



REPUBLIC OF ARMENIA
MINISTRY OF
ENVIRONMENT

INFORMATIVE INVENTORY REPORT (IIR) OF THE REPUBLIC OF ARMENIA 2023

Submission under the UNECE Convention
on Long-range Transboundary Air Pollution

March 2023

National Focal Point of the United Nations Economic Commission for Europe
Convention on Long-range Transboundary Air Pollution:

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LIST OF ABBREVIATIONS

ARMSTAT	Statistics Committee of the Republic of Armenia
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CNG	Compressed natural gas
EEA	European Economic Area
EF	Emission Factor
EMEP	The European Monitoring and Evaluation Programme
HMC	Hydrometeorology and Monitoring Center
HM	Heavy metals
IIR	Informative Inventory Report
IPCC	Intergovernmental Panel on Climate Change
LPS	Large point sources
ME	Ministry of Environmental
NFR	Nomenclature for reporting
QA/QC	Quality assurance/quality control
UNECE	United Nations Economic Commission for Europe

Pollutants

CO	Carbon monoxide
NO _x	Nitrogen oxides reported as nitrogen dioxide (NO ₂)
SO _x	Sulphur oxides reported Sulphur dioxide (SO ₂)
NH ₃	Ammonia
NM VOC	Non-methane volatile organic compounds
PM _{2.5}	Particulate matter with diameter equal to or less than 2.5µm
PM ₁₀	Particulate matter with diameter equal to or less than 10 µm
TSP	Total suspended particulates
As	Arsenic and its compounds
Cd	Cadmium and its compounds
Cr	Chromium and its compounds
Cu	Copper and its compounds
Hg	Mercury and its compounds
Ni	Nickel and its compounds
Pb	Lead and its compounds
Se	Selenium and its compounds

Zn	Zinc and its compounds
HCB	Hexachlorobenzene
PCDD/PCDF	Dioxins and furans
PAH	Polyaromatic hydrocarbons {benzo(a)pyrene, benzo(b)fluoranthene, benzo(k) fluoranthene, indeno (1,2,3- cd)pyrene, total 1-4}
PCB	Polychlorinated biphenyls
PCP	Pentachlorophenol
PFCs	Perfluorocarbons
POP	Persistent organic pollutants

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Executive Summary

Update date - March 2023

The present report is the sixth Informative Inventory Report (IIR) submitted by Armenia under the Convention on Long-Range Transboundary Air Pollution. The first IIR was submitted in 2018.

The report “Armenia’s Informative Inventory Report 2023” contains a complete and comprehensive description of the methodology used for the compilation of the Armenian Air Emission Inventory submission under the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe (UNECE/LRTAP).

Armenia is required to annually report data on emissions of air pollutants covered under the UNECE/LRTAP Convention and its Protocols for the main pollutants NO_x, SO₂, NMVOC, NH₃ and CO, Particulate Matter (PM), Persistent Organic Pollutants (POPs) and Heavy Metals (HM).

The report was prepared in accordance with the Guidelines for Reporting Emissions and Projections of the UNECE Convention on Long-range Transboundary Air Pollution ECE/ EB.AIR / 2013/7 [1].

A key category analysis level assessment is carried out for the time series 1990-2021 showing the relevant sources of air pollution in Armenia.

Chapter 1. Introduction

1.1 National Inventory Background

Update date - March 2023

The Republic of Armenia ratified the Convention on Long-range Transboundary Air Pollution in February 1997.

Armenia has been a party to the Protocol on Long-term Financing of a joint program for monitoring and long-range transmission of pollutants in Europe since 2014.

According to the requirements of the Convention, Ministry of Environment of the Republic of Armenia annually submits information on pollutant emissions (Pollutants) in the established format to the Center for Emission Inventories and Projections (CEIP) of CLRTAP at <http://www.ceip.at/ceip/>, and also inform the UNECE Secretariat on the content of the data provided.

The national pollutant emission inventory has been prepared using the EMEP/EEA Guidebook 2019 Emission Factors (EF) [1]. Emissions from mobile sources are calculated using national methodology.

Selected emission source categories are presented based on national statistics on emissions of sulfur compounds, nitrogen oxides, carbon monoxide, ammonia, non-methane volatile organic compounds and particulate matter from stationary sources.

1.2 Institutional arrangements

Update date - March 2023

The Ministry of Environment of the Republic of Armenia is responsible for reporting to the UNECE under the Convention on Long-range Transboundary Air Pollution.

This task is located within the Hydrometeorology and Monitoring Center (HMC) state non-commercial organization of the Ministry of Environment, which collects activity data from ARMSTAT (the Statistical Committee of the Republic of Armenia) and data on stationary sources. HMC carries out the emission calculation based on the collected data. Quality checking/control is also carried out by HMC. Emissions inventories are made on an annual basis.

1.3 Inventory preparation process

Update date - March 2022

Inventory preparation includes the following steps: planning, data collection and data processing, management and compilation. Inventory planning included:

- identification of relevant pollution sources;
- identification of relevant data sources;
- data collection process;
- examination of all documents containing relevant information.

1.4 Methods and data sources

Date of update - March 2022.

The emission inventory under UNECE/CLRTAP for 2023 submission is prepared based on:

- ✓ EMEP/EEA Guidebook 2019 Emission Factors (EF);
- ✓ Country-specific EF.

The basis for the preparation of the national report to the Convention is official statistics on emissions of pollutants (NO_x, NMVOC, SO₂, NH₃, CO, particulate matter) by type of source: stationary and mobile, obtained from the Statistical Committee of the Republic of Armenia (Armstat).

