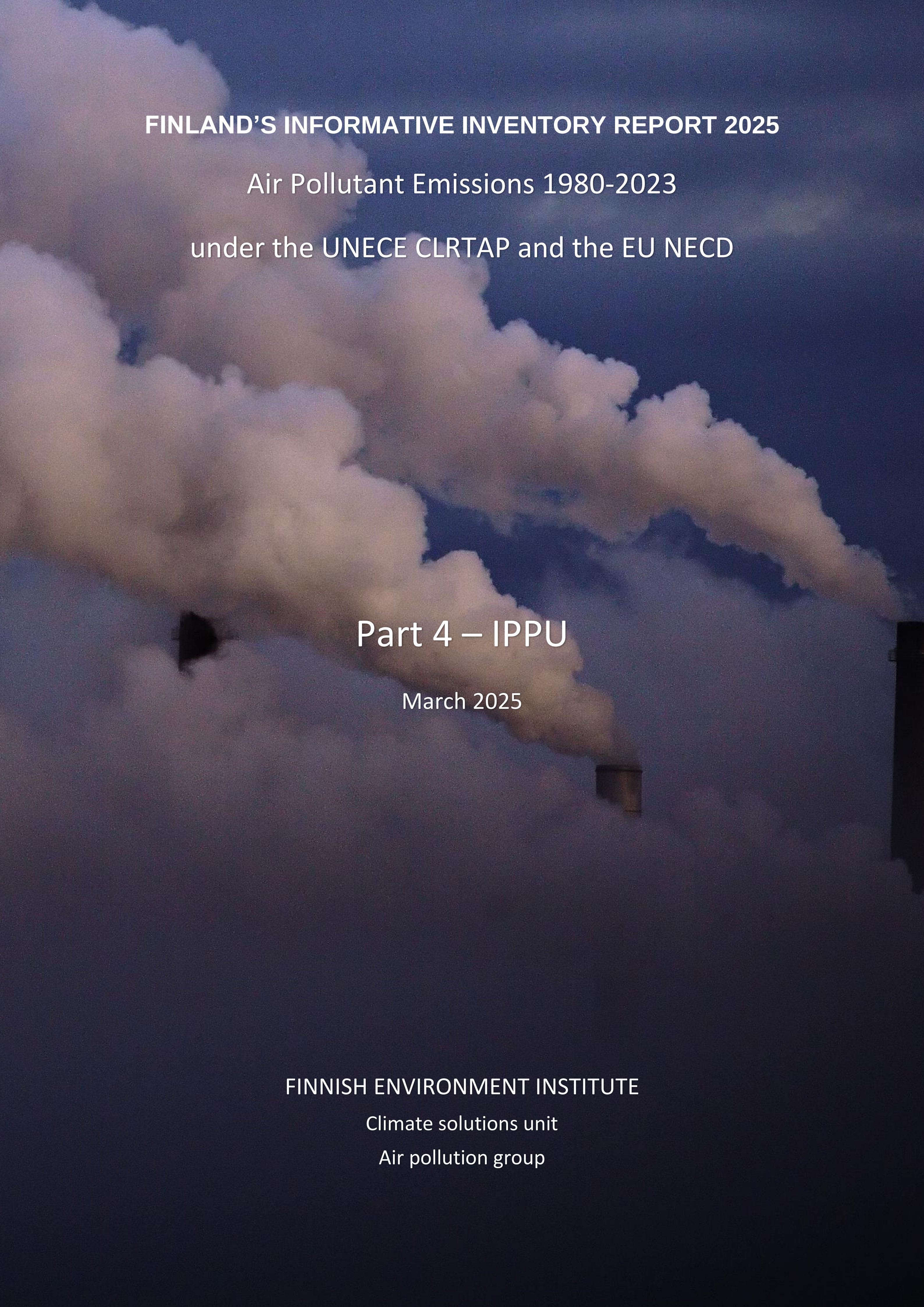

FINLAND'S INFORMATIVE INVENTORY REPORT 2025

Air Pollutant Emissions 1980-2023

under the UNECE CLRTAP and the EU NECD

Part 4 – IPPU

March 2025

FINNISH ENVIRONMENT INSTITUTE

Climate solutions unit

Air pollution group

Finland's IIR

Part 4

IPPU

Photo on the cover page: Ari Andersin (2008), Valkeakoski, ympäristöhallinnon kuvapankki

PART 4 IPPU

4 INDUSTRIAL PROCESSES and PRODUCT USE (NFR 2)

4 INDUSTRIAL PROCESSES AND PRODUCT USE (NFR2)

4.1 Overview of the sector

Changes in chapter	
January 2020	KS

The main activities in the Industrial processes and product use sector in respect to air pollutant emissions in Finland are mineral, chemical, metal and forest industries, as presented in Figure 4.1

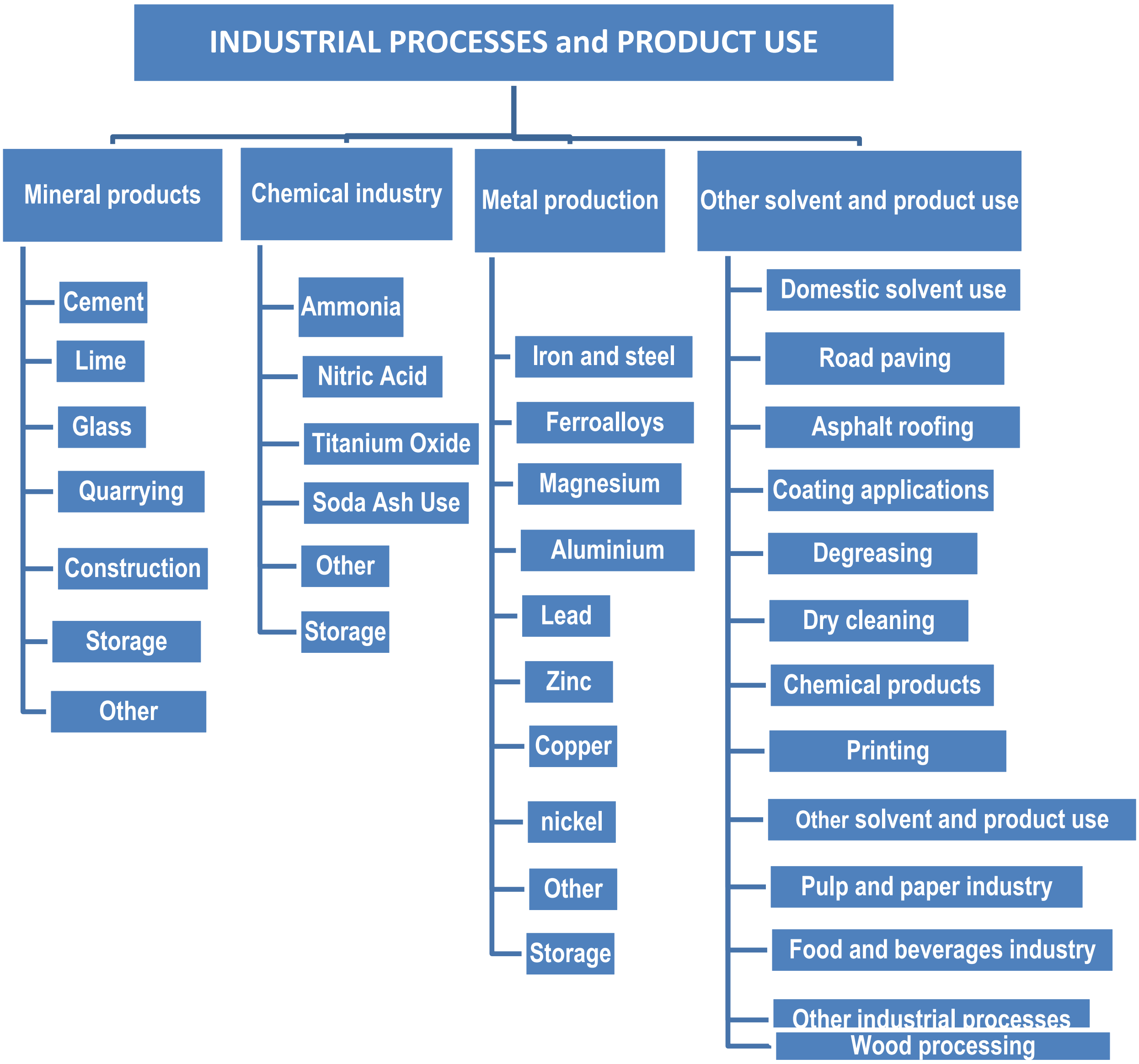

Figure 4.1 Industrial process included in the Finnish air pollutant inventory.

