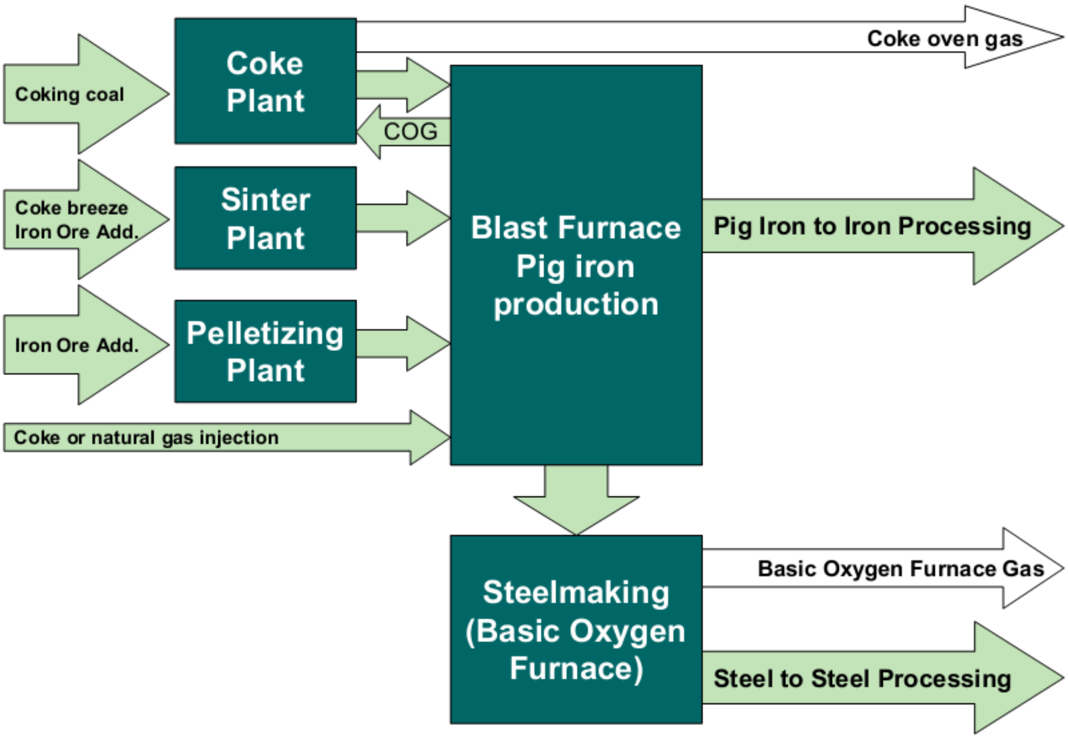


Figure 4.15: Main processes in the iron and steel industry

Emission Trends

NMVOC emissions increased by about 234 % from 1.4 Gg in 1990 to 4.7 Gg in 2015, which is a share of 1 % in total NMVOC emissions in 2015.

PM_{10} emissions increased by about 234 % from 1.70 Gg in 1990 to 5.7 Gg in 2015, which is a share of % 1 total PM_{10} emissions in 2015.

The increases of all emissions in this sector were mainly due to increase of production capacity which is parallel to demand.

Emission trends are illustrated in Figure 4.16.

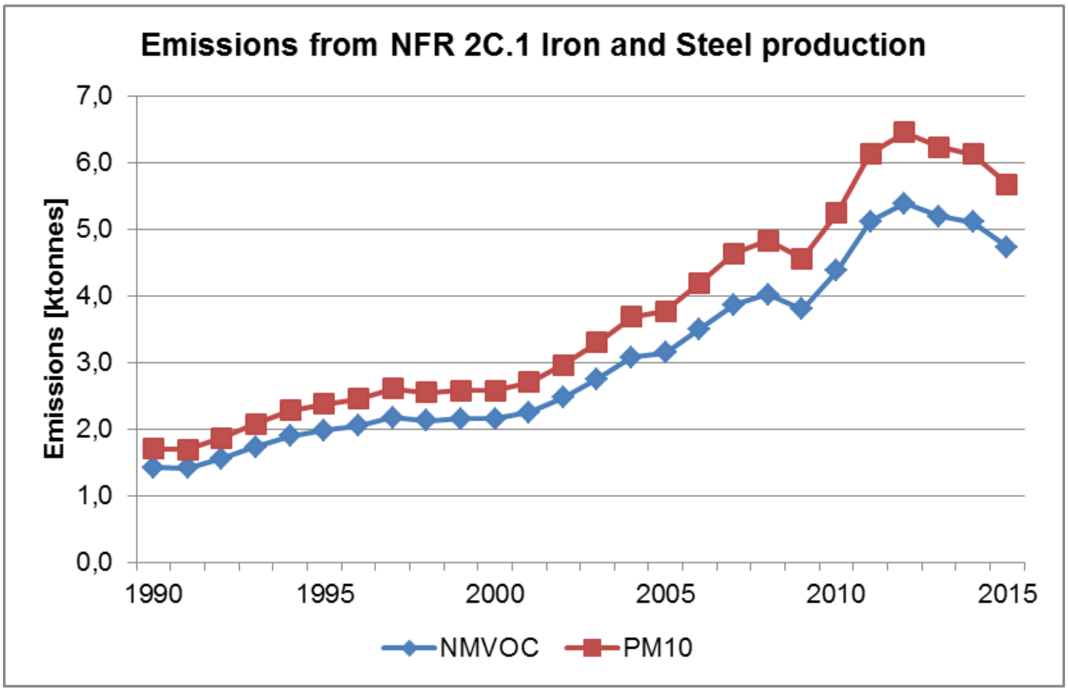


Figure 4.16: Emissions from NFR 2.C.1 iron and steel production for the period 1990 to 2015

Emissions from iron and steel production and activity data are presented in Table 4.23

Table 4.23: Emissions from sector 2.C.1 Iron and Steel Production

Years	NMVOC	PM_{10}	Crude Steel Production
	ktonnes	ktonnes	millontonnes
1990	1.42	1.70	9.44
1991	1.41	1.69	9.40
1992	1.55	1.86	10.34
1993	1.73	2.07	11.52
1994	1.89	2.27	12.62
1995	1.98	2.37	13.18
1996	2.04	2.45	13.62
1997	2.17	2.61	14.48
1998	2.12	2.55	14.14
1999	2.15	2.58	14.31
2000	2.15	2.58	14.33
2001	2.25	2.70	14.98
2002	2.47	2.96	16.47
2003	2.74	3.29	18.30
2004	3.07	3.69	20.48
2005	3.14	3.77	20.97
2006	3.50	4.20	23.32

2007	3.86	4.64	25.75
2008	4.02	4.83	26.81
2009	3.80	4.55	25.30
2010	4.37	5.25	29.14
2011	5.12	6.14	34.10
2012	5.38	6.46	35.89
2013	5.2	6.24	34.65
2014	5.1	6.13	34.04
2015	4.7	5.7	31.51
Trend 1990 - 2015	234%	234%	
Trend 2014 - 2015	-7%	-7%	

Source of Activity Data

Production data was downloaded from http://www.worldsteel.org/statistics/statistics-archive.html for whole time series. Data was same with Iron and Steel Manufacturers Association data.

Methodological Issues

The TIER 1 approach for process emissions from an integrated steel plant uses the general equation:

Emissionpollutant = ∑ AD * EF

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (Gg)

i = NMVOC,PM_{10}

AD = the activity rate for the steel production (Mg)

EF = emission factor of pollutant i for iron and steel production (g/Mg steel)

Source of Emission Factors

Default emission factors (Tier 1) for iron and steel production is taken from the GB.

Emission factors are presented in Table 4.24

Table 4.24: Emission factor (EF) used sector 2.C.1 Iron and Steel production

	Unit	EF	Reference
NMVOC	g/Mg steel	150	EMEP/EEA (2016), Chapter 2.C.1 Iron and Steel, Table 3-1 , page 24; Tier-1
PM_{10}	g/Mg steel	180	

Uncertainty

No uncertainty analysis was made to the inventory.

Recalculations

No recalculations have been done in this inventory.

Planned Improvements

It would be preferable to use official national datasets or plant specific data.

- It is possible to improve the methodology by obtaining information on heavy metal and POP emissions which are relevant for iron and steel production, the process and abatement techniques applied in Turkey in the sector, as well as information on emission measurements and can be calculated using production data and emission factors available from the EMEP/EEA Emission Inventory Guidebook or based on methodologies that other countries are using.
- It is planned to calculate emission in Tier 2 level. Required dataset will be asked to Iron and Steel Manufacturers Association.

These improvements are scheduled to be carried out in 3 years.

4.3.2 NFR 2.C.2 Ferroalloys Production

Source Category Description

Emissions: PM_{10}

Key Source: No

Emission Sources

Ferroalloys contain iron and one or more non-ferrous metals as alloying elements. Ferroalloys can be classified in two groups bulk ferroalloys which are produced in electrical arc furnaces and special ferroalloys which are produced in smaller quantities. Production can be carried out as primary and secondary process. Both of processes scheme in the GB is illustrated in Figure 4.17 Emissions from this subsector are not considered significant.

Ferroalloys production is a source of particle (TSP, PM_{10}, $PM_{2.5}$) emissions factors for these are available in the EMEP/EEA Guidebook.

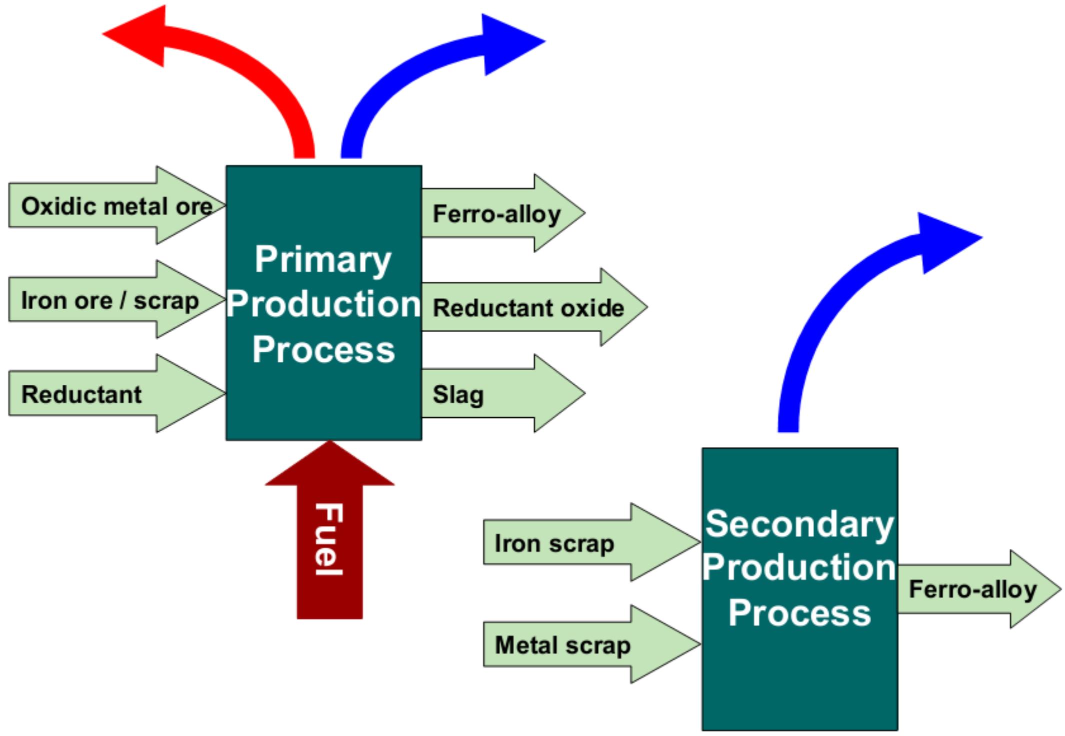


Figure 4.17: Simplified scheme for primary and secondary processes

Emission Trends

PM_{10} emissions decreased by about 7 % from 0.058 Gg in 1990 to 0.054 Gg in 2015, which is a share of less than 1% in total PM_{10} emissions in 2015.

Emission trends are illustrated in Figure 4.18 and emissions and activity data are presented in Table 4.25

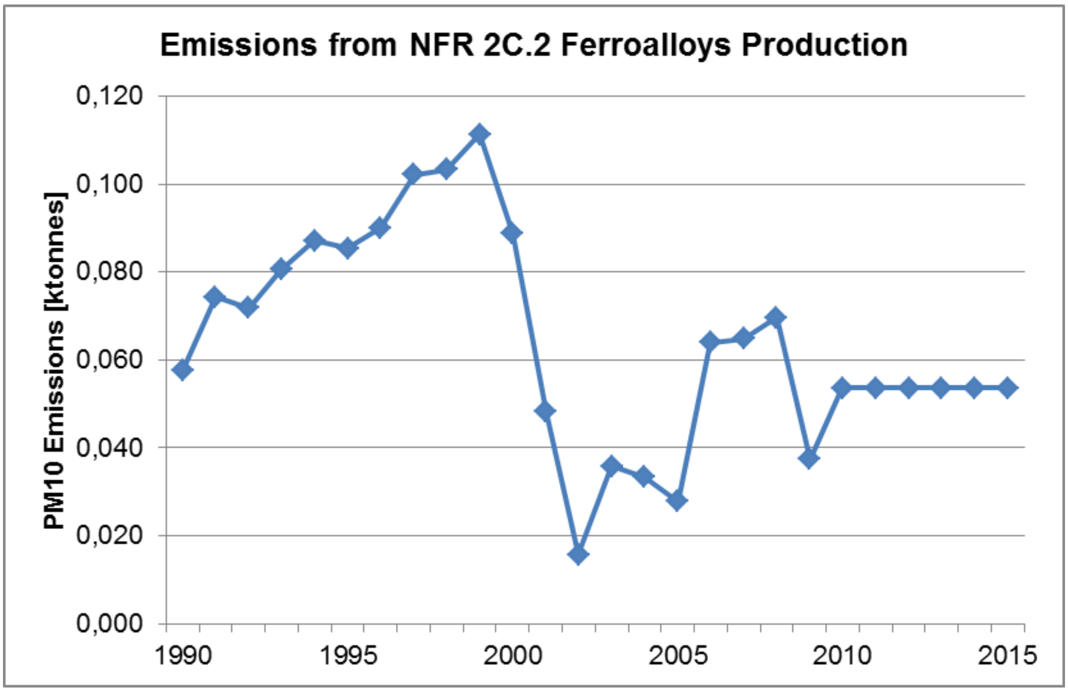


Figure 4.18: Emissions from NFR 2.C.2 ferroalloys production for the period 1990 to 2015

Table 4.25: Emissions from NFR sector 2.C.2 ferroalloys production and activity data

	PM_{10}	Ferroalloys Production
	ktonnes	**ktonnes**
1990	0.058	68
1991	0.074	87
1992	0.072	84
1993	0.081	95
1994	0.087	102
1995	0.085	100
1996	0.090	106
1997	0.102	120
1998	0.103	122
1999	0.111	131
2000	0.089	104
2001	0.048	57

2002	0.016	18
2003	0.036	42
2004	0.033	39
2005	0.028	33
2006	0.064	75
2007	0.065	76
2008	0.070	82
2009	0.037	44
2010	0.054	63
2011	0.054	63
2012	0.054	63
2013	0.054	63
2014	0.054	63
2015	0.054	63
Trend 1990 - 2015	-7%	
Trend 2014 - 2015	0%	

Source of Activity Data

Activity data (1990-2012) were taken from world mineral production reports. Reports were downloaded http://www.bgs.ac.uk/mineralsuk/statistics/worldarchieve.html website. 2014 and 2015 assumed same as 2012 data.

Methodological Issues

The applied methodology is TIER 1 uses the general equation:

Emission pollutant = ∑ AD * EF

Where:

Emission pollutant = emissions of pollutant i for the period concerned in the inventory (Gg)

i = PM_{10},

AD = annual national ferroalloy production (Gg)

EF = emission factor of pollutant i for ferroalloy production (kg/tonnes alloy)

Source of Emission Factors

Default emission factors (Tier 1) for ferroalloy production are taken from the EMEP/EEA Emission Inventory Guidebook 2016.

Emission factors are presented in Table 4.26

Table 4.26: Emission factor (EF) used sector 2.C.2 Ferroalloy production

	Unit	EF	Reference
PM_{10}	kg/tonnes alloy	0.85	EMEP/EEA Guidebook(2016) Chapter 2C.2 Ferroalloys production Table 3-1, page 6, Tier-1

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

No recalculations have been done for this inventory.

Planned improvements

Plant specific information will be collected to better emission estimates.

These improvements are scheduled to be carried out in next coming years.

4.3.3 NFR 2.C.3 Aluminium Production

Source Category Description

Emissions: NO_x, SO_2, CO, PM_{10}

Key Source: No

Emission Sources

Primary aluminium is produced by electrolytic reduction of alumina which is obtained from bauxite. Secondary aluminium is produced by melting the scrap which contains aluminium. Processes schemes for primary and secondary aluminium production according to the EMEP/EEA Guidebok (2013) are illustrated in Figure 4.19 and 4.20

Figure 4.19: Process scheme of primary aluminium production

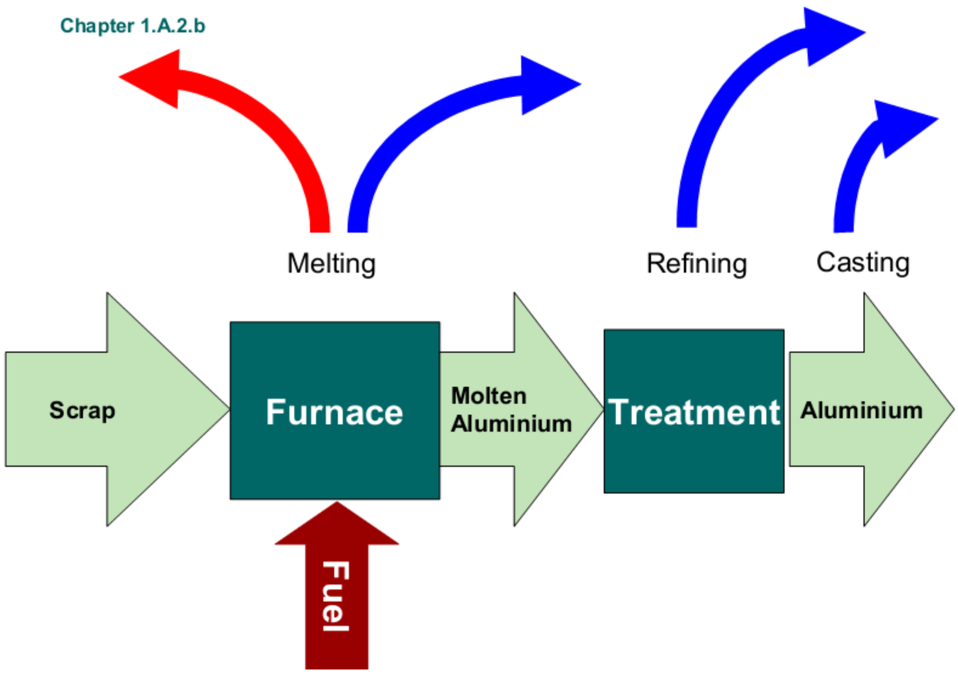


Figure 4.20: Process scheme for secondary aluminium production

Aluminium production in Turkey includes process emissions from both primary and secondary production. Primary aluminium is produced by means of electrolytic reduction of alumina. The most important pollutants emitted from the primary aluminium electrolysis process are sulphur dioxide (SO_2), carbon monoxide (CO), polycyclic aromatic hydrocarbons (PAHs). Dust is emitted mainly during the treatment (refining and casting) in both primary and secondary aluminium production. A secondary aluminium smelter is defined as any plant or factory in which aluminium-bearing scrap or aluminium-bearing materials, other than aluminium-bearing concentrates (ores) derived from a mining operation, is processed into aluminium alloys for industrial castings and ingots.

The Turkish aluminium sector's roots go back to 1950s but the industry veritably took off with the establishment of the only primary aluminium producer in 1974. (Turkish Metal Industry Report, July 2010). The facility produces aluminium by processing bauxite reserves in the region.

Turkey produced a total of approximately 65 thousand tons of aluminium products in 2010; extrusion, flat products and secondary aluminium constituting the major part. Aluminium Manufacturers' Union of Turkey (TALSAD) The aluminium industry is – amongst others - (road paving with asphalt, asphalt roofing, ammonia production, other chemical productions iron and steel production, petroleum industry, pulp and paper) one of the main sources of CO emissions (National Inventory Report Turkey, April 2011).

Emission Trends

NO_x emissions decreased by about 47 % from 0.061 ktonnes in 1990 to 0.032 ktonnes in 2015, which is a share of 0.01 % in total NO_x emissions in 2015.

SO_2 emissions decreased by about 47 % from 0.365 ktonnes in 1990 to 0.192 ktonnes in 2015, which is a share of 0.02 % in total SO_2 emissions in 2015.

CO emissions decreased by about 47 % from 7.31 ktonnes in 1990 to 3.84 ktonnes in 2015, which is a share of 0.27 % in total CO emissions in 2015.

PM_{10} emissions decreased by about 47 % from 0.122 ktonnes in 1990 to 0.064 ktonnes in 2015, which is a share of 0.03 % in total PM_{10} emissions in 2015.

Emission trends are illustrated in Figure 4.21 .The emissions from aluminum production have remained constant since 1990 except for the year 2009. Due to the economic crises less aluminum was produced in 2009.This is reflected by significantly decreasing emissions in this year.