The list of key categories, emissions from which are presented on the basis of official statistics, is given in Table 1.

Table 1. Key categories, emissions from which are presented on the basis of official statistics

NFR	Key categories	Pollutants
2A1	Cement production	NO _x , TSP, CO
2A2	Lime production	NO _x , TSP, CO
2A3	Glass production	NO _x , TSP, CO
2A5a	Quarrying and mining of minerals other than coal	NO _x , TSP, CO, SO ₂
2A5b	Construction and demolition	NO _x , TSP, CO, SO ₂
2B10a	Chemical industry: Other	NO _x , TSP, CO, SO ₂
2C2	Ferroalloys production	NO _x , TSP, CO, SO ₂
1A3bi	Road transport: Passenger cars	NO _x , NMVOC, SO ₂ , TSP, CO, Pb

Based on instrumental measurements or calculations, all legal entities and individual entrepreneurs that have stationary sources of pollutant emissions into the atmospheric air (including boiler houses), regardless of whether they are equipped with treatment plants or not, and their maximum design emissions correspond to air consumption exceeding 200 million cubic meters. meters / year, fill out the statistical reporting form No. 2-TP (air) and submit it to Armstat. Form No. 2-TP (air) is the main form of state statistical reporting for conducting an inventory of pollutant emissions in the territory of Armenia. This form reflects information on stationary sources of pollution, characterizing the number of pollutants captured, used (utilized) and emitted into the atmospheric air, as well as a number of other indicators.

Data on mobile sources of pollution, including vehicles, are not provided in Form No. 2-TP (air).

Emissions from mobile sources are calculated using national methodology.

Currently, the system of state statistical reporting does not cover a number of categories of sources, which is due to several reasons:

- lack of methodology for territorial reference of a number of sources;

- lack of necessary methods for calculating the mass of emissions from certain types of sources;
- lack of necessary statistical data on the activity of some sources;
- lack of an appropriate organizational mechanism to ensure that these types of sources are taken into account.

Emissions of pollutants from source categories that are not included in national statistics but may contribute additionally to total emissions are calculated using the EMEP/EEA Guide [1]. The list of these categories is presented in Table 2.

Emissions from the Energy and Agriculture sectors are calculated based on Tier 1 EMEP/EEA methodology, along with the recommended Tier 1 emission factors from GB2019. To estimate emissions from Energy and Industrial sectors Tier 1 and Tier 2 EMEP/EEA methodology were used. For the subcategory 2A6 (concrete and brick production) a national methodology⁴ is applied. Emissions from Waste sector Tier 1 EMEP/EEA methodology and plant specific emissions from state reporting system.

Table 2 Source categories calculated using the 2019 EMEP/EEA Guidelines

NFR	Key categories	Pollutants
1A1a	Public electricity and heat production	NO _x , NMVOC, SO ₂ , PM _{2.5} , PM ₁₀ , TSP
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	NO _x , NMVOC, CO
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	NO _x , NMVOC, SO ₂ , CO, Zn
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	NO _x
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	NO _x
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	NO _x , NMVOC, CO
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	NO _x , NMVOC, CO
1A2gvi ii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	NO _x , CO
1A4bi	Residential: Stationary	NO _x , NMVOC, SO ₂ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Hg, Cr, Cu, Ni, Zn, PAHs, HCB, PCBs
2D3a	Domestic solvent use including fungicides	NMVOC
2H2	Food and beverages industry	NMVOC
3B1a	Manure management – Dairy cattle	NO _x , NMVOC,
3B1b	Manure management – Non-dairy cattle	NH ₃ , PM _{2.5} ,

NFR	Key categories	Pollutants
3B2	Manure management – Sheep	PM10, TSP
3B3	Manure management – Swine	
3B4d	Manure management – Goats	
3B4e	Manure management – Horses	
3B4gi	Manure management – Laying hens	
3B4giv	Manure management – Other poultry	

1.5 Key Categories

Date of update - March 2023.

Key sources analysis is prepared based on methodology of the EMEP/EEA air pollutant emission inventory Guidebook 2019.

It is good practice for each country to use key category analysis systematically and objectively as a basis for choosing methods of emission calculation. Such a process will lead to improved inventory quality as well as greater confidence in the resulting estimates. This can be achieved by performing a quantitative analysis of the relationship between the magnitude of emissions in any one year (i.e. level) and the change in emissions year to year (i.e. trend) for each category's emissions compared to the total national emissions (EEA, 2019).

All notations, descriptions of identification and results for key categories included in this chapter are based on the latest Inventory Guidebook.

The identification includes all NFR categories and all reported gases:

- SO₂, NO_x, NMVOC, NH₃, CO
- PM: TSP, PM₁₀, PM_{2.5}
- HM: Cd, Hg, Pb
- POP: PAH, PCDD/F, HCB, PCB

Used methodology for identification of key categories

The methodology covers Approaches 1 and 2 for both level and trend assessment. Both approaches identify key categories in terms of their contribution to the absolute level of the national emissions.

In Approach 1: the 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.

In Approach 2: the key categories can be derived by inventory compilers if category uncertainties or parameter uncertainties are available. Under Approach 2 the categories are sorted according to their contribution to uncertainty.

Level assessment

The contribution of each source category to the total national inventory level is calculated according to equation (1) (level assessment (Approach 1)):

Key category level assessment = source category estimate / total contribution

$$L_{x,t} = E_{x,t} / \sum E_t \quad (1)$$

Where:

$L_{x,t}$ = level assessment for source x in latest inventory year (year Gg)

$E_{x,t}$ = value of emission estimate of source category x in year

$\sum E_t$ = total contribution, which is the sum of the emissions in year Gg, calculated using the aggregation level chosen by the country for key category analysis.