Allocation of emissions in the NFR Table

Emissions from industrial activities are allocated under the NFR categories as follows:

Energy	NFR 1	production of electricity consumed in the industry
		electricity and heat autoproducers in the industry
		use of off-road machinery and industrial transport
IPPU	NFR 2	production processes
Waste	NFR 5	industrial waste management

Data reported by the plants

Plant operators report their emissions to the supervising authorities[1] according to the monitoring requirements in their environmental permits. In some cases, the reporting obligations determined in the monitoring programmes are for the total emissions of the plants and not separately for fuel combustion or the individual process emissions. In the case of all the emissions reported in YLVA, the emissions have been classified either as combustion based or process related emissions in the calculation system of the air pollutant emission inventory. In cases where the emissions have been classified as energy related emissions (fuel based), all emissions are reported under the relevant NFR 1A2 or 1A1 subcategory.

In the cases where the reported emissions data in the YLVA system clearly are the total figure of energy and process related emission, the process related emissions are estimated as the difference between the total emissions reported by the plant and the default emissions calculated on basis of fuel consumption, the difference is reported under the industrial process categories. These cases relate mainly to paticulate matter (TSP) emissions reported by a relatively small number of plants.

Condensable part of particulate matter

TSP emission concentrations are measured in the stack according to the agreed the EN standards (EN 13284-1), which is a gravimetric particle measurement and thus does not cover condensable particles. Thus, TSP emissions reported by the operators and used in the preparation of the inventory, do not include the condensable part, neither PM_{10} or $PM_{2.5}$ fractions that are calculated from these TSP emissions.

When Guidebook 2023 EFs for particles are used, we refer to the Guidebook in the knowledge of inclusion or exclusion of condensables.

Activity data

The Finnish air pollutant emissions inventory is largely based on data reported by the plants, where this data is available. This data is considered more accurate than calculation with emission factors and statistical data. In cases where the emissions are based on data reported by the plants, it has in many cases not been possible to present the related activity data. Finland is a small country and for many industrial processes there only exist one or two plants, thus the units of activities fall under three, which is the internationally used threshold for statistical confidentiality and means that the data cannot be publicly presented. This is the case especially for the IPPU sector.

[1] The emission data is available from the YLVA (formely VAHTI) database after it has been checked and approved by the authorities.

Emission trends

Emissions from industrial processes are affected by changes in production volumes, changes in the processes or in the use of raw materials and auxiliary chemicals. In the trends it can be seen that the production volumes decreased in the early 1990s when a number of plants shut down their operations due to the recession and increased again since the mid-1990s until the late-2000s, when a decreasing trend returned with the economic turndown. The production volumes haven't yet returned to the pre late-2000s recession levels (Figure 4.2).

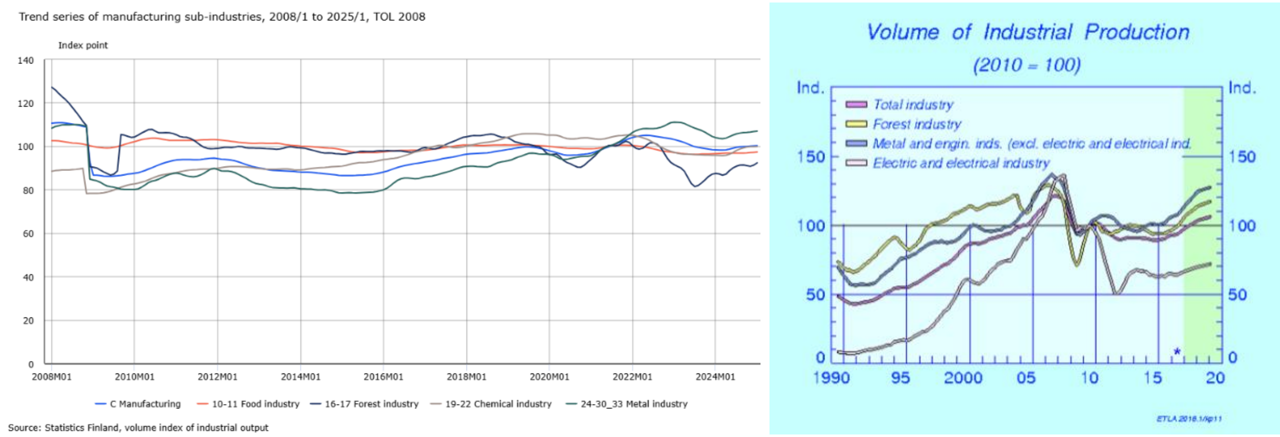

Figure 4.2. Industrial production volumes 1990-2023 (Sources: Statistics Finland, Volume index of industrial output https://stat.fi/en/statistics/ttvi, ETLA Economic Research, https://www.etla.fi/kultap/index.html 2021).

Key categories

Key categories in the Industrial processes and product use sector and the related Tier level of methods are presented in the Table 4.1.

Table 4.1. Key Categories in the IPPU sector.

NFR	Fuel	NO_x	Tier	NMVOC	Tier	SO_x	Tier	NH_3	Tier	CO	Tier
2B10a				L1	3	L1, T1	3				
2C1						L1, T1	3				
2D3a				L1, T1	2						
2D3c				T1	3						
2D3d				L1, T1	2/3						
2D3g				L1	2/3						
2D3h				T1	2/3						
2D3i				L1	2/3						
2H1						L1, T1	3				
2H2				L1	2/3						
NFR	**Fuel**	**$PM_{2.5}$**	**Tier**	**PM_{10}**	**Tier**	**TSP**	**Tier**	**BC**	**Tier**		
2A3								T1	1		
2B10a								T1	1		
2C1		T1	3	T1	3	T1	3				
2H1		T1	3	T1	3	T1	3				
2H2		L1, T1	2/3	L1	2/3						
NFR	**Fuel**	**Pb**	**Tier**	**Cd**	**Tier**	**Hg**	**Tier**	**As**	**Tier**	**Cr**	**Tier**
2B10a						L1, T1	3				
2C1		T1	3			L1, T1	3	L1	3	L1, T1	3
2C2										L1	3
2C7a								L1	3		
2C7c		T1	3	L1, T1	3			L1, T1	3		
2G		L1, T1	2								
NFR	**Fuel**	**Cu**	**Tier**	**Ni**	**Tier**	**Zn**	**Tier**				
2C1				L1, T1	3	T1	3				
2C6						L1	3				
2C7a											
2C7b				L1, T1	3						
2C7c		T1	3	L1, T1	3	T1	3				
NFR	**Fuel**	**PCDD/F**	**Tier**	**PAH-4**	**Tier**	**HCB**	**Tier**	**PCB**	**Tier**		
2A1								L1	2		
2B10a		T1	3			L1, T1	3				
2C1		L1, T1	3	T1	3			L1, T1	3		
2C7a		L1	3			L1, T1	2				

4.2 Mineral Products (NFR 2.A)

Changes in chapter	
February 2025	KS, JMP, TF

Source category description

Industrial activities falling under NFR 2A Mineral products are listed in Table 4.2.

Table 4.2. Industrial activities and air pollutant emissions under NFR 2A Mineral products.

