INFORMATIVE INVENTORY REPORT OF THE REPUBLIC OF MOLDOVA 1990-2022

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

2024

The Republic of Moldova Informative Inventory Report 2024 was developed by experts from the Institute of Chemistry, USM; Institute of Power Engineering, UTM, and Institute of Ecology and Geography, USM, under coordination of the Ministry of Environment.
The aim of the book is inventory of air pollutions as the reporting under the Convention on Long-range Transboundary Air Pollution (CLRTAP) for period 1990-2022.

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List of Acronyms, Abbreviations and Units

AD	Activity Data
As	Arsenic
ATULBD	Administrative Territorial Units on the Left Bank of the Dniester
BC	Black carbon
BREF	Best available techniques reference documents
CCAC	Climate and Clean Air Coalition
CCD	Climb/cruise/descent
Cd	Cadmium
CH_4	Methane
CLRTAP	Convention on Long-Range Transboundary Air Pollution, also LRTAP Convention
CNG	Compressed Natural Gas
CO	Carbon Monoxide
Cr	Chromium
Cu	Copper
EB	Energy Balance
EEA	European Environment Agency
EF	Emission Factor
EMEP	CLRTAP European Monitoring and Evaluation Programme
EMEP/EEA	EMEP/EEA Air Pollutant Emission Inventory Guidebook
EU	European Union
FOD	First Order Decay
FQMS	Fuel Quality Monitoring System
GEF	Global Environment Facility
GHG	Greenhouse gases
GPG	Good Practice Guidance
HCB	Hexachlorobenzene
HCH	Lindane (gamma-Hexachlocyclohexane)
HCFC	Hydrochlorofluorocarbon
HDV	Heavy-duty vehicle
HFCs	Hydrofluorocarbons
Hg	Mercury
IIR	Informative Inventory Report
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
Kt	Kiloton
LDV	Light-duty vehicle

LEAP-IBC	Long-range Energy Alternatives Planning - Integrated Benefits Calculator
LNG	Liquefied Natural Gas
LOSP	Light Organic Solvent Preservative
LPG	Liquefied Petroleum Gas
LTO	Landing and Take-off Cycle
MCF	Methane Correction Factors
MARDE	Ministry of Agriculture, Regional Development and Environment
MSW	Municipal Solid Waste
NBS	National Bureau of Statistics
NFR	Nomenclature for Reporting
NH_3	Ammonia
Ni	Nickel
NIR	National Inventory Report
NMVOCs	Non-Methane Volatile Organic Compounds
NO_x	Nitrogen Oxides
PAHs	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCBs	Polychlorinated Biphenyls
PCDD/PCDF	Polychlorinated dibenzo-dioxins (PCDDs) and Polychlorinated dibenzo-furans (PCDFs)
$PM_{2.5}$	Particulate matter (PM) or Particulates ≤ 2.5 µm (micrometres)
PM_{10}	Particulates ≤ 10 µm
POPs	Persistent Organic Pollutants
RM	Republic of Moldova
SA	Joint Stock Company
Se	Selenium
SEI	State Ecological Inspectorate
SO_2	Sulphur Dioxide
SO_x	Sulphur oxides
SLCPs	Short-lived Climate Pollutants
SNAP	Supporting National Action and Planning on SLCPs
SRL	Limited Liability Company
SSFA	Small-Scale Funding Agreement
SWDS	Solid waste disposal sites
SY	Statistical Yearbook
QA/QC	Quality assurance and quality control
TSP	Total Suspended Particulates
Zn	Zinc
UNFCCC	United Nations Framework Convention on Climate Change
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
WBT	Water Biological Treatment

NFR Code	Long name
1.A.1.a	**Public electricity and heat production**
1.A.1.b	Petroleum refining
1.A.1.c	Manufacture of solid fuels and other energy industries

1.A.2.a Stationary combustion in manufacturing industries and construction: Iron and steel
1.A.2.b Stationary combustion in manufacturing industries and construction: Non-ferrous metals
1.A.2.c Stationary combustion in manufacturing industries and construction: Chemicals
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Executive summary

The Nomenclature for Reporting (NFR) and the Informative Inventory Report 2024 (IIR 2024) contains results of emission inventories for the years from 1990 to 2022, including descriptions of trends, performed QA/QC activities, key categories and uncertainty analysis.

The IIR 2024 fulfils the reporting obligations and the country's commitments to the UNECE Convention on Long-Range Transboundary Air Pollution. Emissions are recalculated of a few categories due update methodological issues and from the purpose update versions of set of its units (during 2024) the EMEP/EEA air pollutant emission inventory guidebook 2023. The inventory results and the trend of emissions' changes at the country level for air pollutants are presented in Table 1.

Table 1. Comparison of pollutant emissions in 1990-2022

Pollutant	Unit	1990	1995	2000	2005	2010	2015	2022	2022/ 1990, %
NOx	kt	102,1	35,2	17,6	23,1	25,3	26,8	23,0	*-77*
NMVOC	kt	111,7	50,8	37,0	48,0	46,6	54,9	70,1	*-44*
SOx	kt	149,3	31,5	4,1	4,8	4,0	4,11	4,19	*-97*
NH_3	kt	52,9	31,9	25,9	26,3	21,8	17,94	16,42	*-69*
$PM_{2.5}$	kt	23,8	5,5	4,4	5,0	4,9	11,69	18,37	*-21*
PM_{10}	kt	32,1	8,9	6,6	8,1	8,1	14,75	23,49	*-20*
TSP	kt	71,8	21,9	12,1	17,7	18,2	23,88	42,75	*-27*
BC	kt	4,0	3,2	1,5	0,8	0,7	1,36	2,09	*-47*
CO	kt	322,0	98,9	55,1	62,6	60,1	90,63	124,51	*-61*
Pb	t	8,1	1,4	0,9	1,1	0,9	1,25	1,42	*-82*
Cd	t	0,45	0,19	0,14	0,14	0,14	0,23	0,36	*-20*
Hg	t	0,48	0,12	0,07	0,09	0,06	0,08	0,07	*-85,8*
As	t	1,13	0,32	0,11	0,11	0,10	0,10	0,11	*-90*
Cr	t	1,34	0,33	0,16	0,18	0,16	0,39	0,62	*-54*
Cu	t	3,14	0,90	0,32	0,36	0,31	0,34	0,44	*-86,1*
Ni	t	25,58	3,90	0,68	0,39	0,43	0,24	0,95	*-96*
Se	t	6,22	0,89	0,31	0,44	0,40	0,37	0,41	*-93*
Zn	t	24,32	6,11	4,12	4,38	4,27	8,83	13,67	*-44*
PCDD/F	g I-TEQ	41,49	10,17	10,07	11,06	8,49	16,40	21,89	*-47*
Benzo(a) pyrene	t	9,18	1,09	0,90	1,11	1,08	2,15	3,09	*-66*
Benzo(b) fluoranthene	t	13,35	1,58	1,29	1,57	1,53	2,43	3,25	*-76*
Benzo(k) fluoranthene	t	5,60	1,02	0,90	1,01	0,99	1,25	1,52	*-73*
Indeno(1,2,3-cd)pyrene	t	4,25	0,41	0,34	0,44	0,43	1,08	1,66	*-61*
PAHs, Total	t	32,38	4,10	3,43	4,12	4,02	6,91	9,52	*-71*
HCB	kg	0,52	0,19	0,05	0,06	0,07	0,13	0,16	*-70*
PCBs	kg	10,25	2,66	2,81	3,39	1,25	1,81	1,23	*-88*

Comparing the last 2022 year to the base 1990, the general trend of emissions is decreasing. In 2022 the range of emissions is decreasing from 19% to 97%.

CHAPTER 1. INTRODUCTION

The Informative Inventory Report 2024 contains information on country emissions inventory for the years from 1990 to 2022, including descriptions of methods, data sources, performed QA/QC activities, key categories analysis, and trend analysis.
The emissions have been estimated for 25 air pollutants, in the obligatory reporting template (NFR 2014 format):

- Main pollutants (5): NO_x, NMVOC, SO_x . NH_3, CO;
- PM (4): $PM_{2.5}$, PM_{10}, TSP, BC;
- HM - Heavy Metals (9): main - Pb, Cd, Hg; other-As, Cr, Cu, Ni, Se, Zn;
- POPs (7): PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno (1,2,3-cd) pyrene, HCB, PCB.

The content of the report is compliant with the template of an Informative Inventory Report to CLRTAP.
For each sector, the report includes, inter alia:

- key categories analysis,
- trends of national totals and NFR key sectors,
- methodology and other information.

1.1. National Inventory Background

The Informative Inventory Report 2024 is performed based on the official public data for the entire country, including the territory of the left bank of the Dniester River. This includes energy, agricultural, transport and industry statistics. The IPCC and international emission factors are used. The report neither contains the grid emissions nor projections.

Emissions of pollutants from sectors in 2022 were in the following ratios:
Energy: Main Pollutants (5) -71,3%, PM-56,4%. HM-88,2%, PAHs-88,2%, HCB-72,1%, PCB-37,5%;
Industry: Main Pollutants (5) -12,4%, PM-36,8%. HM-3,6%, PCB-61,8%;
Agriculture: Main Pollutants (5) -10%, PM-5,4%;
Waste: Main Pollutants (5) -6,3%, PM-1,4%. HM-8,2%, PAHs-11,8%, HCB-27,9%, PCB-0,7%;
The emissions estimation per sectors are illustrated in the table 1.1, below.

Table 1.1. Rates of emissions per sectors in 2022.

	Main Pollutants (5), kt	Particulate Matter (4), kt	Heavy metals (9), t	PCDD/ PCDF, g I-TEQ	PAHs total (1-4), t	HCB, kg	PCBs, kg
Energy	164,70	55,73	14,28	18,04	6,93	0,11	0,46
Industry	28,66	36,30	0,58	0,91	0,00	0,00	0,76
Agriculture	23,06	5,36	0,00	0,01	0,00	0,00	0,00
Waste	14,66	1,37	1,33	2,93	0,92	0,04	0,01
Total	**231,07**	**98,76**	**16,20**	**21,89**	**7,86**	**0,16**	**1,23**
Energy	*71,3*	*56,4*	*88,2*	*82,4*	*88,2*	*72,1*	*37,5*
Industry	*12,4*	*36,8*	*3,6*	*4,2*	*0,0*	*0,0*	*61,8*
Agriculture	*10,0*	*5,4*	*0,0*	*0,0*	*0,0*	*0,0*	*0,0*
Waste	*6,3*	*1,4*	*8,2*	*13,4*	*11,7*	*27,9*	*0,7*

Dynamics of emissions of Main Pollutants (5) and Particulate Matter (4) for all sectors for the period 1990-2022 with a step of 5 years shows a decreasing trends, figure. 1.1.

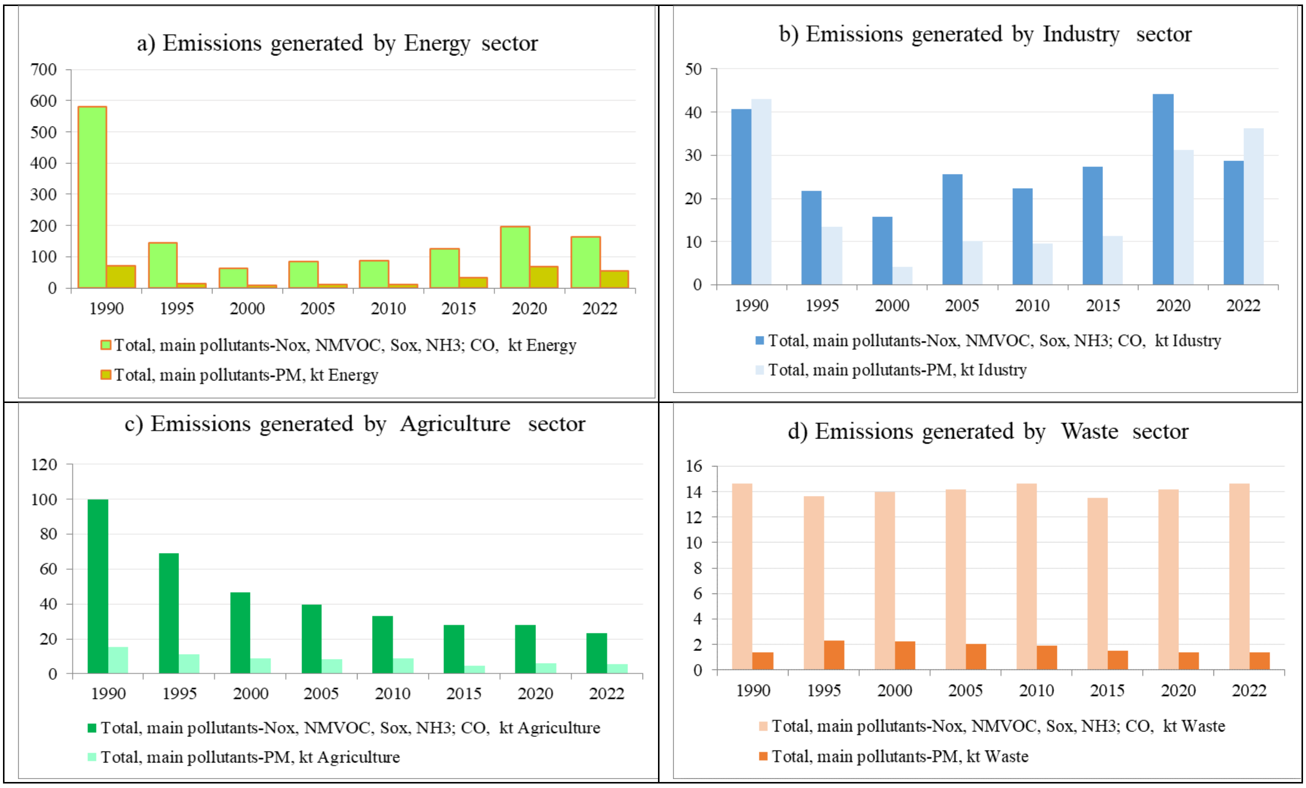


Figure 1.1. Emissions estimation per sectors -Main pollutants (5) and PM (4), kt.

Ratio of sector contributions to total emissions for Main pollutants (5) and PM (4), HM (9) are shown in Figure 1.2, and for PAHs - in Figure 1.3.

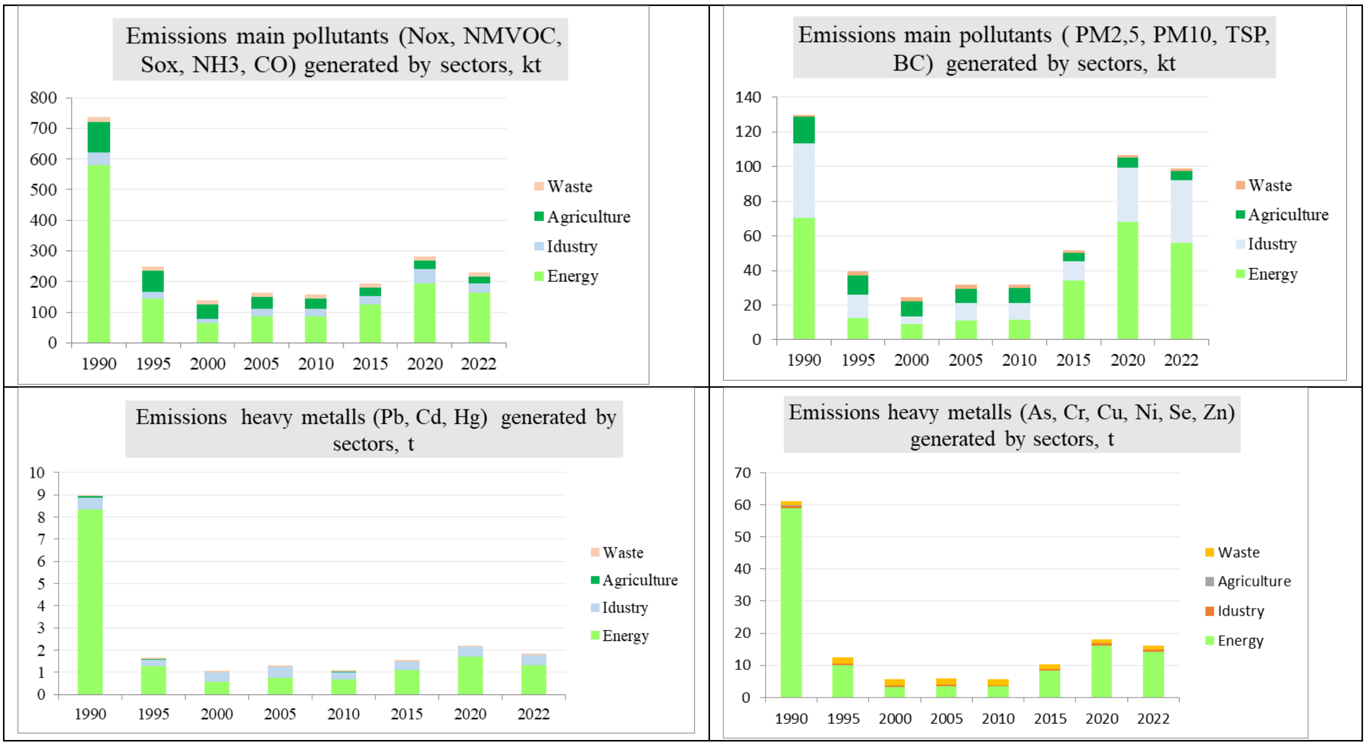


Figure 1.2. Ratio of emissions from sectors (Energy, Industry, Agriculture, Waste) to total emissions for Main pollutants (5), PM (4), HM (9)

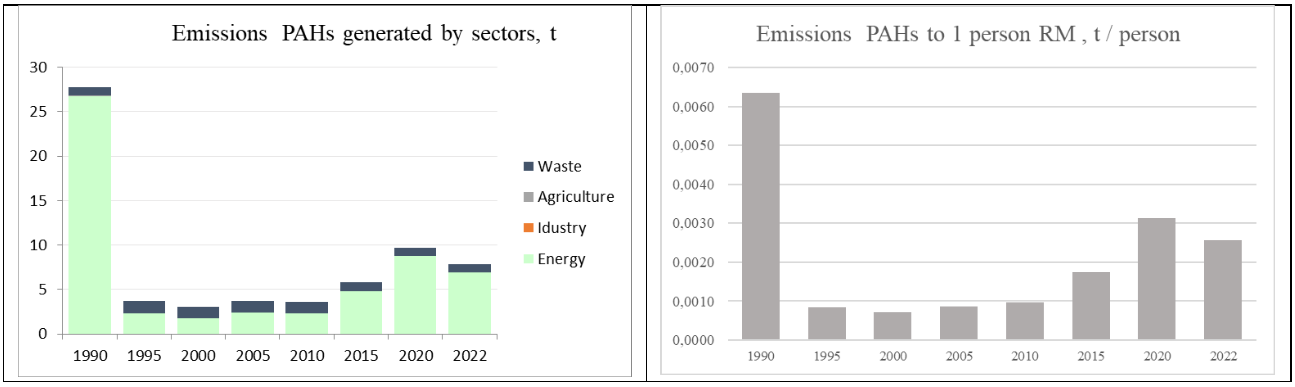


Figure 1.3. Emissions of PAHs by sectors - gross and per capita

Emissions per capita for all groups of pollutants are shown in Figure 1.4.

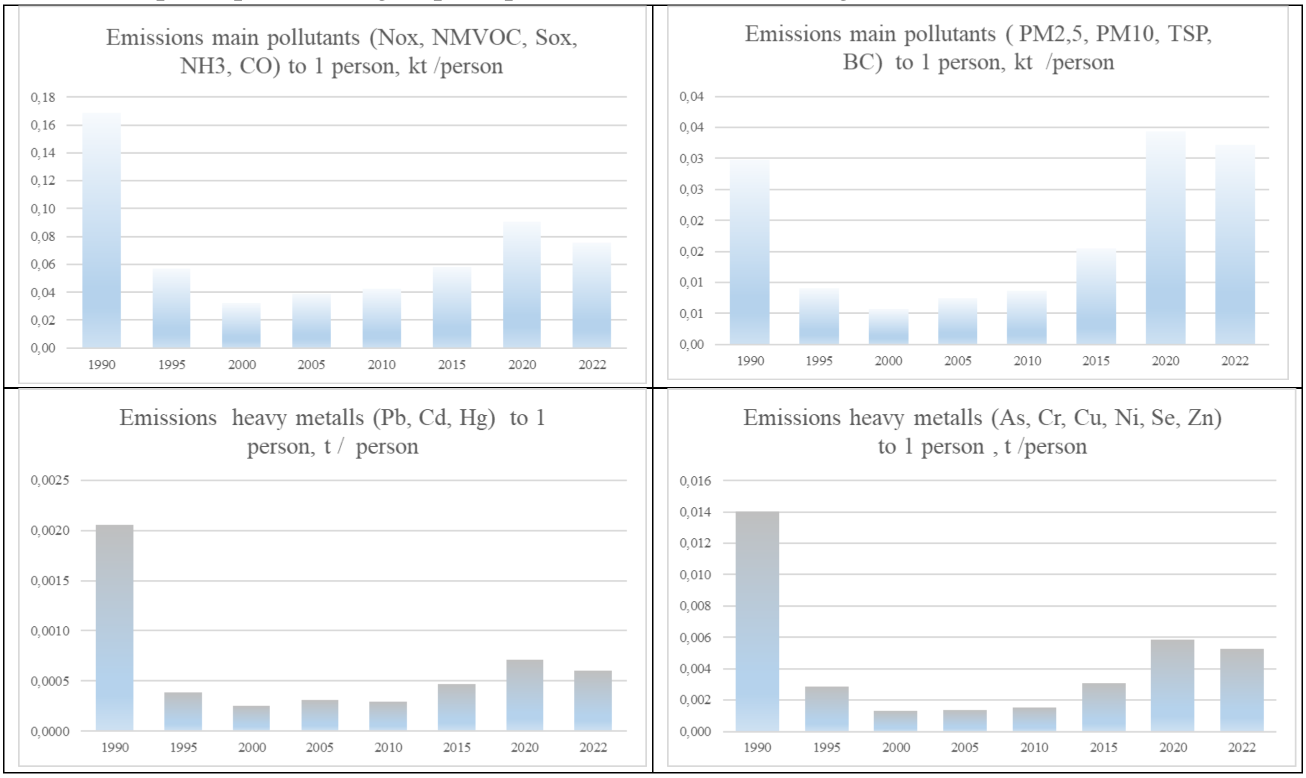


Figure 1.4. Эмиссии в расчете на 1 жителя для групп загрязнителей: main pollutants (5) and PM (4), HM (9).

1.2. Institutional arrangements

The Law on atmospheric air quality was approved by the Government and submitted for further approval by the Parliament. The law transposes partially the Directive 2008/50 / EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, and the Directive 2004/107 / EC of the European Parliament and of the Council of 15 December 2004 relating arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

The inventory system currently existing in the Republic of Moldova is represented in the Figure 1.3.

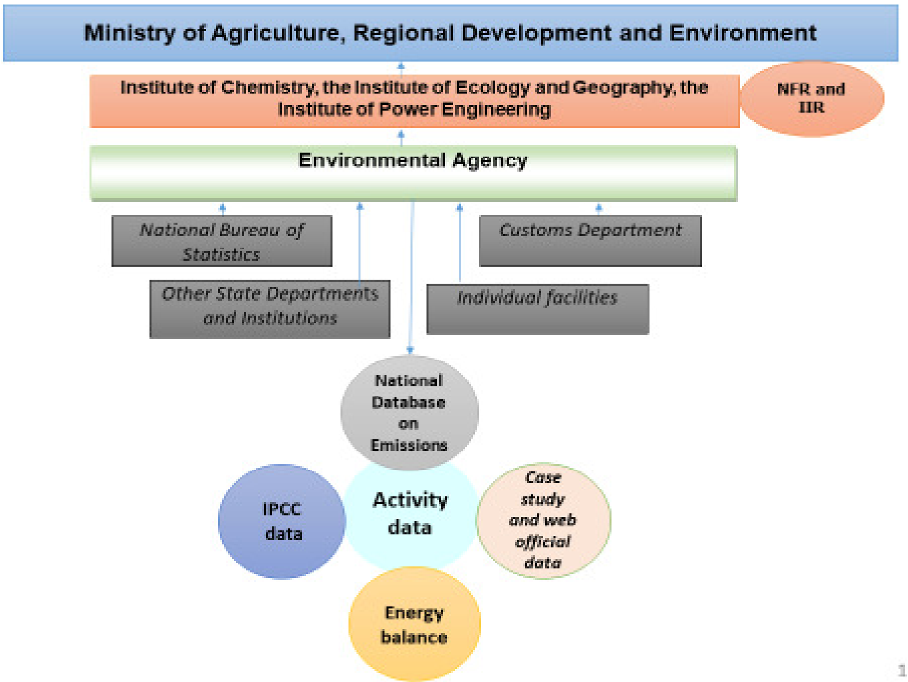


Figure 1.3. Inventory system in the Republic of Moldova.

1.3. Inventory preparation process

The emission estimates are based on methodologies elaborated by EMEP/EEA and the IPCC data Guidance EMEP/EEA air pollutant emission inventory guidebook 2023 and its update categories versions during 2024 is used.

The inventory preparation can be described as follows:

- using the activity data from the official web pages of state institutions and/ or official public registers;
- collected data via official letters signed by the Ministry to the state agencies and entrepreneurs;
- using the research reports, or expert estimates;
- using the emission factors for all categories from EEA/EMEP Emission Inventory Guidebook and IPCC source. The domestic emission factors are not used.

The database is updated and extended to meet the changing requirements for emission reporting. After preparation per sectors, the emission inventory is compiled and verified by the Institute of Power Engineering, in cooperation with the Institute of Ecology and Geography and Institute of Chemistry.

1.4. Methods and data sources

1.4.1. General issues

The methodology for estimating and reporting emissions is consistent with the “EMEP/EEA air pollutant emission inventory guidebook - 2023”. The pollutants covered by this methodology guide are: SO_x (SO_2), NO_x, NH_3, NMVOC, CO, TSP, PM_{10}, $PM_{2.5}$, Heavy Metals (Cd, Pb, Hg, As, Cr, Cu, Ni, Se, Zn), POPs (HCB, PCB, dioxins / furans) and PAHs.

The annual inventory cycle is carried out in accordance with the principles and procedures which are set out in the UNECE Emission Reporting Guidelines (ECE/EB.AIR/128). The RM emission inventories are compiled according to international good practice guidance for national inventories.

According to the recommendations of the EMEP/EEA 2023 and its update categories versions during 2024, the calculation methods are chosen by considering the available technologies in the Republic of Moldova. The calculation of emissions is basically made by using the formula: AD x EF, where the activity data (AD) can be raw material or product, or energy use etc. Part of the available data (e.g. production data) can be directly entered into the formula above; others required previous processing and conversion. For example, energy data are not always available in the required depth and resolution. After preliminary quality control of the basic data, the necessary calculations are carried out by the core experts' team. After other necessary QC/QA steps, NFR table is filled in and the respective chapters of the IIR are prepared.

The Republic of Moldova's IIR is prepared using activity data based on officially published data, (national statistical publications, reports of central public authorities, public sector, scientific literature, and private sector).
The input data were processed in Excel NFR format by applying the reporting formats requested by the UNECE/CRLTAP Secretariat.

Each year, the emission inventories are updated to include the latest data available and new research findings to improve the emission estimation methods. Methodological changes are made to take account of new data sources or new guidance from EMEP/EEA 2023 and its update categories versions during 2024.

1.4.2. RM inventory data and methods overview

A summary of calculation methods, emission factors and primary data by source category for all sectors is provided in the table 1.2.

