REPUBLIC OF TURKEY
MINISTRY OF ENVIRONMENT
AND URBANISATION

Turkey's Informative Inventory Report
(IIR) 2021

General Directorate for Environmental Management
Air Management Department

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Turkey’s Informative Inventory Report (IIR) 2021

Submission under the UNECE Convention Long Range Transboundary Air Pollution for 1990-2019

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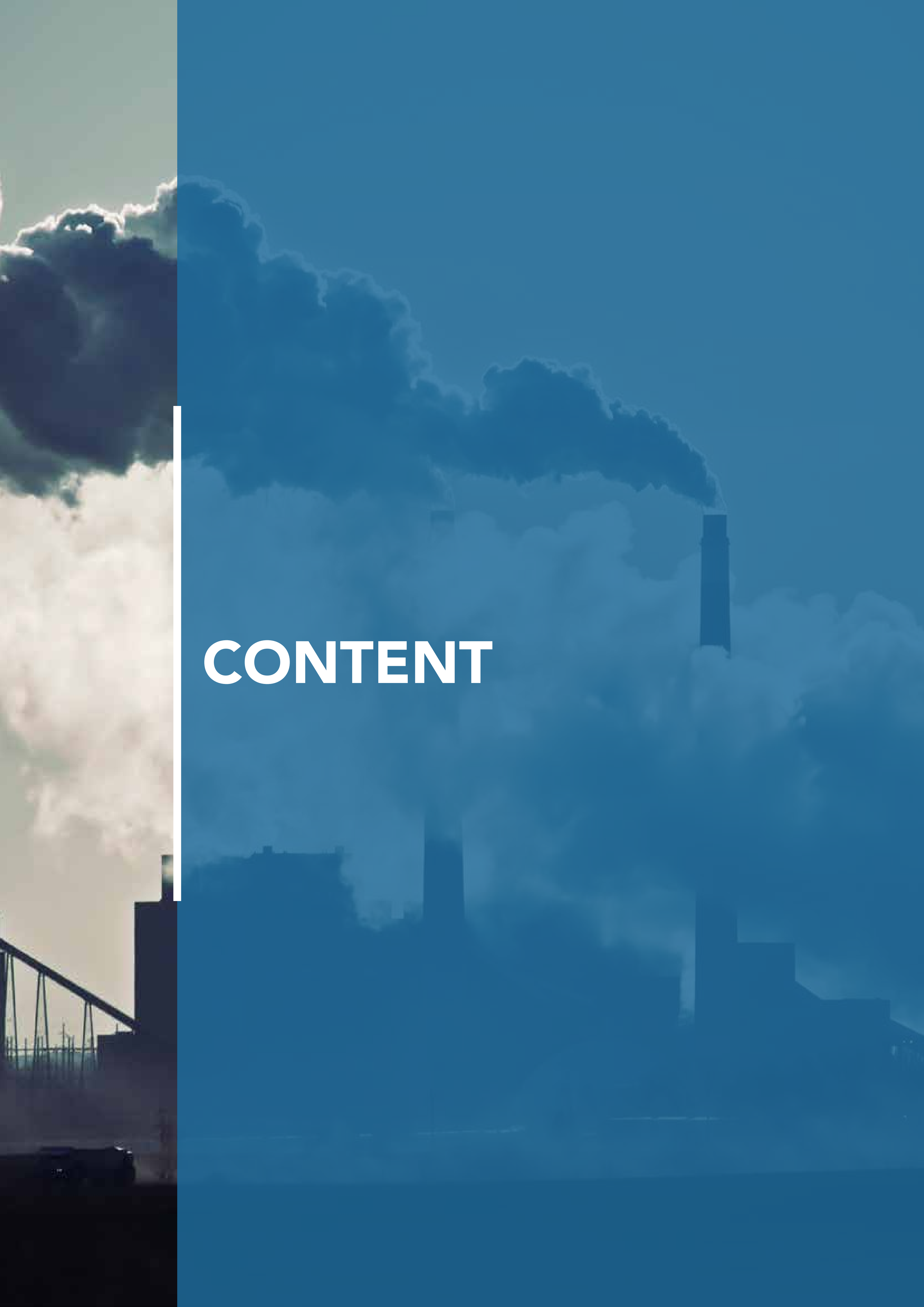
CONTENT



ABBREVIATIONS

CLRTAP	Convention on Long Range Transboundary Air Pollution
EEA	European Environment Agency
EF	Emissions factor
EMEP	European Monitoring and Evaluation Programme
EU	European Union
EUAS	State Electricity Generating Company
GAINS	Greenhouse Gas and Air Pollution Interactions and Synergies (see IIASA)
GB	EMEP/EEA Emissions Inventory Guidebook
GDP	Gross Domestic Product
GHG	Green House Gas
HDV	Heavy Duty Vehicle (HGV: Heavy Goods Vehicle)
IE	(Emissions) Included elsewhere
IEA	International Energy Agency
IEC	Improving Emission Control
IIASA	International Institute for Applied Systems Analysis
IIR	Informative Inventory Report
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
IT	Information Technologies
KCA	Key category analysis
LDV	Light-duty vehicle
LTO	Landing and take-off
MoEU	Ministry of Environment and Urbanization
N	Nitrogen
NA	Not Applicable
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
TurkStat	Turkish Statistical Institute
UA	Uncertainty analysis
UK	United Kingdom
VKM	Vehicle-kilometers

EXECUTIVE SUMMARY

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

As a party to the Convention and EMEP Protocol, National Air Pollutants Emission Inventory has been reported since 2011. Turkey inventory team thanks to Improving of Emission Control project experts for their valuable efforts during establishment of inventory process.

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).

Inventory Awards-2015 have been conferred in six categories, most comprehensive IIR (Denmark and Portugal), good looking IIR (Canada), best small country IIR (Luxembourg), significant IIR improvements (Italy and Turkey), most complete reporting in 2015 (Switzerland) .

By the reporting cycle of Turkey, the country in-depth reviews were organized in 2012, 2016 and 2019. The suggestions from the review report were noted and planned to be fulfilled systematically. This is the 10^{th} IIR for the UNECE CLRTAP air pollutant emission inventory and was prepared under the the reporting guidelines which were revised in 2017.

This year, priory heavy metals (Pb, Cd, Hg) and fine particulate matter pollutants ($PM_{2,5}$) emissions are submitted for some of the sectors. These parameters are not included in the report since the inventory is not complete yet. Therefore, KCA for these parameters are not covered.

The trends in the other emissions calculated for the submission on 2021 are highlited below;

- In 1990 national total for NO_x emissions were 255 Gg and have been increased 205% to 779 Gg. From 2018 to 2019 NO_x emissions were decreased by 1%.
- In 1990 national total for NMVOC emissions were 893 Gg and have been increased 21% to 1120 Gg. From 2018 to 2019 the NMVOC emissions were increased by 3%.
- In 1990 national total for SO_2 emissions were 1691 Gg and have been increased 39% to 2455 Gg. From 2018 to 2019 the SO_2 emissions were decreased by 2.5%.
- In 1990 national total for NH_3 emissions were 585 Gg and have been increased by 28 % to 765 Gg. From 2018 to 2019 the NH_3 emissions were increased by 5%.
- In 1990 national total for CO emissions were 2025 Gg and have been decreased by 18% to 1662 Gg. From 2018 to 2019 the CO emissions were increased by 4.5%.
- In 1990 national total for PM_{10} emissions were 270 Gg and have been increaed 8% to 249 Gg. From 2018 to 2019 the PM_{10} emissions were increased by 4.5%.

Key category analysis 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 NH_3 are belong to agriculture sector. "NFR 3B1a Manure management: dairy cattle" is the first category for NMVOCs. "2B10a Chemical Industry" is the first sector for the PM_{10} emissions and residential combustion is the second for PM. Residential combustion is also responsible for NMVOC and NO_x emissions as key category.

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 this context, national funded project was finalized in 2016 to establish the web based "national air pollution emission management system". Having the system established, the automatization was secured and the inventory was improved by the algorithyms of the system structure, especially for aviation and road transport. Plant specific data is planned to be collect within "national air pollution emission management system" for whole country. The report provides summary information on legal institutional and procedural arrangements in Turkey. Furthermore, the report describes calculation methods, activity data and selected emission factors. Emission trends and significant emission sources 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 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 Nazan ÖZYÜREK and manager for the preparation of the Turkey's Air Pollutant Inventory is İrde ÇETİNTÜRK GÜRTEPE (Acting Manager of Division). Specific responsibilities for the preparation IIR 2021 have been as follows:

- Energy Sector: Canan Esin KÖKSAL
- Transport Sector: Ağça Gül YILMAZ
- Industry-Solvent Use Sector: İrde ÇETİNTÜRK GÜRTEPE
- Agriculture Sector: Ağça Gül YILMAZ
- Waste Sector: Ağça Gül YILMAZ

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 by the Minister. The organization structure are presented in Ministry website **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
- Zero Waste and Waste Handling Department
- Climate Change and Adaptation 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 prepare air quality maps,
- 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.

Moreover, there is other 5 By-Laws besides BCAPIP. These are,

- By-law on reduction in the sulfur content of certain liquid fuels
- By-law on management and assessment of environmental noise
- By-law on control of air pollution from heating
- By-law on control of the emissions from odor
- By-law on control of exhaust gas emissions

In each of the 81 Provinces a Provincial Directorate subordinated to the MoE 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 Environmental 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(NECD) 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.

The MoEU prepares national air emission inventories for SO2, NOx, NMVOC, NH3, PM10 and CO and submit to United Nations European Economic Commission and European Environment Agency (EEA) since 2011[1].

MoEU has also developed "HEY- Air Emission Management Portal" to follow-on emission sources at local level. The portal is established to cover Marmara region as a pilot first under the research project conducted between 2013-2017[2] and supported by the Turkish Scientific and Technical Research Council -TUBITAK. Essential air management steps such as emission inventory compilation, spatial and temporal distribution, historic model run for meteorology and air quality can be done in HEY portal. HEY portal is available for use of MoEU, Provincial Directorates of MoEU, and Regional CACs staffs. A User Manual is also available for the portal.[3]

MoEU initiated a new project namely "HEYGEL" (Supporting Air Emission Management Portal) on November 2018 to extend the HEY-Portal to cover entire country. The project aims to further develop the HEY portal and include all data from whole Turkey by 2023.[4] At local level, Regional CACs are responsible to provide data and run HEY Portal. The Portal includes different modules for mapping, emissions calculations, emissions distribution processing, air quality modelling, solid fuels management, and reporting. In the near future, the HEY system shall run scenarios to determine the effect of mitigation measures.

[1] Available at http://www.ceip.at/ms/ceip_home1/ceip_home/status_reporting/2018_submissions/, and https://cygm.csb.gov.tr/ulusal-hava-kirleticileri-emisyon-envanteri---national-air-pollutants-emission-inventory-i-81051

[2] https://cygm.csb.gov.tr/ulusal-hava-kirliligi-emisyon-yonetim-sisteminin-gelistirilmesi-projesi-kapanis-toplantisi-21-nisan-2017-tarihinde-istanbul-da-yapildi.-haber-158285

[3] HEY Portal User Manual, MoEU, July 2017.

[4] https://cygm.csb.gov.tr/hava-emisyon-yonetim-portalinin-gelistirilmesi-heygel-projesi-acilis-toplantisi-gerceklestirildi.-haber-232477

Monitoring Of CAAP Implementation

In order to reduce bureaucracy and printed copies, MoEU has developed a digital application named THEP-İZ (Clean Air Action Plan Monitoring Application) to follow the actions within the CAAP. Using THEP-İZ, MoEU uploads CAAPs into this system and the approval status can be followed for each CAAP in the system. The status and progress of actions in the CAAP should be updated and uploaded to the THEP-İZ system by Provincial Directorates every six months. Impact of measures are not recorded in the system. System only records completion status of mitigation actions stated in CAAPs.

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} and together with the selected heavy metals with $PM_{2,5}$ for the period 1990 – 2019.

1.2 Institutional Arrangements

Air Management Department is responsible for inventory compilation. The department consist of five divisions for major topics: "air quality assessment", "prevention on industrial air pollution"," prevention on residential and transport related air pollution", "integrated pollution prevention and control" and " environmental noise management"

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 are cited in the calculations and in 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 secondary air pollutants under the GHG inventory are used from this inventory submission.

The 3rd Stage-3 review of Turkey was executed in 2019. The report was noted for continuous improvement for the next 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, TurkSTAT 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 were 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 (2016 NFR template) files that used for submission.

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 (calculation 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 (2016 version). Mostly default factors were used for calculations while national factors are not available. Summary information on source of activity data and selected emission factors is presented in Table 1.1. Different approach was used for the sectors below;

- Road transport – COPERT software was used for the submission in 1994-2017

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. 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 "***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, PM_{10}, $PM_{2,5}$

1.5.1 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.

1.5.2 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 NH_3 are belong to agriculture sector. "NFR 3B1a Manure management: dairy cattle" is the first category for NMVOCs. "2B10a Chemical Industry" is the first sector for the PM_{10} emissions and residential combustion is the second for PM. Residential combustion is also responsible for NMVOC and NO_x emissions as key category.

All key categories are listed in the Table 1.1.

Table 1.1
KCA for 2019 emissions

Component	Key categories (Sorted from high to low from left to right)									Total (%)
SOx	1A1a (75%)	1A4bi (8%)	1A2f (7%)							90
NOx	1A1a (44%)	1A3biii (12%)	1A4ci (8 %)	1A4bi (7%)	1A2f (5%)	1A2a (5%)	1A3bi (5%)			86
NH3	3B1a (20%)	3Da1 (16 %)	3B1b (17%)	3B4gii (12 %)	3B2 (14%)	3Da3 (7%)				86
NMVOC	3Da3 (22%)	1A4bi (9%)	2D3d (9%)	2D3a (9%)	3B1a (9%)	2H2 (8%)	3B1b (7%)	5A (4%)	2D3e (4%)	81
PM10	2B10a (39%)	1A4bi (12%)	1A2f (9%)	1A2a (9%)	2A1 (6%)	1A1a (6%)	1A4ci (2%)			83

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 11.

Figure 1.1
QA/QC Colour Coding

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	

This colour coding convention is used throughout the entire inventory. It is a powerful tool in allowing a user for quickly interpreting 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 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 NO_x, NMVOCs, NH_3, SO_x, PM_{10} and CO. The Emission Review Team encourages Turkey to report the missing pollutants in the future submissions."*

Not complete yet, additional parameters are added within the 2021 submission. The missing parts will be completed next year for other sectors.

CHAPTER 2:

2 EXPLANATION OF KEY TRENDS

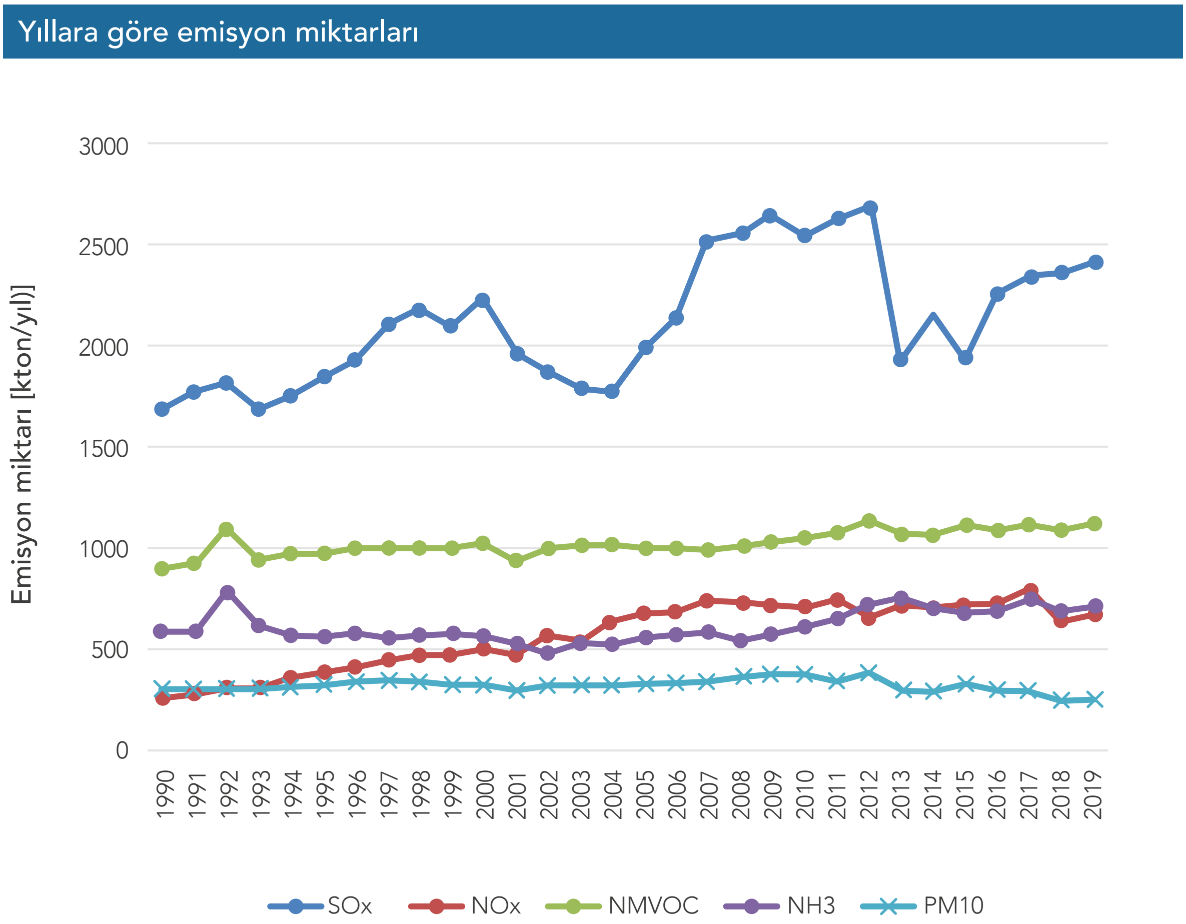
Turkey has been reporting data about national total and sectoral emissions under LRTAP Convention since 2011. Total emissions between 1990 and 2019 are given in Table 2-1 and trends are illustrated in Figure 2-1.

Table 2-1
Emission trends of SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} for ther period 1990-2019

Year	Emissions	Totals in Gg				
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}
1990	1691	255	893	585	2025	271
1991	1781	273	921	580	2063	271
1992	1818	299	1091	789	2094	275
1993	1702	296	947	613	2062	275
1994	1761	355	971	565	2391	288
1995	1847	381	975	557	2413	302
1996	1938	407	994	574	2502	319
1997	2109	436	1002	545	2660	335
1998	2187	458	1006	564	2585	332
1999	2098	456	1000	575	2473	278
2000	2242	495	1016	557	2605	320
2001	1982	473	930	521	2357	285
2002	1872	560	986	479	2420	282
2003	1791	542	1009	526	2376	306
2004	1779	633	1013	518	2376	308
2005	2003	671	998	554	2318	301

Year	Emissions	Totals in Gg				
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}
2006	2160	689	995	566	2350	310
2007	2522	741	988	580	2399	313
2008	2558	732	1002	541	2722	334
2009	2662	713	1027	571	2933	343
2010	2557	707	1049	606	2900	346
2011	2637	745	1034	643	2597	309
2012	2703	656	1094	713	2827	345
2013	1939	710	1039	755	2044	281
2014	2149	705	1039	704	1961	270
2015	1948	713	1077	673	2185	307
2016	2250	722	1062	683	2050	273
2017	2350	785	1099	740	2024	277
2018	2519	785	1088	728	1590	239
2019	2455	779	1121	765	1663	249
Trend 1990-2019	45%	205%	26%	31%	-18%	-9%
Trend 2018-2019	-2.5%	-0.7%	3%	5%	4.5%	3%

Figure 2-1:
National Total Emission of SO2, NOx, NMVOC, NH3, CO and PM10 for 1990 - 2019



From the emissions of Table 2-1, Figure 2-1 shows the 1990-2019 trends in total.

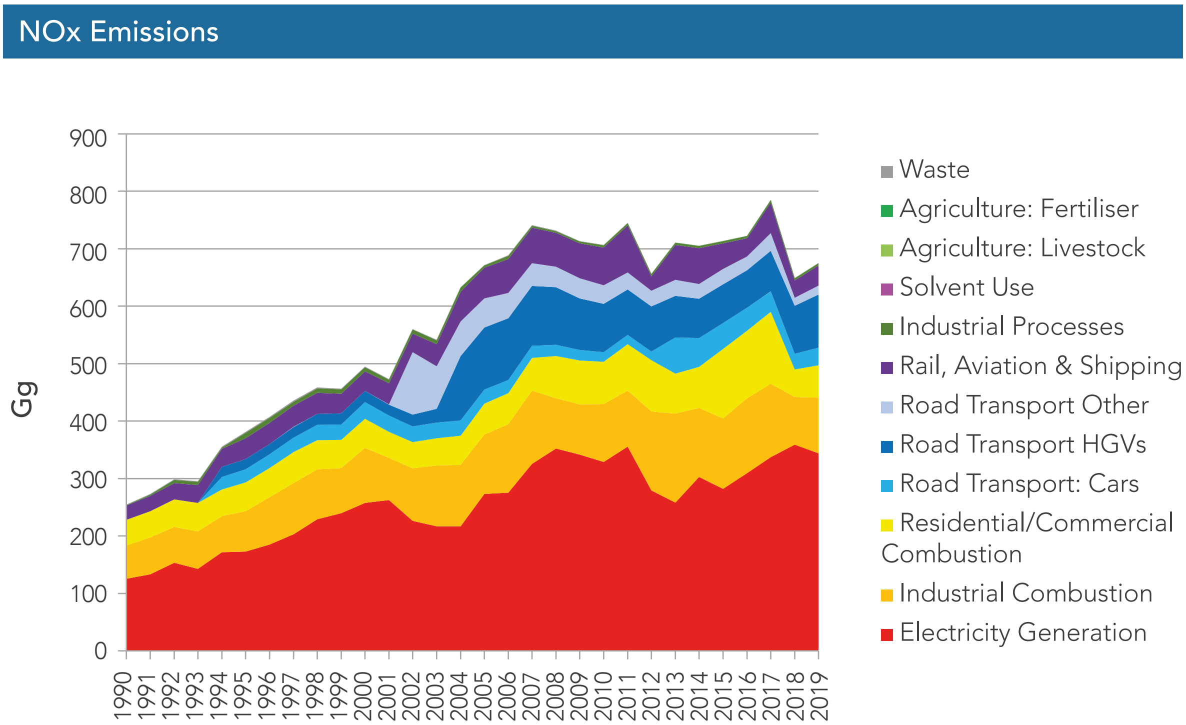
2.1 NOx Emissions

In 1990 national total for NO_x emissions were 255 Gg and has increased to 779 Gg. As presented in Figure 21-2.

Main sources for NO_x emissions in Turkey are 1A1a electricity generation sector with a share of 41,8%, road transport activities from HDVs with a share of 9,0%. The total key category for NOx emissions are originated from NFR 1 category.

Figure 2-1-2

NOx emissions in [Gg], 1990-2019, Sectoral Distributions



Electricity generation contribution increased since consumption of natural gas in electricy production is increasing over years. This caused increasing of overall emissions among 1990-2019.

2.2 NMVOC Emissions

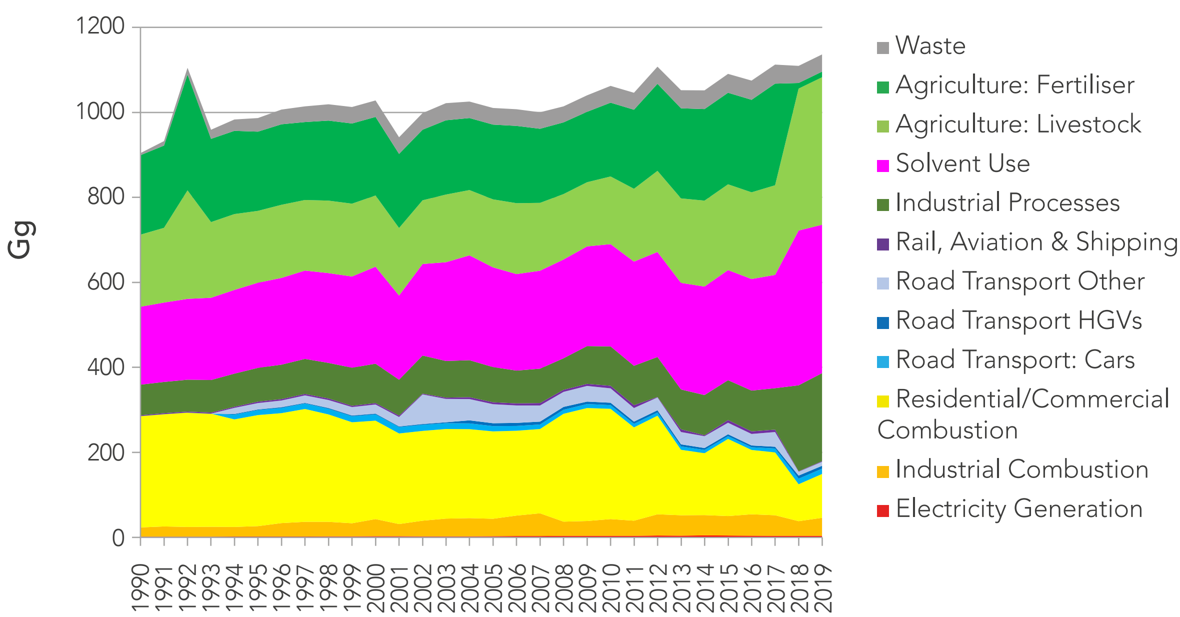
In 1990 national total for NMVOC emissions were 893 Gg and has increased to 1120 Gg. As presented in

Figure 21-2 main source for NMVOC emissions in Turkey is agriculture with a share of 35% as whole NFR topics under KCA and followed by 1A4bi residential combustion activities with a share of about 12,6%.

Figure 2-1-3

NMVOC emissions in [Gg], 1990-2019, Sectoral Distributions

NMVOC Emissions



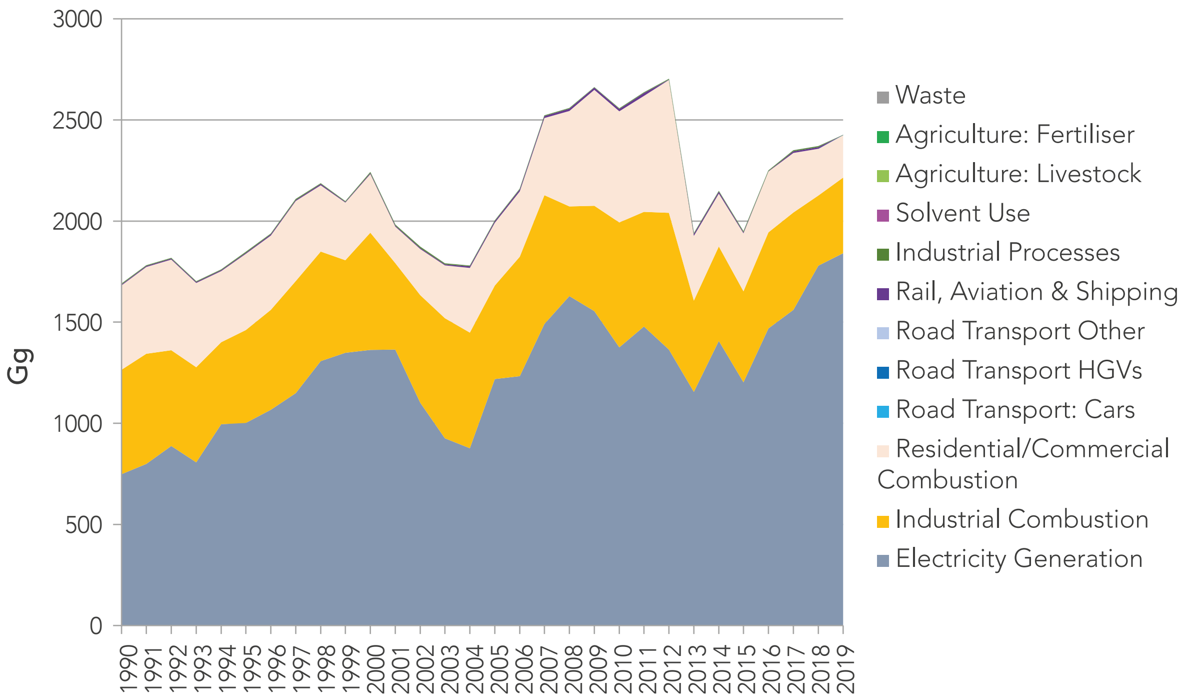
NMVOC emissions are slightly increased from 1990 to 2019, due to effect of more solvent usage of increased population.

2.3 SO_2 Emissions

In 1990 national total for SO_2 emissions were 1691 Gg and has increased to 2455 Gg. As presented in Figure 2-14 main source for SO_2 emissions in Turkey is NFR sector 1A Fuel combustion activities with a share of 66,3 % together with residential combustion with a share of 12%.

Figure 2-14
SO_2 emissions in [Gg], 1990-2019, Sectoral Distributions

SO2 Emissions



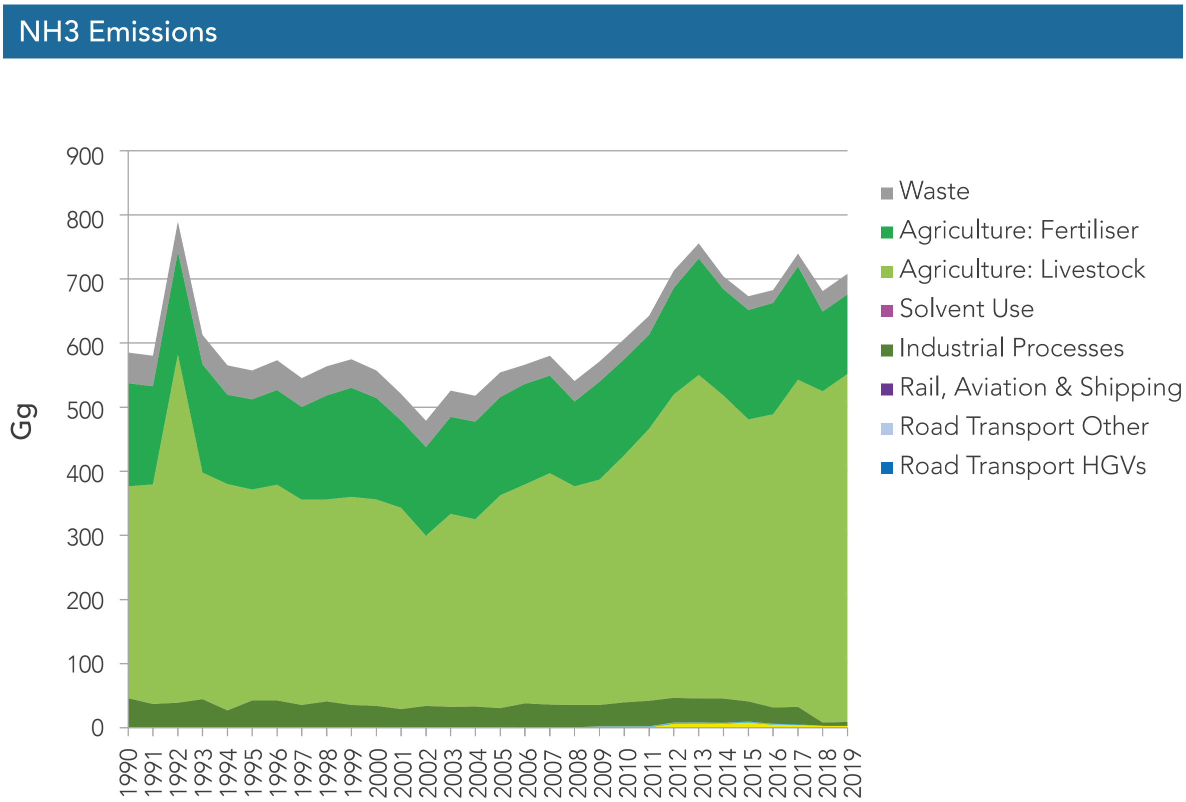
SO_2 emissions are generally increased between 1990-2019, but recently fluctuated because of fuel changes in all combustion sectors.

2.4 NH_3 Emissions

In 1990 national total for NH_3 emissions were 585 Gg and has increased to 765 Gg. As presented in Figure 2-1-5 the main source for NH_3 emissions in Turkey is sector with a share of 24,3% and the total key categories are coming from NFR 3 category.

Figure 2-15

NH_3 emissions in [Gg], 1990-2019, Sectoral Distributions

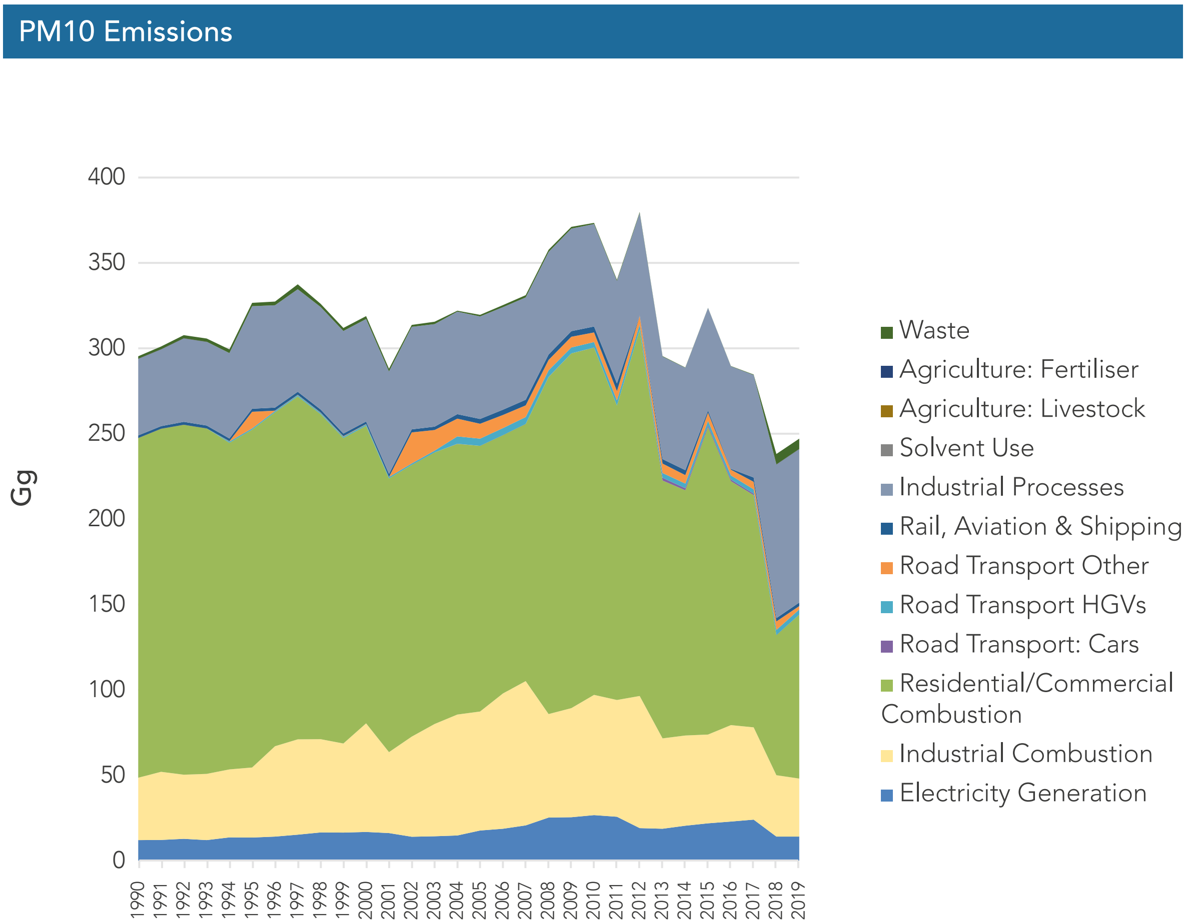


Agricultural emission percentages show parallel leaning between 1990-2019. The emission factor revision and the EMEP/EEA GB revision is the main factor of the big increase in the sector of fertiliser. Waste sector also has an additive emission percentage on NH_3 totals.

2.5 PM_{10} Emissions

In 1990 national total for PM_{10} emissions were 895 Gg and has decreased to 249 Gg. As presented in Figure 2-1-6 the main source for PM_{10} emissions in Turkey is 2B10a especially fertilizer production with a share of 67,5% and followed by residential combustion with a share of 16,9%.

Figure 2-1-6
PM_{10} emissions in [Gg], 1990-2019, Sectoral Distributions



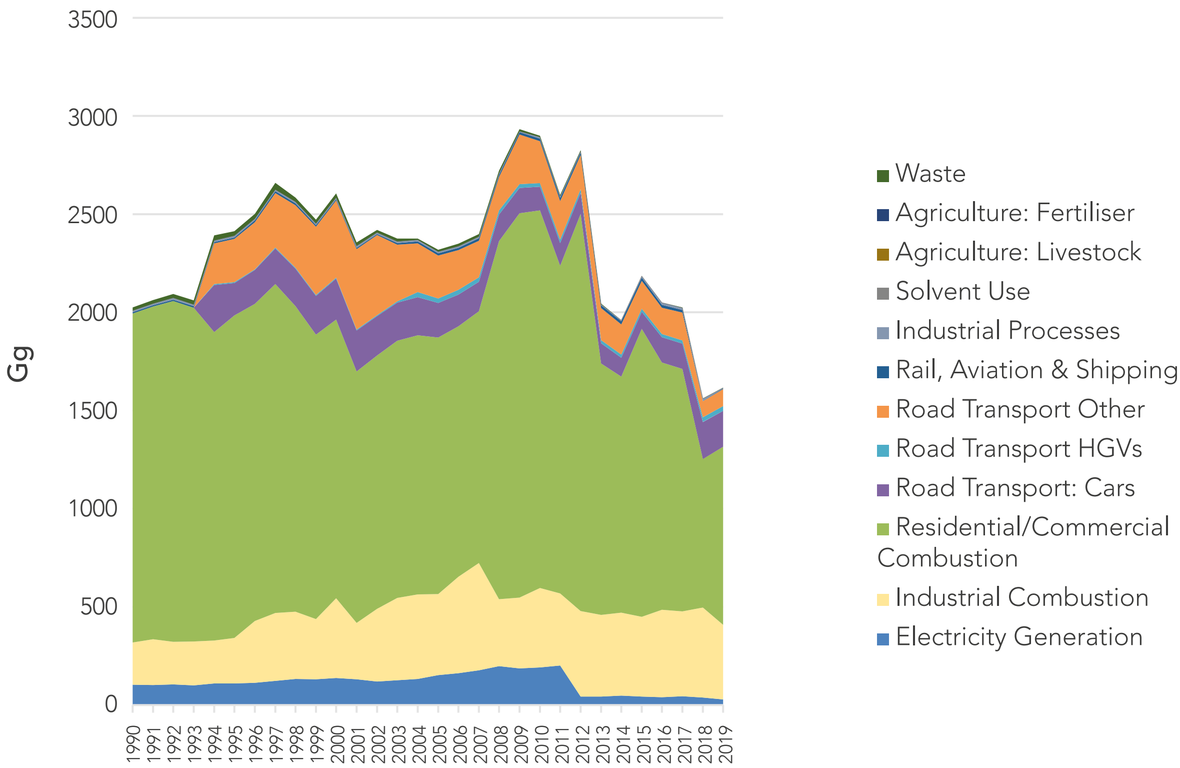
2.6 CO Emissions

In 1990 national total for CO emissions were 2025 Gg and has decreased to 1663 Gg. As presented in Figure 2-1-7 the main source for CO emissions in Turkey is 1A4bi residential combustion activities.