Key categories according to equation (1) are those that, when summed together in descending order of magnitude, add up to 80 % of the sum of all $L_{x,t}$.

Results of the Level and Trend Assessment (Approach 1)

As the analysis was made for all pollutants reported to the UNECE/EC and as these pollutants differ in their way of formation, most of the identified categories are key for more than one pollutant: in total 10 key sources were identified.

Tables 3 - 25 present the source category, sorted by largest contribution to national total.

Table 3. Key categories for NO_x emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] $E_{x,t}$	Level assessment. $E_{x,t}$	Cumulative Total of $L_{x,t}$
1A3bi	Road transport: Passenger cars	17.791	74.9%	74.9%
1A1a	Public electricity and heat production	2.580	10.9%	85.8%

Table 4. Key categories for NMVOC emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] $E_{x,t}$	Level assessment, $E_{x,t}$	Cumulative Total of $L_{x,t}$
5A	Biological treatment of waste - Solid waste disposal on land	138.428	75.3%	75.3%
1A3bi	Road transport: Passenger cars	29.666	16.1%	91.5%

Table 5. Key categories for SO_x emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
2H3	Other industrial processes (please specify in the IIR)	0.357	41.7%	41.7%
2C2	Ferroalloys production	0.348	40.7%	82.4%

Table 6. Key categories for NH₃ emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
3B1a	Manure management - Dairy cattle	8.368	51.6%	51.6%
3B1b	Manure management - Non-dairy cattle	3.543	21.8%	73.4%
3B3	Manure management - Swine	1.810	11.2%	84.6%

Table 7. Key categories for PM_{2.5} emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	2.570	92.6%	92.6%

Table 8. Key categories for PM₁₀ emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	2.638	85.6%	85.6%

Table 9. Key categories for TSP emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
2A5a	Quarrying and mining of minerals other than coal	6.056	44.9%	44.9%
1A4bi	Residential: Stationary	2.776	20.6%	65.5%
2H3	Other industrial processes (please specify in the IIR)	1.704	12.6%	78.2%
2A1	Cement production	0.983	7.3%	85.5%

Table 10. Key categories for BC emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.255	98.5%	98.5%

Table 11. Key categories for CO emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A3bi	Road transport: Passenger cars	130.130	87.1%	87.1%

Table 12. Key categories for Pb emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A3bi	Road transport: Passenger cars	0.700	87.9%	87.9%

Table 13. Key categories for Cd emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.044	100.0%	100.0%

Table 14. Key categories for Hg emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.018	43.0%	43.0%
2D3a	Domestic solvent use including fungicides	0.017	39.8%	82.8%

Table 15. Key categories for As emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.004	45.2%	45.2%
1A1a	Public electricity and heat production	0.003	44.6%	89.8%

Table 16. Key categories for Cr emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.079	99.8%	99.8%

Table 17. Key categories for Cu emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.021	99.6%	99.6%

Table 18. Key categories for Ni emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.007	98.4%	98.4%

Table 19. Key categories for Ni emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.002	71.1%	71.1%
1A1a	Public electricity and heat production	0.000	11.6%	82.7%

Table 20. Key categories for Zn emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	1.757	68.9%	68.9%
2C7a	Copper production	0.780	30.6%	99.5%

Table 21. Key categories for PCDD/ PCDF emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	2.795	99.8%	99.8%

Table 22. Key categories for benzo(a)pyrene emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.421	99.6%	99.6%

Table 23. Key categories for benzo(b)fluoranthene emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.390	100.0%	100.0%

Table 24. Key categories for benzo(k)fluoranthene emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.148	100.0%	100.0%

Table 25. Key categories for Indeno(1,2,3-cd)pyrene emissions for the year 2021

Level Assessment				
NFR category code	NFR category	Latest year (2021) Estimates [Gg] Ex,t	Level assessment, Ex,t	Cumulative Total of Lx,t
1A4bi	Residential: Stationary	0.246	100.0%	100.0%

1.6 QA/QC and Verification methods

Date of update - March 2022.

General quality control procedures include procedures for checking the integrity, correctness and completeness of data, identifying errors and deficiencies, documenting and archiving inventory data, and quality control activities.

The basis of the national emission inventory is the data of the state registration of emissions of pollutants.

State accounting of pollutant emissions is carried out by summarizing emissions from individual sources (bottom-up approach) in order to control sources of air pollution and state regulation of the state of the environment. Primary accounting of emissions is carried out based on the results of the inventory at enterprises that have sources of pollutant emissions.

The enterprise carries out work on inventory, organization of primary accounting and preparation of annual statistical reporting on emissions of pollutants into the atmosphere in the form of federal statistical observation No. 2-TP (air) "Information on the protection of atmospheric air" for the reporting year. Entering false information, as well as late submission of reports, entails penalties in the form of administrative fines, and in some cases, temporary suspension of activities.

Data on emissions of pollutants according to the form No. 2-TP (air) are submitted to the Armstat authorities, where they are checked for completeness and comparability of the data. Then the data is formed by types of economic activity (according to OCTEA-All-Russian classifier of types of economic activity codes) and summarized by the subjects of Armenia, districts and Armenia as a whole.

The data of the national inventory undergo a multi-level check for representativeness, reconciliation for comparability with time series data and with data on industries of comparable scale in other countries.

1.7 General uncertainty evaluation

Date of update - March 2022.