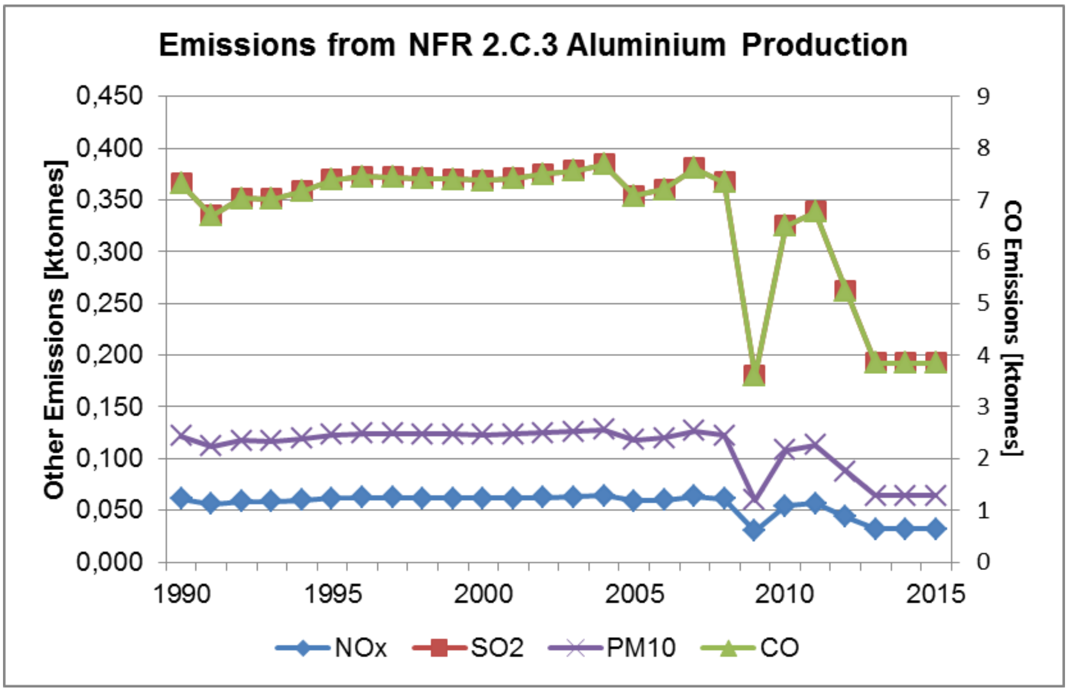


Figure 4.21: Emissions from NFR 2.C.3 for the period 1990 to 2015

Emissions from aluminium production and activity data are presented Table 4.27

Table 4.27: Emissions from NFR sector 2.C.3 Aluminium Production

	NO_x	SO_2	CO	PM_{10}	Aluminium Production
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1990	0.061	0.365	7.308	0.122	61
1991	0.056	0.335	6.698	0.112	56
1992	0.059	0.351	7.030	0.117	59
1993	0.059	0.351	7.020	0.117	59
1994	0.060	0.358	7.164	0.119	60
1995	0.062	0.369	7.382	0.123	62
1996	0.062	0.373	7.452	0.124	62
1997	0.062	0.372	7.442	0.124	62
1998	0.062	0.371	7.416	0.124	62
1999	0.062	0.370	7.405	0.123	62
2000	0.062	0.369	7.380	0.123	62
2001	0.062	0.370	7.408	0.123	62
2002	0.063	0.375	7.500	0.125	63
2003	0.063	0.378	7.560	0.126	63
2004	0.064	0.384	7.680	0.128	64
2005	0.059	0.354	7.080	0.118	59
2006	0.060	0.360	7.200	0.120	60
2007	0.063	0.380	7.608	0.127	63
2008	0.061	0.367	7.332	0.122	61
2009	0.030	0.180	3.600	0.060	30
2010	0.054	0.325	6.492	0.108	54
2011	0.056	0.338	6.768	0.113	56
2012	0.044	0.262	5.244	0.087	44
2013	0.032	0.192	3.840	0.064	32
2014	0.032	0.192	3.840	0.064	32
2015	0.032	0.192	3.840	0.064	32
Trend 1990 - 2015	-47%	-47%	-47%	-47%	
Trend 2014 - 2015	0%	0%	0%	0%	

Source of Activity Data

Activity data (1990-2013) were taken from world mineral production reports. Reports were downloaded http://www.bgs.ac.uk/mineralsuk/statistics/worldarchieve.html website. Data was same with Aluminium Manufacturers' Union of Turkey (TALSAD) data but complete time series were available in these reports. Due to lack of data 2015 data assumed same as 2013.

Methodological Issues

The applied methodology is TIER 1 and uses the general equation:

Emissionpollutant = ∑ ADproduction * EFpollutant

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

ADproduction = the activity rate for the aluminium production (ktonnes)

EFpollutant = emission factor of pollutant i (kg/tonnes aluminium)

Source of Emission Factors

Emission factors for NO_x. SO_2. CO and PM_{10} have been taken from the EMEP/EEA Emission Inventory Guidebook 2016.

For NMVOC there was no emission factor available. Emission factors are presented in Table 4.28

Table 4.28: Emission factor (EF) used sector 2.C.3 Aluminium Production

	Unit	EF	Reference
NO_x	kg/tonne	1	EMEP/EEA (2016). Chapter 2.C.3 Aluminium Production. Table 3-1 Tier 1 emission factors for aluminium production, page 11
SO_2	kg/tonne	6	
CO	kg/tonne	120	
PM_{10}	kg/tonne Al produced	2	

Uncertainty

There is no information on uncertainty of the emission factor in the sector specific chapter (2. C. 3 Aluminium production of the EMEP/EEA emission inventory guidebook 2016.

As the activity data comes from BGS which collects production data on mineral, a low uncertainty 3 of about 5 % can be assumed.

No uncertainty analysis was performed for this inventory.

Recalculations

No recalculation has been made for this inventory.

Planned Improvements

Activity data for secondary aluminum needs to be included.

It would also be an improvement to use country specific emission factors, for which work more information needs to be collected on the process and abatement techniques and emission measurements for plants in Turkey.

These improvements are scheduled to be carried out in 3 years.

4.3.4 NFR 2.C.4 Magnesium Production

Source Category Description

Emissions: NE

Planned improvements

Source category new introduced to 2014 nomenclature for reporting used for the international reporting of emission inventory data. Specific guidance for this sector has not yet been developed in EMEP/EEA 2013.

4.3.5 NFR 2.C.5 Lead Production

Source Category Description

Emissions: PM_{10}

Key Source: No

Emission Sources

The production of refined metallic lead from minerals dug out of the ground involves Mineral extraction i.e. mining and separation of the lead-rich mineral (ore) from the other extracted materials to produce a lead concentrate. (ILZSG World Directory for Primary and Secondary Lead Plants).

Primary lead production:

Lead is obtained from galena by smelting. This involves roasting the ore to remove the sulphur and obtain lead oxide, which is then reacted with coke in a furnace. The resulting lead bullion contains many impurities such as silver and gold as well as antimony, arsenic, copper, tin or zinc. These impurities are removed by various refining steps to obtain pure lead (INTERNATIONAL LEAD ASSOCIATION, 2008).

By smelting the lead rich mineral reacts with other ingredients, to yield impure metallic lead. This is traditionally done in two stages:

- roasting in air, turning the lead concentrate (usually lead sulphide) into lead oxide;

- heating the lead oxide in a blast furnace with coke to yield metallic lead.

Refining is the removal of impurities and other metals from the crude lead (S, Cu, Ni, As, Sb, Bi, Ag, Au, etc.). The refining process is applied in several steps in kettles with addition of specific agents, or alternatively, smaller quantities are processed by electrolytic refining. Alloying of refined lead with other metals gives the desired composition. Processes scheme for primary copper production in the EMEP/EEA Guidebok (2013) are illustrated in Figure 4.22.

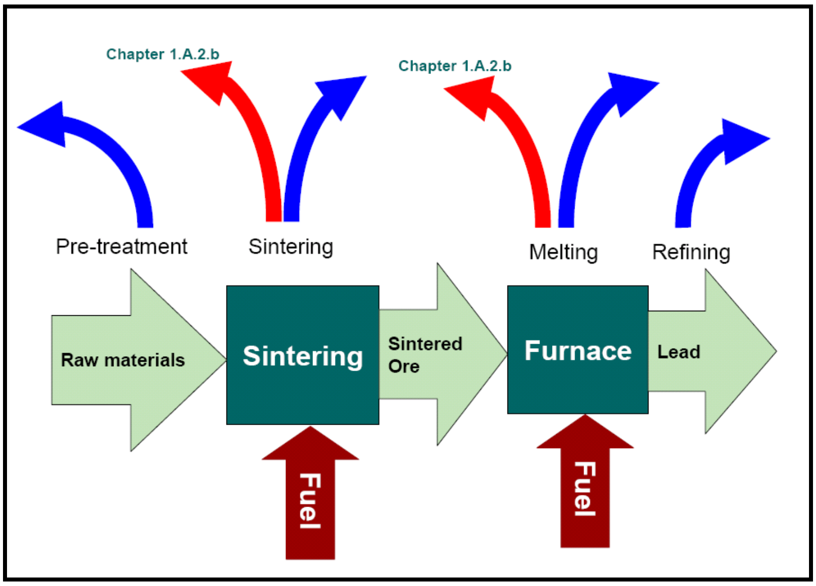


Figure 4.22: Process scheme for primary lead production

Secondary Lead Production

Secondary lead production involves the production of refined metal by processing lead scrap. It is often possible to simply re-melt scrap lead, with very little extra processing. However, compounds of lead (such as battery pastes) require smelting. Refining is often needed to remove any unwanted contamination and alloying additions in the feed material. The procedures are similar to those outlined for primary processing, but in general, fewer operations are required. (ILZSG WORLD DIRECTORY FOR PRIMARY AND SECONDARY LEAD PLANTS[4])

The main air pollutants emitted during the production of lead are sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO) and carbon dioxide (CO_2). Since these are assumed to originate mainly from combustion activities, emissions of these pollutants are included in the energy sector (1.A.2.b). The most important process emissions are heavy metals (particularly lead) and dust. (EMEP/EEA Emission Inventory Guidebook 2013) Information about sector, production and abatement technologies will be collected next coming years.

Emission Trends

PM_{10} emissions increased by about 11 % from 3.6 Mg in 1990 to 4 Mg in 2015, which is a share of less than 0.1 % in total PM_{10} emissions in 2015.

Emission trend is illustrated in Figure 4.23. Between 1990 and 1997 the emissions from lead production fluctuated. Between 1997 and 2005 they remained more or less constant, decreasing again in 2006. From then they have fluctuated.

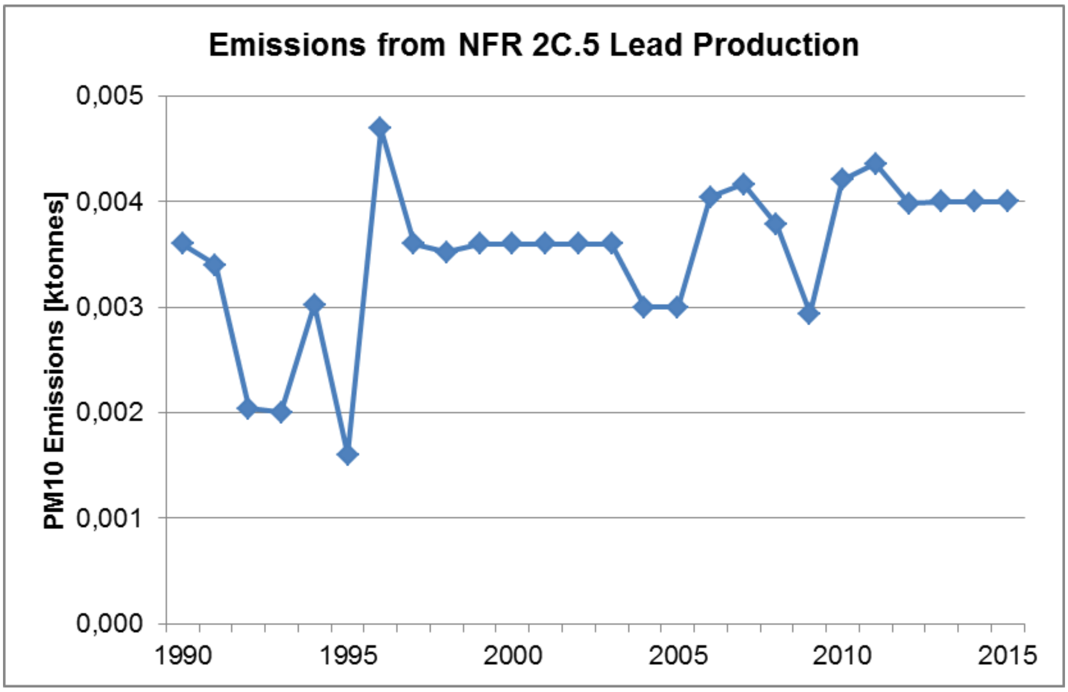


Figure 4.23: Emissions from NFR 2.C.5 b for the period 1990 to 2015

Emissions and activity data from lead production are presented in Table 4.29.

Table 4.29: Emissions from sector 2.C.5 b Lead Production

	PM_{10}	**Lead Production**
	ktonnes	**ktonnes**
1990	0.0036	9
1991	0.0034	9
1992	0.0020	5
1993	0.0020	5
1994	0.0030	5
1995	0.0016	4
1996	0.0047	12
1997	0.0036	9
1998	0.0035	9
1999	0.0036	9
2000	0.0036	9
2001	0.0036	9
2002	0.0036	9
2003	0.0036	9
2004	0.0030	9
2005	0.0030	8
2006	0.0040	10
2007	0.0042	10
2008	0.0038	9
2009	0.0029	7
2010	0.0042	11
2011	0.0044	11
2012	0.0040	10
2013	0.0040	10
2014	0.0040	10
2015	0.0040	10
Trend 1990 - 2015	11%	
Trend 2014 - 2015	0%	

Source of Activity Data

Activity data (1990-1999) were taken from world mineral production reports. Reports were downloaded http://www.bgs.ac.uk/mineralsuk/statistics/worldarchieve.html website. Refined lead production is used as activity data. Due to lack of data 2000-2004 data are assumed same as 1999 data. Moreover extrapolation was made according to Eurostat Turkey Production Index (lead production) for 2005-2012. 2005 was the base year for this extrapolation. 2013, 2014 and 2015 data assumed same as 2012.

Methodological Issues

The applied methodology is TIER 1 and uses the general equation:

Emission PM_{10} = ∑ AD production * EF PM_{10}

Where:

Emission PM_{10} = emissions of pollutant i for the period concerned in the inventory (ktonnes)

ADproduction = the activity rate for the production of lead (ktonnes)

EF PM_{10} = emission factor of pollutant i (kg/tonnes lead)

Source of Emission Factors

Emission factor for PM_{10} have been taken from the EMEP/EEA Emission Inventory Guidebook 2016. Emission factor is presented in Table 4.30

Table 4.30: Emission factor (EF) used sector 2.C.5 b Lead Production

	Unit	EF	Reference
PM_{10}	g/tonne Pb	400	EMEP/EEA (2016) ,Chapter 2.C.5 b Lead Production. Table 3-1 Tier 1 emission factor for lead production, page 11

Uncertainty

There is no information on uncertainty of the emission factor in the sector specific chapter.

As the activity data comes from BGS which collects production data on mineral, a low uncertainty 5 of about 10 % can be assumed.

Recalculations

No recalculations have been done for this inventory.

Planned Improvements

Production statistics sourced from an international source should be checked with data from an official Turkish source.

It would also be an improvement to use country specific emission factors for which more detailed information on the process and abatement techniques used by the Turkish plants needs to be obtained, as well as information on emission measurements.

These improvements are scheduled to be carried out in 5 years.

NFR 2.C.6 Zinc Production

Source Category Description

Emissions: NE

Key Source: No

Emission Sources

Primary zinc is produced from ores. Ores oxidizes with air giving zinc oxide, sulphur oxide and zinc ferro. Chlorine and fluorine are removed from the combustion gas and the sulphur oxide is converted catalytically into sulphuric acid. A secondary zinc smelter is defined as any plant or factory in which zinc-bearing scrap or zinc-bearing materials.Two techniques are used for primary zinc production, electrochemical and thermal smelting. Processes scheme for primary nickel production by electrochemical in the EMEP/EEA Guidebok (2013) is illustrated in Figure 4.24.

Emissions of particulate matter and heavy metals (zinc and cadmium) take place during the receipt and storage of the zinc ores and during the production. The emissions during production occur from tanks, ovens and separation equipment. Pollutants released are sulphur oxides, nitrogen oxides, volatile organic gaseous compounds, carbon monoxide, carbon dioxide, nitrous oxide and ammonia.

In Turkey, there is one facility for primary zinc production which uses waelz process for the enrichment of the ore, afterwards leach and electrolysis methodology to produce high quality zinc. Turkey has also secondary zinc production. One facility produces zinc by leach-electrolysis method from residue. On the other hand ten facilities can produce zinc from hot galvanization residue by distillation.

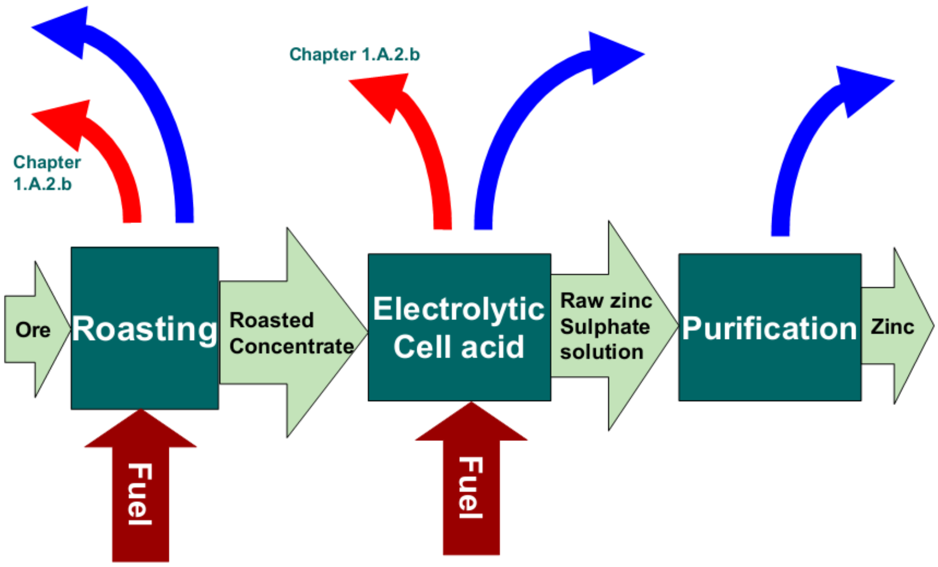


Figure 4.24: Process scheme for electrochemical zinc production

Recalculations

Emissions from zinc production were estimated last year with international data set. It was not estimated this year because of doubts about data source.

Planned Improvements

It would be preferable to use official national datasets or plant specific data.

It is possible to improve the methodology by obtaining information onprocess and abatement techniques used at Turkish plants, as well as information on emission measurements.

Zinc production is also a source for NMVOC and heavy metal (e.g. Pb, Cu, Zn) and POP (e.g. PDCC/F) emissions, which can be estimated using EFs from the EMEP/EEA Emission Inventory Guidebook or using information from other countries' IIRs.

These improvements are scheduled to be carried out in 5 years.

4.3.6 NFR 2.C.7a Copper Production

Source Category Description

Emissions: PM_{10}

Key Source: No

Emission Sources

Primary copper is produced by pyrometallurgical copper smelting process which involves fire refinery of blister copper and electrolytic refinery for impurity removal. Secondary copper is produced by melting the scrap which contains copper. Processes scheme for primary copper production in the EMEP/EEA Guidebook (2013) are illustrated in Figure 4.25.

Information about production and abatement technology for Turkey will be collected within coming years.

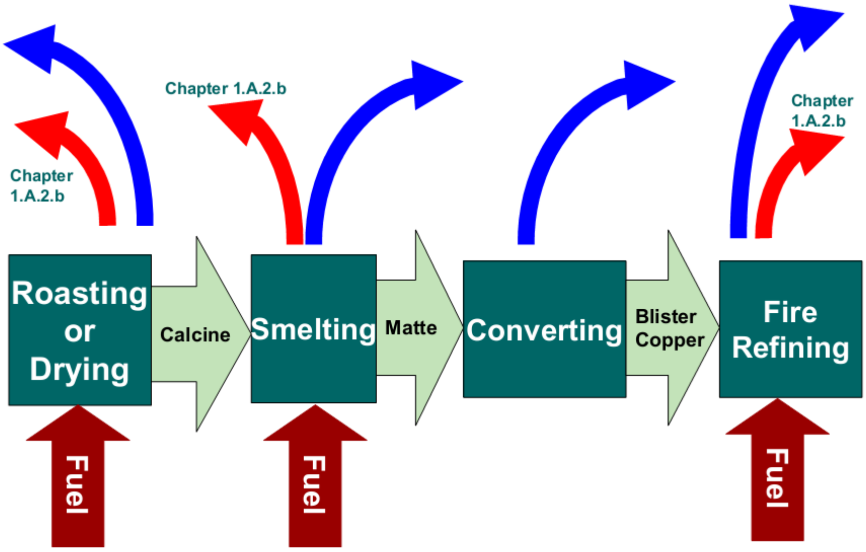


Figure 4.25: Process scheme for primary copper production

Emission Trends

PM_{10} emissions increased by about 88 % from 0.006 ktonnes in 1990 to 0.011 ktonnes in 2015, which is a share of less than 0.01 % in total PM_{10} emissions in 2015.

Emission trends are illustrated in Figure 4.26.