Figure 2-1-7

CO emissions in [Gg], 1990-2019, Sectoral Distributions

CO Emissions



2017 CO emissions are nearly same level of 1990s. Share of residential combustion is fluctuated due to consumers preferances about fuel types for heating.

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

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

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

Figure 3-1
Emission Totals for 1A1 Energy Sector (*same as 2019 submission, to be revised)

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} emissions from NFR 1.A.1 Energy Industries

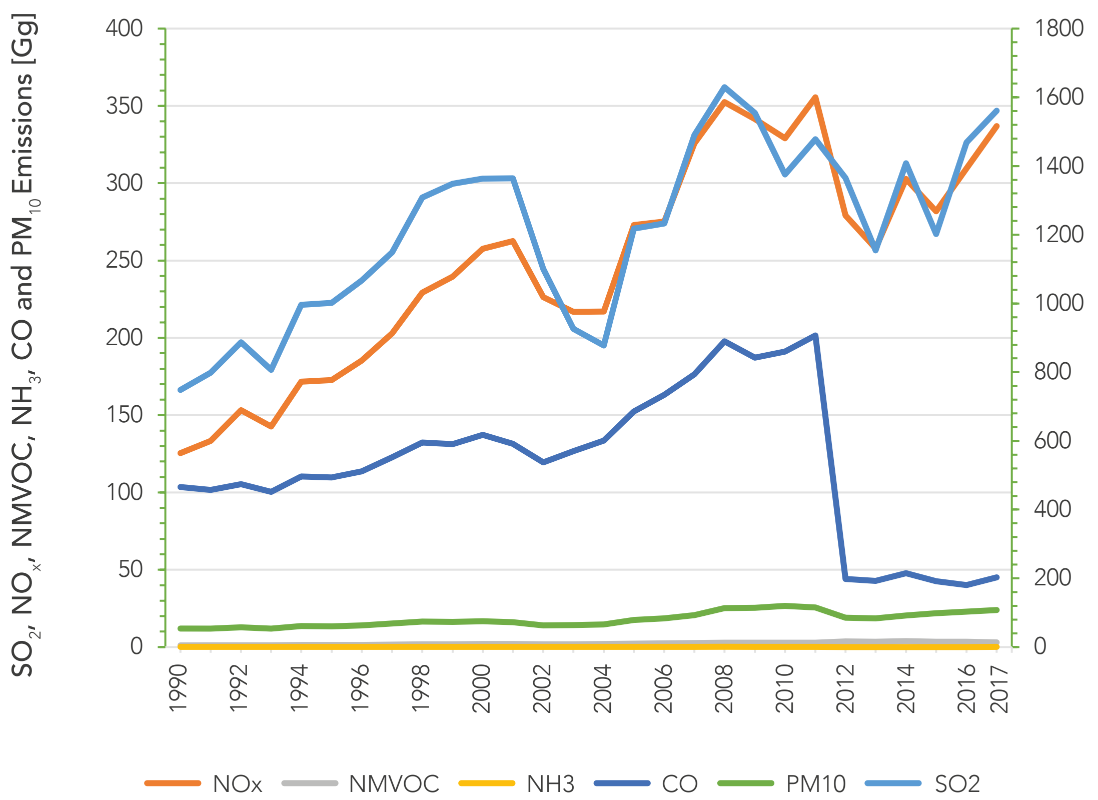


Table 3.1-1

Emissions from 1A1 Energy Industries (*same as 2019 submission, to be revised)

SO2,NOx,NMVOC,NH3,COandPM10emissionsfromNFR1.A.1.EnergyIndustries

Year	Emissions[Gg]					
	SO2	NOx	NMVOC	NH3	CO	PM10
1990	748,4	125,4	1,1	0	103,5	12,0
	798,5	133,4	1,1	0	101,7	12,0
1992	887,2	153,1	1,2	0	105,3	12,8
	806,8	142,7	1,1	0	100,4	12,0
1994	996,0	171,6	1,3	0	110,4	13,6
	1.001,5	172,6	1,3	0	109,7	13,5
1996	1.066,6	185,3	1,4	0	113,7	14,0
	1.148,8	202,9	1,5	0	122,8	15,2
1998	1.308,0	229,2	1,7	0	132,3	16,5
	1.348,4	239,7	1,8	0	131,2	16,4
2000	1.363,1	257,6	2,0	0	137,2	16,7
	1.364,4	262,7	2,0	0	131,4	16,1
2002	1.100,8	226,3	1,8	0	119,4	14,0
	926,4	216,8	1,9	0	126,8	14,2
2004	877,3	217,0	1,9	0	133,6	14,7
	1.218,3	272,9	2,2	0	152,3	17,6
2006	1.232,5	275,3	2,3	0	163,1	18,7
	1.490,4	325,7	2,7	0	176,3	20,6
2008	1.629,5	352,4	2,8	0	197,7	25,2
	1.554,1	341,6	2,8	0	187,2	25,3
2010	1.375,7	329,1	2,8	0	191,2	26,6
	1.478,3	355,6	2,7	0	201,5	25,7
2012	1.364,8	279,1	3,6	0	44,0	19,0
	1.154,8	257,8	3,4	0	42,9	18,6
2014	1.407,7	302,8	3,9	0	47,8	20,4
	1.202,3	281,7	3,5	0	42,6	21,9
2016	1.468,4	309,5	3,4	0	40,1	22,8
2017	1.561,0	337,0	3,0	0	45,0	24,0
Trend1990-2017	108,6%	168,7%	177,3%		-56,5%	100,4%
Trend2016-2017	6,3%	8,9%	-12,3%		12,2%	5,1%

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}, $PM_{2,5}$
Key Source: Yes (SO_2, NO_x, PM_{10})

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

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.1.a Public Electricity and Heat Production

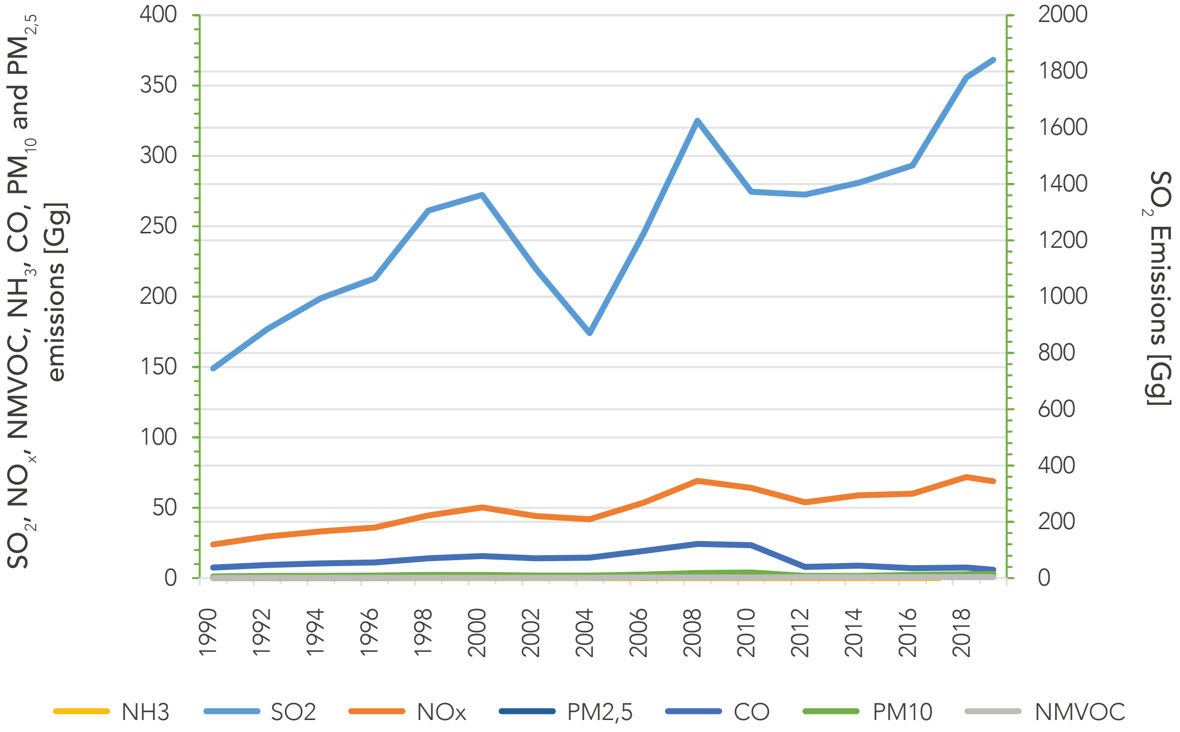


Table 3.1-2
Emissions from sector 1.A.1.a public electricity and heat production

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} emissions from NFR1.A.1.a Public Electricity and HeatProduction

Year	Emissions(Gg)						
	SO2	NOx	NMVOC	NH3	CO	PM10	PM2,5
1990	744,9	119,6	0,7	NA	37,1	5,9	1,1
	795,4	128,0	0,7	NA	40,9	6,5	1,1
1992	884,2	147,6	0,8	NA	46,4	7,4	1,3
	804,4	136,7	0,7	NA	42,6	6,8	1,2
1994	993,8	165,4	0,9	NA	51,9	8,3	1,5
	999,3	167,4	0,9	NA	52,2	8,2	1,5
1996	1.064,4	179,1	1,0	NA	56,2	8,9	1,6
	1.146,5	196,4	1,1	NA	62,0	9,7	1,7
1998	1.305,7	222,5	1,2	NA	70,3	10,9	2,0
	1.346,3	233,4	1,4	NA	74,3	11,2	2,1
2000	1.360,9	251,4	1,5	NA	78,9	11,5	2,2
	1.362,5	256,4	1,6	NA	81,3	11,6	2,3
2002	1.099,0	220,0	1,4	NA	69,9	9,5	1,9
	923,0	210,1	1,4	NA	70,1	9,1	1,9
2004	870,8	209,4	1,4	NA	72,2	9,2	1,9
	1.212,0	266,5	1,8	NA	92,9	12,2	2,5
2006	1.225,0	268,1	1,9	NA	96,2	12,6	2,8
	1.486,7	317,6	2,2	NA	113,7	15,0	3,3
2008	1.625,4	345,0	2,4	NA	121,5	18,3	3,5
	1.551,6	332,7	2,3	NA	118,7	19,2	3,5
2010	1.373,1	320,3	2,3	NA	117,3	19,9	3,6
	1.475,7	352,7	2,4	NA	132,3	19,2	3,6
2012	1.362,1	269,8	3,2	NA	39,9	7,7	3,8
	1.152,0	248,5	3,1	NA	38,8	6,9	3,5
2014	1.404,8	293,8	3,5	NA	43,9	8,4	4,2
	1.199,3	269,1	3,0	NA	36,9	9,2	4,9
2016	1.465,5	300,1	3,1	NA	35,7	10,9	5,9
	1.558,2	327,7	3,5	NA	41,0	11,7	6,3
2018	1.778,6	358,9	3,4	NA	37,9	13,7	7,3
2019	1.841,5	344,8	2,9	NA	29,7	14,6	8,0
Trend1990-2019	147,2%	188,2%	336,9%		-19,9%	145,9%	657,2%
Trend2018-2019	3,5%	-3,9%	-15,3%		-21,6%	6,7%	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 2019).

Methodological Issues

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

$$Emissionpollutant = \sum ADfuel * EFfuel$$

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 andheat 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	Table 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)*
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	Table 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	Table 3-3

Fuel	Unit	Ef	Reference	Table No.
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	Table 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
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

Fuel	Unit	Ef	Reference	Table No.
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
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

Fuel	Unit	Ef	Reference	Table No.
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.

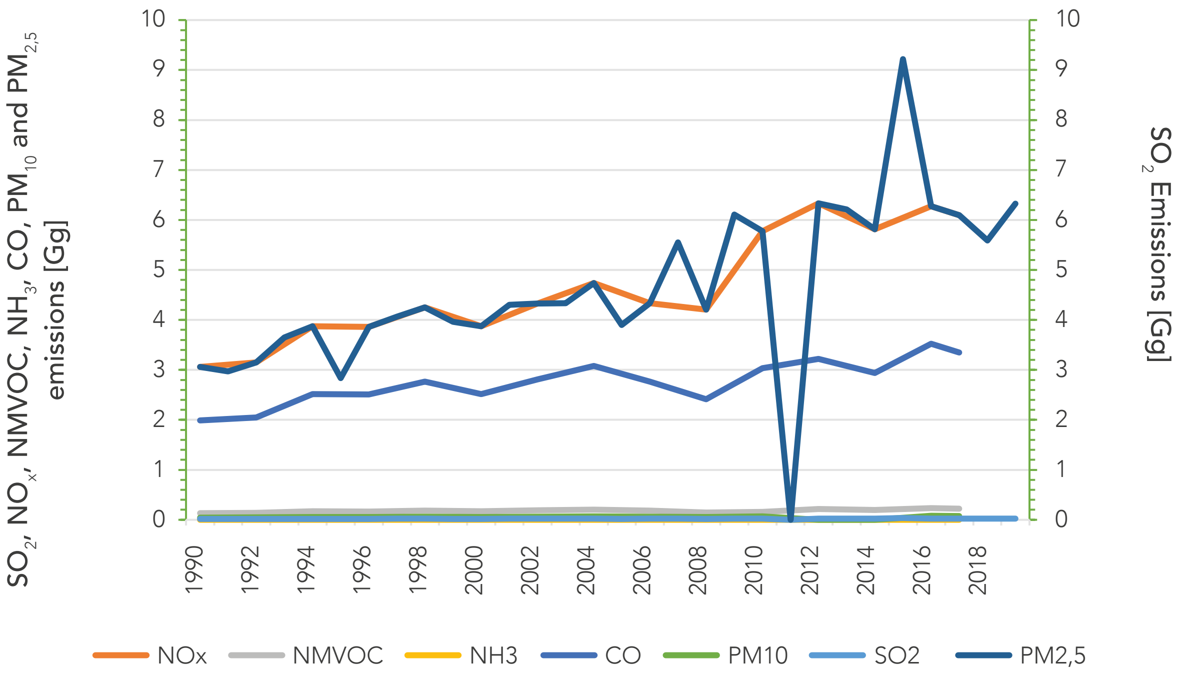
3.1.2 NFR 1.A.1.b Petroleum Refining

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}, $PM_{2,5}$
Key Source: No

Figure 3-1-2
Emissions from petroleum refining

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.1.b Petroleum refining



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

Table 3-1-4
Emissions from sector 1.A.1.b petroleum refining

SO2, NOx, NMVOC, NH3, CO and PM10 emissions fro mNFR 1.A.1.b Petroleum Refining

Year	Emissions(Gg)						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	0,0	3,1	0,1	NA	2,0	0,05	3,06
	0,0	3,0	0,1	NA	1,9	0,04	2,97
1992	0,0	3,2	0,1	NA	2,0	0,05	3,15
	0,0	3,6	0,2	NA	2,4	0,05	3,65
1994	0,0	3,9	0,2	NA	2,5	0,06	3,87
	0,0	2,8	0,1	NA	1,8	0,04	2,84
1996	0,0	3,9	0,2	NA	2,5	0,06	3,86
	0,0	4,1	0,2	NA	2,6	0,06	4,07
1998	0,0	4,3	0,2	NA	2,8	0,06	4,25
	0,0	4,0	0,2	NA	2,6	0,06	3,96
2000	0,0	3,9	0,2	NA	2,5	0,06	3,87
	0,0	4,3	0,2	NA	2,8	0,06	4,30
2002	0,0	4,3	0,2	NA	2,8	0,06	4,33
	0,0	4,3	0,2	NA	2,8	0,06	4,34
2004	0,0	4,7	0,2	NA	3,1	0,07	4,74
	0,0	3,9	0,2	NA	2,5	0,06	3,90
2006	0,0	4,3	0,2	NA	2,8	0,06	4,34
	0,0	5,5	0,2	NA	3,2	0,07	5,55
2008	0,0	4,2	0,1	NA	2,4	0,06	4,21
	0,0	6,1	0,2	NA	3,3	0,08	6,11
2010	0,0	5,8	0,2	NA	3,0	0,07	5,78
	IE	IE	IE	NA	IE	IE	IE
2012	0,0	6,3	0,2	NA	3,2	IE	6,33
	0,0	6,2	0,2	NA	3,2	IE	6,21
2014	0,0	5,8	0,2	NA	2,9	IE	5,81
	0,0	9,2	0,3	NA	4,7	0,11	9,22
2016	0,0	6,3	0,2	NA	3,5	0,08	6,28
	0,0	6,1	0,2	NA	3,3	0,08	6,09
2018	0,0	5,6	0,2	NA	3,0	0,07	5,59
2019	0,0	6,3	0,2	NA	3,3	0,08	6,33
Trend 1990-2019	62,1%	106,8%	66,0%		66,7%	66,7%	106,8%
Trend 2018-2019	12,1%	13,2%	12,3%		12,3%	12,3%	13,2%

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 2019). Due to energy balance table identifications notations were used for the data belong to the categories of the fuel used within the NFR topic.

Methodological Issues

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

Emission pollutant = ∑ 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

Fuel	Unit	Ef	Reference	Table No.
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 Combus-tion, 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 refining-Tier 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.

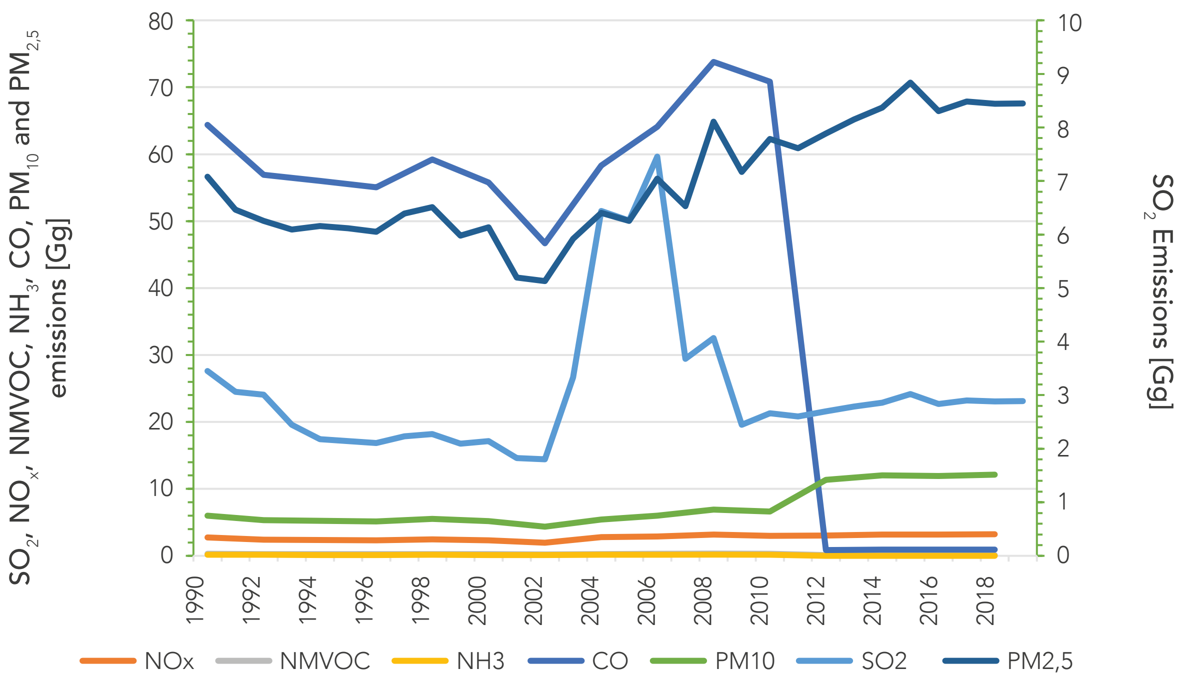
3.1.3 NFR 1.A.1.c Manufacture of solid fuels and other energy industries

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}, NH_3, $PM_{2,5}$
Key Source: No

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

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.1.c Petroleum refining



Emissions are presented in Table 3-1-6.

Table 3-1-6
Emissions from sector 1.A.1.c manufacture of solid fuels and other energy industries

SO_2, NO_x,NMVOC, NH_3, CO and PM_{10} emissionsfrom NFR1.A.1.c Manufacture of solid fules and other e.i.

Year	Emissions(Gg)						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	3,5	2,7	0,3	0	64,4	6,01	7,08
	3,1	2,5	0,3	0	58,8	5,49	6,46
1992	3,0	2,4	0,3	0	56,9	5,31	6,25
	2,4	2,3	0,3	0	55,4	5,17	6,09
1994	2,2	2,3	0,3	0	56,0	5,23	6,16
	2,1	2,3	0,3	0	55,7	5,20	6,12
1996	2,1	2,3	0,3	0	55,0	5,14	6,05
	2,2	2,4	0,3	0	58,1	5,43	6,39
1998	2,3	2,5	0,3	0	59,2	5,53	6,51
	2,1	2,3	0,2	0	54,4	5,08	5,98
2000	2,1	2,3	0,3	0	55,8	5,21	6,13
	1,8	2,0	0,2	0	47,3	4,41	5,20
2002	1,8	2,0	0,2	0	46,7	4,36	5,13
	3,3	2,4	0,2	0	53,9	5,03	5,92
2004	6,4	2,8	0,3	0	58,3	5,44	6,41
	6,3	2,5	0,3	0	56,9	5,31	6,25
2006	7,5	2,9	0,3	0	64,1	5,98	7,04
	3,7	2,6	0,3	0	59,4	5,54	6,53
2008	4,1	3,2	0,3	0	73,8	6,89	8,11
	2,4	2,7	0,3	0	65,2	6,09	7,17
2010	2,7	3,0	0,3	0	70,8	6,61	7,79
	2,6	2,9	0,3	0	69,2	6,46	7,61
2012	2,7	3,0	0,1	NE	0,9	11,33	7,89
	2,8	3,1	0,1	NE	0,9	11,71	8,15
2014	2,9	3,2	0,1	NE	0,9	12,02	8,37
	3,0	3,4	0,1	NE	1,0	12,69	8,84
2016	2,8	3,2	0,1	NE	0,9	11,93	8,30
	2,9	3,2	0,1	NE	0,9	12,18	8,48
2018	2,9	3,2	0,1	NE	0,9	12,13	8,44
2019	2,9	3,2	0,1	NE	0,9	12,13	8,45
Trend 1990-2019	-16,4%	17,8%	-58,3%		-98,6%	101,9%	19,3%
Trend 2018-2019	0,0%	0,0%	0,0%		0,0%	0,0%	0,0%

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 2019).

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

Fuel	Unit	Ef	Reference	Table No.
Coke	g/GJ	21	EMEP/EEA (2016), Chapter 1.A.1.c Manufacture of solid fuels and other energy indus-triesTier 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 indus-tries, 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 indus-tries, 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 indus-tries, 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 indus-tries, 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 indus-tries, Tier 1 emission factors for source category 1.A.1.c	Table 5-1

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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.

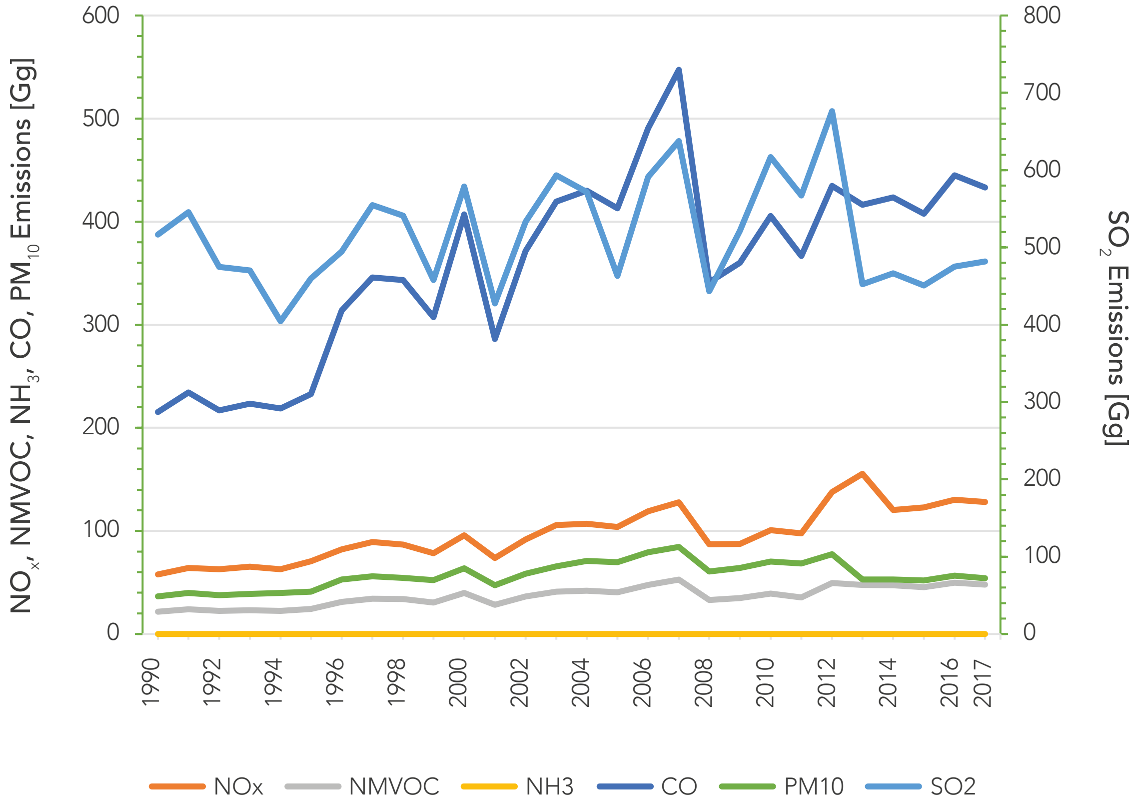
Planned Improvements

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

Emissions in total under the NFR category are represented in the figure below:

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} emissions from NFR 1.A.2 Manufacturing Industries and Construction



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

General total emissions are illustrated above. (same as 2019 submission, to be revised)

Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}, $PM_{2,5}$
Key Source: Yes (PM_{10})

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

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.2.a Iron and Steel

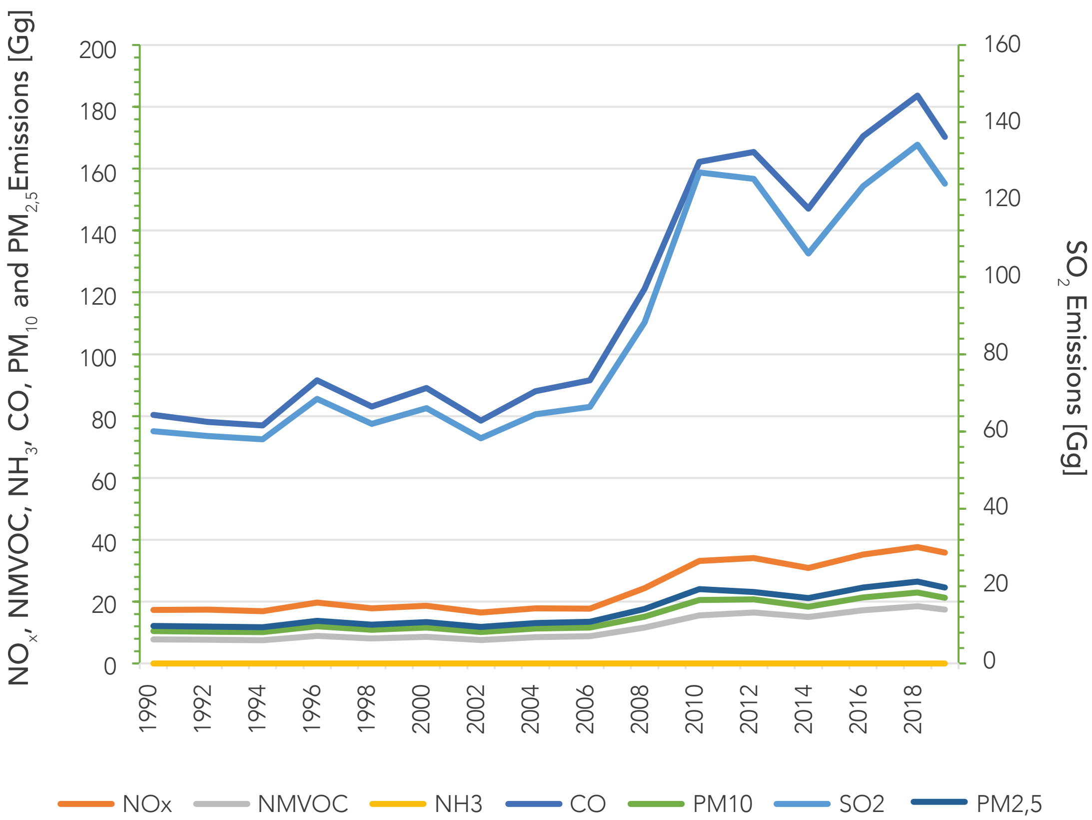


Table 3-2-1
Emission Totals from Iron and Steel - Stat. Comb. In Manufacturing Ind.

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} emissions from NFR1.A.2.a Stat. Comb. in Manufacturing Ind.: Iron and Steel

Year	Emissions[Gg]						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	60,1	17,3	7,8	NE	80,3	10,5	9,7
	60,4	17,6	7,9	NE	80,7	10,6	9,8
1992	58,9	17,4	7,6	NE	78,1	10,3	9,5
	58,3	17,2	7,5	NE	76,9	10,2	9,4
1994	58,0	16,9	7,5	NE	77,0	10,1	9,4
	61,5	17,7	8,0	NE	82,2	10,8	10,0
1996	68,4	19,7	8,9	NE	91,6	12,0	11,1
	69,0	19,7	9,0	NE	92,7	12,1	11,2
1998	62,0	17,8	8,1	NE	83,0	10,9	10,0
	62,4	17,7	8,2	NE	84,1	10,9	10,1
2000	66,0	18,7	8,6	NE	89,1	11,6	10,7
	61,3	17,4	8,0	NE	82,6	10,7	9,9
2002	58,2	16,5	7,6	NE	78,6	10,2	9,4
	63,5	17,8	8,3	NE	86,0	11,1	10,3
2004	64,5	17,8	8,5	NE	88,0	11,3	10,5
	66,6	18,0	8,8	NE	91,3	11,7	10,8
2006	66,4	17,7	8,8	NE	91,6	11,6	10,8
	74,7	19,6	9,8	NE	102,6	13,0	12,0
2008	88,3	24,4	11,6	NE	121,2	15,2	14,1
	86,5	23,7	11,2	NE	117,7	14,7	13,7
2010	127,0	33,2	15,6	NE	162,2	20,6	19,2
	121,6	34,9	15,3	NE	160,1	19,9	18,6
2012	125,4	34,1	16,5	NE	165,4	20,7	18,5
	114,6	31,8	15,5	NE	152,0	19,0	17,5
2014	106,1	30,9	15,0	NE	147,1	18,4	16,9
	114,7	32,9	16,1	NE	158,7	19,8	18,3
2016	123,4	35,3	17,2	NE	170,5	21,3	19,7
	138,1	39,1	19,1	NE	189,3	23,6	21,8
2018	134,2	37,6	18,5	NE	183,6	22,9	21,2
2019	124,1	35,8	17,4	NE	170,3	21,2	19,6
Trend 1990-2019	106,5%	107,2%	122,6%		112,0%	102,0%	101,8%
Trend 2018-2019	-7,5%	-4,9%	-6,0%		-7,3%	-7,4%	-7,4%

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 2019).

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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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}, $PM_{2,5}$
Key Source: No

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

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.2.b Non-Ferrous Metals

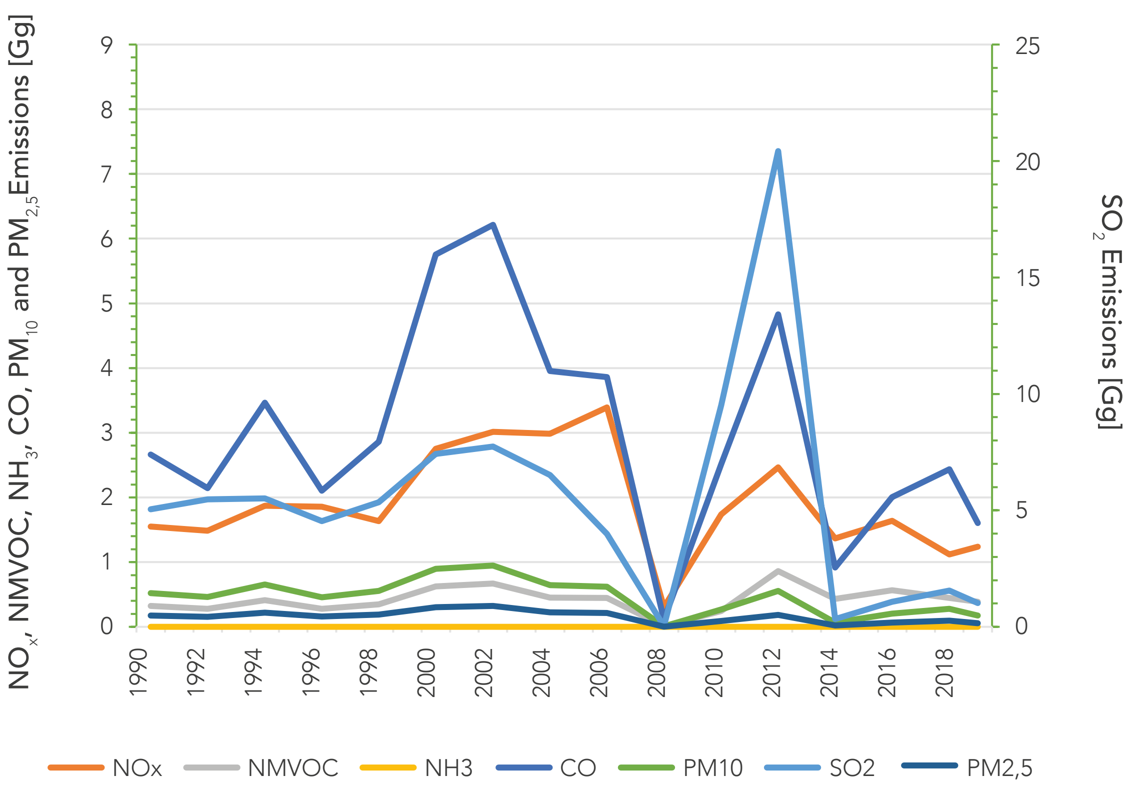


Table 3-2-3
Emissions from non-ferrous metals

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} emissions from NFR1.A.2.b Stat. Comb. in Man. Ind.: Non-Ferrous Metals

Year	Emissions[Gg]						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	5,0	1,5	0,3	NE	2,7	0,5	0,5
	5,2	1,4	0,2	NE	1,8	0,4	0,4
1992	5,5	1,5	0,3	NE	2,1	0,5	0,4
	5,1	1,4	0,3	NE	2,1	0,4	0,4
1994	5,5	1,9	0,4	NE	3,5	0,7	0,6
	6,6	2,5	0,5	NE	4,7	0,8	0,8
1996	4,5	1,9	0,3	NE	2,1	0,5	0,4
	5,1	1,7	0,3	NE	2,7	0,5	0,5
1998	5,4	1,6	0,3	NE	2,9	0,6	0,5
	5,6	2,3	0,4	NE	3,2	0,6	0,6
2000	7,4	2,8	0,6	NE	5,8	0,9	0,8
	7,4	2,8	0,6	NE	5,8	0,9	0,8
2002	7,7	3,0	0,7	NE	6,2	0,9	0,9
	6,1	2,6	0,4	NE	3,5	0,6	0,6
2004	6,5	3,0	0,5	NE	4,0	0,6	0,6
	4,0	3,0	0,4	NE	3,7	0,6	0,6
2006	4,0	3,4	0,4	NE	3,9	0,6	0,6
	5,8	3,4	0,8	NE	8,0	0,9	0,9
2008	0,0	0,3	0,0	NE	0,1	0,0	0,0
	7,4	1,5	0,2	NE	2,3	0,2	0,2
2010	9,5	1,7	0,2	NE	2,5	0,3	0,3
	20,3	1,4	0,4	NE	4,3	0,5	0,5
2012	20,4	2,5	0,9	NE	4,8	0,6	0,5
	1,5	1,3	0,5	NE	2,0	0,2	0,2
2014	0,3	1,4	0,4	NE	0,9	0,1	0,1
	1,1	1,6	0,6	NE	2,0	0,2	0,2
2016	1,1	1,6	0,6	NE	2,0	0,2	0,2
	1,8	1,6	0,6	NE	2,9	0,3	0,3
2018	1,6	1,1	0,4	NE	2,4	0,3	0,3
2019	1,0	1,2	0,4	NE	1,6	0,2	0,2
Trend 1990-2019	-79,7%	-20,0%	19,2%		-39,7%	-66,6%	-67,0%
Trend 2018-2019	-34,2%	10,9%	-13,0%		-34,1%	-37,5%	-37,4%

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 2019).