NFR	Source	Emissions reported under NFR 2A
2A1	Cement production	NMVOC, PCDD/F, PCB, PAHs
2A2	Lime production	TSP, PM_{10}, $PM_{2.5}$, BC, PCDD/F, PCB
2A3	Glass production	$PM_{2.5}$, PM_{10}, TSP, BC, NMVOC, PCDD/F, Pb, Cd, Cu, Se, Zn
2A5a	Quarrying and mining of minerals other than coal	TSP, PM_{10}, $PM_{2.5}$,
2A5b	Construction and demolition	TSP, PM_{10}, $PM_{2.5}$
2A5c	Storage, handling and transport of mineral products	TSP, PM_{10}, $PM_{2.5}$
2A6	Other mineral products	Not Occuring

Cement production (NFR 2A1)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040612 Key category for PCB emissions (level, Approach 1)		Cement has been produced in Finland since 1914. There are currently two operating plants in Finland. At a third plant procution ceased in 1993. The current plants fall under the IED and report their emissions according to the monitoring requirements in their environmental permits. In addition to REF (recovered fuels prepared out of waste material) , rubber waste (since 1996) and other waste fuels, also fossil fuels (mainly coal and coke) are used as fuels in these plants. The plants also have permission to use bio-based fuels (plant or grain-based fuels) for experimental use. Fuel combustion emissions are reported under the energy sector.
Emissions	Tier	Source of emissions
NMVOC	T3/T2	Cement production prosess emissions (partly reported by the plants and partly calculated), allocated under 2A1, emissions reported 1990 onwards.
PCDD/F	T3/T2	Emissions from waste fuel combustion (rubber, REF, carcass) are allocated under 2A1. emissions reported by plants 2001 onwards. Emissions 1990-2000 calculated.
PCB	T2	waste fuel combustion (rubber, REF) allocated under 2A1, emissions calculated 1990-2020.
PAHs	T3	waste fuel combustion (rubber, REF) allocated under 2A1, emissions reported by plants 2007 onwards. Emissions prior 2007 calculated.

Emission trend

Cement industry is a minor source of air pollutant emissions in Finland. Cement production volumes affect emissions over the years. The NMVOC peak in 2016 and PAH peak in 2017 are reported by the plants and are due to malefunction situation at one plant

Part of emissions are reported by the plants. For those plants that do not report emissions, emissions are calculated. The shares of emissions reported by the plants out of total emissions for each air pollutant are presented in Table 4.3.

Table 4.3 Contribution of cement production to total emissions and the shares reported by plants in 2023.

Pollutant	Emissions from cement production in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.027	72.510	Gg	<0.1	50.5
PCDD/F	0.004	8.651	g I-Teq	<0.1	100
PAH-4	<0.001	19.315	Mg	<0.1	0
PCB	2.131	14.315	kg	14.9	0

Methodological issues

Activity data

Cement production volumes used as activity data presented in Table 4.4 are based on yearly statistics in the Kemia-Kemi Journal before the year 2000, and after the year 2000 on data reported by the plants (available from YLVA system) and thus confidential because there are less than 3 plants.

Table 4.4 Cement production volumes (t/a), Kemia-Kemi Journal.

Year	Production (t/a)
1990	1 649 220
1991	1 343 000
1992	1 133 000
1993	836 000
1994	864 000
1995	906 970
1996	975 425
1997	1 151 990
1998	1 232 235
1999	1 309 935
confidential from year 2000 onwards	

Estimation of emissions

Emissions are mainly calculated at T2/T3 level based and partly reported by the plants. For those plants that do not report emissions, or for years of missing data in the companies' reporting, the emissions are calculated.

NMVOC emissions are either reported by the plants or calculated:

- Emissions have reported by one of the plants in 1996 and since 2000.
- For the years 1990-1995 and 1997-1999 emissions are calculated using the IEF of 0.033 kg/t for that period, which is derived from emission data reported by the plants (SYKE, 2007).
- For the year 1996 and since 2000 the emissions include both data reported by the plants according to the monitoring requirements in the environmental permits and calculated emissions using IEF 0.033 kg/t (SYKE 2007).

PCDD/F emissions include both data reported by the plants and calculated data:

- Emissions have been reported by one of the plants since 2001.
- For the years prior to 2001 the emissions of all plants are calculated using the national IEF 25.8 ng I-Teq/t, which is derived from data reported by the plants (SYKE, 2007).
- Since 2001 the reported emission data contains both calculated emission data (using IEF 25.8 ng I-Teq/t) and emission data reported by the plants.
- Since 2018 emissions are reported by plants

PCB emissions are calculated using the EF of 2000 ug/t (BiPRO, 2006).

PAH emissions include both data reported by the plants and calculated data:

- Emissions have been reported by one plant between 2007-2017
- For the years 1990-2006 the same emission estimate based on plant reported data in 1995 has been used.
- Since 2018 the reported emission data contains both calculated emission data (using IEF $1.98*10^{-7}$ kg/t, (SYKE 2021) and emissions data reported by the plants
- PAH emissions have been divided to the PAH fractions based on information received from the plants in 2018. PAH fraction of 25% have been used for all PAH-4 components.
- In 2021, the renewal of an injector of a kiln caused minor emissions.

In EMEP/EEA Guidebook 2023, emission factors are presented for particle emissions. In the Finnish inventory, TSP emissions reported by the plants according to the monitoring and reporting requirements in the environmental permits are used. These emissions are fuel based and therefore the emissions are allocated under NFR 1A2f.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to assessment of magnitude and trends have been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2018

- Recalculation of the energy sector time series enabled harmonization of the reporting under the 2019 NFR codes.
- The whole time series was calculated using same methods.

2020

- Activity data for years 2013-2018 were updated.

Source-specific planned improvements

There are no methods in the Guidebook for quantification of PCDD/F and PCB emissions, therefore we consider that there is need to remove these emissions in the future submissions and/or check if the allocation should be under the IPPU or of the Energy sector.

Lime production (NFR 2A2)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040614 Not a key category for any pollutants		LIME DECARBONIZING Production volumes of lime were constant over the period 1990-2002. A new plant was started in 2003. There are currently four lime-producing plants in Finland, one plant was closed down at the end of 2014, and another one was closed down in 2019. All plants fall under the IED and report their emissions according to monitoring requirements in their environmental permits. The category also includes lime stone mines (quarrying of lime).
Emissions	Tier	Source of emissions
TSP	T3	Particle emissions are reported by plants since 1990. PM_{10} and $PM_{2.5}$ fractions have been calculated from the TSP emissions using fraction factors of 39% and 8% from TSP (GB23). Black carbon emissions are calcuted from $PM_{2.5}$ emissions.
PM_{10}, $PM_{2.5}$, BC	T3	
PCDD/F, PCB	T1	Emissions originate from lime kilns, emissions reported since 1990.

Emission trend

The emission trends are impacted by annual production volumes. The peak in particle emissions in 2007 is due to malfunction of abatement at one plan and the declining emissions are due to new abetement technologies. The strong decrease in particle emissions since 2013 is due to optimization of abatment technologies at one plant.

The shares of emissions reported under the NFR category are presented in Table 4.5.

Table 4.5 Contribution of lime production to total emissions and shares reported by plants in 2023.

Pollutant	Emissions from lime in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	<0.001	13.108	Gg	<0.1	0
PM_{10}	0.001	25.728	Gg	<0.1	0
TSP	0.003	39.531	Gg	<0.1	92.6
BC	<0.001	3.063	Gg	<0.1	0
PCDD/F	0.025	8.651	g I-Teq	0.3	0
PCB	<0.001	14.315	kg	<0.1	0

Methodological issues

Only total particle emissions are reported by the plants (Table 4.5) according to the monitoring requirements in the environmental permits. When no plant specific data is available, the emissions have been calculated from lime production (Table 4.6).

Particles
PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions reported by the plants using fraction factors of 38.8% and 7.8%, respectively (EMEP/EEA Guidebook 2023).

Black carbon emissions have been calculated using the factor presented in the EMEP/EEA Guidebook 2023 (table 3-3).

POPs
Emissions were previously calculated using lime production annual statistics available in the Kemia-Kemi Journal, but since 2012 this activity data has not been available. Since 2022 the data source was changed to data reported by the plants on the production of lime (Table 4.6), which is the same that is used in the calculation of ghg emissions. Activity data for the different plants for years 1990 to 1997 have been estimated by using the proportion of the production data of these. From 1998 to 2004, production data are partly received from the industry and partly available from industrial statistics and environmental permits or the YLVA system. From 2005 onwards production data reported to the EU ETS data has been used.

The following emission factors has been used: for PCDD/F 78 ng I-TEQ/t (UNEP, 1999) and for PCB 0.15 mg/t (BiPRO, 2006) as there are no methods in EMEP/EEA Guidebook 2023. The relevance of the methods will be studied for future submissions.