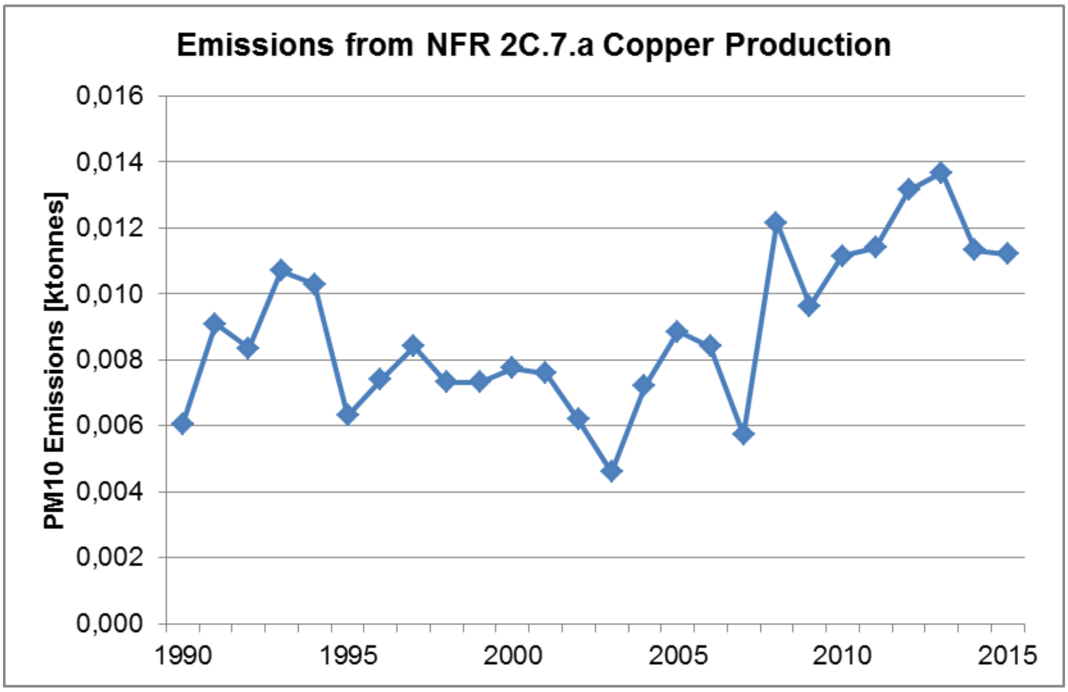


Figure 4.26: Emissions from NFR 2.C.7a for the period 1990 to 2015

Emissions from copper production and activity data are presented in Table 4.31

Table 4.31: Emissions from sector 2.C.7.a Copper Production

	PM_{10}	Copper Production
	ktonnes	ktonnes
1990	0.006	19
1991	0.009	28
1992	0.008	26
1993	0.011	33
1994	0.010	25
1995	0.006	20
1996	0.007	23
1997	0.008	26
1998	0.007	23
1999	0.007	23
2000	0.008	26
2001	0.008	24
2002	0.006	19
2003	0.005	14
2004	0.007	35
2005	0.009	28
2006	0.008	26
2007	0.006	18
2008	0.012	38
2009	0.010	30

2010	0.011	35
2011	0.011	36
2012	0.013	41
2013	0.014	43
2014	0.011	35
2015	0.011	35
Trend 1990 - 2015	88%	
Trend 2014 - 2015	0%	

Methodological Issues

The applied methodology is TIER 1 and uses the general equation:

Emissionpollutant = ∑ ADproduction * EFpollutant

Where:

Emissionpollutant =emissions of pollutant i for the period concerned in the inventory (ktonnes)

ADproduction = the activity rate for the copper production (ktonnes)

EFpollutant = emission factor of pollutant i (kg/tonnes copper)

Source of Activity Data

Activity data (1990-2008) were taken from world mineral production reports. Reports were downloaded http://www.bgs.ac.uk/mineralsuk/statistics/worldarchieve.html website. Smeltery production of copper is used as activity data. Due to lack of data extrapolation was made according to Eurostat Turkey Production Index(copper production) for 2009-2014. 2005 was the base year for this extrapolation.

Source of Emission Factors

Emission factors for PM_{10} have been taken from the EMEP/EEA Emission Inventory Guidebook 2016.

Emission factor is presented in Table 4.32

Table 4.32: Emission factor (EF) used sector 2.C.7.a Copper Production

	Unit	EF	Reference
PM_{10}	kg/tonne Cu produced	0.320	EMEP/EEA (2016). Chapter 2.C.5.a Copper Production. Table 3-1 Tier 1 emission factors for copper production, page 10

Uncertainty

There is no information on uncertainty of the emission factor in the sector specific chapter (2.C.5.a Copper production of the EMEP/EEA emission inventory guidebook 2013.)

No uncertainty calculation was performed for the inventory.

Recalculations

No recalculations have been done for this inventory.

Planned Improvements

Activity data for secondary copper needs to be included.

It would also be an improvement to use country specific emission factors which can be developed based on information on the process and abatement technique and emission measurements.

These improvements are scheduled to be carried out in 5 years.

4.3.7 NFR 2.C.7b Nickel Production

Source Category Description

Emissions: NE

At this stage no emissions from nickel production is estimated.

Emission Sources

Primary nickel is produced by heating reaction of oxide or sulphidic ore. Secondary nickel is produced by melting the scrap which contains nickel. Processes schemes for primary and secondary nickel production in the EMEP/EEA Guidebok (2013) are illustrated in Figure 4.27.

Nickel production occurs in Turkey, but not enough accurate information on the volume of the industry, nor on the production processes has been available for the work.

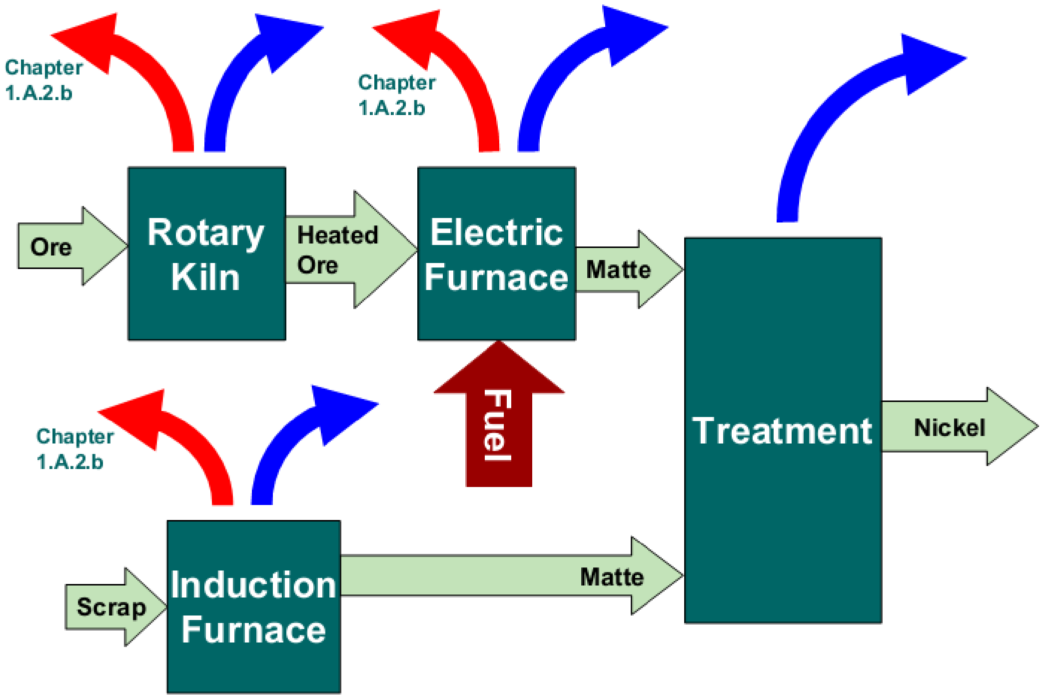


Figure 4.27: Process schemes of primary and secondary nickel production

Planned improvements

To carry out emission estimation for this source information needs to be collected on the process and abatement techniques used at Turkish plants, as well as on emission measurements to enable calculation of specific emissions for each plant.

Nickel production is a source for e.g. NMVOC, SO_x, ammonia and nickel emissions. Emission factors exist in the EMEP/EEA Guidebook for SO_x, TSP and nickel.

These improvements are scheduled to be carried out in next coming years.

4.3.8 NFR 2.C.7c Other Metal Production

Source Category Description

Emissions: NE

Gold, silver production occur in Turkey, but not enough accurate information on the volume of the industry, nor on the production processes has been available for the work.

Planned improvements

To carry out emission estimation for this source information needs to be collected on the process and abatement techniques used at Turkish plants, as well as on emission measurements to enable calculation of specific emissions for each plant.

Production of precious metals is a likely source of PCB emissions. Emission factors exist in emission inventories for other countries.

These improvements are scheduled to be carried out in the next coming years.

4.3.9 NFR 2.C.7d Storage, handling and transport of metal products

Source Category Description

Emissions: NE

Storage, handling and transport of metal products is a source of particle emissions. At the moment, these emissions are not estimated.

Planned improvements

Particle emissions from Storage, handling and transport of metal products can be estimated using production data of metals and emission factors available from website http://www.air.sk/tno/cepmeip/ (TNO. 2002. The Co-ordinated European Programme on Particulate Matter Emission Inventories. Projections and Guidance (CEPMEIP).

Various metal ore production data was available in world mineral production reports. Reportsweredownloaded http://www.bgs.ac.uk/mineralsuk/statistics/worldarchieve.html website. Due to limited time before official reporting information in the reports could not be used.

These improvements are scheduled to be carried out in coming years.

4.4 NFR 2.D Solvent Use

4.4.1 NFR 2.D.3a Domestic Solvent Use including fungicides

Source Category Description

Emissions: NMVOC

Key Source: Yes (NMVOC)

Emission Trends

NMVOC emissions from NFR 2.D.3a Domestic solvent use is 68.1 ktonnes in 1990 and 94.5 ktonnes in 2015, which is an increase of about 39%. From 2014 to 2015 the NMVOC emission increased by 1%.

Emissions from domestic solvent use in Turkey 1990-2015 are presented in Figure 4-28 and Table 4-33 below.

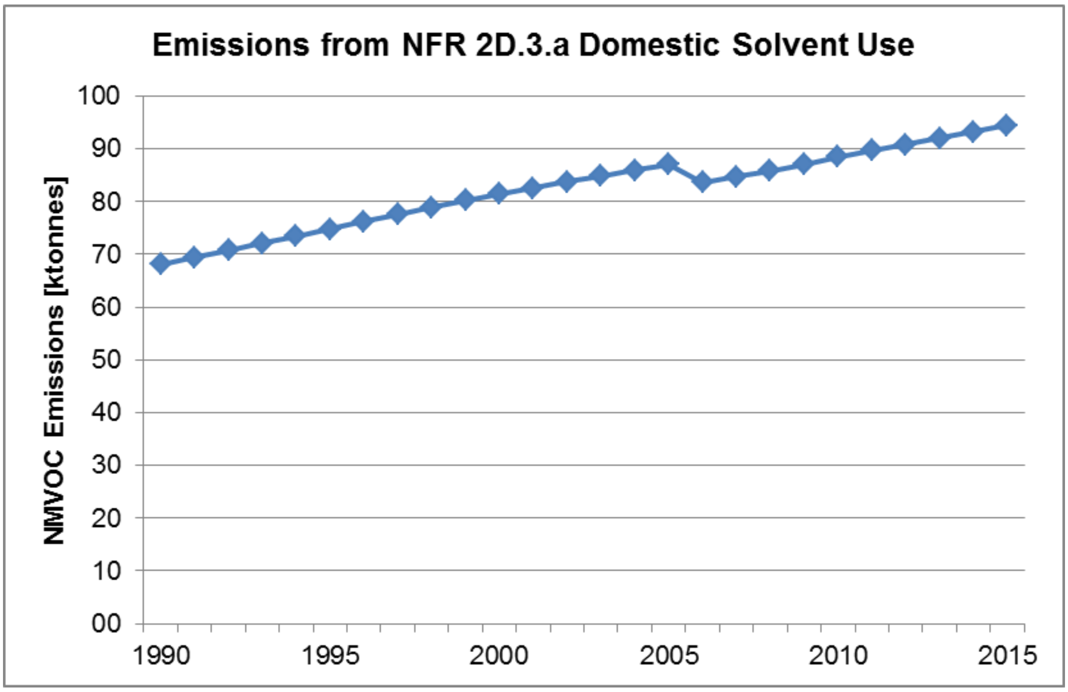


Figure 4.28:NMVOC emission from NFR 2.D.3.a Domestic Solvent Use

Table 4.33:NMVOC emission from NFR 2.D.3.a Domestic Solvent Use

	Emission	Population
	ktonnes	**1000 people**
1990	68.1	56714
1991	69.4	57835
1992	70.8	58959
1993	72.1	60079
1994	73.4	61204
1995	74.8	62338
1996	76.2	63485
1997	77.6	64642
1998	78.9	65787
1999	80.3	66889

2000	81.5	67896
2001	82.6	68838
2002	83.7	69770
2003	84.8	70692
2004	85.9	71610
2005	87.0	72520
2006	83.6	69689
2007	84.7	70586
2008	85.8	71517
2009	87.1	72561
2010	88.5	73723
2011	89.7	74724
2012	90.8	75627
2013	92.0	76668
2014	93.2	77696
2015	94.5	78741
Trend 1990-2015	37%	
Trend 2014-2015	1%	

Source of Activity Data

Population used as activity data in the calculations. 31 December data was downloaded from EUROSTAT website.

Methodological Issues

The TIER 1 approach for emissions from domestic products uses the general equation:
Emission pollutant = ∑ AD * EF

Where:

Emission pollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

i = NMVOC,

AD = population (million people)

EF = emission factor of pollutant i for domestic product use (kg/person)

Source of Emission factors

Emission factors used in the calculation are presented in Table 4-34

Table 4.34:Emission factors for NFR 2.D.3a

NFR	Category	EF	Unit	Reference
2.D.3a	Domestic Solvent Use	1.2	kg NMVOC/person	EMEP/EEA Guidebook(2016) Chapter 2.D.3.a Solvent use paragraph 3.2.4

Uncertainty

No uncertainty estimation was carried out for emissions from this sector. However, uncertainty can be assumed high in those estimates where the calculation is carried out using population as activity data.

Recalculations

No recalculations have been done for this inventory.

Planned Improvements

There is no plan for improvement.

4.4.2 NFR 2.D.3b Road Paving with Asphalt

Source Category Description

Emissions: NE

Emissions from road paving with asphalt are not included in the inventory at the moment.

Road paving with asphalt is a source of NMVOC, TSP, PM_{10}, $PM_{2.5}$ and PCDD/F emissions. Emission factors exist for NMVOC, TSP, PM_{10}, $PM_{2.5}$ in the GB.

There is any information on asphalt roofing volumes.

Planned improvements

It is planned to include emission estimates for at least NMVOC, TSP, PM_{10}, $PM_{2.5}$ from road paving with asphalt in Turkey after information on asphalt production volumes in Turkey have been collected. The methodology to be used for estimating these emissions is available in GB.

4.4.3 NFR 2.D.3c Asphalt roofing

Source Category Description

Emissions: NE

Emissions from asphalt roofing are not included in the inventory at the moment.
Asphalt roofing is a source of CO, NMVOC and TSP emissions. Emission factors for these pollutants are available in the GB.

Asphalt roofing occurs in Turkey and is mainly carried out in mobile plants which work less than one year and do not need a permit.

There is not any information on asphalt roofing volumes.

Planned improvements

It is planned to include emission estimates for NMVOC and TSP from asphalt roofing after information on production volumes of shingles are collected. Emission factors are available in the GB.

4.4.4 NFR 2.D.3d Coating Applications

Source Category Description

Emissions: NMVOC

Key Source: Yes (NMVOC)

Emission Sources

NMVOC emissions were estimated from total paint consumption data.

Emission Trend

Based on the results of the inventory, between 1990-2015 NMVOC emissions from the above mentioned sources increased by about 39%.

Emission trend is illustrated in Figure 4-29. The increase is due to increases in the activity levels.

Due to methodology used in the estimation of emissions from total paint consumption therefore the trend has large uncertainty.

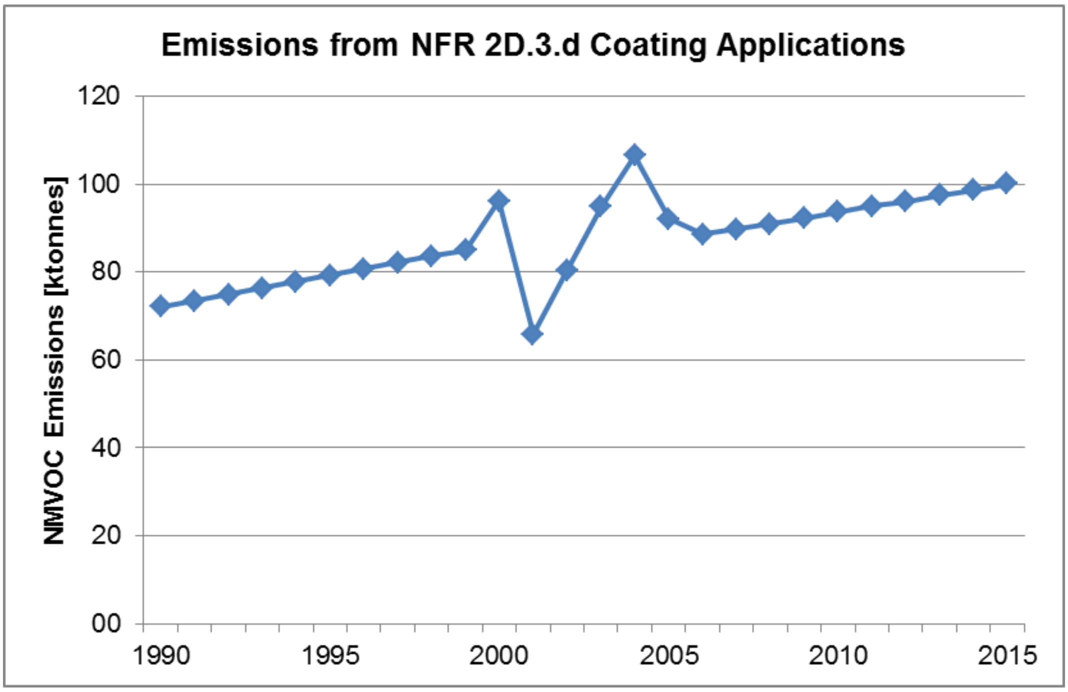


Figure 4.29: Emissions from NFR 2D.3.d Coating Applications for the period 1990 to 2015

Emissions and activity data from decorative coating application are presented in Table 4.35

Table 4.35: NMVOC Emissions (ktonnes) from NFR 2.D.3d Coating Applications for the period 1990 to 2015

	Emissions [ktonnes]	Total paint consumption [ktonnes]
1990	72.04	288
1991	73.46	294
1992	74.89	300
1993	76.31	305
1994	77.74	311
1995	79.18	317
1996	80.64	323

1997	82.11	328
1998	83.56	334
1999	84.97	340
2000	96.20	385
2001	65.88	264
2002	80.19	321
2003	94.79	379
2004	106.50	426
2005	92.12	368
2006	88.52	354
2007	89.66	359
2008	90.84	363
2009	92.17	369
2010	93.65	375
2011	94.92	380
2012	96.06	384
2013	97.39	390
2014	98.69	395
2015	100.00	400
Trend 1990 – 2015	39%	
Trend 2014 - 2015	1%	

Source of Activity Data

Activity data for 2000-2004 was taken from National Development Report. Due to lack of data other years proportioned to the population.

Methodological Issues

The TIER 1 approach for emissions from decorative coating uses the general equation:

Emissionpollutant = ∑ AD * EF

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

i = NMVOC,

AD = population (million people)

EF = emission factor of pollutant i for decorative coating (kg/person)

Source of Emission Factors

Total paint consumption data for the country was available, emissions from NFR 3A paint application were calculated in 3A.1 Decorative coating application with average emission factor 3A.2 Industrial Coating and 3A.3 Other Coating

The emission factors and average emission factor used in the calculation are presented in Table 4.36.

Table 4.36: Emission factors for NFR 3A Paint Application

NFR	Activity	EF	EF unit	Reference
3A1	Decorative Coating	150	g/kg paint	EMEP/EEA Guidebook 2016 Chapter 2D.3d Table 3.1, 3.2,3.3 page 17
3A2	Industrial Coating	400	g/kg paint	
3A3	Other Coating	200	g/kg paint	
Average Emission Factor		250	g/kg paint	

Uncertainty

No uncertainty estimation was carried out for emissions from this sector.

However, uncertainty can be assumed high in those estimates where the calculation is carried out using total paint consumption as activity data and proportioned according to population.

Recalculations

No recalculation has been done for this part of the inventory.

Planned Improvements

Data gaps will be tried to fill, paint consumption data for 3A.1, 3A.2 and 3A.3 should be found for more reliable results. These improvements are likely to be carried out during coming years.

4.4.6 NFR 2.D.3.e Degreasing & NFR 2.D.3.f Dry Cleaning

Source Category Description

Emissions: *NMVOC*

Key Source: *Yes (NMVOC)*

NMVOC emissions were estimated from NFR 3B1 Degreasing and NFR 3B2 Dry cleaning.

Emission Trend

NMVOC emissions from NFR 2.D.3.e Degreasing amount in 28.4 ktonnes in 1990 and 39.4 ktonnes in 2015, which is an increase of about 39%. From 2014 to 2015 the NMVOC emission increased by 1%.

NMVOC emissions from NFR 2.D.3.f Dry cleaning amount in 5.7 ktonnes in 1990 and 7.9 ktonnes in 2015, which is an increase of about 39%. From 2014 to 2015 the NMVOC emission increased by 1%.

Due to methodology used in the estimation of emissions from car respraying the trend is directly following the growth of population which is used as activity data and therefore the trend has large uncertainty.

Emissions from degreasing and dry cleaning activities in Turkey 1990-2015 are presented in Figure 4-30 and Table 4-37 below.