The existing system of state registration of emissions of pollutants into the atmosphere in the Republic of Armenia, based on the processing by the state statistics bodies of the reports of enterprises in the form No. 2-TP (air), does not allow to fully comply with the UNECE requirements. The most significant drawback of the current system is that each enterprise belongs to only one, the so-called "main" type of economic activity, despite the fact that almost every enterprise (especially large ones) carries out a number of technological processes: burning fuel to produce energy, incineration during technological processes, processing of raw materials, manufacturing of products, etc. Such a system makes it impossible to separate combustion-related emissions from process-related emissions, and therefore all further generalizations have little to do with linking emissions to any specific processes, which is required for reporting.

Uncertainty has not been quantified for any of the pollutants or groups of pollutants relevant to this report.

1.8 General Assessment of Completeness

Date of update - March 2023.

List of notation keys

In the following table, notation keys are listed (as defined in the UNFCCC reporting guidelines (ECE/EB.AIR/125):

(a) "NE" (not estimated), for activity data and/or emissions by sources of pollutants which have not been estimated but for which a corresponding activity may occur within a Party. Where NE is used in an inventory to report emissions of pollutants, the Party should indicate why such emissions have not been estimated;

(b) “IE” (included elsewhere), for emissions by sources of pollutants estimated but included elsewhere in the inventory instead of under the expected source category. Where IE is used in an inventory, the Party should indicate where in the inventory the emissions for the displaced source category have been included, and the Party should explain such a deviation from the inclusion under the expected category;

(c) “C” (confidential information), for emissions by sources of pollutants of which the reporting could lead to the disclosure of confidential information. The source category where these emissions are included should be indicated;

(d) “NA” (not applicable), for activities under a given source category that do occur within the Party but do not result in emissions of a specific pollutant;

(e) “NO” (not occurring), for categories or processes within a particular source category that do not occur within a Party;

(f) “NR” (not relevant). According to paragraph 37 in the Guidelines, emission inventory reporting for the main pollutants should cover all years from 1990 onwards if data are available. However, NR is introduced to ease the reporting where reporting of emissions is not strictly required by the different protocols, e.g., emissions for some Parties prior to agreed base years.

Sources Not Estimated– «NE»

Sources Not Estimated (NE) are presented in Table 26.

Table 26 Sources Not Estimated (NE) 2021.

NFR14	Key categories	Pollutants	Reason for not estimated
1A1a	Public electricity and heat production	NH3, PCBs, PCDD/F, HCB, PAHs	Emission occurs, but have not been estimated due to lack of emission factors in methodology (EMEP-EEA guidebook – 2019)
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	NH3	
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	NH3, PCBs, HCB	
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	NH3, PCBs, HCB	
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	NH3, PCBs, HCB	
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	NH3, PCBs, HCB	

NFR14	Key categories	Pollutants	Reason for not estimated
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	NH ₃ , PCBs, HCB	
1A3bi 1A3bii 1A3biii 1A3biv	Road transport	PM _{2.5} , PM ₁₀ , TSP, PCDD/F, PAHs, PCBs, HCB	Emission occurs, but have not been estimated due to lack of statistic data and emission factors in national methodology
1A3bv	Road transport: Gasoline evaporation	NMVOC, PAHs, HCB, PCBs, PCDD/F,	
1A3bvi	Road transport: Automobile tire and brake wear	PM _{2.5} , PM ₁₀ , TSP, PAHs, HCB, PCBs, PCDD/F	
1A3bvii	Road transport: Automobile Road abrasion	PM _{2.5} , PM ₁₀ , TSP, Pb, PAHs, HCB, PCBs, PCDD/F	
1A3bvi-ii	Road transport: Automobile tire and brake wear	PM _{2.5} , PM ₁₀ , TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PAHs, HCB, PCBs	
1A3ei	Pipeline transport	All	Emission occurs, but have not been estimated due to lack of statistic data
1A4ai	Commercial/Institutional: Stationary	All	
1A4aai	Commercial/Institutional: Mobile	All	
1A4bii	Residential: Household and gardening (mobile)	All	
1A4ci	Agriculture/Forestry/Fishing: Stationary	All	
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	NO _x , NMVOC, PM _{2.5} , PM ₁₀ , TSP, BC, CO	
1A4ciii	Agriculture/Forestry/Fishing: National fishing	All	
2A1	Cement production	SO ₂ , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PAHs, HCB, PCDD/F	Emission occurs, but have not been estimated due to lack of statistic data
2A2	Lime production	NMVOC, SO ₂ , PM _{2.5} , PM ₁₀ , BC, Pb, Cd, Hg	
2A3	Glass production	SO ₂ , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PAHs, PCDD/F	
2A5a	Quarrying and mining of minerals other than coal	PM _{2.5} , PM ₁₀	Emission occurs, but have not been estimated due to lack of statistic data
2A5b	Construction and demolition	PM _{2.5} , PM ₁₀	
2C7a	Copper production	NMVOC, PM _{2.5} , PM ₁₀ , PAHs, PCDD/F, HCB, PCBs	
2C7d	Storage, handling and transport of metal products	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, POPs	