Table 1.2. Republic of Moldova Emission Inventory Methodologies by NFR14 Categories

NFR log name	Activity Data	Emission Factors
1.A.1.a Public Electricity & Heat Production	RM statistics (Energy balances), ATULBD statistics (Statistical yearbooks)	Default EFs (2023 EMEP/EEA)
1.A.1.b. Petroleum refining	NE	NE
1.A.1.c Manufacture of solid fuels and other energy industries	NE	NE
1.A.2.a Iron & Steel	RM statistics (Energy balances) ATULBD statistics (Statistical yearbooks)	Fuel analysis or default EFs (2023EMEP/EEA, RM-specific research)
1.A.2.b Non-ferrous Metals	NO	NO
1.A.2.c Chemicals	RM statistics (Energy balances) ATULBD statistics (Statistical yearbooks)	Fuel analysis or default EFs (2023 EMEP/EEA, RM-specific research)
1.A.2.d Pulp, Paper & Print	RM statistics (Energy balances) ATULBD statistics (Statistical yearbooks)	Fuel analysis or default EFs (2023 EMEP/EEA, RM-specific research)
1.A.2.e Food Processing, Beverages & Tobacco	RM statistics (Energy balances) ATULBD statistics (Statistical yearbooks)	Fuel analysis or default EFs (2023 EMEP/EEA, RM-specific research)
1.A.2.f Non-metallic minerals	RM statistics (Energy balances) ATULBD statistics (Statistical yearbooks)	Fuel analysis or default EFs (2023 EMEP/EEA, RM-specific research)
1.A.2.g.viii Other	RM statistics (Energy balances) ATULBD statistics (Statistical yearbooks)	Fuel analysis or default EFs (2023 EMEP/EEA, RM-specific research)
1.A.3.a.i(i) International Aviation (LTO)	RM statistics (Energy balances, NIR-1990-2020) and estimated for 2020	Fuel analysis or default EFs (2023 EMEP/EEA, RM-specific research)
1.A.3.a.ii(i) Civil Aviation (Domestic, LTO)	RM statistics (Energy balances, NIR-1990-2020) and estimated for 2020	Fuel analysis or default EFs (2023 EMEP/EEA, RM-specific research)
1.A.3.b Road Transportation	RM statistics (Energy balances, Third National Environmental Indicators Survey (2010, prepared for UNECE), Statistical Yearbooks, ASP.gov.md	Fuel analysis or default EFs (2023 EMEP/EEA and update version from 2024, RM-specific research)

NFR log name	Activity Data	Emission Factors
1.A.3.c Railways	RM statistics (Energy balances) ATULBD statistics (Statistical yearbooks)	Fuel analysis or default EFs (2023 EMEP/EEA, RM-specific research)
1.A.3.d.ii National Navigation	RM statistics (Energy balances)	Default EFs (2023 EMEP/EEA)
1.A.3.e Pipeline	RM statistics (Energy balances)	Default EFs (2023 EMEP/EEA)
1.A.3.b.v Road transport	As 1.A.3.b Road Transportation	Default EFs (2023 EMEP/EEA)
1.A.4.a Commercial / Institutional	RM statistics Energy balances and statistical publications “Social and Economic Development of Transnistria” and "Press- Release Housing".	Default EFs (2023 EMEP/EEA)
1.A.4.b.i Residential	RM statistics Energy balances and statistical publications “Social and Economic Development of Transnistria” and "Press- Release Housing".	Default EFs (2023 EMEP/EEA)
1.A.4.c.i Agriculture/Forestry/Fishing: Stationary	RM statistics (Energy balances)	Default EFs (2023 EMEP/EEA)
1.A.4.c.ii/iii Off-road Vehicles & Other Machinery	RM statistics (Energy balances)	Default EFs (2023 EMEP/EEA)
1.A.5.a Other, Stationary	RM statistics (Energy balances), ATULBD statistics (Statistical yearbooks)	Default EFs (2023 EMEP/EEA)
1.A.5.b Other, Mobile (Including military)	RM statistics (Energy balances)	Default EFs (2023 EMEP/EEA)
1.B.1.a Coal Mining & Handling	NO	NO
1.B.1.b Solid fuel transformation	NO	NO
1.B.1.c Other	NO	NO
1.B.2 Oil & natural gas	RM statistics (Energy balances)	Default EFs (2023 EMEP/EEA)
2.A Mineral Products	Industry & Estimated, RM Statistics (Statistical Yearbooks of ATULBD, SYs of RM, NIR 1990-2019), Official letter of the Inventory team	Default EFs (2023 EMEP/EEA)
2.B Chemical Industry	RM statistics (statistical yearbooks), ATULBD statistics (Statistical yearbooks), Official letter of the Inventory team	Default EFs (2023 EMEP/EEA)
2.C Metal Production	RM statistics (National Inventory Report 1990-2016. SYs of RM and SY of ATULBD)	Default EFs (2023 EMEP/EEA)
2.D Solvents	National Inventory Report 1990-2016, Statistical yearbooks, Industry and state organizations Statistical Reports PRODMOLD-A and estimated, Official letter of the Inventory team	Default EFs (2023 EMEP/EEA)
2.G Other product use	National Inventory Report 1990-2016. Data collected from SY and estimated based on information on production and the quantity of tobacco in cigarettes and number of cigarettes, and use of footwear, Official letter of the Inventory team	Default EFs (2023 EMEP/EEA)
2.H Pulp and paper industry, Food and beverages industry	National Inventory Report 1990-2016. Data collected from SY and estimated based on information on production	Default EFs (2023 EMEP/EEA)
2.I Wood processing	NA	NA
2.J Production of POPs	NA	NA
2.K Consumption of POPs and heavy metals	NA	NA
2.L Other production, consumption, storage, transportation or handling of bulk products	NA	NA
3.B Manure Management	RM statistics: StatBank and Statistic Yearbooks of ATULBD	Default EFs (2023 EMEP/EEA)
3.D Agricultural Soils	RM statistics (National Bureau of Statistics, Statistic Yearbooks of ATULBD, data from Ministry of Agriculture, Regional Development and Environment)	Default EFs (2023 EMEP/EEA), 2006 IPCC Guidelines
3.F Field Burning of Agricultural Wastes	RM statistics (National Bureau of Statistics, Statistic Yearbooks of ATULBD, data from Ministry of Agriculture, Regional Development and Environment)	Default EFs (2023EMEP/EEA), 2006 IPCC Guidelines
3.I Other	NA	NA
5.A Solid Waste Disposal on Land	Statistical Yearbook of Moldova, Annual Reports on the Activities of the Ministry of Agriculture and Natural Resources of Transnistria	Default EFs (2023 EMEP/EEA)
5.B Biological treatment of waste	NA	NA
5.C Waste Incineration	National Mercury Emissions Inventory, the National Public Health Centre of the Ministry of Health of the Republic of Moldova	Default EFs (2023 EMEP/EEA)
5.D Waste-Water Handling	RM statistics (StatBank)	Default EFs (2023 EMEP/EEA)
5.E Other Waste	RM statistics (National Bureau Statistics)	Default EFs (2023 EMEP/EEA)
6.A Other	NA	NA
1.A.3.a.i(ii) International aviation cruise (civil)	RM statistics (Energy balances)	Default EFs (2023 EMEP/EEA)
1.A.3.d.i(ii) International navigation	RM statistics (Energy balances) and NIR-1990-2020	Default EFs (2023 EMEP/EEA)
Memo1.A.3 Transport (fuel used)	Same as 1.A.3 Road	Default EFs (2023 EMEP/EEA and update version from 2024)

1.5. Key Categories

The purpose of key categories analysis is a quantitative analysis of fluctuations in emissions for one year (levels) and changes in theamount of emissions from year to year (trends) for all categories of sources in total emissions for each pollutant.

Key categories are calculated with REPDAB system from the site www. ceip.at for each pollutant separately for all years (1990-2022). The tables for last year 2022 and for base year 1990 are presented below.

1) 2022

Key categories that contribute most to each pollutant emissions (Level assessment) (category with maximum contribution above 20%):

- 1.A.4.b *Residential: Stationary*: SO_x 39,8%; NMVOC 18,4%; CO 72,0%; TSP 40.0%; PM_{10} 69,4%; $PM_{2.5}$ 86.0%; Pb 53.6%; Cd 74,8%; PCDD/F 80,6%; PAHs-72,9%; HCB - 66,5%;
- 1.A.3.b.iii *Road transport: Heavy duty vehicles and buses* NO_x 7,7%; CO-6,2%;
- 2.D.3.i *Other solvent use*: NMVOC 20,4 %;
- 3Da1: NH3 44,8%; 3Da2a: NH313,3%;
- 5.C.1.b.iii *Clinical waste incineration*: Hg 20,8%; HCB -27,9%, table 1.3.

Table 1.3. Key Source for 2022 year, Cumulative %

Component	Key categories (Sorted from high to low from left to right)							Total (%)
SO_x	1A4bi (39.8%)	1A1a (32.8%)	1A4ai (13.3%)					85.9
NO_x	1A1a (23.3%)	1A4cii (16.1%)	1A3bi (12.7%)	1A4bi (9.7%)	3Da1 (9.0%)	1A3bii (7.7%)	1A3biii (7.7%)	86.3
NH_3	3Da1 (44.8%)	3Da2a (13.3%)	3B3 (9.3%)	3B1a (8.3%)	5D1 (7.0%)			82.8
NMVOC	2D3i (20.4%)	1A4bi (18.7%)	5A (13.0%)	2D3d (10.2%)	2H2 (7.5%)	2D3g (5.4%)	2D3a (5.3%)	80.4
CO	1A4bi (72.0%)	1A3bi (6.4%)	1A3biii (6.2%)					84.7
TSP	1A4bi (40.0%)	2D3b (22.7%)	2D3g (19.4%)					82.1
PM10	1A4bi (69.1%)	2D3b (8.8%)	3Dc (7.3%)					85.2
$PM_{2.5}$	1A4bi (86.0%)							86.0
Pb	1A4bi (53.6%)	2A3 (28.9%)						82.5
Hg	1A4bi (31.4%)	5C1biii (20.8%)	2C1 (10.6%)	1A4ai (7.9%)	1A2f (5.7%)	1A1a (5.5%)		82.1
Cd	1A4bi (74.8%)	2A3 (8.7%)						83.6
DIOX	1A4bi (80.6%)							80.6
PAH	1A4bi (72.9%)	2D3g (15.4%)						88.4
HCB	1A4bi (66.5%)	5C1biii (27.9%)						94.4

The table also indicates other key categories, the contribution of which, although smaller, is still significant (presented in descending order of contribution). Together, these categories make 80% of emissions for each pollutant (cumulative contribution with accumulation), Table 1.3.

Analysis of the table can be carried out as follows:

For example, there are five key categories for NO_x (in descending order of contribution to total emissions):

- 1.A.1.a *Public electricity and heat production* 23,3%,

- 1.A.4.c.ii *Agriculture/Forestry/Fishing: Off-road vehicles and other machinery* 16,1%,
- 1.A.3.b.i *Road transport: Passenger cars* 12,7%,
- 1.A.4.b.i *Residential: Stationary* 9,7%,
- 3.D.a.1 *Inorganic N-fertilizers* 9,0%,
- 1.A.3.b.iii *Road transport: Heavy duty vehicles and buses* 7,7%.

The cumulative contribution of these categories is 85,9% in NO_x emissions.
The largest contribution is made by category 1.A.1.a *Public electricity and heat production* 23,3%,

2) 1990

Table 1.4. Key Source for 1990 year, Cumulative %

Component	Key categories (Sorted from high to low from left to right)											Total (%)
SOx	1A1a (68.6%)	1A4bi (21.1%)										89.7
NOx	1A1a (38.6%)	1A4cii (13.2%)	1A3biii (9.4%)	1A2f (7.2%)	1A3c (6.6%)	1A4bi (4.6%)	3Da1 (3.6%)					83.3
NH3	3Da2a (22.4%)	3Da1 (14.9%)	3B3 (14.8%)	3B1a (13.6%)	3B1b (10.3%)	3Da2c (8.4%)						84.4
NMVOC	1A4bi (15.8%)	3B3 (12.4%)	2H2 (11.9%)	2D3d (9.0%)	5A (7.4%)	2D3a (4.7%)	3B1a (4.7%)	2D3g (4.2%)	3B1b (4.0%)	3B4gi (3.6%)	1A3bi (3.4%)	81.1
CO	1A4bi (51.7%)	1A3bii (10.4%)	1A3aii(i) (8.8%)	1A3bi (7.3%)	3F (3.5%)							81.8
TSP	2D3b (23.8%)	1A4bi (23.1%)	2D3g (20.4%)	3B4gi (6.5%)	1A1a (5.8%)	2A2 (4.5%)						84.0
PM10	1A4bi (47.1%)	2D3b (11.4%)	1A1a (9.1%)	1A4ai (4.6%)	2A2 (3.9%)	3B4gi (3.1%)	3Dc (2.9%)					82.2
PM2.5	1A4bi (62.6%)	1A1a (8.7%)	1A4ai (5.7%)	1A4cii (3.1%)								80.2
Pb	1A4bi (56.7%)	1A4ai (19.9%)	1A1a (11.6%)									88.3
Hg	1A4bi (37.3%)	1A1a (28.4%)	1A4ai (19.3%)									85.0
Cd	1A1a (39.4%)	1A4bi (15.3%)	2G (10.4%)	1A4cii (8.7%)	2A3 (7.5%)							81.2
DIOX	1A4bi (69.9%)	5E (11.3%)										81.2
PAH	1A4bi (79.3%)	2D3g (8.7%)										88.0
HCB	1A1a (88.3%)											88.3

The key categories in the period 1990-2022 are as follows:

- 1.A.1 *Public electricity and heat production*,
- 1.A.4.a *Commercial/Institutional sector*,
- 1.A.3.b *Road Transport*, *Heavy duty vehicles and buses*
- 1.A.4.b *Residential: Stationary*,
- 1.A.4.c.ii *Agriculture/Forestry/Fishing: Off-road vehicles and other machinery*,
- 2.A.3 *Glass production*,
- 2.D.3.i *Other solvent use*,
- 3.B.1. *Manure management - Dairy cattle*,
- 3.B.3 *Manure management - Swine (Sows+ Fattening pigs)*,
- 3.D.a.2.a *Animal manure applied to soils*.

1.6. QA/QC and Verification methods

1.6.1. Requirements for control procedures and quality assurance

QA/QC procedures recommended in EMEP/EEA 2019 and its update categories versions are carried out at all stages of the calculation of the entire list of pollutants. Pollutant emissions, according to CLRTAP goals, are expressed in absolute pollutant emissions, and presented in dynamics for the period 1990-2022.

The inventory has an annual reporting cycle. Primary data have a wide and diverse coverage and include:

- Energy statistics;
- Industry data (production, technology);
- Agricultural statistics;
- Transport statistics;
- Demographic data and other information.

Data was detailed for several categories previously represented by total values. The *geographical coverage* of the categories of emission sources in both regions (Right and the Left Bank of the Dniester River) has significantly expanded. A few categories of the Energy module IIR-2024 include fact information on the Left Bank region, and set of data was reconstructed from indirect data using recovery methods according to EMEP-2023.

New primary information for 2021-2022 was collected, during which requests for information were sent to economic enterprises and then the received answers were processed.
Timeliness: Inventory team recalculated emissions based on updated activity data in the RM for the 1990-2022 period.
The *key requirements* that must be met to achieve data quality objectives are as follows:

1. *Transparency:*
   - Presence of reference to sources;
   - Description of the method;
   - Description of Trends;
   - Description of subsectors;
   - Carrying out a complete cycle of inventory;
   - Considering recommendations of international experts.
2. *Consistency:*
   - Identification of "outlier" points;
   - Comparison with data presented in other studies;
   - Comparison with independent statistical data.
3. *Comparability*:
   - Analysis of results obtained by subsector and aggregates;
   - Chart shares of sector's contribution to overall pollution;
   - Comparison of emission factors with other countries.
4. *Completeness:*
   - Maximum consideration of all the recommendations on time series, factors;
   - Correct designation of lacking figures in the tables using allowed symbols;
   - Providing, where appropriate, sectorial background data.
5. *Accuracy:*
   - Use of more advanced techniques;
   - Reporting of uncertainties.

1.6.2. Quality control procedures carried out in the current cycle

According to the list of key requirements, the following quality control procedures have been completed in the current cycle:

1. Transparency:

- *Presence of reference to sources*: Provides links to sources of primary data, applied emission factors, selected methods for calculating emissions.
- *Description of the method*: The methodology for calculating emissions is described for each category, the necessary formulas, algorithms, and links to sources are given. The

methodologies and emission factors for EMEP/EEA -2023 and its last update versions from 2024 were used.

- *Description of Trends*: For all the categories, the series of primary data in the necessary units of measurement are built. There are several graphs that reflect the series of data on activity. Graphs and charts of calculated emissions are given for all categories, the dynamics of their changes, % reduction/growth of pollutant emissions, contribution to total quantities, shares of category emissions in 1990 and 2022 are described, a comparison with the base (1990) year is made.
- *Carrying out a complete cycle of inventory*: The inventory cycle was completed according to the plan and the main stages. A description of the categories was made. A choice of methodology for calculating emissions, a choice of emission factors, collection and preparation, double-checking data, preparing series of primary data, calculation of emissions for all categories, the implementation of the necessary auxiliary research work in the preparation of series of primary data (the use of several methods of recovering values), the calculation of uncertainties, calculations of key categories with REPDAB system, preparation of NFR, preparing IIR-books, documentation, archiving of all information by sector, identification of opportunities for further improvement of inventory in the future were made.
- *Considering recommendations of international experts*. The recommendations of international experts received in 2016, 2018 Review were studied, most of the recommendations were applied during two last circle.

2. Consistency:

- *Completion of data series.* In the current cycle, the data for 2021-2022 have been collected, documented, systematized, used in the calculations. The data were checked for consistency with previous values in the time series for each category.
- *Comparison with data presented in other studies*: In preparing the work, the study of NFR, IIR of other countries was carried out, which allowed us to use the useful experience of other countries, to outline ways for further improvement in the future.

3. Comparability:

- *Analysis of results* obtained by subsector and aggregates: aggregation was performed for sectors with detailed data, for example, by type of fuel, by type of vehicle, etc., the national emission values of each pollutant were also summed for the 4 considered sectors.
- *Comparison* of emission factors *with other countries*: emission factors are used by default according to the EMEP/EEA 2023 guidelines and its update categories units. In the process of studying the IIR of other countries, a comparison was made of the applied methodology and emission factors, the useful experience of other countries was documented.

4. Completeness:

Maximum consideration of all the recommendations on time series, factors:

- the work was done to improve geographical coverage in the data on activities of the regions;
- the list of categories has also expanded additionally.

5. Accuracy:

- *Use of more advanced techniques*: key categories were calculated using REPDAB system.
- *Reporting of uncertainties*: uncertainties are calculated according to the EMEP/EEA 2023 methodology, % of uncertainties of EF and AD are documented in tables, and results of calculation tables for all pollutants are given in the special table below.

1.6.3. QA/QC Plan

The expert team conduced quality and technical procedures described in the Guidebook, Chapter “Inventory management, improvement and QA/QC”.

These actions are reflected in the diagram below in the form of a plan in which the quality assurance procedures, quality control procedures, the timeline of the inventory process for the months of the year (one cycle), documents for presenting the results, archiving procedures are highlighted (Figure 1.6).

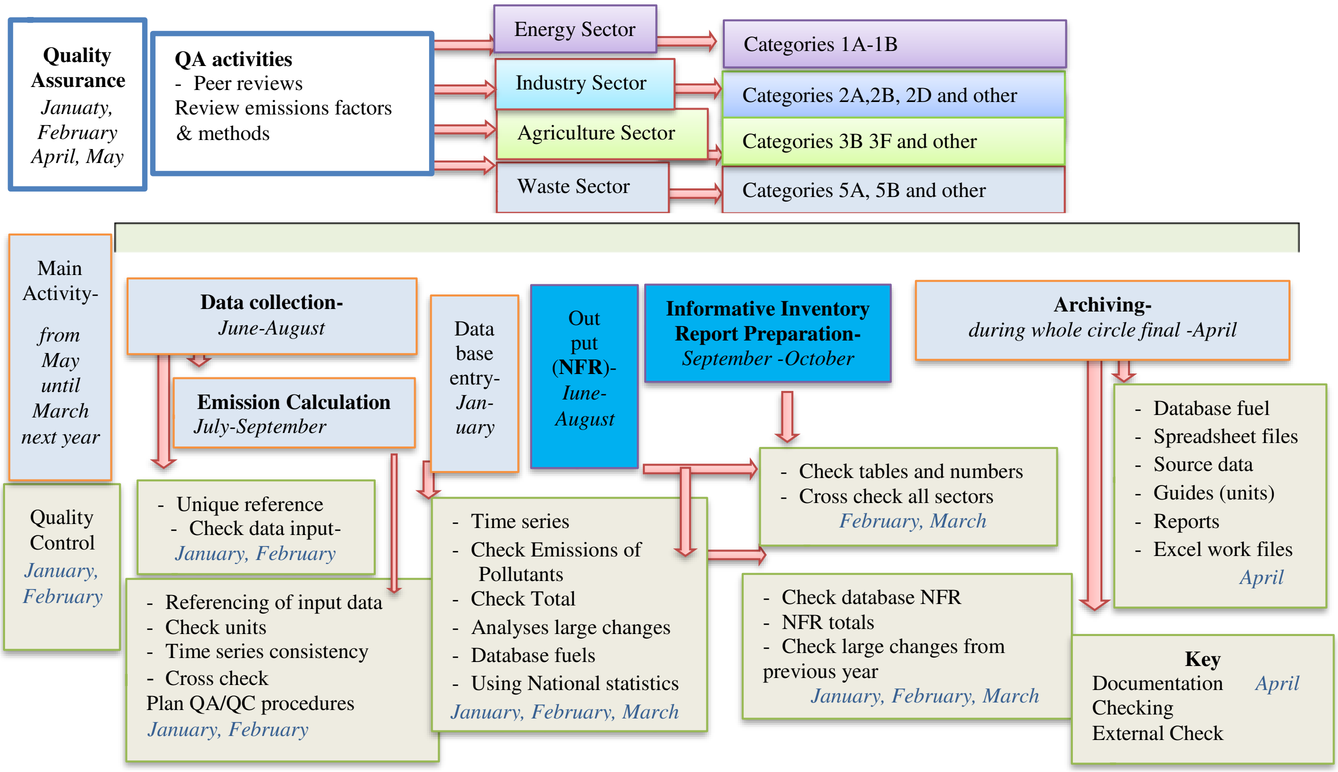


Figure 1.6. QA/QC plan process conducted in the current inventory cycle.

1.7. General uncertainty evaluation

Uncertainties were calculated according to the methodology described in Chapter 5 "Uncertainties" of the 2023 EMEP/EEA Guidebook and include estimates of uncertainties arising from imperfect emission factors (sensitivity of type A) and activity data (sensitivity of type B). Calculation algorithm implemented in the form of a special calculation table, where for each category the uncertainty in the current year and the uncertainty trend for the study period are calculated.

The following are necessary for the calculation:

1) initial spread ranges for emission factors for each sector and category;

2) ranges showing the degree of accuracy of initial data.

They vary significantly across sectors and categories. Therefore, it is necessary to calculate the total aggregate uncertainties for the received emissions of each pollutant for the current year and trend. The determination of these quantities is the goal of calculating the uncertainties. According to the EMEP/EEA 2023 methodology, the uncertainties for activity data based on national statistics with annual updates are in the range of 0-2%. When using other statistical sources, this value is slightly higher (Table 1.6).

Table 1.6. Indicative error ranges in activity data for uncertainty analysis

Data source	Error range	Remarks
The national (official) statistics	0-2%	The official statistics of a country may be reported with an uncertainty range, although it is also common for the data to be assumed to be 'fixed', with no uncertainty. However, for energy data an indication of the uncertainties could be derived from the entry under 'statistical differences', representing the mismatch between production and consumption.
An update of last year's statistics, using gross economic growth factors	0-2%	The economic system of a country will probably not shift more than a few per cent between successive years. Hence, if an update of last year's data is used, an uncertainty of a few per cent seems reasonable.

IEA Energy statistics/balances	OECD: 2-3%, non-OECD: 5-10%	The International Energy Agency (IEA) publishes national energy statistics and balances for many countries. For the Organization for Economic Co-operation and Development (OECD) countries, these statistics will ideally be equal to the official energy statistics. For other countries, the uncertainties could be expected to range from 5% to 10% (educated guess).
UN statistical databases	5-10%	These data might have a similar uncertainty as the ones provided by IEA.
Default values, other sectors, and data sources	30-100%	

Source: EMEP/EEA 2019, Table 2-1, p.8. Indicative error ranges in activity data for uncertainty analysis, Volume "A5 Uncertainties 2019".

The ranges of variation in the emission factors vary significantly among pollutants (Table 1.7).

Table 1.7. Rating definitions

Rating	Definition	Typical error range
A	An estimate based on many measurements made at a large number of facilities or individual sources across a comprehensive range of operating conditions that fully represent the sector	10 to 30%
B	An estimate based on many measurements made at a large number of facilities or individual sources across a range of operating conditions that represent a large part of the sector	20 to 60%
C	An estimate based on a number of measurements made at a small number of representative facilities or individual sources across a smaller range of operating conditions, or an engineering judgement based on a number of relevant facts. An estimate based on a large number of measurements across a range of conditions for a source, which is complex and/or variable.	50 to 200%
D	An estimate based on single measurements, or an engineering calculation derived from a number of relevant facts. An estimate based on a large number of measurements across a range of conditions for a source, which is particularly complex and/or variable.	100 to 300%
E	An estimate based on an engineering calculation derived from assumptions only. An estimate based on a limited number of measurements for a source, which is particularly complex and/or variable.	0

Source: EMEP/EEA 2019, Table 2-2, p.9, Rating definitions, Volume "A5 Uncertainties 2019".

Table 1.8. Uncertainty ranges for default emission factors by category and pollutant

NFR	SOURCE CATEGORY	SO_2	NO_x	VOC	CO	NH_3	PM	HM/POPs
1.A.1	Public power, cogeneration, and district heating	A	B	C	B	E	C	D
1.A.2	Industrial combustion	A	B	C	B	E	C	D
1.A.3.b	Road transport	A	C	C	C	E	C	E
1.A.3.a, 1.A.3.c, 1.A.3.d, 1.A.3.e	Other mobile sources and machinery	B	D	D	D	E	D	E
1.A.4	Commercial, institutional, and residential combustion	A	C	C	C	E	D	E
1.B	Extraction and distribution of fossil fuels	C	C	C	C	D	E	
2	Industrial processes	B	C	C	C	E	C	E
3	Solvent use	B	D	E				
4	Agriculture activities	D	D	D	D	E	E	
5.A, 5.B	Waste treatment	B	B	B	C	C	D	
5.C	Waste disposal activities	C	C	C	C	E	C	E

Source: EMEP/EEA 2019, Table2-3, p.10. Rating definitions, Volume "A5 Uncertainties 2019".

Table 1.9. Main NFR source categories with applicable quality data ratings

NFR	SOURCE CATEGORY	NO_x			VOC			SO_x		
1.A.1	Public power, cogeneration, and district heating	B	20-60%	20	C	50-200%	50	A	10-30%	10
1.A.2	Industrial combustion	B	20-60%	20	C	50-200%	50	A	10-30%	10
1.A.3.b	Road transport	C	50-200%	50	C	50-200%	50	A	50-200%	50
1.A.3.a, 1.A.3.c, 1.A.3.d, 1.A.3.e	Other mobile sources and machinery	D	100-300%	100	D	100-300%	100	C	50-200%	50
1.A.4	Commercial, institutional and residential combustion	C	50-200%	50	C	50-200%	50	B	20-60%	20
1.B	Extraction and distribution of fossil fuels	C	50-200%	50	C	50-200%	50	C	50-200%	50
2	Industrial processes	C	50-200%	50	C	50-200%	50	B	20-60%	20
3	Solvent use	C	50-200%	50	B	20-60%	20	-	-	-
4	Agriculture activities	D	100-300%	100	D	100-300%	100	-	-	-
5.A ; 5.B	Waste treatment	B	20-60%	20	B	20-60%	20	-	-	-
5.C	Waste disposal activities	C	50-200%	50	C	50-200%	50	C	50-200%	50

continued

NFR	SOURCE CATEGORY	NH_3				CO		HM/POPs			PM		
1.A.1	Public power, cogeneration, and district heating	-	-	-	B	20-60%	20	D	100-300%	100	C	50-200%	50
1.A.2	Industrial combustion	-	-	-	B	20-60%	20	D	100-300%	100	C	50-200%	50
1.A.3.b	Road transport	E	order	300	C	50-200%	50	E	order	300	D	100-300%	100
1.A.3.a, 1.A.3.c, 1.A.3.d, 1.A.3.e	Other mobile sources and machinery	-	-	-	D	100-300%	100	E	order	300	D	100-300%	100
1.A.4	Commercial, institutional, and residential combustion	-	-	-	C	50-200%	50	E	order	300	D	100-300%	100
1.B	Extraction and distribution of fossil fuels	-	-	-	C	50-200%	50	E	order	300	D	100-300%	100

2	Industrial processes	E	order	300	C	50-200%	50	E	order	300	C	50-200%	50
3	Solvent use	E	order	300	-	-	-	E	order	300	D	100-300%	100
4	Agriculture activities	D	100-300%	100	D	100-300%	100	E	order	300	E	order	300
5.A; 5.B	Waste treatment	-	-	-	C	50-200%	50	D	100-300%	100	C	50-200%	50

For some categories, there are special instructions on the application of values from the ranges of scatter for domestic aviation, railway transport (Table 1.10).

Table 1.10. Summary information on % of uncertainties in activity data and emission factors for a list of categories.

Category	NO_x		NMVOC		SO_x		NH_3		$PM_{2.5}$, PM_{10}, TSP		CO		Heavy metals, POPs	
	% AD	% EF	% AD	% EF	% AD	% EF	% AD	% EF	% AD	% EF	% AD	% EF	% AD	% EF
1.A.1	5	20	5	20	5	10			5	50	5	20	5	100
1.A.2	5	20	5	20	5	10			5	50	5	20	5	100
1.A.3.a	5	30	5	30	5	50			5	100	5	100	5	300
1.A.3.b	5	50	5	50	5	50	5	300	5	50	5	50	5	300
1.A.3.c	5	100	5	100	5	50			5	100	5	100	5	300
1.A.3.d	30	40	30	40	30	50			30	100	30	100	30	300
1.A.3.e	5	100	5	100	5	50			5	100	5	100	5	300
1.A.4	5	50	5	50	5	20			5	100	5	50	5	300
1.A.5	5	50	5	50	5	20			5	100	5	50	5	300
1.B.2	5	50	5	50	5	50			5	100	5	50	5	300
2.A	5	50	5	50	5	20	5	300	5	50	5	50	5	300
2.B	5	50	5	50	5	20	5	300	5	50	5	50	5	300
2.C	5	50	5	50	5	20	5	300	5	50	5	50	5	300
2.D			5	20					5	100			5	300
2.G	5	50	5	20			5	300	5	100			5	300
2.H	5	50	5	50	5	20	5	300	5	50	5	50	5	300
2.I	5	50	5	50	5	20	5	300	5	50	5	50	5	300
2.J	5	50	5	50	5	20	5	300	5	50	5	50	5	300
2.K	5	50	5	50	5	20	5	300	5	50	5	50	5	300
2.L	5	50	5	50	5	20	5	300	5	50	5	50	5	300
3.B.1	5	100	5	100			5	100	5	300	5	100	5	300
3.B.2	7	100	7	100			7	100	7	300	7	100	5	300
3.B.3	20	100	20	100			20	100	20	300	20	100	5	300
3.B.4.a-f	5	100	5	100			5	100	5	300	5	100	5	300
3.B.4.g-h	10	100	10	100			10	100	10	300	10	100	5	300
3.D.a-f	5	100	5	100			5	100	5	300	5	100	5	300
3.F	5	100	5	100	5	100	5	100	5	300	5	100	5	300
3.I	5	100	5	100			5	100	5	300	5	100	5	300
5.A	5	20	5	20					5	50	5	50	5	100
5.B	5	20	5	20					5	50	5	50	5	100
5.C.1	5	50	5	50	5	50	5	300	5	50	5	50	5	300
5.C.2	5	50	5	50	5	50	5	300	5	50	5	50	5	300
5.D.1	5	50	5	50	5	50	5	300	5	50	5	50	5	300
5.D.2	5	50	5	50	5	50	5	300	5	50	5	50	5	300
5.D.3	5	50	5	50	5	50	5	300	5	50	5	50	5	300
5.E	5	50	5	50	5	50	5	300	5	50	5	50	5	300
6.A	5	50	5	50	5	50	5	300	5	50	5	50	5	300

Uncertainty calculation tables are given in Annex 1.4. The generalized values of combined uncertainty and uncertainty introduced into the trend for all pollutants are given in Table 1.11.

Table 1.11. Calculated combined uncertainty and uncertainty introduced into the trend in total national emissions for all pollutants.

Pollu-tant	Combined uncertainty as % of total national emissions in year t	Uncertainty introduced into the trend in total national emissions	Pollutant	Combined uncertainty as % of total national emissions in year t	Uncertainty introduced into the trend in total national emissions
	%	%		%	%
NO_x	16,417	2,438			
NMVOC	12,460	7,363	**Cr**	237,552	70,046
SO_x	11,146	0,255	**Cu**	166,963	10,870
NH_3	53,490	10,863	**Ni**	85,507	1,686
$PM_{2.5}$	86,168	19,527	**Se**	203,586	9,503
PM_{10}	73,105	20,576	**Zn**	239,589	79,643
TSP	51,791	15,283	**PCDD**	243,364	23,445

BC	75,071	73,735	**Benzo(a)pyrene**	276,907	6,734
CO	36,611	5,932	**Benzo(b)fluoranthene**	259,796	6,003
Pb	184,044	14,445	**Benzo(k)fluoranthene**	226,152	16,928
Cd	226,687	147,859	**Indeno(1,2,3-cd)pyrene**	294,647	8,751
Hg	121,186	11,022	**HCB**	216,515	64,880
As	152,483	14,171	**PCBs**	198,692	20,915

Chapter 2: REPUBLIC OF MOLDOVA EMISSION TRENDS OF POLLUTANTS

Total emissions of pollutants for the 1990-2022 period are summarized in the Table 2.1. Pollutant emissions were significantly reduced in 2022 compared to 1990 levels, namely:

- *Main Pollutants*:
- NO_x decreased from 102 to 23 kt;
- NMVOC decreased from 111,7 to 70,1 kt;
- SO_x decreased from 149,3 to 4,19 kt;
- NH_3 decreased from 52,9 to 16,42 kt;
- CO decreased from 322,0 to 124,51 kt.