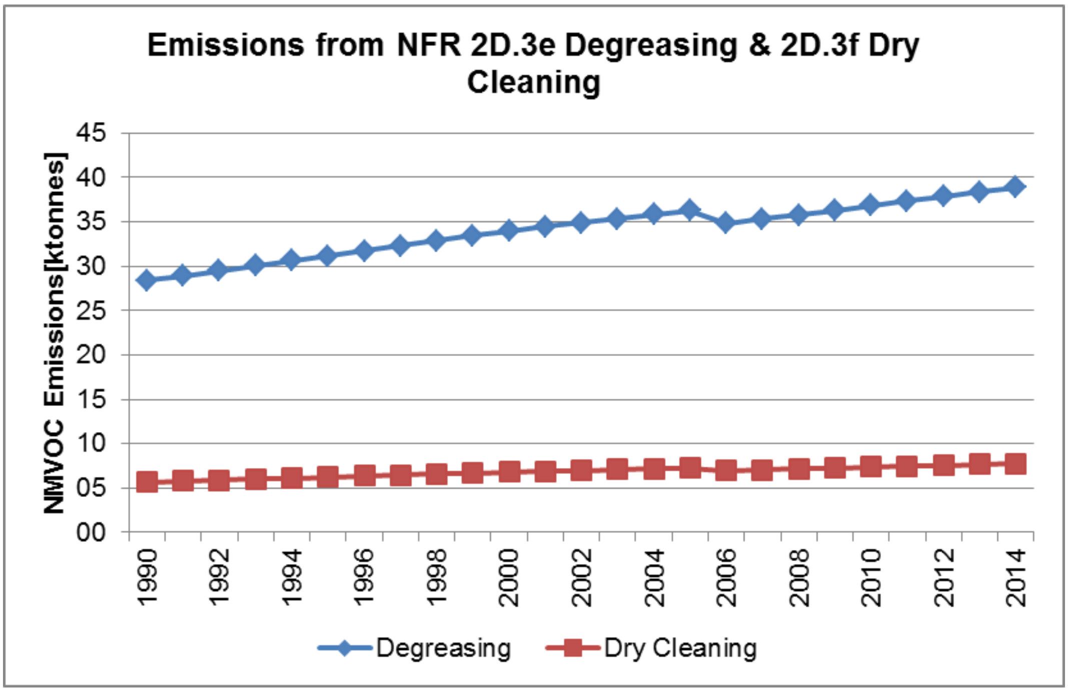


Figure 4.30: Emissions from NFR 2D.3.e and NFR 2D.3f for the period 1990 to 2015

Table 4.37: NMVOC emission from NFR 2.D.3.e Degreasing and NFR 2.D.3.f Dry Cleaning

NFR	2.D.3.e	2.D.3.f
	Degreasing	**Dry cleaning**
	ktonnes	**ktonnes**
1990	28.4	5.7
1991	28.9	5.8
1992	29.5	5.9
1993	30.0	6.0
1994	30.6	6.1
1995	31.2	6.2
1996	31.7	6.3
1997	32.3	6.5
1998	32.9	6.6
1999	33.4	6.7
2000	33.9	6.8
2001	34.4	6.9
2002	34.9	7.0
2003	35.3	7.1
2004	35.8	7.2
2005	36.3	7.3
2006	34.8	7.0
2007	35.3	7.1
2008	35.8	7.2
2009	36.3	7.3
2010	36.9	7.4
2011	37.4	7.5
2012	37.8	7.6
2013	38.3	7.7
2014	38.8	7.8
2015	39.4	7.9
Trend 1990-2015	39%	39%
Trend 2014-2015	1%	1%

Source of Activity Data

Population used as activity data in the calculations.

Methodological Issues

The TIER 1 approach for emissions from degrassing and dry cleaning uses the general equation:

Emission pollutant = ∑ AD * EF

Where:

Emission pollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

i = NMVOC,

AD= population (million people)

EF= emission factor of pollutant i for other coating (kg/person)

Source of Emission factors

As no country-specific statistical data for this category was available, a methodology was used where "per capita" EFs were derived from the UK and Ireland emission inventories by dividing the emissions reported under NFR 3A3 by the population of the country were used for estimating NMVOC emissions from car respraying. It is therefore estimated that the emissions may slightly overestimate the Turkish emissions.

Emission factors used in the calculation are presented in Table 4-38.

Table 4.38:Emission factors for NFR 2.D.3e Degreasing and 2.D.3.f Dry Cleaning

NFR	Category	EF	Unit	Reference
2D3e	Degreasing	0.5	kg NMVOC/person	Based on UK and IE emission inventory (from years before influence of Solvents directive)
2D3f	Dry Cleaning	0.1	kg NMVOC/person	

Uncertainty

No uncertainty estimation was carried out for emissions from this sector. However, uncertainty can be assumed high in those estimates where the calculation is carried out using population as activity data.

Recalculations

No recalculation has been done for this part of the inventory.

Planned Improvements

Consistency with data used in the Turkish greenhouse gas inventory will be checked, for instance

Availability of national data will be studied and missing activity data collected. Information sources could be e.g.

- manufacture and use of solvents in Turkey
- import statistics (solvents and products containing solvents)
- volume of solvent waste processed in hazardous waste treatment plants.

These improvements are likely to be carried out during coming years.

4.4.7 NFR 2.D.3.g Chemical Products

Source Category Description

Emissions: NMVOC

Key Source: No

NMVOC emissions from NFR 3.C Chemical products amount in 6.80 ktonnes in 1990 and 14.3 ktonnes in 2015, which is an increase of about 110%. From 2014 to 2015 the NMVOC emission increased by 6 %.

NMVOC emissions under NFR 3C were estimated from textile, tyres, paint, inks&glue and rubber manufacture.

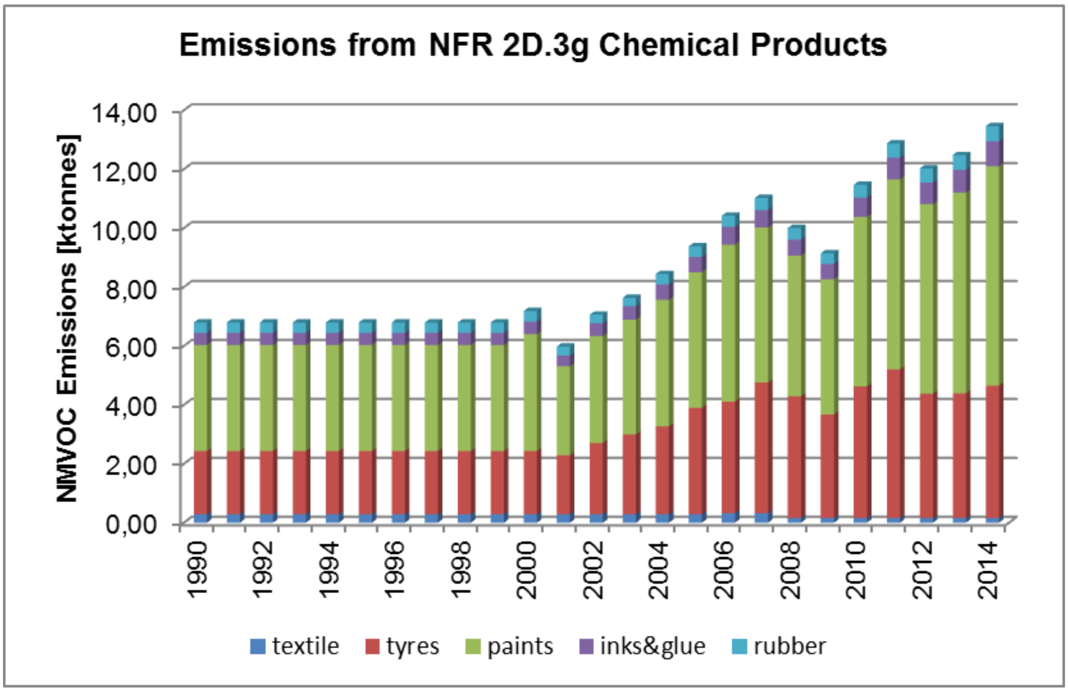


Figure 4.31:NMVOC emission from NFR 2D.3g Chemical products

Table 4.39:NMVOC emission from NFR 2D.3g Chemical products

NFR	2D.3.g
	Chemical products
	ktonnes
1990	6.796
1991	6.796
1992	6.796
1993	6.796
1994	6.796
1995	6.796
1996	6.796
1997	6.796
1998	6.796
1999	6.796
2000	7.184
2001	5.977

2002	7.061
2003	7.634
2004	8.443
2005	9.382
2006	10.420
2007	11.022
2008	10.000
2009	9.146
2010	11.468
2011	12.872
2012	12.025
2013	12.477
2014	13.461
2015	14.303
Trend 1990-2015	110%
Trend 2014-2015	6%

4.4.7.1 Textile Industry

Textile industries producing cotton and woven fabrics as well as machined carpets were included in the inventory.

Based on results from the inventory, between 1990-2015 NMVOC emissions from textile industry decreased by about 44%.

Source of Activity Data

Production data 2005-2008 were available for the following parts of the textile industry from the TURKSTAT website www.tuik.gov.tr. Due to lack of data 1990-2004 data assumed same as 2005 and 2009-2015 data assumed same as 2008 data.

- Cotton fabric production (metres)
- Machined Carpet production (metres^2)
- Woven fabric production (metres).

To perform the calculations data were converted into mass equivalents using the assumptions presented below:

Table 4-.40:Conversion of textile product volumes (m and m2) into mass units (g)

Assumptions			
Cotton fabric	Assume 1m is	0.01	g
Machined Carpet	Assume 1m2 is	500	g
Woven fabric	Assume 1m is	0.1	g

Methodological Issues

The TIER 1 approach for process emissions from textile productions uses the general equation:

Emission pollutant = ∑ AD * EF

Where:

Emission pollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

i = NMVOC

AD = the activity rate for the textile production (ktonnes)

EF = emission factor of pollutant i for textile production (kg/tonne textile)

Source of Emission Factors

The EMEP/EEA Emission Inventory Guidebook (2016) emission factor 10 kg/tonne of textile was used in the calculation.

Uncertainty

No uncertainty estimation was carried out for emissions from this sector.

Recalculations

No recalculations have been done for this part of the inventory.

Planned Improvements

Availability of national data will be studied and missing activity data collected.

Consistency with data used in the Turkish greenhouse gas inventory will be checked, availability of other emission factors applicable to Turkish data will be studied

These improvements are likely to be carried out during the next coming years.

4.4.7.2 Tyre Manufacturing

NMVOC emissions from manufacturing of tyres are included in the inventory calculations.

Based on results from the inventory, between 1990-2015 NMVOC emissions from tyre manufacturing increased by about 122%.

The sharp changes in emissions are due to the use of different statistics for the time series 1990-2015. The reason for the use of different statistics is the availability of data in a single source. The statistics will be checked and emissions corrected where relevant, to the next submission.

Source of Activity Data

Numbers and mass of tyres produced in country were available in National Development Reports for 2000-2005. Due to lack of data 2000 data was assumed same for 1990-1999, 2006-2015 data was extrapolated according to Eurostat production index (Manufacture of rubber tyres and tubes)

Methodological Issues

The TIER 2 approach for process emissions from tyre production uses the general equation:

Emissionpollutant = ∑ AD * EF

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

i = NMVOC

AD = the activity rate for the tyre production (ktonnes)

EF = emission factor of pollutant i for tyre production (kg/tonne tyre)

Source of Emission Factors

The EMEP/EEA Emission Inventory Guidebook (2013) emission factor 10 kg/tonne of tyres was used in the calculation.

Uncertainty

No uncertainty estimation was carried out for emissions from this sector.

Recalculations

No recalculation has been done for this part of the inventory

Planned Improvements

Missing activity data will be searched.

4.4.7.3 Paints Manufacturing

NMVOC emissions from manufacturing of paints manufacturing are included in the inventory calculations this year.

Based on results from the inventory, between 1990-2015 NMVOC emissions from tyre manufacturing increased by about 121%.

Source of Activity Data

Production data of decorative paints,wood protection,wood paints,otomotive paints,metal paints and other paints was available in National Development Report for 1999-2005. Due to lack of data 1999 data was assumed same for 1990-1998 data. For 2006-2015 extrapolation was made with EUROSTAT production index (manufacture of paints,varnishes,)

Methodological Issues

The TIER 1 approach for process emissions from paint production uses the general equation:

Emissionpollutant = ∑ AD * EF

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

i = NMVOC

AD = the activity rate for the production (ktonnes)

EF = emission factor of pollutant i for production (kg/tonne product)

Source of Emission Factors

The EMEP/EEA Emission Inventory Guidebook emission factor 10 kg/tonne of product was used in the calculation.

Uncertainty

No uncertainty estimation was carried out for emissions from this sector.

Recalculations

No recalculation has been done for this part of the inventory

Planned Improvements

Missing activity data will be searched.

4.4.7.4 Inks&Glue Manufacturing

NMVOC emissions from manufacturing of inks and glue are included in the inventory calculations this year.

Based on results from the inventory, between 1990-2015 NMVOC emissions from inks and glue manufacturing increased by about 120 %.

Source of Activity Data

Production data of inks and glue was available in National Development Report for 1999-2005. Due to lack of data 1999 data was assumed same for 1990-1998 data. For 2006-2015 extrapolation was made with EUROSTAT production index (manufacture of paints,varnishes,)

Methodological Issues

The TIER 1 approach for process emissions from paint production uses the general equation:

Emissionpollutant = ∑ AD * EF

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

i = NMVOC

AD = the activity rate for the production (ktonnes)

EF = emission factor of pollutant i for production (kg/tonne product)

Source of Emission Factors

The EMEP/EEA Emission Inventory Guidebook (2016) emission factor 10 kg/tonne of product was used in the calculation.

Uncertainty

No uncertainty estimation was carried out for emissions from this sector.

Recalculations

No recalculation has been done for this part of the inventory.

Planned Improvements

Missing activity data will be searched.

4.4.7.5 SBR-CBR Rubber Manufacturing

NMVOC emissions from manufacturing of synthetic rubber are included in the inventory calculations this year.

Based on results from the inventory, between 1990-2015 NMVOC emissions from synthetic rubber manufacturing increased by about 48%.

Source of Activity Data

Production data of SBR-CBR rubber was available in National Development Report for 2000-2004. Due to lack of data 2000 data was assumed same for 1990-1999 data. For 2005-2015 extrapolation was made with EUROSTAT production index (manufacture of rubber and plastic products,)

Methodological Issues

The TIER 2 approach for process emissions from paint production uses the general equation:

Emissionpollutant = ∑ AD * EF

Where:

Emissionpollutant = emissions of pollutant i for the period concerned in the inventory (ktonnes)

i = NMVOC

AD = the activity rate for the production (ktonnes)

EF = emission factor of pollutant i for production (kg/tonne product)

Source of Emission Factors

The EMEP/EEA Emission Inventory Guidebook (2016) emission factor 8 kg/tonne of product was used in the calculation.

Uncertainty

No uncertainty estimation was carried out for emissions from this sector.

Recalculations

No recalculation has been done for this part of the inventory

Planned Improvements

Missing activity data will be searched.

Possibilities to include other industrial activities such as

- rubber processing
- pharmaceutical products
- leather tanning
- textile finishing
- polyester, polyvinylchloride, polyurethane and polystyrene foams manufacturing and processing
- manufacture of glues. adhesives
- manufacture of magnetic tapes, films and photographs
- paints manufacture
- manufacture of inks
- asphalt blowing will be studied in the next coming years.

4.4.8 NFR 2.D.3.h Printing

Source Category Description

Emissions: NE

No emissions were estimated in this inventory. Typical emissions from this source include NMVOCs.

Planned Improvements

Possibilities to collect national data that can be used to estimate emissions in accordance with EMEP/EEA Guidebook for this source will be studied in the next coming years, such as

- use of solvent containing inks, ink types and other products for different printing processes
- information on process and abatement techniques

4.4.9 NFR 2.G Other product use

Source Category Description

Emissions: NE

No emissions were estimated in this inventory. Typical emissions from this source include NMVOCs.

NMVOC emission sources under NFR 3D2 include, for instance:

- glass and mineral wool enduction
- tobacco smoking
- fat and edible oil extraction
- preservation of wood
- underseal treatment and conservation of vehicles
- vehicles dewaxing
- use of pesticides in cultivations and in construction
- preservation of seeds
- use of firework
- tobacco smoking
- car and house fires
- industrial application of glues and adhesives

Planned Improvements

Possibilities to collect national data that can be used to estimate emissions in accordance with EMEP/EEA Guidebook for this source will be studied in the next coming years.

4.5 NFR 2.H Other Production Industry

4.5.1 NFR 2.H.1 Pulp and paper production

Source Category Description

Emissions: NMVOC, PM_{10}, CO, SO_2, NO_X

Key Source: No

Emission Sources

Pulp and paper production involves three major steps: pulping, bleaching and paper production. General processes scheme for pulp and paper production in the EMEP/EEA Guidebok (2013) are illustrated in Figure 4.32

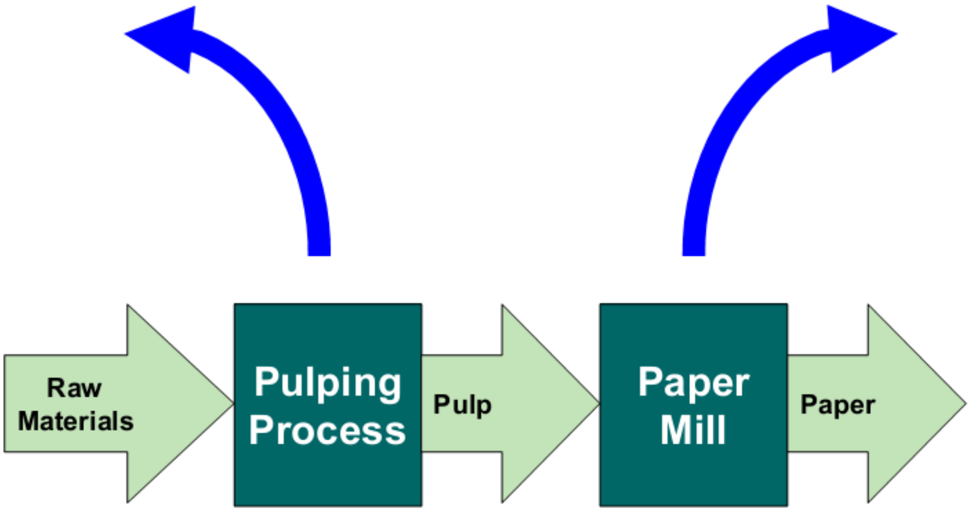


Figure 4.32: General process scheme for pulp and paper production

Pulping has three different chemical processes: kraft pulping, sulphite pulping and neutral sulphite semi-chemical (NSSC) pulping. Kraft pulping uses white liquor, sulphite pulping uses caustic solution, NSSC pulping uses neutral solution under high temperature and pressure to chemically dissolve lignin which is binder of cellulose and wood fibres.

Information about sector in Turkey, production and abatement technologies will be collected next coming years.

Emission Trends

NO_X emissions increased by about 17 % from 0.227 Gg in 1990 to 0.265 Gg in 2015, which is a share of less than 0.1 % in total NO_x emissions in 2015.

SO_2 emissions increased by about 17 % from 0.454 Gg in 1990 to 0.531 Gg in 2015, which is a share of less than 0.1 % in total SO_2 emissions in 2015.

NMVOC emissions increased by about 17 % from 0.454 Gg in 1990 to 0.531 Gg in 2015, which is a share of less than 0.1 % in total NMVOC emissions in 2015.

PM_{10} emissions increased by about 17 % from 0.182 Gg in 1990 to 0.212 Gg in 2015, which is a share of less than 0.1 % in total PM_{10} emissions in 2015.

CO emissions increased by about 8 % from 1.249 Gg in 1990 to 1.460 Gg in 2015, which is a share of less than 0.1 % in total CO emissions in 2015.