Table 4.6. Activity data for lime production (Finland's NID 2025).

Year	Lime production (t)
1990	488 177
1995	478 877
2000	540 272
2005	631 709
2010	513 878
2015	445 001
2016	479 606
2017	495 274
2018	384 000
2019	327 000
2020	327 000
2021	393 000
2022	327 500
2023	315 140

Uncertainty analysis and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2019

- PM_{10} and $PM_{2.5}$ fractions have been recalculated from the TSP emissions using the fraction from Guidebook 2019.

2022

- Activity data has been replaced with AD reported under the GHG inventory.

Source-specific planned improvements

There are no methods in the Guidebook for estimating PCDD/F and PCB, therefore we consider that there may be need to remove these emissions in the future submissions or to allocate these rather under the Energy than the IPPU sector.

Glass production (NFR 2A3)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040613		GLASS MANUFACTURING
Key category for BC emissions (level, Approach 1)		Activities under this sector include manufacturing of glass, glass fibre, glass wool and glass felt . The history of the industry is presented below: 1923-2012 Flat glass production 1987-2008 Flat glass production with float technique Until 2008 Container glass production Until 2009 Glass fibre at 2 plants 1996-2006 Glass wool Since 2010 Glass felt at one of the former glass fibre plants Until 2010 Dinnerware; Since 2010 Only certain parts of the dinnerware were manufactured in Finland. Since 2015 Only one glass felt manufacturer and some minor glass ovens are left.
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$, BC	T3	Reported since 1990.
Pb, Cd, Cu, Se, Zn	T3	Reported 1990-2014. Heavy metal emissions from dinnerware production reported by plants.
SOx		Included to the Energy sector (IE). Emissions due to fuel combustion are reported under the Energy sector.
NH_3	T3	Reported 1988-2010. NH_3 emissions from manufacture of glassfibre are reported by the plants.
NMVOC	T3/T2	Reported since 1990. NMVOC emissions from glass wool are reported by plants. NMVOC emissions from glass manufacturing for those plants not reporting their emissions are calculated on basis of production volumes.
PCDD/F	T1/T2	PCDD/F emissions from glass manufacturing calculated on basis of production volumes. Reported since 1990.

The share of glass manufacture emissions to national total emissions and the share of emissions reported by the operators are presented in Table 4.7.

Table 4.7. Contribution of emissions from Glass products to total emissions in 2023.

Pollutant	Emissions from glass production in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.008	72.510	Gg	<0.1	99.9
$PM_{2.5}$	0.002	13.108	Gg	<0.1	0
PM_{10}	0.002	25.728	Gg	<0.1	0
TSP	0.003	39.531	Gg	<0.1	100
BC	<0.001	3.063	Gg	<0.1	0
PCDD/F	<0.001	8.651	g I-Teq	<0.1	0

Emission trend

Glass production volumes have decreased to only some percentages from their levels in the 1990s and from the high production volume period in 2005-2008. In 2009 a large flat glass plant was closed. The large variations in the reported emissions are due to the fluctuating production levels (Table 4.8).

Cd emissions originated from raw material processing in dinnerware production. In 2014 this raw material processing was relocated abroad and the activity causing Cd emissions was closed down. Note, while the share of air pollutant emissions in national total emissions are generally low, cadmium emissions contributed to 10% of the national total of Cd emissions during 2008-2013.

Table 4.8. Glass production volumes (tonnes/year) from YLVA database.

Year	Plants that do not report emissions to supervising authorities, used in calculation of NMVOC emissions	All glass production plants, used in calculation of POP and NH_3 emissions
1990	137 600	169 153
1995	137 600	168 530
2000	119 034	171 134
2005	257 764	301 203
2010	6 072	41 359
2015	1 535	8 717
2016	1 562	9 094
2017	1 819	9 286
2018	1 788	9 928
2019	1 573	10 661
2020	1 307	9 560
2021	1 815	11 200
2022	1 579	12 340
2023	859	10 890

Methodological issues

Heavy metals
The emissions originate in energy production and are mainly reported by the plants according to the monitoring requirements in the environmental permits. Heavy metal emissions (lead, copper, selenium, zinc and cadmium), cadmium as most significant, origante from raw material processing in dinnerware production in melting of glass and in mixing colours in glass melting. The process of mixing colours was relocated abroad in 2014 and therefore heavy metal emissions ceased from this category and therefore heavy metal emission occurred only in 1990-2004. No fuel based heavy metal emissions occur from these plants due to use of natural gas for the heating of their process ovens.

Particles
TSP emissions are generated in the glass smelting process. TSP emissions are reported by the plants according to their emissions monitoring requirements.

PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions using fraction factors of 90% and 80% from TSP (EMEP/EEA Guidebook 2023).

Black carbon emissions have been calcuted using the emission factor presented in EMEP/EEA Guidebook 2023 (table 3-1).

NMVOC

Glass production
For glass manufacture plants that do not report their emissions, the emissions are calculated using the emission factor of 0.01 kg/t of glass produced (BREF Manufacture of Glass, Table 4.40, 2013), together with the production rates of the companies.

Dinnerware production
There is no method presented in the Guidebook for dinnerware production. Due to the varying quality of data reported by the plants it has not been possible to develop a national emission factor.

Glass wool
NMVOC emissions from glass wool are reported by the plants according to the monitoring requirements in the environmental permits.

Glass fibre
There are no emission factors for glass fibre production in the Guidebook.

NH_3

Glass fibre and glass felt (i.e. glass fibre)
Ammonia emissions are related to the glass fibre production. There has been one glassfibre producer operating under the period of 1988-2010. In 2011, the production process of glass fibre was converted to a production process of glass felt. Glass felt production does not generate ammonia emissions, therefore no ammonia emissions occur after the year 2010.

For the period of 1988-2010 data reported by the plants have been available only for 2007-2010 and therefore the emission value of 2007 has been used over the whole period of 1988-2006. No production data is available after 2007.

PCDD/F

Glass fibre, glas wool and dinner ware
The emissions have been calculated using the emission factor of 32 ng I-TEQ/t from UNEP (UNEP, 1999), because no method is presented in the EMEP/EEA Guidebook 2023. The relevance of emissions will be studied for future submissions.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to assessment of magnitude and trends have been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2013
- NMVOC: Change of method to the EF from BREF for Manufacture of Glass (previously,1990-2011, calculated with the EF of 0.005 kg/t from USEPA AP-42 (USEPA, 1990) and AD based on information collected in the Finnish national BAT Group for glass industry (Conclusions of Finnish BAT group for Glass Industry, 2001). The same value was used for all the years.

2014
- The emission factor for NMVOC emissions and activity data were revised for the whole time series. Previosly, the same activity data was used for whole time series, since 2014 submission production rates of the companies are used.

2015
- NH_3 emissions from glass wool production were included.

2018
- Notation key corrections 2010-2016 for CO (IE to NA)
- Allocation correction for Pb and Zn (1990 to 1A2fI)
- Se 1990-2007 and 2012-2014 completion of the time series for the missing emissions
- Se 2015-2016 notation key IE to NA

2019
- All heavy metal (Cd, Pb, Cu, Se, Zn) emissions reported in 1990-2014 under NFR 2A3 are based on plant reported data and according to information in the plant's environmental permit, also lead, copper, selenium and zinc emissions originate from smelting of glass, not only cadmium. The process of mixing colours was relocated abroad in 2014 and therefore heavy metal emissions ceased from this category. No fuel based heavy metal emissions occur from these plants due to use of natural gas for the heating of their process ovens. The description provided in the IIR submitted in 2020 has already been updated to the draft of the 2021 IIR to reflect this response to the TERT.

Source-specific planned improvements

None.