- *Particulate Matter:*
- $PM_{2,5}$ decreased from 23,8 to 18,37 kt;
- PM_{10} decreased from 32,1 to 23,49 kt;
- TSP decreased from 71,8 to 42,75 kt;
- BC decreased from 4,0 to 2,09 kt.

- *Heavy metals (main):*
- Pb decreased from 8,1 to 1,42 t;
- Cd decreased from 0,45 to 0,36 t;
- Hg decreased from 0,48 to 0,07 t.

- *POPs*
- PCDD/F decreased from 41,49 to 21,89 g I-TEQ.
- Group PAHs:
  - Benzo(a)pyrene decreased from 9,18 to 3,09 t;
  - Benzo(b)fluoranthene decreased from13,35 to 3,25 t;
  - Benzo(k)fluoranthene decreased from 5,60 to 1,52 t;
  - Indeno(1,2,3-cd) pyrene decreased from 4,25 to 1,66 t;
- HCB decreased from 0,52 to 0,16 kg;
- PCBs decreased from 10,25 to 1,23 kg.

The ranking average for 2022/1990 is shown in a separate column.

Table 2.1. Total emission trends and pollutants average ranking (25- most polluting, 1-least) polluting)

Pollutant	Unit	1990	1995	2000	2005	2010	2015	2022	2022/ 1990, %	Ranking
NOx	kt	102,1	35,2	17,6	23,1	25,3	26,8	23,0	*-77*	**9**
NMVOC	kt	111,7	50,8	37,0	48,0	46,6	54,9	70,1	*-44*	**21**
SOx	kt	149,3	31,5	4,1	4,8	4,0	4,11	4,19	*-97*	**1**
NH_3	kt	52,9	31,9	25,9	26,3	21,8	17,94	16,42	*-69*	**25**
$PM_{2.5}$	kt	23,8	5,5	4,4	5,0	4,9	11,69	18,37	*-21*	**22**

PM_{10}	kt	32,1	8,9	6,6	8,1	8,1	14,75	23,49	*-20*	**20**
TSP	kt	71,8	21,9	12,1	17,7	18,2	23,88	42,75	*-27*	**19**
BC	kt	4,0	3,2	1,5	0,8	0,7	1,36	2,09	*-47*	**24**
CO	kt	322,0	98,9	55,1	62,6	60,1	90,63	124,51	*-61*	**15**
Pb	t	8,1	1,4	0,9	1,1	0,9	1,25	1,42	*-82*	**8**
Cd	t	0,45	0,19	0,14	0,14	0,14	0,23	0,36	*-20*	**23**
Hg	t	0,48	0,12	0,07	0,09	0,06	0,08	0,07	*-85,8*	**7**
As	t	1,13	0,32	0,11	0,11	0,10	0,10	0,11	*-90*	**4**
Cr	t	1,34	0,33	0,16	0,18	0,16	0,39	0,62	*-54*	**16**
Cu	t	3,14	0,90	0,32	0,36	0,31	0,34	0,44	*-86,1*	**6**
Ni	t	25,58	3,90	0,68	0,39	0,43	0,24	0,95	*-96*	**2**
Se	t	6,22	0,89	0,31	0,44	0,40	0,37	0,41	*-93*	**3**
Zn	t	24,32	6,11	4,12	4,38	4,27	8,83	13,67	*-44*	**18**
PCDD/F	g I-TEQ	41,49	10,17	10,07	11,06	8,49	16,40	21,89	*-47*	**17**
Benzo(a) pyrene	t	9,18	1,09	0,90	1,11	1,08	2,15	3,09	*-66*	**14**
Benzo(b) fluoranthene	t	13,35	1,58	1,29	1,57	1,53	2,43	3,25	*-76*	**10**
Benzo(k) fluoranthene	t	5,60	1,02	0,90	1,01	0,99	1,25	1,52	*-73*	**11**
Indeno(1,2,3-cd)pyrene	t	4,25	0,41	0,34	0,44	0,43	1,08	1,66	*-61*	**15**
PAHs, Total	t	32,38	4,10	3,43	4,12	4,02	6,91	9,52	*-71*	**13**
HCB	kg	0,52	0,19	0,05	0,06	0,07	0,13	0,16	*-70*	**12**
PCBs	kg	10,25	2,66	2,81	3,39	1,25	1,81	1,23	*-88*	**5**

*) Reduction of PAHs emissions, Total (4 pollutants) in the aggregate has a rank of 13th place, but each substance separately (Benzo (a) pyrene Benzo (b) fluoranthene Benzo (k) fluoranthene Indeno (1,2,3-cd) pyrene) has its own rank shown in the table.

Emission reduction/growth (2022/1990) of each pollutant are shown in the Figure 2.1a. Emissions of other pollutants decreased. Emissions of SO_x and Ni decreased most of all (by 97% and 96%), while those $PM_{2,5}$, PM10 and Cd decreased least of all (by 21% and 20%).

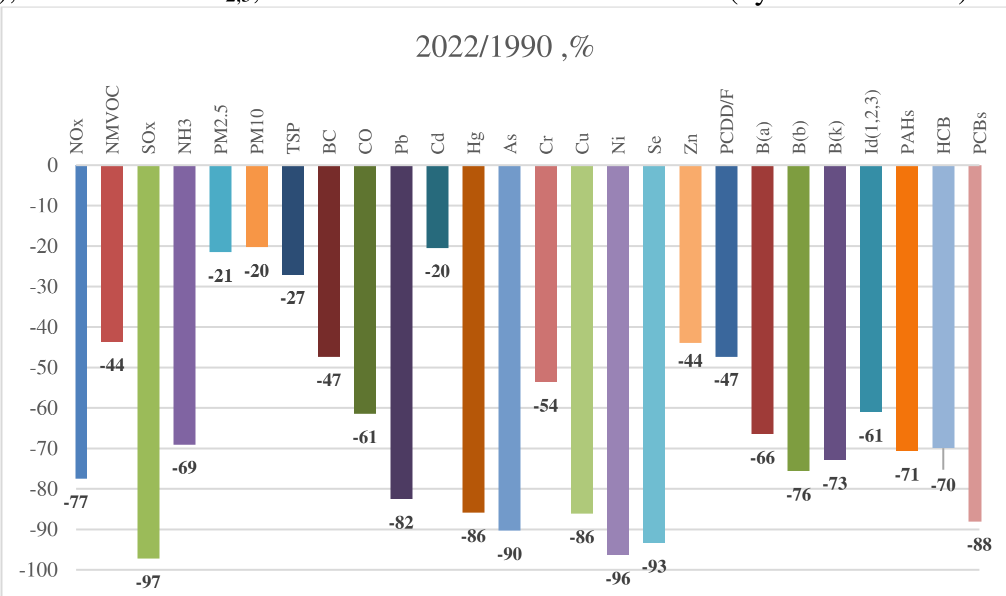


Figure 2.1a. Reduction of pollutant emissions in 2022 compared to 1990, %

The graphs below show the emission trends of pollutants by groups: main pollutants, heavy metals, POPs (Figures 2.1b, 2.1c and 2.1d).

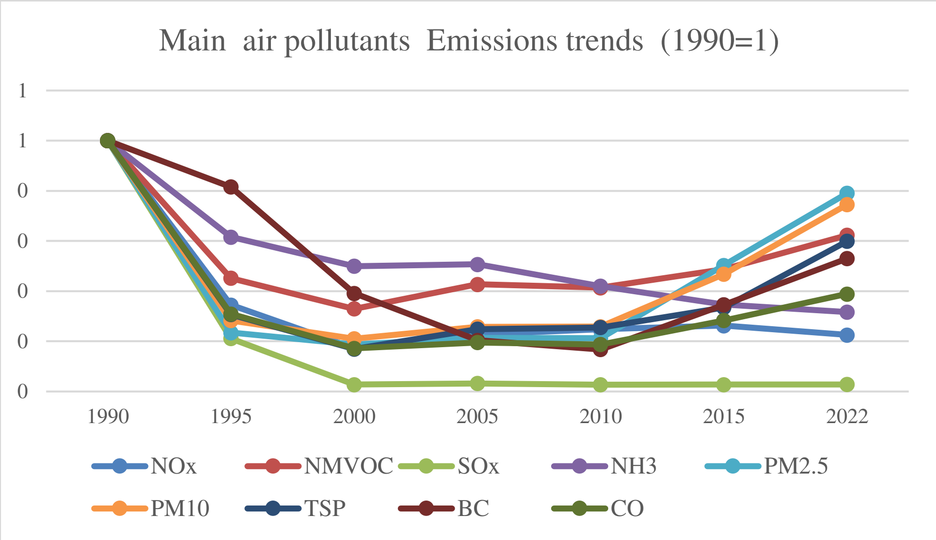


Figure 2.1b. Main pollutants National Emissions trends (1990=1).

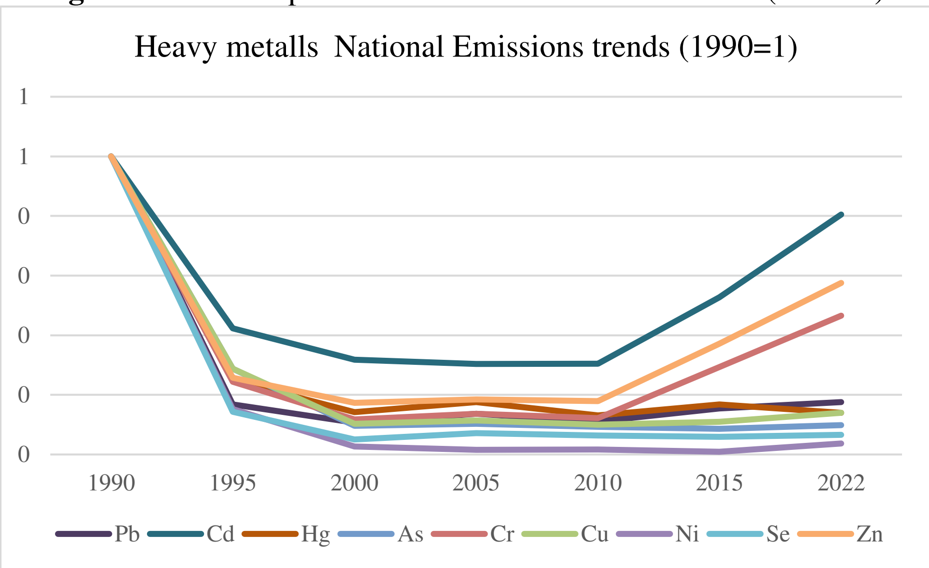


Figure 2.1c. Heavy metals National Emissions trends (1990=1).

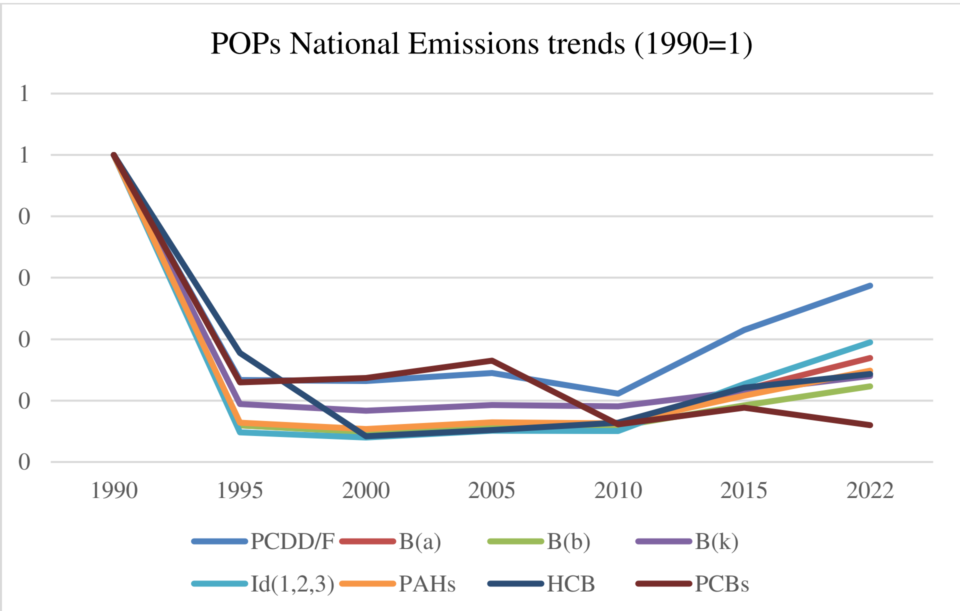


Figure 2.1d. POPs National Emissions trends (1990=1).

Emission Trends are of two types:
i) decrease in the whole time series;
ii) time series for 1990-2022 emissions are divided into 3 sections:

1[st] section is a trend of sharp decline,

2[nd] section is a constant trend of emissions in a certain quantitative range, and

3[rd] section is a growth trend.

Nitrogen oxides (NO_x)

NO_x emissions tend to fall sharply in the period 1990-2022 from 102 kt to 30,1 kt, (Fig. 2.2).

		NO_x (as NO_2),kt	NO_x (as NO_2),kt	2022
		1990	**2022**	**%**
1A1a	Public electricity and heat production	39,5	5,4	*17,9*
1A3biii	Road transport: Heavy duty vehicles and buses	9,6	8,8	*29,4*
1A4bi	Residential: Stationary	4,7	2,2	*7,4*
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	13,5	3,7	*12,3*
3Da2b	Sewage sludge applied to soils	0,0	0,0	*0,0*
Other	Other categories	34,8	9,9	*33,0*
	Total	**102,1**	**30,1**	*100,0*

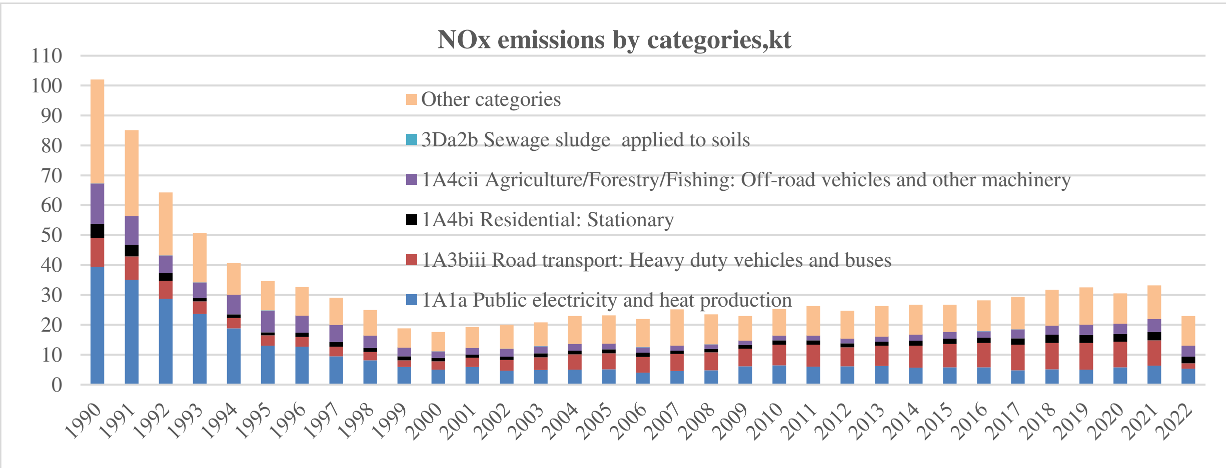


Figure 2.2. Trends in NO_x emissions in the 1990-2022 period, by categories, kt.

The structure of category contributions has changed towards decreasing the share of *1.A.1.a Public electricity and heat production* from 39% to 23% and increasing the share of *1.A.3.b.iii Road transport: Heavy duty vehicles and buses* (N2-N3 trucks, and M2-M3 buses) from 9% to 8% (1990/2022).

The share of category *1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery* increased from 13% to 16% (1990/2020). All *other* categories make a total contribution to NO_x emissions increasing the share from 34% (1990) to 43% (2022) (Figure 2.3).

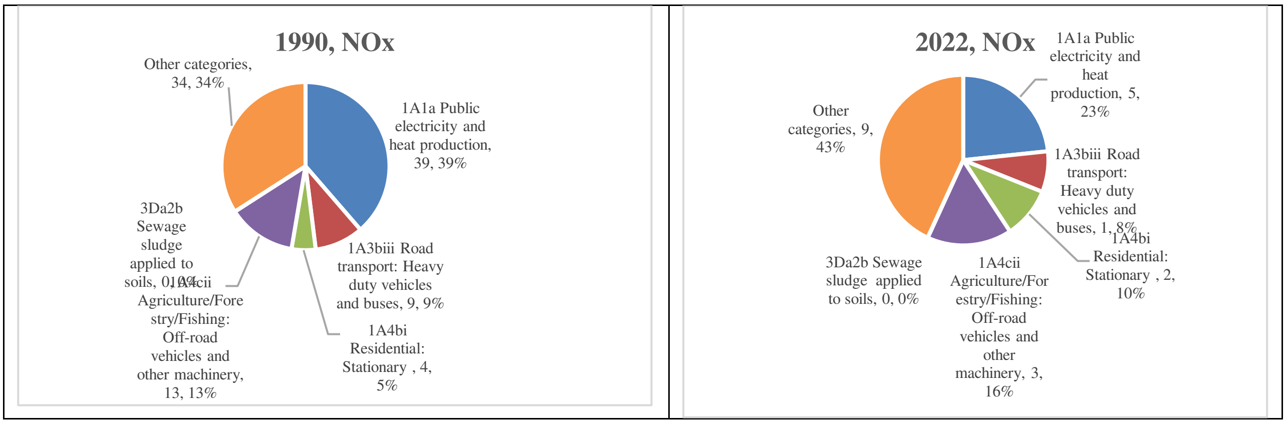


Figure 2.3. NO_x emissions by sectors in 1990 and 2022.

Non-methane volatile organic compounds (NMVOC)

Total NMVOC emissions decreased from 111,7 kt to 70,0 kt (2022/1990).

		NMVOC, kt	NMVOC, kt	2022
		1990	2022	%
1A4bi	Residential: Stationary	17,7	13,1	*18,7*
2D3a	Domestic solvent use including fungicides	5,2	3,7	*5,3*
2D3d	Coating applications	10,0	7,1	*10,2*
2D3i	Other solvent use (please specify in the IIR)	3,1	14,3	*20,4*
2H2	Food and beverages industry	13,3	5,3	*7,5*
3B1a	Manure management - Dairy cattle	5,2	1,0	*1,4*
5A	Biological treatment of waste - Solid waste disposal on land	8,3	9,1	*13,0*
Other	Other categories	48,9	16,4	*23,4*
	Total	111,7	70,0	*100,0*

They had a declining trend between 1990 and 2000, followed by a slow growth (Figure 2.4).

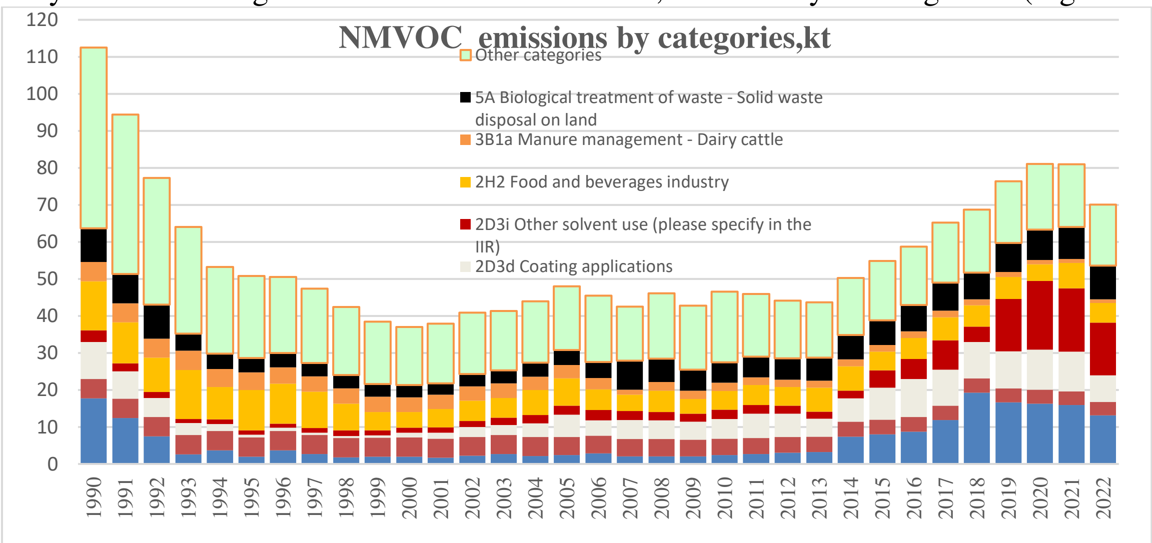


Figure 2.4. Trends in NMVOC emissions in the 1990-2022 period, by categories, kt.

The following categories make the largest contribution of NMVOC emissions (1990/2022):

1) with a growing trend in emissions:
- *1.A.4.b.i Residential: Stationary* – from 16% to 19%;
- *2.D.3.d Coating applications* – from 9% to 10%;
- *2.D.3.i Other Solvents Use* – 3% (1990) and 20% (2022) - the largest increase;

2) with a downward trend in emissions:
- *2.H.2 Food and Beverages Industry* – from 12% to 8%;
- *3.B.1.a Manure Management*- daily cattle 4% in 1990 and 1% in 2022 (Fig. 2.5).

All *other* categories have a total contribution of 43% of NMVOC emissions in 1990 and 24% in 2022.

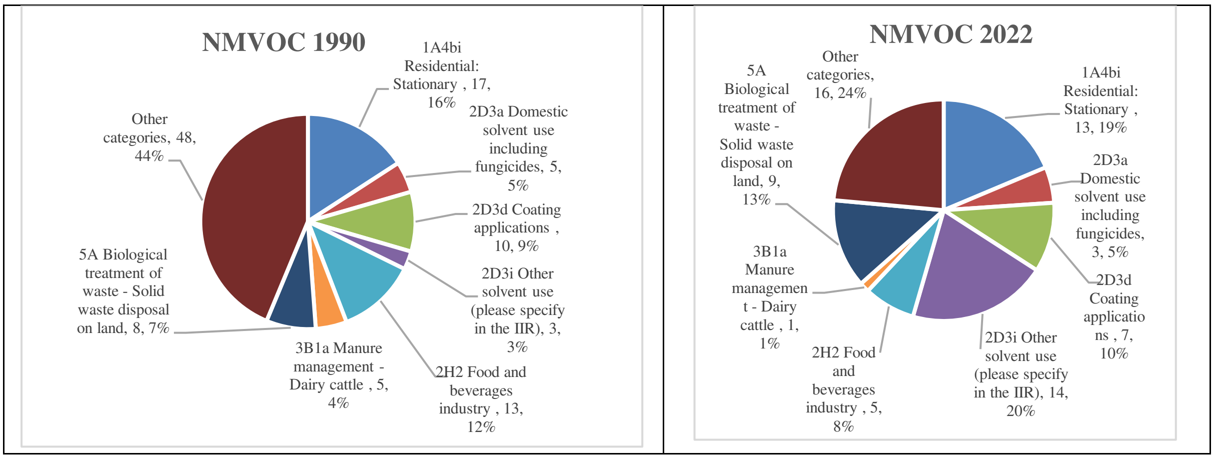


Figure 2.5. NMVOC emissions by sectors in 1990 and 2022.

Sulphur oxides (SO_x)

SO_x emissions decreased from 149,3 to 4,18 kt (1990/2022), Figure 2.6.

		SO_x, kt	SO_x, kt	2022
		1990	2022	%
1A1a	Public electricity and heat production	102,4	1,37	*32,8*
1A4ai	Commercial/institutional: Stationary	10,8	0,56	*13,3*
1A4bi	Residential: Stationary	31,6	1,66	*39,8*
Other	Other categories	4,2	0,59	*14,1*
	Total	149,3	4,18	*100,0*

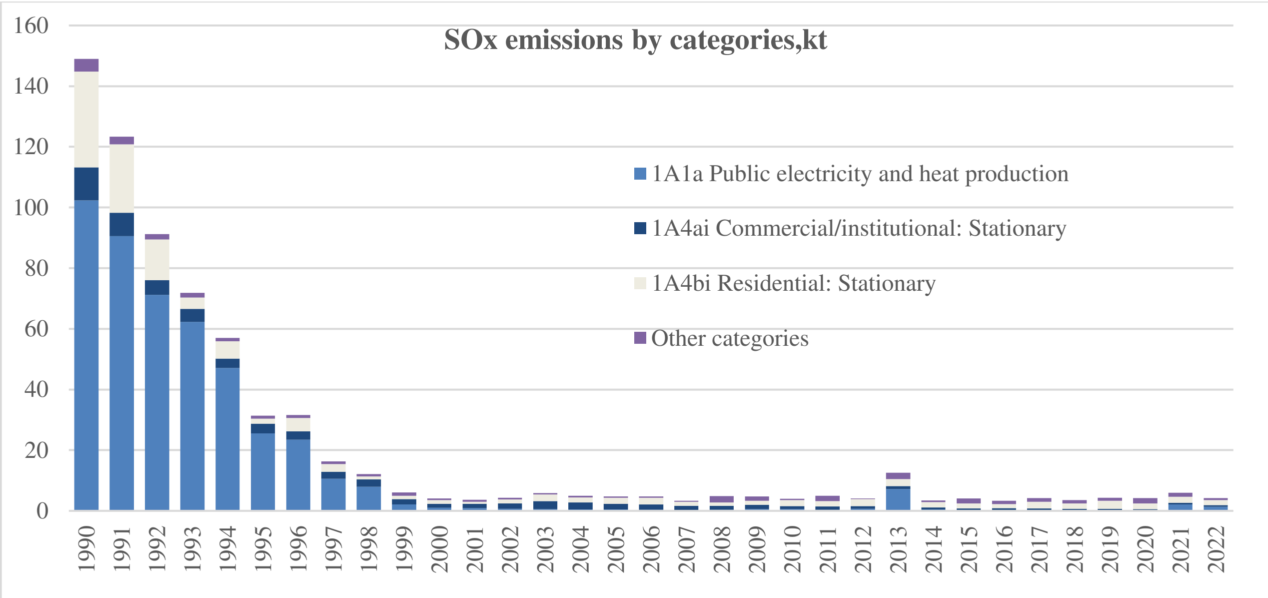


Figure 2.6. Trends in SO_x emissions in the 1990-2022 period, by categories, kt

The structure of SO_x emissions presented in pie charts allows us to see a decrease in the contribution of category *1.A.1.a Public Electricity* and an increase in the shares of *1.A.4.a.i Commercial/institutional*, *1.A.4.b*i *Residential*. The value in 2013, which differs markedly from others in the category 1.A.1.a *Public Electricity*, is due to the fact that there was an increase in coal consumption at the Moldavian Thermal Power Station (only one year during 2000-2022).

The largest SO_x emissions were 102,4 kt in 1990 in the *1.A.1.a Public Electricity* category to 1,37 kt in 2022.

The share of categories changed as follows (1990/2022): for *1.A.1.a Public Electricity* from 69% to 33%, for *1.A.4.a.i Commercial/institutional* from 7% to 13%, for *1.A.4.b*i *Residential* from 21% to 40% and for "*Other*" from 3% to 14% (Figure 2.7).

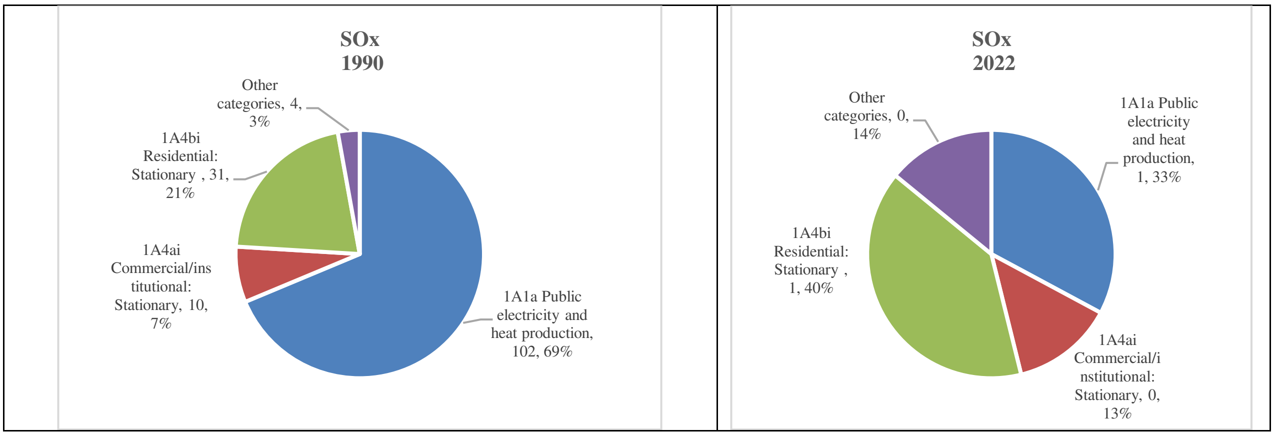


Figure 2.7. SO_x emissions by sectors in 1990 and 2022

Ammonia (NH_3)

NH_3 emissions decreased from 52,9 to 16,4 kt (1990/2022) and have a gradual decline trend (Figure 2.8).