NFR14	Key categories	Pollutants	Reason for not estimated
2D3a	Domestic solvent use including fungicides	PM _{2.5}	
2D3b	Road paving with asphalt	NO _x , NMVOC, SO ₂ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, PAHs, PCDD/F, HCB	
2D3c	Asphalt roofing	NO _x , NMVOC, PM _{2.5} , PM ₁₀ , TSP, BC, CO, Pb, Cd, Hg, PAHs, PCDD/F, HCB	
2D3f	Dry cleaning	NMVOC, PM _{2.5}	
2D3h	Printing	NMVOC, PM _{2.5} , BC	
2D3i and 2G	Other solvent use	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, POPs	
2H1	Pulp and paper industry	NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, PAHs, HCB	
2H2	Food and beverages industry	PM _{2.5} , PM ₁₀ , TSP, BC	
2I	Wood processing	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO, As, Cu	
2K	Consumption of POPs and heavy metals	HMs, PCB, HCB	
3Da1	Inorganic N-fertilizers (includes also urea application)	NO _x , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP	
3Da2a	Animal manure applied to soils		
3Da2c	Other organic fertilizers applied to soils, including compost		
3Da3	Urine and dung deposited by grazing animals		
3Da4	Crop residues applied to soils		
3Db	Indirect emissions from managed soils		
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products		
3Dd	Off-farm storage, handling and transport of bulk agricultural products		
3De	Cultivated crops		
3F	Field burning of agricultural residues	All	
5A	Biological treatment of waste - Solid waste disposal on land	NH ₃ , CO, Hg	
5B1	Biological treatment of waste - Composting	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, CO,	

NFR14	Key categories	Pollutants	Reason for not estimated
5C1a	Municipal waste incineration	All	
5C1bi	Industrial waste incineration	All except PCB	
5C1biii	Clinical waste incineration	All	
5C2	Open burning of waste	All except PCB	Emission occurs, but have not been estimated due to lack of statistic data
5D1	Domestic wastewater handling	NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, HMs	
5D2	Industrial wastewater handling	NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, HMs	
5D3	Other wastewater handling	NH ₃ , PM _{2.5} , PM ₁₀ , TSP, BC, HMs	

Sources Included Elsewhere – «IE»

Sources of pollutant emissions accounted for in other categories in 2020 are listed in Table 27.

Table 27. Sources Included Elsewhere

NFR14	Pollutants	Included in NFR code
1A2e	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A2b
1A2f	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A3bi
1A2gviii	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A2b
1A3bii	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A3bi
1A3biii	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A3bi
1A3biv	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A3bi
1A3ei	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A3bi
1A3eii	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A3bi
1A4ai	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A3bi
1A4aii	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A3bi
1A4bii	NO _x , NMVOC, SO ₂ , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO	1A3bi
3B4d	NO _x , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP	3B2
3B4gii	NO _x , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP	3B4gi
3B4giii	NO _x , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP	3B4gi
3B4giv	NO _x , NMVOC, NH ₃ , PM _{2.5} , PM ₁₀ , TSP	3B4gi

Chapter 2: Explanation of key trends

Date of update - March 2023.

In Armenia, ambient air pollution is mainly caused by emissions from motor vehicles, the energy, industrial and agriculture sectors. Emission trends for main pollutants are presented in Table 28 and Figure 1. Carbon monoxide is the largest emission among all pollutants, followed by non-methane volatile organic compounds (NMVOCs).

The chapter provides an analysis of trends in pollutant emissions for 1990 - 2021.

In 2021, the emissions of SO₂ and NMVOC have increased by 1.2% and 12.1%, respectively, compared to 2020. The emissions of NO_x, CO and NH₃ have decreased by 10.5 %, 11.5% and 11.3%, respectively (Table 28, Figure 1).

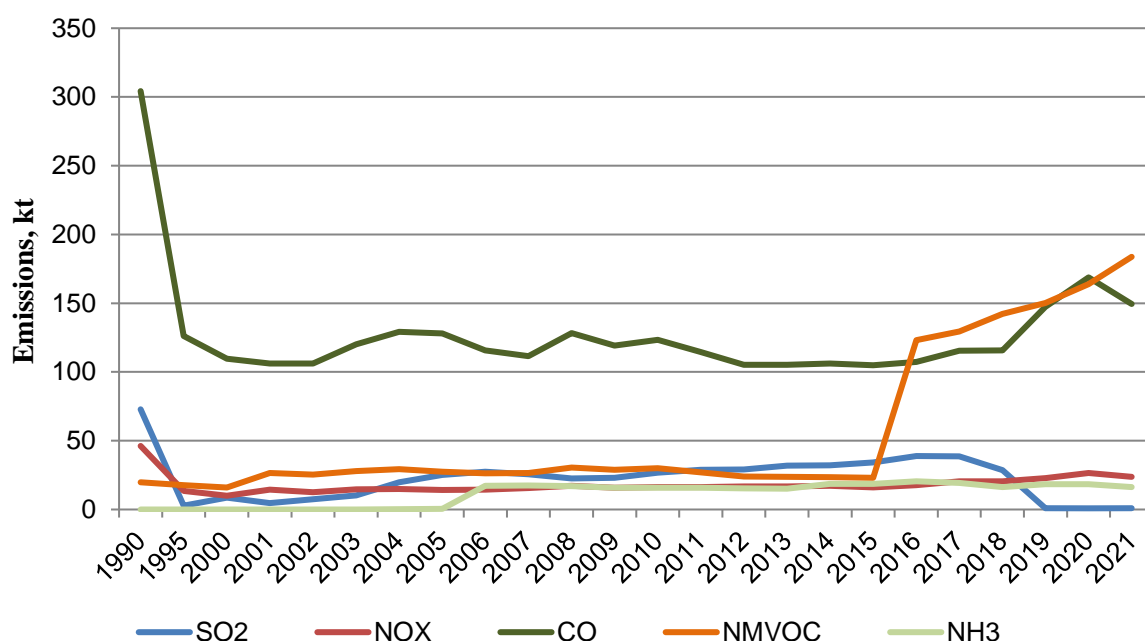


Figure 1. Emissions trends of main pollutants, 1990 -2021.