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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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, page 15	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, 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)*

Fuel	Unit	Ef	Reference	Table No.
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, page 15	Table 3-5

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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, page 16	Table 3-4

Fuel	Unit	Ef	Reference	Table No.
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, page 15	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)*

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

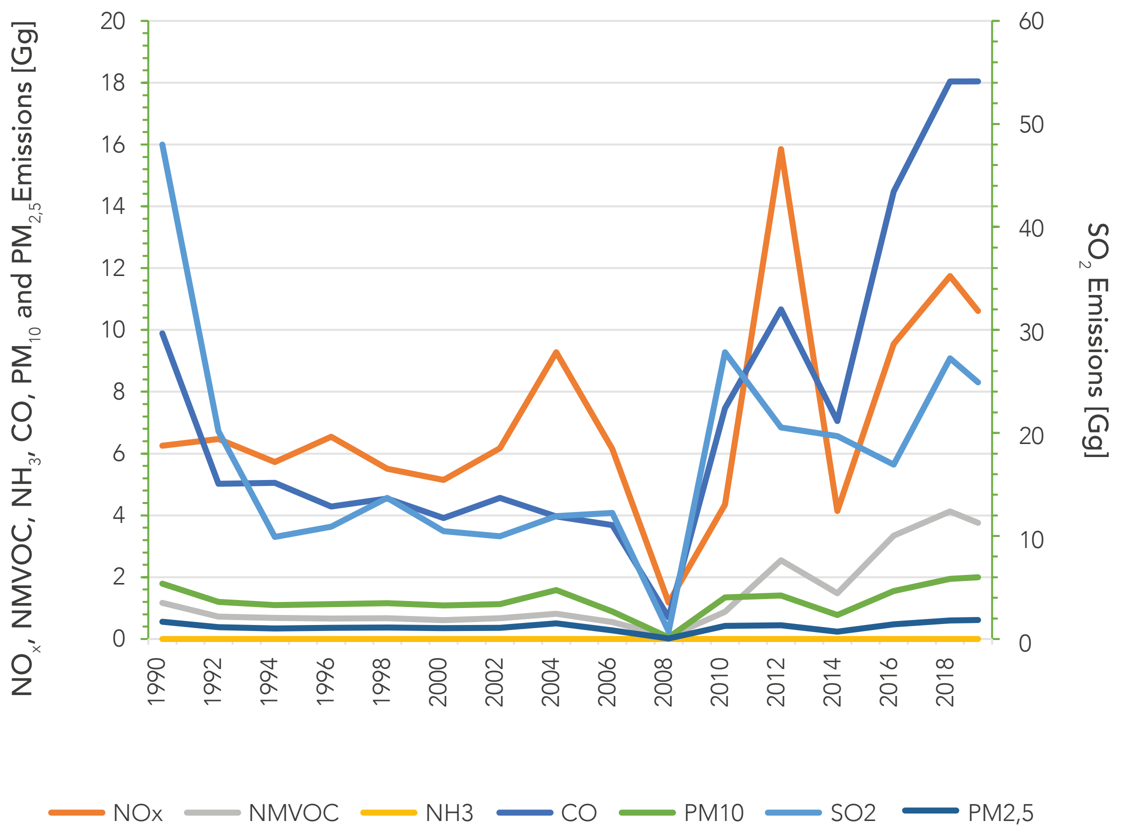
Source Category Description

Emissions: NOx, SO2, NMVOC, CO, PM10, $PM_{2,5}$
Key Source: No

Within the structural changes in the EMEP/EEA GB, chemicals category covers the total of subcategories chemicals, petrochemical and fertilizer.

Figure 3-2-3
Emission trend of chemical manufacturing

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.2.c Chemicals



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

Table 3-2-5
Emissions from Chemicals

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} emissions from NFR1.A.2.c Stat. Comb. in Man. Ind.: Chemicals

Year	Emissions[Gg]						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	48,0	6,3	1,2	NE	9,9	1,8	1,7
	24,7	5,8	0,8	NE	5,7	1,2	1,2
1992	20,1	6,5	0,7	NE	5,0	1,2	1,1
	13,8	6,4	0,8	NE	6,1	1,2	1,1
1994	9,9	5,7	0,7	NE	5,1	1,1	1,0
	13,4	6,6	0,7	NE	4,7	1,2	1,1
1996	10,9	6,5	0,7	NE	4,3	1,1	1,1
	10,9	6,6	0,7	NE	4,4	1,1	1,0
1998	13,7	5,5	0,7	NE	4,5	1,2	1,1
	10,5	4,9	0,6	NE	3,9	1,0	1,0
2000	10,5	5,1	0,6	NE	3,9	1,1	1,0
	12,2	6,9	0,8	NE	4,5	1,4	1,4
2002	10,0	6,2	0,7	NE	4,6	1,1	1,1
	7,7	5,9	0,5	NE	2,7	0,9	0,9
2004	11,9	9,3	0,8	NE	4,0	1,6	1,5
	12,8	7,3	0,6	NE	4,1	1,0	1,0
2006	12,3	6,1	0,6	NE	3,7	0,9	0,8
	1,5	2,6	0,1	NE	1,2	0,1	0,1
2008	0,7	1,2	0,1	NE	0,7	0,1	0,1
	14,6	1,9	0,4	NE	4,5	0,6	0,5
2010	27,8	4,3	0,9	NE	7,5	1,3	1,3
	24,1	6,9	1,1	NE	9,8	1,6	1,5
2012	20,5	15,9	2,5	NE	10,7	1,4	1,3
	22,6	4,8	1,8	NE	9,8	1,1	1,0
2014	19,7	4,1	1,5	NE	7,1	0,8	0,7
	22,9	9,3	3,3	NE	15,2	1,7	1,5
2016	16,9	9,6	3,3	NE	14,5	1,6	1,4
	15,5	8,4	2,8	NE	9,5	0,9	0,9
2018	27,3	11,7	4,1	NE	18,0	1,9	1,8
2019	24,9	10,6	3,8	NE	18,0	2,0	1,8
Trend 1990-2019	-48,1%	69,6%	222,1%		82,4%	11,8%	9,5%
Trend 2018-2019	-8,6%	-9,6%	-9,0%		0,0%	2,9%	2,9%

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 2019).

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

Fuel	Unit	Ef	Reference	Table No.
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)*

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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)*

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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)*

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, $PM_{2,5}$
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" under this section from 1990-2010.

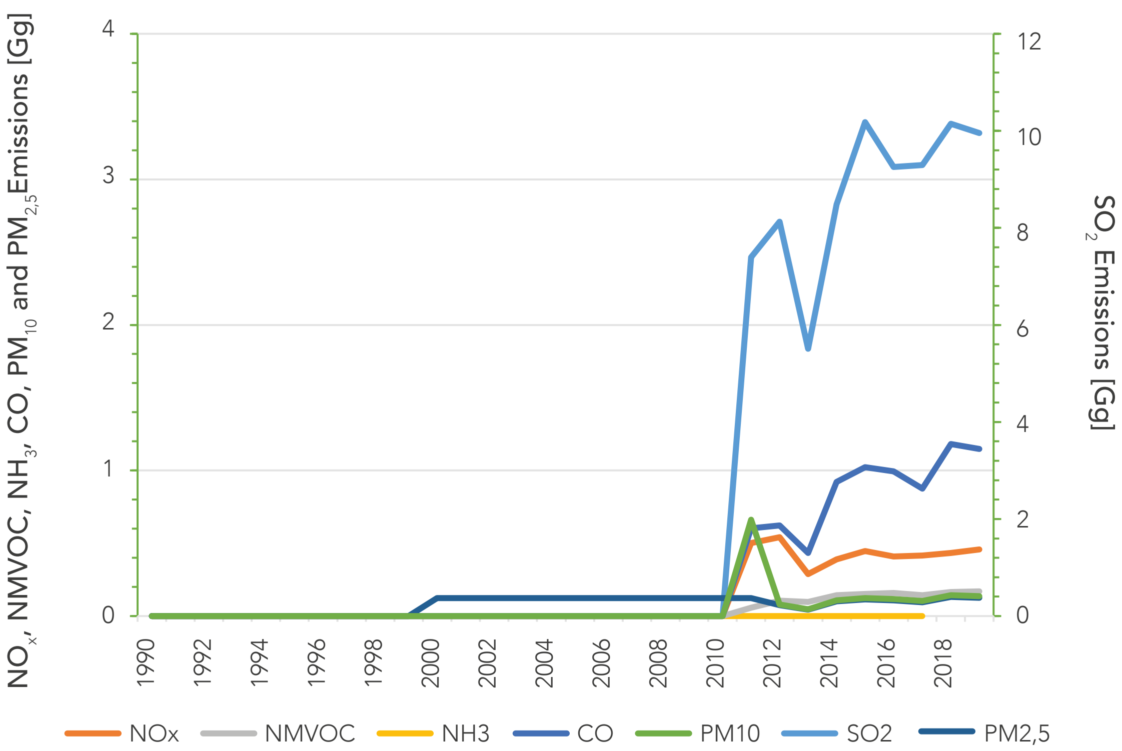
By 2011, energy balance tables were configured by the subcategories under manufacturing industries. Therefore emissions were calculated separately under the topic of Pulp, Paper and Print.

Activity data is originated from different type of fuels used in this sector and are taken from the energy balance tables (Source: Ministry of Energy and Natural resources 2017).

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

Figure 3-2-4
Emissions from 1.A.2.d Pulp, Paper and Print, 1990-2017

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.2.d Pulp, Paper and Print



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

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

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} emissions from NFR1.A.2.d Stat. Comb. in Man. Ind.: Pulp, Paper and Print

Year	Emissions[Gg]						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	IE	IE	IE	NE	IE	IE	NE
	IE	IE	IE	NE	IE	IE	NE
1992	IE	IE	IE	NE	IE	IE	NE
	IE	IE	IE	NE	IE	IE	NE
1994	IE	IE	IE	NE	IE	IE	NE
	IE	IE	IE	NE	IE	IE	NE
1996	IE	IE	IE	NE	IE	IE	NE
	IE	IE	IE	NE	IE	IE	NE
1998	IE	IE	IE	NE	IE	IE	NE
	IE	IE	IE	NE	IE	IE	NE
2000	IE	IE	IE	NE	IE	IE	0,4
	IE	IE	IE	NE	IE	IE	0,4
2002	IE	IE	IE	NE	IE	IE	0,4
	IE	IE	IE	NE	IE	IE	0,4
2004	IE	IE	IE	NE	IE	IE	0,4
	IE	IE	IE	NE	IE	IE	0,4
2006	IE	IE	IE	NE	IE	IE	0,4
	IE	IE	IE	NE	IE	IE	0,4
2008	IE	IE	IE	NE	IE	IE	0,4
	IE	IE	IE	NE	IE	IE	0,4
2010	IE	IE	IE	NE	IE	IE	0,4
	7,4	1,5	0,2	NE	1,8	2,0	0,4
2012	8,1	1,6	0,3	NE	1,9	0,2	0,2
	5,5	0,9	0,3	NE	1,3	0,1	0,1
2014	8,5	1,2	0,4	NE	2,8	0,3	0,3
	10,2	1,3	0,5	NE	3,1	0,4	0,3
2016	9,3	1,2	0,5	NE	3,0	0,3	0,3
	9,3	1,2	0,4	NE	2,6	0,3	0,3
2018	10,1	1,3	0,5	NE	3,5	0,4	0,4
2019	10,0	1,4	0,5	NE	3,4	0,4	0,4
Trend 1990-2019	34,5%	-8,9%	190,8%		90,4%	-79,3%	3,5%
Trend 2018-2019	-1,9%	5,3%	3,2%		-2,9%	-3,9%	-3,9%

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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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), 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 (combus-tion),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 (combus-tion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in in-dustry using hard or brown coal	Table 3-2

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
Coke	g/GJ	931	EMEP/EEA (2016), Chapter 1.A.2 Manufacturing industries and construction (combus-tion),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 (combus-tion),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 (combus-tion),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 (combus-tion),Table 3-2 Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2

Fuel	Unit	Ef	Reference	Table No.
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. Together with the amanedments od the energy balance tables this category covers the sum of sugar, food, drink and tobacco under the topic of manufacturing. 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, 1990-2019.

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

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.2.e Food processing, beverages and tobacco

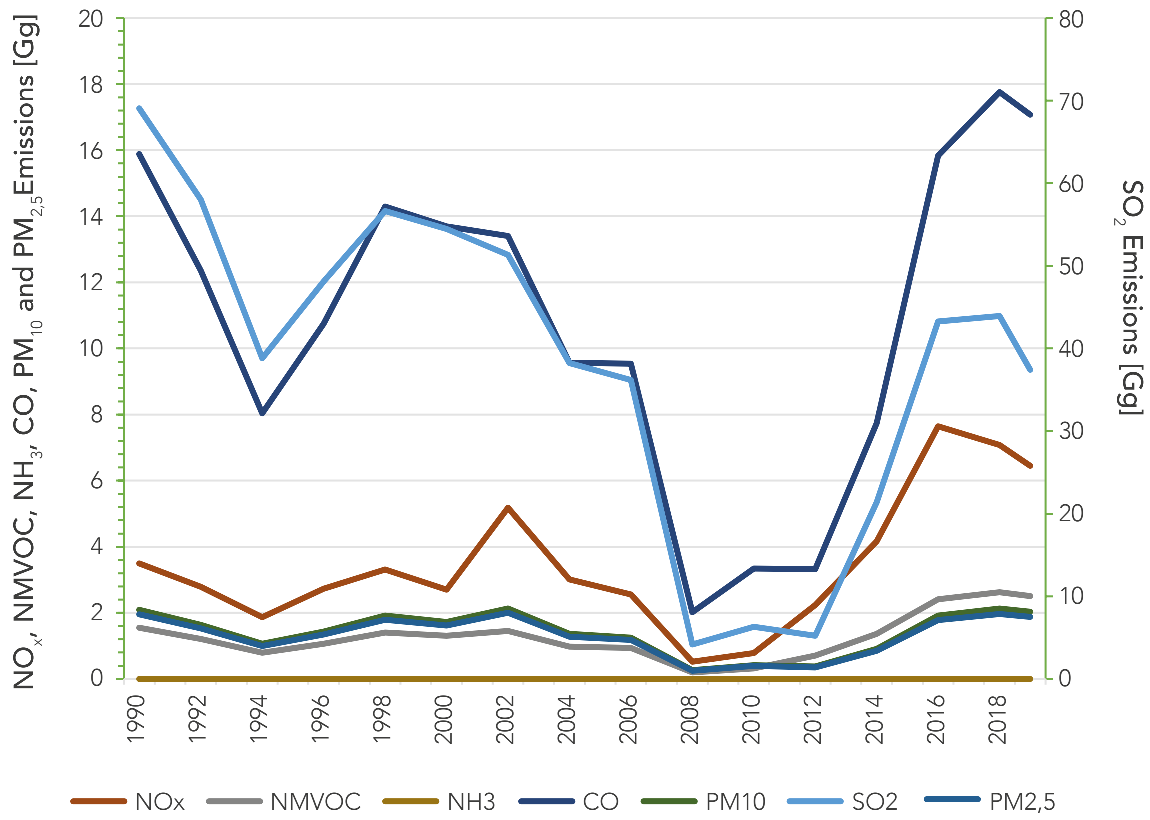


Table 3-2-9

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

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} emissions from NFR1.A.2.e Foodprocessing, beverages and tobacco

Year	Emissions[Gg]						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	69,1	3,5	1,6	NE	15,9	2,1	2,0
	73,6	3,5	1,5	NE	15,8	2,1	1,9
1992	58,0	2,8	1,2	NE	12,4	1,6	1,5
	55,5	2,5	1,1	NE	11,1	1,5	1,4
1994	38,8	1,9	0,8	NE	8,0	1,1	1,0
	39,6	2,0	0,8	NE	8,4	1,1	1,0
1996	48,1	2,7	1,1	NE	10,8	1,4	1,3
	48,8	2,7	1,1	NE	10,7	1,4	1,3
1998	56,6	3,3	1,4	NE	14,3	1,9	1,8
	58,1	3,2	1,4	NE	14,2	1,9	1,7
2000	54,5	2,7	1,3	NE	13,7	1,7	1,6
	58,8	5,2	1,6	NE	14,9	2,3	2,1
2002	51,3	5,2	1,4	NE	13,4	2,1	2,0
	47,2	3,5	1,2	NE	11,8	1,7	1,6
2004	38,2	3,0	1,0	NE	9,6	1,4	1,3
	43,0	2,7	1,0	NE	10,7	1,4	1,3
2006	36,2	2,6	0,9	NE	9,5	1,3	1,2
	26,5	1,6	0,6	NE	6,2	0,8	0,8
2008	4,2	0,5	0,2	NE	2,0	0,3	0,2
	6,3	0,6	0,3	NE	2,6	0,3	0,3
2010	6,3	0,8	0,3	NE	3,3	0,4	0,4
	3,9	0,7	0,2	NE	2,3	0,3	0,3
2012	5,2	2,2	0,7	NE	3,3	0,4	0,3
	8,5	3,5	1,1	NE	5,0	0,6	0,5
2014	21,4	4,2	1,4	NE	7,7	0,9	0,8
	41,9	6,6	2,2	NE	15,0	1,8	1,7
2016	43,3	7,6	2,4	NE	15,8	1,9	1,8
	43,2	6,5	2,4	NE	16,6	2,0	1,8
2018	43,9	7,1	2,6	NE	17,8	2,1	2,0
2019	37,4	6,5	2,5	NE	17,1	2,0	1,9
Trend 1990-2019	-45,8%	84,6%	61,5%		7,5%	-2,8%	-4,0%
Trend 2018-2019	-14,8%	-8,9%	-4,5%		-3,9%	-4,3%	-4,3%

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 2019).

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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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)*

Fuel	Unit	Ef	Reference	Table No.
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), 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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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)*

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

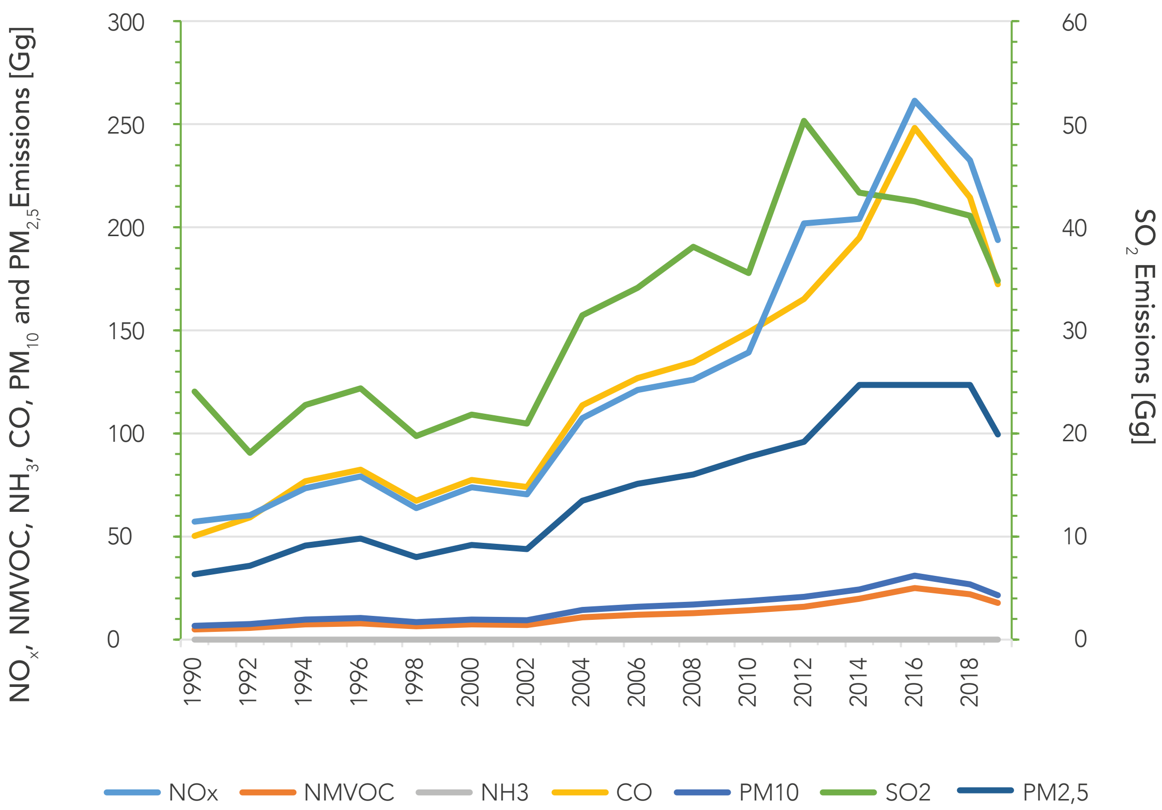
Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}, $PM_{2,5}$
Key Source: Yes (SO_2,NO_x, PM_{10})

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, 1990-2017

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.2.f Non-metallic Minerals



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

Table 3-2-11

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

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} emissions from NFR1.A.2.f Non-metallic Minerals

Year	Emissions[Gg]						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	120,3	11,4	4,9	NE	50,3	6,7	6,3
	108,4	13,1	5,7	NE	58,7	7,7	7,3
1992	90,6	12,1	5,7	NE	59,3	7,5	7,2
	88,9	12,4	5,9	NE	60,8	7,8	7,3
1994	113,8	14,7	7,3	NE	76,8	9,7	9,1
	113,9	13,3	6,6	NE	68,8	8,7	8,2
1996	121,9	15,8	7,9	NE	82,5	10,4	9,8
	111,9	14,2	7,1	NE	74,6	9,4	8,9
1998	98,8	12,8	6,4	NE	67,4	8,5	8,0
	98,2	16,6	8,3	NE	87,1	11,0	10,4
2000	109,2	14,8	7,4	NE	77,4	9,8	9,2
	116,8	13,7	6,8	NE	71,5	9,0	8,5
2002	104,9	14,1	7,1	NE	74,0	9,3	8,8
	124,9	15,7	7,9	NE	82,4	10,4	9,8
2004	157,2	21,5	10,9	NE	113,7	14,3	13,5
	163,3	23,9	12,0	NE	125,0	15,8	14,9
2006	170,6	24,2	12,1	NE	126,8	16,0	15,1
	152,5	22,5	11,4	NE	119,6	15,0	14,3
2008	190,5	25,2	12,9	NE	134,7	16,9	16,0
	170,0	26,7	13,6	NE	143,0	18,0	17,0
2010	177,8	27,9	14,2	NE	149,1	18,8	17,7
	253,9	32,7	14,1	NE	147,6	18,6	17,5
2012	251,6	40,4	15,9	NE	165,2	20,8	19,2
	218,0	35,9	17,6	NE	176,8	22,1	24,7
2014	216,8	40,8	19,7	NE	195,0	24,4	24,7
	203,5	46,3	22,4	NE	221,3	27,6	24,7
2016	212,6	52,3	25,0	NE	248,2	31,0	24,7
	220,1	52,3	24,0	NE	235,0	29,4	24,7
2018	205,6	46,5	21,9	NE	214,5	26,8	24,7
2019	174,1	38,8	17,8	NE	172,4	21,5	19,9
Trend 1990-2019	44,7%	238,8%	260,4%		242,7%	221,6%	214,2%
Trend 2018-2019	-15,3%	-16,6%	-18,9%		-19,6%	-19,6%	-19,4%

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 2019).

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 Fact

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

fuel	unit	EF	Reference	Table No.
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

fuel	unit	EF	Reference	Table No.
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)*

fuel	unit	EF	Reference	Table No.
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

fuel	unit	EF	Reference	Table No.
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

fuel	unit	EF	Reference	Table No.
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

fuel	unit	EF	Reference	Table No.
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)*

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 : Other

Source Category Description

Emissions: NOx, SO2, NMVOC, CO, PM10, $PM_{2,5}$
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 vehicle manufacturing and the 'other' manufacturing industry. "Other" subcategory covers under the listing of energy balance tables; fabric metal products, wood and products, mining, machine, electrical, electronical products, other transport vehicles manufacturing, furniture and other products, construction and other.

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 1990-2019 Emission totals are given in the table 3-2-13.

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.2.gviii Other Stationary

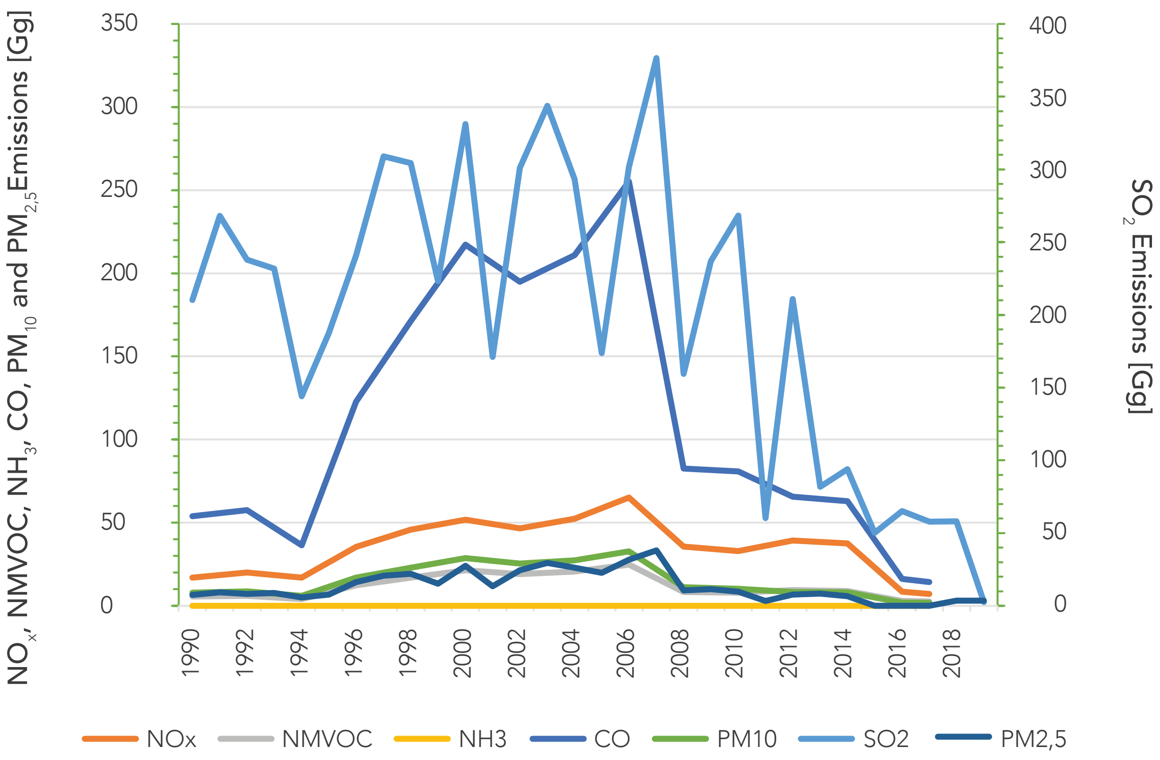


Table 3-2-13

Emissions from NFR 1.A.2.gviii. Other Stationary combustion in manufacturing industries and construction

SO2, NOx, NMVOC, NH3, CO and PM10 emissions from NFR1.A.2.gviii Other Stationary Combustion from Manufacturing Ind.

Year	Emissions[Gg]						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	210,2	17,0	5,6	NE	53,9	7,9	7,4
	268,0	20,5	7,0	NE	68,5	9,8	9,2
1992	237,9	20,0	6,0	NE	57,5	8,6	8,1
	231,7	22,7	6,5	NE	61,0	9,3	8,8
1994	144,0	17,0	4,1	NE	36,5	6,0	5,7
	187,6	22,5	5,6	NE	51,3	8,2	7,7
1996	240,7	35,3	12,4	NE	122,7	17,0	16,2
	309,0	44,4	16,0	NE	160,7	21,9	20,8
1998	304,4	45,8	17,0	NE	171,2	23,0	22,0
	223,1	33,7	11,5	NE	114,7	15,8	15,1
2000	331,2	51,8	21,3	NE	217,3	28,8	27,6
	171,2	27,6	10,5	NE	107,1	14,0	13,5
2002	301,1	46,7	19,0	NE	194,8	25,5	24,5
	343,8	60,2	22,9	NE	233,0	30,7	29,4
2004	293,3	52,3	20,5	NE	211,0	27,3	26,2
	173,6	48,8	17,5	NE	178,3	23,4	22,6
2006	301,7	65,1	24,8	NE	255,2	32,8	31,6
	376,5	77,9	30,0	NE	309,8	39,6	38,1
2008	159,5	35,6	8,4	NE	82,6	11,2	10,6
	236,7	33,0	9,0	NE	89,9	12,0	11,4
2010	268,2	32,8	8,0	NE	80,9	10,3	9,7
	60,4	14,7	2,7	NE	24,8	3,6	3,4
2012	210,8	39,3	9,5	NE	65,7	8,3	7,8
	81,8	77,2	10,9	NE	69,5	9,8	8,4
2014	93,9	37,6	8,8	NE	63,0	8,1	6,6
	50,2	6,8	2,3	NE	12,8	1,5	0,0
2016	65,0	8,5	2,9	NE	16,1	1,9	0,1
	57,8	7,1	2,6	NE	14,3	1,8	0,1
2018	58,1	15,4	4,3	NE	17,9	4,1	3,6
2019	2,6	8,2	1,6	NE	3,2	2,5	3,5
Trend 1990-2019	-98,8%	-52,0%	-71,5%		-94,0%	-68,7%	-53,1%
Trend 2018-2019	-95,6%	-47,2%	-63,0%		-82,0%	-39,3%	-4,6%

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 2019).

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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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)*

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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 using hard or brown coal	Table 3-2
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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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 12.76 Gg in 2019.
SO2 emissions increased from 0.12 Gg in 1990 to 0.94 Gg in 2019.
NMVOC emissions increased from 0.45 Gg in 1990 to 3.09 Gg in 2019.
CO emissions increased from 0,89 Gg in 1990 to 7.13 Gg in 2019.
Emission trends are presented in Figure 3.3.1 and Figure 3.3.2.

Figure 3.3.1
Emission trends for domestic LTO between 1990-2019

Emissions from Domestic LTO

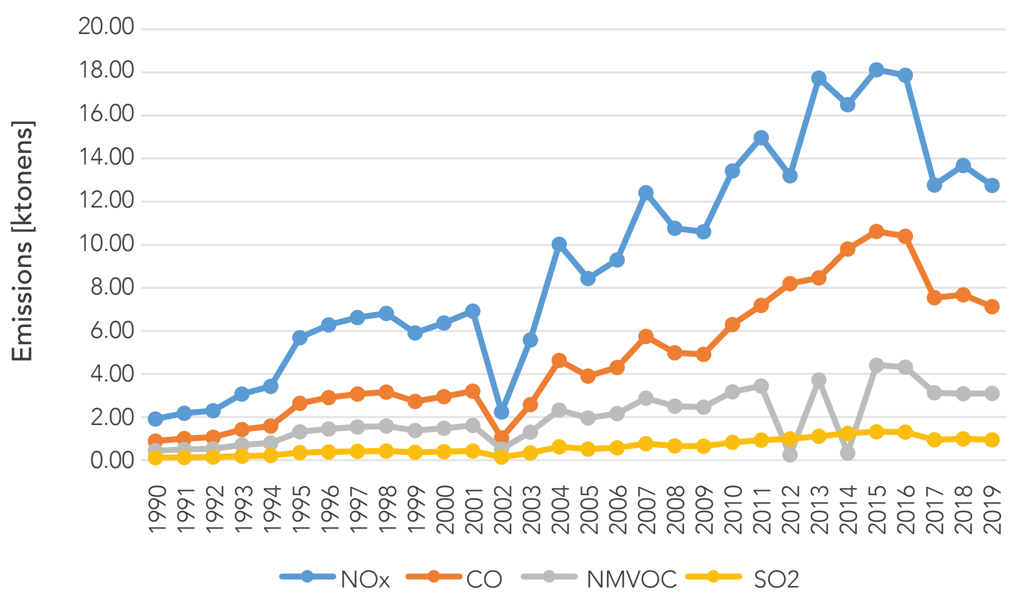


Table 3.2-15:
Emissions from sector NFR 1.A.3.a.ii (i) Civil Aviation, Domestic (LTO) for the period 1990 to 2019

Years	SO_2	NO_x	NMVOC		CO	
	ktonnes	ktonnes	ktonnes	ktonnes		
1990	0,12	1,92	0,45		0,89	
1991	0,13	2,17	0,50		1,00	
1992	0,14	2,30	0,53		1,07	
1993	0,19	3,07	0,71		1,42	
1994	0,21	3,42	0,79		1,58	
1995	0,35	5,69	1,32		2,63	
1996	0,38	6,27	1,46		2,90	
1997	0,41	6,63	1,54		3,07	
1998	0,42	6,81	1,58		3,15	
1999	0,36	5,90	1,37		2,73	
2000	0,39	6,37	1,48		2,95	
2001	0,42	6,92	1,61		3,20	
2002	0,14	2,24	0,52		1,03	
2003	0,34	5,58	1,30		2,58	
2004	0,61	10,02	2,33		4,64	
2005	0,52	8,43	1,96		3,90	
2006	0,57	9,30	2,16		4,30	
2007	0,76	12,41	2,88		5,74	
2008	0,66	10,77	2,50		4,98	
2009	0,65	10,60	2,46		4,91	
2010	0,83	13,43	3,17		6,30	
2011	0,93	14,97	3,44		7,19	
2012	0,98	13,20	0,25		8,20	
2013	1,11	17,73	3,72		8,46	
2014	1,24	16,51	0,34		9,80	

Years	SO_2	NO_x	NMVOC		CO	
	ktonnes	ktonnes	ktonnes	ktonnes		
2015	1,32	18,13	4,41		10,62	
2016	1,31	17,86	4,32		10,40	
2017	0,94	12,74	3,13		7,53	
2018	0,99	13,69	3,08	7,68		
2019	0,94	12,76	3,09	7,13		
Trend 1990 - 2019	699%	566%	595%	703%		
Trend 2018 - 2019	-5%	-7%	0%	-7%		

Figure 3.3.2
Emission trends for international LTO between 1990-2019

Emissions from international LTO

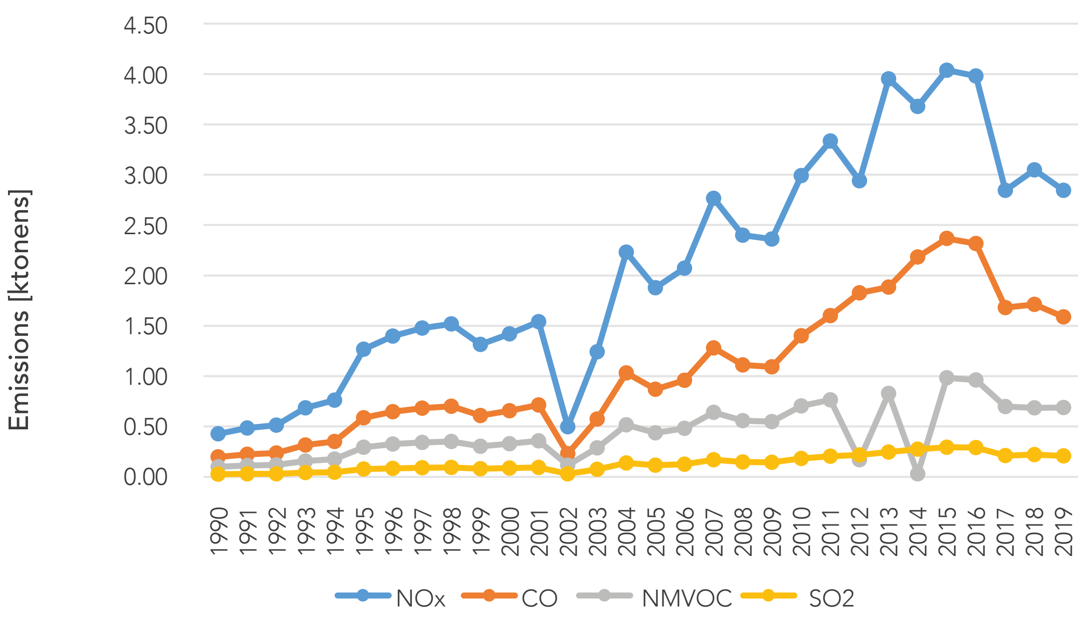


Table 32-16:
Emissions from sector NFR 1.A.3.a.i (i) International Aviation (LTO) for the period 1990 to 2019

Years	SO_2	NOx	NMVOC		CO	
	ktonnes	ktonnes	ktonnes	ktonnes		
1990	0,03	0,43	0,10		0,20	
1991	0,03	0,48	0,11		0,22	
1992	0,03	0,51	0,12		0,24	
1993	0,04	0,68	0,16		0,32	
1994	0,05	0,76	0,18		0,35	
1995	0,08	1,27	0,29		0,59	
1996	0,09	1,40	0,32		0,65	
1997	0,09	1,48	0,34		0,68	
1998	0,09	1,52	0,35		0,70	
1999	0,08	1,31	0,31		0,61	
2000	0,09	1,42	0,33		0,66	
2001	0,09	1,54	0,36		0,71	
2002	0,03	0,50	0,12		0,23	
2003	0,08	1,24	0,29		0,58	
2004	0,14	2,23	0,52		1,03	
2005	0,12	1,88	0,44		0,87	
2006	0,13	2,07	0,48		0,96	
2007	0,17	2,76	0,64		1,28	
2008	0,15	2,40	0,56		1,11	
2009	0,14	2,36	0,55		1,09	
2010	0,18	2,99	0,71		1,40	
2011	0,21	3,33	0,77		1,60	
2012	0,22	2,94	0,17		1,83	
2013	0,25	3,95	0,83		1,89	
2014	0,28	3,68	0,03		2,18	

Years	SO_2	NOx	NMVOC		CO	
	ktonnes	ktonnes	ktonnes	ktonnes		
2015	0,29	4,04	0,98		2,37	
2016	0,29	3,98	0,96		2,32	
2017	0,21	2,84	0,70		1,68	
2018	0,22	3,05	0,69	1,71		
2019	0,21	2,85	0,69	1,59		
Trend 1990 – 2019	699%	566%	595%	703%		
Trend 2018 - 2019	-5%	-7%	0%	-7%		

Source of Activity Data

Domestic LTO

For domestic aviation the number of LTO per aircraft type is available for the years 2009-2019. 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 calculation EMEP/EEA Guidebook 2019 is used. Emission factors are represented in Table 3-2-17 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	8.1	2.6
	(0.74 - 65)	(2.33 - 45)	(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	5.5	0.10
	(10.8- 38.20)	(5.5 -82.9)	(0.10 – 13.20)

Uncertainty

Estimation of uncertainties based on default values from EMEP/EEA emission inventory guidebook 2019.

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

Recalculations

No recalculation has been done for this inventory.

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, Maritime and Communication 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 2.01 Gg in 2019.
SO_2 emissions increased from 0.17 Gg in 1990 to 0.16 Gg in 2019.
NMVOC emissions decreased from 0.12 Gg in 1990 to 0.11 Gg in 2019.
CO emissions decreased from 1.22 Gg in 1990 to 1.13 Gg in 2019.

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). Forcalculation EMEP/EEA Guidebook 2019 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

No recalculation has been done for this inventory.