		NH_3, kt	NH_3, kt	2022
		1990	2022	%
3B3	Manure management - Swine (Sows+ Fattening pigs)	7,8	1,52	*9,3*
3Da2a	Animal manure applied to soils	11,8	2,19	*13,3*
3Da1	Inorganic N-fertilizers (includes also urea application)	7,9	7,36	*44,8*
Other	categories	25,4	5,34	*32,6*
		52,9	16,42	*100,0*

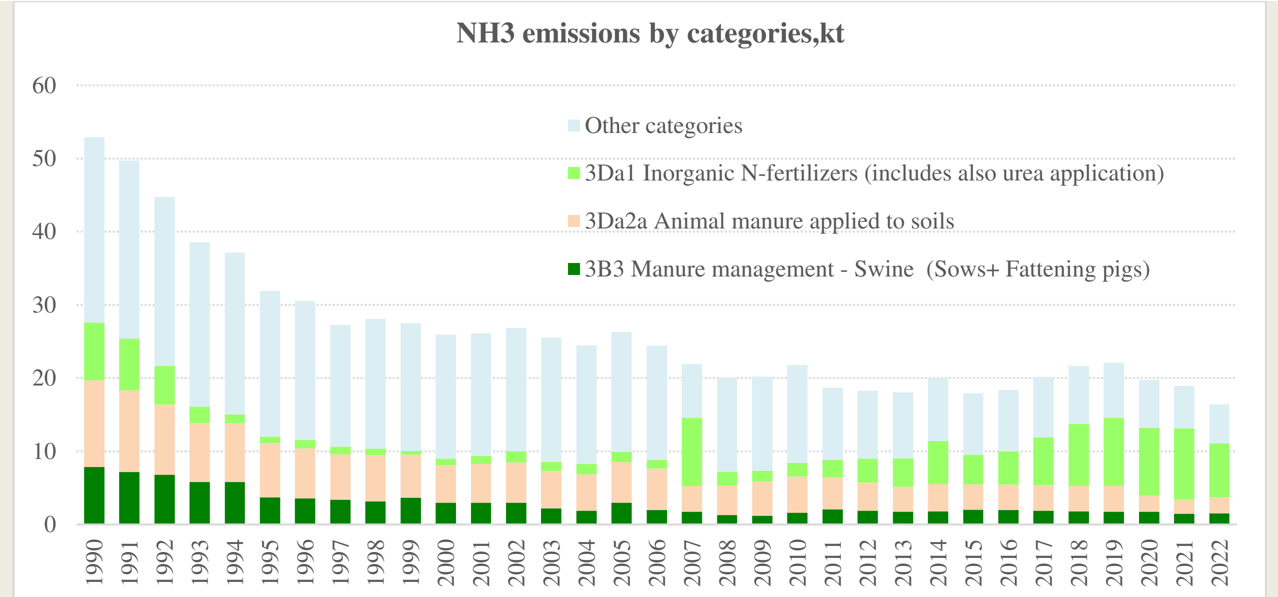
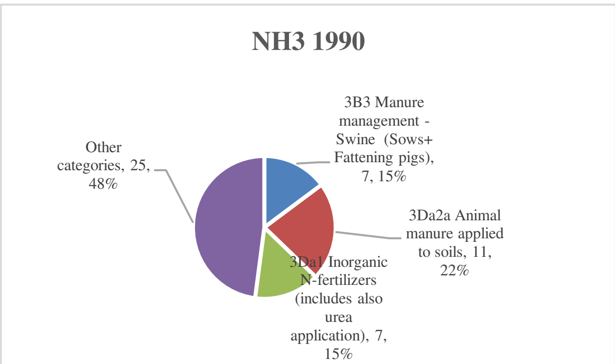


Figure 2.8. Trends in NH_3 emissions in the 1990-2022 period, by categories, kt

The structural distribution of NH_3 emissions changed in 2022: 3B3 Manure management - Swine (Sows+ Fattening pigs) decreased to 15% compared to 9%; the share of 3.D.a.2.a *Animal manure applied to soils* decreased to 22% compared to 13% in 1990; 3.D.a.1 *Inorganic N-fertilizers* (includes also urea application) decreased to 7,9% compared to 7,3%; *Other* Categories – decreased to 48% in 2022 compared with 33% in 1990 (Figure 2.9).



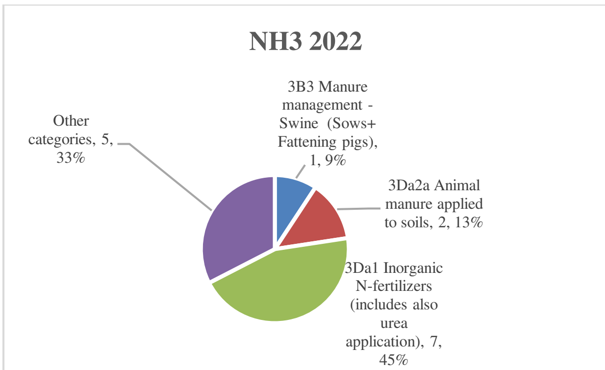


Figure 2.9. NH_3 emissions by sectors in 1990 and 2022

Particulate matter ($PM_{2.5}$)

The time series of $PM_{2.5}$ emissions have decreasing trend from 23,8 to 18,4 kt (1990/2022), Figure 2.10.

		$PM_{2,5}$, kt	$PM_{2,5}$, kt	2022
		1990	2022	%
1A4ai	Commercial/institutional: Stationary	1,4	0,1	*0,8*
1A4bi	Residential: Stationary	14,9	15,8	*86,0*
5C2	Open burning of waste	0,4	0,3	*1,7*
5E	Other waste (please specify in IIR)	0,5	0,1	*0,5*
Other	Other categories	6,6	2,0	*11,1*
	Total	23,8	18,4	*100,0*

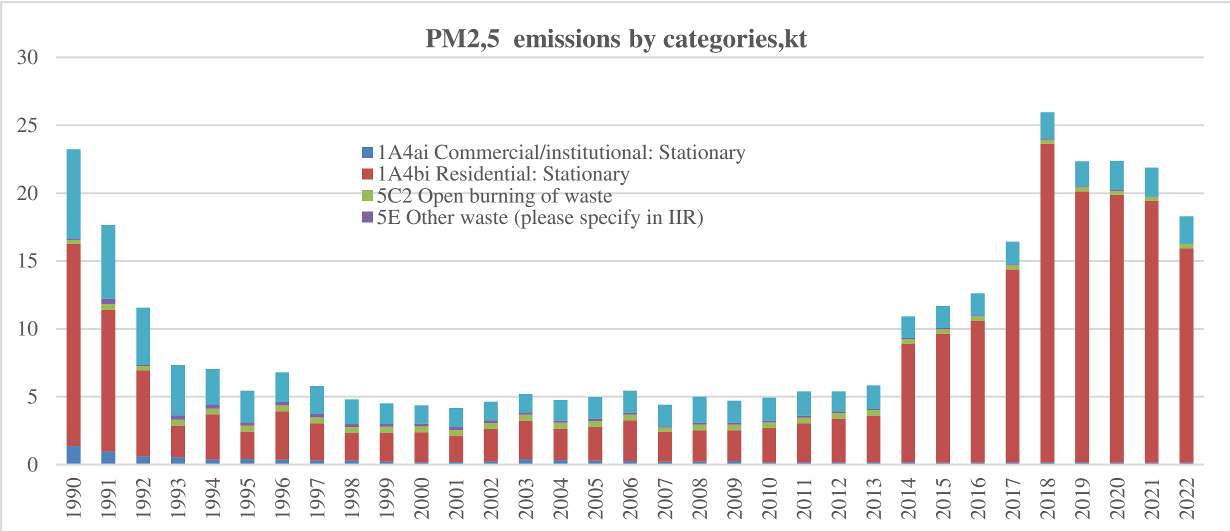


Figure 2.10. Trends in $PM_{2.5}$ emissions in the 1990-2022 period, by categories, kt

The largest number of $PM_{2.5}$ emissions comes from the residential sector *1.A.4.b.i Residential: Stationary* - 64% and 86% in 1990 and 2022, respectively. *Other* categories combined accounted for 29% of $PM_{2.5}$ emissions in 1990 and 11% in 2022.

The gross emissions of $PM_{2.5}$ from the *1.A.4.b.i Residential: Stationary* sector in 1990 and 2020 amounted to approximately the same amount of 14,9 and 15,8 kt, emissions from all other categories decreased significantly, as can be seen in the pie charts (Figure 2.11).

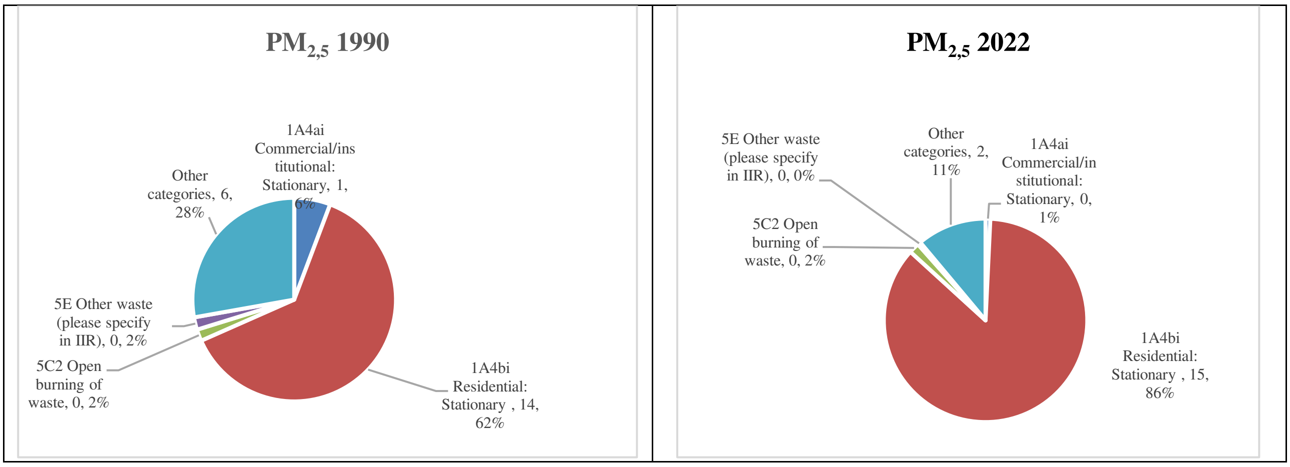


Figure 2.11. $PM_{2.5}$ emissions by sectors in 1990 and 2022

Particulate matter (PM_{10})

PM_{10} emissions have decreasing dynamic from 32,1 to 23,5 kt (1990/2022), Figure 2.12.

		PM_{10}, kt	PM_{10}, kt	2022
		1990	2022	%
1A1a	Public electricity and heat production	2,9	0,1	*0,3*
1A4bi	Residential: Stationary	15,1	16,2	*69,1*
2D3b	Road paving with asphalt	3,7	2,1	*8,8*
Other	Other categories	10,4	5,1	*21,8*
	Total	32,1	23,5	*100,0*

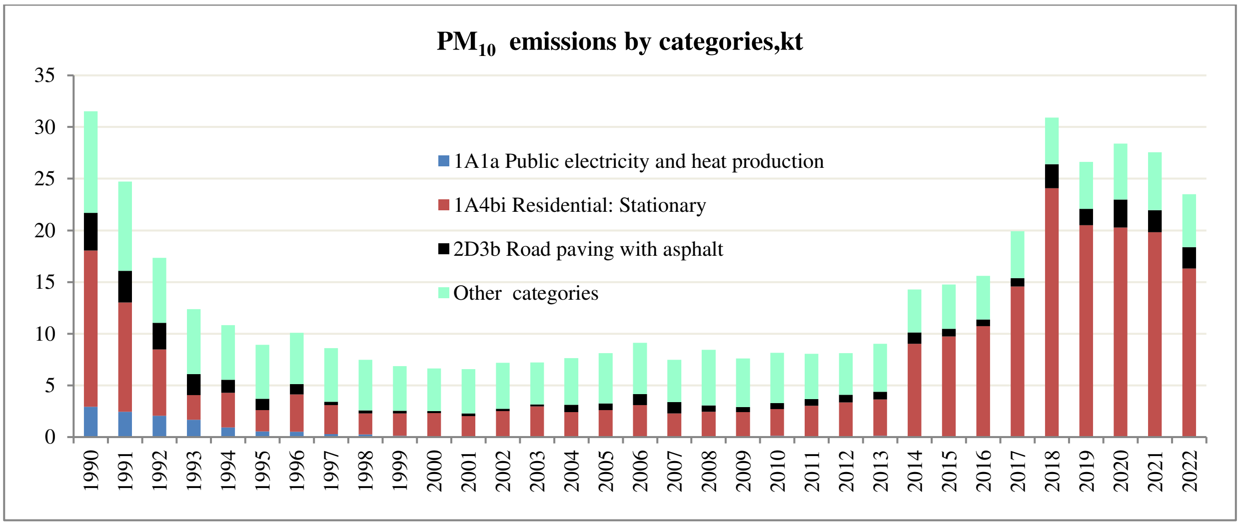
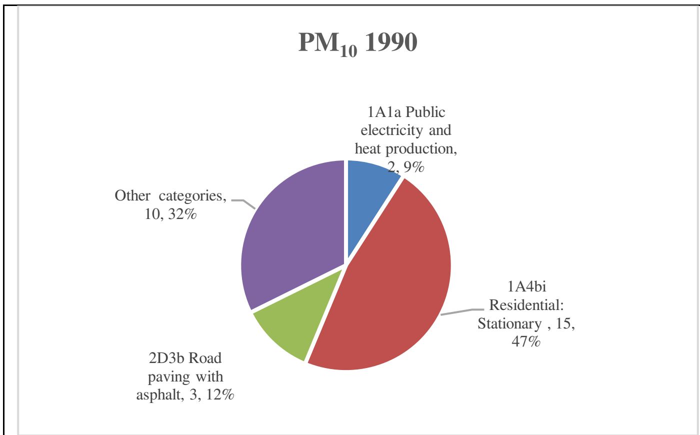


Figure 2.12. Trends in PM_{10} emissions in the 1990-2022, by categories, kt

The largest emissions come from the following categories:

- *1.A.1.a Public electricity and heat production* (trend is a gradual decrease from 9% in 1990 to 0% in 2022);
- *1.A.4.b.i Residential: Stationary* (47% and 69%),
- *2.D.3.b Road paving with asphalt* (12% and 9%).

The emissions of PM_{10} from all *other* categories decreased from 31% (1990) to 22% in 2022. PM_{10} emissions from *1.A.4.b.i Residential: Stationary* in gross terms in 1990 and 2022 amounted to close values of 15,1 and 16,2 kt PM_{10}, but the share of their contribution increased from 47% in 1990 to 69% in 2022 (Figure 2.13).



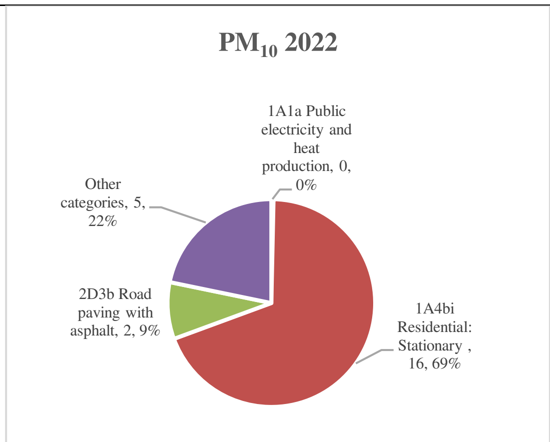


Figure 2.13. PM_{10} emissions by sectors in 1990 and 2022

Total suspended particulates (TSP)

TSP emissions decreased from 71,8 to 42,7 kt TSP (1990/2022). Figure 2.14.

		TSP, kt	TSP, kt	2022
		1990	2022	%
1A4bi	Residential: Stationary	16,6	17,1	*40,0*
2D3b	Road paving with asphalt	17,1	9,7	*22,7*
2D3g	Chemical products	14,6	8,3	*19,4*
Other	Other categories	23,5	7,7	*17,9*
	Total	71,8	42,7	*100*

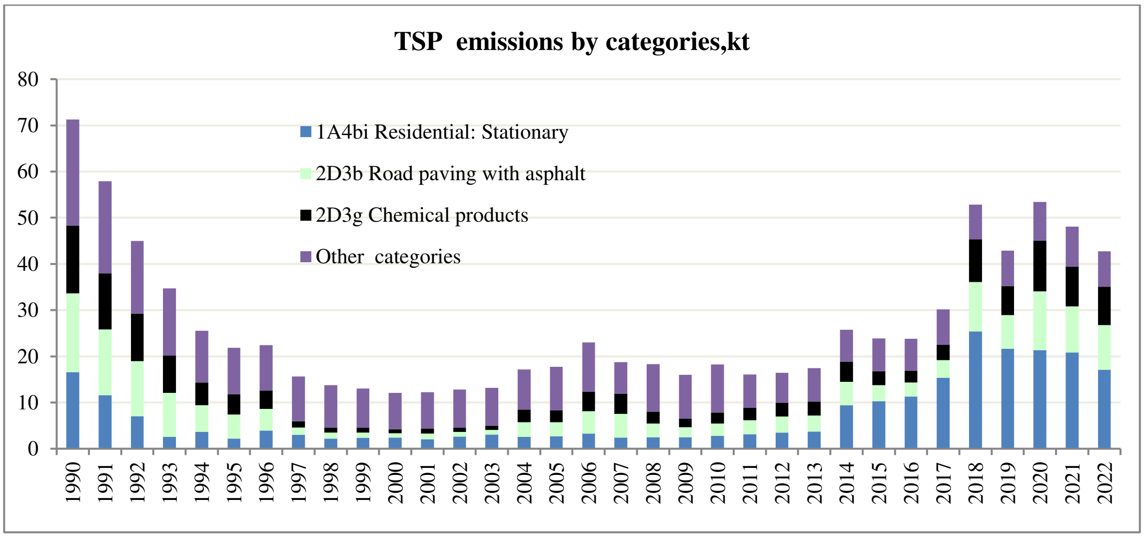
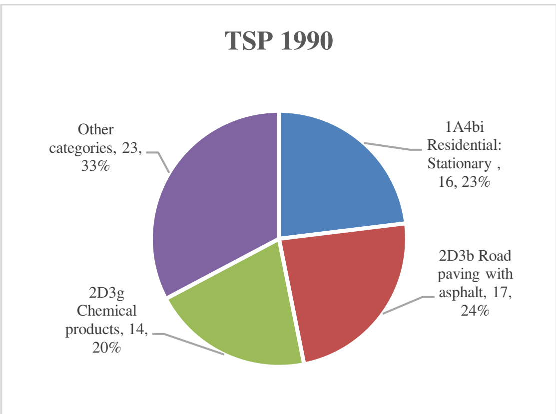


Figure 2.14. Trends in TSP emissions in the 1990-2022 period, by categories, kt

The largest emissions are observed from category *1.A.4.b.ii Residential: Stationary*.
The emissions in categories that has changed in 2022 compared to 1990:

- *1.A.4.b.ii Residential: Stationary*- from 23% to 40%.
- *2.D.3.b Road paving with asphalt* (from 17% to 23%).
- *2.D.3.g Chemical products* (from 20% to 19%).
- *Other* categories -from 33% to 18%, (Figure 2.15).



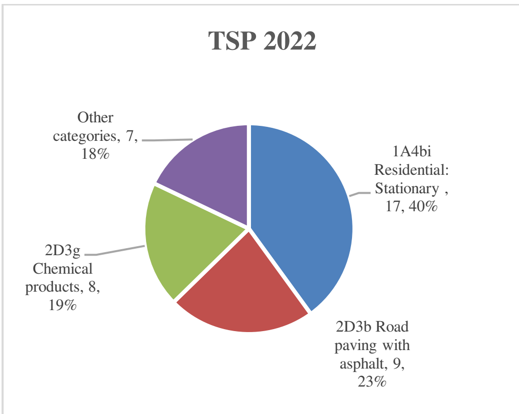


Figure 2.15. TSP emissions by sectors in 1990 and 2022

Black carbon (BC)

BC emissions have a decrease trend from 4,0 kt to 2,09 kt (1990/2022), Figure 2.16.

		BC, kt	BC, kt	2022
		1990	2022	%
1A4bi	Residential: Stationary	0,99	1,56	*74,6*
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0,4	0,12	*5,7*
3F	Field burning of agricultural residues	1,8	0,001	*0,0*
Other	Other categories	0,8	0,41	*19,6*
	Total	4,0	2,09	*100,0*

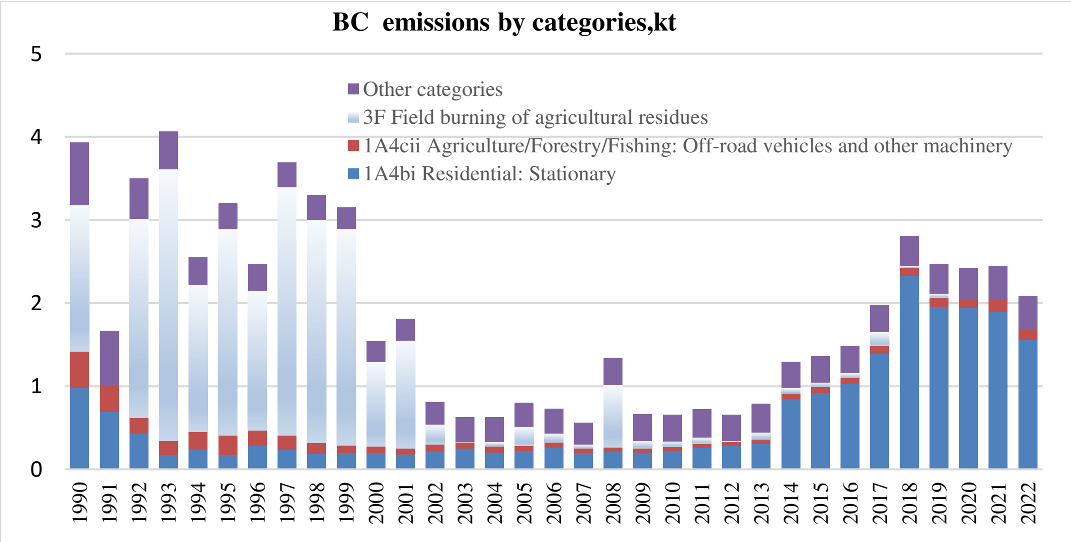


Figure 2.16. Trends in BC emissions in the 1990-2022 period, by categories, kt

The largest contribution within 1990-2001 is made by category *3.F Field burning of agricultural residues*, emissions from which amounted to 1,8 kt (45%) in 1990 and 0,001 kt (0%) in 2022. Category *1.A.4.b.i Residential: Stationary* had the largest contribution of BC emissions due to increase in biomass use from 0,99 (1990) to 1,56 (2022) kt. The second reason is also the change in the methodology for biomass consumption accounting by the National Bureau of Statistics in Energy Balances, which was introduced in 2013.

The share categories of BC emissions are following:

-*1.A.4.b.i Residential: Stationary* increased from 25% (1990) to 74% (2022);

-*1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery* decreased from 11% (1990) to 6% (2022);

-*3.F Field burning of agricultural residues* decreased from 44% (1990) to 0,0% (2020);

-*Other* - decreased from 0,8 kt (1990) to 0,41 kt (2022), (Figure 2.17).

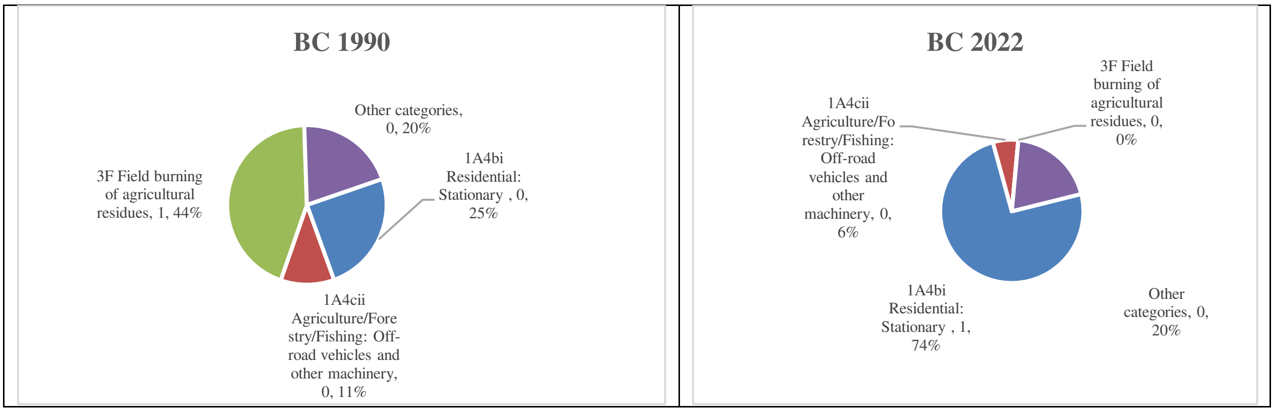


Figure 2.17. BC emissions by sectors in 1990 and 2022

Carbon monoxide (CO)

CO emissions decreased from 322,0 (1990) to 124,5 kt (2022), Figure 2.18.

		CO, kt	**CO, kt**	**2020**
		1990	**2022**	***%***
1A3bi	Road transport: Passenger cars	23,7	8,0	*6,4*
1A3bii	Road transport: Light duty vehicles	33,6	5,5	*4,4*
1A4bi	Residential: Stationary	166,3	89,7	*72,1*
Other	Other categories	98,4	21,4	*17,2*
	Total	322,0	124,5	*100,0*

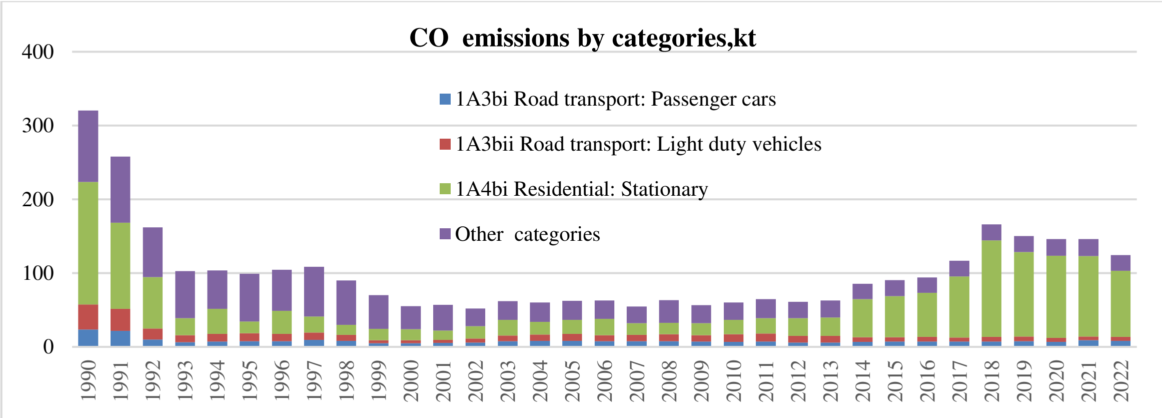


Figure 2.18. Trends in CO emissions in the 1990-2022, by categories, kt

The largest amounts of CO emissions are generated during *mobile* combustion in the categories *1.A.3.b.i Road transport: Passenger cars, 1.A.3.b.ii Road transport: Light duty vehicles* and during *stationary* burning in the categories *1.A.4.b.i Residential: Stationary*. For each of these categories, the following dynamics of emission reduction is observed (1990/2022):

- *1.A.3.b.i Road transport: Passenger cars* - from 23,7 to 8,0 kt CO;
- *1.A.3.b.ii Road transport: Light duty vehicles* - from 33,6 to 5,5 kt CO;
- *1.A.4.b.ii Residential: Stationary* - from 166,3 to 89,7 kt CO;
- *Other* categories together have a reduction in emissions from 98,4 to 21,4 kt CO.

The distribution of category contributions in total emissions in 1990/2022 changed to:
a) growth of emissions from *stationary* combustion in *1.A.4.b.i Residential: Stationary* (from 52% in 1990 to 72% in 2022);
b) a decrease in the share of category *1.A.3.b.i Road transport: Passenger cars* from 7% in 1990 to 8% in 2022, and a share of *1.A.3.b.i Road transport: Light duty vehicles* from 11% in 1990 to 5% in 2022 (Figure 2.19).

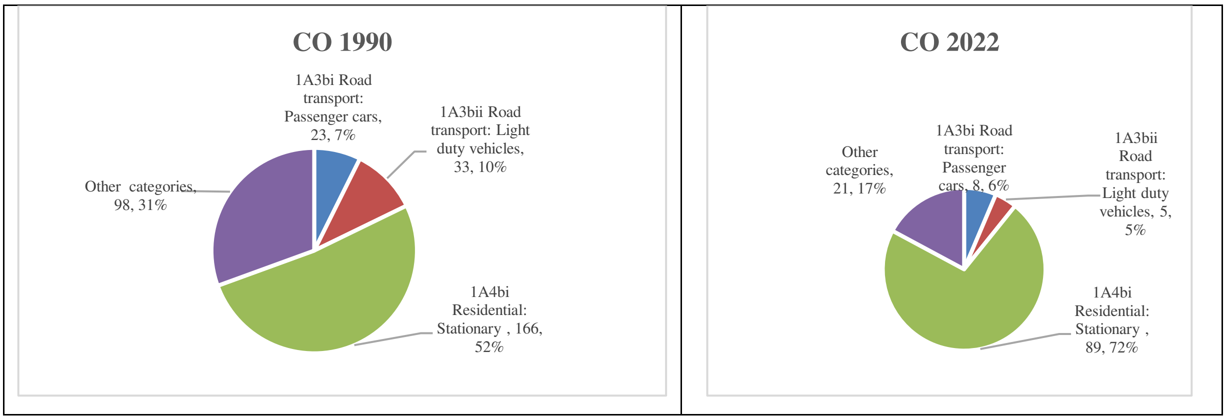


Figure 2.19. CO emissions by sectors in 1990 and 2022

Lead (Pb)

Pb emissions decreased from 8,1 to 1,4 tons (1990/2022), Figure 2.20.

		Pb, t	Pb, t	2022
		1990	2022	%
1A4ai	Commercial/institutional: Stationary	1.6	0,1	*6,6*
1A4bi	Residential: Stationary	4.6	0,8	*53,6*
2A3	Glass production	0.4	0,4	*28,9*
Other	Other categories	1.4	0,2	*10,9*
	Total	8.1	1,4	*100,0*

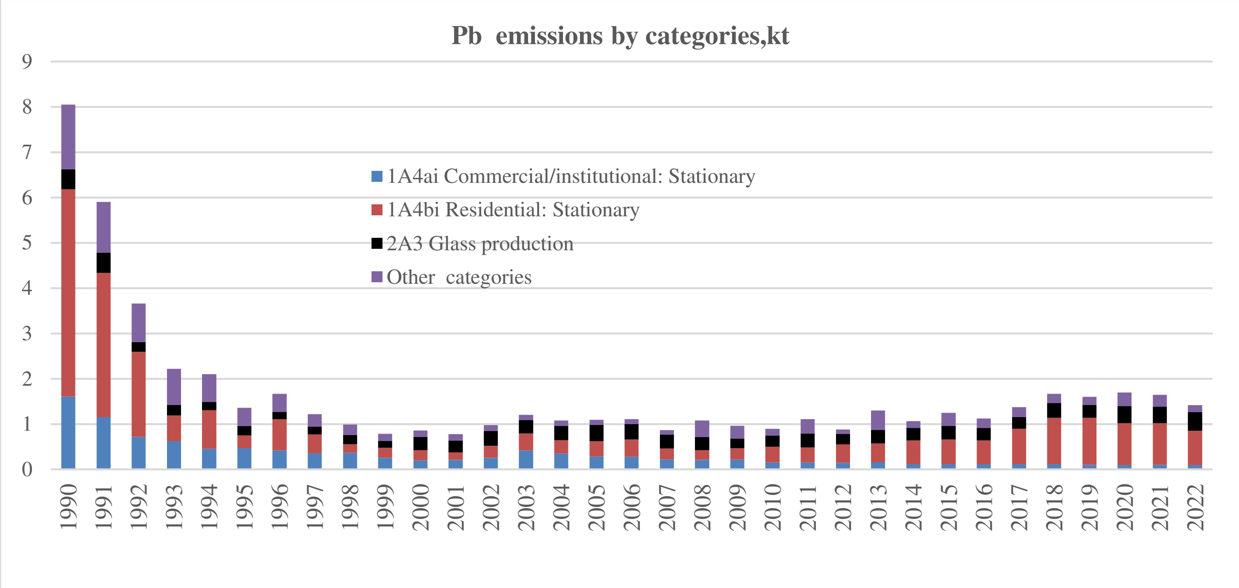


Figure 2.20. Trends in Pb emissions in the 1990-2022 period, by categories, tons

The largest emissions come from categories *1.A.4.a.i Commercial/institutional: Stationary, 1.A.4.b.i Residential: Stationary, 2.A.3 Glass production.*

The contribution of category *1.A.4.a.i Commercial/institutional: Stationary* decreased from 20% to 6% (1990/2022), while that of category *2.A.3 Glass production* increased from 5% to 29%.
The contribution of category *1.A.4.b.i Residential: Stationary* increased from 57% to 54% (1990/2022).
Other categories together contributed by 18% and 11% of Pb emissions (1990/2022) (Figure 2.21).