Table 28 Total emissions of basic pollutants, 1990-2021

Year	Emissions, kt				
	NO ₂	NMVOC	SO ₂	NH ₃	CO
1990	46.2	19.89	72.85		304.25
1995	13.5	17.66	2.79		126.1
2000	10.00	15.99	8.71		109.66
2001	14.48	26.45	4.71		106.17
2002	12.68	25.45	7.55		106.23
2003	14.57	27.96	10.31		120.1
2004	14.94	29.32	19.83		129.18
2005	14.16	27.47	25.08		128.00

Year	Emissions, kt				
	NO ₂	NM VOC	SO ₂	NH ₃	CO
2006	14.4	26.27	27.38		115.77
2007	15.51	26.58	25.7		111.47
2008	17.32	30.6	22.49		128.17
2009	15.83	28.96	22.93		119.16
2010	16.23	30.02	26.71	15.74	123.42
2011	16.24	27.05	28.87	15.83	114.51
2012	16.67	24.06	29.21	15.33	105.33
2013	16.76	23.67	31.81	15.08	105.19
2014	17.17	23.57	32.07	18.64	106.14
2015	16.07	23.15	34.14	18.64	104.89
2016	17.58	123.09	38.76	20.50	107.31
2017	20.41	129.39	38.53	19.41	115.42
2018	20.47	142.16	28.67	16.25	115.75
2019	22.73	150.16	0.91	18.32	147.41
2020	26.55	163.97	0.67	18.29	168.77
2021	23.75	183.74	0.86	16.22	149.43
Change comparing to 2010, %	46.3	-*	-96.8	3.0	21.1
Change comparing to 2020, %	-10.5	-*	28.4	-11.3	11.5

2.1 Nitrogen oxides

Energy sector has the biggest share in total NO_x emissions (about 95 %). Approximately 75 % of total NO_x emissions and 79% of energy sector emissions comes from transport.

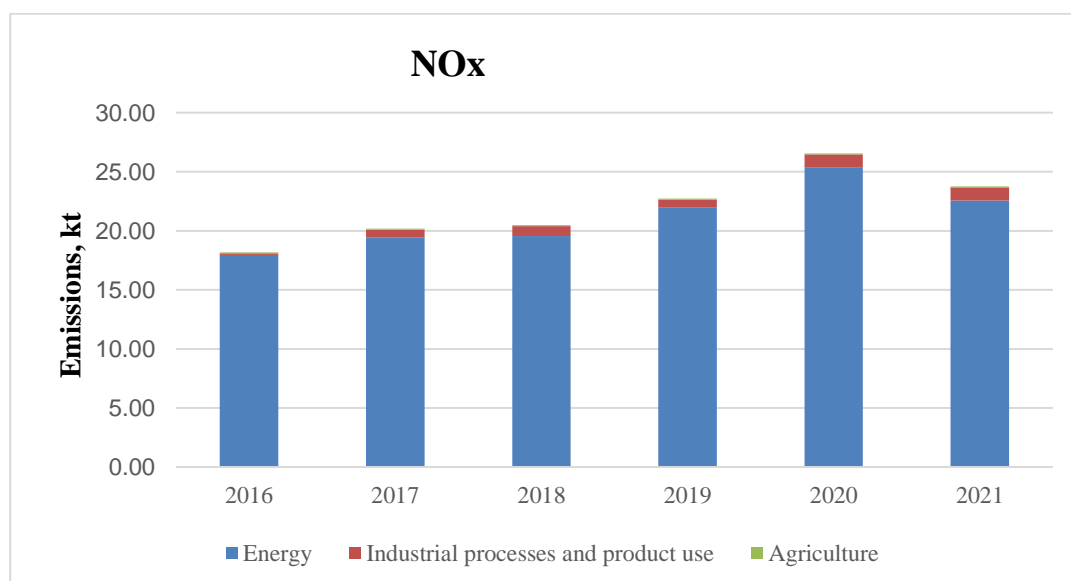


Figure 2. Trends of NO_x emissions by sectors, 2016 -2021.

2.2 Non-methane volatile organic compounds

In 2021, the improvement of inventory was done, waste sector has been included and the emission for previous years (2016-2020) has been recalculated. According to the emission data for 2021, waste sector is the main source of pollution with NMVOC (about 75%), then energy sector within 17 % of total emissions. The emission of NMVOC is showing increasing trends due to the waste sector.

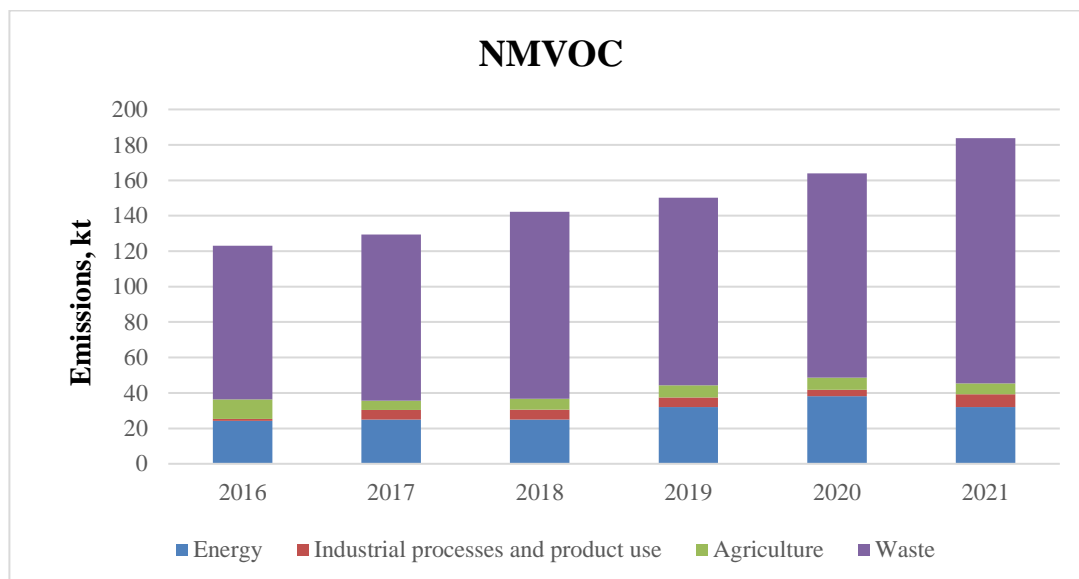


Figure 3. Trends of NMVOC emissions by sectors, 2016 -2021.