Emission estimates prepared in this inventory are based on production volumes of paper board and paper and emission factors taken from the EMEP/EEA Guidebook that are related to production of air dried tonnes of pulp. The emissions are presented in Figure 4.33 and Table 4.41

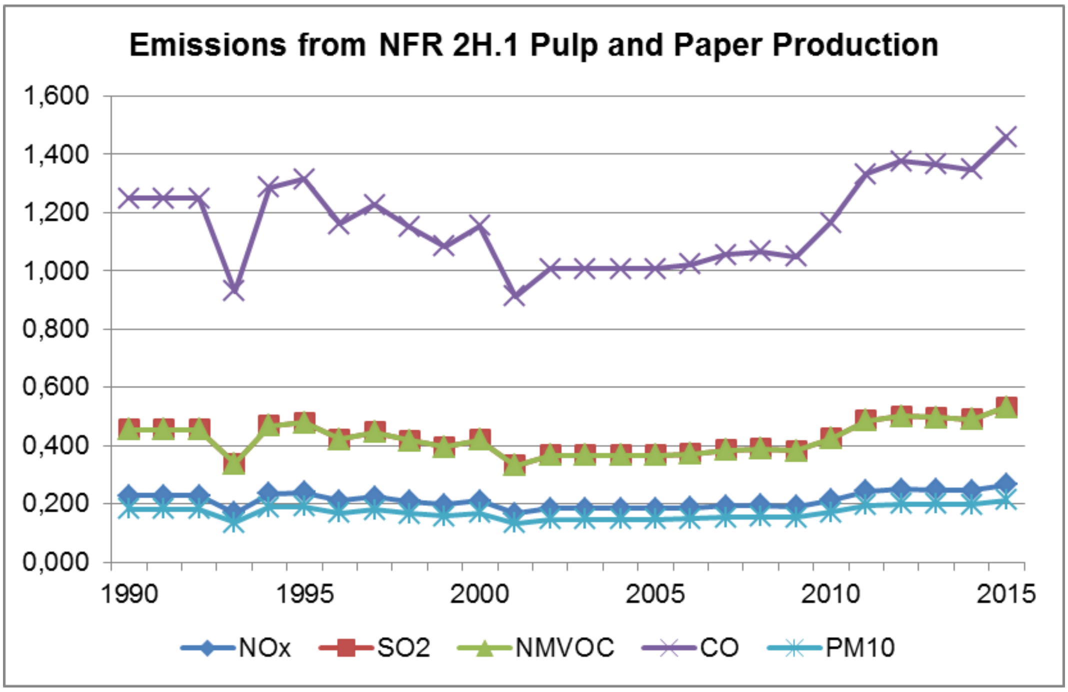


Figure 4.33: Emissions from NFR 2.H.1 Pulp and Paper Production for the period 1990 to 2015

Table 4.41: Emissions from NFR 2.H.1 Pulp and Paper Production

	NO_X	SO_2	NMVOC	CO	PM_{10}	Chem. Woodpulp
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1990	0.227	0.454	0.454	1.249	0.182	227
1991	0.227	0.454	0.454	1.249	0.182	227
1992	0.227	0.454	0.454	1.249	0.182	227

1993	0.169	0.338	0.338	0.930	0.135	169
1994	0.234	0.468	0.468	1.287	0.187	234
1995	0.239	0.478	0.478	1.315	0.191	239
1996	0.211	0.422	0.422	1.161	0.169	211
1997	0.223	0.446	0.446	1.227	0.178	223
1998	0.209	0.418	0.418	1.150	0.167	209
1999	0.197	0.394	0.394	1.084	0.158	197
2000	0.210	0.420	0.420	1.155	0.168	210
2001	0.166	0.332	0.332	0.913	0.133	166
2002	0.183	0.366	0.366	1.007	0.146	183
2003	0.183	0.366	0.366	1.007	0.146	183
2004	0.183	0.366	0.366	1.007	0.146	183
2005	0.183	0.366	0.366	1.007	0.146	183
2006	0.186	0.372	0.372	1.022	0.149	186
2007	0.192	0.383	0.383	1.054	0.153	192
2008	0.194	0.388	0.388	1.066	0.155	194
2009	0.191	0.381	0.381	1.048	0.152	191
2010	0.212	0.424	0.424	1.166	0.170	212
2011	0.242	0.485	0.485	1.332	0.194	242
2012	0.250	0.501	0.501	1.377	0.200	250
2013	0.248	0.496	0.496	1.365	0.199	248
2014	0.245	0.490	0.490	1.348	0.196	245
2015	0.265	0.531	0.531	1.460	0.212	265
Trend 1990 - 2015	17%					
Trend 2014 - 2015	8%					

Source of Activity Data

Production data was downloaded from Eurostat for 1992-2005 as chemical wood-pulp. Due to lack of data 1992 was used for 1990-1992 and extrapolation was made for 2005-2015 according to Eurostat Turkey production index (manufacture of pulp,paper and paperboard)

Methodological Issues

The TIER 1 approach for process emissions from pulp and paper productions uses the general equation:

Emission pollutant = ∑ AD * EF

Where:

Emission pollutant =emissions of pollutant i for the period concerned in the inventory (ktonnes)

i = NMVOC,PM_{10},SO_2,CO,NO_x

AD = the activity rate for the air dried pulp (ktonnes)

EF = emission factor of pollutant i for pulp and paper production (kg/ktonnes)

Source of Emission Factors

Emissions were estimated using emission factors from the EMEP/EEA Emission Inventory Guidebook, 2016 which are actually for production of air dried tonnes of pulp and production volumes of paper board and paper presented in Table 4.42

Table 4.42: Emission factors (EMEP/EEA Guidebook)

NO_x	SO_2	NMVOC	CO	PM_{10}
kg/tonne	kg/tonne	kg/tonne	kg/tonne	kg/tonne
1	2	2	5.5	0.8

Uncertainty

No uncertainty assessment was performed for the inventory.

Recalculations

No recalculation has been done for this part of the inventory.

Planned Improvements

It is recommended to collect plant level data on production processes, production volumes and emission measurements, to improve the present estimates.

Possibilities to collect plant specific data for this source will be studied in the next coming years.

4.5.2 NFR 2.H.2 Food and beverages industry

Source Category Description

Emissions: NMVOC

Key Source: Yes (NMVOC)

This subsector includes NMVOC emissions from food and drink manufacturing, except emissions from vegetable oil extraction. Emissions from food manufacturing include all processes in the food production chain which occur after the slaughtering of animals and the harvesting of crops. Emissions from drink manufacturing include the production of alcoholic beverages, especially wine, beer and spirits.

Food Consumption:

Turkey has traditional eating habits that remain stable in the majority of the population. However, the Turkish food sector is becoming more elaborated as retailers require higher standards from food manufacturers, and investments accompanied by improvements in the sector take place. Through the widespread presence of modern markets and rising disposable incomes, consumption patterns have been shifting to packaged and processed foods, such as ready-to-eat meals and frozen foods. Additionally, the increases in the number of females in full-time employment have supported the trend towards packaged, frozen and ready food. Therefore, considering that Turkey still has the lowest per capita consumption of packaged food in Europe, there is considerable potential in the sub-sectors.

Globally, Turkey is one of the largest markets for baked goods, since such goods have a significant share in the diets of the Turkish population. With rising incomes, packaged bread consumption presents an increase and at the same time, demand for different bread varieties, such as high-fiber and specialty artisan breads offer an opportunity for this higher profit market compared with traditional baked products.

Beverage Consumption:

The beverage sector in Turkey can be analyzed in terms of hot beverages, soft beverages and alcoholic beverages.

Hot Beverages:

Turkey ranks 7th in the tea cultivation area within the world and 5th in dry tea production and 4th in annual per capita tea consumption. Among other hot drinks, Turkish coffee is widely consumed in Turkey although the global coffee chains.

Soft Beverages:

According to the Federation of Food and Drink Industry Associations of Turkey, bottled water ranks in first place with regards to the production capacities in the Turkish beverage industry, accounting for around 50 percent of the total beverage industry production capacity of 13,236 million liters.

Alcoholic Beverages:

The top four alcoholic beverages produced in Turkey are beer, raki, wine and vodka. Beer is the main alcoholic drink, constituting 90 percent of total alcoholic drinks production in 2009. Raki, the Turkish traditional alcoholic drink constitutes 4.4 percent of the total production together with wine. In addition to the large wine producers, there are almost 300 small-sized producers located in Central Anatolia, Marmara Thrace and the Aegean region. Total capacity of the wine sector is approximately 120 million liters per annum. (Deloitte Turkish Food & Beverage Industry Report, July 2010)

In the inventory, production data were available from national development reports.

Food data as Biscuits, Sugar- crystal, Sugar- cube, Margarine are available for (1999-2008) bread, meat big, meat small,fish and poultry production are available for 1994-2004, other years are proportioned to population. It is assumed that production is equivalent to consumption.

Drink data as beer, wine and raki are available for (1999-2008) whiskey, vodka, vermouts, likors are available for 1994-2004, other years are proportioned to population. It is assumed that production is equivalent to consumption.

Emission Trends

NMVOC emissions increased by about 39 % from 68.1 ktonnes in 1990 to 94.5 ktonnes which is a share of 11 % in total NMVOC emissions in 2015.

Emission trend is illustrated in Figure 4.34.

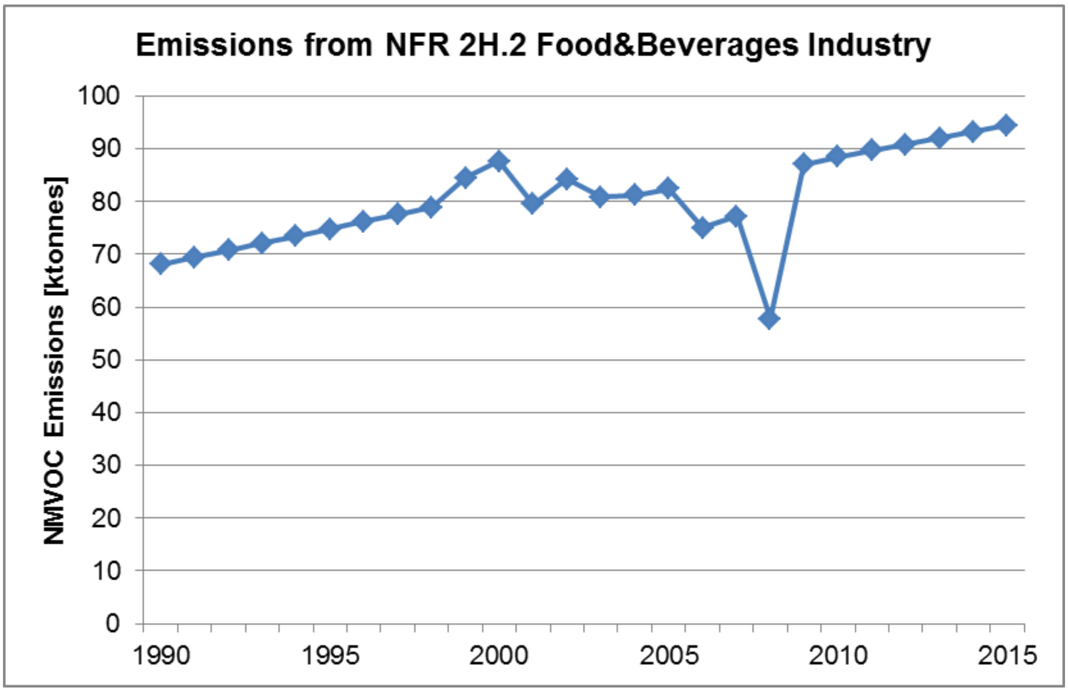


Figure 4.34: Emissions from NFR 2.H.2 for the period 1990 to 2015

Emissions from food and drink production are presented in Table 4.35.

Table 4.43: Emissions from sector 2.H.2 Food and Beverages Industry

	NMVOC
	ktonnes
1990	68.1
1991	69.4
1992	70.8
1993	72.1
1994	73.5
1995	74.8
1996	76.2
1997	77.6
1998	79.0
1999	84.5
2000	87.7
2001	79.5
2002	84.3

2003	80.9
2004	81.2
2005	82.5
2006	75.0
2007	77.2
2008	57.7
2009	87.1
2010	88.5
2011	89.7
2012	90.8
2013	92.0
2014	93.3
2015	94.5
Trend 1990 - 2015	39%
Trend 2014 - 2015	1%

Source of Activity Data

Activity data are given in tonnes and litres of food and drink produced per year in National Development Report. It is assumed that production is equivalent to consumption.

Methodological Issues

The applied methodology is TIER 1 and uses the general equation:

Emission_pollutant = ∑ ADproduction * EFpollutant

Where:

Emission_pollutant=emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD production= the activity rate for the every kind of food and drink production (ktonnes)

EF pollutant = emission factor of pollutant i (kg/tonnes biscuits etc.)

Source of Emission Factors

Emission factors for NMVOC have been taken from the EMEP/EEA Emission Inventory Guidebook. Emission factors in the guidebook and used factors in the calculations are presented in Table 4.43 and 4.44

Table 4.44: Emission factors (EF) in the EMEP/EEA Guidebook

	Unit	EF	Reference
NMVOC	kg/Mg product produced	0.3 – 150	Emission factors from the EMEP/EEA Guidebook(2016) Chapter 2H.2 Food&Beverages Table 3.27(beer)pg19, Table3.24(wine)pg18,Table3.28(sprits) pg18,Table3.29(Whisky)pg20,Table3.32(otherspirits)pg21,Table3.18(biscuits9 pg16,Table3.19(MeatFishPolutry)pg16, Table3.20(Sugar)pg16,Table 3.21(Margarine)pg17,Table3.14 (Bread)pg14,tier 2

Table 4.45: Emission factor (EF) used sector 2.H.2 Food and Beverages Industry

Product type	Unit of EF	EF
Biscuits	kg/tonne	1
Sugar- crystal	kg/tonne	10
Sugar- cube	kg/tonne	10
Margarine	kg/tonne	10
Bread	kg/tonne	4.5
Meat, fish & poultry	kg/tonne	0.3
Beer	kg/h litre beer	0.035
Wine	kg/h litre wine	0.08
Raki	kg/h litre of alcohol	15
Whiskey	kg/h litre of alcohol	15
Vodka	kg/h litre of alcohol	15
Vermouth	kg/h litre of alcohol	0.4
Coffee roasting	kg/tonne of beans	0.55
Animal feed	kg/tonne	1

Uncertainty

No uncertainty assessment was performed for the inventory.

Recalculations

No recalculation has been done for this part of the inventory.

Planned Improvements

Activity data for years which proportioned to population will be tried to find.

4.5.3 NFR 2.H.3 Other industrial processes

Source Category Description

Emissions: NE

This subsector involves particle emissions from processing of wood: manufacturing of polywood, reconstituted wood products and engineered wood products.

Wood processing is a source of particle emissions. At the moment, these emissions are not estimated.

Planned improvements

Particle emissions from wood processing can be estimated using production data and emission factors.

These improvements are scheduled to be carried out in coming years.

5 CHAPTER 5: AGRICULTURE (NFR SECTOR 3)

This chapter includes information on the methodologies used for the estimation of emissions in the following NFR subsectors:

3.B. Manure management
3.D Crop Production and Agricultural Soils

Emissions from sub-sector 3.F Field burning of agricultural wastes and Agriculture other including use of pesticides have not been estimated in the Turkish inventory (NE). Because there is no available data.

5.1 NFR 3.B Manure Management

Emissions: NH_3, *NmVOC*

Key Source: Yes (NH3)

Source Category Description

This source category includes ammonia emissions from the animal housings, the storage of manure and the manure application to fields. SO2 and NOX emissions from manure management are reported as NA. Following a recommendation of the stage 3 in-depth review under the UNECE LRTAP Convention 2012 (para 122) the notation key for NMVOC (3.B) has been changed from NA "not applicable" to calculated one and noted.

Ammonia emissions from excreta deposited by grazing animals are also calculated within sector 3.B

Emission Trends

Firstly, it should be emphasized that dairy cattle and other cattle numbers for 90-2015 time series are recalculated according to the meetings with TURKSTAT .NH3 emissions increased by 24% from 314 Gg in 1990 to 388 Gg in 2015 which is a share of 40,2% in total NH3 emissions of Turkey in 2015. From 2014 to 2015 NH3 emissions increased by 1%, mainly due to an increase in chicken numbers. NMVOC emissions increased by 23,3% from 163 Gg in 1990 to 201 Gg in 2015. From 2014 to 2015 NMVOC emissions increased by 1%, mainly due to an increase in Manure Management part, and also fertilizer application for 90-2015 time series nearly same 20 ktonnes because of cropped area nearly same taken in all time series, so is recalculation .

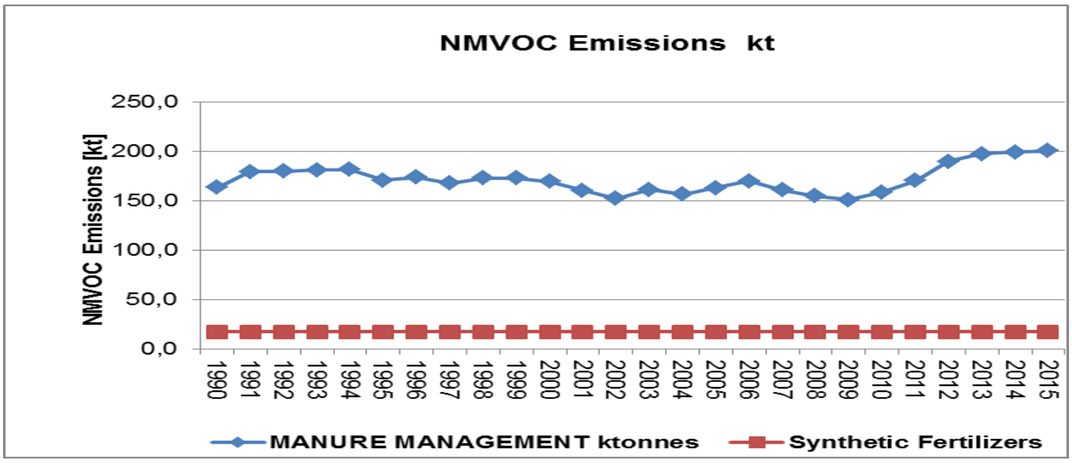


Figure 5.1. Emissions from NFR 3B-3D for the period 1990 to 2015

Table 5.1. NMVOC emissions by Manure Management-Agricultural Soil 1990-2015

	Total	Total
	ktonnes NMVOC Manure Management	ktonnes NMVOC Agricultural Soil
1990	163,268046	20
1991	179,432111	20
1992	179,952098	20
1993	181,325099	20
1994	181,405837	20
1995	170,62443	20
1996	174,013767	20
1997	167,597112	20
1998	172,836702	20
1999	172,924868	20
2000	169,726157	20
2001	160,593841	20
2002	152,355454	20
2003	161,399502	20

2004	156,416276	20
2005	162,874851	20
2006	169,893742	20
2007	161,034335	20
2008	154,857578	20
2009	151,143181	20
2010	158,914448	20
2011	170,508337	20
2012	189,933187	20
2013	197,535678	20
2014	199,392837	20
2015	200,457184	20
Trend 1990 - 2015	23,3%	0%
Trend 2014- 2015	1%	0%

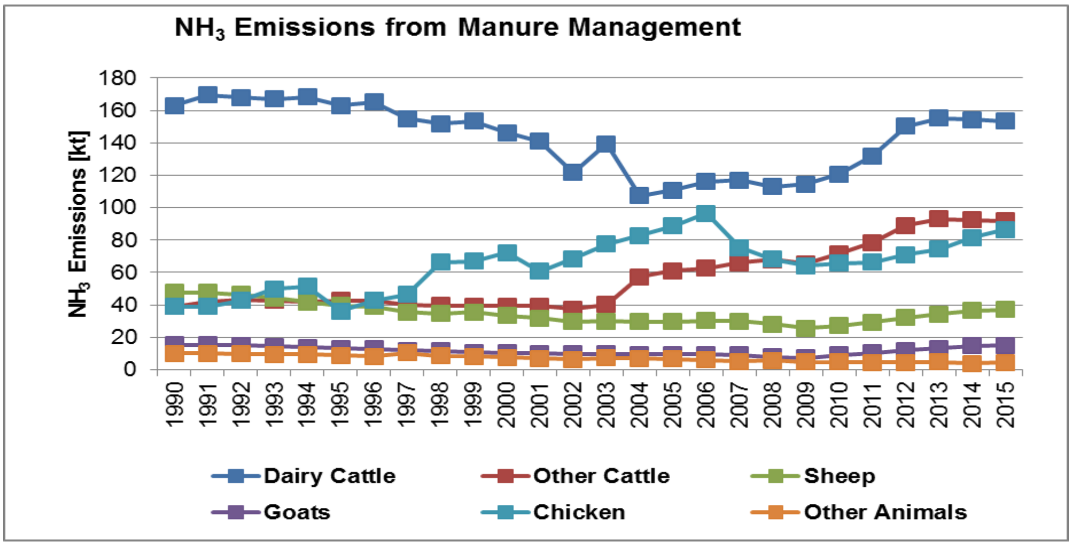


Figure 5.2 Emissions from NFR 3.B for the period 1990 to 2015

Table 5.2. Ammonia emissions by sub-categories1990-2015(I)

	Dairy Cows	Other Cattle	Buffalo	Fattening pigs	Breeding Sows	Laying hens	Broilers
	ktonnes NH3	ktonnes NH3	ktonnes NH3	ktonnes NH3	ktonnes NH3	ktonnes NH3	ktonnes NH3
1990	163	36	3	0	0	17	22
1991	169	39	3	0	0	17	22
1992	168	40	3	0	0	19	24
1993	167	40	3	0	0	22	28
1994	168	39	3	0	0	23	28
1995	163	40	2	0	0	16	20
1996	165	41	2	0	0	19	24
1997	155	38	2	0	0	21	26
1998	152	38	2	0	0	30	37
1999	153	38	1	0	0	30	37
2000	146	38	1	0	0	32	40
2001	141	38	1	0	0	27	34
2002	122	36	1	0	0	31	38
2003	140	39	1	0	0	35	43
2004	107	56	1	0	0	37	46
2005	111	60	1	0	0	40	49
2006	116	62	1	0	0	43	53
2007	117	65	1	0	0	34	42
2008	113	67	1	0	0	30	38
2009	114	64	1	0	0	29	36
2010	121	71	1	0	0	29	36
2011	132	78	1	0	0	30	37
2012	150	88	1	0	0	32	39

2013	155	92	1	0	0	33	41
2014	154	91	1	0	0	35	46
2015	153	91	1	0	0	37	49
Trend 1990 – 2015	-6%	153%	-63%	0%	0%	115%	129%
Trend 2014- 2015	-1%	0%	0%	0%	0%	5%	7%

Table 5.3. Ammonia emissions by sub-categories1990-2015 (II)

	Turkeys	Ducks & Geese- other poultry	Sheep	Goats	Horses	Camels – other animals
	ktonnes NH3	**ktonnes NH3**	**ktonnes NH3**	**ktonnes NH3**	**ktonnes NH3**	**ktonnes NH3**
1990	3	NO	48	15	6	0
1991	3	NO	48	15	6	0
1992	4	NO	46	15	6	0
1993	4	NO	44	15	6	0
1994	4	NO	42	14	6	0
1995	4	NO	40	13	5	0
1996	3	NO	39	13	5	0
1997	6	NO	36	12	4	0
1998	4	NO	35	12	4	0
1999	4	NO	36	11	4	0
2000	4	NO	33	10	3	0
2001	4	NO	32	10	3	0
2002	3	NO	30	10	3	0
2003	4	NO	30	10	3	0

2004	4	NO	30	9	3	0
2005	4	NO	30	9	3	0
2006	4	NO	30	10	2	0
2007	3	NO	30	9	2	0
2008	4	NO	28	8	2	0
2009	3	NO	26	7	2	0
2010	3	NO	27	9	2	0
2011	3	NO	29	10	2	0
2012	3	NO	32	12	2	0
2013	3	NO	34	13	1	0
2014	3	NO	37	15	1	0
2015	3	NO	37	15	1	0
Trend 1990 - 2015	0%	NO	30%	0%	-83%	0%
Trend 2014-2015	0%	NO	0%	0%	0%	0%

In the report for the stage 3 in-depth review under the UNECE LRTAP Convention 2012, Turkey was recommended to estimate NH_3 emissions from ducks and geese (para. 124). Following Table 6.7 these animals are only held on pastures and no emissions are occurring in sector 3.B (NO). Emissions from solid manure of ducks and geese (see also Table 6.8) are included in NFR sector 3.D.2.c "N-excretion on pasture range and paddock".

Activity Data

Official annual livestock data from the TURKSTAT was used. In converting the livestock numbers into the required categories the following assumptions were made.