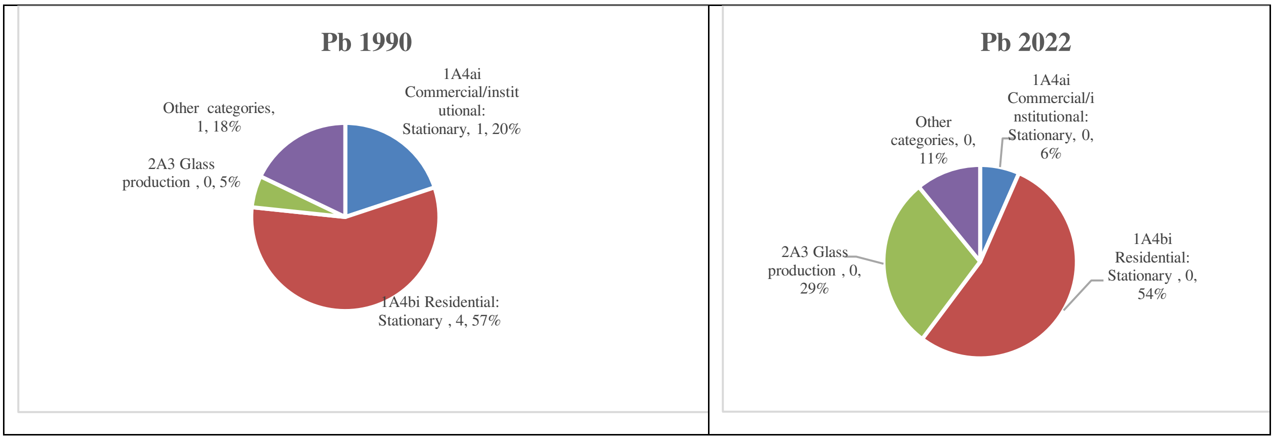


Figure 2.21. Pb emissions by sectors in 1990 and 2022, tons and %

Cadmium (Cd)

Cd emissions have a decreased trend of change from 0,45 t (1990) to 0,36 t in 2022 (Figure 2.22). The contribution of categories to Cd emissions changed significantly by 1990 compared to 2022. The share of category *1.A.4.b.i Residential: Stationary* increased significantly due to the increase in biomass use, Figure 2.22.

		Cd, t	Cd, t	2022
		1990	2022	%
1A1a	Public electricity and heat production	0.18	0,003	*0,9*
1A4bi	Residential: Stationary	0.07	0,27	*74,8*
2A3	Glass production	0.03	0,03	*8,7*
2G	Other product use (please specify in the IIR)	0.05	0,01	*3,5*
Other	Other categories	0.12	0,04	*12,0*
	Total	0.45	0,36	*100,0*

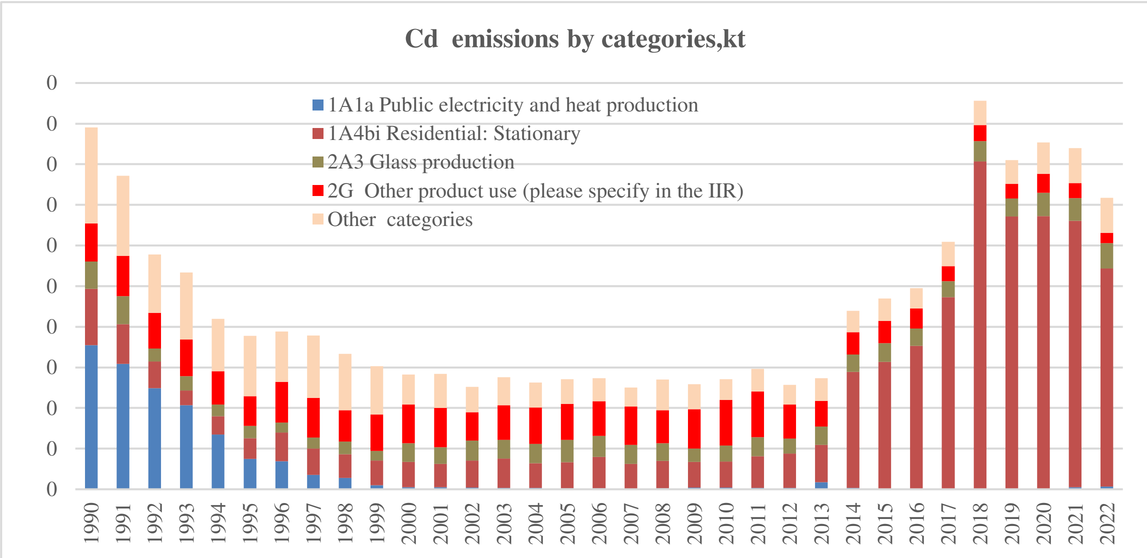


Figure 2.22. Trends in Cd emissions in the 1990-2022 period, by categories, tons

The Cd emissions trends by categories has following dynamic:

- *1.A.1.a Public electricity and heat production* - 40% in 1990 and 1% in 2022;
- *1.A.4.b.i Residential: Stationary* - 15% in 1990 and 75% in 2022;
- *2.A.3 Glass production* - 8% in 1990 and 9% in 2022;
  All *other* categories - 27% in 1990 and 12% in 2022 (Figure 2.23).

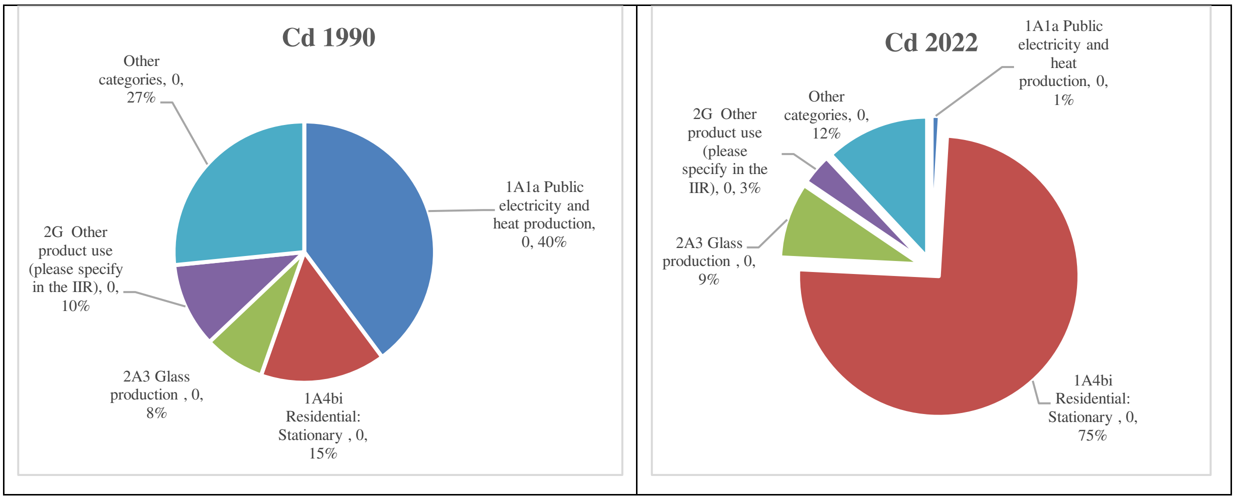


Figure 2.23. Cd emissions by sectors in 1990 and 2022, tons and %

Mercury (Hg)

Mercury emissions trend to decrease gradually from 0,48 in 1990 to 0,07 tons in 2022 (Figure 2.24).

		Hg, t	Hg, t	2020
		1990	2020	%
1A1a	Public electricity and heat production	0.14	0,004	*5,5*
1A4ai	Commercial/institutional: Stationary	0.09	0,01	*7,9*
1A4bi	Residential: Stationary	0.18	0,02	*31,4*
2C1	Iron and steel production	0.02	0,01	*10,6*
Other	Other categories	0.06	0,03	*44,5*
	Total	0.48	0,07	*100,0*

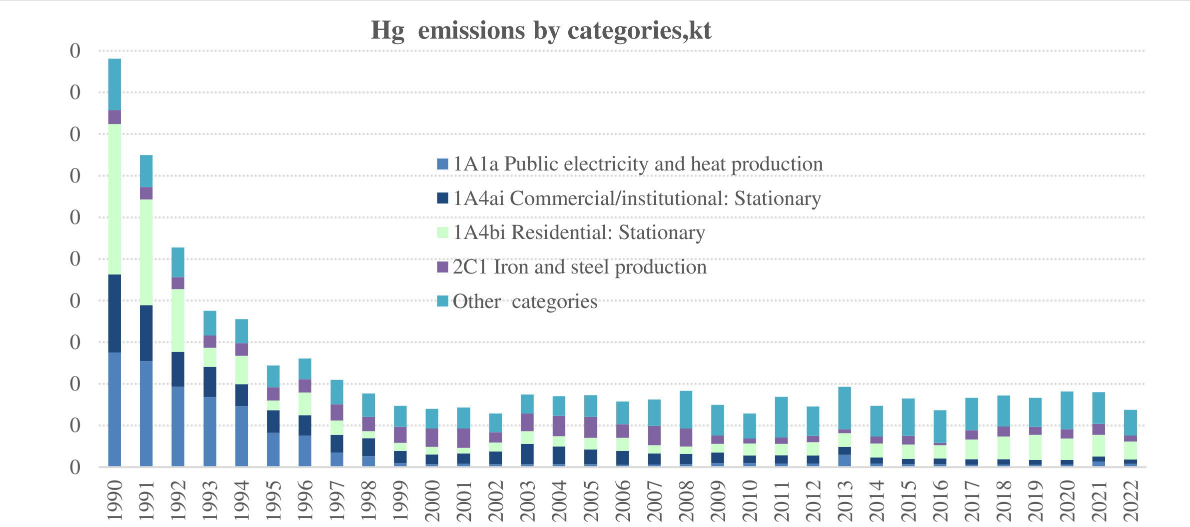


Figure 2.24. Trends in Hg emissions in the 1990-2022 period, by categories, tons

The share of the category *1.A.1.a Public electricity and heat production* contribution decreased from 29% in 1990 to 6% in 2022, category *1.A.4.a.i Commercial / institutional: Stationary* decreased from 19% in 1990 to 8% in 2022.

The share of category *2.C.1 Iron and steel production* increased from 3% in 1990 to 11% in 2022, while the share of *other categories* increased from 13% in 1990 to 44% in 2022 (Figure 2.25)

The emissions from *1.A.4.b.i Residential: Stationary* category - 37% in 1990 and 31% in 2022.

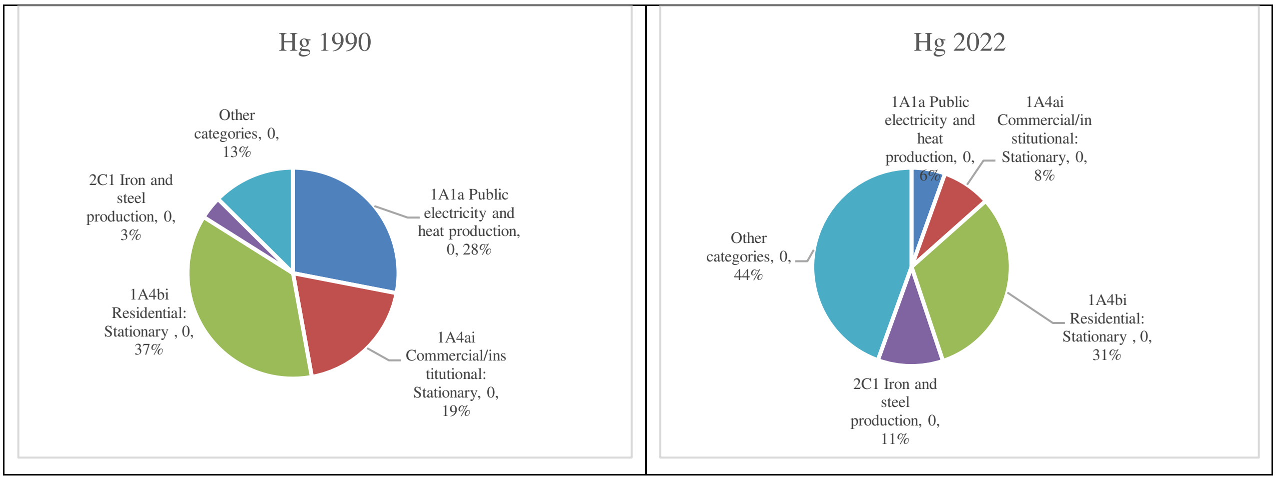


Figure 2.25. Hg emissions by sectors in 1990 and 2022, tons and %

Arsenic (As)

As emissions have a gradual decline trend from 1,13 to 0,11 tons (1990/2022) (Figure 2.26).

		As, t	As, t	2022
		1990	**2022**	*%*
1A1a	Public electricity and heat production	0.88	0,02	*16,3*
1A4bi	Residential: Stationary	0.09	0,01	*7,8*
2A3	Glass production	0.05	0,05	*41,7*
5C2	Open burning of waste	0.04	0,03	*27,3*
Other	Other categories	0.07	0,01	*6,9*
	Total	1.13	0,11	*100,0*

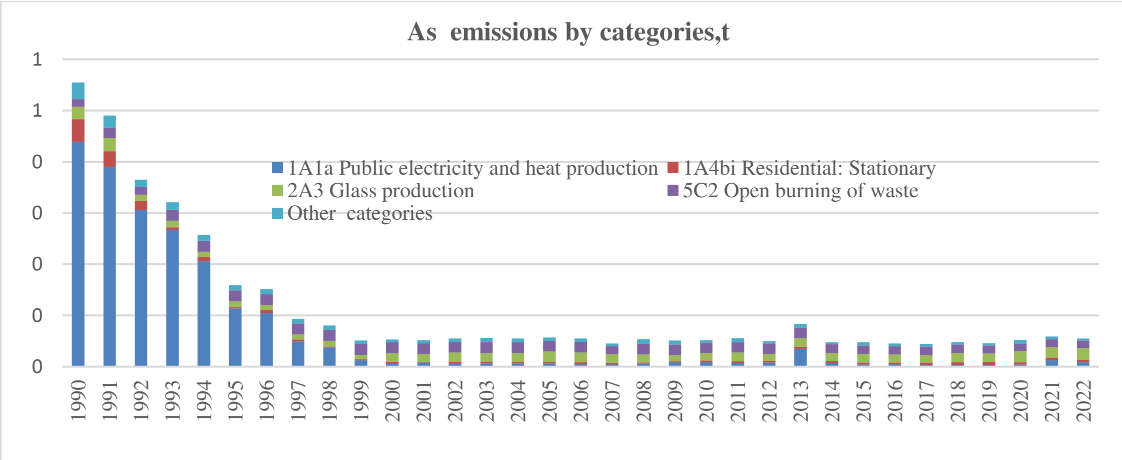


Figure 2.26. Trends in As emissions in the 1990-2022 period, tons

In 1990, the majority of As emissions came from category *1.A.1.a Public electricity and heat production* (78%). By 2022, the share of this category decreased to 16%. The increase in emissions in 2013 is associated with the increase of values of coal consumption for burning at the Moldavian Thermal Power Station.

The structure of emissions has changed, and the shares of other categories have increased: *2.A.3 Glass production* from 4% to 42%, and *5.C.2 Open burning of waste* from 3% to 27% (1990/2020).

Categories *1.A.4.b.i Residential: Stationary* and *all other categories* maintained their contributions at almost the same level (8%) during the period 1990-2022 (Figure 2.27).

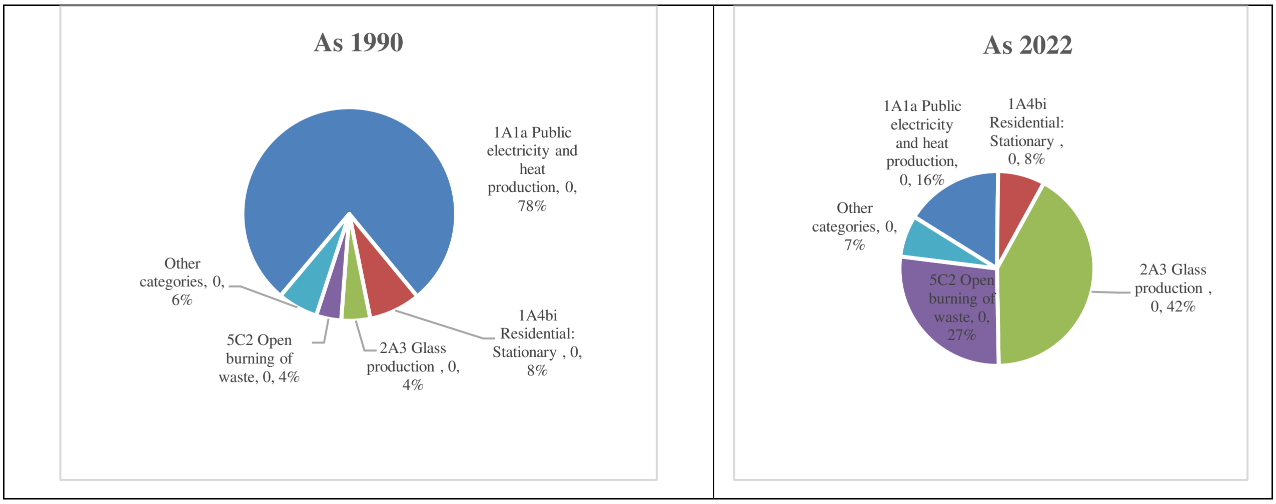


Figure 2.27. As emissions by sectors in 1990 and 2022, tons and %

Chromium (Cr)

Cr emissions overall decline from 1,34 to 0,6 tons (1990/2022) (Figure 2.28).

		Cr, t	Cr, t	2022
		1990	**2022**	**%**
1A1a	Public electricity and heat production	0.55	0,01	*1,2*
1A4ai	Commercial/institutional: Stationary	0.19	0,02	*3,0*
1A4bi	Residential: Stationary	0.42	0,5	*78,6*
2A3	Glass production	0.06	0,1	*8,9*
Other	Other categories	0.12	0,1	*8,4*
	Total	1.34	0,6	*100,0*

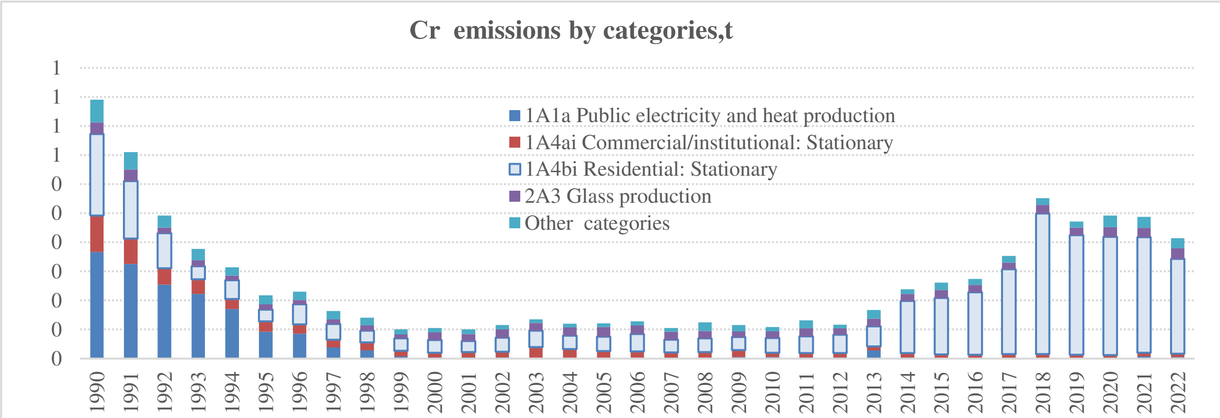


Figure 2.28. Trends in Cr emissions in the 1990-2022 period, by categories, tons

The largest contribution and the largest decrease took place in category *1.A.1.a Public electricity and heat production* (from 0,5 tons in 1990 to 0,01 tons in 2022).

The *1.A.4.a.i Commercial/institutional: Stationary category* also dropped significantly from 14% to 3% (1990/2022). For category *1.A.4.b.i Residential: Stationary* emissions increased from 31% to 79% (reason- increase in biomass use). For category *2.A.3 Glass production*, emissions increased from 5% to 9%. Emissions from all *Other categories* -9% and 8%, (Figure 2.29).

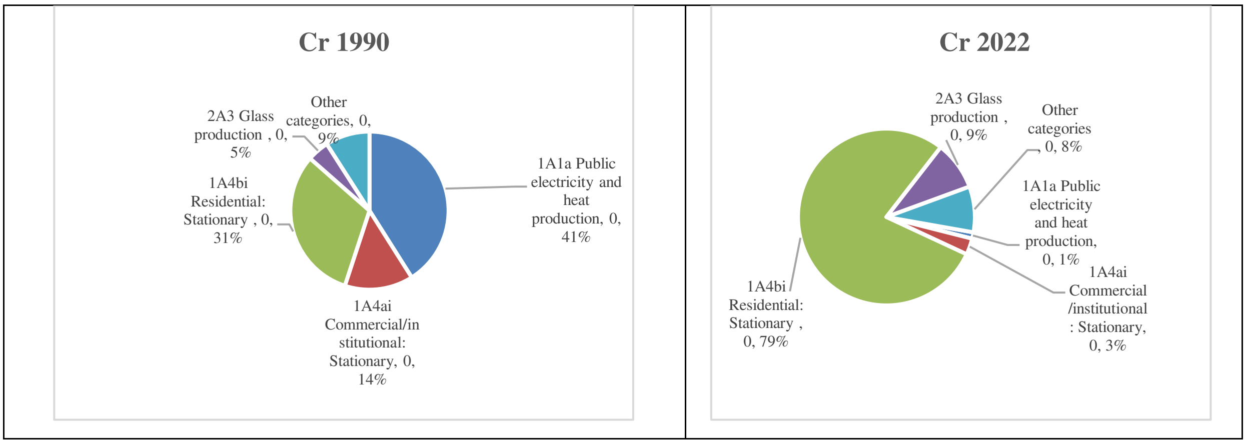


Figure 2.29. Cr emissions by sectors in 1990 and 2022

Copper (Cu)

Cu emissions had decreased from 3,1 tons (1990) to 0,44 tons (2022) (Figure 2.30).

		Cu, t	Cu, t	2022
		1990	2022	%
1A1a	Public electricity and heat production	1.04	0.015	*3,4*
1A4bi	Residential: Stationary	0.8	0.158	*36,2*
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.7	0.182	*41,8*
Other	Other categories	0.6	0.081	*18,5*
		3.1	0.437	*100,0*

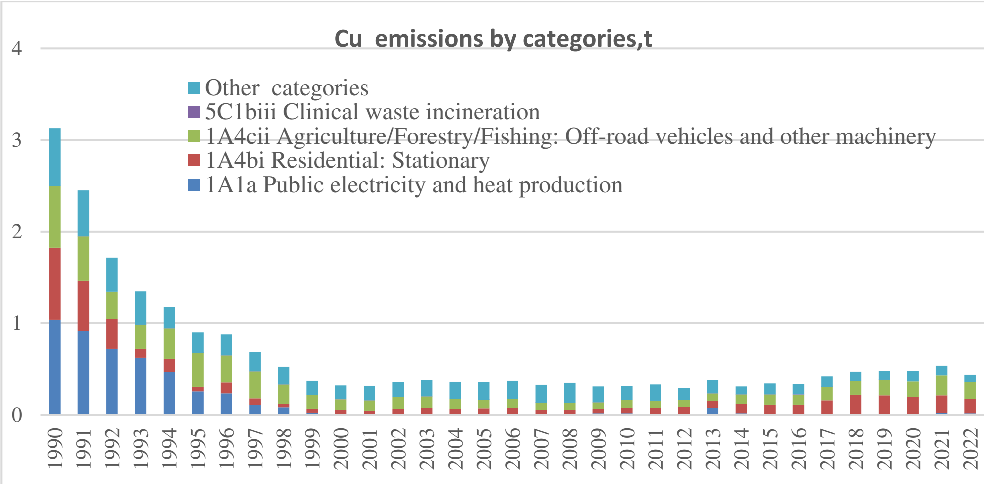


Figure 2.30. Trends in Cu emissions in 1990-2022, by categories, tons

Emissions from the sector *1.A.1.a Public electricity and heat production* decreased from 1,04 t to 0,02 kt.

Category contributions to total Cu emissions were as follows:

- *1.A.1.a Public electricity and heat production* - 33% in 1990 and 3% in 2022;
- *1.A.4.b.i Residential: Stationary* - 25% in 1990 and 36% in 2022;
- *1.A.4.c.ii Agriculture / Forestry / Fishing: Off-road vehicles and other machinery* - 22% in 1990 and 42% in 2022;
- *All Other categories*- 20% and 19% (Figure 2.31).

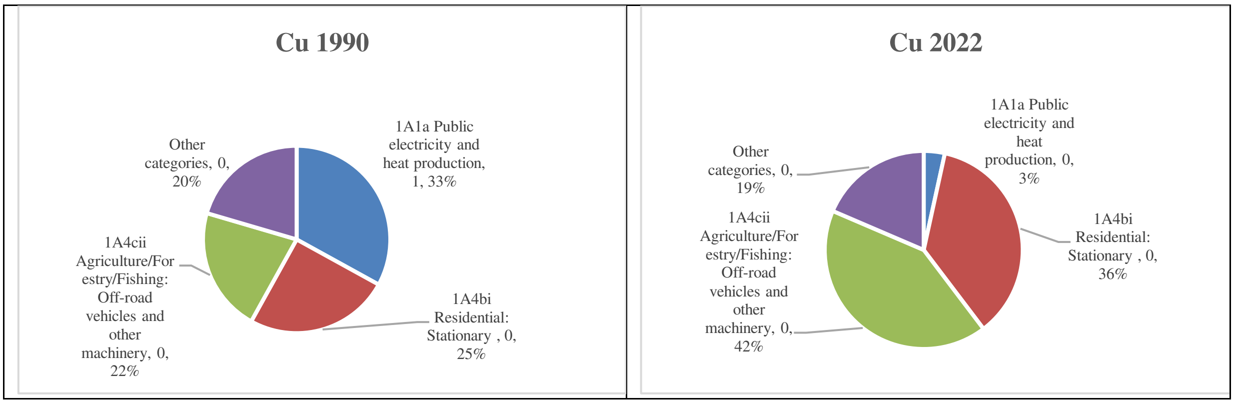


Figure 2.31. Cu emissions by sectors in 1990 and 2022

Nickel (Ni)

Ni emissions had a significant decrease from 25,6 tons (1990) to 0,95 tons (2022) (Figure 2.32).

		Ni, t	**Ni, t**	**2022**
		1990	**2022**	**%**
1A1a	Public electricity and heat production	24.2	0,70	*73,5*
1A4a	Commercial	0.4	0,01	*1,4*
1A4b	Residential	0.4	0,06	*6,4*
2A3	Glass production	0.1	0,12	*12,4*
Other	Other categories	0.4	0,06	*6,3*
		25.6	0,95	*100,0*

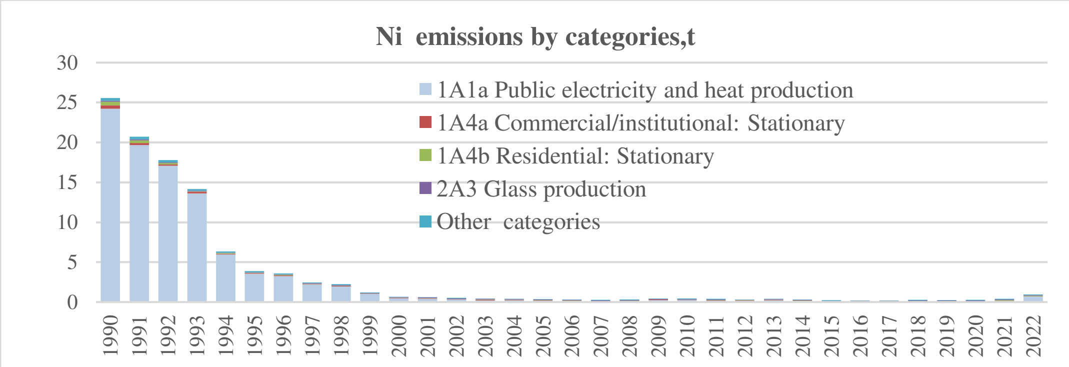
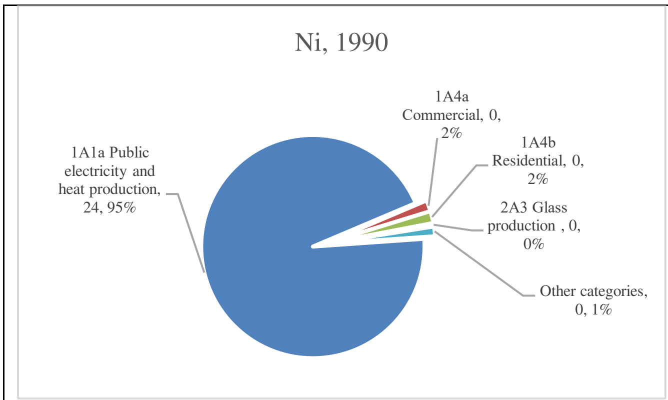


Figure 2.32. Trends in Ni emissions in 1990-2022, by categories, tons

The largest decline was from the sector *1.A.1.a Public electricity and heat production* from 24,2 tons (1990) to 0,7 tons (2020).

Due to such large decrease, the structural distribution of category contributions to total emissions has changed, and the share of categories became:

- *1.A.1.a Public electricity and heat production* – decrease from 24,2 (1990) to 0,7 (2022) tons (95% and 74%),
- *1.A.4.a Commercial/Institutional sector*– share increase from 2% to 1%*;*
- *1.A.4.b Residential sector* - share increase from 2% to 7%;
- *2.A.3 Glass production* - values decreased from 0,1 t to 0,12 t, but share in structure share has become noticeable from 0% (1990) to 12% (2022);
- *Other* categories - values decreased from 0,4 t to 0,06 t, but in structure share has become noticeable too- from 1% (1990) to 6% (2022), (Figure 2.33).