Quarrying and mining of minerals other than coal (NFR 2A5a)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040616 and 040623 Not a key category for any pollutants		EXTRACTION OF MINERAL ORES and QUARRYING includes copper and zinc, talc manufacturing, limestone and quartzite quarrying
Emissions	Tier	Source of emissions
NOx, SOx, CO and heavy metals (Pb, Cd, As, Cr, Cu, Ni, Zn)		These emissions are related to combustion and reported under the Energy sector.
Particles (TSP, PM_{10}, $PM_{2.5}$)	T3	TSP reported by the plants, fraction factors used for PM_{10} and $PM_{2.5}$

Mining of metallic minerals in Finland includes iron, chromium, copper, nickel, zinc, gold, vanadium, titanium, lead, cobalt, silver, tungsten, and molybdenum, along with ores containing rare-earth elements. In 2023, there were 8 metallic mineral mines (Tables 4.10 and 4.11) operating in Finland. Three of these were gold mines, and the other mines produced chromium, copper, nickel, zinc, sulphur, cobalt, silver, lead and platinum group metals (PGE). (Vasara et al. 2023)

Industrial minerals are excavated e.g. for the production of building materials, fertilisers, dishes, paper, plastics, electronics, cosmetics, medicines, foodstuffs, and clean drinking water. Industrial stones are crushed and ground, then used as raw material for stone wool, cement, and similar products. The major industrial minerals mined in Finland are carbonates, apatite and talc (Finnish Safety and Chemicals Agency (Tukes), 2024).
Significant processing and refining of copper and nickel concentrates in Harjavalta, zinc in Kokkola, chromium in Kemi, and of iron in Raahe.

The shares of emissions of national total emissions and shares emissions reported by the operators are presented in Table 4.9 and the structure of the Finnish mining industry is presented in Figure 4.3 and the mining sites in Figure 4.4.

Table 4.9. Contribution of Quarrying and mining of minerals other than coal (NFR 2A5a) in 2023.

Pollutant	Emissions from Quarrying and mining of minerals other than coal in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	<0.001	13.108	Gg	<0.1	0
PM_{10}	0.002	25.728	Gg	<0.1	0
TSP	0.004	39.531	Gg	<0.1	99

Table 4.10. Mining in Finland 2023 (Finnish Safety and Chemicals Agency (Tukes), 2025).

Group	Mines/Quarries	Total output (t)	Total ore output (t)	Leftover rock (t)
Metallic ores	8	92 473 025	32 356 177	60 116 848
Carbonate rocks	11	4 147 042	2 934 715	1 212 327
Other industrial minerals	12	30 957 068	11 342 599	19 614 469
Industrial rocks and other	8	494 818	126 215	368 603
In total	39	128 071 953	46 759 706	81 312 247

Table 4.11. Mining of metallic ores in Finland 2023 (Finnish Safety and Chemicals Agency (Tukes), 2025).

Mine/Quarry	Locality	Commodity	Operator	Total output (t)	Total ore output (t)
Kittilä	Kittilä	Au	Agnico Eagle Finland Oy	2 538 668	1 976 064
Jokisivu	Huittinen	Au	Dragon Mining Oy	327 132	322 277
Pampalo	Ilomantsi	Au	Endomines Oy	433 998	187 817
Hopeakaivos	Sotkamo	Ag, Au, Pb, Zn	Sotkamo Silver Oy	713 323	515 955
Kevitsa	Sodankylä	Ni, Cu, PGE	Boliden Kevitsa Mining	36 407 795	9 404 537
Kemi	Keminmaa	Cr	Outokumpu Chrome Oy	2 057 525	1 906 409
Terrafame	Sotkamo, Kajaani	Zn, Cu, Ni	Terrafame Oy	49 673 335	18 043 118
Suhanko	Ranua, Tervola	Pb, Cu, Pt, Ni, Au	Sulanko Arctic Platinum	321 249	
Total: 8				92 473 025	32 356 177

PGM = platinum group metals, Kv=quartz

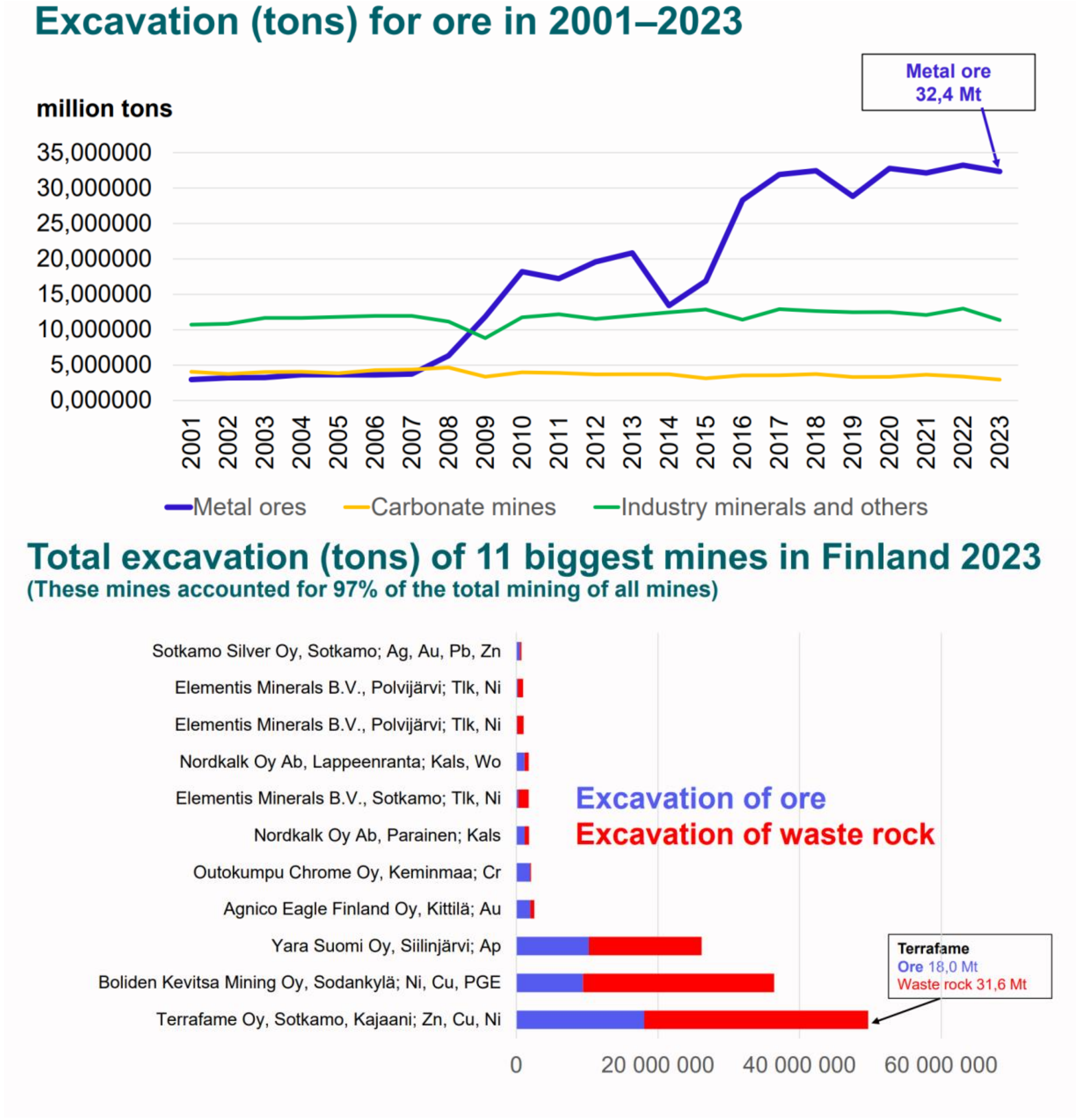

Figure 4.3 Excavation for ore in Finland (Tukes, 2024).