2.3 Sulphur dioxide

Stationary combustion in manufacturing industries and construction accounted for nearly 87% of SO_x emissions in 2021. Significant decrease after 2018 (by 98 % 2019-2021) was caused by copper production.

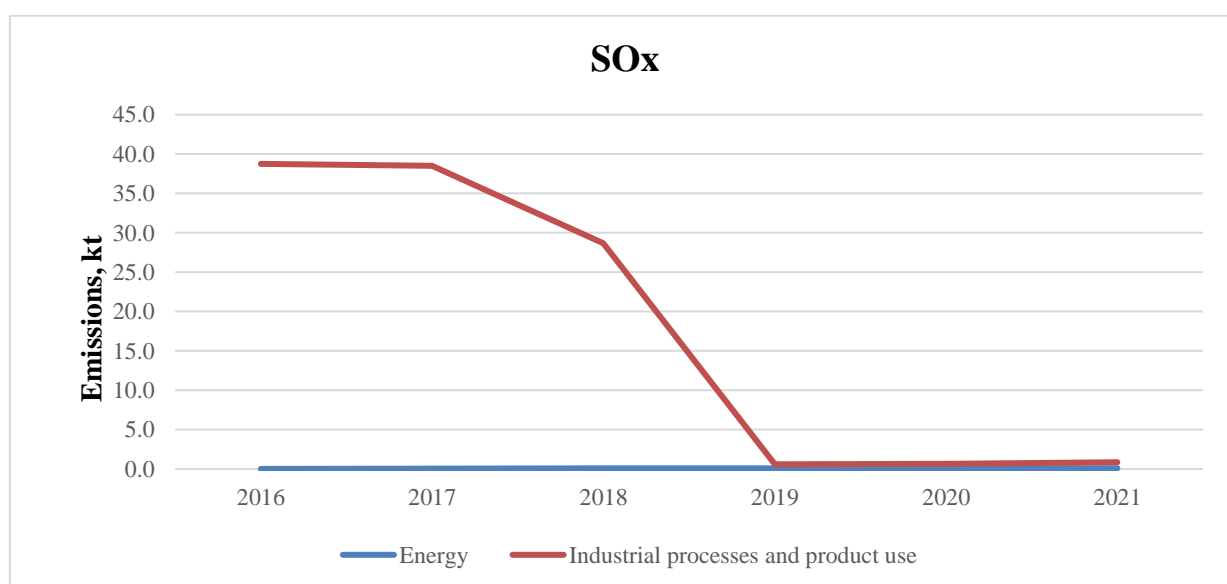


Figure 4. Trends of SO₂ emissions by sectors, 2016 -2021.

2.4 Ammonia

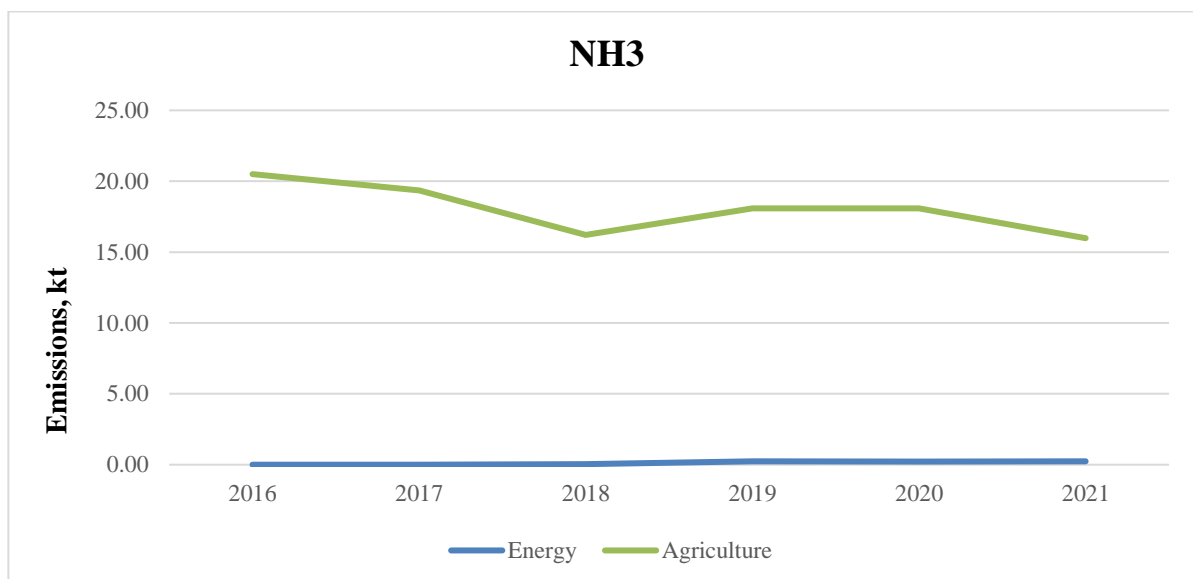


Figure 5. Trends of NH₃ emissions by sectors, 2016 - 2021.