Planned Improvements

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

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

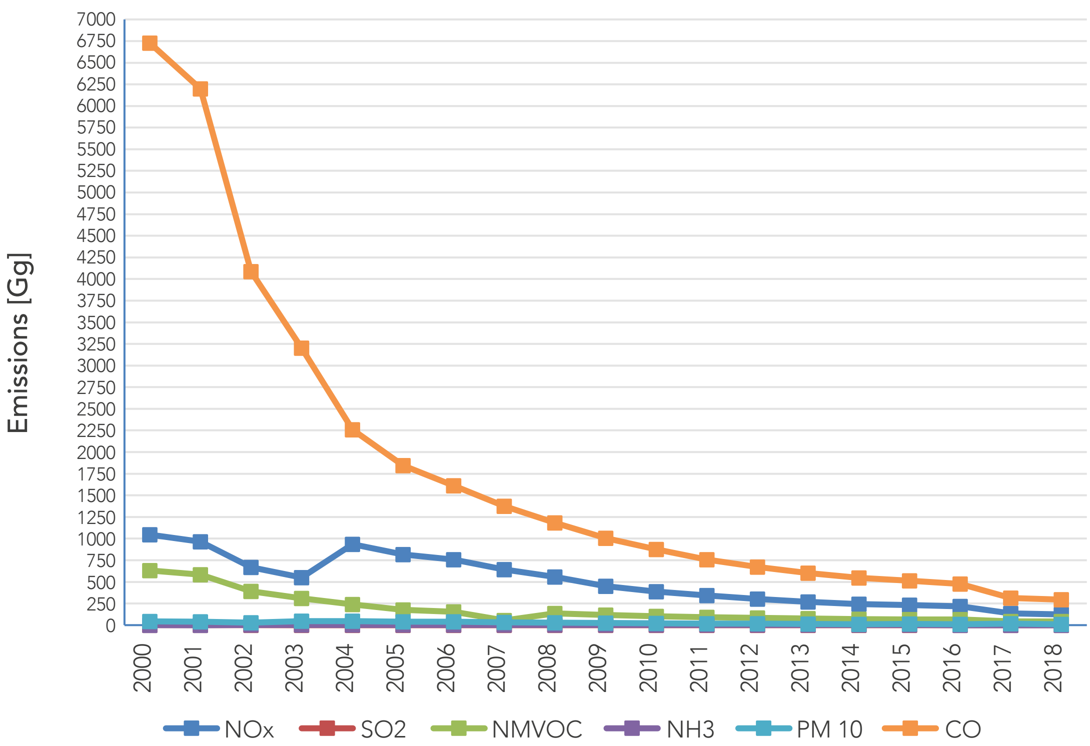
Emissions: NOx, SO2, NMVOC, NH3, CO, PM10
Key Source: Yes(NOx,NMVOC)

Emission Trends

NOx emissions decreased by about 88% from 1045Gg in 2000 to 124 Gg in 2019.
SO2 emissions decreased by about 11% from 0,072 Gg in 2000 to 0,064 Gg in 2019.
NMVOC emissions decreased by about 94% from 632Gg in 2000 to 42 Gg in 2019.
NH3 emissions increased by about 0,3% from 0,512 Gg in 2000 to 0,514 Gg in 2019.
CO emissions decreased by about 95% from 6427 Gg in 2000 to 294 Gg in 2019.
PM10 emissions decreased by about 80% from 44Gg in 2000 to 9 Gg in 2019.

Figures 3-2-13
Emissions with COPERT

National Total Emissions for 2000-2019



Emissions trend from road transport are presented for 2000-2019, however COPERT was run for 1990-2019.

Here we have revised the inventory reporting all time series 1990-2019 the Copert input files coming from Hey portal preparation Rcodes rewriting.

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

Recalculation is done for the time series 1990-2018. 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 39% from 9.86 Gg in 1990 5.97 Gg in 2019,

NMVOC emissions decreased by about 52% from 1.12 Gg in 1990 to 0.53 Gg in 2019,

CO emissions decreased by about 72% from 4.33 Gg in 1990 to 1.22 Gg in 2019,

PM10 emissions decreased by about 65% from 0.47 Gg in 1990 to 0.16 Gg in 2019.

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 1990 to 2019

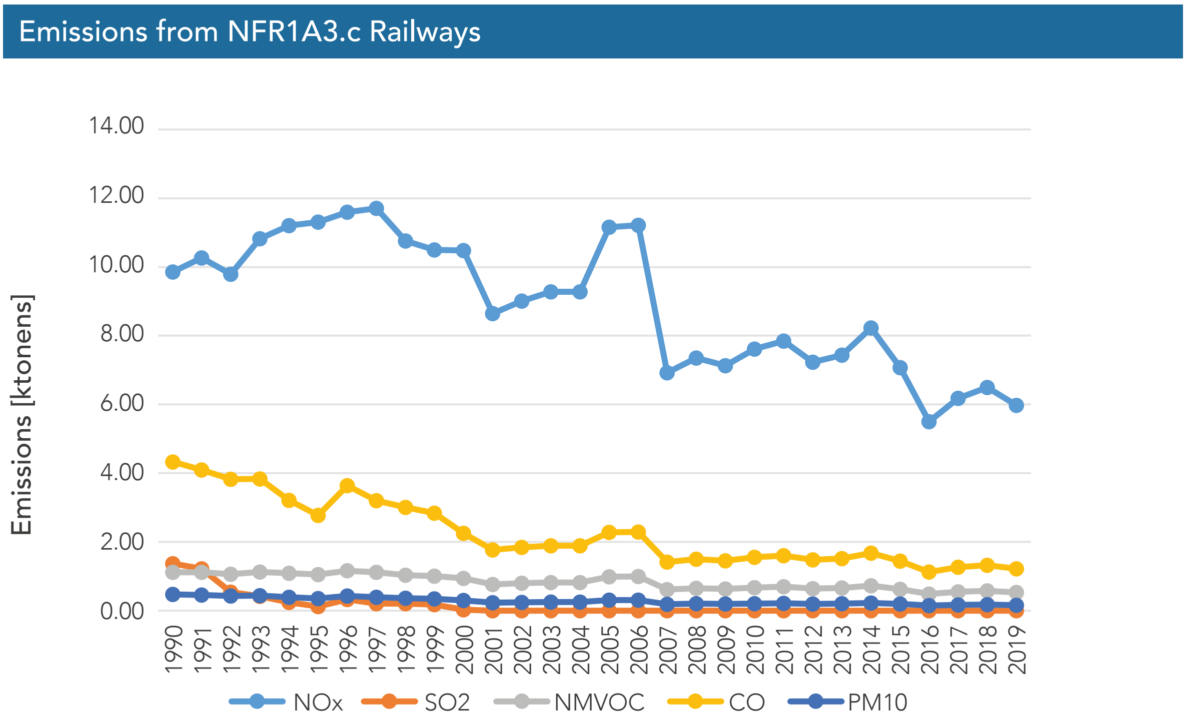


Table 3-2-21
Emissions from sector 1.A.3.c.Railways

Years	NOX	NMVOC	CO	PM10	SO2
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1990	9,86	1,12	4,33	0,47	1,37
1991	10,27	1,12	4,10	0,46	1,22
1992	9,79	1,06	3,82	0,43	0,54
1993	10,83	1,13	3,83	0,44	0,42
1994	11,21	1,09	3,22	0,39	0,24
1995	11,31	1,05	2,77	0,35	0,12
1996	11,59	1,16	3,64	0,43	0,33
1997	11,71	1,12	3,20	0,39	0,21

Years	NOX	NMVOC	CO	PM10	SO2
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1998	10,76	1,04	3,01	0,37	0,21
1999	10,50	1,00	2,84	0,35	0,18
2000	10,48	0,94	2,26	0,30	0,03
2001	8,65	0,77	1,77	0,24	0,00
2002	9,01	0,80	1,84	0,25	0,00
2003	9,27	0,82	1,89	0,25	0,00
2004	9,27	0,82	1,89	0,25	0,00
2005	11,16	0,99	2,28	0,31	0,00
2006	11,21	1,00	2,29	0,31	0,00
2007	6,92	0,61	1,41	0,19	0,00
2008	7,35	0,65	1,50	0,20	0,00
2009	7,13	0,63	1,46	0,20	0,00
2010	7,61	0,68	1,55	0,21	0,00
2011	7,84	0,70	1,60	0,22	0,00
2012	7,23	0,64	1,48	0,20	0,00
2013	7,44	0,66	1,52	0,20	0,00
2014	8,23	0,73	1,68	0,23	0,00
2015	7,07	0,63	1,44	0,19	0,00
2016	5,50	0,49	1,12	0,15	0,00
2017	6,18	0,55	1,26	0,17	0,00
2018	6,50	0,58	1,33	0,18	0,00
2019	5,97	0,53	1,22	0,16	0,00

Source of Activity Data

Activity data is annual fuel consumption data for railways in National Energy Balance Tables.

Methodological Issues

The applied methodology is TIER 1, which is a specific locomotive usage methodology and uses the algorithm below:

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 coverted from the EMEP/EEA GB 2019 Table 3.1 energy based factors using national net calorific values. Emission factors are presented in Table 3.2-22.

Table 3-2-22
Emission factor (EF) used sector 1.A.3.d.ii national navigation

Fuel	Unit	Ef	Reference
NOx			
Petroleum	kg/tonne	52.4	EMEP/EEA (2019), Chapter 1.A.3.c railways Tier 1 emission factors
Lignite	t/ktonne	1	
H.coal	t/ktonne	3	
SO2			
petroleum	kg/tonne	-	EMEP/EEA (2019), Chapter 1.A.3.c railways Tier 1 emission factors
Lignite	t/ktonne	46	
H.coal	t/ktonne	30	
NMVOC			
petroleum	kg/tonne	4.65	EMEP/EEA (2019), Chapter 1.A.3.c railways Tier 1 emission factors
Lignite	t/ktonne	4.45	
H.coal	t/ktonne	12.2	

Fuel	Unit	Ef	Reference
CO			
petroleum	kg/tonne	10.7	EMEP/EEA (2019), Chapter 1.A.3.c railways Tier 1 emission factors
Lignite	t/ktonne	42	
H.coal	t/ktonne	117	
PM10			
petroleum	kg/tonne	6.2	EMEP/EEA (2019), Chapter 1.A.3.c railways Tier 1 emission factors
Lignite	t/ktonne	3.72	
H.coal	t/ktonne	10.2	

Uncertainty

Estimation of uncertainties based on default values from GB.

Recalculations

No recalculation has been done for this inventory.

Planned Improvements

Improvement is planned to use National Emission Management System algortihms which already defined as Tier 3.

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

NO_x emissions increased by about 140% from 12.64 Gg in 1990 to 30.37 Gg in 2019.

SO_2 emissions increased by about 140% from 3.19 Gg in 1990 to 7.66 Gg in 2019.

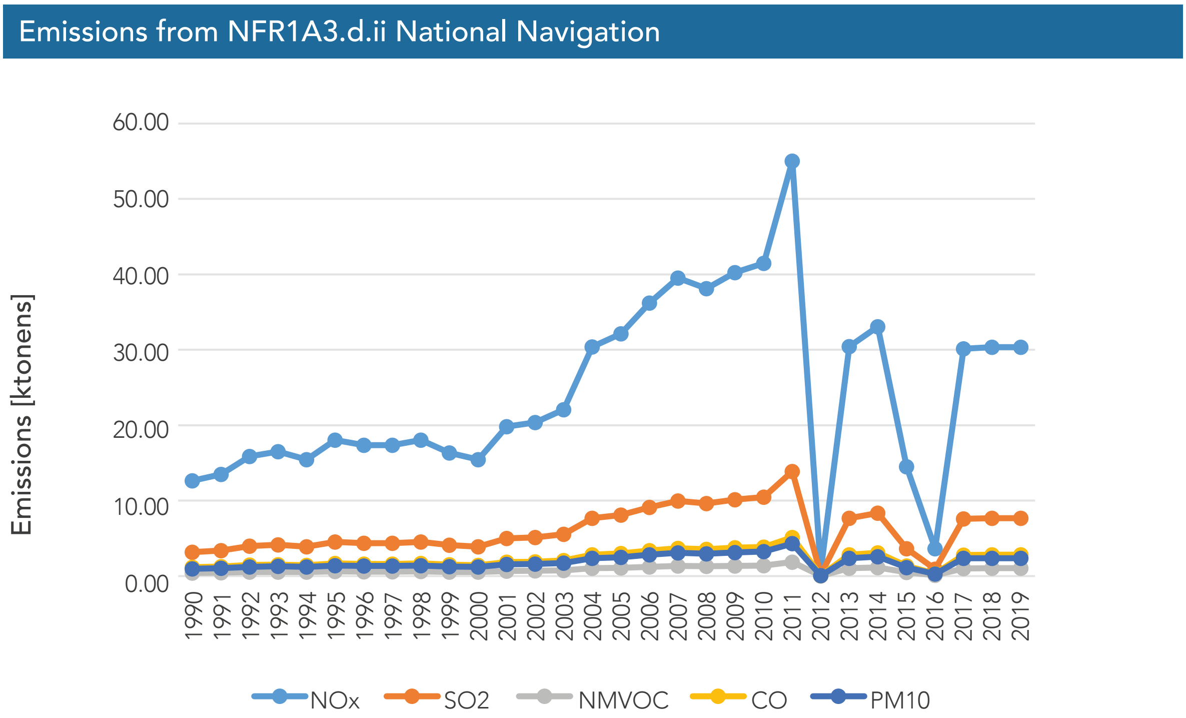
NMVOC emissions increased by about 140% from 0.43 Gg in 1990 1.03 Gg in 2019.

CO emissions increased by about about 140% from 1.18 Gg in 1990 to 2.83 Gg in 2019.

PM_{10} emissions increased by about 140% from 0.99 Gg in 1990 to 2.37 Gg in 2019.

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 2019



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

Years	NOx	SO2	NMVOC	CO	PM10
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
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	0,79	0,20	0,03	0,07	0,06
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
2016	3,65	0,92	0,12	0,34	0,29
2017	30,13	7,60	1,03	2,81	2,36
2018	30,37	7,66	1,03	2,83	2,37
2019	30,37	7,66	1,03	2,83	2,37

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 2019).

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 (2019), 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 (2019), 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 (2019), 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 (2019), Chapter 1.A.3.d shipping, Tier 1 emission factors for ships using bunker fuel oil, page 13

Fuel	Unit	Ef	Reference
PM10			
petroleum	kg/tonne	6.2	EMEP/EEA (2019), 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.

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

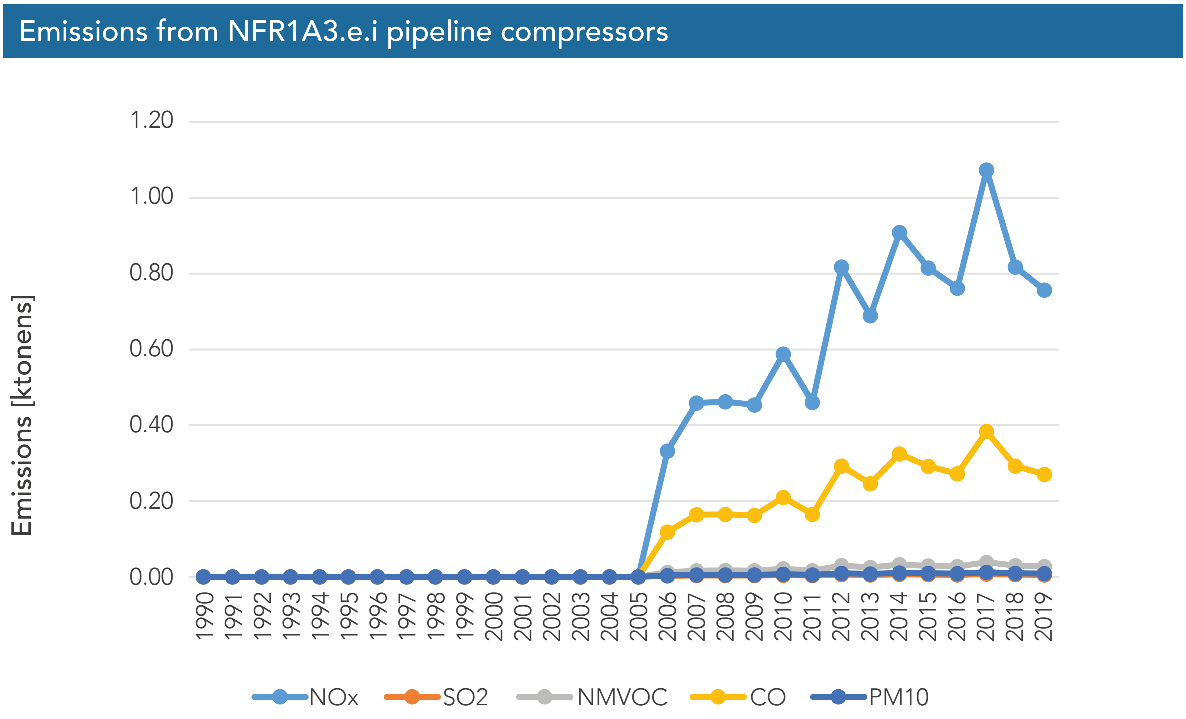
Emissions: NOx, SO2, NMVOC, PM10, CO
Key Source:No

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 2019



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	0
2005	0	0	0	0	0
2006	0,33	0.00	0,01	0,12	0.00
2007	0,46	0.00	0,02	0,16	0.00
2008	0,46	0.00	0,02	0,16	0.00
2009	0,45	0.00	0,02	0,16	0.00
2010	0,59	0.00	0,02	0,21	0.00
2011	0,46	0.00	0,02	0,16	0.00
2012	0,82	0.01	0,03	0,29	0.01

Years	NOx	SO2	NMVOC	CO	PM10
	kg	kg	kg	kg	kg
2013	0,69	0.00	0,02	0,25	0.00
2014	0,91	0.01	0,03	0,32	0.01
2015	0,81	0.01	0,03	0,29	0.01
2016	0,76	0.01	0,03	0,27	0.01
2017	1,07	0.01	0,04	0,38	0.01
2018	0,82	0.01	0.03	0,29	0.01
2019	0,76	0.01	0.03	0,27	0.01

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 m^3. 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 2019). 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 (2019), 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 (2019), 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 (2019), 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 (2019), 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 (2019), 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.

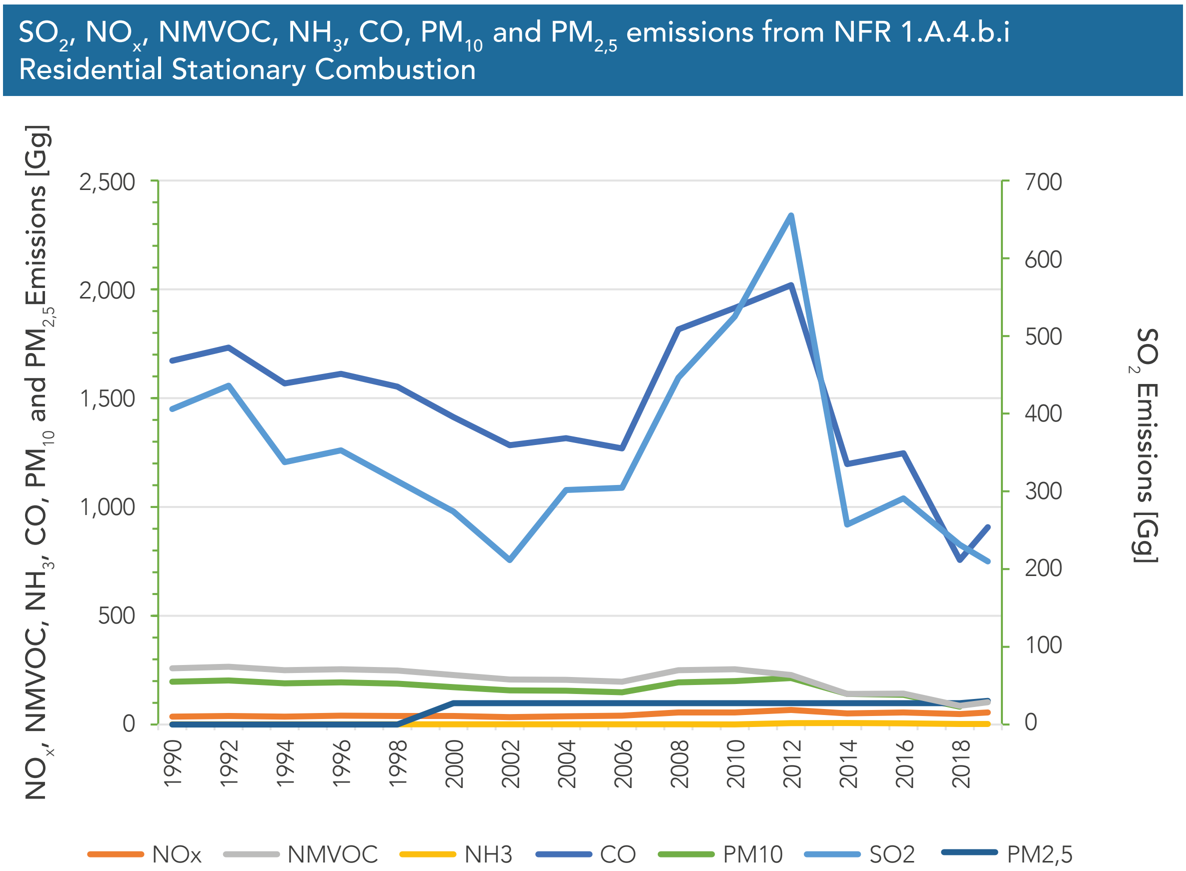
3.3.6.3. NFR 1.A.4.b.i Residential (Stationary)

Source Category Description

Emissions: NOx, SO_2, NMVOC, PM_{10}, CO, NH_3, $PM_{2,5}$
Key Source: Yes (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 stationary combustion.

SO2, NOx, NMVOC, NH3, CO and PM10 emissions from NFR1.A.4.b.i.
Residential Stationary Combustion

Year	Emissions[Gg]						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	405,8	36,9	258,0	0,87	1.671,6	197,2	NE
	417,3	37,8	260,5	0,87	1.690,6	199,1	NE
1992	436,0	39,8	265,5	0,88	1.732,9	203,1	NE
	402,7	39,5	262,2	0,88	1.696,0	200,2	NE
1994	337,7	36,3	249,1	0,88	1.567,0	189,1	NE
	362,3	39,9	257,3	0,89	1.638,0	195,6	NE
1996	352,7	40,5	254,7	0,89	1.611,6	193,2	NE
	380,4	42,8	261,0	0,89	1.670,7	198,4	NE
1998	313,4	39,8	248,5	0,88	1.552,2	187,9	NE
	268,7	37,7	233,8	0,84	1.444,2	176,4	NE
2000	274,2	39,0	227,6	0,81	1.413,7	171,7	98,5
	164,8	33,5	209,8	0,77	1.276,7	157,8	98,5
2002	211,7	34,0	207,6	0,75	1.284,4	156,6	98,5
	244,5	36,3	207,1	0,72	1.304,8	156,6	98,5
2004	301,7	38,2	205,7	0,70	1.315,3	155,8	98,5
	292,3	41,0	202,0	0,67	1.301,2	152,8	98,5
2006	304,7	40,9	196,1	0,65	1.269,0	148,3	98,5
	360,4	42,0	194,6	0,62	1.276,8	147,5	98,5
2008	446,3	55,4	249,0	0,64	1.815,8	193,4	98,5
	547,4	58,2	260,8	0,63	1.950,0	203,8	98,5
2010	525,0	55,4	254,7	0,60	1.915,4	199,5	98,5
	544,4	59,7	214,8	0,45	1.660,5	167,9	98,5
2012	655,1	67,0	228,1	6,41	2.019,5	213,6	98,5
	317,3	52,9	150,3	6,52	1.276,8	149,3	98,5
2014	257,5	50,6	141,2	6,26	1.196,5	140,7	98,5
	277,8	59,5	173,3	8,20	1.455,0	174,6	98,5
2016	291,0	56,2	142,7	4,78	1.247,5	136,4	98,5
	283,4	60,7	137,7	3,96	1.221,3	129,2	98,5
2018	231,5	48,4	86,0	2,83	756,2	81,9	98,5
2019	209,9	56,2	102,4	3,05	907,7	96,4	108,7
Trend 1990-2019	-48,3%	52,2%	-60,3%	251,2%	-45,7%	-51,1%	10,5%
Trend 2018-2019	-9,3%	16,1%	19,1%	7,9%	20,0%	17,6%	10,4%

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 2019).

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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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)*

Fuel	Unit	Ef	Reference	Table No.
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)

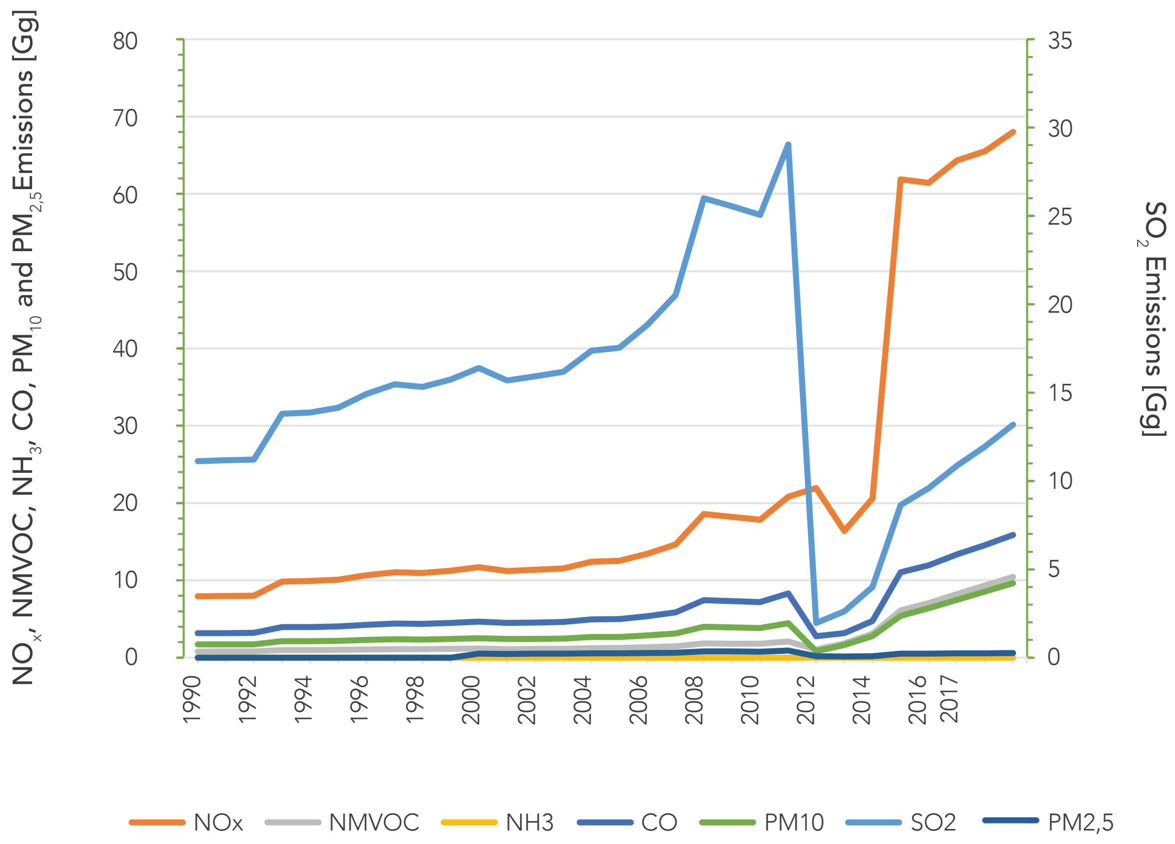
Source Category Description

Emissions: NO_x, SO_2, NMVOC, CO, PM_{10}, $PM_{2,5}$
Key Source: Yes (PM10, NOx)

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

Figure 3-2-17
Emission trend for 1A4ci

SO_2, NO_x, NMVOC, NH_3, CO, PM_{10} and $PM_{2,5}$ emissions from NFR 1.A.4.c.i Agriculture/Forestry/Fishing: Stationary Combustion



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

Table 3-2-28

Emissions from 1.A.4.c Agriculture/Forestry/Fisheries.

SO_2, NO_x, NMVOC, NH_3, CO and PM_{10} emissions from NFR1.A.4.c.i Agriculture/Forestry/Fishing: Stationary

Year	Emissions[Gg]						
	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}	$PM_{2,5}$
1990	11,1	7,9	0,8	NA	3,2	1,7	NE
	11,2	8,0	0,8	NA	3,2	1,7	NE
1992	11,2	8,0	0,8	NA	3,2	1,7	NE
	13,8	9,9	1,0	NA	3,9	2,1	NE
1994	13,9	9,9	1,0	NA	4,0	2,1	NE
	14,2	10,1	1,0	NA	4,0	2,2	NE
1996	14,9	10,7	1,1	NA	4,3	2,3	NE
	15,5	11,0	1,1	NA	4,4	2,4	NE
1998	15,3	10,9	1,1	NA	4,4	2,4	NE
	15,7	11,2	1,1	NA	4,5	2,4	NE
2000	16,4	11,7	1,2	NA	4,7	2,5	0,2
	15,7	11,2	1,1	NA	4,5	2,4	0,2
2002	15,9	11,4	1,1	NA	4,6	2,4	0,2
	16,2	11,6	1,2	NA	4,6	2,5	0,2
2004	17,4	12,4	1,2	NA	5,0	2,7	0,2
	17,5	12,5	1,3	NA	5,0	2,7	0,2
2006	18,8	13,5	1,3	NA	5,4	2,9	0,3
	20,5	14,7	1,5	NA	5,9	3,2	0,3
2008	26,0	18,6	1,9	NA	7,4	4,0	0,4
	25,5	18,2	1,8	NA	7,3	3,9	0,4
2010	25,1	17,8	1,8	NA	7,2	3,8	0,3
	29,0	20,8	2,1	NA	8,3	4,5	0,4
2012	2,0	22,0	1,1	NA	2,8	0,8	0,1
	2,6	16,4	1,8	NA	3,2	1,6	0,1
2014	4,0	20,6	3,1	NA	4,7	2,8	0,1
	8,6	61,9	6,1	NA	11,0	5,4	0,2
2016	9,6	61,4	7,1	NA	12,0	6,4	0,2
	10,9	64,3	8,2	NA	13,4	7,5	0,2
2018	12,0	65,5	9,3	NA	14,6	8,5	0,2
2019	13,2	68,0	10,4	NA	15,9	9,6	0,3
Trend 1990-2019	18,5%	755,9%	1214,8%	#DEĞER!	399,7%	464,0%	13,9%
Trend 2018-2019	10,3%	3,8%	11,9%	#DEĞER!	9,0%	12,8%	3,5%

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 2019).

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

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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), 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

Fuel	Unit	Ef	Reference	Table No.
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), 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), Tier 1 emission factors 1.A.2 Combustion in industry using hard or brown coal	Table 3-2

Fuel	Unit	Ef	Reference	Table No.
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

Fuel	Unit	Ef	Reference	Table No.
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)*

3.3.6.6. 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, fugitive category and the subcategories will be finalised by 2019.

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

By the EMISSION project mentioned in the introduction sections of the IIR, fugitive category and the subcategories will be finalised by 2019.

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 of the IIR, fugitive category and the subcategories will be finalised by 2019.

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 of the IIR, fugitive category and the subcategories will be finalised by 2019.

4

CHAPTER 4: 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

4.1.1 NFR 2.A.1 Cement Production

Source Category Description

Emissions: PM10

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

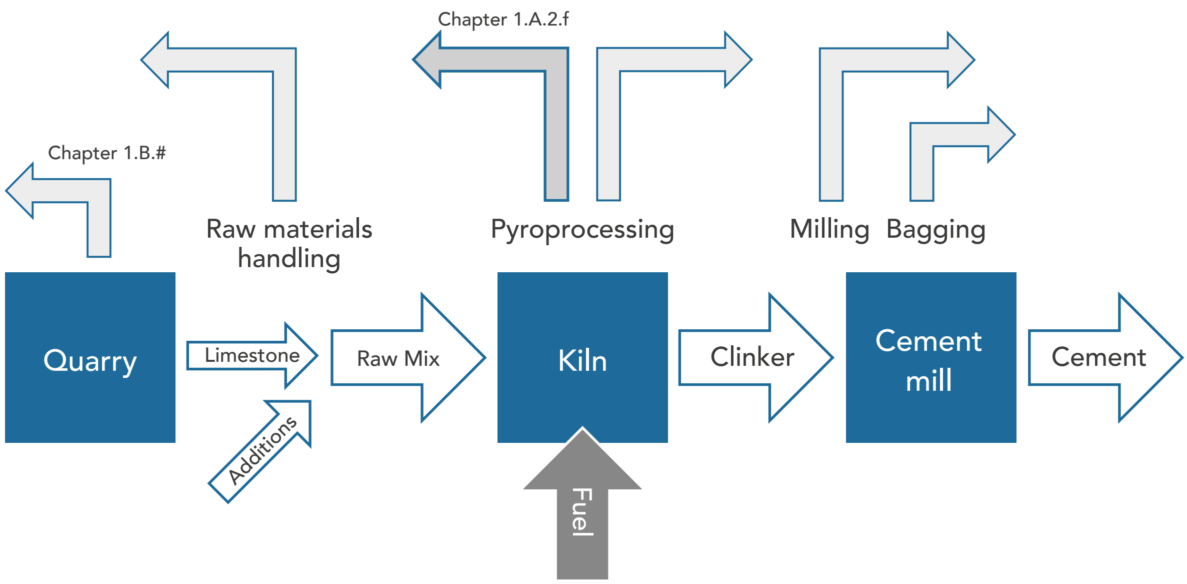
There are 48 integrated cement plants with 75 rotary kilns in Turkey. 15 plants are grinding and packing facilities. All cement plants are subject to the environmental permit. Clinker production capacity is 39 million tones and grinding capacity is 68 million tones by 2005. (Development plan 2007-2013)

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.

Emission Sources

Procution of cement involves four stages: extraction fo raw materials, pyroprocessing, blending of clinker and storage. Simplified process scheme in the GB is illustrated in Figure 4.1

Figure 4.1
Process scheme of Ammonia production



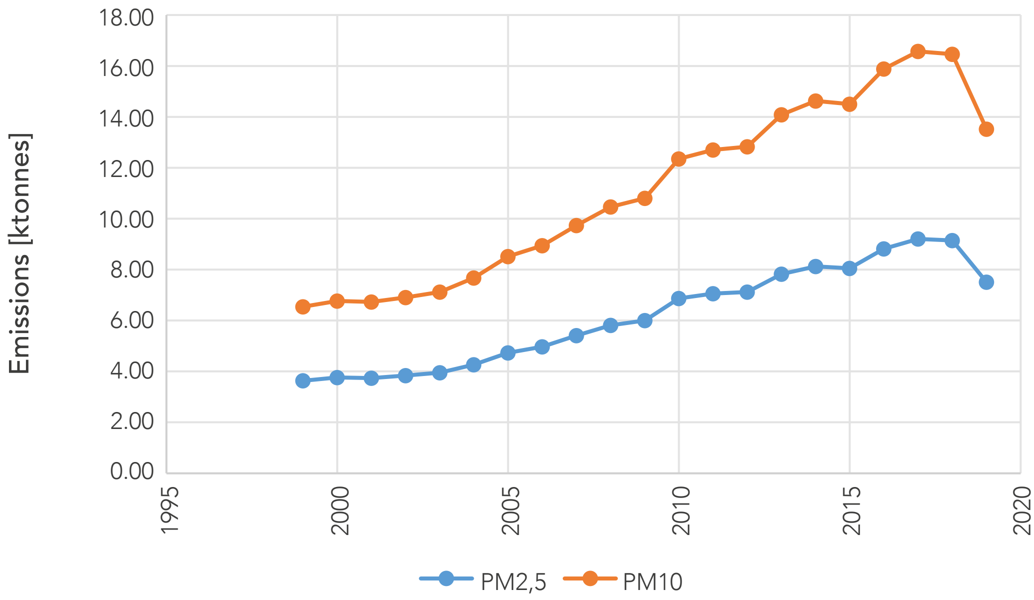
Emission Trends

PM10 emissions increased by about 107 % from 6.54 Gg in 1999 to 13.52 Gg in 2019, which is a share of 2% in total PM10 emissions in 2019.

Emission trends are illustrated in Figure 4.2 and emissions and activity data are presented in Table 4.1

Figure 4.3:
Emissions from NFR 2.A.1 cement production for the period 1999 to 2019

Emissions for NFR 2.A.1 Cement Production



Production of cement increased linearly between 1999-2018 and decreased in 2019.

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

Years	PM10	PM2.5	Clinker Production
	ktonnes	ktonnes	ktonnes
1999	3,64	3,64	27,97
2000	3,76	3,76	28,95
2001	3,74	3,74	28,75
2002	3,83	3,83	29,50
2003	3,95	3,95	30,42
2004	4,26	4,26	32,79
2005	4,73	4,73	36,40

Years	PM10	PM2.5	Clinker Production
	ktonnes	ktonnes	ktonnes
2006	4,97	4,97	38,20
2007	5,41	5,41	41,60
2008	5,81	5,81	44,70
2009	6,01	6,01	46,20
2010	6,86	6,86	52,80
2011	7,06	7,06	54,30
2012	7,12	7,12	54,80
2013	7,83	7,83	60,20
2014	8,13	8,13	62,50
2015	8,06	8,06	61,97
2016	8,82	8,82	67,86
2017	9,21	9,21	70,81
2018	9,14	9,14	70,34
2019	7,51	7,51	57,80
Trend 1999 – 2019	107%		
Trend 2018 - 2019	-18%		

Source of Activity Data

Production data was available in website of Turkish Cement Manufacturer's Associations for 1999-2019. 1990-1999 data is not calculated due to lack of activtiy data.

Methodological Issues

The applied methodology is TIER 1 uses the general equation:

Emissionpollutant = ∑ AD * EF

Where:

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

i = PM10

AD = annual national clinker production (Gg)

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

Source of Emission Factors

Default emission factors (Tier 1) for cement production are taken from the EMEP/EEA Emission Inventory Guidebook 2019.

Emission factors are presented in Table 4.3.

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

	Unit	EF	Reference
	g/Mg Clinker	234	EMEP/EEA (2019), Chapter 2.A Mineral Industry, Table 3-1 , page 10,Tier 1
PM2.5	g/Mg Clinker	130	

Uncertainty

No uncertainty analysis was carried out for this inventory.

Recalculations

Recalculations has been done for this inventory and fine particulate matter emission factor was used instead of particulate matter emission factor .

Planned Improvements

It is planned to use plant specific data in next coming years. 1990-1999 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.

4.1.2 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.

4.1.3 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.

4.1.4 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.

4.1.5 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.

4.1.6 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.

4.1.7 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 2B Chemical Industry

Figure 4.2 and Table 4.4 presents the emissions, trend and share within NFR 2.B.Chemical Industry.

Figure 4.2:
Emissions from NFR 2.B.Chemical Industry.