- Dairy cattle and other cattle numbers are obtained from TURKSTAT and 90-2015 times series are recalculated.
- Horses, donkeys and mules are summed to give a single figure.
- Ducks and geese are assumed as other poultry part.
- Camels are accountes as other animals

- Fattening pigs ("market swine") are assumed to account for 90% of the total swine numbers in line with IPCC (2006) Table 10.19. Swine make only a minor contribution to total emissions in Turkey.

Table 5.4. Domestic livestock population and its trend 1990-2015 (I)

	Dairy	Other Cattle	Buffalo	Market Swine	Breeding Swine
	Head	head	head	head	head
1990	5.892.550	5.484.507	366.150	9.284	1.032
1991	6.118.997	5.853.926	366.150	9.284	1.032
1992	6.070.175	5.880.732	352.410	10.620	1.180
1993	6.031.954	5.878.046	316.000	8.100	900
1994	6.082.178	5.818.822	305.000	7.200	800
1995	5.885.586	5.903.414	255.000	4.500	500
1996	5.968.210	5.917.790	235.000	4.500	500
1997	5.594.294	5.595.643	194.000	4.140	460
1998	5.489.043	5.541.957	176.000	4.500	500
1999	5.537.892	5.516.108	165.000	3.060	340
2000	5.279.569	5.481.431	146.000	2.700	300
2001	5.085.814	5.462.186	138.000	2.430	270
2002	4.392.568	5.410.930	121.077	3.236	360
2003	5.040.362	4.747.740	113.356	6.381	709
2004	3.875.721	6.193.625	103.900	3.959	440
2005	3.998.097	6.528.343	104.965	1.741	193
2006	4.187.931	6.683.433	100.516	1.226	136
2007	4.229.440	6.807.313	84.705	1.632	181
2008	4.080.243	6.779.699	86.297	1.545	172
2009	4.133.148	6.590.810	87.207	1.706	190
2010	4.361.841	7.007.959	84.726	1.402	156

2011	4.761.142	7.625.195	97.632	1.663	185
2012	5.431.400	8.483.512	107.435	2.687	299
2013	5.607.272	8.807.985	117.591	2.831	315
2014	5.609.240	8.613.869	122.114	2.390	266
2015	5.535.774	8.458.297	133.766	1.478	164
Trend 1990 – 2015	-6,1%	54,2%	-63%	-84%	-84%
Trend 2014 - 2015	-1,3%	-1,8%	9,5%	-38%	-38,3%

Table 5.5. Domestic livestock population and its trend 1990-2015 (II)

	Poultry-Chickens (Layers)	Poultry-Chickens (Broilers)	Turkeys	Poultry-Ducks&Geese
	Head	**head**	**head**	**head**
1990	45.938.047	93.268.157	3.132.676	2.711.846
1991	45.938.047	93.268.157	3.132.676	2.711.846
1992	50.334.917	102.195.135	3.332.794	2.907.238
1993	58.825.794	119.434.188	3.340.241	2.859.557
1994	60.615.820	123.068.483	3.441.995	2.906.724
1995	42.574.761	86.439.666	3.291.000	2.945.088
1996	50.475.800	102.481.170	3.063.540	2.735.775
1997	54.869.920	111.402.565	5.327.501	3.623.402
1998	78.209.225	158.788.426	3.805.345	3.110.795
1999	79.116.819	160.631.118	3.762.516	2.965.740
2000	85.195.546	172.972.774	3.681.558	2.600.780
2001	71.799.813	145.775.379	3.254.018	2.311.308
2002	81.106.187	164.670.136	3.092.408	2.232.227
2003	91.585.757	185.946.839	3.994.093	2.147.685

2004	97.969.102	198.906.965	3.902.346	2.021.070
2005	104.774.048	212.723.066	3.697.103	1.722.990
2006	113.790.549	231.029.296	3.226.941	1.355.331
2007	88.891.619	180.476.923	2.675.407	1.504.540
2008	80.612.524	163.667.852	3.230.318	1.533.045
2009	75.889.903	154.079.500	2.755.349	1.357.454
2010	77.523.067	157.395.318	2.942.170	1.112.406
2011	78.498.245	159.375.224	2.563.330	1.061.739
2012	83.724.819	169.986.754	2.760.859	1.032.909
2013	88.720.709	177.432.745	2.925.473	1.123.107
2014	93.751.470	199.976.150	2.990.305	1.311.810
2015	98.597.340	213.658.294	2.827.731	1.249.081
Trend 1990 – 2015	114,6%	129,1%	-9,7%	-53,9%
Trend 2014 – 2015	5,2%	6,8%	-5,4%	-4,8%

Table 5.6 Domestic livestock population and its trend 1990-2015 (III)

	Sheep	Goats	Horses	Camels
	Head	**head**	**head**	**head**
1990	40.432.340	10.764.198	1.631.144	1.914
1991	40.432.340	10.764.198	1.631.144	1.914
1992	39.415.938	10.453.940	1.558.575	1.900
1993	37.541.000	10.133.000	1.463.000	2.000
1994	35.646.000	9.564.000	1.415.000	2.000
1995	33.791.000	9.111.000	1.315.000	2.000
1996	33.072.000	8.951.000	1.234.000	2.000

1997	30.238.000	8.376.000	1.127.000	1.400
1998	29.435.000	8.057.000	1.066.000	1.400
1999	30.256.000	7.333.000	989.000	1.350
2000	28.492.000	7.201.000	859.000	1.000
2001	26.972.000	7.022.000	830.000	930
2002	25.173.706	6.780.094	761.130	887
2003	25.431.539	6.771.675	716.951	808
2004	25.201.155	6.609.937	664.020	865
2005	25.304.325	6.517.464	630.863	811
2006	25.616.912	6.643.294	608.845	1.004
2007	25.462.293	6.286.358	552.953	1.057
2008	23.974.591	5.593.561	515.623	970
2009	21.749.508	5.128.285	452.483	1.041
2010	23.089.691	6.293.233	414.307	1.254
2011	25.031.565	7.277.953	398.975	1.290
2012	27.425.233	8.357.286	377.416	1.315
2013	29.284.247	9.225.548	363.393	1.374
2014	31.140.244	10.344.936	131.480	1.442
2015	31.507.934	10.416.166	320.385	1.543
Trend 1990 – 2015	-22,1%	-3,2%	-80,36%	-19,38%
Trend 2014- 2015	1,2%	0,69%	143,68%	7%

N excretion values

N excretion rates were taken from the IPCC 2006 Guidance. The amount of N excretion rate for dairy cattle is calculated by assuming that animals in Turkey are the average of "Western Europe" and "Asian" animals. Other dairy cattle of N-excretion rate is calculated by assuming that animals in Turkey is Asian animals. This year for dairy cattle N-excretion rate is calculated according to the weigths of dairy cattle along to 90-2015 time series taken form TURKSTAT as average for dairy cattle and for other cattle Nexcretion rates for 90-2015 time series are calculated as asian values.

Table 5.7. N excretion values for all livestock categories

Livestock	Nitrogen excretion
	[kg/animal*year]
Dairy cows	*
Other cattle	**
Buffalo	44.38
Fattening pigs	6.80
Breeding sows	16.40
Layering hens	7.98
Broilers	0.55
Turkeys	0.36
Ducks & Geese	1.84
Sheep	0.82
Goats	13.50
Horses	16.49
Camels	37.87

Years	(*) N Excretion Factors for dairy cattle	(**) N Excretion Factors for other cattle
1990	60,74	22,39
1991	61,82	22,63
1992	62,46	23,16
1993	63,33	23,32
1994	63,82	23,22
1995	65,43	23,49
1996	65,87	23,56
1997	66,24	23,47
1998	66,54	23,41

1999	66,93	23,49
2000	67,44	23,76
2001	67,83	23,92
2002	68,68	23,07
2003	69,13	28,38
2004	69,46	31,24
2005	70,06	31,47
2006	71,65	31,66
2007	73,06	32,88
2008	74,79	33,85
2009	75,58	33,52
2010	76,45	34,59
2011	77,46	34,84
2012	78,28	35,62
2013	78,81	35,81
2014	79,93	36,37
2015	80,49	36,72

Animal Waste Management System (AWMS) Distribution

Differences in agricultural practices such as housing and manure management, and differences in climate have significant impacts on emissions.

Manure management system usage data of dairy, sheep, goats, horses, camel and poultry is based on expert opinion of the Ministry of Food, Agriculture and Livestock. Data for buffalo and swine was obtained from IPCC (2006), Tables 10A-5 to 10A-8.

Table 5.8. Manure management system usage: buildings and pastures

Livestock	Building	Pasture
	[%]	[%]
Dairy cows	70	30

Other cattle	60	40
Buffalo	60	40
Fattening pigs	100	0
Breeding sows	100	0
Laying hens	100	0
Broilers	100	0
Turkeys	100	0
Ducks & Geese	0	100
Sheep	20	80
Goats	20	80
Horses	20	80
Camels	20	80

Data on AWMS distribution in the buildings is country specific, based on expert judgement and information of the Ministry of Food, Agriculture and Livestock

Table 5.9 Animal waste management system distribution in the buildings

Livestock	Slurry	Solid
	[%]	[%]
Dairy cows	50	50
Other cattle	50	50
Buffalo	0	100
Fattening pigs	50	50
Breeding sows	50	50
Laying hens	0	100
Broilers	0	100
Turkeys	0	100
Ducks & Geese	0	100
Sheep	0	100
Goats	0	100
Horses	0	100
Camels	0	100

Ammonia emission factors and TAN proportions

NH_3 emission factors for different manure storage systems and proportions of TAN in the manure excreted are default values taken from the latest Tier 2 technology-specific approach presented in the EMEP/EEA Guidebook 2009.

Table 5.10 NH3-N emission factors, TAN proportions and proportion stored

Livestock	System	TAN	Prop. stored	Housing	Storage	Spreading	Grazing
	Manure type	[%]	[%]	kg NH3-N / kg TAN	kg NH3-N / kg TAN	kg NH3-N / kg TAN	kg NH3-N / kg TAN
Dairy cows	slurry	60	60	0.20	0.20	0.55	0.10
	solid	60	90	0.19	0.27	0.20	0.10
Other cattle	slurry	60	50	0.20	0.20	0.55	0.06
	solid	60	70	0.19	0.27	0.79	0.06
Buffalo	slurry	50	50	0.20	0.20		
	solid	50	80	0.20	0.17	0.55	0.13
Fattening pigs	slurry	70	50	0.28	0.14	0.40	
	solid	70	80	0.27	0.45	0.81	0.25
Breeding sows	slurry	70	50	0.22	0.14	0.29	
	solid	70	80	0.25	0.45	0.81	0.25
Laying hens	slurry	70	50	-	0.14	0.69	
	solid	70	80	0.41	0.14	0.69	
Broilers	slurry	70	50	-			
	solid	70	80	0.28	0.17	0.66	
Turkeys	slurry	70	50	-			
	solid	70	80	0.35	0.24	0.54	
Ducks & Geese	slurry	70	50	-			
	solid	70	80	0.405	0.2	0.495	0,24
Sheep	slurry	50	50	-			0.10
	solid	50	80	0.22	0.28	0.90	0.10
Goats	slurry	50	50	-			0.10
	solid	50	80	0.22	0.28	0.90	0.10
Horses	slurry	60	50	-			0.10

	solid	60	80	0.22	0.35	0.90	0.10
Camels	slurry	50	50	-			0.10
	solid	50	80	0.20	0.35	0.90	0.10

The fractions of fertilizers which are stored before applicated on agricultural land are based on expert judgement and information of the experts of the Ministry of Food, Agriculture and Livestock

Default emission factors for other losses needed in the mass-flow calculation are obtained from EMEP/EEA (2010), Table 3-8.

Uncertainty

No uncertainty analyses has been carried out for this inventory

Recalculations

3.B.Manure Management

There is recalculation. In fact only 2014 and 2015 is the truly written NMVOC result. The others 90-2013 are rewritten.

Planned Improvements

Applied AWMS data reflect a first estimate which has to be further elaborated. It was planned to improve AWMS distribution data by consultation of relevant national experts for submission 2014. However, the legal procedure is changed. In fact we have achieved 2 meetings as air work group by using Coordination Committee and especially for agriculture Meeting for Committee of Agriculture have been done on 23 November 2015. However, TURKSTAT was missing. So, it has been decided that next meeting to be done in 2016. 13 January 2017 TURKSTAT and Ministry of Food, Agriculture and Livestock and Ministry of Environment and Urbanization came together and how improvements could be achieved decided. The dairy cattle and other cattle 90-2015 series numbers are revised. Sythetic fertilizer exact values 90-2015 is corrected. The cropped area for NMVOC calculation is rounded. N excretion rates for dairy cattle and other cattle 90-2015 is calculated with TURKSTAT technical group together work. However, pesticide calculation part sould not be achieved. Because, the new datas to be collected need to have coordinated long term work. The fraction of as an example aldrin in insecticides is not known. Ministry of Food, Agriculture and Livestock has no work started. In the future the following IIR reporting can have this complementary part, but there is no exact foreseen.

5.2 NFR 3.D Agricultural Soils

Emissions: NH_3, NMVOC

Key Source: Yes (NH3)

Source Category Description

This source category includes emissions from synthetic fertilizer application and excreta deposited on fields by grazing animals. NO_X and SO_X emissions are reported as NA.

NH_3 emissions from manure application on agricultural soils are included in sector 3.B.

Emission Trends

NH_3 emissions from synthetic fertilizer application increased nearly by 25% from 97kt NH_3 in 1990 to 121 kt NH_3 in 2015.Last year in the IIR we mentioned the peak From 2009 to 2014 emissions .However, now it is corrected by the correct values inserted having decision under the meeting January 2017 with TURKSTAT and Ministry of Food, Agriculture and Livestock. NH_3 emissions from pastured livestock decreased by 24% from 58kt NH_3 in 1990 to 44kt NH_3 in 2015.

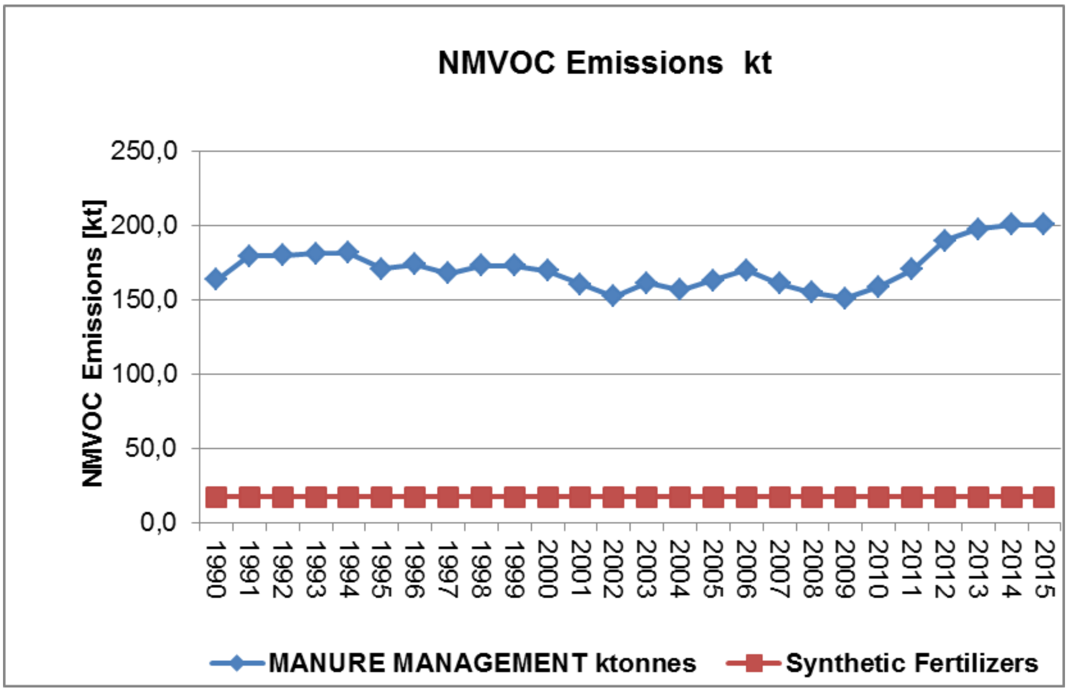


Figure 5.3 NMVOC emissions from 3.B Manure Management and 3.D Agricultural Soils for the period 1990 to 2015

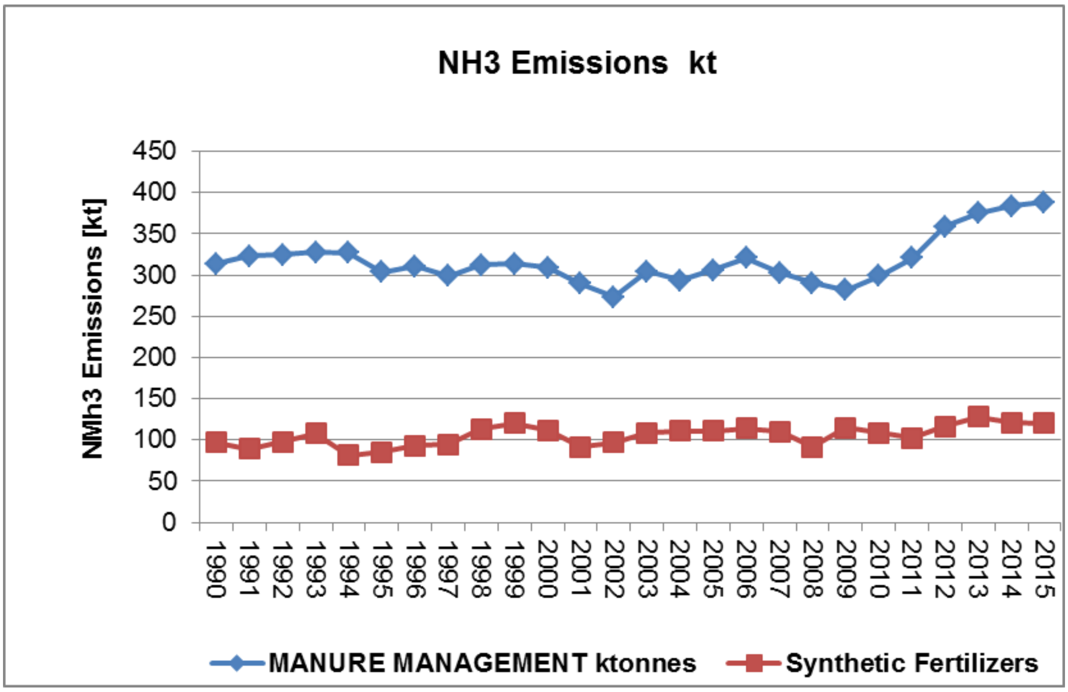


Figure 5.4 NH3 emissions from 3.B Manure Management and 3.D Agricultural Soils for the period 1990 to 2015

5.7. NFR 3.D.1.a Synthetic fertilizers

Activity data

Following a recommendation of the stage 3 in-depth review under the UNECE LRTAP Convention 2012 (para 121) activity data on fertilizer use has been taken from the national statistics (TURKSTAT, eg. fertilizer statistics 2015)

Emission Factors

The Tier 1 default approach presented in the EMEP/EEA Guidebook 2009 and the default NMVOC and NH_3 emission factors have been used (EMEP/EEA 2013 revised, Table 3.xxx).

Planned Improvements

No further improvements are planned.

5.8. NFR 3.D.2.c N-excretion on pasture range and paddock unspecified

Activity Data

Official annual livestock data from the Ministry of Food, Agriculture and Livestock were used (see chapter 3.B).

Emission Factors

NH_3 emissions from grazed animals have been estimated within the calculations of sector 3.B. Default emission factors from the EMEP/EEA Guidebook 2013 revised have been used.

Planned Improvements

Improvements regarding activity data and animal waste management distribution are included in chapter 3.B 'planned improvements'.

5.3 NFR 3.F Field Burning

The open burning of crop residue on arable land after harvesting is legally restricted by law in Turkey. No data on illegal field burning is available.

Planned Improvements

No further improvements are planned.

6 CHAPTER 6 WASTE SECTOR

According to EMEP/EEA Emission Inventory Guidebook 2016, NFR sector 5 includes subsectors as below:

5 Waste

5.A Biological Treatment Of Waste: Solid Waste Disposal On Land

5.B.1 Biological Treatment Of Waste: Composting

5.B.2 Biological Treatment Of Waste: Anaerobic Digestion At Biogas Facilities

5.C.1.a Municipal Waste Incineration

5.C.1.b Industrial Waste Incineration Including Hazardous Waste And Sewage Sludge

5.C.1.b.iii Clinical Waste Incineration

5.C.1.b.v Cremation

5.C.2 Open Burning Of Waste

5.D Wastewater Handling

5.E Other Waste

General description

According to the results of the emission inventory, emissions from waste sector mainly generates from disposal of waste and wastewater handling. In addition to this, NMVOC and NH_3 are the most significant pollutants in this sector. On the other hand, NO_x, SO_2, CO and PM_{10} are the other pollutants emitted from burning of waste in lesser amounts.
For calculating pollutant emissions, emission factors were used from EMEP/EEA Emission Inventory Guidebook 2016.
Even though one industrial waste incineration plant operates for hazardous waste exists in Turkey, emissions from this plant could not be included in this inventory due to the lack of data.

6.1. NFR 5A Solid Waste Disposal On Land

Source Category Description

Emissions: NMVOC, TSP, PM_{10}, $PM_{2.5}$.

Key Source: Yes (NMVOC)

Emission Sources

NMVOC, TSP, PM_{10} and $PM_{2.5}$ emissions were estimated from using amount of solid waste disposal which is reported by TURKSTAT.

Major emissions from waste disposal are emissions of greenhouse gases (EMEP/EEA EMISSION INVENTORY GUIDEBOOK 2016, chapter 5.A Biological treatment of waste-Solid waste disposal on land, page 3).

In Turkey, by the year 2015 there are 81 landfills serving for 1091 municipalities and for 48,9 milllion people according to current information from Waste Management Department of MoEU. Up to 2003, number of landfills was only 15 and has been increased dramatically over the years.