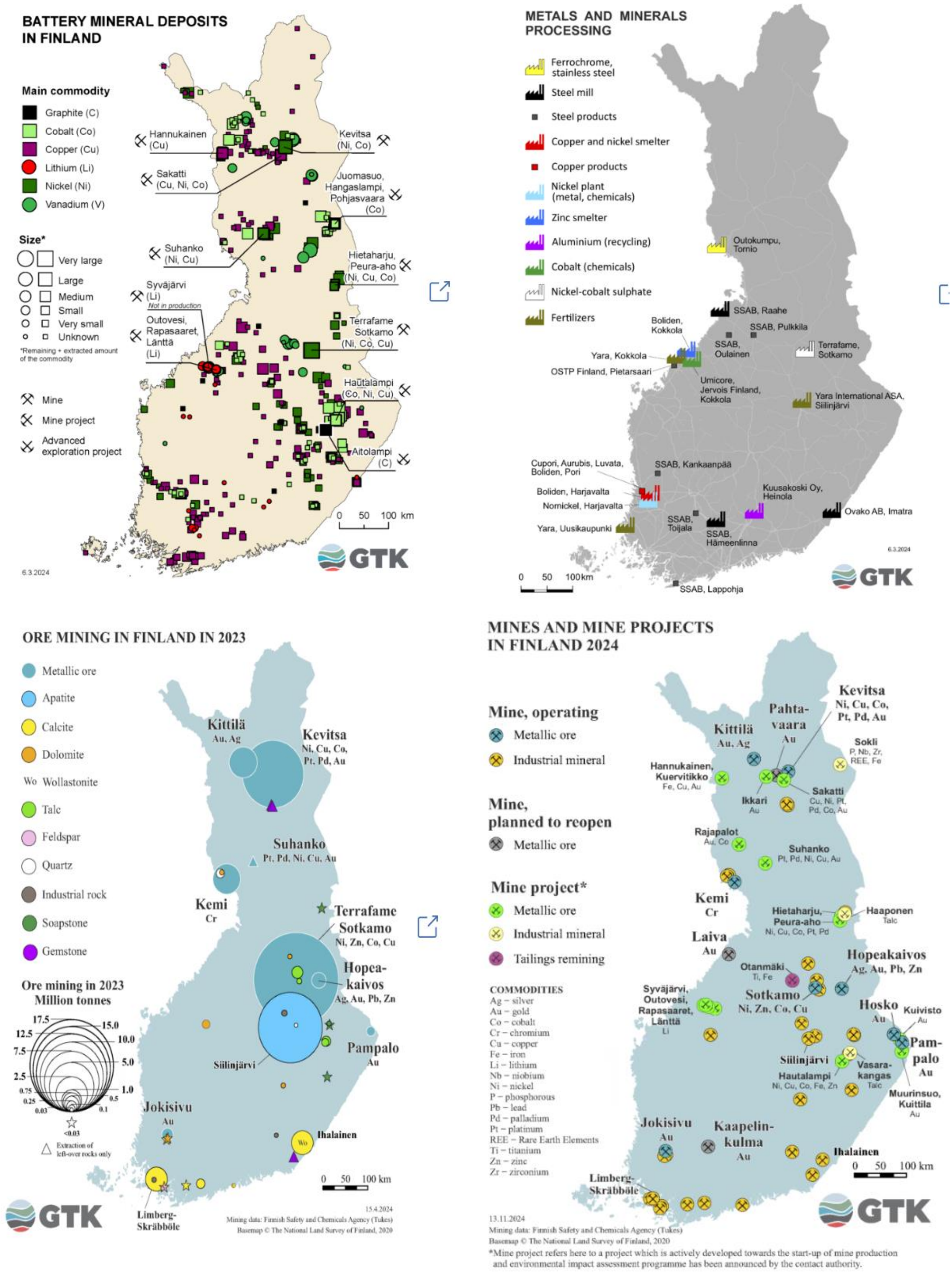

Figure 4.4 Battery mineral deposits, Metals and minerals processing, Mines, Mine projects Geological Survey of Finland (2025) https://www.gtk.fi/en/current/mining-and-deposit-maps/

Emission trend

The emission trends follow closely the quarrying and mining volumes.

The peak in particle emissions in 2013 is due to a fault situation in one mine that has had problems with environmental emissions from time to time. The mine has been in operation since 2011 but was temporary closed down in 2018. The operation in the mine has been declining since 2013 and thereforethe emissions are a hundredth part of the earlier emission level. Zinc has been mined only at one mine in central Finland and the production ceased at the end of 2020. Mining of copper at the same mine ceased at August 2022.

Methodological issues

Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available, emissions have been calculated as presented below.

Activity data is presented in Table 4.12. Note that there is no activity data available at the level of detail (e.g. average area/height of the hole etc.) for the use of the new calculation method presented in EMEP/EEA Guidebook 2023 (Tier 2). However, the category is not a key category for particles in Finland.

Particles

Most of the TSP emissions are generated in zinc and copper ore quarrying and preparation and are mainly reported by the plants according to their monitoring requirements in their environmental permits. Particle fractions are calculated with EMEP/EEA Guidebook 2023 fraction factors (table 3-1).
For plants that do not report emissions, the emissions are calculated using emission factors from the EMEP/EEA Guidebook 2023 (table 3-1).

Table 4.12. Mining of copper and zinc ores: activity data (First Quantum Minerals Ltd).

Year	Amount of mined copper ore (1000 t)	Amount of mined zinc ore (1000 t)
1990	1439	357
1995	1087	119
2000	1211	118
2005	1378	257
2010	1307	191
2015	1321*	138*
2016	148	10.8
2017	135	17.4
2018	119	22.7
2019	80	12
2020	45	2.5
2021	33	0**
2022	24	0**
2023	0	0**

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Part 3 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2018
- Fuel combustion related emissions were reallocated in the 2018 submission under NFR1A2gviii.

2019
- Particle fractions are calculated with Guidebook 2016 fraction factors.

2021
- Particle fractions are calculated with Guidebook 2019 fraction factors.

Source-specific planned improvements

None

Construction and demolition (NFR 2A5b)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040624 Not a key category for any pollutants		PUBLIC WORKS AND BUILDING SITES Activities include manufacturing of light expanded clay aggregate (LECA), granulates and asphalt mixing plants. Emissions from rock-crushing plants are included in the emissions of asphalt stations in cases where the activity is required to have an environmental permit. Small rock-crushing plants are not included in the inventory.
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$	T2	calculated using GB23

Process emissions from asphalt mixing plants are reported under NFR 2A5b and fuel combustion related emissions under NFR 1A2gviii.

Construction and demolition is a minor source of particle emissions. The missions have decreased since the early 2000s due to increased abatement.

The shares of total emissions and of emissons reported by the plants are presented in Table 4.12.

Table 4.12. Contribution of Construction and demolition (NFR 2A5b) to total emissions in 2023.

Pollutant	Emissions from construction and demolition in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	<0.001	13.108	Gg	<0.1	0
PM_{10}	0.007	25.728	Gg	<0.1	0
TSP	0.022	39.531	Gg	<0.1	1.1

Methodological issues

Particle emissions

Emissions are calculated as described in EMEP/EEA Guidebook 2023. The same assumptions for duration of construction and for control efficiency of applied emission reduction measures (CE) as presented in the EMEP/EEA Guidebook 2023 have been used also for Finland. For PE index value of 128 (wet) is used. The same silt content (20%) is used in the calculation as is assumed for Germany in Guidebook 2023. In Finland only total constructed area is available. As described in the Guidebook 2023 affected area is estimated using 0.8 m^2 footprint are per m^2 utility floor area. In Finland information of constructed area (provided by Statistic Finland) is available from 1995 onwards, for years 1990-1994 has been used same value as for year 1995. Volumes of constructed houses, apartment buildings and non-residential buildings used as activity data are presented in Table 4.13.

Emissions from road construction are calculated as described in the EMEP/EEA Guidebook 2023. Activity data presented in Table 4.14 is provided by Statistic Finland (2024).

Table 4.13. Volumes of constructed houses, apartment buildings and non-residential buildings (Statistics Finland).

Year	Constructed houses (m^2)	Constructed apartment buildings(m^2)	Non-residentail construction (m^2)
1990*	1 508 775	658 752	3 560 360
1995	1 508 775	658 752	3 560 360
2000	2 772 252	1 253 966	5 688 264
2005	3 618 269	1 072 646	5 711 187
2010	2 629 159	1 361 794	5 166 918
2015	1 391 401	1 579 064	3 711 899
2016	1 419 991	1 736 980	4 044 515
2017	1 514 086	2 157 886	4 322 511
2018	1 441 103	2 231 769	4 532 115
2019	1 375 233	1 849 109	4 540 234

Year	Constructed houses (m²)	Constructed apartment buildings(m²)	Non-residentail construction (m²)
2020	1 418 484	2 077 659	4 566 141
2021	1 596 431	2 405 403	4 660 856
2022	1 369 984	1 855 284	4 101 593
2023	756 307	1 185 799	3 580 564

** Statistics have been available only from 1995 onwards, for years 1990-1994 values from year 1995 have been used*

Table 4.14. Length of new roads (only new mains roads i.e highways) in Finland (Road statistics, Statistics Finland)

Year	New roads (km)
1990	208
1995	215
2000	33
2005	0
2010	45
2015	21
2016	0
2017	31
2018	50
2019	0
2020	0
2021	0
2022	0
2023	0

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2019
- The whole time series was recalculated using Guidebook 2016 method.
- Heavy metal emissions reported currently under this NFR were removed under energy.