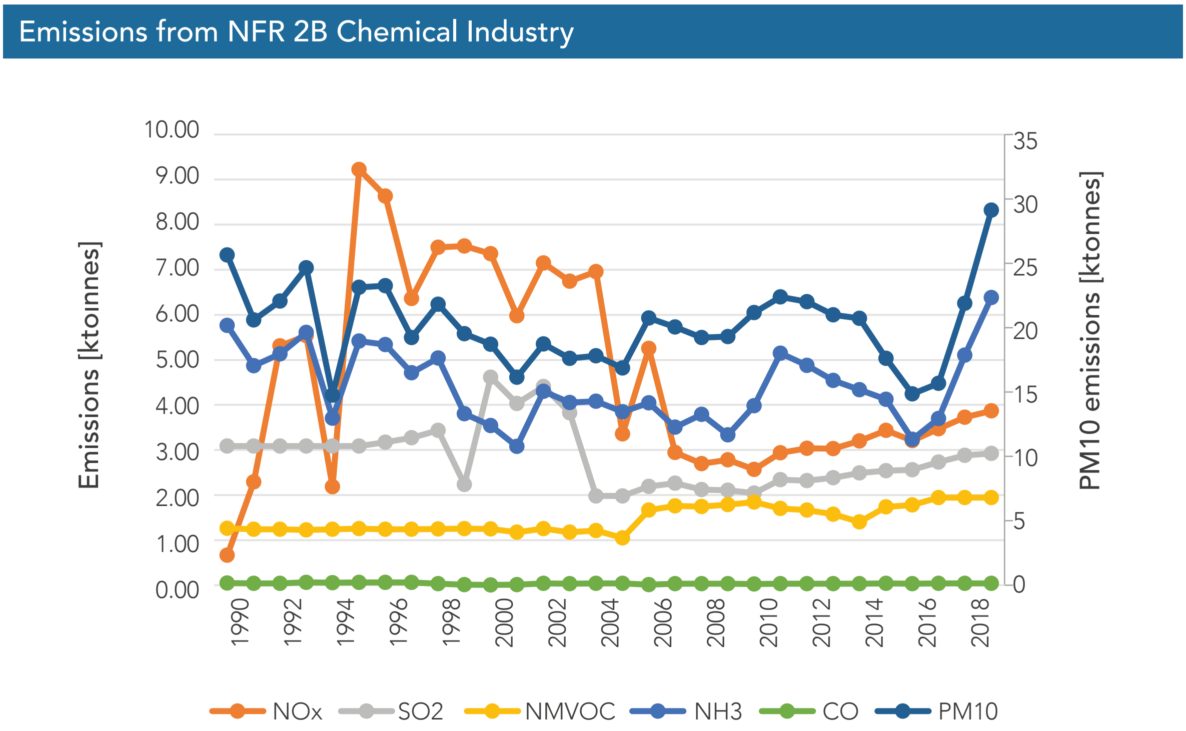


Table 4.4:
Emissions from NFR 2.B.Chemical Industry.

	SO_2	NO_x	NMVOC	NH_3	CO	PM_{10}
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1990	3,09	0,66	1,26	5,76	0,04	25,651
1991	3,09	2,29	1,24	4,87	0,04	20,604
1992	3,09	5,31	1,24	5,13	0,04	22,058
1993	3,09	5,54	1,23	5,61	0,06	24,64
1994	3,09	2,18	1,24	3,71	0,05	14,747
1995	3,09	9,22	1,25	5,42	0,06	23,125
1996	3,17	8,63	1,24	5,33	0,06	23,247
1997	3,27	6,36	1,24	4,71	0,06	19,224
1998	3,43	7,49	1,25	5,04	0,04	21,825
1999	2,24	7,53	1,25	3,80	0,01	19,533
2000	4,61	7,35	1,24	3,54	0,01	18,706
2001	4,03	5,98	1,18	3,08	0,01	16,14
2002	4,41	7,15	1,25	4,30	0,04	18,732
2003	3,82	6,74	1,18	4,05	0,04	17,618
2004	1,98	6,96	1,21	4,08	0,04	17,803
2005	1,98	3,36	1,05	3,85	0,04	16,871
2006	2,19	5,25	1,67	4,04	0,01	20,749
2007	2,26	2,94	1,76	3,51	0,03	20,04
2008	2,12	2,70	1,74	3,79	0,03	19,221
2009	2,11	2,78	1,79	3,34	0,03	19,297
2010	2,04	2,57	1,84	3,98	0,03	21,166
2011	2,34	2,94	1,70	5,15	0,03	22,39
2012	2,32	3,04	1,67	4,87	0,03	22,02
2013	2,38	3,03	1,57	4,55	0,03	20,992
2014	2,49	3,20	1,40	4,33	0,04	20,719
2015	2,54	3,43	1,74	4,13	0,04	17,604
2016	2,56	3,21	1,78	3,24	0,04	14,85
2017	2,73	3,47	1,94	3,70	0,04	15,684
2018	2,88	3,72	1,94	5,10	0,04	21,89
2019	2,924	3,87	1,94	6,38	0,04	29,12
Trend 1990 – 2019	-5%	483%	53%	11%	-4%	14%
Trend 2018 – 2019	2%	4%	0%	25%	4%	33%

4.2.1 NFR 2.B.1 Ammonia Production

Source Category Description

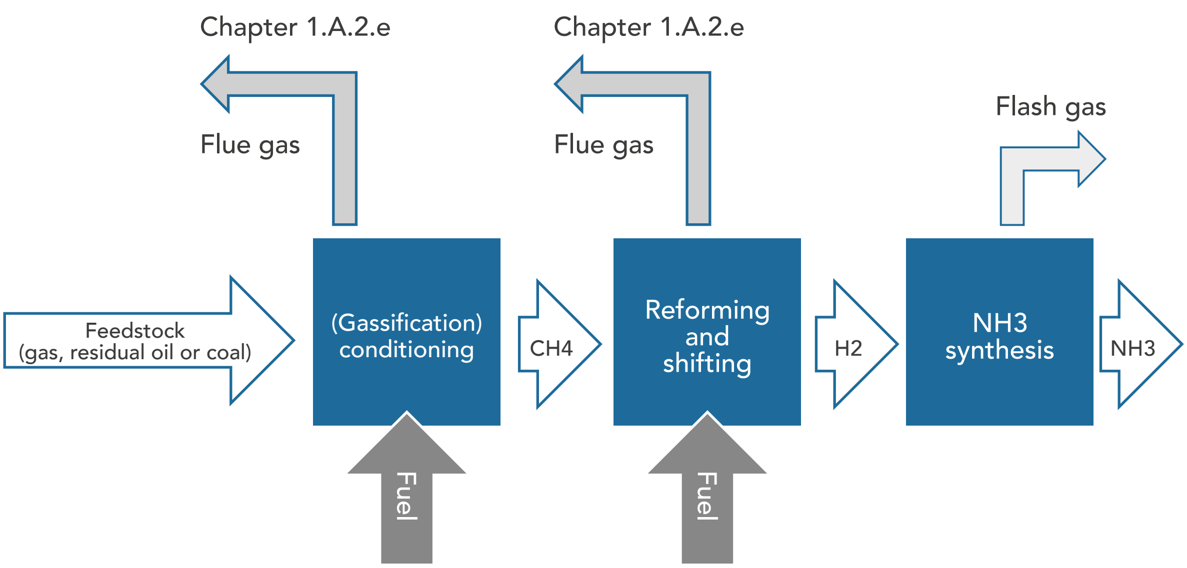
Emissions: NO_x, NH_3, CO
Key Source: No

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 4.3

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 4.3
Process scheme of Ammonia production



Emission Trends

NO_x emissions decreased by about 4 % from 0.446 Gg in 1990 to 0.427 Gg in 2019, which is a share of less than 1% in total NO_x emissions in 2019.

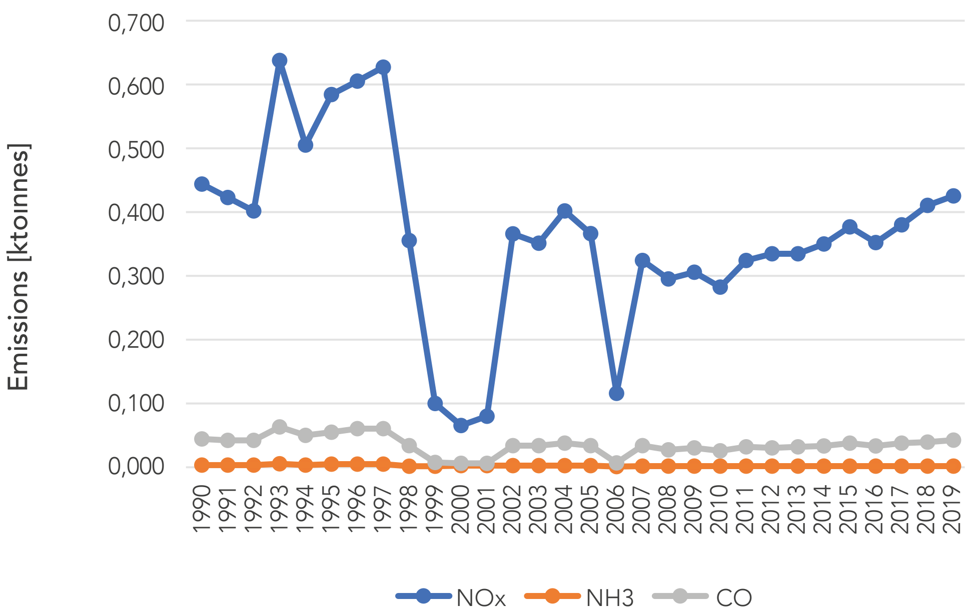
NH_3 emissions decreased by about 4 % from 0.0045 Gg in 1990 to 0.0043 Gg in 2019, which is a share of less than 1% in total NH_3 emissions in 2019.

CO emissions decreased by about 4 % from 0.045 Gg in 1990 to 0.043 Gg in 2019, which is a share of less than 1% in total CO emissions in 2019.

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

Figure 4.4:
Emissions from NFR 2.B.1 ammonia production for the period 1990 to 2019

Emissions from NFR 2B1 Ammonia Production



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 4.5:
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	0,283	0,003	0,028	283,3
2011	0,324	0,003	0,032	324,2
2012	0,335	0,003	0,034	335,2
2013	0,334	0,003	0,033	334,4
2014	0,353	0,004	0,035	353,0
2015	0,379	0,004	0,038	378,8
2016	0,354	0,004	0,035	354,1
2017	0,383	0,004	0,038	382,9
2018	0,411	0,004	0,041	411,0
2019	0,427	0,004	0,043	426,9
Trend 1990 - 2019	-4%			
Trend 2018 - 2019	4%			

Source of Activity Data

Production data was available in CRF tables for 1990-2006. 2007-2019 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:

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 2019.

Emission factors are presented in Table 4.6.

Table 4.6:
Emission factor (EF) used sector 2.B.1 Ammonia production

	Unit	EF	Reference
NO_x	kg/tonne NH_3	1	EMEP/EEA (2019), 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 2007-2019 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

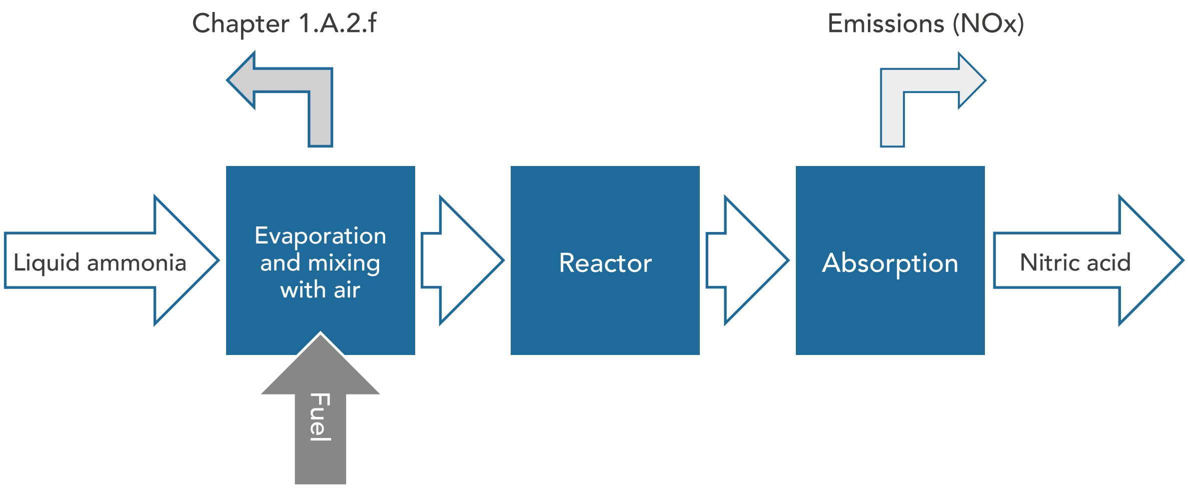
Emissions: NO_x
Key Source: No

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 4.5 This process is a source of NO_x emissions at least.

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

Figure 4.5:
Process scheme of nitric acid production



Emission Trends

NO_x emissions increased by about 1483 % from 0.217 Gg in 1990 to 3.342 Gg in 2019, which is a share of less than 1% in total NO_x emissions in 2019.

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

Figure 4.6
Emissions from NFR 2.B.2 nitric acid production for the period 1990 to 2019

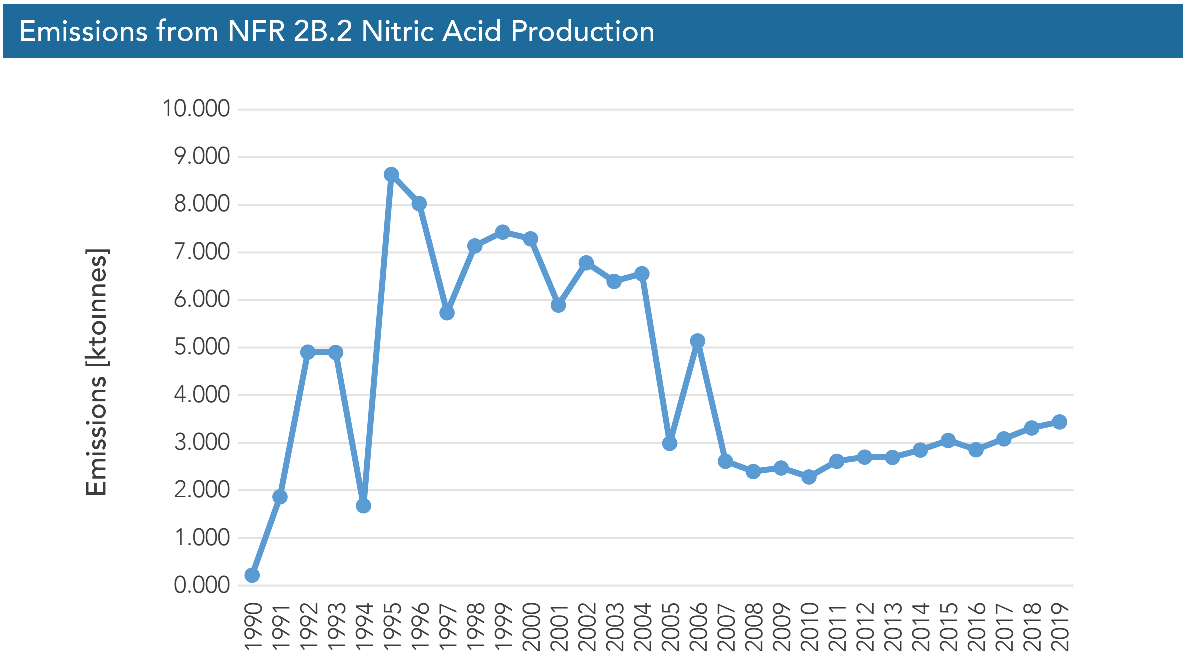


Table 4.6
Emissions from NFR sector 2.B.2 Nitric Acid production and activity data

	NO_x	HNO_3 Production
	ktonnes	ktonnes
1990	0.22	21.75
1991	1.87	186.73
1992	4.90	490.50
1993	4.90	489.85
1994	1.68	167.96
1995	8.64	863.89
1996	8.03	802.89
1997	5.74	573.70
1998	7.14	713.64
1999	7.43	742.76
2000	7.29	728.73
2001	5.90	589.62
2002	6.79	678.63
2003	6.39	639.07
2004	6.56	655.76
2005	2.99	298.81
2006	5.14	514.06
2007	2.62	261.61
2008	2.40	239.80
2009	2.48	247.59
2010	2,28	228,44
2011	2,61	261,43
2012	2,70	270,28
2013	2,70	269,67
2014	2,85	284,64
2015	3,05	305,40
2016	2,86	285,55
2017	3,09	308,76
2018	3,31	331,36
2019	3,44	344,19
Trend 1990 – 2019	1483%	
Trend 2018 – 2019	4%	

Source of Activity Data

Production data was available in CRF tables for 1990-2006. 2007-2019 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:

Emission pollutant = ∑ 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 2019.

Emission factors are presented in Table 4.7.

Table 4.7
Emission factor (EF) used sector 2.B.2 Nitric Acid production

	Unit	EF	Reference
NOx	kg/Mg HNO_3	10	EMEP/EEA Guidebook(2019) 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 also included to greenhouse gas emission inventory.

4.2.4 NFR 2.B.5 Carbide Production

Source Category Description

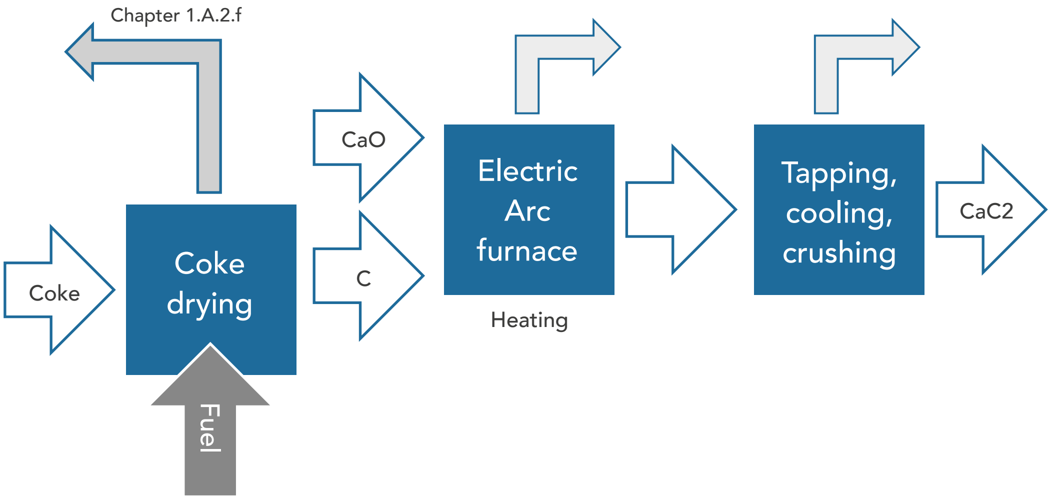
Emissions: NO_x, CO, PM10
Key Source : No

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 4.7

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 4.7:
Process scheme for carbide production



Emission Trends

PM_{10} emissions decreased by about 18 % from 0.003 Gg in 1990 to 0.0025 Gg in 2019, which is a share of less than 1% in total PM_{10} emissions in 2019.

Emission trends are illustrated in Figure 4.8 and emissions and activity data are presented in Table 4.8

Figure 4.8
Emissions from NFR 2.B.5 carbide production for the period 1990 to 2019

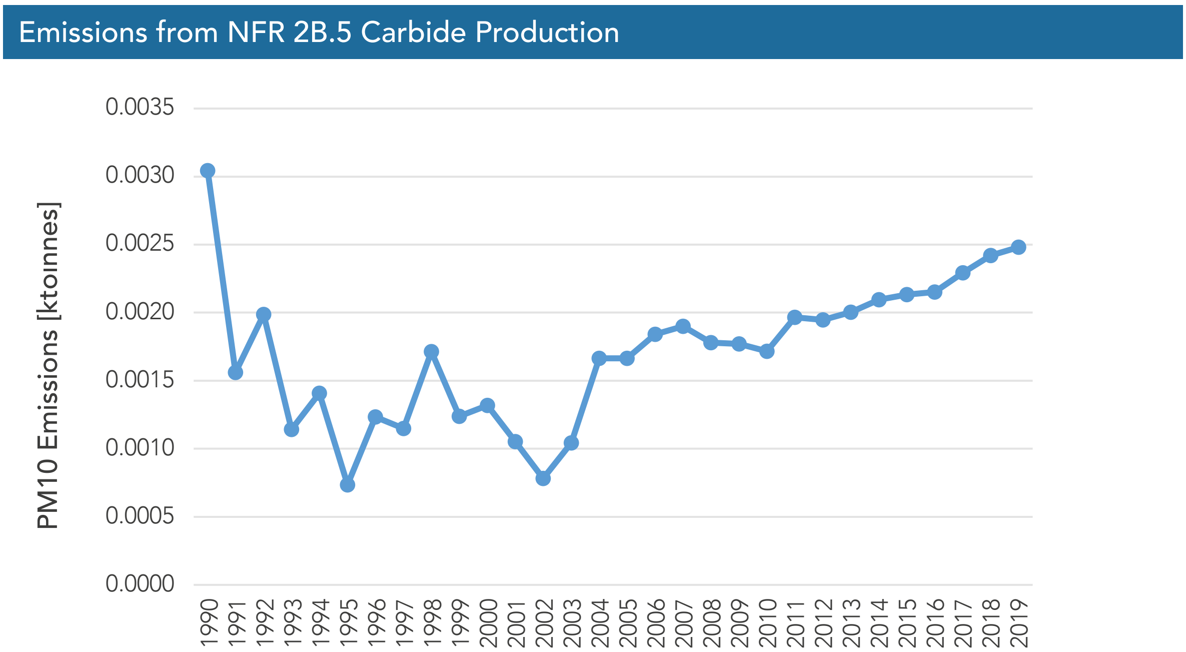


Table 4.8
Emissions from NFR sector 2.B.5 Carbide production and activity data

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	0,0017	21,47
2011	0,0020	24,56
2012	0,0019	24,35
2013	0,0020	25,04
2014	0,0021	26,19
2015	0,0021	26,67
2016	0,0022	26,91
2017	0,0023	28,67
2018	0,0024	30,24
2019	0,0025	30,72
Trend 1990 – 2019	-18%	
Trend 2018 – 2019	3%	

Source of Activity Data

Production data was available in CRF tables for 1990-2004. 2005 is assumed same as 2004 data. 2006-2019 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 2019.

Emission factors are presented in Table 4.9.

Table 4.9:
Emission factor (EF) used sector 2.B.5 Carbide production

	Unit	EF	Reference
TSP	g/Mg Product	100	EMEP/EEA Guidebook(2019) 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.

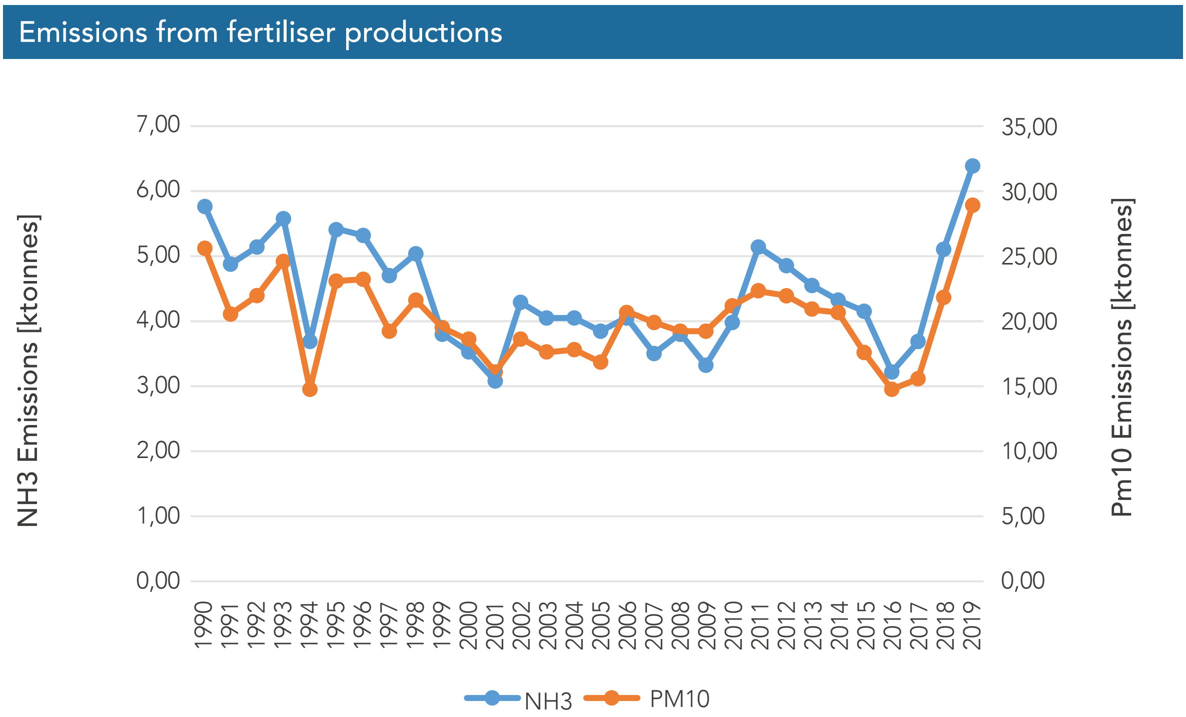
Emission Trends

NH_3 emissions increased by about 11 % from 5.8 Gg in 1990 to 6.4 Gg in 2019, which is a share of 1 % in total NH_3 emissions in 2019.

PM_{10} emissions increased by about 25% from 26 Gg in 1990 to 29 Gg in 2019, which is a share of 60% in total PM_{10} emissions in 2019.

Emission trends are illustrated in Figure 4.9 while emissions are presented in Table 4.10. Activity data are given in Annex C.23.

Figure 4.9:
Emissions from NFR 2.B.10.a fertiliser production for the period 1990 to 2019



The annual changes in emissions reflect the changes in production volumes and parallel for both pollutants.

Table 4.10
Emissions from sector 2.B.10.a Fertiliser Production

Years	NH_3	PM_{10}
	ktonnes	ktonnes
1990	5,76	25,63
1991	4,86	20,58
1992	5,13	22,03
1993	5,60	24,62
1994	3,70	14,72
1995	5,41	23,10
1996	5,33	23,22
1997	4,71	19,20
1998	5,03	21,80
1999	3,80	19,51
2000	3,54	18,68
2001	3,08	16,12
2002	4,30	18,71
2003	4,05	17,60
2004	4,08	17,78
2005	3,84	16,85
2006	4,04	20,73
2007	3,50	20,02
2008	3,79	19,20
2009	3,33	19,27
2010	3,98	21,14
2011	5,15	22,37
2012	4,87	22,00
2013	4,54	20,97
2014	4,33	20,70
2015	4,12	17,58
2016	3,23	14,83
2017	3,69	15,66
2018	5,10	21,86
2019	6,38	29,09
Trend 1990 - 2019	11%	41%
Trend 2018 - 2019	25%	33%

Source of Activity Data

Production data was available from web site of Ministry of Agriculture, Food and Livestock as annual statistics.

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 2019.

Emission factors are presented in Table 4.11, 4.12, 4.13 and 4.14

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

	Unit	EF	Reference
TSP	kg/tonne	6	EMEP/EEA (2019), Chapter 2.B Chemical Industry, Table 3-26 , page 27,Tier2, controlled emission factors are used with %90 efficiency
PM10	*kg/tonne*	*4.8*	Since PM10 EF is not given in the guidebook, it is assumed PM10 is 80% of TSP

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

	Unit	EF	Reference
NH_3	kg/tonne	3	EMEP/EEA (2019), Chapter 2.B Chemical Industry, Table 3-27 , page 28
TSP	kg/tonne	20	
PM10	*kg/tonne*	*16*	Since PM10 factor is not given in the guidebook, it is assumed PM10 is 80% of TSP. Controlled emission factors are used with %90 efficiency

Table 4.13
Emission factor (EF) used sector 2.B.10.a other chemical industry, ammonium phosphate production

	Unit	EF	Reference
TSP	kg/tonne	0.3	EMEP/EEA (2019), Chapter 2.B Chemical Industry, Table 3-28 , page 29 EMEP/EEA
PM_{10}	kg/tonne	0.240	

Table 4.14
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 (2019), 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

Controlled emission factors are used since all fertilizer facility have controlled equipments. National historic activity datasets were included to calculations. Calcium ammonium nitrate production amounts were not included to emission calculation in previous submissions. EMEP/EEA guidebook classified calcium ammonium nitrate and ammonium nitrate as ammonium nitrate, therefore production amounts were summed and emissions were recalculated.

Planned Improvements

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 decreased by about 5 % from 3.09 Gg in 1990 to 2.92 Gg in 2019 which is a share of less than 1% in total SO_2 emissions in 2019.

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.10.a sulphuric acid production for the period 1990 to 2019

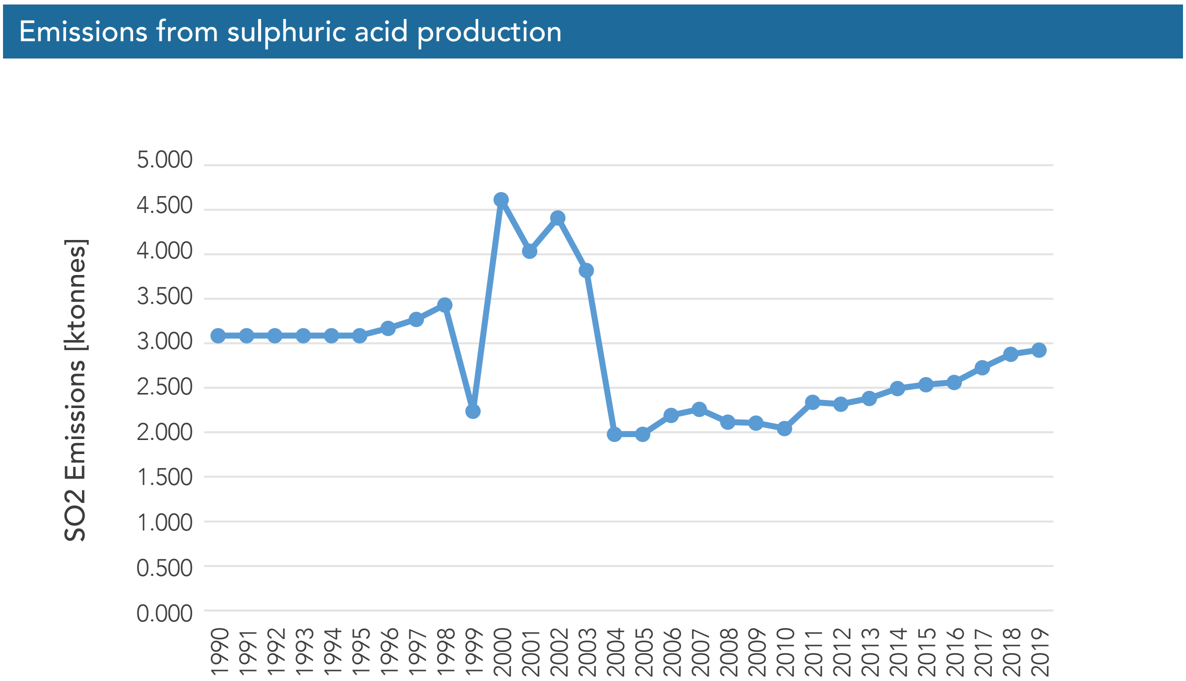


Table 4.15
Emissions from NFR sector 2.B.10.a Sulphuric Acid production and activity data

Years	SO_2	H_2SO_4 Production
	ktonnes	ktonnes
1990	3.09	440.96
1991	3.09	440.96
1992	3.09	440.96
1993	3.09	440.96
1994	3.09	440.96
1995	3.09	440.96
1996	3.17	452.96
1997	3.27	467.31
1998	3.43	490.12
1999	2.24	319.53
2000	4.61	659.23

Years	SO_2	H_2SO_4 Production
	ktonnes	ktonnes
2001	4.03	576.30
2002	4.41	629.79
2003	3.82	545.93
2004	1.98	282.93
2005	1.98	282.93
2006	2.19	312.99
2007	2.26	322.78
2008	2.12	302.59
2009	2.11	300.95
2010	2.04	291,89
2011	2.34	333,95
2012	2.32	331,05
2013	2.38	340,48
2014	2.49	356,07
2015	2.54	362,60
2016	2.56	365,86
2017	2.73	389,79
2018	2.88	411,18
2019	2.92	417,71
Trend 1990 - 2019	-5%	
Trend 2018- 2019	2%	

Source of Activity Data

Production data was available in National Development Reports for 1995-2004. 2005 is assumed same as 2004 data. 2005-2017 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 2019.

Emission factors are presented in Table 4.14.

Table 4.16:
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(2019) 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 increased by about 34 % from 0.256 Gg in 1990 to 0.343 Gg in 2019, which is a share of less than 1% in total NMVOC emissions in 2019.

Emission trends are illustrated in Figure 4.11 and emissions and activity data are presented in Table 4.17

Figure 4.11
Emissions from NFR 2.B.5 ethylene production for the period 1990 to 2019

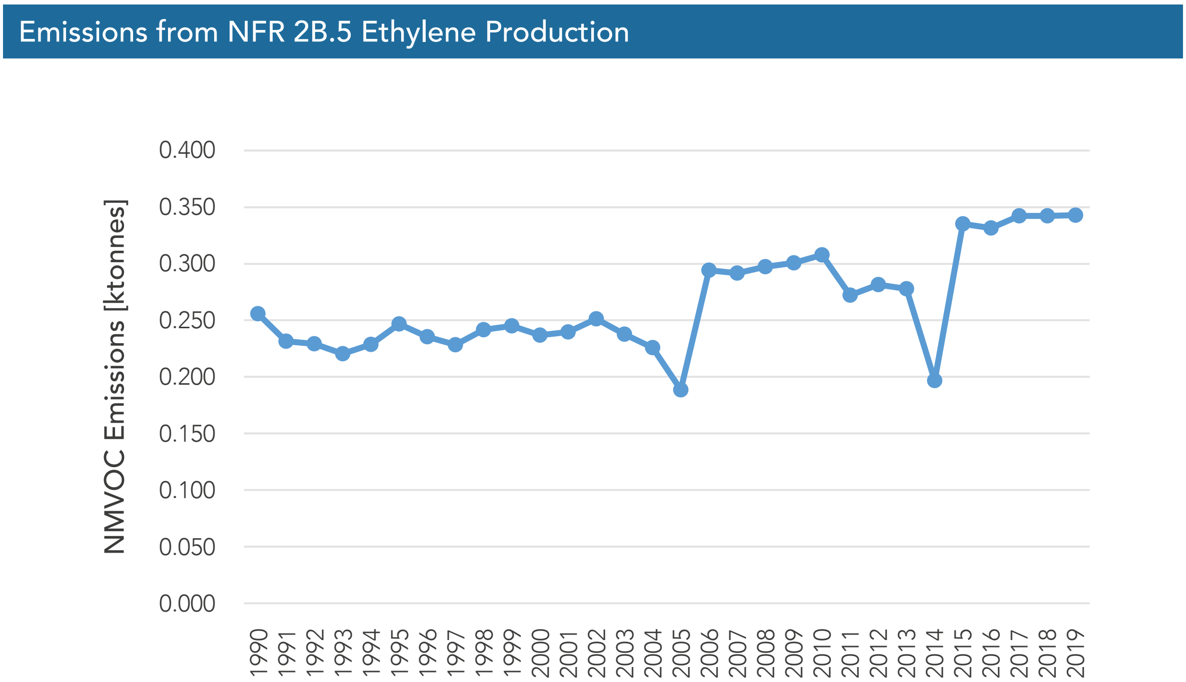


Table 4.17
Emissions from NFR sector 2.B.10.a ethylene production and activity data

Years	NMVOC	Ethylene Production
	ktonnes	ktonnes
1990	0.26	426
1991	0.23	386
1992	0.23	382
1993	0.22	367
1994	0.23	381
1995	0.25	411
1996	0.24	392
1997	0.23	380
1998	0.24	403
1999	0.25	409
2000	0.24	395
2001	0.24	400
2002	0.25	419
2003	0.24	396
2004	0.23	376
2005	0.19	314
2006	0.29	490
2007	0.29	486
2008	0.30	495
2009	0.30	501
2010	0.31	513
2011	0.27	454
2012	0.28	469
2013	0.28	463
2014	0.20	328
2015	0.34	559
2016	0.33	553
2017	0.34	570
2018	0.34	570
2019	0.34	572
Trend 1990 – 2019	34%	
Trend 2018 - 2019	0%	

Source of Activity Data

Production data was available in CRF tables for 1990-2004. Activity data for 2005-2019 were taken from PETKİM activity reports.

Methodological Issues

The applied methodology is TIER 2 uses the general equation:

Emission pollutant $= \sum AD * EF$

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 2019.

Emission factors are presented in Table 4.18

Table 4.18:
Emission factor (EF) used sector 2.B.10.a Ethylene production

	Unit	EF	Reference
NMVOC	kg/tonne	0.6	EMEP/EEA Guidebook(2019) 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, PM10
Key Source: No

Emission Trends

NMVOC emissions increased by about 49 % from 0.687 Gg in 1990 to 1.024 Gg in 2019, which is a share of less than 0.01 % in total NMVOC emissions in 2017.

Emission trends are illustrated in Figure 4.12 while emissions are presented in Table 4.19

Figure 4.12
Emissions from NFR 2.B.5 Polyethene Manufacture for the period 1990 to 2019

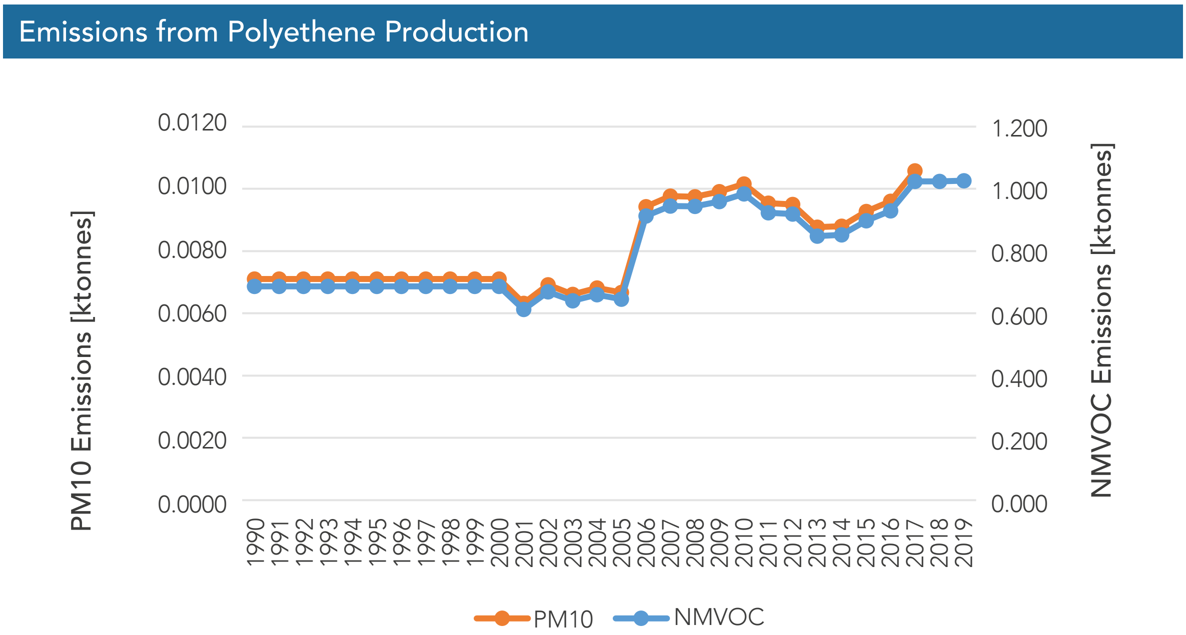


Table 4.19
Emission factor (EF) used sector 2.B.10.a Polyethene Low density

	Unit	EF	Reference
NMVOC	kg/tonne	2.4	EMEP/EEA (2019), Chapter 2.B.5 Polyethene Productions, Table 3-38, page 36
PM10	kg/tonne	0.031*0.8	

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.