17.807 ktonnes of municipal solid waste have been deposited on controlled landfill sites, and 9.936 ktonnes have been depósted on dumping sites in 2014 (source: TURKSTAT), assumed to be unmanaged.

Emission Trend

NMVOC emissions increased by about 9% from 4.56 ktonnes in 1990 to 43.47 ktonnes in 2015.

Also TSP, PM_{10} and $PM_{2.5}$ emissions were calculated for this sector according to the EMEP/EEA Emission Inventory Guidebook 2016. TSP emissions increased by about 9% from 0.0014 ktonnes in 1990 to 0.0129 ktonnes in 2015. PM_{10} emissions increased by about 9% from 0.001 ktonnes in 1990 to 0.006 ktonnes in 2015. $PM_{2.5}$ emissions increased by about 9% from 0.0001 ktonnes in 1990 to 0.0009 ktonnes in 2015.

The increase of all emissions in this sector was mainly due to an increase in population and arising waste amounts in Turkey and also correspondingly it was due to more secure data in this sector.

Emission trends are illustrated in Figure 6.1.

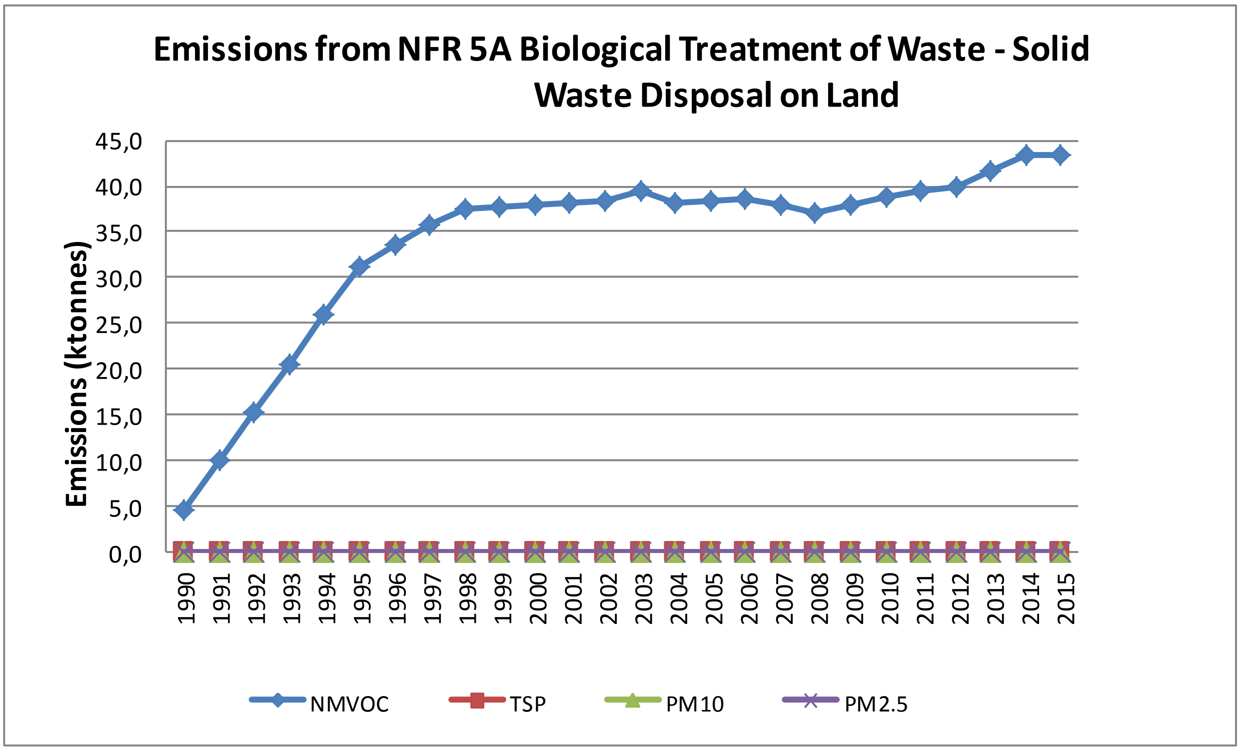


Figure 6.1 Emissions From Nfr 5.A Biological Treatment of WasteSolid Waste Disposal On Land For The Period 1990 To 2015

Emissions from Solid Waste Disposal on Land are presented in Table 6.1.

Table 6.1 Emissions From Sector 5.A Biological Treatment of Waste-Solid Waste Disposal On Land

Years	NMVOC	TSP	PM10	PM2.5
	ktonnes	ktonnes	ktonnes	ktonnes
1990	4.56	0.0014	0.001	0.0001
1991	9.88	0.0029	0.001	0.0002
1992	15.20	0.0045	0.002	0.0003
1993	20.52	0.0061	0.003	0.0004
1994	25.84	0.0077	0.004	0.0005
1995	31.16	0.0092	0.004	0.0007
1996	33.53	0.0100	0.005	0.0007
1997	35.85	0.0106	0.005	0.0008
1998	37.44	0.0111	0.005	0.0008
1999	37.69	0.0112	0.005	0.0008
2000	37.93	0.0113	0.005	0.0008
2001	38.17	0.0113	0.005	0.0008
2002	38.33	0.0114	0.005	0.0008
2003	39.48	0.0117	0.006	0.0008
2004	38.07	0.0113	0.005	0.0008

2005	38.31	0.0114	0.005	0.0008
2006	38.54	0.0114	0.005	0.0008
2007	37.83	0.0112	0.005	0.0008
2008	37.12	0.0110	0.005	0.0008
2009	37.99	0.0113	0.005	0.0008
2010	38.85	0.0115	0.005	0.0008
2011	39.35	0.0117	0.006	0.0008
2012	39.86	0.0118	0.006	0.0008
2013	41.66	0.0124	0.006	0.0009
2014	43.47	0.0129	0.006	0.0009
2015	43.47	0.0129	0.006	0.0009
Trend 1990-2015	9%	9%	9%	9%
Trend 2014-2015	0%	0%	0%	0%

Methodological Issues

The applied methodology for estimation of emissions from solid waste disposal is TIER 1 and uses the general equation:

$$Emission_{NMVOC} = AD * EF_{NMVOC} / 10^6$$

Where:

$Emission_{NMVOC}$ = emissions of NMVOC for the period concerned in the inventory (ktonnes)

AD = municipal waste (ktonnes)

EF_{NMVOC} = emission factor of NMVOC for municipal waste (kg/ Mg)

$$Emission_{TSP} = AD * EF_{TSP} / 10^9$$

Where:

$Emission_{TSP}$ = emissions of TSP for the period concerned in the inventory (ktonnes)

AD = municipal waste (ktonnes)

EF_{TSP} = emission factor of TSP for municipal waste (g/ Mg)

$$Emission_{PM10} = AD * EF_{PM10} / 10^9$$

Where:

$Emission_{PM10}$	=	emissions of PM_{10} for the period concerned in the inventory (ktonnes)
AD	=	municipal waste (ktonnes)
EF_{PM10}	=	emission factor of PM_{10} for municipal waste (g/ Mg)

$$Emission_{PM2.5} = AD * EF_{PM2.5} / 10^9$$

Where:

$Emission_{PM2.5}$	=	emissions of $PM_{2.5}$ for the period concerned in the inventory (ktonnes)
AD	=	municipal waste (ktonnes)
$EF_{PM2.5}$	=	emission factor of $PM_{2.5}$ for municipal waste (g/ Mg)

Source of Activity Data

For calculating NMVOC and PM10 emissions of solid waste disposal is taken municipal solid waste disposal data. The solid waste disposal data is included total amount of "municipality's dumping site" and "waste delivered to controlled landfill site" and "burial" and "other waste". These are taken from database of waste statistics of TURKSTAT.

Source of Emission Factors

The emission factor of NMVOC, TSP, PM_{10} and $PM_{2.5}$ for biological treatment of waste-solid waste disposal on land is taken from the EMEP/EEA Emission Inventory Guidebook 2016 (TIER 1).

Emission factors are presented in Table 6.2.

Table 6.2 Emission factor (EF) used in sector 5.A Biological Treatment of Waste- Solid Waste Disposal On Land

Pollutant	Unit	EF	Reference
NMVOC	kg/Mg	1.56	EMEP/EEA (2016), Chapter 5.A Biological treatment of waste-Solid waste disposal on land, Table 3-1 Tier 1 emission factor for source category 5.A. Biological treatment of waste-Solid waste disposal on land, page 5.
TSP	g/Mg	0.463	
PM_{10}	g/Mg	0.219	
$PM_{2.5}$	g/Mg	0.033	

Uncertainty

There is no information on uncertainties in the sector specific chapter of the EMEP/EEA Emission Inventory Guidebook 2013.

NMVOC and PM_{10} emissions are calculated using solid waste data according to Guidebook is published in 2013. The total amount of "municipality's dumping site" and "waste delivered to controlled landfill site" and "burial" and "other waste" are used for the reporting. For several years data for municipal solid waste disposal was available from TURKSTAT, for the missing years interpolation and extrapolation was used.

Planned Improvements

As the EMEP/EEA Emission Inventory Guidebook 2016, emission of the Sector 5.A Biological treatment of waste-Solid waste disposal on land was calculated as using data of solid waste disposal. For calculating NMVOC and PM10 emissions, database of waste statistic from TURKSTAT is used as activity data. But there are missing years in this waste statistic, so it was necessary to interpolate for this years. If this past data for missing years in statistic is completed, air emission inventory for this chapter can be further improved.

7.2 NFR 5.C.1.a Municipal waste incineration

Source Category Description

Emissions: NO

Key Source: Key source analysis not carried out for this inventory.

Source of Activity Data

According to information of the Waste Management Department of the MoEU, there is no municipal waste incineration in operation in Turkey between 1990 and 2015. For this reason the emissions are reported as not occurring (NO).

Planned Improvements

No improvement planned, as long as no municipal waste incineration plant is operating in Turkey.

6.3. NFR 5.C.1.b Industrial waste incineration

Source Category Description

Emissions: NE

Source of Activity Data

There is one facility in Turkey for incineration of hazardous industrial waste, but the activity data is not available for the whole time period, so it has not been calculated.
Other industrial plants (e.g. cement industry) are also co-incinerating industrial waste for energy purposes and should therefore be covered in the energy balance and accounted for in the energy sector.

Planned Improvements

It will be tried to obtain specific data of the one facility incinerating industrial waste.

6.4. NFR 5.C.1.b.iii Clinical waste incineration

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, TSP, PM_{10}

Key Source: *No*

Emission Sources

The most important pollutants from clinical waste incineration are heavy metals and also HCL, SO_x, NO_x, NMVOC, CO, CO_2, N_2O. Carbon monoxide result when carbon in the waste is not completely oxidized to CO_2. High levels of CO normally indicate that the combustion gases were not held at a sufficiently high temperature in the presence of oxygen (O_2) for a long enough time to convert CO to CO_2, or that quenching has occurred. In addition to this, nitrogen oxides are products of all fuel/air combustion processes. NO is the primary component of NO_x; however, NO_2 and N_2O are also formed in smaller amounts. Nitrogen oxides are formed during combustion through oxidation of in the waste, and oxidation of atmospheric nitrogen. NO_x from hospital waste incineration is typically lower than from other waste incineration processes (EMEP/EEA Emission Inventory Guidebook 2016, Chapter 5.C.1.b.iii Clinical waste incineration, page 5).

Emission Trends

NO_x emissions decreased by about 0,9% from 0.017 ktonnes in 1990 to 0.017 ktonnes in 2015.

SO_2 emissions decreased by about 0,9% from 0.004 ktonnes in 1990 to 0.004 ktonnes in 2015.

NMVOC emissions decreased by about 0,9% from 0.005 ktonnes in 1990 to 0.005 ktonnes in 2015.

CO emissions decreased by about 0,9% from 0.001 ktonnes in 1990 to 0.001 ktonnes in 2015.

TSP emissions decreased by about 0,9% from 0.129 ktonnes in 1990 to 0.128 ktonnes in 2015.

PM_{10} emissions decreased by about 0,9% from 0.103 ktonnes in 1990 to 0.102 ktonnes in 2015.

The decrease of NO_x, SO_2, NMVOC, CO, TSP and PM_{10} emissions in this sector were mainly due to the decrease in the annual amount of incinerated clinical waste in Turkey. Therefore, since all the types of pollutant emissions are calculated by the same method, they have the same trend between the years 1990 to 2015.

Some fluctuations can be observed in the time interval for 1990 to 2015 as seen in Figure 5.2., and this may be directly related to activity data. Especially for PM_{10}, fluctuations are sharper since EFs for the pollutants are bigger and lead to higher emission levels.

Emission trends are illustrated in Figure 6.2.

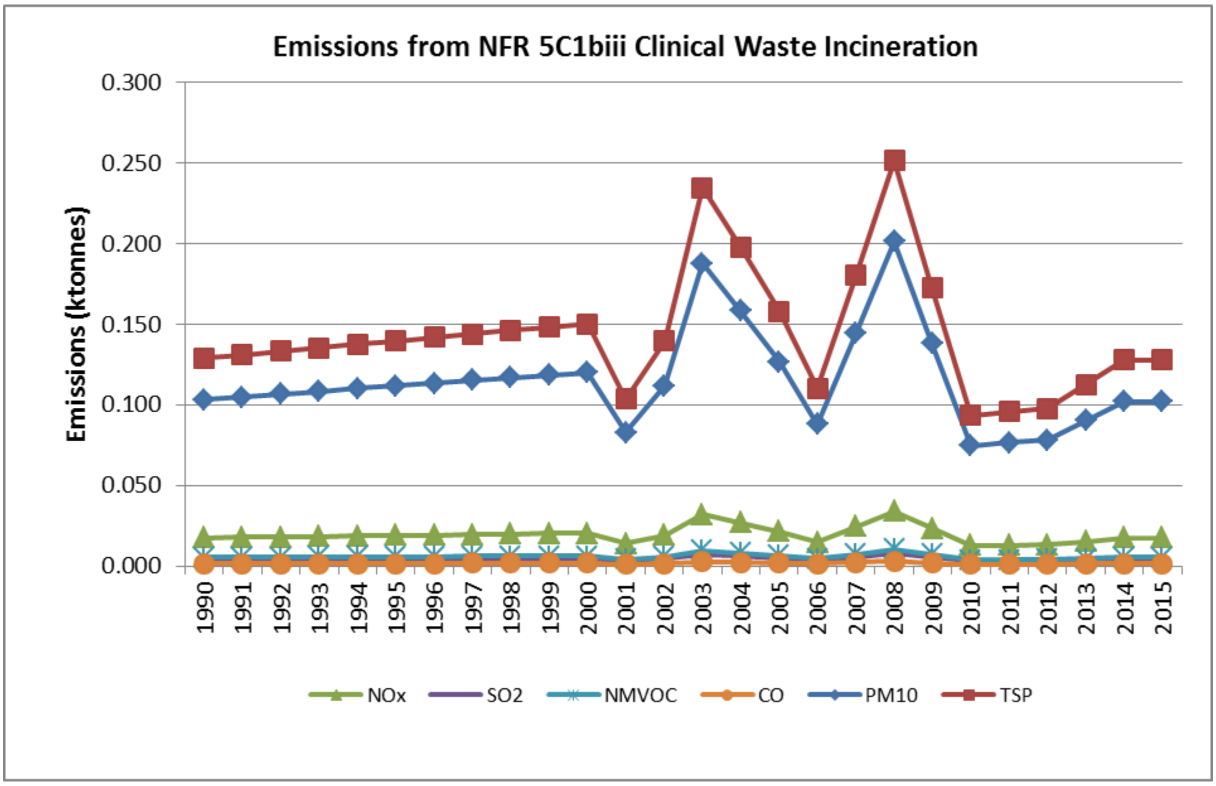


Figure 6.2: Emissions From NFR 5C1biii Clinical Waste Incineration For The Period 1990 to 2015

Emissions from Clinical Waste Incineration are presented in Table 6.3.

Table 6.3: Emissions From Sector 5C1biii Clinical Waste Incineration

Years	NO_x	SO_2	NMVOC	CO	TSP	PM_{10}
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1990	0.017	0.004	0.005	0.001	0.129	0.103
1991	0.018	0.004	0.005	0.001	0.131	0.105
1992	0.018	0.004	0.005	0.001	0.133	0.107
1993	0.018	0.004	0.006	0.002	0.135	0.108
1994	0.019	0.004	0.006	0.002	0.138	0.110
1995	0.019	0.004	0.006	0.002	0.140	0.112
1996	0.019	0.005	0.006	0.002	0.142	0.114
1997	0.019	0.005	0.006	0.002	0.144	0.115
1998	0.020	0.005	0.006	0.002	0.146	0.117
1999	0.020	0.005	0.006	0.002	0.148	0.119
2000	0.020	0.005	0.006	0.002	0.150	0.120
2001	0.014	0.003	0.004	0.001	0.104	0.083
2002	0.019	0.004	0.006	0.002	0.140	0.112
2003	0.032	0.007	0.010	0.003	0.235	0.188
2004	0.027	0.006	0.008	0.002	0.198	0.158

2005	0.021	0.005	0.007	0.002	0.158	0.127
2006	0.015	0.003	0.005	0.001	0.110	0.088
2007	0.024	0.006	0.007	0.002	0.181	0.145
2008	0.034	0.008	0.010	0.003	0.252	0.201
2009	0.023	0.005	0.007	0.002	0.173	0.138
2010	0.013	0.003	0.004	0.001	0.093	0.075
2011	0.013	0.003	0.004	0.001	0.096	0.076
2012	0.013	0.003	0.004	0.001	0.098	0.078
2013	0.015	0.004	0.005	0.001	0.113	0.090
2014	0.017	0.004	0.005	0.001	0.128	0.102
2015	0.017	0.004	0.005	0.001	0.128	0.102
Trend 1990-2015	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%
Trend 2014-2015	0%	0%	0%	0%	0%	0%

Methodological Issues

The applied methodology is TIER 1, which is an approach for process emissions from clinical waste incineration and uses the general equation:

$$Emission_{pollutant} = AD * EF_{pollutant} / 10^3$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD = clinical waste (ktonnes)

$EF_{pollutant}$ = emission factor of pollutant i for clinical waste (kg/Mg)

For calculating pollutant emissions of this sector, annual amount of clinical waste is used as activity data. These are taken from database of waste statistics of TURKSTAT (Waste statistics V.2).

Source of Activity data

The amount of clinical waste incineration was taken from the clinical statistic database of TURKSTAT.

Source of Emission Factors

The emission factors for all pollutants for clinical waste incineration are taken from the EMEP/EEA Emission Inventory Guidebook 2016 (TIER 1).

Table 6.4: Emission Factor (EF) Used In Sector 5C1biii Clinical Waste Incineration

Pollutant	Unit	EF	Reference
NO_x	kg / Mg waste	2.3	EMEP/EEA (2016). Chapter 5.C.1.b.iii Clinical waste incineration. Table 3-1 Tier 1 emission factors for source category 5.C.1.b.iii Clinical waste incineration, page 8
SO_2		0.19	
NMVOC		0.7	
CO		0.54	
PM_{10} *		14*	

*Assumption: PM_{10} = 80 % of TSP

Uncertainty

There is no information on uncertainties in the EMEP/EEA Emission Inventory Guidebook 2016.

Planned Improvements

There are improvements that can be made to the above emission estimates. Some of the activity data is incomplete across the time series.

6.5. NFR 5.C.1bv Cremation

Source Category Description

Emissions: NO

Key Source: No

Source of Activity Data

Cremation does not occur in Turkey, and emissions are therefore reported as NO.

6.6. NFR 5.C.2 Open burning of waste- Small-scale waste burning

Source Category Description

Emissions: NMVOC, CO, PM_{10}, SO_2, TSP, $PM_{2.5}$, NO_x

Key Source: No

Source of Activity Data

Activity data were taken from TURKSTAT, whereby missing years were interpolated.

Source of Emission Factors

Default emission factors (TIER 1) were taken from the EMEP/EEA Emission Inventory Guidebook 2016, Chapter 5.C.2 Open burning of waste for NMVOC, CO; SO_2, NO_X and PM_{10}. Emission factors are constant for the whole time series.

Emission Sources

Emissions from this sector are due to open waste burning, which is reported by TURKSTAT. It is not clearly known which type of waste is included here under.

One of the main concerns regarding agricultural waste combustion is the emission of smoke/particulates. Since the combustion is usually slow and inefficient, CO and VOCs are more significant emissions than NO_x. (EMEP/EEA Emission Inventory Guidebook 2016, Chapter 5.C.2. Open burning of waste, page 6).

One of the main concerns regarding agricultural waste combustion is the emission of smoke/particulates. Since the combustion is usually slow and inefficient, CO and VOCs are more significant emissions than NO_x. (EMEP/EEA Emission Inventory Guidebook 2013, Chapter 5.C.2. Open burning of waste, page 6).

Emission Trends

CO emissions decreased by about 99% from 16.41 ktonnes in 1990 to 0,22 ktonnes in 2015.

NO_x emissions decreased by about 99% from 0.93 ktonnes in 1990 to 0.01 ktonnes in 2015.

SO_2 emissions decreased by about 99% from 0.0323 ktonnes in 1990 to 0.0004 ktonnes in 2015.

NMVOC emissions decreased by about 99% from 0.362 ktonnes in 1990 to 0.005 ktonnes in 2015.

TSP emissions increased by about 99% from 1.36 ktonnes in 1990 to 0.02 ktonnes in 2015

PM_{10} emissions increased by about 99% from 1.33 ktonnes in 1990 to 0.02 ktonnes in 2015.

$PM_{2.5}$ emissions increased by about 99% from 1.23 ktonnes in 1990 to 0.02 ktonnes in 2015.

All emissions were calculated for this sector according to the EMEP/EEA Emission Inventory Guidebook 2016. Since all the types of pollutant emissions are calculated by the same method, they have the same trend between the years 1990 to 2015.

Some fluctuations can be observed in the time interval for 1990 to 2015 as seen in Figure 5.3., and this may be directly related to activity data. Especially for CO, fluctuations are sharper since EFs for the pollutants are bigger and lead to higher emission levels.