2020
- Guidebook 2019 method equals to that of Guidebook 2016.

2024
- Guidebook 2023 method equals to that of Guidebook 2019.

Source-specific planned improvements

None.

Storage, handling and transport of mineral products (NFR 2A5c)

Changes in chapter	
February 2025	JMP, KS, TF

Source category description

SNAP 040900 Not a key category for any pollutants		STORAGE, HANDLING AND TRANSPORT OF MINERAL PRODUCTS Activities included here are storage and handling of aluminoxide, bentonite, clay, cement, coal, coke, fly ash and kaolin
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$	T2	Calculated

The category is a minor source of particle emissions. The shares of emissions are presented in Table 4.15.

Table 4.15. Contribution of Storage, handling and transport of mineral products (NFR 2A5c) to total emissions and the shares of emissions reported by the plants in 2023.

Pollutant	Emissions from Storage, handling and transport of mineral products in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	0.017	13.108	Gg	0.1	0
PM_{10}	0.162	25.728	Gg	0.6	0
TSP	0.420	39.531	Gg	1.1	0

Emission trend

The emission trends are impacted by annual production volumes.

Methodological issues

Particle emissions are calculated using emission factors (TNO, 2002) presented in Table 4.16. There are no methods in the EMEP/EEA Guidebook 2023 for the different species presented below, therefore we prefer to use the specific fraction factors of TNO.

Table 4.16 TSP. PM_{10}. $PM_{2.5}$ emission factors for NFR 2A5c storage and handling.

Source	EFs t/t (TNO, 2002)		
	TSP	PM_{10}	$PM_{2.5}$
Storage and handling, aluminoxide	0.0002	0.00008	0.000008
Storage and handling, bentonite	0.00004	0.0000128	0.0000016
Storage and handling, clay	0.000025	0.000008	0.000001
Storage and handling, cement	0.00001	0.00005	0.0000005
Storage and handling, coal	0.00015	0.00006	0.000006
Storage and handling, coke	0.00011	0.000044	0.0000044
Storage and handling, fly ash	0.0001	0.000032	0.000004
Storage and handling, kaolin	0.00004	0.0000128	0.0000016

Used activity data is presented in Table 4.17. In Table 4.17 amounts of imported alumina, bentonite, coal and kaolin are taken from ULJAS database, amount of used cement as production and import is taken from YLVA and ULJAS databases. Amount of handled clay as tiles and light gravel is taken from statistics of the Confederation of Finnish Construction Industries and YLVA database (production amounts of light gravel). Amount of produced and imported coke is taken from statistic of the Federation of Finnish Technology Industries and YLVA database. Amount of produced fly ash in taken from statistics of Finenergy.

Table 4.17. Activity data for storage and handling of minerals

Year	Imported alumina (t/m^2)	Imported bentonite (t/m^2)	Handled clay as tiles and light gravel (t/m^2)	Used cement as production and import(t/m^2)	Imported coal (t/m^2)	Produced and imported coke (t/m^2)	Produced fly ash (t/m^2)	Imported kaolin (t/m^2)
1990	3 317	7 841	339 000	1 917 740	6 101 614	1 273 047	939 702	967 917
1995	1 669	18 688	156 000	1 106 527	5 887 526	1 083 946	739 563	1 378 081
2000	2 179	30 609	188 715	1 939 579	5 072 701	1 327 170	590 000	1 493 786
2005	2 659	26 395	162 000	904 064	4 724 395	1 398 969	541 376	1 144 335
2010	2 421	16 084	116 000	1 807 747	5 902 004	1 266 970	692 256	944 809
2015	2 834	43 347	41 200	1 595 705	3 500 330	876 098	537 737	696 962
2016	3 078	35 630	238 000	1 844 920	3 896 830	882 613	715 000	660 800
2017	3 700	24 140	142 000	2 106 350	3 855 300	864 340	715 000	639 780
2018	3 624	31 970	148 200	555 258	3 982 297	861 048	715 000	604 098
2019	2 929	34 100	252 300	453 092	3 077 538	836 544	715 000	526 023
2020	2 899	41 560	255 200	495 600	2 365 854	762 077	715 000	384 570
2021	3 346	38 909	252 259	500 847	2 153 587	835 216	715 000	384 321
2022	11 914	43 258	79 829	447 959	3 898 352	808 367	715 000	286 122
2023	11 780	39 279	66 832	387 445	1 606 374	811 491	715 000	218 329

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2009
- Emissions from storage, handling and transport of mineral products were included in the inventory.

2022
- Acitvity data for clay handled as tiles and light gravel upadated 2013 onwards.

2025
- Activity data for storage, handling and transport of coke updated 2009 onwards.

Source-specific planned improvements

We are using the material specific TNO EFs which we consider more precise than the T1 EFs in Guidebook 2023. However, we plan to compare the results of the two methods in the near future.

Other Mineral products (NFR 2A6)

Changes in chapter	
January 2020	JMP

Source category description

SNAP 040613z 040615 040618 040628 040629	OTHER (MINERAL PRODUCTS), BATTERIES MANUFACTURING, LIMESTONE AND DOLOMITE USE, BRICKS AND TILES (DECARBONIZING), FINE CERAMIC MATERIALS (DECARBONIZING)

No activities falling under NFR 2A6 occur currently in Finland.

4.3 Chemical Industry (NFR 2.B)

Changes in chapter	
February 2025	JMP, TF

NFR	Chemical Industy	Description		Emissions
2B1	Ammonia production	There has been no ammonia production in Finland since 1993.		Not Occuring after 1992
2B2	Nitric acid production	Three nitric acid plants, a fourth was closed down in 1992. In 2004 a new plant replaced an older plant, which was closed down in 2005.		NO_x
2B10a	Other chemical industry			NOx, NMVOC, SOx, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, Pb, Hg, Cr, Cu, Ni, Zn, PCDD/F, HCB
	040401	Sulfuric acid		
	040406	Ammonium phosphate		
	040407	NPK fertilisers		
	040410	Titanium dioxide		
	040413	Chlorine production		
	040414	Phosphate fertilizers		
	040416	Other	Calcium Carbonate manufacturing	
	040416	Other	Silicon wafer manufacturing	
	040416	Other	Production of oxygen, nitrogen and hydrogen	
	040416	Other	Al- and Fe-chemicals manufacturing	
	040416	Other	Manufacturing of ion exchange and chromatographic resins and special polymers	
	040416	Other	Pigments manufacturing	
	040416	Other	Manufacturing of explosives	
	040416	Other	Fertilizer manufacturing	
	040416	Other	Manufacturing of cobolt based special chemicals	
	040416	Other	Hydrogenperoxide plant	
	040416	Other	Manufacturing of natrium silicate	
	040416	Other	Potassium sulphate manufacturing	
	040416	Other	Formic acid and hydrogen peroxide manufacturing	
	040416	Other	Manufacturing of viscose staple fibres and by-products	
	040501	Ethylene		
	040506	Polyethylene Low Density		
	040507	Polyethylene High Density		
	040509	Polypropylene		
	040511	Polystyrene		
	040512	Styrene butadiene		
	040513	Styrene-butadiene latex		
	040527	Other (phytosanitary,...)	Entzyme production	
	040527	Other (phytosanitary,...)	Manufacturing of techno-chemical products	
	040527	Other (phytosanitary,...)	Manufacturing of benzene, cumene and phenols	
	040527	Other (phytosanitary,...)	Drag reducing additive production	

NFR	Chemical Industy	Description		Emissions
	040527	Other (phytosanitary,...)	Manufacturing of organic base chemicals	
	040527	Other (phytosanitary,...)	Manufacturing of tall oil	
	040527	Other (phytosanitary,...)	Manufacturing of organic fine chemicals	
	040527	Other (phytosanitary,...)	Manufacturing of pharmaceuticals	
	040527	Other (phytosanitary,...)	Manufacturing of titanium dioxide pigments	
	040527	Other (phytosanitary,...)	Manufacturing of lignosulphonate products	
	040527	Other (phytosanitary,...)	Cleaning of solvents and manufacturing of solvent mixtures	
	040527	Other (phytosanitary,...)	Manufacturing of biocides and other agricultural chemicals	
	040527	Other (phytosanitary,...)	Manufacturing of carboxymethylcellulose	
2B10b	Storage, handling and transport of chemical products	Chemical and fuel storages, storage and handling of phosphates.		NMVOC, TSP, PM_{10}, $PM_{2.5}$

Ammonia production (NFR 2B1)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040403 Not a key category for any pollutants	Tier T1	AMMONIA PRODUCTION Ammonia was produced between the years 1951-1992 in Finland. The annually produced amounts of ammonia were between 12-30 kt. Ammonia was mainly used as raw material of fertilizers and in the production of nitric acid.