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

4.2.7.5 PVC Production

Source Category Description

Emissions: NMVOC, PM10
Key Source: No

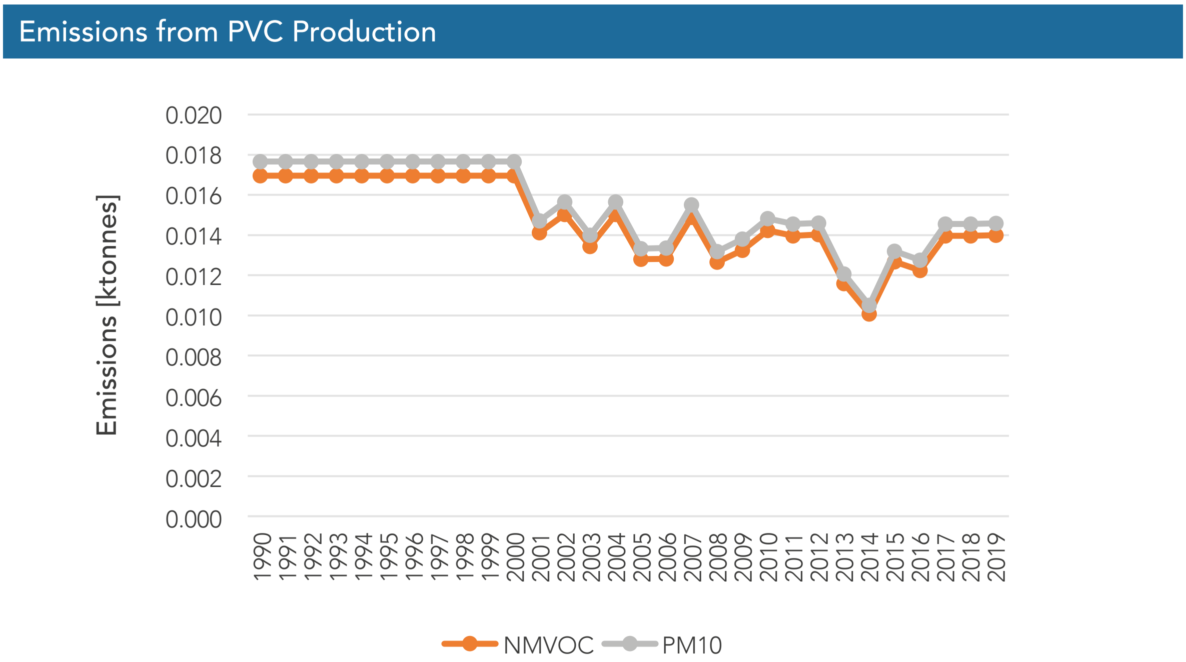
Emission Trends

NMVOC emissions decreased by about 18 % from 0.017 Gg in 1990 to 0.014 Gg in 2019, which is a share of less than 0.01 % in total NMVOC emissions in 2019.

PM10 emissions decreased by about 18 % from 0.018 Gg in 1990 to 0.015 Gg in 2019, which is a share of less than 0.01 % in total PM10 emissions in 2019.

Emission trends are illustrated in Figure 4.13.

Figure 4.13
Emissions from NFR 2.B.5 PVC production for the period 1990 to 2019



Emissions and activity data from PVC production are presented in Table 4.20

Table 4.20
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	176.63
1991	0.017	0.018	176.63
1992	0.017	0.018	176.63
1993	0.017	0.018	176.63
1994	0.017	0.018	176.63
1995	0.017	0.018	176.63
1996	0.017	0.018	176.63
1997	0.017	0.018	176.63
1998	0.017	0.018	176.63
1999	0.017	0.018	176.63

Years	NMVOC	PM_{10}	PVC Production
	ktonnes	ktonnes	ktonnes
2000	0.017	0.018	176.63
2001	0.014	0.015	147.17
2002	0.015	0.016	156.53
2003	0.013	0.014	139.97
2004	0.015	0.016	156.59
2005	0.013	0.013	133.28
2006	0.013	0.013	133.57
2007	0.015	0.016	155.02
2008	0.013	0.013	131.81
2009	0.013	0.014	137.98
2010	0.014	0.015	148.29
2011	0.014	0.015	145.49
2012	0.014	0.015	146.04
2013	0.012	0.012	120.68
2014	0.010	0.011	105.00
2015	0.013	0.013	132.00
2016	0.012	0.013	127.50
2017	0.014	0.015	145.50
2018	0.014	145.50	
2019	0.014	145.80	

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

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 4.21.

Table 4.21
Emission factor (EF) used sector 2.B.10.a PVC production

	Unit	EF	Reference
NMVOC	g/tonne	96	EMEP/EEA (2019), 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 Polypropylene Manufacture

Source Category Description

Emissions: NMVOC
Key Source: No

Emission Trends

NMVOC emissions increased by about 84 % from 0.304 Gg in 1990 to 0.560 Gg in 2019, which is a share of less than 1% in total NMVOC emissions in 2019.

PM_{10} emissions increased by about 84 % from 0.091 Gg in 1990 to 0.168 Gg in 2019, which is a share of less than 1% in total PM_{10} emissions in 2019.

Emission trends are illustrated in Figure 4.14 and emissions and activity data are presented in Table 4.22

Figure 4.14
Emissions from NFR 2.B.10.a polypropylene production for the period 1990 to 2019

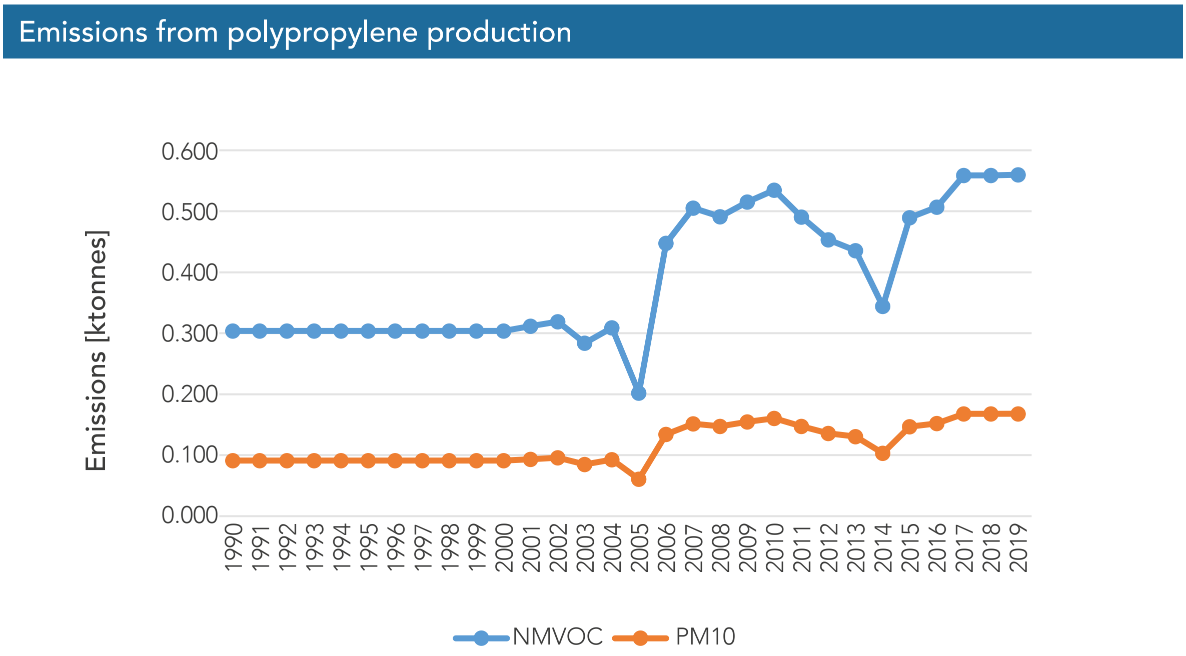


Table 4.22
Emissions from NFR sector 2.B.10.a polypropylene production and activity data

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
2016	0.507	0.152	127
2017	0.559	0.168	140
2018	0.559	0.168	140
2019	0.559	0.168	140
Trend 1990 – 2019	84%	84%	
Trend 2018 - 2019	0%	0%	

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 = $\sum$ 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 2019.

Emission factors are presented in Table 4.23.

Table 4.23
Emission factor (EF) used sector 2.B.10.a Polypropylene production

	Unit	EF	Reference
NMVOC	kg/tonne	4	EMEP/EEA Guidebook(2019) Chapter 2B.Chemical Industry Table 3-42, page 39
PM10	kg/tonne	1.2	EMEP/EEA Guidebook(2019) 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

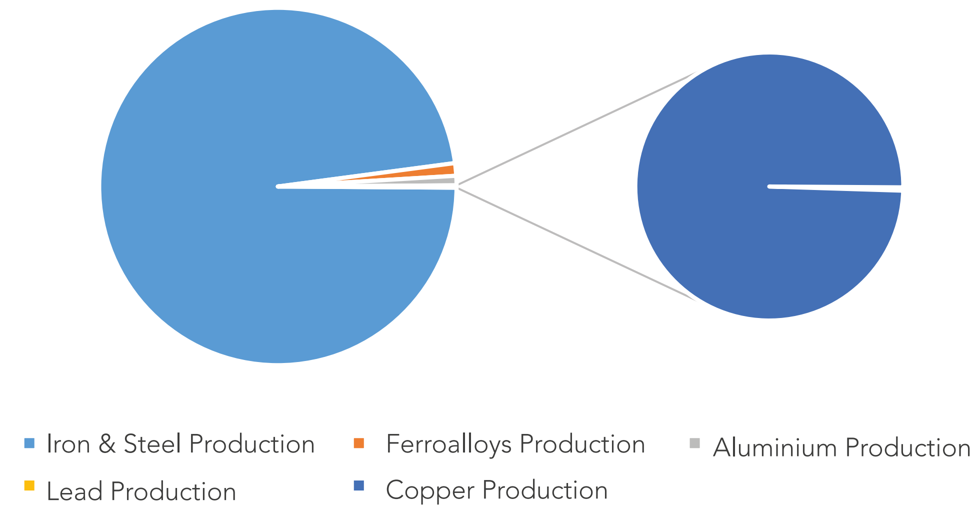
NFR 2.C Metal Industry includes following subsectors;

- 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 4.15 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 4.15
Contributions of subsectors to metal industry

PM10 Emission shares of NFR 2C subsectors in 2019



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

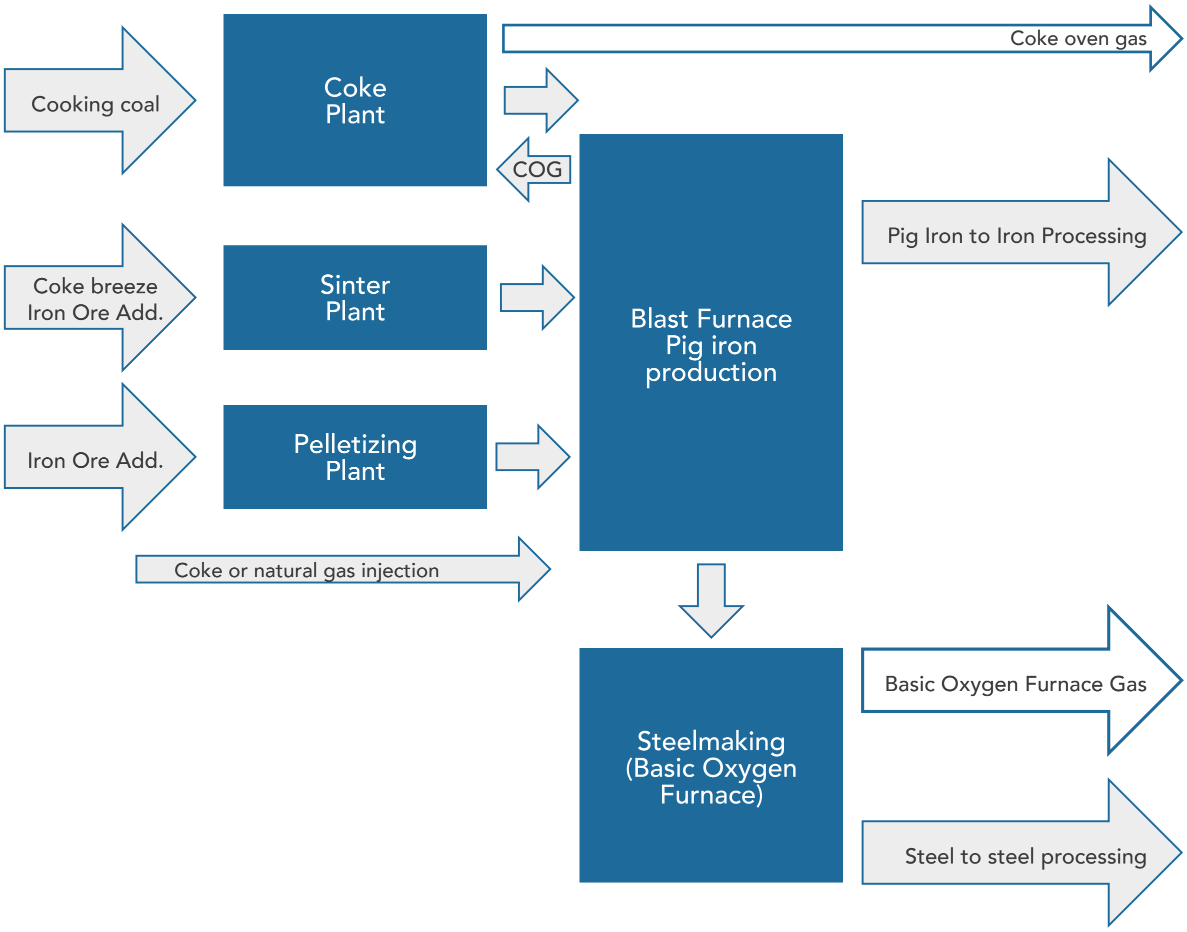
Key Source: No

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 4.16.

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 33 million tonnes in 2019 (World Steel Organization). Information about production and abatement technology will be collected next coming years.

Figure 4.16
Main processes in the iron and steel industry



Emission Trends

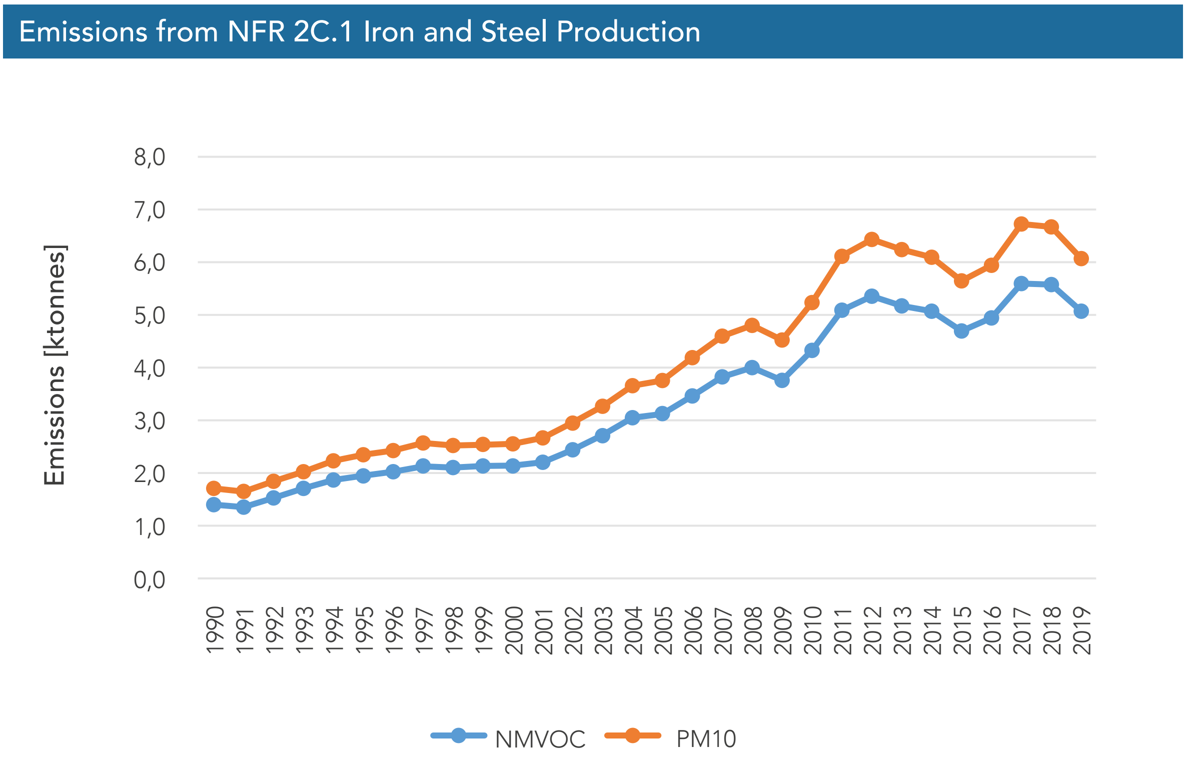
NMVOC emissions increased by about 257 % from 1.4 Gg in 1990 to 5.1 Gg in 2019, which is a share of 1 % in total NMVOC emissions in 2019.

PM_{10} emissions increased by about 257 % from 1.70 Gg in 1990 to 6.1 Gg in 2019, which is a share of % 1 total PM_{10} emissions in 2019.

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 4.17.

Figure 4.17
Emissions from NFR 2.C.1 iron and steel production for the period 1990 to 2019



Emissions from iron and steel production and activity data are presented in Table 4.24

Table 4.24
Emissions from sector 2.C.1 Iron and Steel Production

Years	NMVOC	PM_{10}	Crude Steel Production
	ktonnes	ktonnes	millontonnes
1990	1.4	1.7	9
1991	1.4	1.7	9
1992	1.6	1.9	10
1993	1.7	2.1	12
1994	1.9	2.3	13
1995	2.0	2.4	13
1996	2.0	2.5	14
1997	2.2	2.6	14
1998	2.1	2.5	14

Years	NMVOC	PM_{10}	Crude Steel Production
	ktonnes	ktonnes	millontonnes
1999	2.1	2.6	14
2000	2.1	2.6	14
2001	2.2	2.7	15
2002	2.5	3.0	16
2003	2.7	3.3	18
2004	3.1	3.7	20
2005	3.1	3.8	21
2006	3.5	4.2	23
2007	3.9	4.6	26
2008	4.0	4.8	27
2009	3.8	4.6	25
2010	4.4	5.2	29
2011	5.1	6.1	34
2012	5.4	6.5	36
2013	5.2	6.2	35
2014	5.1	6.1	34
2015	4.7	5.7	32
2016	5.0	6.0	33
2017	5.6	6.8	38
2018	5.6	6.7	38
2019	5.1	6.1	33
Trend 1990 – 2019	257%	257%	
Trend 2018 - 2019	-10%	-10%	

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 4.25

Table 4.25
Emission factor (EF) used sector 2.C.1 Iron and Steel production

	Unit	EF	Reference
NMVOC	g/Mg steel	150	EMEP/EEA (2019), 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

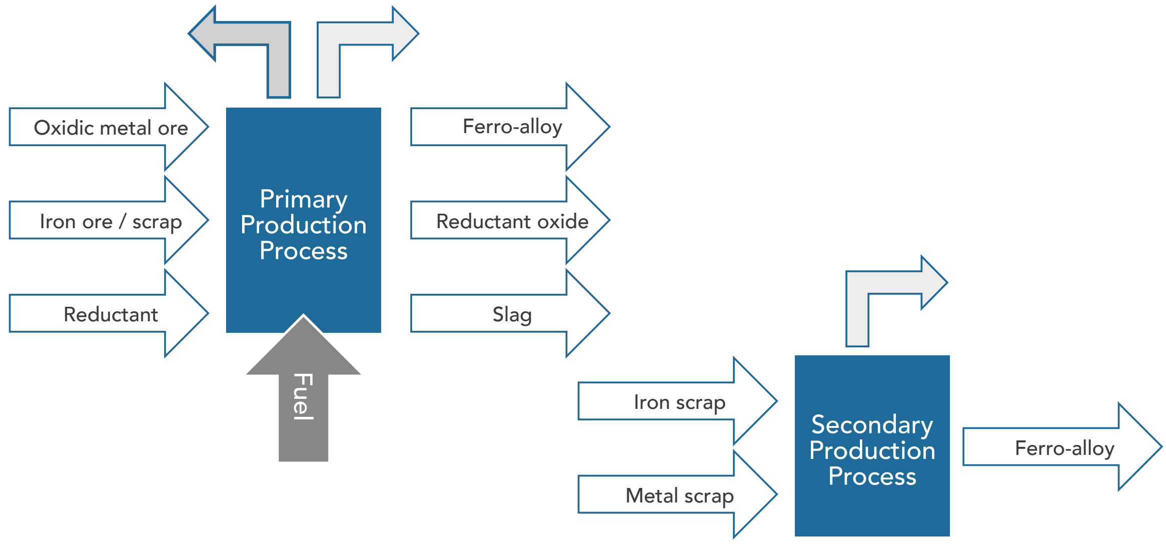
Emissions: PM_{10}
Key Source: No

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 4.18 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 4.18
Simplified scheme for primary and secondary processes



Emission Trends

PM_{10} emissions increased by about 23 % from 0.058 Gg in 1990 to 0.071 Gg in 2019, which is a share of less than 1% in total PM_{10} emissions in 2019.

Emission trends are illustrated in Figure 4.19 and emissions and activity data are presented in Table 4.26

Figure 4.19
Emissions from NFR 2.C.2 ferroalloys production for the period 1990 to 2019

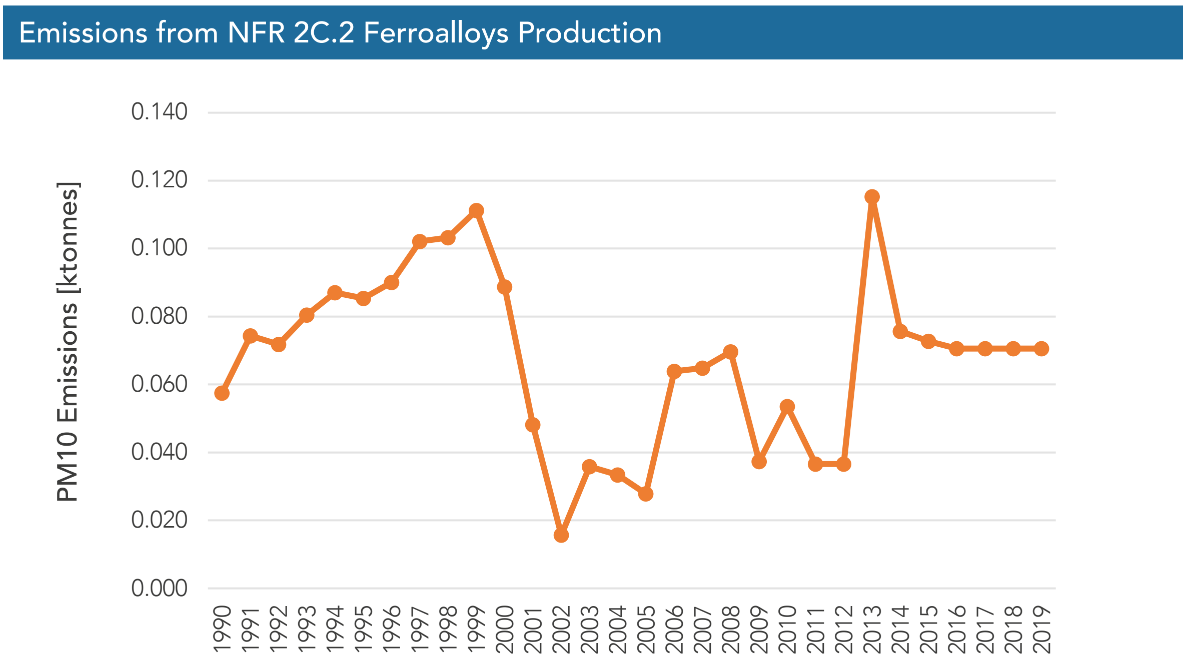


Table 4.26
Emissions from NFR sector 2.C.2 ferroalloys production and activity data

	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	0.037	43
2012	0.037	43
2013	0.115	136
2014	0.076	89
2015	0.073	86
2016	0.071	83
2017	0.071	83
2018	0.071	83
2019	0.071	83
Trend 1990 - 2019	23%	
Trend 2018 - 2019	0%	

Source of Activity Data

Activity data (1990-2015) were taken from world mineral production reports. Reports were downloaded http://www.bgs.ac.uk/mineralsuk/statistics/worldarchieve.html website. 2016-2019 assumed same as 2015 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 2019.

Emission factors are presented in Table 4.27

Table 4.27
Emission factor (EF) used sector 2.C.2 Ferroalloy production

	Unit	EF	Reference
PM_{10}	kg/tonnes alloy	0.85	EMEP/EEA Guidebook(2019) 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 (2019) are illustrated in Figure 4.20 and 4.21

Figure 4.20
Process scheme of primary aluminium production

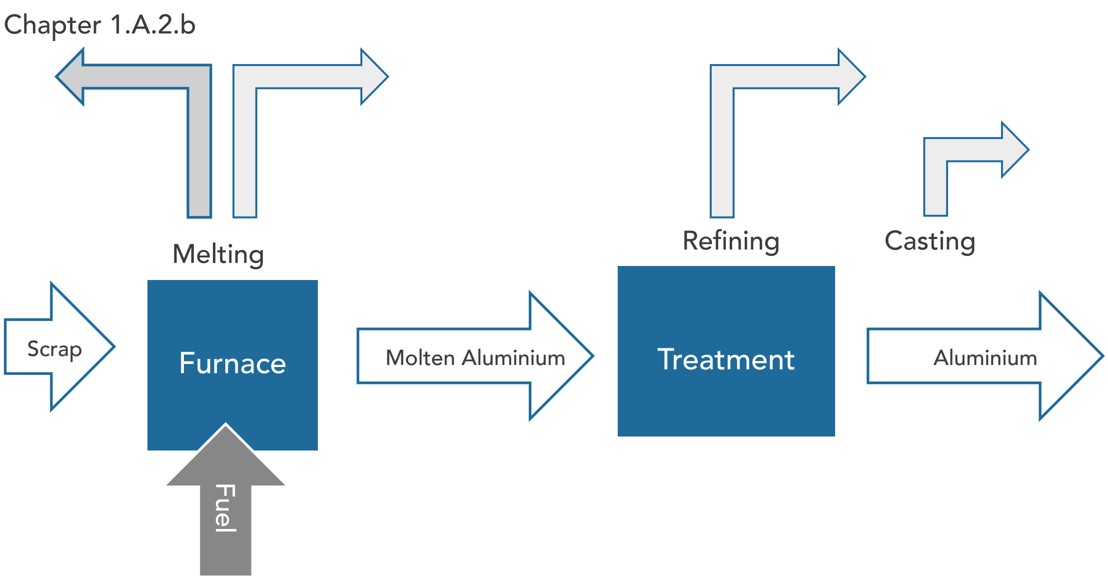


Figure 4.21
Process scheme for secondary aluminium production

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 increased by about 25 % from 0.061 ktonnes in 1990 to 0.076 ktonnes in 2019, which is a share of 0.01 % in total NO_x emissions in 2019.

SO_2 emissions increased by about 25 % from 0.274 ktonnes in 1990 to 0.342 ktonnes in 2019, which is a share of 0.02 % in total SO_2 emissions in 2019.

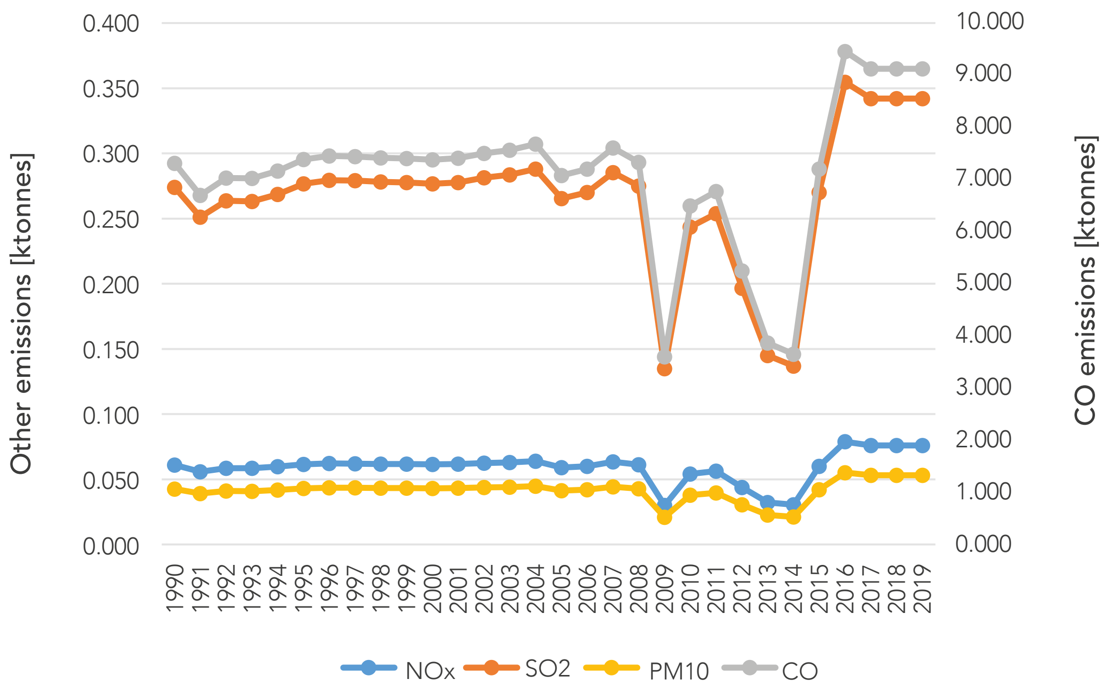
CO emissions increased by about 25 % from 7.31 ktonnes in 1990 to 9.12 ktonnes in 2019, which is a share of 0.27 % in total CO emissions in 2019.

PM_{10} emissions increased by about 25 % from 0.043 ktonnes in 1990 to 0.053 ktonnes in 2019, which is a share of 0.03 % in total PM_{10} emissions in 2019.

Emission trends are illustrated in Figure 4.22. 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 4.22
Emissions from NFR 2.C.3 for the period 1990 to 2019

Emissions from NFR 2.C.3 Aluminium Production



Emissions from aluminium production and activity data are presented Table 4.28

Table 4.28

Emissions from NFR sector 2.C.3 Aluminium Production

	NO_x	SO_2	CO	PM_{10}	Aluminium Production
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1990	0,06	0,27	7,31	0,04	61
1991	0,06	0,25	6,70	0,04	56
1992	0,06	0,26	7,03	0,04	59
1993	0,06	0,26	7,02	0,04	59
1994	0,06	0,27	7,16	0,04	60
1995	0,06	0,28	7,38	0,04	62
1996	0,06	0,28	7,45	0,04	62
1997	0,06	0,28	7,44	0,04	62
1998	0,06	0,28	7,42	0,04	62
1999	0,06	0,28	7,40	0,04	62
2000	0,06	0,28	7,38	0,04	62
2001	0,06	0,28	7,41	0,04	62
2002	0,06	0,28	7,50	0,04	63
2003	0,06	0,28	7,56	0,04	63
2004	0,06	0,29	7,68	0,04	64
2005	0,06	0,27	7,08	0,04	59
2006	0,06	0,27	7,20	0,04	60
2007	0,06	0,29	7,61	0,04	63
2008	0,06	0,27	7,33	0,04	61
2009	0,03	0,14	3,60	0,02	30
2010	0,05	0,24	6,49	0,04	54
2011	0,06	0,25	6,77	0,04	56
2012	0,04	0,20	5,24	0,03	44
2013	0,03	0,14	3,86	0,02	32
2014	0,03	0,14	3,65	0,02	30
2015	0,06	0,27	7,20	0,04	60
2016	0,08	0,35	9,46	0,06	79
2017	0,08	0,34	9,12	0,05	79
2018	0,08	0,34	9,12	0,05	76
2019	0,08	0,34	9,12	0,05	76
Trend 1990-2019	25%				
Trend 2018 -2019	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 2017 data assumed same as 2016.

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 2019.

For NMVOC there was no emission factor available. Emission factors are presented in Table 4.28

Table 4.29
Emission factor (EF) used sector 2.C.3 Aluminium Production

	Unit	EF	Reference
NO_x	kg/tonne	1	EMEP/EEA (2019). Chapter 2.C.3 Aluminium Production. Table 3-1 Tier 1 emission factors for aluminium production, page 11
SO_2	kg/tonne	4.5	
CO	kg/tonne	120	
PM_{10}	kg/tonne Al produced	0.7	

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 1 of about 5 % can be assumed.

No uncertainty analysis was performed for this inventory.

Recalculations

No recalculations have been done 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

Activity data for magnesium production will be searched for the emission inventory.

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:

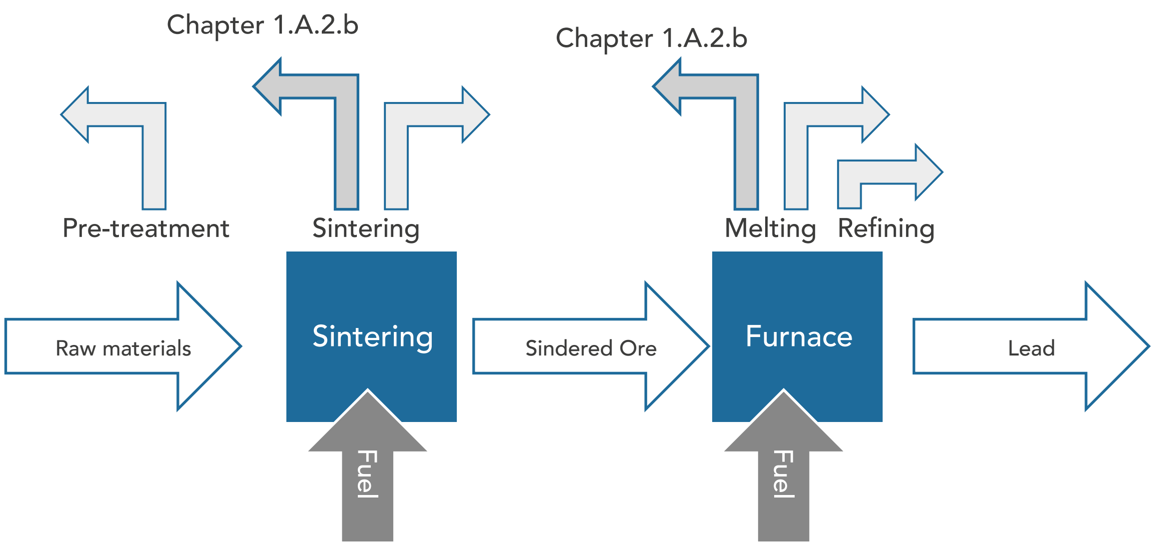
Lead is obtained from galena by smelting. This involves roasting the ore to remove the sulphur and obtain lead oxide, which is then reacted with coke in a furnace. The resulting lead bullion contains many impurities such as silver and gold as well as antimony, arsenic, copper, tin or zinc. These impurities 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:

- oasting 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 (2019) are illustrated in Figure 4.23.

Figure 4.23
Process scheme for primary lead production



Secondary Lead Production

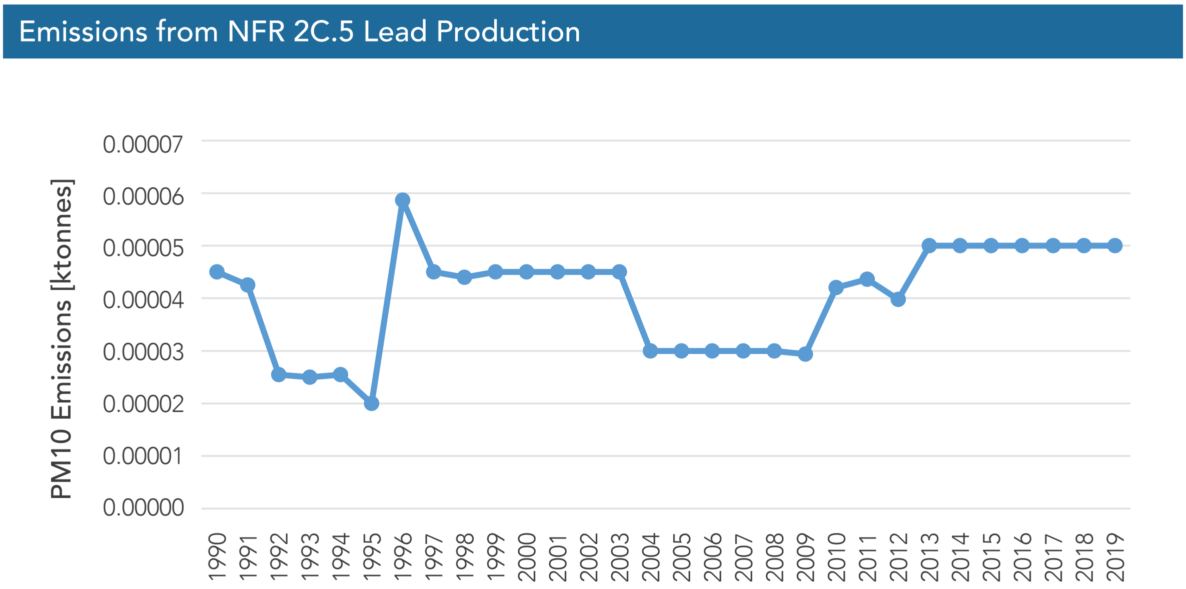
Secondary lead production involves the production of refined metal by processing lead scrap. It is often possible to simply re-melt scrap lead, with very little extra processing. However, compounds of lead (such as battery pastes) require smelting. Refining is often needed to remove any unwanted contamination 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)

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 2019) Information about sector, production and abatement technologies will be collected next coming years.