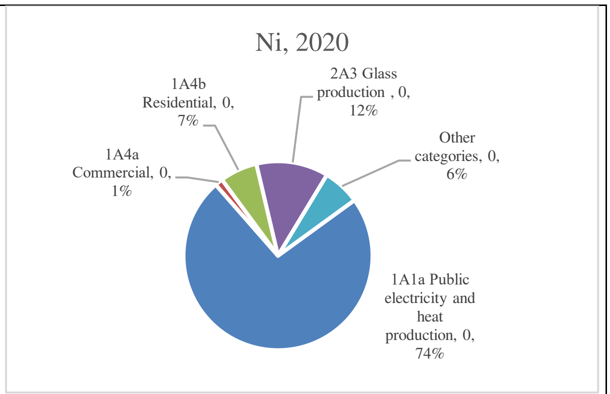


Figure 2.33. Ni emissions by sectors in 1990 and 2022, tons and %

Selenium (Se)

Se emissions had a significant decrease from 6,2 tons (1990) to 0,4 tons (2022) (Figure 2.34).

		Se, t	Se, t	2022
		1990	2022	%
1A1a	Public electricity and heat production	1,8	0,006	*1,5*
1A4bi	Residential: Stationary	4,2	0,2	*49,1*
Other	Other categories	0,2	0,2	*49,4*
	Total	6,2	0,4	*100,0*

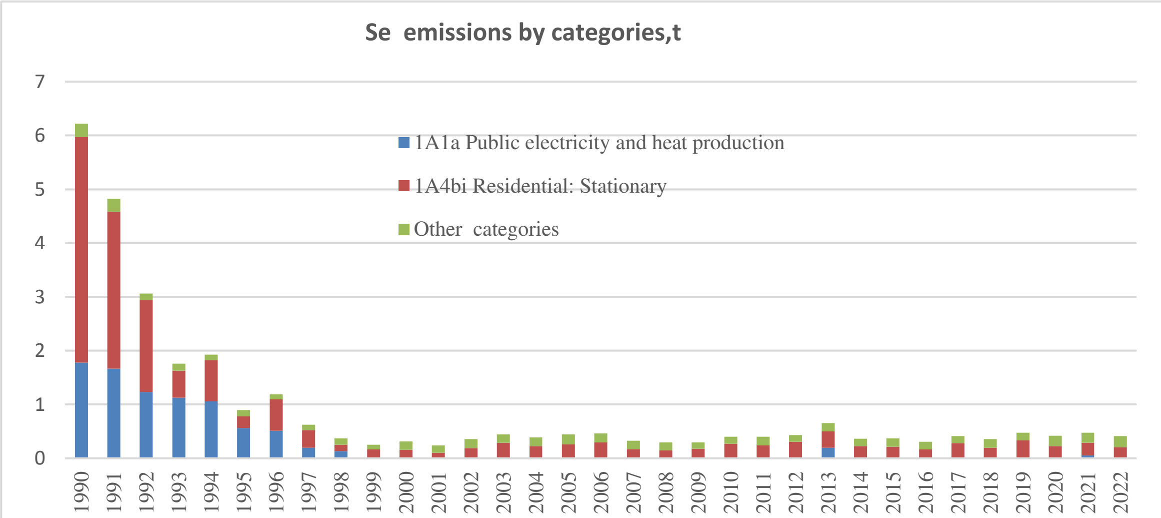


Figure 2.34. Trends in Se emissions in the 1990-2022 period, by categories, tons

In the structural distribution of emissions, there is a noticeable decrease for the share of *1.A.1.a Public electricity and heat production* (from 29% in 1990 to 2% in 2022).
All *Other* categories increased from 4% to 49%.
The *1.A.4.b.i Residential: Stationary* category has the same values - 67% in 1990 to 49% in 2022. (Figure 2.35).

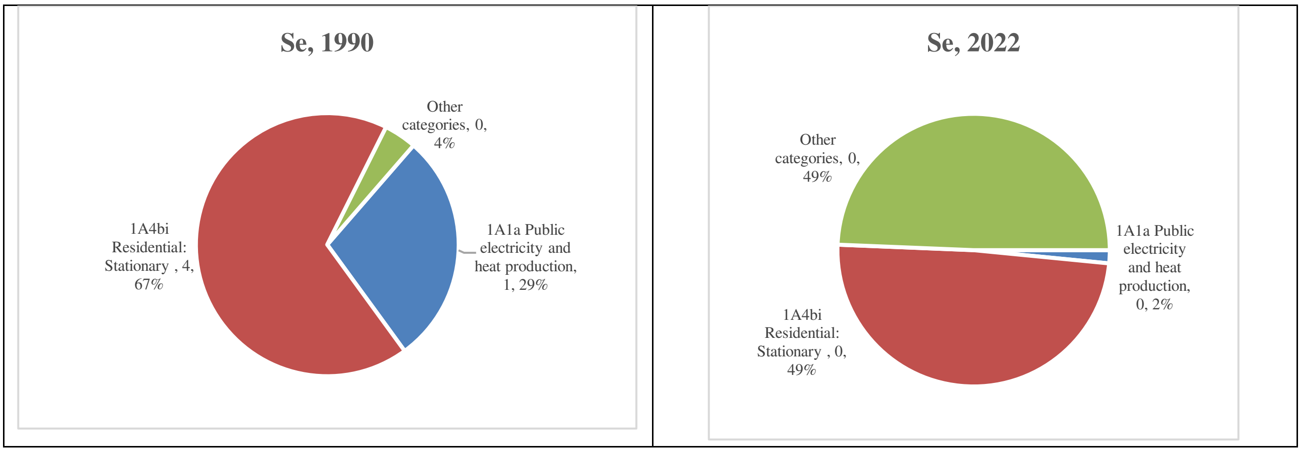


Figure 2.35. Se emissions by sectors in 1990 and 2022, tons and %

Zinc (Zn)

Zn emissions decline from 23,3 (1990) to 13,7 tons (2022) (Figure 2.36).

		Zn	Zn	2022
		1990	2022	%
1A1a	Public electricity and heat production	9,5	0,2	*1,8*
1A4ai	Commercial/institutional: Stationary	2,6	0,3	*2,5*
1A4bi	Residential: Stationary	8,3	10,8	*79,2*
5C2	Open burning of waste	1,8	1,3	*9,3*
Other	Other categories	2,0	1,0	*7,1*
		23,3	13,7	*100,0*

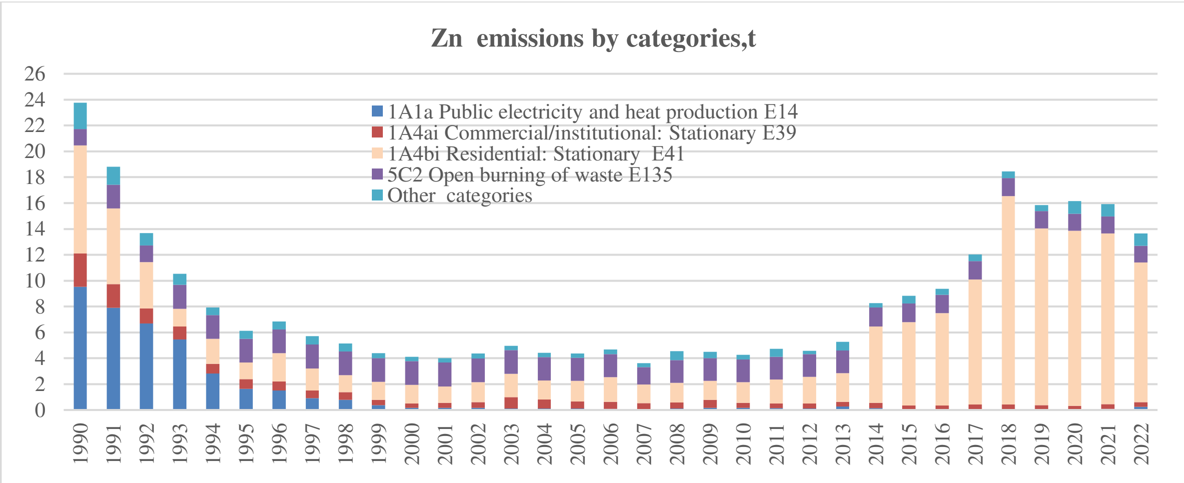


Figure 2.36. Trends in Zn emissions in the 1990-2022 period, by categories, tons

The structure of emissions by categories has changed significantly:

- The share of sectors *1.A.1.a Public electricity and heat production* decreased from 40% to 2%;
- *1.A.4.a.i Commercial / institutional: Stationary* decreased from 11% to 3% (1990/2022);
- The share of the *1.A.4.b.i Residential: Stationary category* increased from 34% to 79% (1990/2022). A large increase has been observed in the last 7 years. The reason is the change to the methodology for biomass accounting in Energy Balances of the National Bureau of Statistics.
- The share of all categories "*Other*" decreased from 8% to 7% (1990/2022), Figure 2.37.

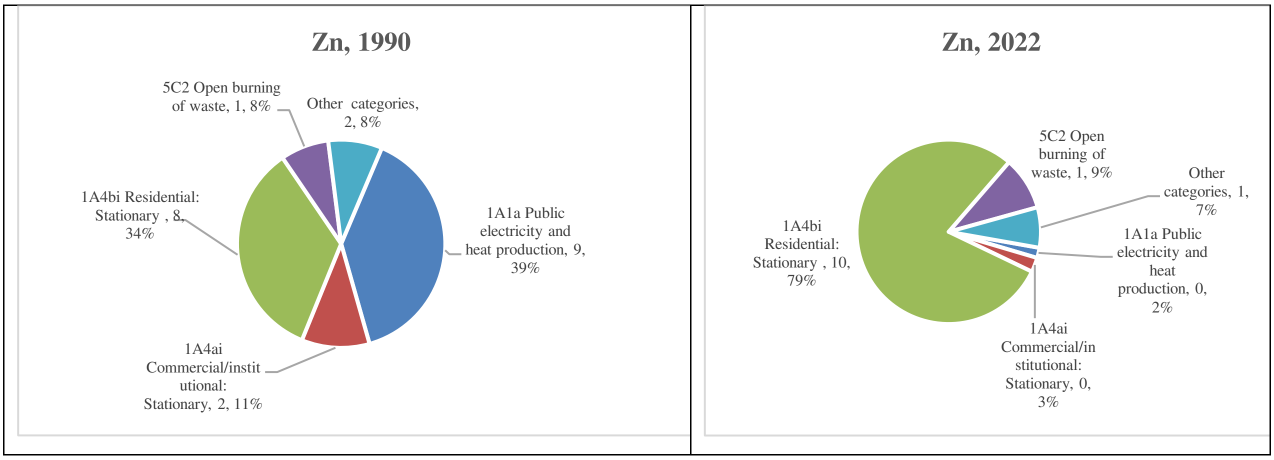


Figure 2.37. Zn emissions by sectors in 1990 and 2022

PCDD/F

PCDD/F emissions decreased from 41,5 g I-TEQ (1990) to 21,9 g I-TEQ in 2022, (Figure 2.38)

		PCDD, g I-TEQ	PCDD. g I-TEQ	2022
		1990	2022	%
1A4bi	Residential: Stationary	29,0	17,6	*80,6*
5C1biii	Clinical waste incineration	0,5	1,3	*5,9*
Other	Other categories	119	2,9	*13,4*
	Total	41,5	21,9	*100,0*

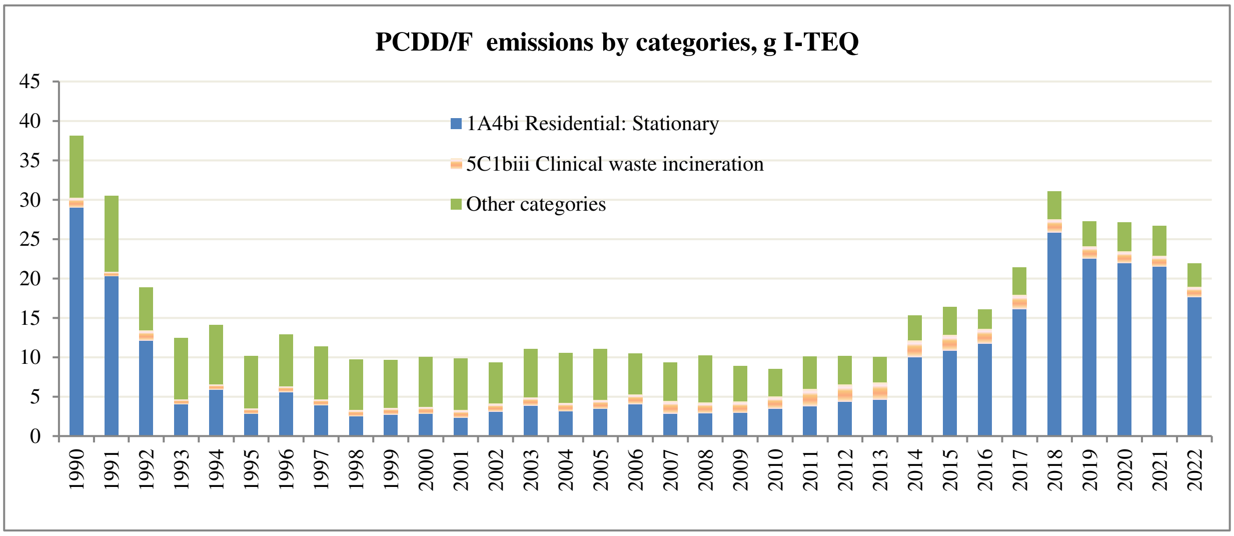


Figure 2.38. Trends in PCDD/F emissions in the 1990-2022 period, by categories, g I-TEQ

The share of *1.A.4.b.i Residential: Stationary* category increased from 70% to 81% (1990-2022). The category *5.C.1.b.iii Clinical waste* incineration category increased from 1% to 6% in 2022. The share of all categories "*Other*" decreased from 29% to 13% (1990/2022) (Figure 2.39).

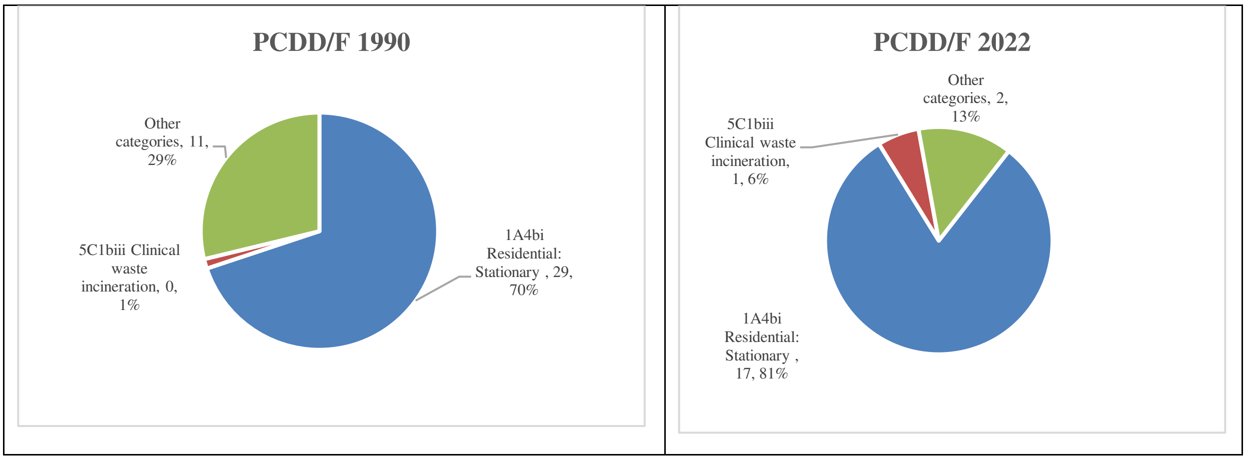


Figure 2.39. PCDD/F emissions by sectors in 1990 and 2022, g I-TEQ

Benzo(a)pyrene

The total reduction in gross emissions was from 9,1 tons to 3,1 tons (1990/2022) (Figure 2.40).

		Benzo(a) pyrene, t	Benzo(a) pyrene, t	2022
		1990	2022	%
1A4bi	Residential: Stationary	8,2	2,8	*92,1*
Other	Other Categories	1,0	0,2	*7,9*
	Total	9,2	3,1	*100,0*

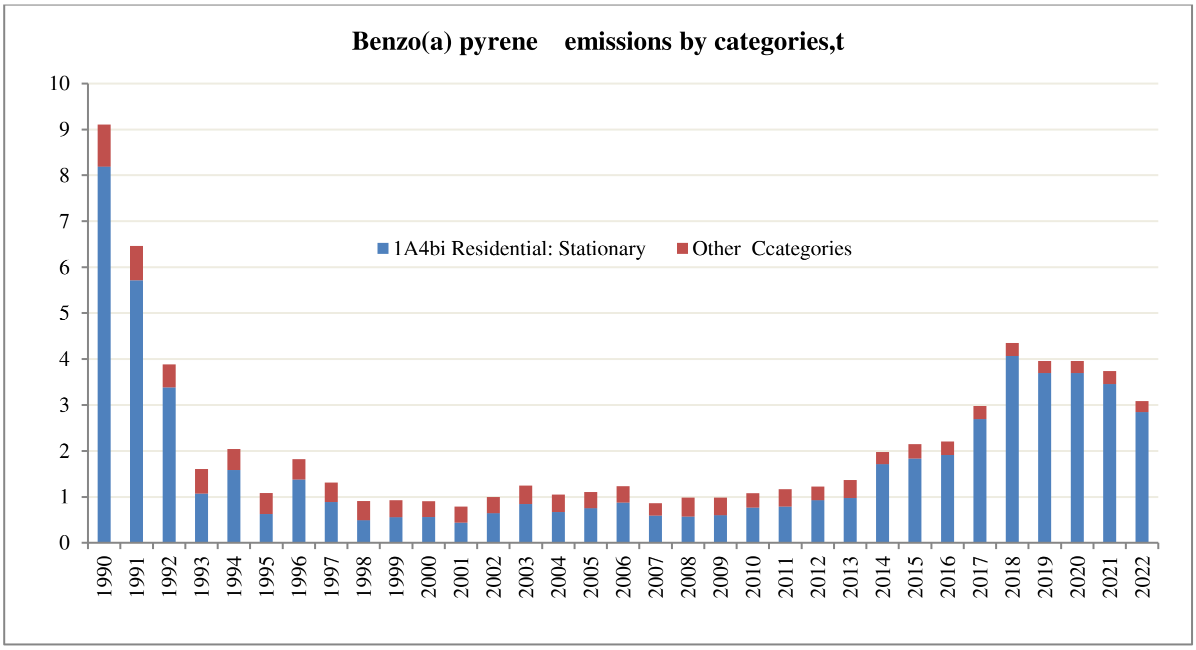


Figure 2.40. Trends in Benzo(a)pyrene emissions in the 1990-2022 period, by categories, tons

Large emission reductions occurred in category *1.A.4.b.i Residential: Stationary* from 89% to 92% (1990/2022). Emissions from the remaining categories in aggregate decreased from 11% to 8% (Figure 2.41).

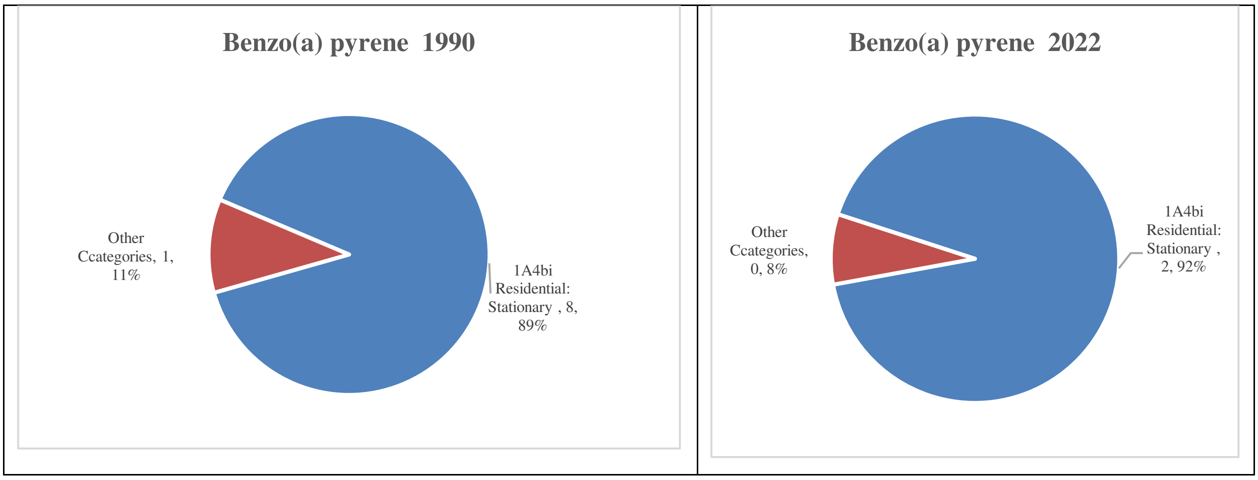


Figure 2.41. Benzo(a)pyrene emissions by sectors in 1990 and 2022, tons and %

Benzo(b)fluoranthene

The total reduction in Benzo(b)fluoranthene gross emissions was from 13,35 tons to 3,25 tons (1990/2022), Figure 2.42.

		Benzo(b) fluoranthene ,t	Benzo(b) fluoranthene ,t	2022
		1990	2022	%
1A2f	Manufacturing industry: mineral	0.25	0,04	*1,1*
1A4ai	Commercial/Institutional	0.70	0,04	*1,3*
1A4bi	Residential	11.67	2,80	*86,0*
1A5a	Other combustion	0.02	NO	*0*
5C2	Open burning of waste	0.48	0,34	*10,4*
Other	categories	0.21	0,04	*1,3*
	Total	13.35	3,25	*100,0*

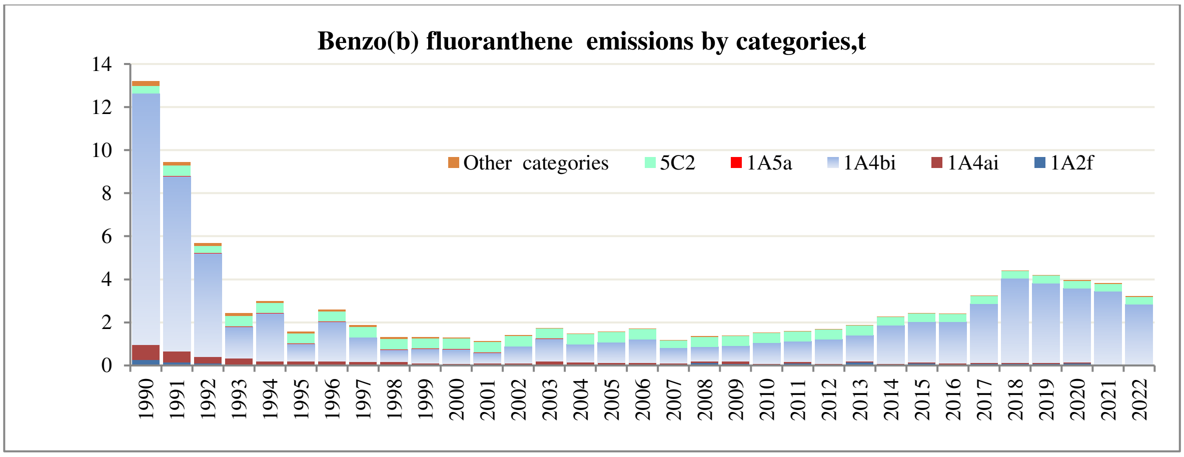


Figure 2.42. Trends in Benzo(b)fluoranthene emissions in the 1990-2022, by categories, t

The largest reduction in emissions took place in 3 categories (1990/2022):

- *1.A.4.a.ii Commercial/Institutional*- from 5% to 1%;
- *1.A.4.b.ii Residential*- from 87% and 86%;
- *5.C.2 Open burning of waste* from 4% to 11%;
- *Other* categories have small from 2% to 1% (Figure 2.43).

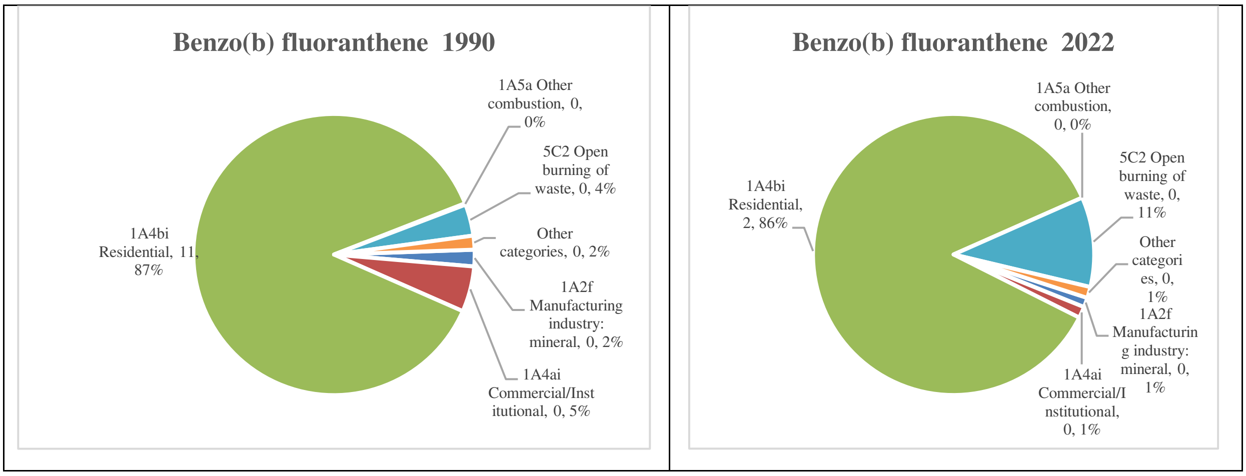


Figure 2.43. Benzo(b)fluoranthene emissions by sectors in 1990 and 2022, tons and %

Benzo(k)fluoranthene

Benzo(k)fluoranthene emissions decreased from 5,6 tons to 1,5 tons (1990/2022) (Figure 2.44).

		Benzo(k) fluoranthene, t	Benzo(k) fluoranthene, t	2022
		1990	2022	%
1A4ai	Commercial/institutional: Stationary	0.28	0,02	*1,1*
1A4bi	Residential: Stationary	4.60	1,1	*70,3*
5C2	Open burning of waste	0.59	0,4	*27,2*
Other	categories	0.13	0,02	*1,4*
		5.60	1,5	*100,0*

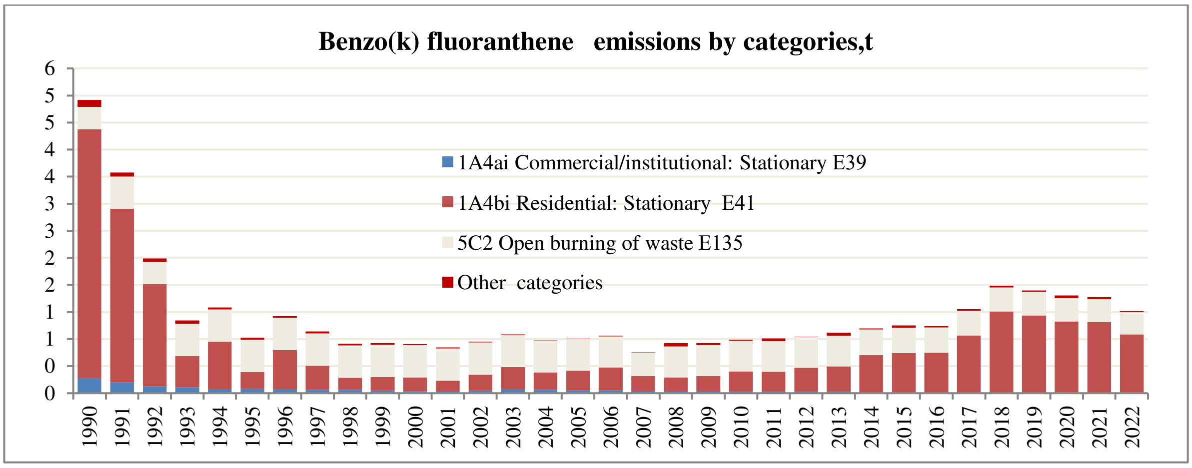


Figure 2.44. Trends in Benzo(k)fluoranthene emissions in the 1990-2022, by categories, t

The largest emission reductions took place in the following category:

- *1.A.4.b.i Residential: Stationary* - 82% in 1990 and 70% in 2022. Despite the total gross reduction in emissions in this category from 4,6 to 1,1 tons;
- The share of emissions in the *5.C.2 Open burning of waste* category increased from 11% in 1990 to 27% in 2022.
- *Other* categories in values -2% (1990, 2022) (Figure 2.45).

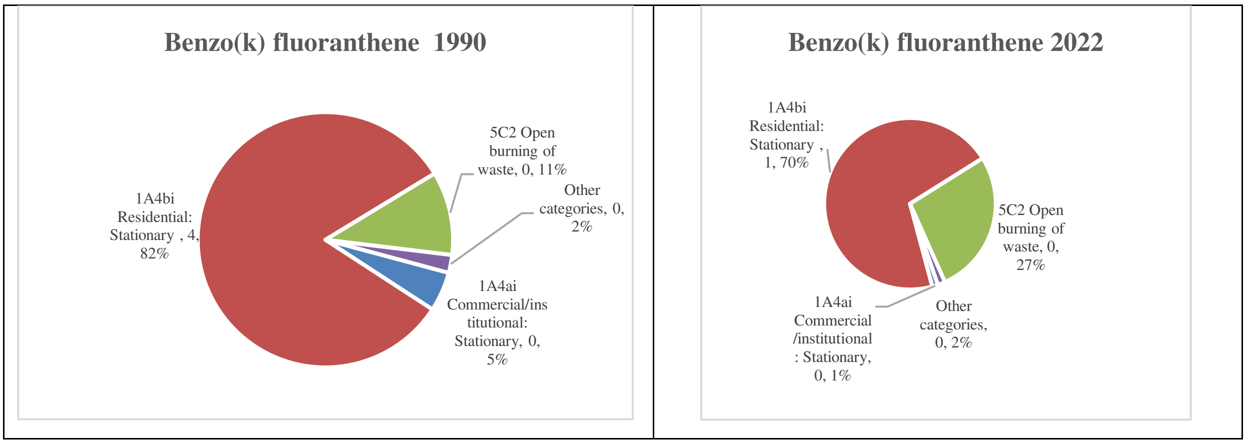


Figure 2.45. Benzo(k) fluoranthene emissions by sectors in 1990 and 2022

Indeno(1,2,3-cd)pyrene

The total reduction in gross emissions was from 4,3 tons (1990) to 1,7 tons (2022) (Figure 2.46).