Emission trends are illustrated in Figure 6.3 and emissions are presented Table 6.5.

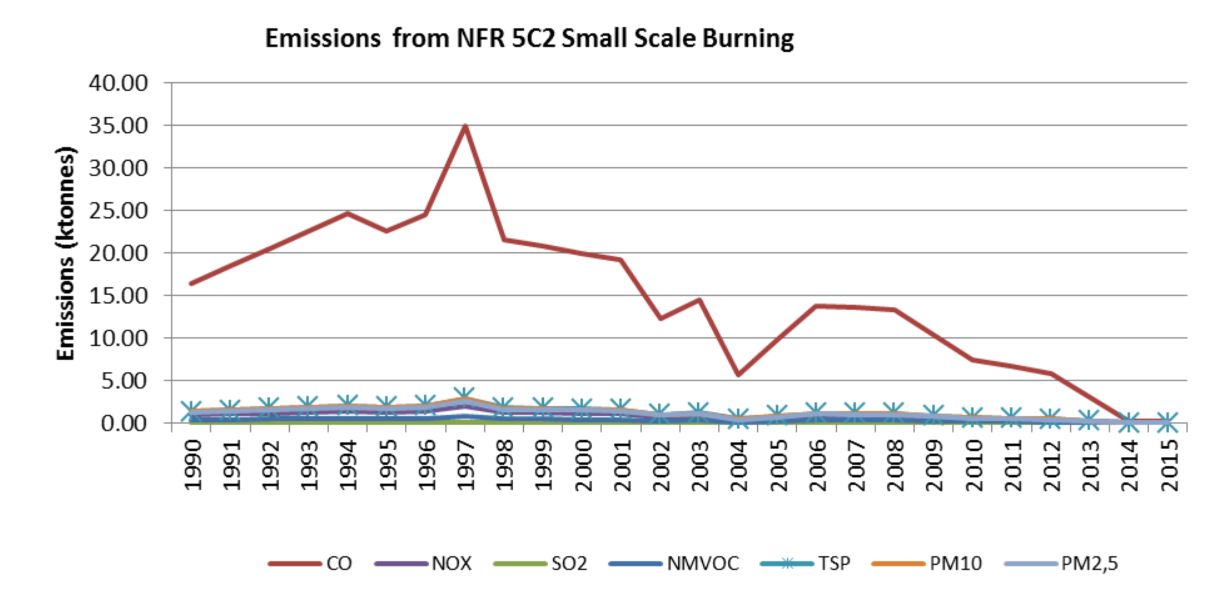


Figure 6.3 Emissions From NFR 5C2 Small-Scale Waste Burning For The Period 1990 To 2015

Emissions from open waste burning are presented in Table 6.5.

Table 6.5 Emissions from sector 5C2 Small-scale waste burning

Years	CO	NO_X	SO_2	NMVOC	TSP	PM_{10}	$PM_{2.5}$
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1990	16.41	0.93	0.0323	0.362	1.36	1.33	1.23
1991	18.48	1.05	0.0364	0.407	1.54	1.49	1.39
1992	20.55	1.17	0.0405	0.453	1.71	1.66	1.54
1993	22.61	1.29	0.0446	0.498	1.88	1.83	1.70
1994	24.68	1.41	0.0486	0.544	2.05	1.99	1.85
1995	22.61	1.29	0.0446	0.498	1.88	1.83	1.70
1996	24.45	1.39	0.0482	0.539	2.03	1.98	1.84
1997	34.89	1.99	0.0688	0.769	2.90	2.82	2.62
1998	21.55	1.23	0.0425	0.475	1.79	1.74	1.62
1999	20.77	1.18	0.0409	0.458	1.73	1.68	1.56
2000	19.99	1.14	0.0394	0.440	1.66	1.61	1.50
2001	19.21	1.09	0.0378	0.423	1.60	1.55	1.44
2002	12.34	0.70	0.0243	0.272	1.03	1.00	0.93
2003	14.46	0.82	0.0285	0.319	1.20	1.17	1.09

2004	5.69	0.32	0.0112	0.125	0.47	0.46	0.43
2005	9.74	0.55	0.0192	0.215	0.81	0.79	0.73
2006	13.79	0.79	0.0272	0.304	1.15	1.11	1.03
2007	13.57	0.77	0.0267	0.299	1.13	1.10	1.02
2008	13.34	0.76	0.0263	0.294	1.11	1.08	1.00
2009	10.41	0.59	0.0205	0.229	0.87	0.84	0.78
2010	7.48	0.43	0.0147	0.165	0.62	0.60	0.56
2011	6.67	0.38	0.0131	0.147	0.55	0.54	0.50
2012	5.86	0.33	0.0116	0.129	0.49	0.47	0.44
2013	3.04	0.17	0.0060	0.067	0.25	0.25	0.23
2014	0.22	0.01	0.0004	0.005	0.02	0.02	0.02
2015	0.22	0.01	0.0004	0.005	0.02	0.02	0.02
Trend 1990-2015	-0.99%	-0.99%	-0.99%	-0.99%	-0.99%	-0.99%	-0.99%
Trend 2014-2015	0%	0%	0%	0%	0%	0%	0%

Methodological Issues

The applied methodology is TIER 1, which is an approach for process emissions from municipal waste incineration and uses the general equation:

$$Emission_{pollutant} = AD * EF_{pollutant} / 10^3$$

Where:

$Emission_{pollutant}$ = emissions of pollutant i for the period concerned in the inventory (ktonnes)

AD = municipal waste (burning in an open area) (ktonnes)

$EF_{pollutant}$ = emission factor of pollutant i for municipal waste (kg/Mg)

For calculating pollutant emissions of this sector, annual amount of open burnt waste is used as activity data. These are taken from database of waste statistics of TURKSTAT (Waste statistics V.2).

Source of Emission Factors

The emission factors for all pollutants for open waste burning are taken from the EMEP/EEA Emission Inventory Guidebook 2016 (TIER 1). Emission factors are presented in Table 6.5.

Table 6.5 Emission factor (EF) used in sector 5.C2. Small-scale waste burning

Pollutant	Unit	EF	Reference
NO_x	kg / Mg waste	3.18	EMEP/EEA (2016). Chapter 5.C.2 Open burning of waste Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning, page 6
NMVOC		1.23	
PM_{10}		4.51	
SO_2		0.11	
CO		55.83	
TSP		4.64	
$PM_{2.5}$		4.19	

Uncertainty

There is no information on uncertainties in the EMEP/EEA Emission Inventory Guidebook 2016.

6.7. NFR 5D Waste water handling

Source Category Description

Emissions: NMVOC, NH_3

Key Source: No

Emission Sources

In urban areas wastewater treatment plants results in the formation of NMVOC emissions. In general, air emissions of NMVOC, CO and NH_3 occur from waste water treatment plants, but are mostly insignificant for national total emissions. (EMEP/EEA Emission Inventory Guidebook 2016, chapter 5D Waste water handling, page 3).

In 2012, there are 57 physical, 244 biological, 70 advanced and 89 natural wastewater treatment plants in Turkey which corresponds to a rate of 78% as population served by sewerage system in total population. (Main Wastewater Indicators of Municipalities, 1994-2014, TURKSTAT)

By the way according to information of the Water And Soil Management Department of the MoEU, there are 595 domestic wastewater treatment plants in Turkey since March 2015.

5.D. Waste Water Handling sector didn't take place at "NFR 14 Reporting Template", therefore emission of 5.D Waste Water Handling is reported as 5.D.1 Sector at "NFR 14 Reporting Template".

Emission Trends

NMVOC emissions increased by 2222% from 0.002 ktonnes in 1990 to 0.052 ktonnes in 2015. The huge increase of NMVOC emissions in this sector was mainly due to the high increase in amount of wastewater treated in Turkey.

NH_3 emissions decreased by 55% between 1990 and 2015, the main reason for this decrease is that the number of people connected to the sewerage system is constantly increasing and population using latrines is decreasing.

Emission trends are illustrated in Figure 6.4 and Table 6.6.

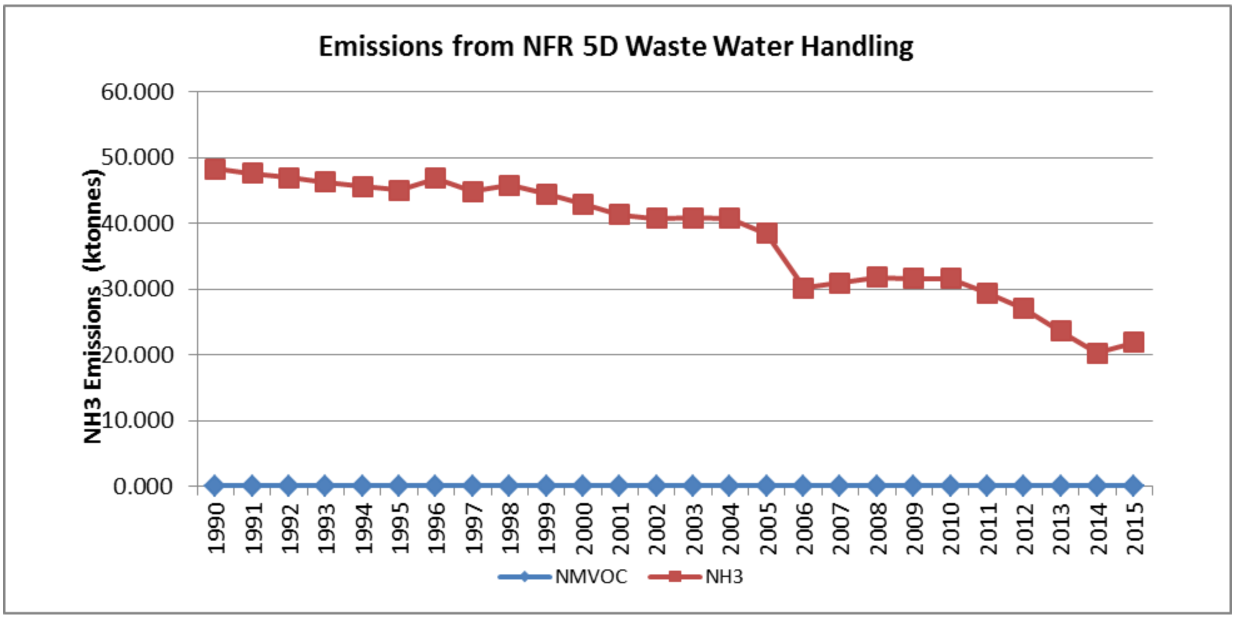


Figure 6.4. Emissions from NFR 5.D Waste Water Handling For The Period 1990 to 2014

Emissions from Waste water Handling are presented in Table 6.6

Table 6.6 Emissions From Sector 5.D Waste Water Handling

Years	NMVOC	NH_3
	ktonnes	ktonnes
1990	0.002	48.216
1991	0.002	47.562
1992	0.002	46.913
1993	0.002	46.259
1994	0.002	45.611
1995	0.003	44.979
1996	0.003	46.782
1997	0.005	44.783
1998	0.009	45.755
1999	0.012	44.402
2000	0.015	42.895
2001	0.018	41.286
2002	0.020	40.684
2003	0.024	40.783
2004	0.029	40.737
2005	0.030	38.427
2006	0.032	30.132
2007	0.033	30.914
2008	0.034	31.750
2009	0.037	31.546
2010	0.041	31.529
2011	0.045	29.341
2012	0.049	26.996
2013	0.051	23.607
2014	0.052	20.199
2015	0.052	21.871
Trend 1990-2015	2222%	-55%
Trend 2014-2015	0%	8%

Methodological Issues

The applied methodology is TIER 2, which is an approach for process emissions from wastewater handling and uses the general equations:

$$\text{Emission}_{NMVOC} = AD * EF_{NMVOC} / 10^9$$

Where:

Emission_{NMVOC} = emissions of NMVOC for the period concerned in the inventory (ktonnes)

AD = wastewater treated (1000 m^3)

EF_{NMVOC} = emission factor of NMVOC for wastewater (mg/m^3)

$$\text{Emission}_{NH3} = AD * EF_{NH3} / 10^6$$

Where:

Emission_{NH3}	=	emissions of NH_3 for the period concerned in the inventory (ktonnes)
AD	=	population not on sewerage system (latrine users) (million people)
EF_{NH3}	=	emission factor of NH_3 for wastewater (kg/person/year)

Source of Activity Data

For calculating NMVOC emissions, the volume (m^3) of wastewater is used as activity data. These are taken from database of waste statistics of TURKSTAT, whereby missing years were interpolated.

For calculating NH_3 emissions, number of people not served by sewerage system is subtracted from total population for Turkey and were used to derive activity data. The total population data were taken from statistics of EUROSTAT but the data of municipal population served by sewerage system was taken from waste statistics of TURKSTAT.

Source of Emission Factors

The emission factor of NMVOC and NH_3 for waste-water handling is taken from the EMEP/EEA Emission Inventory Guidebook 2016 (TIER 2).

Table 6.7 Emission Factor (EF) Used In Sector 5.D Waste Water Handling

Pollutant	Unit	EF	Reference
NMVOC	mg/m^3 wastewater	15	EMEP/EEA (2016), Chapter 5D Waste water handling, Table 3-3 Tier 2 emission factor for NFR source category 5D, Waste water handling, latrines page 7
NH_3	kg/person/year	1.6	EMEP/EEA (2016), Chapter 5D Waste water handling, Table 3-3 Tier 2 emission factor for NFR source category 5D, Waste water handling, latrines page 8

Uncertainty

There is no information on uncertainties in the EMEP/EEA Emission Inventory Guidebook 2016.

6.8. NFR.5E Other Waste

Source Category Description

Emissions: NA

Source of Activity Data

Generally under this category composting of waste is reported, but due to information received from the Waste Management Department of MoEU currently there isn’t any composting plant in Turkey. But further investigations are necessary together with TURKSTAT on this subject.

Planned Improvements

If specific data about other waste can be obtained, contribution of this sector can be calculated and evaluated in the next coming years. Also it should be clarified together with TURKSTAT where the reported data for composting waste is coming from and whether it is reliable or not.

7. OTHER AND NATURAL EMISSIONS

Forest Fires: No emission estimates have been made for this source because no activity data could be sourced. However it may be that information is available, and could be incorporated into the inventory in the future.

NMVOC Emissions from Forests: No emission estimates of NMVOCs from forests have been included in the emission inventory. National estimates may exist and efforts will be tried for inclusion in the inventory in the future.

8. RECALCULATIONS AND IMPROVEMENTS

8.1. Recalculations

Recalculations are carried out for the COPERT output under the road transport category together with the aviation category. Road transport recalculations are covering the years 2000-2015 in the reporting. The rets of the recalculation for road transport will be added to next years' submission.

For energy production facility-based EF study will be finalized and added to the inventory within the next submissions after the finalization of the EMISSION project. Also 1B NFR category will be calculated and added for next years'submission.

Due to structural changes on the energy balance table together with the revisions for the activity data available for the sectors regarding time series recalculations are already included within the submission for 2016. Additionally, petroleum balance will be integrated for future submissions.

Other areas which are prioritized previously will be tried to be integrated in the future submissions by the contributing effect of the EMISSION project and the recalculations will be added.

8.2. Planned improvements

Planned improvements are listed below based on pollutants and NFR sector.

8.2.1. Improving Data Provision and Consistency

The presence of institutional barriers to the exchange of information between Ministries significantly hampers the process of inventory compilation and detracts from its potential accuracy and completeness. The same comments apply to the process of preparing emission projections. Climate Change and Air Management Coordination Board was established in May 2014 to ensure data flow with cooperation of all stakeholders. Additionally referred above in the IIR, Working Group on Air Management was approved on May 2014 and will ensure the cooperation and inventory connections between the modeling, action plans, national programmes and strategies.

Specific measures will be taken to ensure consistency between the Air pollutants and GHG emission inventories in the coordination board.

Together with the EMISSION project data and acitivty flow, the data consistency will be studied and analised every year also by using the specific portal developed for this purpose by the mentioned project.

8.2.2. Major Improvements for Specific Pollutants

NO_x emissions: Obtaining reliable point source data is the highest priority for improving the NO_X emission estimates. The questionnaries ,which were previously, are planned to be used in next submissions. Road transport input data for COPERT will be analysed and studied to compile the time series continuously. The versions of the software will be analysed as well for continuous improvement.

NMVOC emissions: Improvements should focus on developing a more country-specific method for estimating emissions from solvent use, and checking that the generic emission factors used for residential wood combustion are appropriate.

SO_2 emissions: Improving the data sets for (i) the sulphur content of fuels (lignite especially) (ii) the extent to which flue gas desulphurisation plant is installed and (iii) the operational performance of such plant are the highest priority for improving SO_2 emission estimates. Comprehensive and reliable emissions data for large point-sources (electricity generation and other large scale industrial combustion plants) would significantly reduce the uncertainty of SO_2 emission estimates. The data obtained from the facilities to calculate specific EFs will be studied and integrated to the inventory in the next submissions.

NH_3 emissions: The methodology applied to derive these estimates used a combination of country specific data, default data from the literature and expert judgement. There are some important parameters in the methodology, such as N excretion from livestock, where the use of country-specific data would bring a significant improvement.

8.2.3. Improvements for Specific NFR Sectors

Stationary Combustions Sources: A number of improvements that can be made to the emission calculations:

- This source sector makes a large contribution to several pollutants. It is therefore important to use an accurate calculation methodology. Presently a simple Tier 1 method is used primarily with default emission factors from the

GB. This is not sufficiently reliable, and improvements are a high priority (and probably the most important improvement to make in the entire inventory). Region by region the facility based data will be added to the inventory and the stationary combustions properties of national profile will be presented more accurate in the future submissions.

- It is recommended that the current estimates are replaced by point source emissions data. It is discussed with the Ministry of Energy and within the studies under CoBoard, data exchange and data compatibility will be considered for next submissions.
- The fuel data from the energy balance tables only specifies "Petroleum" for liquid fuels. Different liquid fuels have very different properties, and this should be taken into account in the emissions inventory. A considerable improvement will be tried for the Petroleum could be split into the following: Petrol (gasoline), Diesel (Gas Oil), Aviation fuel and Heating or Burning Oil. These issues were analysed together with the Ministry of Energy representatives and next submissions will cover the petroleum split calculations within the energy balance.
- NFR 1B category will be calculated and included for next submissions.

Mobile Machinery: There are several NFR categories where emissions from mobile machinery are reported. However, for this emissions inventory, all are reported as IE. This is because the energy balance tables do not resolve the fuel used in a sector into stationary and mobile, and consequently emissions from all mobile machinery is considered to be included in the corresponding stationary source sector. By the EMISSION project this issue will be studied for more valuable assumptions for Turkey.

Aviation: Updated data from the Ministry of Transport are obtained. For next submissions this data sharing process will be saved.

Road Transport: The rest of the recalculations will be added by the results of COPERT software.

8.3. Preparation of a Continuous Improvement Programme

Continuous Improvement Programme has not been prepared. It is planned to discuss improvement programme in the working group of Air Management under CoBoard.

Within the results of the EMISSION project mentioned in the previous sectors, the continuous improvement stpes of the new network will be planned to be used.

The in depth reviews executed under the TFEIP are very important for Turkey. The findings underlined in the reports of the ERT are our key steps for our contiuous improvement programme to be followed.

Therefore; the points written and underlined with special importance in the Stage-3 report will be taken into account. The list of these findings' explanations is given below:

- ✓ Full source descriptions will be analysed to be integrated for all years respectively.
- ✓ The activity data integration in the reporting of the nfr template will be analysed within the ministry to be decided by the high-level representatives.
- ✓ Fugitive emissions and geothermal category and the others which are present in turkey and noted in the 2nd stage-3 review findings will be analysed respectively.
- ✓ Notation keys will be revised due to the recalculations and re-analysis of the reporting cycle.
- ✓ GHG reporting will be analysed again and the integration of the categories and sub-categories will be revised by cooperation with turkstat.
- ✓ Petroleum split will be integrated in the next submissions.
- ✓ EF selections will be revised due to the outputs gained by the emission project and analysed.
- ✓ The missing pollutants in the NFR template will be studied to be covered.In the short term they will be tried to be calculated with expert assumptions if required.
- ✓ Activity data synchronization will be assessed with TURKSTAT under bilateral cooperation.
- ✓ Higher Tier approach will be analysed and tried to be implemented for available categories under NFR template.
- ✓ IIR structure will be revised in the need of user-friendly perspective for the readers and users especially emission experts.

9. PROJECTIONS

Projections for NECD pollutants and scenarios have been prepared in TA component of Improving Emissions Control Project. It will be updated with the coordination of all stakeholders under the Coordination Board. Additionally the EMISSION project will allow the activity data and the calculations to be completed. The legal basis for this chapter to be used as reference is still under preparation and implementation process.

Projections are planned to be reported for 2019.

10. REPORTING OF GRIDDED EMISSIONS AND LPS

Gridded emissions for LRTAP inventory are planned to be reported under the CLRTAP Convention together with the LPS data obligation.

This reporting obligation is under preparation within the ongoing studies of our EMISSION Project. Gridded emissions will be prepared with the support of this project in the line of the reporting instructions. These reporting is planned to be in 2019.

11. ADJUSTMENTS

N/A

IIR References

- EMEP/EEA Guidebook
- TURKSTAT Official Statistics
- Ministry of Energy and Natural Resources, Energy Balance
- Eurostat Production Index
- GHG Submissions
- Institutional Progress and Activity Reports
- National Inventory Reports, Turkey
- Steel Statistics
- Improving Emissions Control TA Project Inventory Guidelines
- Improving Emissions Control TA Inventory Report Part 1 And 2
- Improving Emissions Control TA Project Documents
- TR Development Plan
- Turkstat, Ministry of Development, Ministry of Finance, Ministry of Food, Agriculture and Livestock, Ministry of Transport, Maritime and Communications, Ministry of Science, Industry and Technology
- Unions, Chambers and Associations' websites in the title of industry, energy, transport, agriculture, waste and product usage
- World Mineral Report
- Sectoral Statistics