Emission Trends

PM_{10} emissions stayed same 0.00005 ktonnes in 1990 to 2019, which is a share of less than 0.1 % in total PM_{10} emissions in 2019.

Figure 4.24
Emissions from NFR 2.C.5 b for the period 1990 to 2019



Emissions and activity data from lead production are presented in Table 4.30.

Table 4.30
Emissions from sector 2.C.5 b Lead Production

	PM_{10}	Lead Production
	ktonnes	ktonnes
1990	0,00005	9
1991	0,00004	9
1992	0,00003	5
1993	0,00003	5
1994	0,00003	5
1995	0,00002	4
1996	0,00006	12
1997	0,00005	9
1998	0,00004	9
1999	0,00005	9
2000	0,00005	9
2001	0,00005	9
2002	0,00005	9
2003	0,00005	9
2004	0,00003	9
2005	0,00003	8
2006	0,00003	10
2007	0,00003	10
2008	0,00003	9
2009	0,00003	7
2010	0,00004	11
2011	0,00004	11
2012	0,00004	10
2013	0,00005	10
2014	0,00005	10
2015	0,00005	10
2016	0,00005	10
2017	0,00005	10
2018	0,00005	10
2019	0,00005	10
Trend 1990 - 2019	0%	
Trend 2018 - 2019	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. 2013-2019 data assumed same as 2012.

Methodological Issues

The applied methodology is TIER 1 and uses the general equation:

$$\text{Emission } PM_{10} = \sum \text{AD production} * \text{EF } PM_{10}$$

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 4.31

Table 4.31
Emission factor (EF) used sector 2.C.5 b Lead Production

	Unit	EF	Reference
PM_{10}	g/Mg lead	5	EMEP/EEA (2019) ,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 1 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.

4.3.6 NFR 2.C.6 Zinc Production

Source Category Description

Emissions: NE
Key Source: No

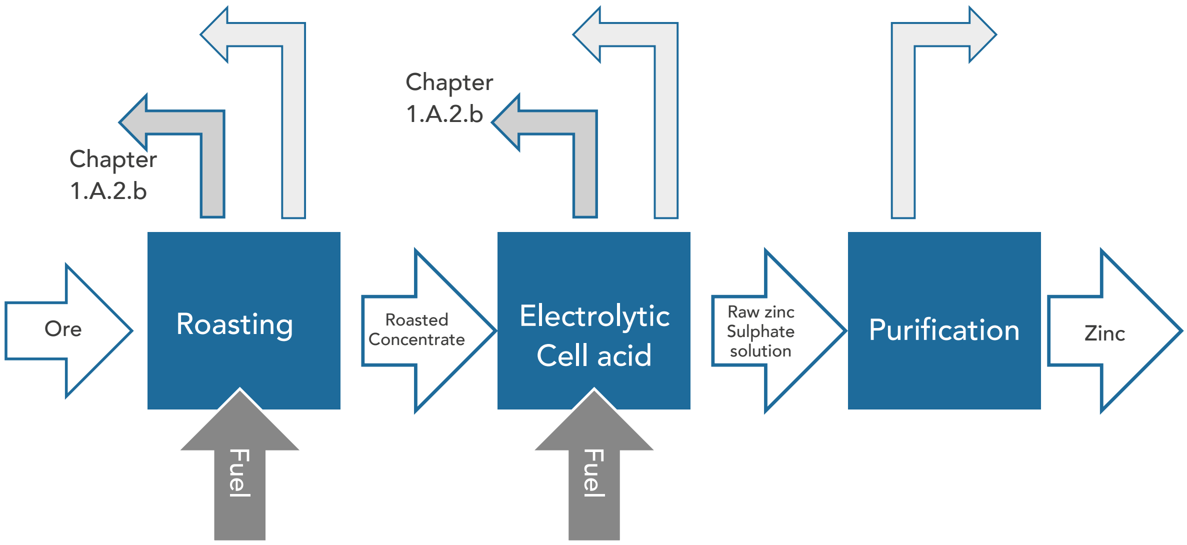
Emission Sources

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 (2019) is illustrated in Figure 4.25

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 4.25
Process scheme for electrochemical zinc production



Recalculations

No recalculations have been done for 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 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.

4.3.7 NFR 2.C.7a Copper Production

Source Category Description

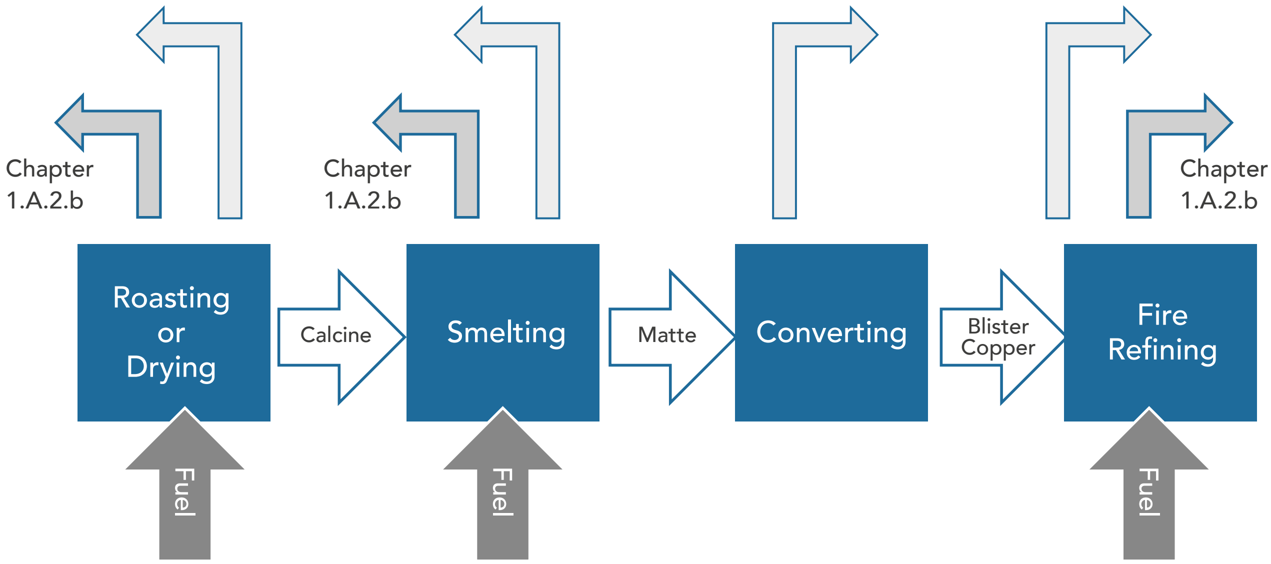
Emissions: PM_{10}
Key Source: No

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 4.26.

Information about production and abatement technology for Turkey will be collected within coming years.

Figure 4.26
Process scheme for primary copper production

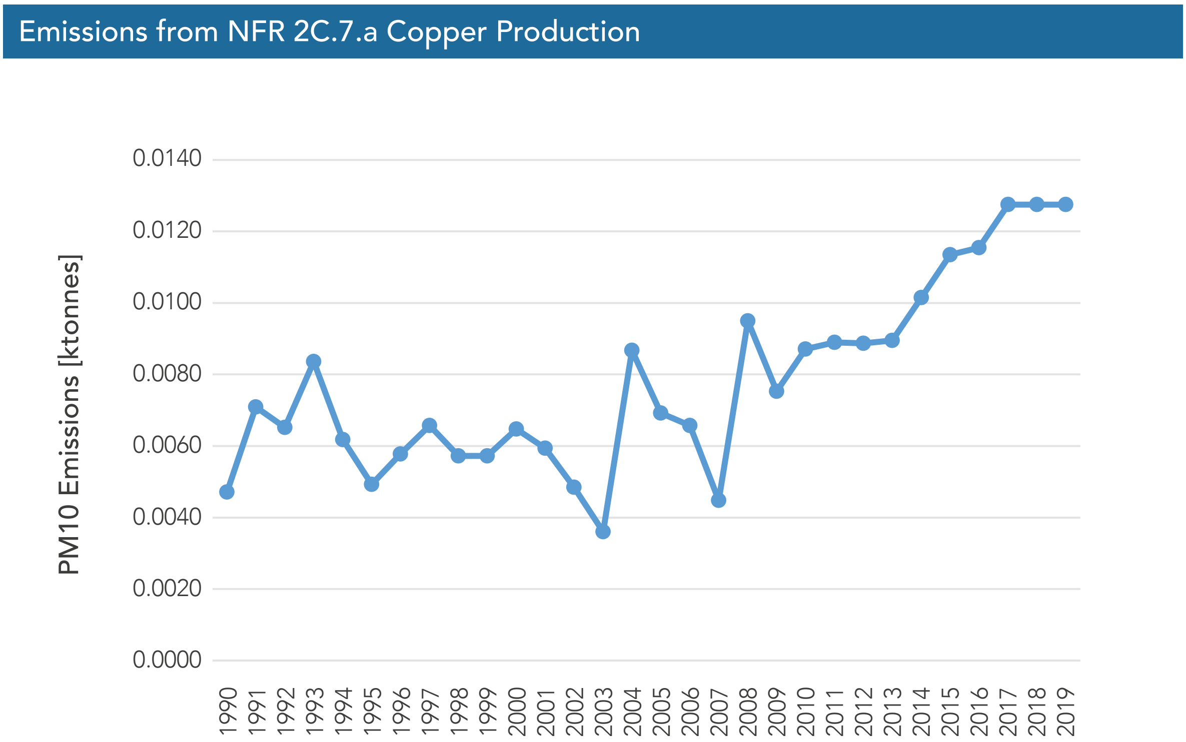


Emission Trends

PM_{10} emissions increased by about 171 % from 0.005 ktonnes in 1990 to 0.013 ktonnes in 2019, which is a share of less than 0.01 % in total PM_{10} emissions in 2019.

Emission trends are illustrated in Figure 4.27

Figure 4.27
Emissions from NFR 2.C.7a for the period 1990 to 2019



Emissions from copper production and activity data are presented in Table 4.32

Table 4.32
Emissions from sector 2.C.7.a Copper Production

	PM_{10}	Copper Production
	ktonnes	ktonnes
1990	0.0047	19
1991	0.0071	28
1992	0.0065	26
1993	0.0084	33
1994	0.0062	25
1995	0.0049	20
1996	0.0058	23
1997	0.0066	26
1998	0.0057	23
1999	0.0057	23
2000	0.0065	26
2001	0.0059	24
2002	0.0048	19
2003	0.0036	14
2004	0.0087	35
2005	0.0069	28
2006	0.0066	26
2007	0.0045	18
2008	0.0095	38
2009	0.0075	30
2010	0.0087	35
2011	0.0089	36
2012	0.0089	36
2013	0.0090	36
2014	0.0102	41
2015	0.0114	45
2016	0.0116	46
2017	0.0128	51
2018	0.0128	51
2019	0.0128	51
Trend 1990 - 2019	86%	
Trend 2018 - 2019	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 2009-2019. 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 2019.

Emission factor is presented in Table 4.33

Table 4.33
Emission factor (EF) used sector 2.C.7.a Copper Production

	Unit	EF	Reference
PM_{10}	kg/tonne Cu produced	0.250	EMEP/EEA (2019). 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.

4.3.8 NFR 2.C.7b Nickel Production

Source Category Description

Emissions: NE

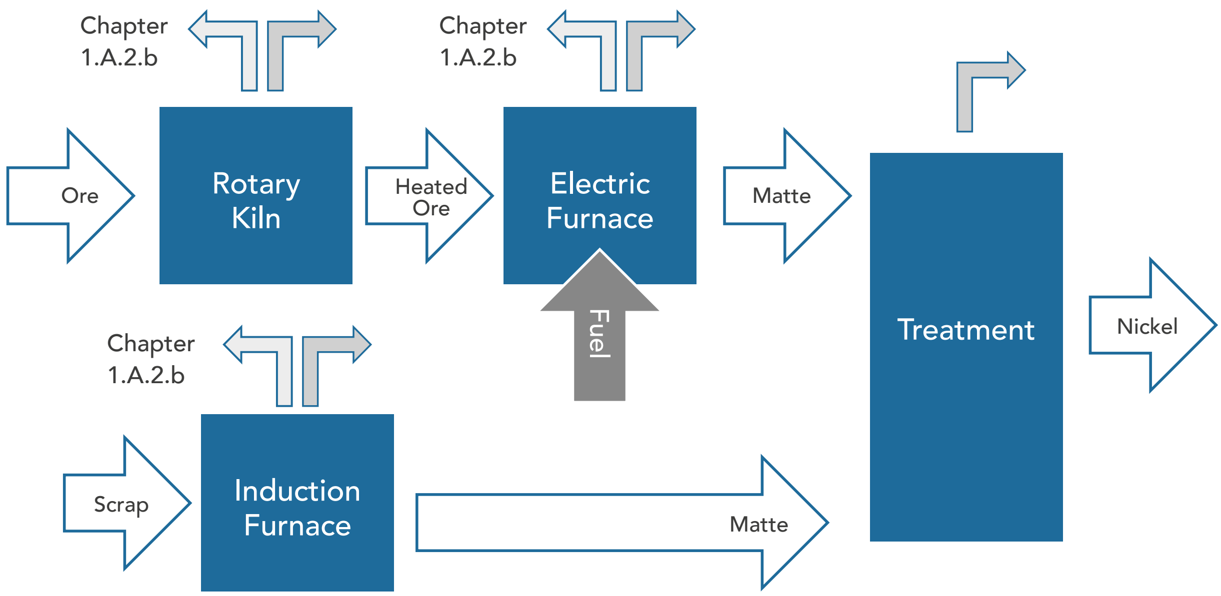
At this stage no emissions from nickel production is estimated.

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 (2019) are illustrated in Figure 4.28.

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 4.28
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.

4.3.9 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.

4.3.10 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. Reports-weredownloaded 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 99.8 ktonnes in 2019, which is an increase of about 47%. From 2018 to 2019 the NMVOC emission increased by 1%.

Emissions from domestic solvent use in Turkey 1990-2019 are presented in Figure 4-29 and Table 4-34 below.

Figure 4.29
NMVOC emission from NFR 2.D.3.a Domestic Solvent Use

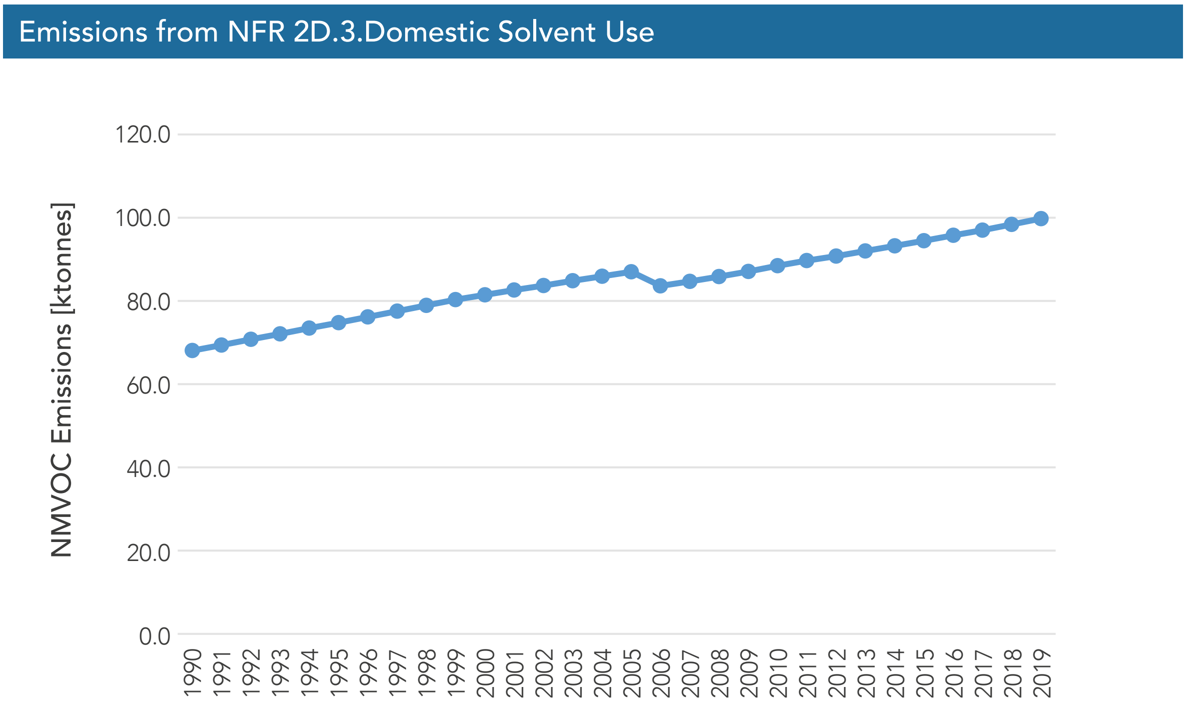


Table 4.34
NMVOC emission from NFR 2.D.3.a Domestic Solvent Use

	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
2016	95.8	79814
2017	97	80810
2018	98.4	82004
2019	99.8	83155
Trend 1990-2016	41%	
Trend 2015-2016	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 = $\sum$ 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 4-35

Table 4.35
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(2019) 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 no 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

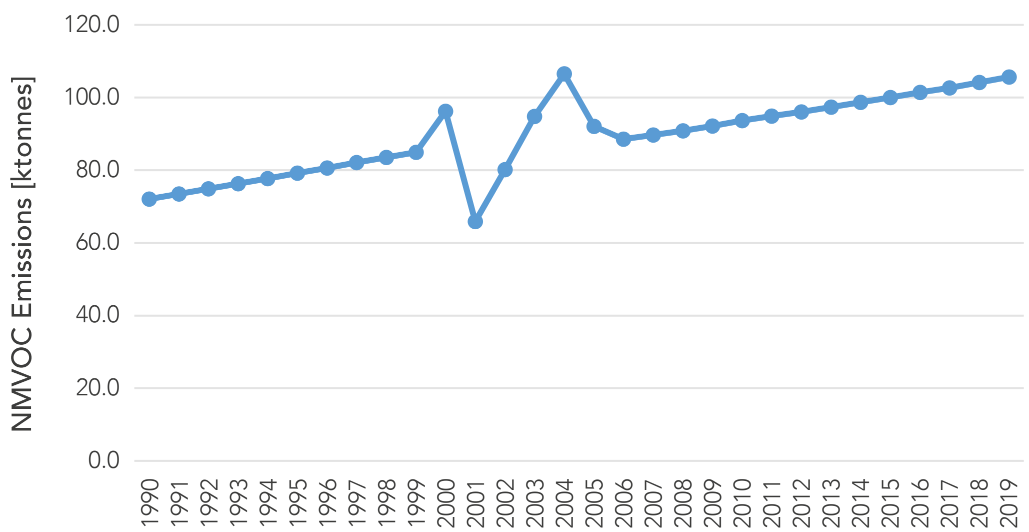
Based on the results of the inventory, between 1990-2019 NMVOC emissions from the above mentioned sources increased by about 47%.

Emission trend is illustrated in Figure 4-30. 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 4.30
Emissions from NFR 2D.3.d Coating Applications for the period 1990 to 2019

Emissions from NFR 2D.3d Coating Applications



Emissions and activity data from decorative coating application are presented in Table 4.36

Table 4.36
NMVOC Emissions (ktonnes) from NFR 2.D.3d Coating Applications for the period 1990 to 2019

	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
2016	101.4	406
2017	102.7	411
2018	104.2	417
2019	105.6	423
Trend 1990 – 2019	47%	
Trend - 2019	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 4.37.

Table 4.37
Emission factors for NFR 3A Paint Application

NFR	Activity	EF	EF unit	Reference
3A1	Decorative Coating	150	g/kg paint	EMEP/EEA Guidebook 2019 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 41.6 ktonnes in 2019, which is an increase of about 47%. From 2018 to 2019 the NMVOC emission increased by 1%.

NMVOC emissions from NFR 2.D.3.f Dry cleaning amount in 5.7 ktonnes in 1990 and 8.3 ktonnes in 2019, which is an increase of about 47%. From 2018 to 2019 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 1990-2019 are presented in Figure 4-31 and Table 4-38 below.

Figure 4.31
Emissions from NFR 2D.3.e and NFR 2D.3f for the period 1990 to 2019

Emissions from NFR 2D.3eD Degreasing and NFR 2D.3.f Dry Cleaning Applications

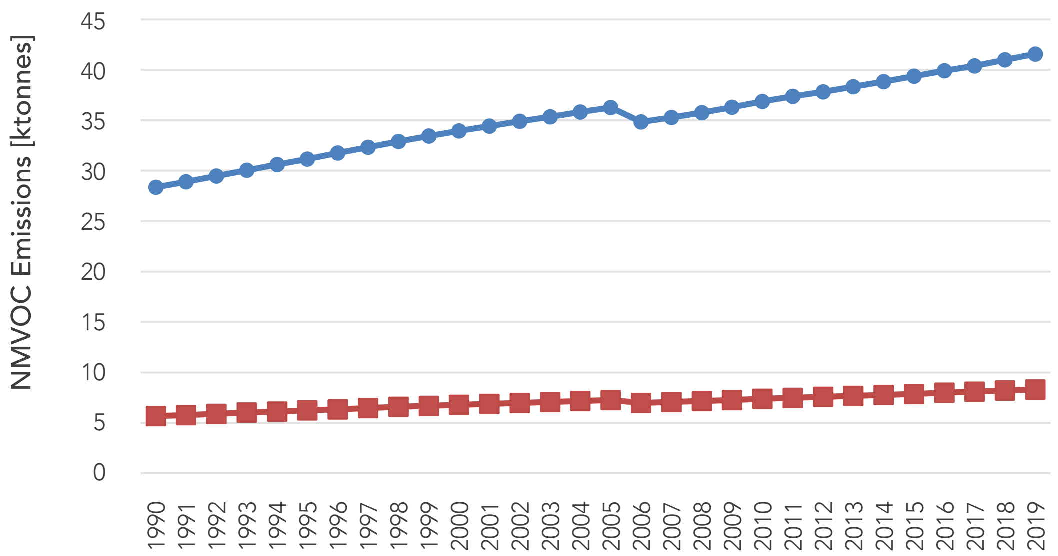


Table 4.38
NMVOC emission from NFR 2.D.3.e Degreasing and NFR 2.D.3.f Dry Cleaning

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

NFR	2.D.3.e	2.D.3.f
	Degreasing	Dry cleaning
	ktonnes	ktonnes
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
2016	39.9	8.0
2017	40.4	8.1
2018	41.0	8.2
2019	41.6	8.3
Trend 1990-2019	41%	41%
Trend 2016-2019	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 4-39.

Table 4.39
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 Clean-ing	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 12.8 ktonnes in 2019, which is an increase of about 88%. From 2018 to 2019 the NMVOC emission decreased by 4%.

NMVOC emissions under NFR 3C were estimated from textile, tyres, paint, inks&glue and rubber manufacture.

Figure 4.32
NMVOC emission from NFR 2D.3g Chemical products

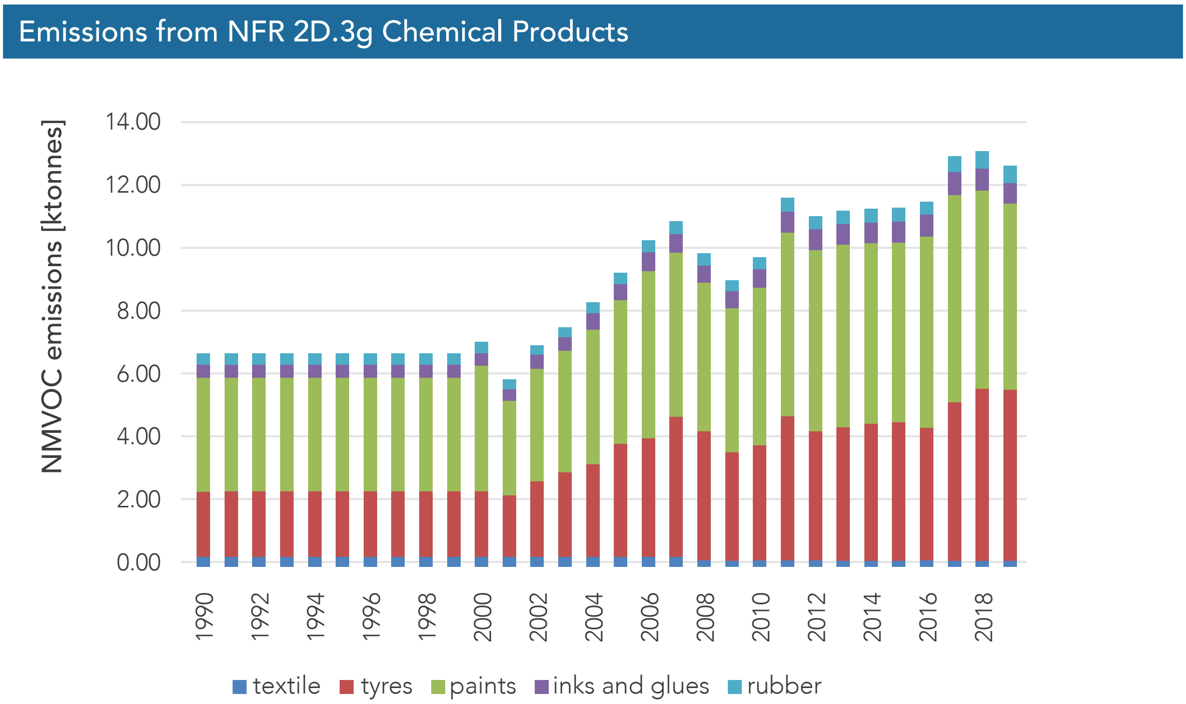


Table 4.40
NMVOC emission from NFR 2D.3g Chemical products

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	9,86
2011	11,78
2012	11,18
2013	11,36
2014	11,42
2015	11,45
2016	11,65
2017	13,11
2018	13,26
2019	12,79
Trend 1990-2019	88%
Trend 2018-2019	-4%

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 1990-2019 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 2009-2019 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-.41
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 (2019) 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 1990-2019 NMVOC emissions from tyre manufacturing increased by about 156%.

The sharp changes in emissions are due to the use of different statistics for the time series 1990-2019. 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, 2006-2019 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 (2019) 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 1990-2019 NMVOC emissions from tyre manufacturing increased by about 65%.

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 2006-2019 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 1990-2019 NMVOC emissions from inks and glue manufacturing increased by about 65 %.

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 2006-2019 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 (2019) 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 1990-2019 NMVOC emissions from synthetic rubber manufacturing increased by about 50%.

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 2005-2019 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	$= \sum AD * EF$
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 (2019) 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

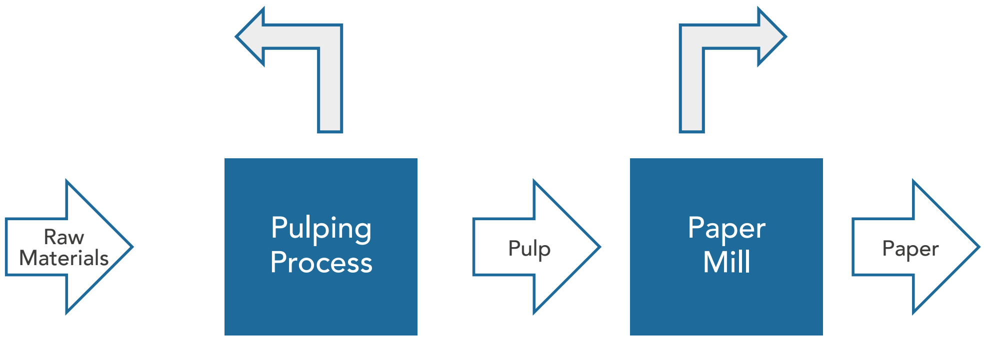
Source Category Description

Emissions: NMVOC, PM10, CO, SO2, NOX
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 (2019) are illustrated in Figure 4.33

Figure 4.33
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 11% from 0.227 Gg in 1990 to 0.253 Gg in 2019, which is a share of less than 0.1 % in total NO_x emissions in 2019.

SO_2 emissions increased by about 11 % from 0.454 Gg in 1990 to 0.506 Gg in 2019, which is a share of less than 0.1 % in total SO_2 emissions in 2019.

NMVOC emissions increased by about 11 % from 0.454 Gg in 1990 to 0.506 Gg in 2019, which is a share of less than 0.1 % in total NMVOC emissions in 2019.

PM_{10} emissions increased by about 11 % from 0.182 Gg in 1990 to 0.202 Gg in 2019, which is a share of less than 0.1 % in total PM_{10} emissions in 2019.

CO emissions increased by about 11 % from 1.249 Gg in 1990 to 1.391 Gg in 2019, which is a share of less than 0.1 % in total CO emissions in 2019.

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 represented in Figure 4.34 and Table 4.42.

Figure 4.34
Emissions from NFR 2.H.1 Pulp and Paper Production for the period 1990 to 2019

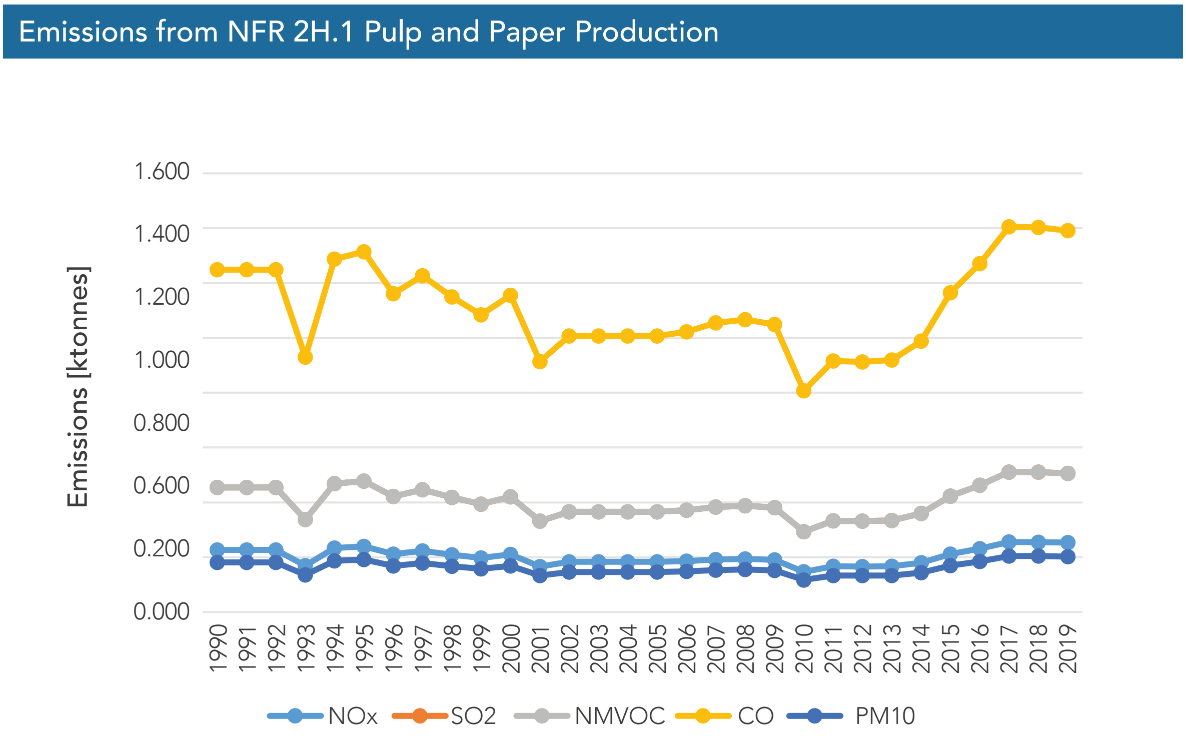


Table 4.42
Emissions from NFR 2.H.1 Pulp and Paper Production

	NO_X	SO_2	NMVOC	CO	PM_{10}	Chem. Wood-pulp
	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

	NO_x	SO_2	NMVOC	CO	PM_{10}	Chem. Wood-pulp
	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
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	0,147	147	167	166	167	180
2011	0,167	147	167	166	167	180
2012	0,166	147	167	166	167	180
2013	0,167	147	167	166	167	180
2014	0,180	147	167	166	167	180
2015	0,212	147	167	166	167	180
2016	0,231	147	167	166	167	180
2017	0,256	147	167	166	167	180
2018	0,255	147	167	166	167	180
2019	0,253	147	167	166	167	180
Trend 1990 – 2019	11%					
Trend 2018 – 2019	-1%					

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 2005-2019 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, 2019 which are actually for production of air dried tonnes of pulp and production volumes of paper board and paper presented in Table 4.43

Table 4.43
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.

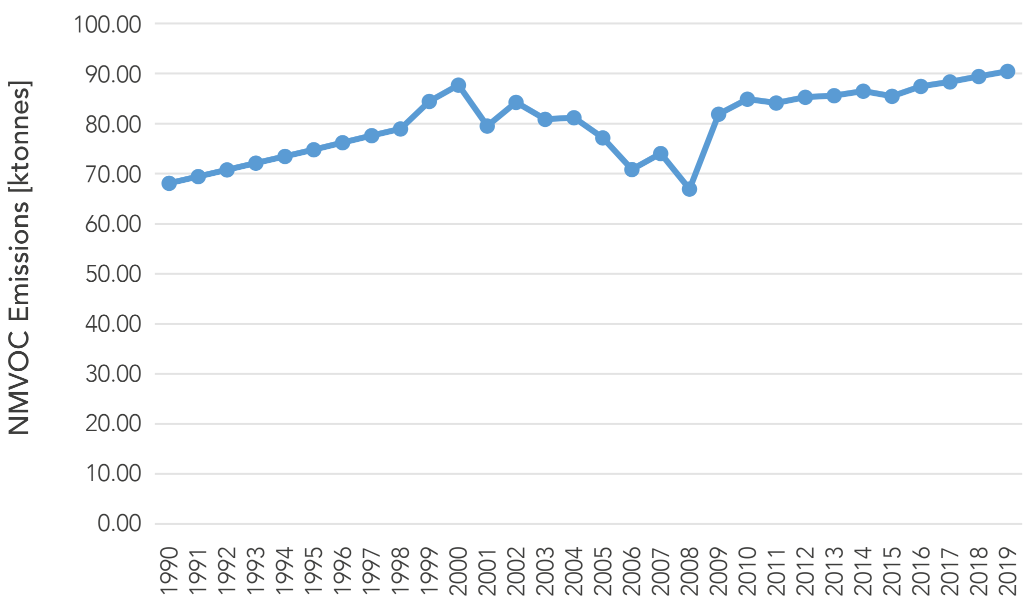
Emission Trends

NMVOC emissions increased by about 30 % from 68.1 ktonnes in 1990 to 90.5 ktonnes which is a share of 11 % in total NMVOC emissions in 2019.

Emission trend is illustrated in Figure 4.35.

Figure 4.35
Emissions from NFR 2.H.2 for the period 1990 to 2019

Emissions from NFR 2H.2 Food&Beverages Industry



Emissions from food and drink production are represented in Table 4.44.

Table 4.44
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	77.1
2006	70.8
2007	74.1
2008	66.9
2009	81.9
2010	84.9
2011	84.1
2012	85.3
2013	85.6
2014	86.5
2015	85.4
2016	87.4
2017	88.3
2018	89.4
2019	90.5
Trend 1990 – 2019	11%
Trend 2018 - 2019	-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. Also non-confidential consumption data of TURKSTAT is used for calculation.

Methodological Issues

The applied methodology is TIER 2 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 4.45 and 4.46

Table 4.45
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(2019) 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(biscuits9pg16, Table3.19(MeatFishPolutry)pg16,Table3.20(Sugar) pg16,Table 3.21(Margarine)pg17,Table3.14 (Bread) pg14,tier 2

Table 4.46
Emission factor (EF) used sector 2.H.2 Food and Beverages Industry

Product type	Unit of EF	EF
	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 AGRICULTURE (NFR SECTOR 3)

This chapter includes information on the methodologies used for the estimation of emissions in the following NFR subsectors:

- 5B. Manure management
- 5D 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.

NFR3.B Manure Management

Emissions: NH3, 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. SO_2 and NO_X 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 5.B.

Emission Trends

Firstly, We had the important meeting it should be emphasized that dairy cattle and other cattle numbers for 90-2019 time series are recalculated according to the meetings with TURKSTAT .Also mules and asses are shinelined as separate headings. Camels are on the other poultry assumed. NH_3 emissions increased by 38% from 521 Gg in 1990 to 721 Gg in 2019 which is a share of 94 % in total NH_3 emissions of Turkey in 2019.

NMVOC emissions increased by 33% from 187 Gg in 1990 to 250 Gg in 2019 which is a share of 23% in total NMVOC emissions of Turkey in 2019.