		Indeno (1,2,3-cd) pyrene ,t	Indeno (1,2,3-cd) pyrene ,t	2022
		1990	2022	%
1A4ai	Commercial/institutional: Stationary	0,2	0,01	*0,8*
1A4bi	Residential: Stationary	3,9	1,6	*98,2*
Other	Other categories	0,1	0,02	*1,0*
	Total	4,3	1,7	*100,0*

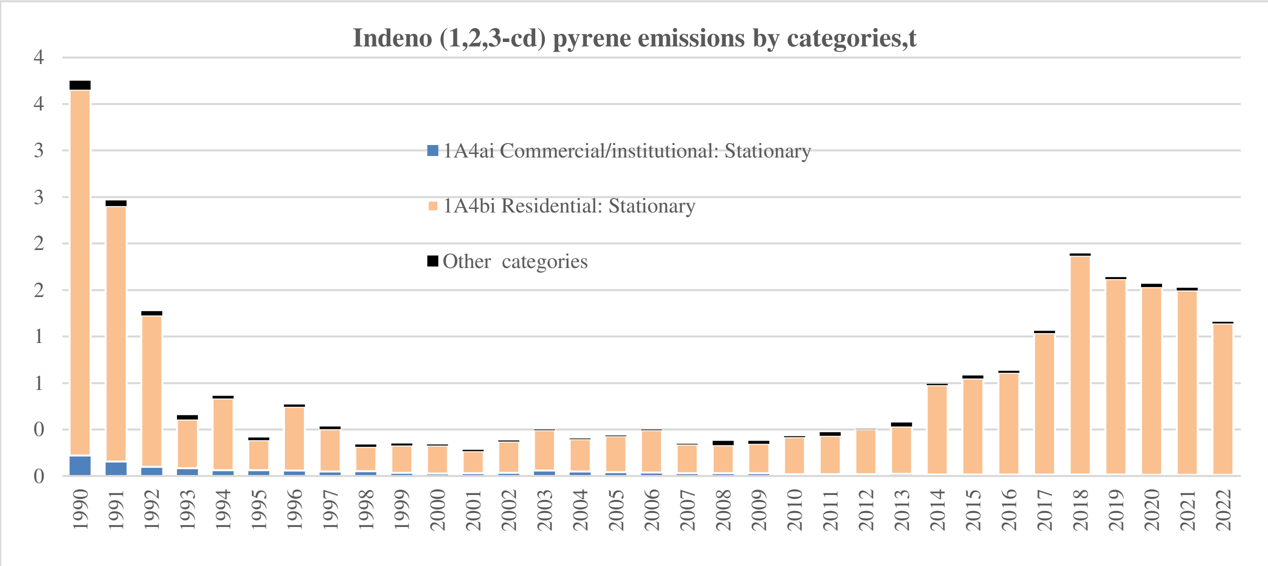


Figure 2.46. Indeno(1,2,3-cd) pyrene emissions in the 1990-2022 by categories, t

The largest contribution of emissions comes from the residential sector *1.A.4.b.i Residential: Stationary* - 93% in 1990 and 98% in 2022, shares of other categories are small (Figure 2.47).

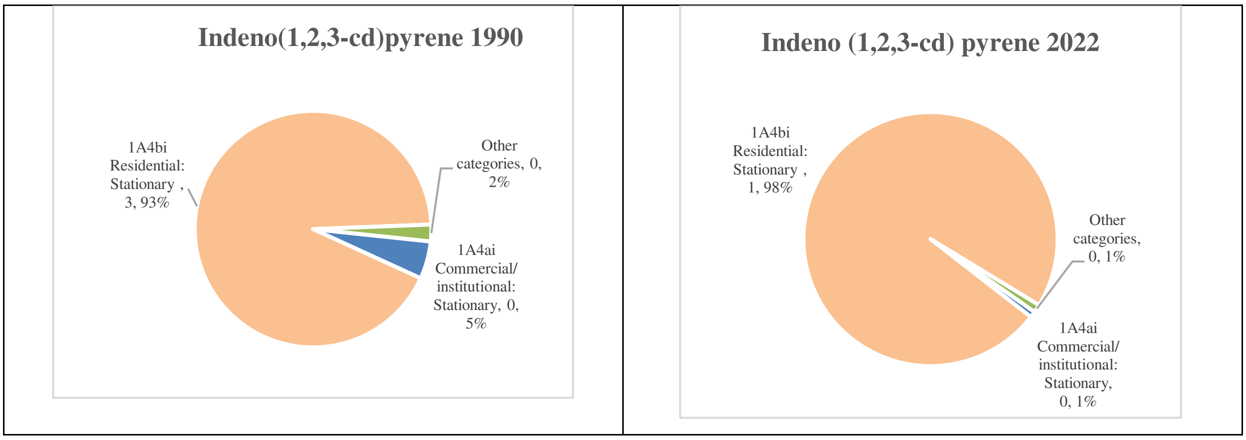


Figure 2.47. Indeno(1,2,3-cd) pyrene emissions by sectors in 1990 and 2022

Hexachlorobenzene (HCB)

The total decrease in gross HCB emissions (1990/2022) from 0,52 to 0,15 kg of HCB (Figure 2.48).

		HCB, kg	HCB, kg	2022
		1990	2022	%
1A1a	Public electricity and heat production	0.46	0,00	*0,1*
1A4ai	Commercial/institutional: Stationary	0.009	0,00	*1,7*
1A4bi	Residential: Stationary	0.03	0,10	*69,2*
5C1biii	Clinical waste incineration	0.02	0,04	*29,0*
Other	Other categories	0.005	0,00	*0,0*
	Total	0.52	0,15	*100*

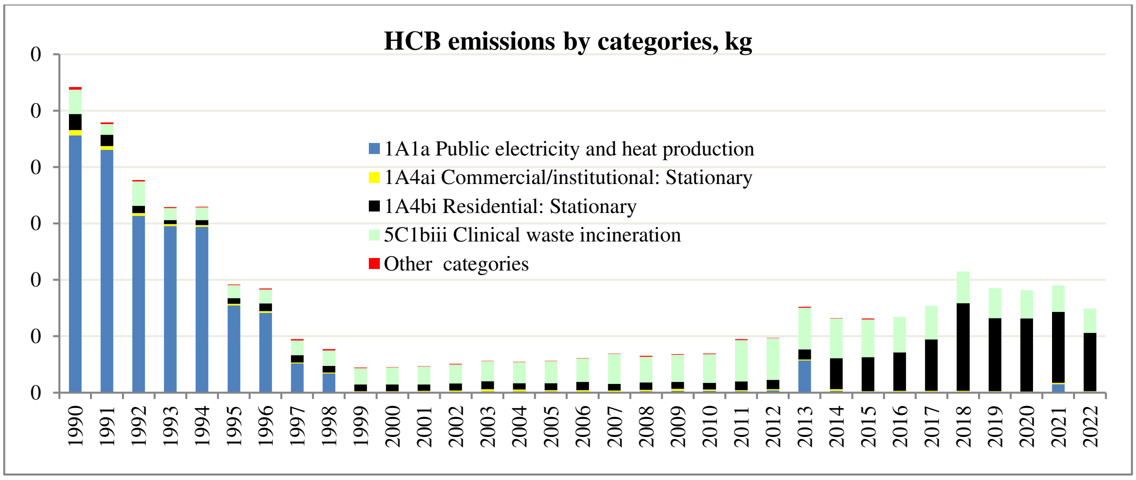


Figure 2.48. Trends in HCB emissions in the 1990-2022 period, by categories, kg

The structure of emission contributions by categories to total emissions has changed significantly (1990/2022):

- the values of emissions in category *1.A.1.a Public electricity and heat production* decreased from 0,46 kg to 0,001 kg or from 84% to 0%,
- the values of emissions in category *1.A.4.b.i Residential: Stationary* decreased from 0,03 kg to 0,1 kg, but the share in total structure increased from 5% to 69%,
- the share of *5.C.1.biii Clinical waste incineration* category increased from 4% to 29% (in values – the same 0,04 kg),
- the share of all *Other* categories remains from 1% to 0% (1990/2022) (Figure 2.49).

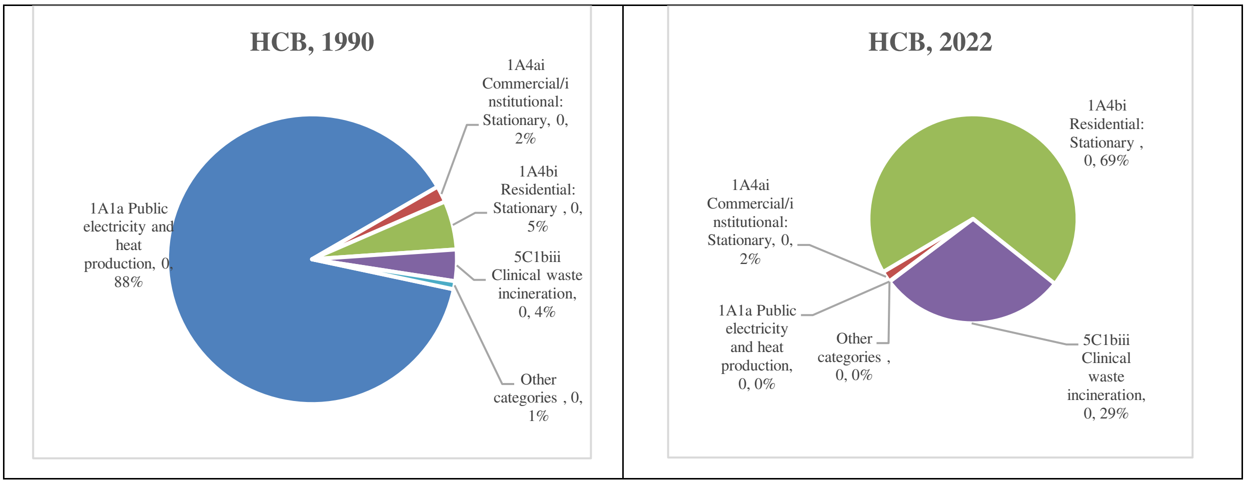


Figure 2.49. HCB emissions by sectors in 1990 and 2022, kg and %

Polychlorinated biphenyls (PCB)

PCB emissions tend to decrease gradually from 10,2 kg (1990) to 1,2 kg in (2022) (Figure 2.50).

		PCB, kg 1990	PCB, kg 2022	2022 %
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.2	0,1	*5,2*
1A4ai	Commercial/institutional: Stationary	2.0	0,1	*8,6*
1A4bi	Residential: Stationary	5.9	0,3	*22,7*
2C1	Iron and steel production	1.8	0,8	*63,5*
Other	Other categories	0.4	0,0	*0*
	Total	10.2	1,2	*100,0*

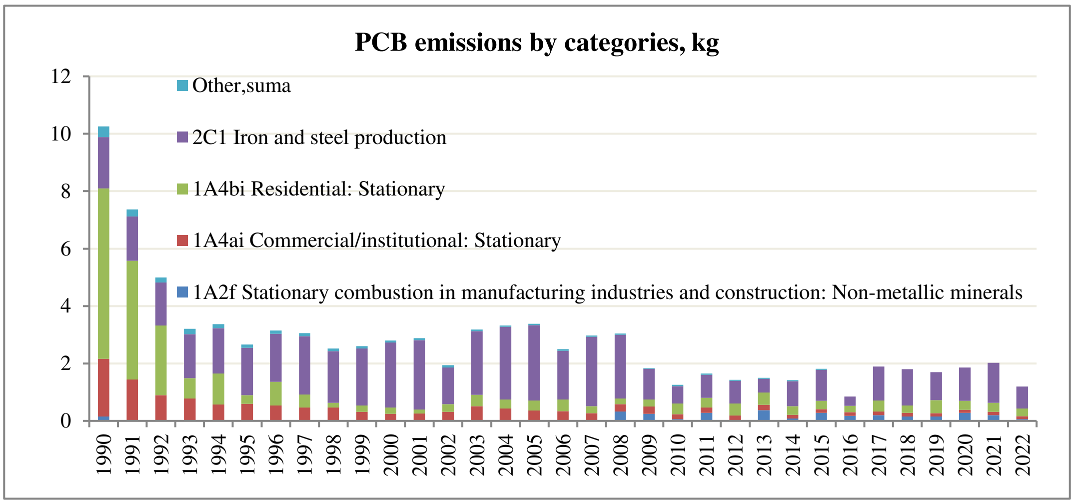


Figure 2.50. Trends in PCB emissions in 1990-2022, by categories, kg

The structure of category contributions to total emissions in 1990 and 2020 has changed significantly:

- *1.A.4.b.i Residential: Stationary* category decreased from 58% to 23%,
- *1.A.4.a.i Commercial/institutional: Stationary* decreased from 20% to 9%,
- *2.C.1 Iron and steel production* decreased from 1,8 to 0,8 kg, but the share in total sum increased from 17% to 63%,
- all *Other* categories remains from 4% to 0% (1990/2022), (Figure 2.51).

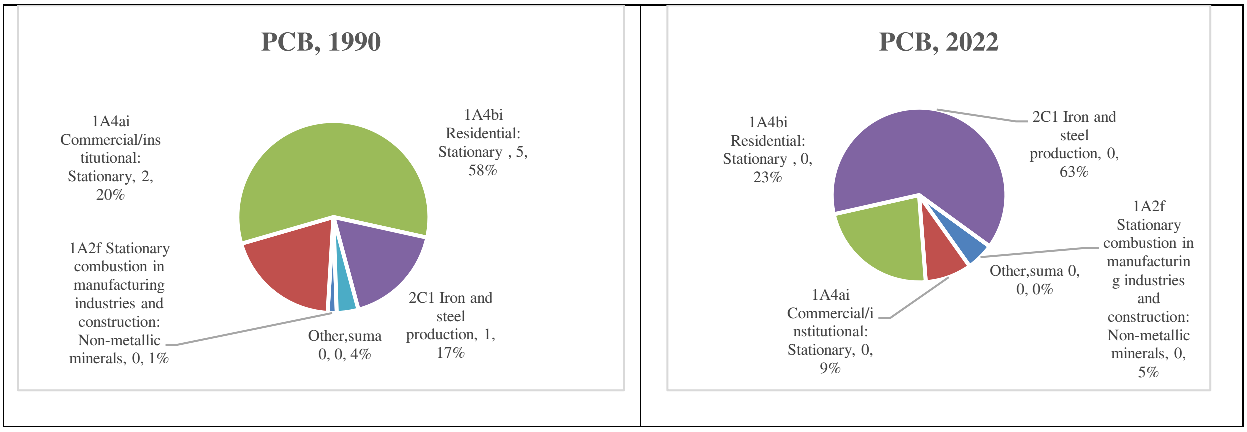


Figure 2.51. PCB emissions by sectors in 1990 and 2022, kg and %

Chapter 3: RECALCULATIONS AND IMPROVEMENTS

3.1. Recalculations

Energy Sector

The EMEP/EEA 2023 recommendations describe the following reasons for recalculations:

- Use of updated emission factors;
- Use of an updated version of the Guidebook (2024);
- Emergence of new data for 2021-2022;
- Transition of a category to a key status;
- Increased inventory potential (human, financial, training).

The reasons for recalculations in the current inventory cycle (2024) of pollutant emissions in the Republic of Moldova compared to the previous cycles (1990-2020) were:

- use of emission factors according to EMEP/EEA 2023 and its unit versions from 2024;
- development of the NFR settlement file system (type of software) for further permanent use;
- considering the recommendations of international experts expressed as part of the audit of IIR 2014 (Review in 2016 and Review in 2018).

Recommendations of international experts on the results of the IIR 2016 in the "Report for the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive, CEIP/S3.RR/2018/Moldova, 19/10/2018" were also implemented in the IIR 2019 (the actions performed are described in IIR-2019) and continued in current circle.

Industrial processes Sector

The emissions of CO, NH3, NMVOC, NOx, SOx (SO2); PM (4) = PM 2.5, PM10, TSP, BC; Heavy metals (9) = Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn; POPs (8) benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, PAH (HCB), PCBs from source categories in the sector "Industrial Processes and Product Use" for the years 2021 and 2022 have been estimated for the first time. Recalculations of emissions in the "Industrial Processes and Product Use" sector were carried out following the use of an updated set of activity data available in the statistical publications of the administrative-territorial units on the left bank of the Nistru River and those of the Republic of Moldova, as well as the Statistical Reports "PROMOLD-A" "Total production, as a natural expression, in the republic, by types of products in the years 2005-2022", respectively, as a result of updating the values of emission factors specific to the national level.

Agriculture sector

The emissions for the years 1990-2022 for sectors 3Da1 and 3Da4 were recalculated because of the EF for ammonia in the new version of the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2023 were changed.

Waste Sector

The emissions of pollutants from category 5 Waste were recalculated for the 1990 through 2022 time series, due to the use of an updated set of activity data or population for 2014-2022. The information for 2020 – 2022 was calculated for the Right Bank, and extrapolations were made for the Left Bank due to the unavailability of information for Transnistria.

3.2. Planned improvements

The following improvements are planned in the next inventory cycle.

Energy Sector

1. Use of emission factors according to the new update versions by categories for the energy sector EMEP/EEA Guidebook-2023;
2. Expanding the series of values of consumed fuels and adding data for new years;
3. Analyzing approaches and opportunities for the application of higher-level methods for key categories;
4. Update of the series of values in case of errors.

Industrial processes Sector

1. Possible improvements could include activities aimed at specifying the activity data used in the evaluation of emissions from the categories within the "Industry" sector for the reporting period from previous inventory cycles, except for category 2D "Non-energy products from fossil fuels and solvent use", for which no improvements are planned.
2. Additionally, activity data regarding the consumption of pyrotechnic articles within category 2G "Production and use of other products" will need to be collected.

Agriculture Sector

Improving the accuracy and completeness of calculations is planned. This will be possible when missing statistical data about the Left Bank for 2021-2023 will be received.

Waste sector

1. Use of emission factors from the 2023 EMEP/EEA Guidebook for the Waste sector;
2. Expanding the series of values of consumed fuels and adding data for new years;
3. Updating the series of values in case of errors;
4. Improving the quality of calculations.

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IIR Annexes

Table 1-1. Uncertainty estimation of NO_x emissions 1990 and 2022, Approach 1.

A	B	C	D	E	F	G	H	I	J	K	L	M
Sector NFR	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
						$\sqrt{E^2+F^2}$	$\frac{(G*D)^2}{(\sum D)^2}$		$\frac{D}{\sum C}$	$I*F$	$J*E*\sqrt{2}$	K^2+L^2
		Gg	Gg	%	%	%	%	%	%	%	%	%
1A1a	NO_x (as NO_2)	39,4697	5,3670	5	20	20,62	23,143	0,034	0,053	0,689	0,372	0,613
1A2a	NO_x (as NO_2)	0,1903	0,0992	5	20	20,62	0,008	0,001	0,001	0,011	0,007	0,000
1A2c	NO_x (as NO_2)	0,0588	0,0196	5	20	20,62	0,000	0,000	0,000	0,001	0,001	0,000
1A2d	NO_x (as NO_2)		0,0042	5	20	20,62	0,000	0,000	0,000	0,001	0,000	0,000
1A2e	NO_x (as NO_2)	1,0661	0,1057	5	20	20,62	0,009	0,001	0,001	0,026	0,007	0,001
1A2f	NO_x (as NO_2)	7,3950	0,6865	5	20	20,62	0,379	0,010	0,007	0,192	0,048	0,039
1A2gviii	NO_x (as NO_2)	0,2532	0,6621	5	20	20,62	0,352	0,006	0,006	0,119	0,046	0,016
1A3ai(i)	NO_x (as NO_2)	0,0235	0,1216	5	30	30,41	0,026	0,001	0,001	0,034	0,008	0,001
1A3aii(i)	NO_x (as NO_2)	0,0947	0,0001	5	30	30,41	0,000	0,000	0,000	0,006	0,000	0,000
1A3bi	NO_x (as NO_2)	2,5504	2,9239	5	50	50,25	40,808	0,023	0,029	1,151	0,203	1,365
1A3bii	NO_x (as NO_2)	3,2285	1,7757	5	50	50,25	15,052	0,010	0,017	0,513	0,123	0,279
1A3biii	NO_x (as NO_2)	9,6089	1,7757	5	50	50,25	15,052	0,004	0,017	0,191	0,123	0,052
1A3biv	NO_x (as NO_2)	0,1555	0,0725	5	50	50,25	0,025	0,000	0,001	0,018	0,005	0,000
1A3c	NO_x (as NO_2)	6,7071	0,3096	5	100	100,12	1,816	0,012	0,003	1,177	0,021	1,386
1A3dii	NO_x (as NO_2)	0,4331	0,0040	30	40	50,00	0,000	0,001	0,000	0,037	0,002	0,001
1A3ei	NO_x (as NO_2)	0,2844	0,0012	5	100	100,12	0,000	0,001	0,000	0,062	0,000	0,004
1A4ai	NO_x (as NO_2)	2,8346	0,4672	5	50	50,25	1,042	0,002	0,005	0,084	0,032	0,008
1A4bi	NO_x (as NO_2)	4,7280	2,2305	5	50	50,25	23,748	0,011	0,022	0,570	0,155	0,349
1A4ci	NO_x (as NO_2)	0,5222	0,0385	5	50	50,25	0,007	0,001	0,000	0,039	0,003	0,002
1A4cii	NO_x (as NO_2)	13,5132	3,6982	5	50	50,25	65,284	0,006	0,036	0,319	0,256	0,168
2C1	NO_x (as NO_2)	0,0926	0,0396	5	50	50,25	0,007	0,000	0,000	0,009	0,003	0,000
2G	NO_x (as NO_2)	0,0197	0,0054	5	50	50,25	0,000	0,000	0,000	0,000	0,000	0,000
3B1a	NO_x (as NO_2)	0,2128	0,0432	5	100	100,12	0,035	0,000	0,000	0,005	0,003	0,000
3B1b	NO_x (as NO_2)	0,0600	0,0024	5	100	100,12	0,000	0,000	0,000	0,011	0,000	0,000
3B2	NO_x (as NO_2)	0,0157	0,0053	7	100	100,24	0,001	0,000	0,000	0,002	0,001	0,000
3B3	NO_x (as NO_2)	0,0124	0,0048	20	100	101,98	0,000	0,000	0,000	0,002	0,001	0,000
3B4d	NOx (as NO2)	0,0004	0,0018	5	100	100,12	0,000	0,000	0,000	0,002	0,000	0,000
3B4e	NOx (as NO2)	0,0115	0,0049	5	100	100,12	0,000	0,000	0,000	0,002	0,000	0,000
3B4gi	NOx (as NO2)	0,0132	0,0031	10	100	100,50	0,000	0,000	0,000	0,000	0,000	0,000
3B4gii	NO_x (as NO_2)	0,0263	0,0579	10	100	100,50	0,029	0,000	0,001	0,044	0,007	0,002
3B4giii	NO_x (as NO_2)	0,0066	0,0067	10	100	100,50	0,000	0,000	0,000	0,004	0,001	0,000

3B4giv	NO_x (as NO_2)	0,0105	0,0140	10	100	100,50	0,002	0,000	0,000	0,009	0,002	0,000
3B4h	NO_x (as NO_2)	0,0002	0,0004	10	100	100,50	0,000	0,000	0,000	0,000	0,000	0,000
3Da1	NO_x (as NO_2)	3,6840	2,0808	5	100	100,12	82,060	0,012	0,020	1,225	0,144	1,521
3Da2b	NO_x (as NO_2)	0,0087	0,0060	5	100	100,12	0,001	0,000	0,000	0,004	0,000	0,000
3Da2c	NO_x (as NO_2)	2,2190	0,1114	5	100	100,12	0,235	0,004	0,001	0,381	0,008	0,145
3Da4	NO_x (as NO_2)	0,5469	0,0910	5	100	100,12	0,157	0,000	0,001	0,032	0,006	0,001
3F	NO_x (as NO_2)	0,0833	0,0034	5	100	100,12	0,000	0,000	0,000	0,015	0,000	0,000
5C1biii	NO_x (as NO_2)	0,0005	0,0011	5	50	50,25	0,000	0,000	0,000	0,000	0,000	0,000
5C2	NO_x (as NO_2)	0,3320	0,2314	5	50	50,25	0,256	0,002	0,002	0,077	0,016	0,006
Total		102,145	22,999				269,504					5,945
							16,417					2,438

Table 1-2. Uncertainty estimation of NMVOC emissions 1990 and 2022, Approach 1

A	B	C	D	E	F	G	H	I	J	K	L	M
Sector NFR	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
						$\sqrt{sE^2 + F^2}$	$\frac{(G * D)^2}{(\sum D)^2}$		$\frac{D}{\sum C}$	$I * F$	$J * E * \sqrt{2}$	$K^2 + L^2$
		Gg	Gg	%	%	%	%	%	%	%	%	%
1A1a	NMVOC	0,6298	0,1518	5	20	20,62	0,002	0,002	0,001	0,044	0,010	0,002
1A2a	NMVOC	0,0647	0,0308	5	20	20,62	0,000	0,000	0,000	0,002	0,002	0,000
1A2c	NMVOC	0,0075	0,0333	5	20	20,62	0,000	0,000	0,000	0,005	0,002	0,000
1A2d	NMVOC		0,0013	5	20	20,62	0,000	0,000	0,000	0,000	0,000	0,000
1A2e	NMVOC	0,1479	0,0356	5	20	20,62	0,000	0,001	0,000	0,010	0,002	0,000
1A2f	NMVOC	0,5436	0,0971	5	20	20,62	0,001	0,002	0,001	0,044	0,006	0,002
1A2gviii	NMVOC	0,1125	0,4062	5	20	20,62	0,014	0,003	0,004	0,060	0,026	0,004
1A3ai(i)	NMVOC	0,0014	0,0073	5	30	30,41	0,000	0,000	0,000	0,002	0,000	0,000
1A3aii(i)	NMVOC	0,4497	0,0004	5	30	30,41	0,000	0,003	0,000	0,076	0,000	0,006
1A3bi	NMVOC	3,8534	1,4969	5	50	50,25	1,151	0,008	0,013	0,412	0,095	0,178
1A3bii	NMVOC	2,1970	0,4340	5	50	50,25	0,097	0,008	0,004	0,422	0,027	0,179
1A3biii	NMVOC	0,3274	0,4340	5	50	50,25	0,097	0,002	0,004	0,102	0,027	0,011
1A3biv	NMVOC	1,9949	0,9297	5	50	50,25	0,444	0,003	0,008	0,144	0,059	0,024
1A3bv	NMVOC	0,6614	1,5415	5	50	50,25	1,221	0,010	0,014	0,504	0,098	0,264
1A3c	NMVOC	0,5952	0,0275	5	100	100,12	0,002	0,003	0,000	0,310	0,002	0,096
1A3dii	NMVOC	0,0105	0,0001	30	40	50,00	0,000	0,000	0,000	0,002	0,000	0,000
1A3ei	NMVOC	0,0026	0,0000	5	100	100,12	0,000	0,000	0,000	0,001	0,000	0,000
1A4ai	NMVOC	1,2276	0,2822	5	50	50,25	0,041	0,004	0,003	0,218	0,018	0,048
1A4bi	NMVOC	17,7118	13,0887	5	50	50,25	88,024	0,018	0,117	0,884	0,828	1,467
1A4ci	NMVOC	0,0894	0,0276	5	50	50,25	0,000	0,000	0,000	0,013	0,002	0,000
1A4cii	NMVOC	1,5200	0,3851	5	50	50,25	0,076	0,005	0,003	0,254	0,024	0,065
1A5a	NMVOC	0,0459	0,0210	5	50	50,25	0,000	0,000	0,000	0,004	0,001	0,000
1B2av	NMVOC	1,7270	0,4452	5	50	50,25	0,102	0,006	0,004	0,286	0,028	0,082
2B10a	NMVOC	0,0650	0,0190	5	50	50,25	0,000	0,000	0,000	0,010	0,001	0,000
2C1	NMVOC	0,0370	0,0161	5	50	50,25	0,000	0,000	0,000	0,003	0,001	0,000
2D3a	NMVOC	5,2339	3,6809	5	20	20,62	1,172	0,004	0,033	0,071	0,233	0,059
2D3b	NMVOC	0,0195	0,0111	5	20	20,62	0,000	0,000	0,000	0,000	0,001	0,000
2D3d	NMVOC	10,0303	7,1477	5	20	20,62	4,418	0,008	0,064	0,153	0,452	0,228
2D3e	NMVOC	0,5444	0,2660	5	20	20,62	0,006	0,001	0,002	0,014	0,017	0,000
2D3f	NMVOC	0,0255	0,0125	5	20	20,62	0,000	0,000	0,000	0,001	0,001	0,000
2D3g	NMVOC	4,6598	3,7664	5	20	20,62	1,227	0,008	0,034	0,151	0,238	0,080
2D3h	NMVOC	0,2457	0,2083	5	20	20,62	0,004	0,000	0,002	0,010	0,013	0,000
2D3i	NMVOC	3,0888	14,2762	5	20	20,62	17,626	0,110	0,128	2,208	0,903	5,690
2G	NMVOC	1,5459	0,3552	5	20	20,62	0,011	0,005	0,003	0,110	0,022	0,013
2H2	NMVOC	13,2825	5,2767	5	50	50,25	14,306	0,027	0,047	1,366	0,334	1,976
3B1a	NMVOC	5,2228	1,0058	5	100	100,12	2,064	0,020	0,009	2,031	0,064	4,129
3B1b	NMVOC	4,4389	0,2722	5	100	100,12	0,151	0,022	0,002	2,247	0,017	5,051
3B2	NMVOC	2,2254	0,7475	7	100	100,24	1,143	0,006	0,007	0,580	0,066	0,341

3B3	NMVOC	13,8038	2,5330	20	100	101,98	13,578	0,055	0,023	5,476	0,641	30,393
3B4d	NMVOC	0,0173	0,0800	5	100	100,12	0,013	0,001	0,001	0,062	0,005	0,004
3B4e	NMVOC	0,1967	0,0838	5	100	100,12	0,014	0,000	0,001	0,035	0,005	0,001
3B4gi	NMVOC	4,0631	0,6134	10	100	100,50	0,773	0,017	0,005	1,731	0,078	3,004
3B4h	NMVOC	0,0147	0,0227	10	100	100,50	0,001	0,000	0,000	0,012	0,003	0,000
3De	NMVOC	0,4536	0,3484	5	100	100,12	0,248	0,001	0,003	0,057	0,022	0,004
3F	NMVOC	0,0181	0,0007	5	100	100,12	0,000	0,000	0,000	0,009	0,000	0,000
5A	NMVOC	8,3215	9,1124	5	20	20,62	7,181	0,035	0,082	0,696	0,577	0,817
5C1biii	NMVOC	0,0001	0,0003	5	50	50,25	0,000	0,000	0,000	0,000	0,000	0,000
5C2	NMVOC	0,1284	0,0895	5	50	50,25	0,004	0,000	0,001	0,004	0,006	0,000
5D2	NMVOC	0,0039	0,0019	5	50	50,25	0,000	0,000	0,000	0,000	0,000	0,000
Total		111,748	70,102				155,257					54,220
							12,460					7,363
		$\sum C$	$\sum D$				$\sqrt{\sum H}$					$\sqrt{\sum M}$