The emissions from agricultural sector, which accounts for 98.5% of total NH₃ emissions, decreased in 2021 by 11.6 % due to decrease of livestock population size in the sectorz

2.5 Carbon monoxide

Energy sector is a main source of CO emissions. In 2021, the shares of emissions from transport and residential combustion sources were 87% and 9.7%.

CO emissions were increased by 39 % in 2021 compared to 2016. The increase of CO emissions mainly was a result of the increase emissions from transport sector as by 23 % in 2016-2021. CO emissions from transport have variable trend: it increases from 2014 to 2020 and decreases in 2021.

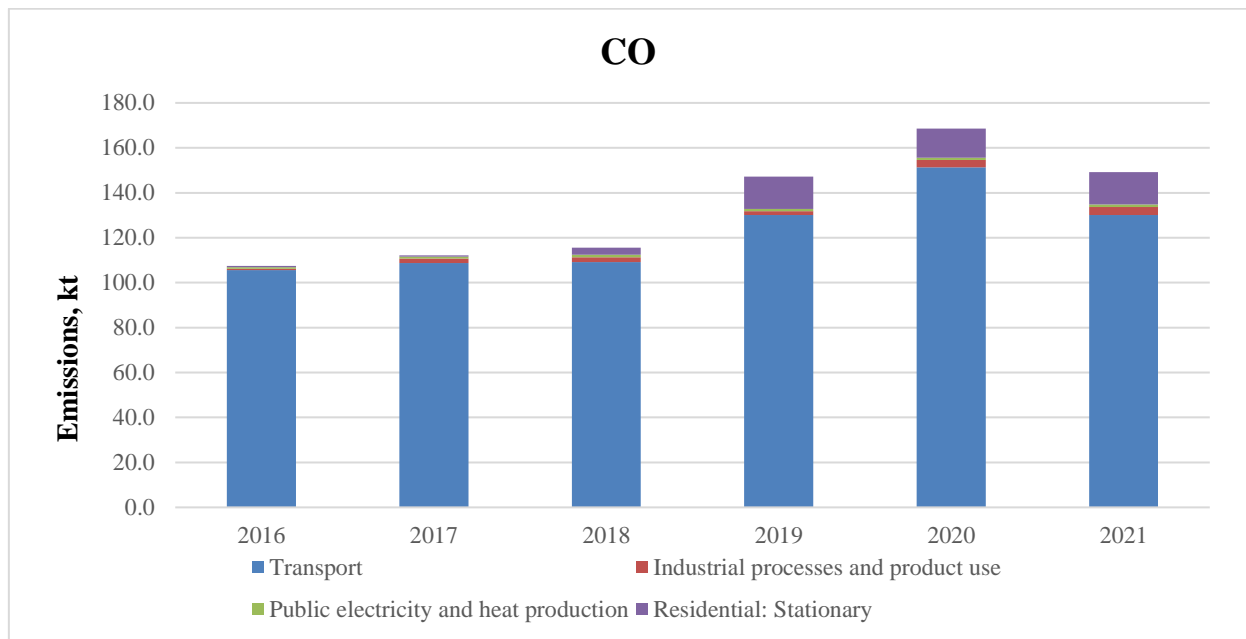


Figure 6. Trends of CO emissions by sectors, 2016 - 2021.

Chapter 3: Recalculations and Improvements

Update date - March 2023

In 2021, the improvement of inventory was done, waste sector has been included and the emission for previous years (2016-2020) has been recalculated. The reporting improvement consists in the fact that for the first time the national emission inventory is presented in the NFR14 format.

Chapter 4: Reporting of gridded emissions and LPS

Update date: March 2023

Reporting on cells of the EMEP grid and data on CUs was not provided.

REFERENCES

- 1 EMEP/EEA Air pollutant emission inventory guidebook 2019 Emission Factors EEA, 13/2019 <https://www.eea.europa.eu/publications/emep-eea-guidebook-2019>.
- 2 Руководящие принципы представления данных о выбросах и прогнозах в соответствии с Конвенцией о трансграничном загрязнении воздуха на большие расстояния. Целевая группа по кадастрам и прогнозам выбросов. ECE/EB.AIR/2013/7.
- 3 Протокол к Конвенции о трансграничном загрязнении воздуха на большие расстояния, касающийся долгосрочного финансирования Совместной программы наблюдения и оценки распространения загрязнителей воздуха на большие расстояния в Европе (ЕМЕР). ООН, Женева, 1984.
- 4 Протокол к Конвенции 1979 года о трансграничном загрязнении воздуха на большие расстояния о сокращении выбросов серы или их трансграничных потоков по меньшей мере на 30%. ООН, Хельсинки, 1985.
- 5 Протокол об ограничении выбросов окислов азота или их трансграничных потоков Конвенции 1979 года о трансграничном загрязнении воздуха на большие расстояния. ООН, София, 1988.
- 6 Распоряжение Росприроднадзора от 01.11.2013 №6-р «Об утверждении Порядка организации работ по оценке выбросов от отдельных видов передвижных источников»
- 7 Решение Комиссии Таможенного союза от 18.10.2011 № 826 «О принятии технического регламента Таможенного союза «О требованиях к автомобильному и авиационному бензину, дизельному и судовому топливу, топливу для реактивных двигателей и мазуту» (вместе с «ТР ТС 013/2011. Технический регламент Таможенного союза. О требованиях к автомобильному и авиационному бензину, дизельному и судовому топливу, топливу для реактивных двигателей и мазуту».