NMVOC EMISSIONS KT

Figure6.1.
Emissions from NFR 5B-5D for the period 1990 to 2019

NmVOC Emissions ktonnes

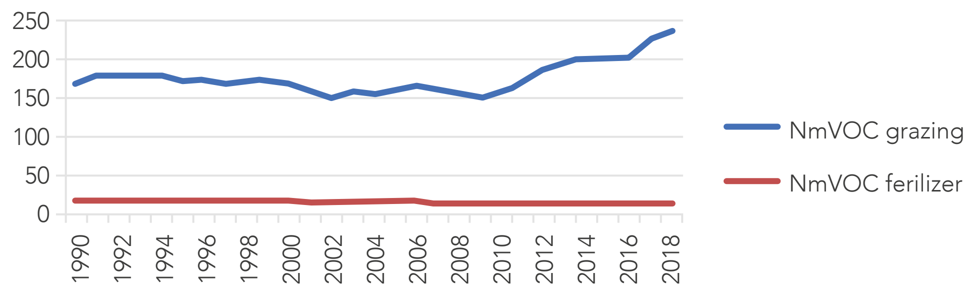


Table 6.1.
NMVOC emissions by Manure Management-Agricultural Soil 1991-2019

	Total ktonnes NMVOC Manure Management	Total ktonnes NMVOC Agricultural Soil
1990	169.5	17.2
1991	179.7	17.2
1992	180.1	17.2
1993	181.3	17.2
1994	181.2	17.2
1995	171.5	17.2
1996	174.2	17.2
1997	168.0	17.2
1998	172.4	17.2
1999	172.8	17.2
2000	168.6	17.2
2001	159.7	15.4

	Total	Total
	ktonnes NMVOC Manure Management	ktonnes NMVOC Agricultural Soil
2002	151.0	15.4
2003	159.6	15.4
2004	154.2	15.4
2005	160.3	15.5
2006	166.8	14.9
2007	159.6	14.6
2008	153.9	14.6
2009	150.6	14,6
2010	158.5	14.6
2011	170.5	14.6
2012	190.0	13.3
2013	197.5	13.3
2014	200.4	13.29
2015	200.5	13.29
2016	202.8	13.29
2017	223.8	13.29
2018	236.6	13.29
2019	242,7	13.29
Trend 1990 - 2019	43%	-23%
Trend 2018- 2019	3%	0%

Figure 6.1.
Emissions from NFR 3.B for the period 1990 to 2019

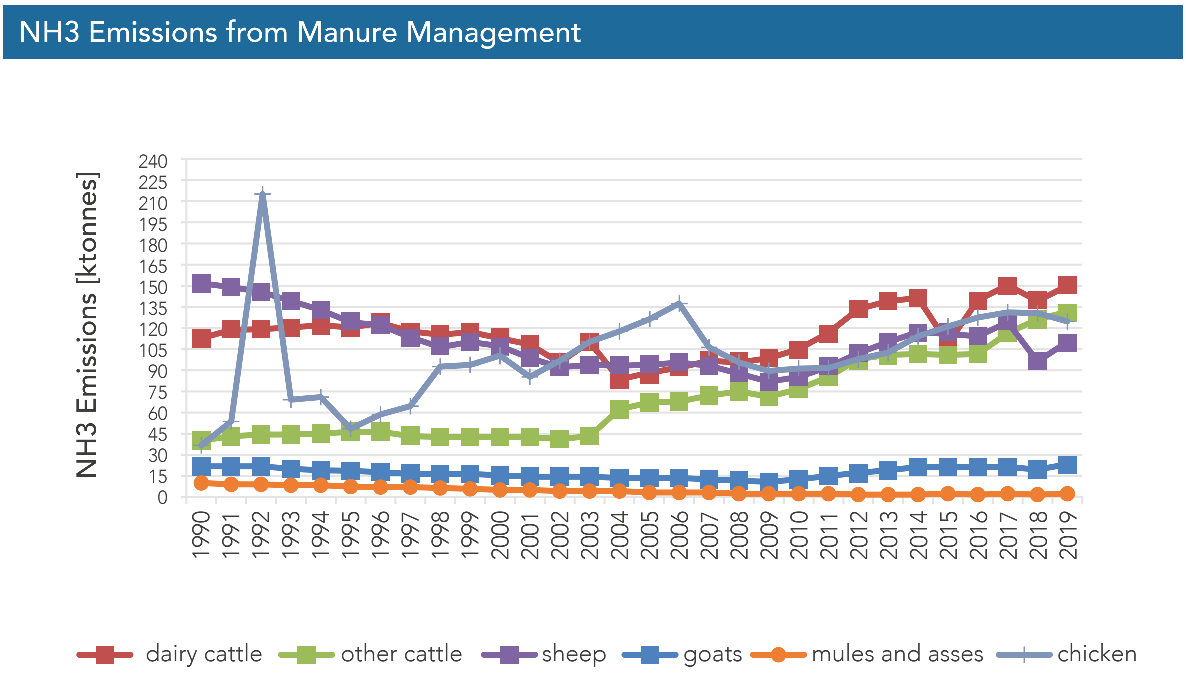


Table 6.1.
Ammonia emissions by sub-categories1990-2019(I)

	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	112	39	3.623730046	0.043935096	0.003291001	17.62925991	18.12323765
1991	119	43	3.577244914	0.037765877	0.002830261	17.05392957	36.29137369
1992	119	44	3.443006637	0.043202845	0.003236151	175.2227619	41.18837389
1993	120	44	3.087284973	0.032951322	0.002468251	19.52088625	49.30894289
1994	122	44	2.979816192	0.029290064	0.002194001	19.40780787	51.67472468
1995	121	45	2.491321734	0.01830629	0.001371251	19.23421073	29.4380363
1996	123	45	2.295923951	0.01830629	0.001371251	18.07945187	40.68280512

	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
1997	116	43	1.895358496	0.016841787	0.00126155	20.60221477	43.06315117
1998	115	42	1.719500491	0.01830629	0.001371251	23.39399821	68.68844051
1999	116	42	1.61203171	0.012448277	0.00093245	24.11973075	68.92962457
2000	112	42	1.426403816	0.010983774	0.00082275	21.71190272	79.44035903
2001	108	43	1.348244703	0.009885397	0.000740475	18.68095197	66.48091423
2002	95	40	1.182908869	0.013162223	0.000984558	19.17200425	77.46020894
2003	109	43	1.107475555	0.025958319	0.001944433	20.26592425	89.16155129
2004	85	62	1.015091483	0.016105874	0.0012067	19.72056926	97.77199639
2005	88	66	1.025496415	0.007080873	0.000529303	20.22437005	105.6230724
2006	94	69	0.982030178	0.004986633	0.00037298	19.69517391	117.4902727
2007	97	72	0.827558461	0.006637861	0.000496393	21.57008811	84.21307235
2008	96	74	0.843112124	0.00628638	0.000474453	21.26087428	74.28951913
2009	98	72	0.852002723	0.006941745	0.000521075	22.31298039	67.12539943
2010	105	78	0.827763628	0.00570424	0.00042783	23.80045703	67.33719587
2011	116	85	0.953853818	0.006766005	0.000507363	26.4924914	65.2560704
2012	133	97	1.049628041	0.010932516	0.000820008	28.41187388	69.41070044
2013	139	101	1.148851035	0.011514656	0.000861145	29.76856716	72.85936848
2014	141	101	1.193040244	0.00972064	0.000726763	31.45654451	82.11638725
2015	105	100	1.306878993	0.006011786	0.00044977	33.08248515	87.73469841
2016	139	103	1.388037462	0.004755974	0.000356525	36.46863126	90.47105529
2017	150	118	1.577241135	0.004982972	0	40.78584126	90.85016658
2018	139	118	1.577241135	0.004982972	0	40.78584126	90.85016658
2019	150	131	1.8	0	0	33	91
Trend 1990 – 2019	33%	235%	-50%	-89%	-100%	88%	500%
Trend 2018-2019	-7%	11%	20%	0%	0%	-17%	1.1%

Table 6.2.
Ammonia emissions by sub-categories1990-2019 (II)

	Turkeys	Ducks & Geese	Sheep	Goats	Horses	Camels	Mules and Asses
	ktonnes NH3	ktonnes NH3	ktonnes NH3	ktonnes NH3	ktonnes NH3	ktonnes NH3	Ktonnes NH3
1990	1.99	1.06	150.00	21.41	4.31	0.01	9.97
1991	2.01	0.96	149.56	21.09	4.16	0.01	9.54
1992	2.14	1.03	145.80	20.48	4.06	0.01	9.03
1993	2.14	1.01	138.86	19.85	3.78	0.01	8.51
1994	2.21	1.03	131.92	18.74	3.67	0.01	8.22
1995	2.11	1.04	125.05	17.85	3.49	0.01	7.56
1996	1.97	0.97	122.45	17.54	3.28	0.01	7.08
1997	3.42	1.28	112.01	16.41	2.90	0.01	6.57
1998	2.44	1.10	109.08	15.79	2.77	0.01	6.18
1999	2.41	1.05	112.02	15.23	2.60	0.01	5.71
2000	2.36	0.92	105.49	14.11	2.28	0.01	4.94
2001	2.09	0.82	99.91	13.76	2.28	0.01	4.70
2002	1.98	0.79	93.25	13.28	2.09	0.00	4.30
2003	2.56	0.76	94.20	13.27	1.91	0.00	4.11
2004	2.50	0.71	93.39	12.95	1.78	0.00	3.79
2005	2.37	0.61	93.78	12.77	1.75	0.00	3.55
2006	2.07	0.48	94.98	13.02	1.72	0.01	3.40
2007	1.72	0.53	94.49	12.32	1.58	0.01	3.06
2008	2.07	0.54	89.02	10.96	1.51	0.01	2.82
2009	1.77	0.48	80.87	10.05	1.40	0.01	2.40
2010	1.89	0.39	85.85	12.33	1.30	0.01	2.18
2011	1.64	0.38	93.11	14.26	1.27	0.01	2.08
2012	1.77	0.37	102.16	16.38	1.19	0.01	1.98
2013	1.88	0.40	109.19	18.08	1.14	0.01	1.91
2014	1.92	0.46	116.27	20.27	1.10	0.01	1.78
2015	1.81	0.44	117.64	20.41	1.03	0.01	1.66

	Turkeys	Ducks & Geese	Sheep	Goats	Horses	Camels	Mules and Asses
	ktonnes NH3	ktonnes NH3	ktonnes NH3	ktonnes NH3	ktonnes NH3	ktonnes NH3	Ktonnes NH3
2016	2.04	0.48	115.80	20.27	1.01	0.01	1.59
2017	2.48	0.52	125.80	20.84	0.96	0.01	1.48
2018	2.48	0.00	95.80	19.16	0.96	0.01	1.46
2019	2.91	0.00	109.9	21.98	0.861	0.009	1.313
Trend 1990 - 2019	46%	-100%	-27%	2.7%	-80%	-10%	-86%
Trend 2018- 2019	17%	0%	-14.7%	14.7%	-11%	-10%	-10%

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 90-2019 times series are recalculated.
- Horses and Mules and Asses are newly separately figured.
- Camels are assumed as other poultry part.
- Ducks and geese are accountes as other animals
- Fattening pigs ("market swine") are exactly to account. Swine make only a minor contribution to total emissions in Turkey.

Table 6.3.
Domestic livestock population and its trend 1990-2019 (I)

	Dairy	Other Cattle	Buffalo	Market Swine	Breeding Swine
	Head	head	head	head	head
1990	5892550	5484507	370908	10800	1200
1991	6119000	5853923	366150	9284	1032
1992	6070178	5880729	352410	10620	1180
1993	6031952	5878048	316000	8100	900
1994	6082180	5818820	305000	7200	800
1995	5885586	5903414	255000	4500	500
1996	5968211	5917789	235000	4500	500
1997	5596611	5593326	194000	4140	460
1998	5489048	5541952	176000	4500	500
1999	5537883	5516117	165000	3060	340
2000	5279573	5481427	146000	2700	300
2001	5085819	5462181	138000	2430	270
2002	4392574	5410924	121077	3236	359
2003	5040370	4747732	113356	6381	709
2004	3875722	6193624	103900	3959	440
2005	3998095	6528345	104965	1741	193
2006	4187934	6683430	100516	1226	136
2007	4229442	6807311	84705	1632	181
2008	4080242	6779700	86297	1544	173
2009	4133150	6590808	87207	1706	190
2010	4361842	7007958	84726	1402	156
2011	4761150	7625187	97632	1663	185
2012	5431403	8483509	107435	2687	299
2013	5607278	8807979	117591	2831	314
2014	5609249	8613860	122114	2390	265
2015	5535779	8458292	133766	1478	164
2016	5431720	8648435	142073	1169	130
2017	5969051	9974535	161439	1225	136
2018	6337906	10704600	178397	1472	164
2019	6580834	11107305	184192	1436	154
Trend 1990 – 2019	11%	102%	-50%	-86%	-87%
Trend 2018 - 2019	3.8%	3%	3%	-2.4%	-6%

Table 6.4.
Domestic livestock population and its trend 1990-2018 (II)

	Poultry-Chickens (Layers)	Poultry-Chickens (Broilers)	Turkeys	Ducks&Geese
	Head	head	head	head
1990	52541341	44135104	3106250	2471990
1991	50826656	88379548	3132676	2711846
1992	52222492	100305100	3332794	2907238
1993	58179047	120080935	3340241	2859557
1994	57842034	125842269	3441995	2906724
1995	57324654	71689773	3291000	2945088
1996	53883070	99073900	3063540	2735775
1997	61401783	104870702	5327501	3623402
1998	69722271	167275380	3805345	3110795
1999	71885207	167862730	3762516	2965740
2000	64709040	193459280	3681558	2600780
2001	55675750	161899442	3254018	2311308
2002	57139257	188637066	3092408	2232227
2003	60399520	217133076	3994093	2147685
2004	58774172	238101895	3902346	2021070
2005	60275674	257221440	3697103	1722990
2006	58698485	286121360	3226941	1355331
2007	64286383	205082159	2675407	1504540
2008	63364818	180915558	3230318	1533045
2009	66500461	163468942	2755349	1357454
2010	70933660	163984725	2942170	1112406
2011	78956861	158916608	2563330	1061739
2012	84677290	169034283	2760859	1032909
2013	88720709	177432745	2925473	1123107
2014	93751470	199976150	2990304	1311810
2015	98597340	213658294	2827731	1249081
2016	108689236	220322081	3182751	1347194
2017	121556027	221245322	3872460	1469945
2018	124054810	229506689	4043332	1613031
2019	120725299	221841860	4541102	1676624
Trend 1990 – 2019	129%	402%	46%	-32%
Trend 2018 – 2019	-2.7%	-3.3%	12%	3.9%

Table 6.5.
Domestic livestock population and its trend 1990-2019 (III)

	Sheep	Goats	Horses	Camels
	Head	head	head	head
1990	40553000	10,926,200	513000	2000
1991	40432340	10764198	495543	1914
1992	39415938	10453940	483290	1900
1993	37541000	10133000	450000	2000
1994	35646000	9564000	437000	2000
1995	33791336	9111000	415000	2000
1996	33072000	8951000	391000	2000
1997	30238000	8376000	345000	1400
1998	29435000	8057000	330000	1400
1999	30256000	7774000	309000	1350
2000	28492000	7201000	271000	1000
2001	26972000	7022000	271000	930
2002	25173706	6780094	248992	887
2003	25431539	6771675	227399	808
2004	25201155	6609937	212414	865
2005	25304325	6517464	207808	811
2006	25616912	6643294	204352	1004
2007	25462293	6286358	188640	1057
2008	23974591	5593561	179855	970
2009	21749508	5128285	166753	1041
2010	23089691	6293233	154702	1254
2011	25031565	7277953	151230	1290
2012	27425233	8357286	141422	1315
2013	29284247	9225548	136209	1374
2014	31140244	10344936	131480	1442
2015	31507934	10416166	122704	1543
2016	30983933	10345299	120040	1599
2017	33677636	10634672	114047	1703
2018	35194972	10922427	108076	1708
2019	37276050	11205429	102467	1651
Trend 1990 – 2019	-8%	2.5%	-80%	-18%
Trend 2018- 2019	5.9%	2.5%	-5%	-33.5%

N excretion values

N excretion rates were taken from the IPCC 2006 Guidance. The amount of N excretion rate for dairy cattle and other dairy cattle is calculated by assuming that animals in Turkey are the average of "Western Europe" and "Asian" animals.

Table 6.6.
N excretion values for all livestock categories

Livestock	Nitrogen excretion [kg/animal*year]
Dairy cows	*
Other cattle	**
Buffalo	44,384
Swine average	4,10844
Layering hens	0,61
Broilers	0.8030
Turkeys	1,3505
Ducks & Geese	0,9089
Sheep	12,1449
Goats	22.50225
Horses	39,9602
Camels	36,4343

Year	(*) N Excretion Factors for dairy cattle	(**) N Excretion Factors for other cattle
1990	60.74405006	22.3912916
1991	61.82157413	22.9718286
1992	62.45843818	23.15463622
1993	63.33180679	23.32068985
1994	63.81707743	23.56891657
1995	65.42888924	23.83703439
1996	65.86519498	23.91040271
1997	66.2517214	23.80066883
1998	66.5403875	23.76387972

Year	(*) N Excretion Factors for dairy cattle	(**) N Excretion Factors for other cattle
1999	66.93207889	23.84523992
2000	67.44113681	24.11342164
2001	67.82833496	24.27903197
2002	68.68475997	23.06937758
2003	69.12595374	28.3777163
2004	69.46455263	31.24325454
2005	70.05517436	31.47258849
2006	71.65043884	32.12912689
2007	73.06435566	32.88250544
2008	74.791983	33.85242714
2009	75.57824966	34.01829362
2010	76.44737318	34.59346238
2011	77.45866993	34.84476242
2012	78.2834903	35.6221669
2013	78.81239074	35.80936918
2014	79.92875762	36.37000467
2015	80.48583146	36.72804261
2016	81.11958501	36.92329334
2017	82.197702	36.72923933
2018	82.60008279	37.1894052
2019	82.5	37.25

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 6.7.
Manure management system usage: buildings and pastures

Livestock	Building	Pasture
	[%]	[%]
Dairy cows	70	30
Other cattle	70	30
Buffalo	70	30
Fattening pigs	100	0
Breeding sows	100	0
Laying hens	100	0
Broilers	100	0
Turkeys	100	0
Ducks & Geese	0	100
Sheep	40	60
Goats	20	80
Horses	40	60
Camels	40	60

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 6.8.
Animal waste management system distribution in the buildings

Livestock	Slurry	Solid
	[%]	[%]
Dairy cows	50	50
Other cattle	50	50
Buffalo	0	100
Fattening pigs	43	58
Breeding sows	43	58
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 6.9.
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	15	0.20	0.20	0.55	0.10
	solid	60	85	0.19	0.27	0.20	0.10
Other cattle	slurry	60	15	0.20	0.20	0.55	0.06
	solid	60	85	0.19	0.27	0.79	0.06
Buffalo	slurry	50	0	0.20	0.20		
	solid	50	100	0.20	0.17	0.55	0.13
Fattening pigs	slurry	70	43	0.28	0.14	0.40	
	solid	70	58	0.27	0.45	0.81	0.25
Breeding sows	slurry	70	43	0.22	0.14	0.29	
	solid	70	58	0.25	0.45	0.81	0.25
Laying hens	slurry	70	0	-	0.14	0.69	
	solid	70	100	0.41	0.14	0.69	
Broilers	slurry	70	0	-			
	solid	70	100	0.28	0.17	0.66	
Turkeys	slurry	70	0	-			
	solid	70	100	0.35	0.24	0.54	
Ducks & Geese	slurry	70	0	-			
	solid	70	100	0.405	0.2	0.495	0,24
Sheep	slurry	50	0	-			0.10
	solid	50	100	0.22	0.28	0.90	0.10

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
Goats	slurry	50	0	-			0.10
	solid	50	100	0.22	0.28	0.90	0.10
Horses	slurry	60	0	-			0.10
	solid	60	100	0.22	0.35	0.90	0.10
Camels	slurry	50	0	-			0.10
	solid	50	100	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. All 90-2019 is recalculated.

Planned Improvements

N excretion rates for all animals 90-2019 is calculated and revised 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 Agriculture and Forestry has no work started. In the future the following IIR reporting can have this complementary part, but there is no exact foreseen. Morover, Applied AWMS data reflect a first estimate which has to be further elaborated. Also number of animals, rates and whole sheet are checked by TURKSTAT on the meeting of January and February 2020 with the experts the Ministry of Environment and Urbanization.There is no further meeting.

5.1 NFR 5.D Crop Production and 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 28% from 97kt NH_3 in 1990 to 124 kt NH_3 in 2019. NH_3 emissions from pastured livestock increased by 44 % from 370 kt NH_3 in 1990 to 543 kt NH_3 in 2019.

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 2016)

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.

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 2016 revised have been used.

Planned Improvements

Improvements regarding activity data and animal waste management distribution are included in chapter 3.B 'planned improvements'.

5.2 NFR 3.F Field Burning of Agricultural Residues

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 WASTE MANAGEMENT

According to EMEP/EEA Emission Inventory Guidebook 2016, NFR sector 5 includes subsectors as below:

6 Waste

6.A Biological Treatment Of Waste: Solid Waste Disposal On Land

6.B.1 Biological Treatment Of Waste: Composting

6.B.2 Biological Treatment Of Waste: Anaerobic Digestion At Biogas Facilities

6.C.1.a Municipal Waste Incineration

6.C.1.b Industrial Waste Incineration Including Hazardous Waste And Sewage Sludge

6.C.1.b.iii Clinical Waste Incineration

6.C.1.b.v Cremation

6.C.2 Open Burning Of Waste

6.D Wastewater Handling

6.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.

NFR 6A 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 2018 there are 87 landfills serving for 1134 municipalities and for 54,7 milllion people according to current information from Waste Management Department of MoEU. So, it is served 74.3 % of the Turkey's population. Up to 2003, number of landfills was only 15 and has been increased dramatically over the years.

21644 ktonnes of municipal solid waste have been deposited on controlled landfill sites, and 4252 ktonnes have been deposted on dumping sites in 2018 (source: TURKSTAT), assumed to be unmanaged.

Emission Trend

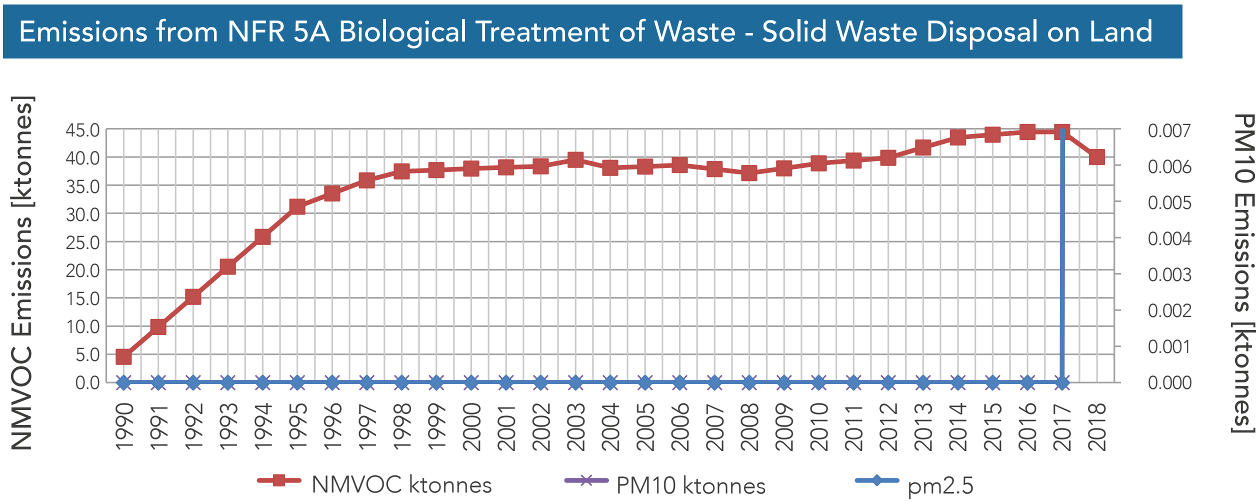
NMVOC emissions increased by about 800% from 4.56 ktonnes in 1990 to 40.4 ktonnes in 2019.

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 from 0.0001023 ktonnes in 1990 to 12 ktonnes in 2019. PM_{10} emissions increased from 0.0000484 ktonnes in 1990 6 ktonnes in 2019. $PM_{2.5}$ emissions increased from 0.0000073 ktonnes in 1990 to 1 ktonnes in 2019.

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 Waste Solid Waste Disposal On Land For The Period 1990 To 2019



Emissions from Solid Waste Disposal on Land are presented in Table 5.1.

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	0.000102	0,00063948	0,00009636
1991	9.88	0.001128	0,001386489	0,000208923
1992	15.20	0.002154	0,002133498	0,000321486
1993	20.52	0.003180	0,002880507	0,000434049
1994	25.84	0.004206	0,003627516	0,000546612
1995	31.16	0.005232	0,004374525	0,000659175
1996	33.53	0.006348	0,004707186	0,000709302
1997	35.85	0.007377	0,005033058	0,000758406
1998	37.44	0.007984	0,005256438	0,000792066
1999	37.69	0.008413	0,005290675	0,000797225
2000	37.93	0.008843	0,005324912	0,000802384
2001	38.17	0.009272	0,005359149	0,000807543
2002	38.33	0.009214	0,005381487	0,000810909

Years	NMVOC	TSP	PM10	PM2.5
	ktonnes	ktonnes	ktonnes	ktonnes
2003	39.48	0.009529	0,005541795	0,000835065
2004	38.07	0.009178	0,005345133	0,000805431
2005	38.31	0.009587	0,0053780925	0,0008103975
2006	38.54	0.009996	0,005411052	0,000815364
2007	37.83	0.009899	0,005311407	0,000800349
2008	37.12	0.009803	0,005211762	0,000785334
2009	37.99	0.010147	0,005332869	0,000803583
2010	38.85	0.010490	0,005453976	0,000821832
2011	39.35	0.010800	0,0055248225	0,0008325075
2012	39.86	0.011111	0,005595669	0,000843183
2013	41.66	0.011447	0,0058489425	0,00881345
2014	43.47	0.011783	0,006102216	0,000919512
2015	44	0.013044	0,0062	0,0009297255
2016	44	0.011814	0,0063	0,000939939
2017	44	0.011814	0,0063	0,000939939
2018	40	11.989848	6,000.0000	10,000,000.00
2019				
40	11.989848	6,000.0000	10,000,000.00	10

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, TSP, PM_{10} and $PM_{2.5}$ 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 5.2.

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 2016.

NMVOC and PM_{10} emissions are calculated using solid waste data according to Guidebook is published in 2016. 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. For the year 2017 same value with 2016 is taken because of lack of data. Turkstat has no announcement for 2017 datas for the calculation of all headings for waste.

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 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.

6.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 2019. For this reason the emissions are reported as not occurring (NO).

Planned Improvements

Municipal waste usually are landfilled in Turkey. Since there is no incineration plant for municipal waste, there is no improvement planned.

6.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.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. Conversion of nitrogen in the waste occurs at relatively low temperatures (less than 1090 ^{0}C) while oxidation of atmospheric nitrogen occurs at higher temperatures 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 increased by about from 0.017 ktonnes in 1990 to 0.189 ktonnes in 2019.

SO_2 emissions increased by about from 0.004 ktonnes in 1990 to 0.044 ktonnes in 2019.

NMVOC emissions increased by about from 0.005 ktonnes in 1990 to 0.057ktonnes in 2019.

CO emissions increased by about from 0.001 ktonnes in 1990 to 0.016 ktonnes in 2019.

TSP emissions increased by about from 0.129 ktonnes in 1990 to 1.329 ktonnes in 2019.

PM_{10} emissions increased by about from 0.103 ktonnes in 1990 to 1,115 ktonnes in 2019.

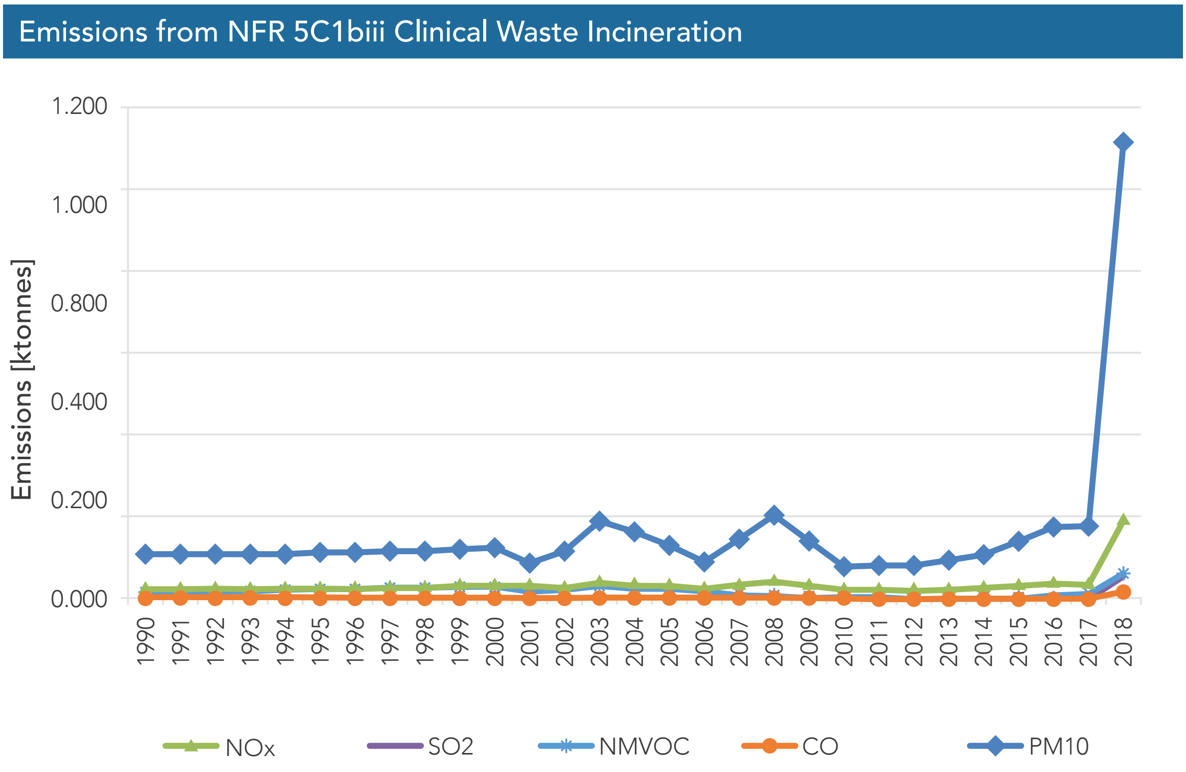
The decrease of NO_x, SO_2, NMVOC, CO, TSP and PM_{10} emissions in this sector were mainly due to the decrease in the annual amount of incinerated clinical waste in Turkey. Therefore, since all the types of pollutant emissions are calculated by the same method, they have the same trend between the years 1990 to 2019.

Some fluctuations can be observed in the time interval for 1990 to 2019 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 5.2.

Figure 6.2

Emissions From NFR 5C1biii Clinical Waste Incineration For The Period 1990 to 2019.



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	0,023	0,005	0,007	0,002	0,17	0,136
2016	0.02898	0.006804	0.00882	0.002	0.214	0.171
2017	0.02898	0.006804	0.00882	0.002	0.214	0.171
2018	0.1886	0.0443	0.0574	0.0156	1.3940	1.1152
2019	0.1886	0.0443	0.0574	0.0156	1.3940	1.1152
2018-2019	0,1596	0,03749	0,0485	0,0136	1,18	0,9442

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.C.1bv Cremation

Source Category Description

Emissions: NO
Key Source: *Key source analysis not carried out for this inventory.*

Source of Activity Data

Cremation does not occur in Turkey, and emissions are therefore reported as NO.

6.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, TSP, PM_{10}, and $PM_{2.5}$. 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, emissions of CO and VOCs are more significant than emissions of NO_x. (EMEP/EEA Emission Inventory Guidebook 2016, Chapter 5.C.2. Open burning of waste, page 4).

Emission Trends

CO emissions decreased from 16.41 ktonnes in 1990 to 0,558 ktonnes in 2019.

NO_x emissions decreased from 0.93 ktonnes in 1990 to 0,03 ktonnes in 2019.

SO_2 emissions decreased from 0.0323 ktonnes in 1990 to 0,001 ktonnes in 2019.

NMVOC emissions from 0.362 ktonnes in 1990 to 0,012 ktonnes in 2019.

TSP emissions from 1.36 ktonnes in 1990 to 0,046 ktonnes in 2019.

PM_{10} emissions from 1.33 ktonnes in 1990 to 0,045 ktonnes in 2019.

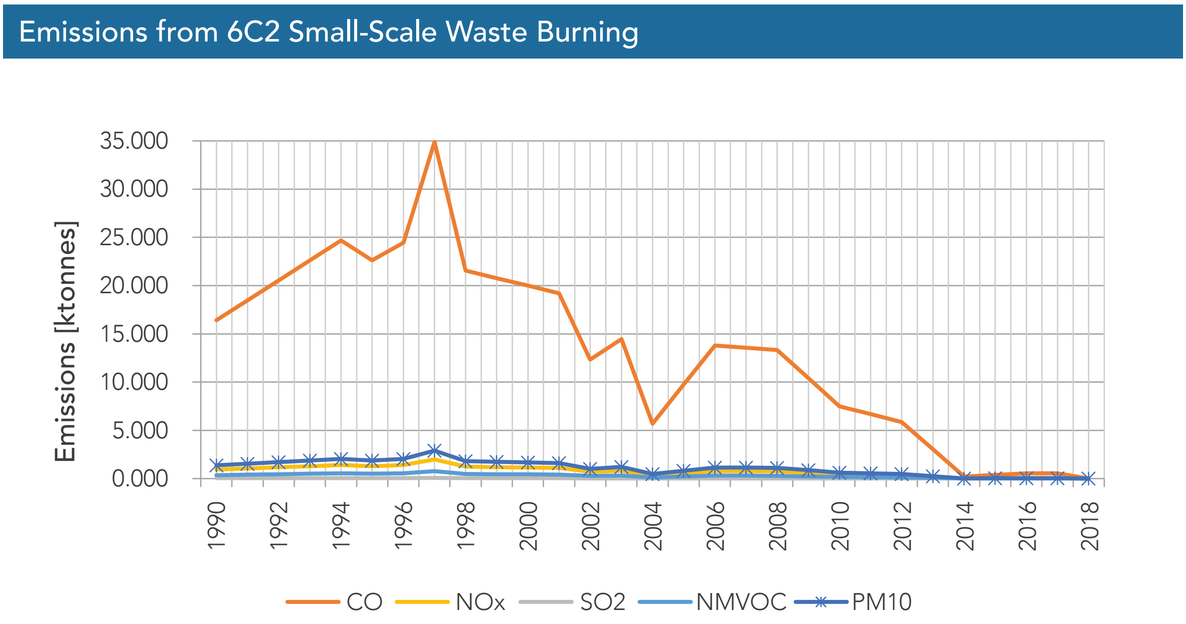
$PM_{2.5}$ emissions from 1.23 ktonnes in 1990 to 0,042 ktonnes in 2019.

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 2019.

Some fluctuations can be observed in the time interval for 1990 to 2019 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 5.3 and emissions are presented Table 6.5.

Figure 6.3
Emissions From NFR 6C2 Small-Scale Waste Burning For The Period 1990 To 2018.



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	0,391	0,022	0,001	0,009	0,032	0,032	0,029
2016	0.558	0.032	0.001	0.012	0.046	0.046	0.046
2017	0.558	0.032	0.001	0.012	0.045	0.045	0.045
2018	0,558	0,032	0,001	0,012	0.042	0.042	0.042
2019	0,558	0,032	0,001	0,012	0.042	0.042	0.042

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.

NFR 6D 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 2016, there are 55 physical, 492 biological, 135 advanced and 199 natural wastewater treatment plants in Turkey which corresponds to a rate of 84% as population served by sewerage system in total population. (Main Wastewater Indicators of Municipalities, 1994-2016, TURKSTAT)And There is no additional information for 2019 datas

By the way according to information of the Water And Soil Management Department of the MoEU, there are 976 domestic wastewater treatment plants in Turkey since December 2016

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".

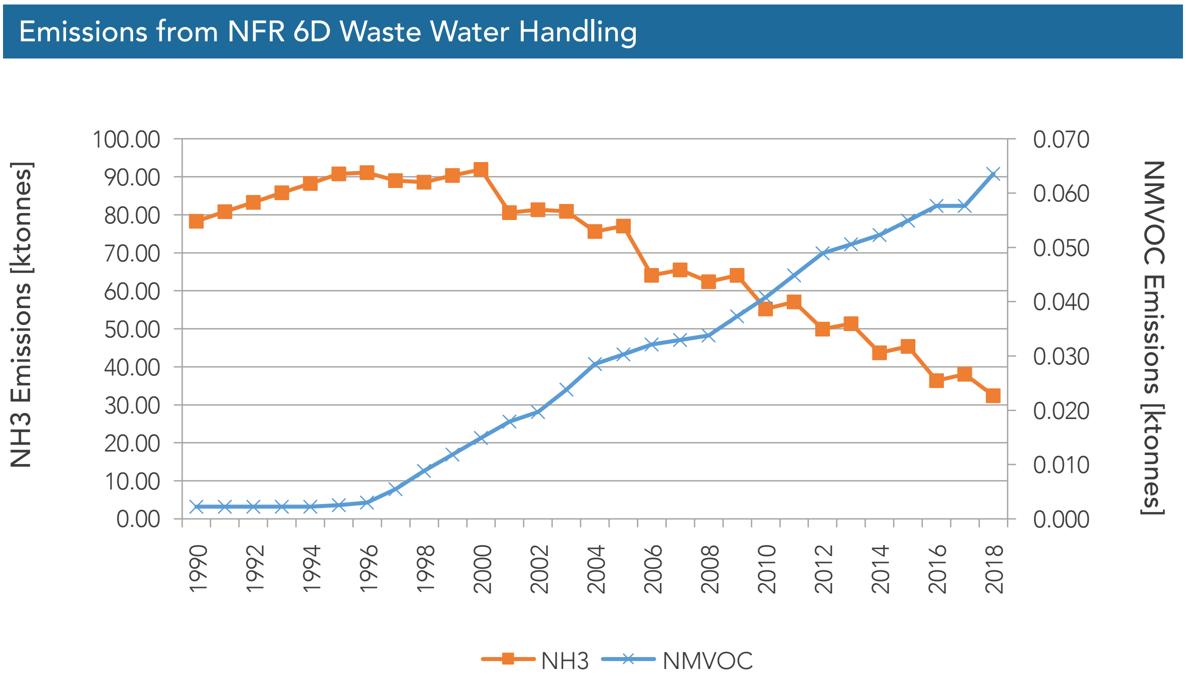
Emission Trends

NMVOC emissions increased by 2800% from 0.002 ktonnes in 1990 to 0.058 ktonnes in 2019. 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 59% between 1990 and 2019, 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 6.D Waste Water Handling For The Period 1990 to 2019



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**
2016	**0.052**	**36**
2017	**0.052**	**38**
2018	**0.052**	**32**
2019	**0.052**	**32**
Trend 1990-2019	2800%	-59%

Methodological Issues

The applied methodology is TIER 2, which is an approach for process emissions from wastewater handling and uses the general equations:

$$Emission_{NMVOC} = AD * EF_{NMVOC} / 10^9$$

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)

$$Emission_{NH3} = AD * EF_{NH3} / 10^6$$

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

A default emission factor for NMVOC emissions from waste water handling has been derived from a Turkish study (Atasoy et al.,2004) (Table 3-1, Tier 1) The emission factor of 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 handled	15	EMEP/EEA (2016), Chapter 5D Waste water handling, Table 3-1, Tier 1 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 3-2 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.

NFR.6E 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 studies will be checked for integrating 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. Road transport recalculations are covering the years 1994-2017 in the reporting.

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' submissions.

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. Additionally, petroleum balance will be integrated for future submissions. The sub-category data for 1A2 sectors' information, both calculations and recalculations are revised.

Fertiliser production statistic national data set is included to the calculations therefore emissions were recalculated.

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.

$PM_{2,5}$ emissions: After the recommendations of the ERT by the in-depth reviews, the emission calulations are added step by step for each submission annually for selected sectors. The NFR categoires will be completed continuously.

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 next submissions.

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.

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

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