Table 1-3. Uncertainty estimation of SO_x emissions 1990 and 2022, Approach 1

A	B	C	D	E	F	G	H	I	J	K	L	M
Sector NFR	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
						$\sqrt{E^2+F^2}$	$\frac{(G*D)^2}{(\sum D)^2}$		$\frac{D}{\sum C}$	$I*F$	$J*E*\sqrt{2}$	K^2+L^2
		Gg	**Gg**	%	%	%	%	%	%	%	%	%
1A1a	SO_x	102,3750	1,3745	5	20	20,62	45,834	0,010	0,009	0,199	0,065	0,044
1A2a	SO_x	0,1441	0,0009	5	20	20,62	0,000	0,000	0,000	0,000	0,000	0,000
1A2c	SO_x	0,0039	0,0012	5	20	20,62	0,000	0,000	0,000	0,000	0,000	0,000
1A2e	SO_x	0,7288	0,0371	5	20	20,62	0,033	0,000	0,000	0,002	0,002	0,000
1A2f	SO_x	1,4581	0,3740	5	20	20,62	3,394	0,002	0,003	0,045	0,018	0,002
1A2gviii	SO_x	0,3449	0,0443	5	20	20,62	0,048	0,000	0,000	0,005	0,002	0,000
1A3ai(i)	SO_x	0,0023	0,0117	5	50	50,25	0,020	0,000	0,000	0,004	0,001	0,000
1A3aii(i)	SO_x	0,0237	0,0000	5	50	50,25	0,000	0,000	0,000	0,000	0,000	0,000
1A3bi	SO_x	0,2002	0,0027	5	50	50,25	0,001	0,000	0,000	0,001	0,000	0,000
1A3bii	SO_x	0,1855	0,0011	5	50	50,25	0,000	0,000	0,000	0,001	0,000	0,000
1A3biii	SO_x	0,1194	0,0020	5	50	50,25	0,001	0,000	0,000	0,000	0,000	0,000
1A3biv	SO_x	0,0071	0,0001	5	50	50,25	0,000	0,000	0,000	0,000	0,000	0,000
1A3dii	SO_x	0,0109	0,0001	30	50	58,31	0,000	0,000	0,000	0,000	0,000	0,000
1A4ai	SO_x	10,8124	0,5562	5	20	20,62	7,506	0,002	0,004	0,034	0,026	0,002
1A4bi	SO_x	31,5785	1,6649	5	20	20,62	67,249	0,005	0,011	0,104	0,079	0,017
1A4ci	SO_x	0,6332	0,0856	5	20	20,62	0,178	0,000	0,001	0,009	0,004	0,000
1A4cii	SO_x	0,3142	0,0006	5	20	20,62	0,000	0,000	0,000	0,001	0,000	0,000
2C1	SO_x	0,0427	0,0183	5	20	20,62	0,008	0,000	0,000	0,002	0,001	0,000
3F	SO_x	0,0181	0,0007	5	100	100,12	0,000	0,000	0,000	0,000	0,000	0,000
5C1biii	SO_x	0,0001	0,0001	5	50	50,25	0,000	0,000	0,000	0,000	0,000	0,000
5C2	SO_x	0,0115	0,0080	5	50	50,25	0,009	0,000	0,000	0,003	0,000	0,000
Total		149,324	4,186				124,242					0,065
							11,146					0,255
		$\sum C$	$\sum D$				$\sqrt{\sum H}$					$\sqrt{\sum M}$

Table 1-4. Uncertainty estimation of NH_3 emissions 1990 and 2022, Approach 1

A	B	C	D	E	F	G	H	I	J	K	L	M
Sector NFR	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
						$\sqrt{E^2+F^2}$	$\frac{(G*D)^2}{(\sum D)^2}$		$\frac{D}{\sum C}$	$I*F$	$J*E*\sqrt{2}$	K^2+L^2
		Gg	**Gg**	%	%	%	%	%	%	%	%	%
1A2e	NH_3	0,0002	0,0000	5	300	300,04	0,000	0,000	0,000	0,000	0,000	0,000
1A2f	NH_3	0,0000	0,0000	5	300	300,04	0,000	0,000	0,000	0,000	0,000	0,000
1A2gviii	NH_3	0,0002	0,0012	5	300	300,04	0,000	0,000	0,000	0,006	0,000	0,000
1A3bi	NH_3	0,4159	0,1556	5	300	300,04	8,090	0,001	0,003	0,151	0,021	0,023
1A3bii	NH_3	0,2141	0,0316	5	300	300,04	0,333	0,001	0,001	0,198	0,004	0,039
1A3biii	NH_3	0,0072	0,0067	5	300	300,04	0,015	0,000	0,000	0,025	0,001	0,001
1A3biv	NH_3	0,0011	0,0005	5	300	300,04	0,000	0,000	0,000	0,001	0,000	0,000
1A3c	NH_3	0,0009	0,0000	5	300	300,04	0,000	0,000	0,000	0,001	0,000	0,000
1A4ai	NH_3	0,0003	0,0004	5	300	300,04	0,000	0,000	0,000	0,002	0,000	0,000
1A4bi	NH_3	0,0208	0,1642	5	300	300,04	9,006	0,003	0,003	0,894	0,022	0,800
1A4ci	NH_3	0,0000	0,0000	5	300	300,04	0,000	0,000	0,000	0,000	0,000	0,000
1A4cii	NH_3	0,0032	0,0009	5	300	300,04	0,000	0,000	0,000	0,001	0,000	0,000
2G	NH_3	0,0453	0,0123	5	300	300,04	0,050	0,000	0,000	0,010	0,002	0,000
3B1a	NH_3	7,1837	1,3661	5	100	100,12	69,421	0,016	0,026	1,628	0,183	2,684
3B1b	NH_3	5,4642	0,3136	5	100	100,12	3,658	0,026	0,006	2,608	0,042	6,805
3B2	NH_3	0,5224	0,1755	7	100	100,24	1,148	0,000	0,003	0,025	0,033	0,002
3B3	NH_3	7,8426	1,5235	20	100	101,98	89,568	0,017	0,029	1,716	0,814	3,609
3B4d	NH_3	0,0128	0,0591	5	100	100,12	0,130	0,001	0,001	0,104	0,008	0,011
3B4e	NH_3	0,3220	0,1372	5	100	100,12	0,700	0,001	0,003	0,070	0,018	0,005
3B4f	NH_3		0,0077	5	100	100,12	0,002	0,000	0,000	0,015	0,001	0,000
3B4gi	NH_3	3,8021	0,5809	10	100	100,50	12,644	0,011	0,011	1,131	0,155	1,303
3B4h	NH_3	0,0050	0,0077	10	100	100,50	0,002	0,000	0,000	0,012	0,002	0,000
3Da1	NH_3	7,8686	7,3623	5	100	100,12	2016,154	0,093	0,139	9,286	0,984	87,198
3Da2a	NH_3	11,8427	2,1866	5	100	100,12	177,850	0,028	0,041	2,805	0,292	7,953
3Da2b	NH_3	0,0297	0,0200	5	100	100,12	0,015	0,000	0,000	0,020	0,003	0,000
3Da2c	NH_3	4,4380	0,8912	5	100	100,12	29,543	0,009	0,017	0,917	0,119	0,855
3Da3	NH_3	0,5534	0,2603	5	100	100,12	2,520	0,002	0,005	0,167	0,035	0,029
3F	NH_3	0,0869	0,0036	5	100	100,12	0,000	0,000	0,000	0,044	0,000	0,002
5D1	NH_3	2,2320	1,1481	5	300	300,04	440,294	0,009	0,022	2,582	0,153	6,691
Total		52,915	16,417				2861,146					118,010
							53,490					10,863
		$\sum C$	$\sum D$				$\sqrt{\sum H}$					$\sqrt{\sum M}$

Table 1-5. Uncertainty estimation of $PM_{2.5}$ emissions 1990 and 2022, Approach 1.

A	B	C	D	E	F	G	H	I	J	K	L	M
Sector NFR	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
						$\sqrt{E^2+F^2}$	$\frac{(G*D)^2}{(\sum D)^2}$		$\frac{D}{\sum C}$	$I*F$	$J*E*\sqrt{2}$	K^2+L^2
		Gg	**Gg**	%	%	%	%	%	%	%	%	%
1A1a	PM2,5	2,0694	0,0634	5	50	50,25	0,030	0,065	0,003	3,233	0,019	10,451
1A2a	PM2,5	0,0188	0,0010	5	50	50,25	0,000	0,001	0,000	0,028	0,000	0,001
1A2c	PM2,5	0,0018	0,0141	5	50	50,25	0,001	0,001	0,001	0,027	0,004	0,001
1A2e	PM2,5	0,1309	0,0064	5	50	50,25	0,000	0,004	0,000	0,200	0,002	0,040
1A2f	PM2,5	0,3744	0,0601	5	50	50,25	0,027	0,010	0,003	0,483	0,018	0,234
1A2gviii	PM2,5	0,0662	0,1518	5	50	50,25	0,172	0,004	0,006	0,212	0,045	0,047
1A3ai(i)	PM2,5	0,0002	0,0010	5	100	100,12	0,000	0,000	0,000	0,004	0,000	0,000
1A3bi	PM2,5	0,0482	0,1483	5	50	50,25	0,164	0,005	0,006	0,234	0,044	0,057
1A3bii	PM2,5	0,1493	0,1403	5	50	50,25	0,147	0,001	0,006	0,052	0,042	0,004
1A3biii	PM2,5	0,2190	0,2050	5	50	50,25	0,314	0,001	0,009	0,075	0,061	0,009
1A3biv	PM2,5	0,0110	0,0051	5	50	50,25	0,000	0,000	0,000	0,007	0,002	0,000
1A3bvi	PM2,5	0,2057	0,1205	5	50	50,25	0,109	0,002	0,005	0,081	0,036	0,008
1A3bvii	PM2,5	0,1067	0,0624	5	50	50,25	0,029	0,001	0,003	0,042	0,019	0,002
1A3c	PM2,5	0,1754	0,0081	5	100	100,12	0,002	0,005	0,000	0,537	0,002	0,288
1A4ai	PM2,5	1,3655	0,1390	5	100	100,12	0,573	0,039	0,006	3,859	0,041	14,894
1A4bi	PM2,5	14,8789	15,8027	5	100	100,12	7415,788	0,180	0,665	17,965	4,704	344,880
1A4ci	PM2,5	0,0909	0,0177	5	100	100,12	0,009	0,002	0,001	0,221	0,005	0,049
1A4cii	PM2,5	0,7472	0,2050	5	100	100,12	1,248	0,016	0,009	1,570	0,061	2,467
2A1	PM2,5	0,2341	0,0990	5	50	50,25	0,073	0,003	0,004	0,173	0,029	0,031
2A2	PM2,5	0,2493	0,0264	5	50	50,25	0,005	0,007	0,001	0,350	0,008	0,123
2A3	PM2,5	0,0622	0,0577	5	50	50,25	0,025	0,000	0,002	0,020	0,017	0,001
2C1	PM2,5	0,0150	0,0064	5	50	50,25	0,000	0,000	0,000	0,011	0,002	0,000
2D3b	PM2,5	0,4881	0,2769	5	100	100,12	2,276	0,004	0,012	0,424	0,082	0,186
2D3i	PM2,5	0,0767	0,0605	5	100	100,12	0,109	0,000	0,003	0,005	0,018	0,000
2G	PM2,5	0,2334	0,0632	5	100	100,12	0,119	0,005	0,003	0,494	0,019	0,244
3B1a	PM2,5	0,1648	0,0317	5	300	300,04	0,269	0,004	0,001	1,209	0,009	1,462
3B1b	PM2,5	0,1491	0,0091	5	300	300,04	0,022	0,004	0,000	1,341	0,003	1,798
3B2	PM2,5	0,0261	0,0088	7	300	300,08	0,021	0,000	0,000	0,144	0,004	0,021
3B3	PM2,5	0,0164	0,0030	20	300	300,67	0,002	0,000	0,000	0,122	0,004	0,015
3B4d	PM2,5	0,0006	0,0030	5	300	300,04	0,002	0,000	0,000	0,031	0,001	0,001
3B4e	PM2,5	0,0064	0,0027	5	300	300,04	0,002	0,000	0,000	0,028	0,001	0,001
3B4gi	PM2,5	0,0739	0,0112	10	300	300,17	0,033	0,002	0,000	0,581	0,007	0,337
3B4h	PM2,5	0,0010	0,0015	10	300	300,17	0,001	0,000	0,000	0,010	0,001	0,000
3Dc	PM2,5	0,1101	0,0977	5	300	300,04	2,543	0,001	0,004	0,158	0,029	0,026
3F	PM2,5	0,1955	0,0080	5	300	300,04	0,017	0,006	0,000	1,808	0,002	3,267
5A	PM2,5	0,0001	0,0001	5	50	50,25	0,000	0,000	0,000	0,000	0,000	0,000
5C2	PM2,5	0,4375	0,3049	5	50	50,25	0,695	0,001	0,013	0,070	0,091	0,013
5E	PM2,5	0,4699	0,0890	5	50	50,25	0,059	0,012	0,004	0,578	0,026	0,334
Total		23,755	18,374				7424,903					381,292
							86,168					19,527

		$\sum C$	$\sum D$				$\sqrt{\sum H}$					$\sqrt{\sum M}$

Table 1-6. Uncertainty estimation of PM_{10} emissions 1990 and 2022, Approach 1.

A	B	C	D	E	F	G	H	I	J	K	L	M
Sector NFR	Pollutant	Base year emissions	Year t e missions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivit y	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
						$\sqrt{E^2+F^2}$	$\frac{(G*D)^2}{(\sum D)^2}$		$\frac{D}{\sum C}$	$I*F$	$J*E*\sqrt{2}$	K^2+L^2
		Gg	**Gg**	%	%	%	%	%	%	%	%	%
1A1a	PM_{10}	2,9227	0,0800	5	50	50,25	0,029	0,064	0,002	3,212	0,018	10,320
1A2a	PM_{10}	0,0203	0,0010	5	50	50,25	0,000	0,000	0,000	0,022	0,000	0,000
1A2c	PM_{10}	0,0018	0,0144	5	50	50,25	0,001	0,000	0,000	0,020	0,003	0,000
1A2e	PM_{10}	0,1377	0,0068	5	50	50,25	0,000	0,003	0,000	0,147	0,001	0,022
1A2f	PM_{10}	0,3827	0,0633	5	50	50,25	0,018	0,007	0,002	0,339	0,014	0,115
1A2gviii	PM_{10}	0,0700	0,1548	5	50	50,25	0,110	0,003	0,005	0,161	0,034	0,027
1A3ai(i)	PM_{10}	0,0002	0,0010	5	100	100,12	0,000	0,000	0,000	0,003	0,000	0,000
1A3bi	PM_{10}	0,0482	0,1483	5	50	50,25	0,101	0,004	0,005	0,176	0,033	0,032
1A3bii	PM_{10}	0,1493	0,1403	5	50	50,25	0,090	0,001	0,004	0,048	0,031	0,003
1A3biii	PM_{10}	0,2190	0,2050	5	50	50,25	0,192	0,001	0,006	0,069	0,045	0,007
1A3biv	PM_{10}	0,0110	0,0051	5	50	50,25	0,000	0,000	0,000	0,005	0,001	0,000
1A3bvi	PM_{10}	0,3967	0,2325	5	50	50,25	0,247	0,002	0,007	0,091	0,051	0,011
1A3bvii	PM_{10}	0,1966	0,1150	5	50	50,25	0,061	0,001	0,004	0,045	0,025	0,003
1A3c	PM_{10}	0,1843	0,0085	5	100	100,12	0,001	0,004	0,000	0,395	0,002	0,156
1A3dii	PM_{10}	0,0064	0,0001	30	100	104,40	0,000	0,000	0,000	0,014	0,000	0,000
1A4ai	PM_{10}	1,4789	0,1458	5	100	100,12	0,386	0,029	0,005	2,924	0,032	8,552
1A4bi	PM_{10}	15,1143	16,2216	5	100	100,12	4780,389	0,160	0,506	15,978	3,578	268,091
1A4ci	PM_{10}	0,1001	0,0187	5	100	100,12	0,006	0,002	0,001	0,170	0,004	0,029
1A4cii	PM_{10}	0,7472	0,2050	5	100	100,12	0,763	0,011	0,006	1,068	0,045	1,143
2A1	PM_{10}	0,4214	0,1783	5	50	50,25	0,145	0,004	0,006	0,204	0,039	0,043
2A2	PM_{10}	1,2464	0,1321	5	50	50,25	0,080	0,024	0,004	1,218	0,029	1,485
2A3	PM_{10}	0,0699	0,0649	5	50	50,25	0,019	0,000	0,002	0,021	0,014	0,001
2C1	PM_{10}	0,0171	0,0073	5	50	50,25	0,000	0,000	0,000	0,008	0,002	0,000
2D3b	PM_{10}	3,6609	2,0764	5	100	100,12	78,324	0,019	0,065	1,889	0,458	3,777
2D3i	PM_{10}	0,1150	0,0907	5	100	100,12	0,150	0,000	0,003	0,020	0,020	0,001
2G	PM_{10}	0,2457	0,0923	5	100	100,12	0,155	0,003	0,003	0,274	0,020	0,075
2H2	PM_{10}	0,0521	0,0174	5	50	50,25	0,001	0,001	0,001	0,032	0,004	0,001
3B1a	PM_{10}	0,2533	0,0488	5	300	300,04	0,388	0,004	0,002	1,280	0,011	1,639
3B1b	PM_{10}	0,1527	0,0094	5	300	300,04	0,014	0,003	0,000	0,959	0,002	0,920
3B2	PM_{10}	0,0784	0,0263	7	300	300,08	0,113	0,001	0,001	0,291	0,008	0,085
3B3	PM_{10}	0,3886	0,0713	20	300	300,67	0,833	0,007	0,002	1,997	0,063	3,992
3B4d	PM_{10}	0,0019	0,0089	5	300	300,04	0,013	0,000	0,000	0,070	0,002	0,005
3B4e	PM_{10}	0,0101	0,0043	5	300	300,04	0,003	0,000	0,000	0,029	0,001	0,001
3B4gi	PM_{10}	0,9850	0,1487	10	300	300,17	3,610	0,018	0,005	5,361	0,066	28,747
3B4h	PM_{10}	0,0020	0,0031	10	300	300,17	0,002	0,000	0,000	0,015	0,001	0,000
3Dc	PM_{10}	0,9337	1,7095	5	300	300,04	476,730	0,032	0,053	9,591	0,377	92,138
3F	PM_{10}	0,2063	0,0085	5	300	300,04	0,012	0,004	0,000	1,335	0,002	1,783
5A	PM_{10}	0,0005	0,0006	5	50	50,25	0,000	0,000	0,000	0,000	0,000	0,000
5C2	PM_{10}	0,4709	0,3282	5	50	50,25	0,493	0,001	0,010	0,026	0,072	0,006
5E	PM_{10}	0,4699	0,0890	5	50	50,25	0,036	0,008	0,003	0,398	0,020	0,159
Total		32,058	23,491				5344,305					423,377
							73,105					20,576

		$\sum C$	$\sum D$				$\sqrt{\sum H}$					$\sqrt{\sum M}$

Table 1-7. Uncertainty estimation of TSP emissions 1990 and 2022, Approach 1.

A	B	C	D	E	F	G	H	I	J	K	L	M
Sector NFR	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
						$\sqrt{E^2+F^2}$	$\frac{(G*D)^2}{(\sum D)^2}$		$\frac{D}{\sum C}$	$I*F$	$J*E*\sqrt{2}$	K^2+L^2
		Gg	Gg	%	%	%	%	%	%	%	%	%
1A1a	TSP	4,1400	0,1084	5	50	50,25	0,016	0,033	0,002	1,639	0,011	2,687
1A2a	TSP	0,0214	0,0010	5	50	50,25	0,000	0,000	0,000	0,008	0,000	0,000
1A2c	TSP	0,0018	0,0151	5	50	50,25	0,000	0,000	0,000	0,010	0,001	0,000
1A2e	TSP	0,1436	0,0071	5	50	50,25	0,000	0,001	0,000	0,055	0,001	0,003
1A2f	TSP	0,3894	0,0659	5	50	50,25	0,006	0,002	0,001	0,115	0,006	0,013
1A2gviii	TSP	0,0737	0,1617	5	50	50,25	0,036	0,002	0,002	0,082	0,016	0,007
1A3ai(i)	TSP	0,0002	0,0010	5	100	100,12	0,000	0,000	0,000	0,001	0,000	0,000
1A3bi	TSP	0,0482	0,1483	5	50	50,25	0,030	0,002	0,002	0,083	0,015	0,007
1A3bii	TSP	0,1493	0,1403	5	50	50,25	0,027	0,001	0,002	0,036	0,014	0,001
1A3biii	TSP	0,2190	0,2050	5	50	50,25	0,058	0,001	0,003	0,052	0,020	0,003
1A3biv	TSP	0,0110	0,0051	5	50	50,25	0,000	0,000	0,000	0,001	0,001	0,000
1A3bvi	TSP	0,5064	0,2966	5	50	50,25	0,122	0,000	0,004	0,003	0,029	0,001
1A3bvii	TSP	0,3933	0,2300	5	50	50,25	0,073	0,000	0,003	0,003	0,023	0,001
1A3c	TSP	0,1946	0,0090	5	100	100,12	0,000	0,001	0,000	0,149	0,001	0,022
1A4ai	TSP	1,5637	0,1531	5	100	100,12	0,129	0,011	0,002	1,083	0,015	1,172
1A4bi	TSP	16,5633	17,1039	5	100	100,12	1604,752	0,101	0,238	10,064	1,684	104,123
1A4ci	TSP	0,1043	0,0197	5	100	100,12	0,002	0,001	0,000	0,059	0,002	0,003
1A4cii	TSP	0,7472	0,2050	5	100	100,12	0,230	0,003	0,003	0,334	0,020	0,112
2A1	TSP	0,4683	0,1981	5	50	50,25	0,054	0,001	0,003	0,056	0,020	0,004
2A2	TSP	3,2050	0,3396	5	50	50,25	0,159	0,022	0,005	1,091	0,033	1,192
2A3	TSP	0,0777	0,0721	5	50	50,25	0,007	0,000	0,001	0,018	0,007	0,000
2C1	TSP	0,0266	0,0119	5	50	50,25	0,000	0,000	0,000	0,003	0,001	0,000
2D3b	TSP	17,0843	9,6898	5	100	100,12	515,050	0,007	0,135	0,666	0,954	1,354
2D3g	TSP	14,6437	8,3056	5	100	100,12	378,404	0,006	0,116	0,571	0,818	14,6437
2D3i	TSP	0,1406	0,1109	5	100	100,12	0,067	0,000	0,002	0,038	0,011	0,002
2G	TSP	0,2334	0,0632	5	100	100,12	0,022	0,001	0,001	0,105	0,006	0,011
3B1a	TSP	0,5548	0,1068	5	300	300,04	0,562	0,003	0,001	0,933	0,011	0,871
3B1b	TSP	0,3302	0,0202	5	300	300,04	0,020	0,002	0,000	0,736	0,002	0,542
3B2	TSP	0,1828	0,0614	7	300	300,08	0,186	0,001	0,001	0,198	0,008	0,039
3B3	TSP	2,6994	0,4953	20	300	300,67	12,137	0,015	0,007	4,641	0,195	21,579
3B4d	TSP	0,0045	0,0207	5	300	300,04	0,021	0,000	0,000	0,075	0,002	0,006
3B4e	TSP	0,0221	0,0094	5	300	300,04	0,004	0,000	0,000	0,016	0,001	0,000
3B4gi	TSP	4,6788	0,7063	10	300	300,17	24,597	0,029	0,010	8,678	0,139	75,320
3B4h	TSP	0,0045	0,0069	10	300	300,17	0,002	0,000	0,000	0,018	0,001	0,000
3Dc	TSP	0,9337	1,7095	5	300	300,04	143,950	0,016	0,024	4,818	0,168	23,245
3F	TSP	0,2099	0,0086	5	300	300,04	0,004	0,002	0,000	0,486	0,001	0,236
5C2	TSP	0,4845	0,3377	5	50	50,25	0,158	0,001	0,005	0,034	0,033	0,002
5E	TSP	0,4699	0,0890	5	50	50,25	0,011	0,003	0,001	0,133	0,009	0,018
Total		71,818	42,750				2682,308					233,584
							51,791					15,283

		$\sum C$	$\sum D$				$\sqrt{\sum H}$					$\sqrt{\sum M}$

Table 1-8. Uncertainty estimation of BC emissions 1990 and 2022, Approach 1.

	B	C	D	E	F	G	H	I	J	K	L	M
Sector NFR	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
						$\sqrt{E^2 + F^2}$	$\frac{(G * D)^2}{(\sum D)^2}$		$\frac{D}{\sum C}$	$I * F$	$J * E * \sqrt{2}$	$K^2 + L^2$
		Gg	**Gg**	%	%	%	%	%	%	%	%	%
1A1a	BC	0,1074	0,0031	5	50	50,25	0,005	0,013	0,001	0,665	0,005	0,443
1A2c	BC	0,0009	0,0039	5	50	50,25	0,009	0,001	0,001	0,043	0,007	0,002
1A2e	BC	0,0301	0,0006	5	50	50,25	0,000	0,004	0,000	0,189	0,001	0,036
1A2f	BC	0,1572	0,0134	5	50	50,25	0,104	0,017	0,003	0,862	0,024	0,744
1A2gviii	BC	0,0105	0,0443	5	50	50,25	1,139	0,010	0,011	0,486	0,079	0,243
1A3ai(i)	BC	0,0001	0,0005	5	100	100,12	0,001	0,000	0,000	0,011	0,001	0,000
1A3bi	BC	0,0231	0,0831	5	50	50,25	4,011	0,018	0,021	0,891	0,147	0,815
1A3bii	BC	0,0793	0,0768	5	50	50,25	3,421	0,009	0,019	0,442	0,136	0,214
1A3biii	BC	0,0100	0,0093	5	50	50,25	0,050	0,001	0,002	0,051	0,016	0,003
1A3biv	BC	0,0012	0,0006	5	50	50,25	0,000	0,000	0,000	0,001	0,001	0,000
1A3c	BC	0,0011	0,0001	5	100	100,12	0,000	0,000	0,000	0,014	0,000	0,000
1A4ai	BC	0,1175	0,0241	5	100	100,12	1,343	0,009	0,006	0,935	0,043	0,876
1A4bi	BC	0,9864	1,5563	5	100	100,12	5582,850	0,260	0,390	26,025	2,759	684,929
1A4ci	BC	0,0192	0,0027	5	100	100,12	0,017	0,002	0,001	0,183	0,005	0,034
1A4cii	BC	0,4332	0,1190	5	100	100,12	32,636	0,027	0,030	2,694	0,211	7,303
2A1	BC	0,0070	0,0030	5	50	50,25	0,005	0,000	0,001	0,009	0,005	0,000
2A2	BC	0,0011	0,0001	5	50	50,25	0,000	0,000	0,000	0,006	0,000	0,000
2D3b	BC	0,0278	0,0158	5	100	100,12	0,574	0,000	0,004	0,031	0,028	0,002
3F	BC	1,7596	0,0007	5	300	300,04	0,011	0,230	0,000	68,855	0,001	4740,957
5C2	BC	0,1837	0,1281	5	50	50,25	9,521	0,008	0,032	0,401	0,227	0,212
Total		3,988	2,086				5635,697					5436,812
							75,071					73,735
			$\sum D$				$\sqrt{\sum H}$					$\sqrt{\sum M}$

Table 1-9 Uncertainty estimation of CO emissions 1990 and 2022, Approach 1.

A	B	C	D	E	F	G	H	I	J	K	L	M
Sector NFR	Pollutant	Base year emissions	Year t emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions Sin year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
						$\sqrt{E^2+F^2}$	$\frac{(G*D)^2}{(\sum D)^2}$		$\frac{D}{\sum C}$	$I*F$	$J*E*\sqrt{2}$	K^2+L^2
		Gg	Gg	%	%	%	%	%	%	%	%	%
1A1a	CO	7,2099	2,2232	5	20	20,62	0,136	0,002	0,007	0,035	0,049	0,004
1A2a	CO	0,2114	0,0389	5	20	20,62	0,000	0,000	0,000	0,003	0,001	0,000
1A2c	CO	0,0122	0,0611	5	20	20,62	0,000	0,000	0,000	0,004	0,001	0,000
1A2d	CO		0,0016	5	20	20,62	0,000	0,000	0,000	0,000	0,000	0,000
1A2e	CO	0,8576	0,0792	5	20	20,62	0,000	0,001	0,000	0,016	0,002	0,000
1A2f	CO	1,9037	0,4539	5	20	20,62	0,006	0,001	0,001	0,018	0,010	0,000
1A2gviii	CO	0,4820	0,7244	5	20	20,62	0,014	0,002	0,002	0,033	0,016	0,001
1A3ai(i)	CO	0,0334	0,1729	5	100	100,12	0,019	0,000	0,001	0,050	0,004	0,002
1A3aii(i)	CO	28,4009	0,0276	5	100	100,12	0,000	0,034	0,000	3,398	0,001	11,546
1A3bi	CO	23,6666	7,9576	5	50	50,25	10,314	0,004	0,025	0,185	0,175	0,065
1A3bii	CO	33,6306	5,4710	5	50	50,25	4,876	0,023	0,017	1,168	0,120	1,379
1A3biii	CO	7,9071	7,7520	5	50	50,25	9,788	0,015	0,024	0,729	0,170	0,560
1A3biv	CO	5,2675	2,4547	5	50	50,25	0,982	0,001	0,008	0,065	0,054	0,007
1A3c	CO	1,3696	0,0632	5	100	100,12	0,003	0,001	0,000	0,145	0,001	0,021
1A3dii	CO	0,0230	0,0002	30	100	104,40	0,000	0,000	0,000	0,003	0,000	0,000
1A3ei	CO	0,0731	0,0002	5	100	100,12	0,000	0,000	0,000	0,009	0,000	0,000
1A4ai	CO	11,4100	0,9378	5	50	50,25	0,143	0,011	0,003	0,539	0,021	0,291
1A4bi	CO	166,3414	89,7155	5	50	50,25	1311,047	0,078	0,279	3,924	1,970	19,280
1A4ci	CO	0,6712	0,1209	5	50	50,25	0,002	0,000	0,000	0,022	0,003	0,000
1A4cii	CO	9,8692	1,4056	5	50	50,25	0,322	0,007	0,004	0,374	0,031	0,141
2C1	CO	1,2103	0,5175	5	50	50,25	0,044	0,000	0,002	0,008	0,011	0,000
2G	CO	0,6017	0,1644	5	50	50,25	0,004	0,000	0,001	0,011	0,004	0,000
3F	CO	11,4313	0,0993	5	100	100,12	0,006	0,013	0,000	1,341	0,002	1,798
5C1biii	CO	0,0000	0,0001	5	50	50,25	0,000	0,000	0,000	0,000	0,000	0,000
5C2	CO	5,8294	4,0628	5	50	50,25	2,689	0,006	0,013	0,281	0,089	0,087
Total		322,045	124,506				1340,395					35,184
							36,611					5,932
		$\sum C$	$\sum D$				$\sqrt{\sum H}$					$\sqrt{\sum M}$