Emission trends

All emissions follow the trend of produced ammonia.

Methodological issues

Ammonia was produced during the years 1990-1992 as presented in Table 4.18. Ammonia was mainly produced using peat and heavy oil as feedstock for the needed hydrogen. There was an experimentation to use sod peat to produce synthesis gas for ammonia, hydrogen peroxide and formic acid production in 1988 to 1991. The experimentation ended uneconomic and instead, peat gasification of oil products was continued (Finland's NID 2025).

Table 4.18. Estimated Ammonia production in 1990-1992 (Expert estimate, Regional Environmental Centre 2010).

Year	Produced ammonia (t)
1990	30 000
1991	30 000
1992	12 000

NH_3, NO_x, CO, NMVOC

Emissions are calculated using emission factors presented in EMEP/EEA Guidebook 2023 (Table 3-7).

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2019
- Information of ammonia production volumes 1990-1992 added to the IIR.
- NH_3 emissions in 1990-1992 were included in the inventory and documented in the IIR.

2020
- NOx, NMVOC and CO emissions in 1990-1992 were included in the inventory.

Source specific planned improvements

None

Nitric acid production (NFR 2B2)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040402 Not a key category for any pollutants		NITRIC ACID PRODUCTION Nitric acid is currently produced at three plants. Two of these plants are situated at the same site. In 1990–1992 there were four plants producing nitric acid. In 2004 a new plant replaced an older plant, which was closed down in 2005. The operating plants are single-stage medium pressure plants (3.8, 6.5 and 7.5 bar). The produced nitric acid is mainly used for the integrated fertiliser production. Total annual total production volume has varied from 430 to 620 Gg of nitric acid per year.
Emissions	Tier	Source of emissions
NO_x	T3	Emissions are reported by the plants according to their reporting obligations in the environmental permits and available in YLVA database. NOx emissions include NO_2, NO, N_2O_3, N_2O_4, HNO_3 compounds.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.19.

Table 4.19. Contribution of nitric acid production to total emissions in 2023.

Pollutant	Emissions from other mineral products in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NO_x (as NO_2)	0.181	90.3	Gg	0.2	100

Emission trend

Air pollutant emissions from nitric acid production vary according to the production volumes over the years.

Methodological issues

Nitric acid plants report their emissions to the supervising authorities according to the monitoring requirements in the environmental permits. The reporting covers all NOx emissions from nitric acid production processes.

Uncertainty and time series’ consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

None.

Source-specific planned improvements

None.

Adipic acid production (NFR 2B3)

SNAP 040521	ADIPIC ACID PRODUCTION Adipic acid production does not occur in Finland.

Carbide production (NFR 2B5)

SNAP 040412	CARBIDE PRODUCTION Carbide production does not occur in Finland.

Titanium dioxide production (NFR 2B6)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040410 Not a key category for any pollutants		TITANIUM DIOXIDE PRODUCTION One plant has produced titanium dioxide pigments since 1957. These pigments have been used in paint and cosmetics industry and also in manufacture of printing inks. Manufacture of titanium dioxide has in ended in 2022 and therefore, as of 2023 emissions are reported as NO.
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$, BC	T3/T2	Particle emissions are reported by the plant according to its environmental monitoring programme from dry kiln.

Emission trend

The particle emissions since 2017 are one tenth to the emissions in the 2000s due to major changes made in production in 1997. Following the changes, the emision level decreased. The operation of the only titanium dioxide plant in Finland ceased in 2022, so from 2023 onwards notation key NO has been used.

The shares of emissions of total emissions and the shares reported by the plants are presented in table 4.20.

Table 4.20 Contribution of Titanium dioxide production (NFR 2B6) to total emissions in 2023.

Pollutant	Emissions from titanium dioxide production in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
PM2.5	NO	13.108	Gg	0	0
PM10	NO	25.728	Gg	0	0
TSP	NO	39.531	Gg	0	0
BC	NO	3.063	Gg	0	0

Methodological issues

TSP emissions are reported by the TiO2 manufacturer. PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions using the default fractions for 2B chemical production in the EMEP/EEA Guidebook 2023, 0.8 × TSP for PM_{10} and 0.6 × TSP for $PM_{2.5}$. There are no sector specific methods or fraction factors available for titanium dioxide production in the Guidebook, hence the use of default fractions for 2B chemical production.

For black carbon, the EMEP/EEA Guidebook 2023 (Table 3-1) Tier 1emission factor has been used.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2023

- Following the recommendation in the 2022 NECD inventory review, PM_{10} and $PM_{2.5}$ emissions were recalculated for the whole time series 1990 to 2020 due to correction of small particle fractions from TSP:PM_{10}:$PM_{2.5}$ – 1:1:1 to the 2019 Guidebook defaults for 2B chemical production.

Source-specific planned improvements

None.

Soda ash production (NFR 2B7)

Changes in chapter	
February 2023	JMP, KS, TF

SNAP 040619	SODA ASH PRODUCTION AND USE NFR 2B7 SODA ASH PRODUCTION Soda ash is not produced in Finland. Soda ash is used in Finland in the production of tile, steel, calcium chloride, phosphates, mineral wool and in the energy industry. Emissions from soda ash use in these sectors are reported by the plants according to the monitoring programmes in their environmental permits (available in YLVA). The emissions are allocated under the NFR category of the main activity of these plants using soda ash and it is not possible to report the emissions separately under NFR 2B7.

Other chemical industry (NFR 2B10a)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040401		SULPHURIC ACID Number of plants (<5) Production capacity: 1 000 000 t sulphuric acid
Emissions		Source of emissions
NOx, SOx, TSP, PM_{10}, $PM_{2.5}$, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040406		AMMONIUM PHOSPHATE Number of plants (<5) Phosphoric acid is produced from phosphorus containing minerals, the most important mineral is phosphorite (=apatite $3Ca_3(PO_4)_2*CaF_2$). There are two different methods to produce phosphoric acid; thermal and wet process; in Finland the wet process has been used. In the wet process the raw phosphate is dissolved into sulphur acid and the released phosphoric acid is separated from calcium sulphate. Production capacity: 300 000 t phosphoric acid and polyphosphoric acids
Emissions		Source of emissions
SOx	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NOx		reported by one plant in year 1990, should be allocated under the energy sector

SNAP 040407		NPK FERTILISERS Number of plants (<5) Production capacity: 1.5 million t mineral or chemical fertlisers (including N,P,K)
Emissions		Source of emissions
NH_3, NMVOC, SOx, TSP, PM_{10}, $PM_{2.5}$, BC	T3	reported by the plants according to the monitoring and reportin The emission trends are impacted by annual production volumes. g obligations in their environmental permits

SNAP 040413		CHLORINE PRODUCTION Number of plants (<5) Production capacity: 200 000 t chlorine
Emissions		Source of emissions
Hg	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
SOx	T3	reported by plants 1990-1993, should be allocated under Energy sector

SNAP 040414		PHOSPHATE FERTILIZERS Number of plants (< 5)
Emissions		Source of emissions
		Only NH_3 emissions from 1990. No emission since 1991.

SNAP 040416		OTHER Production of oxygen, nitrogen and hydrogen Number of plants <5 Production capacity: oxygen (liquid) 45 000t/a, nitrogen (liquid) 40 000t/a and argon (liquid) 8000t/a
Emissions		Source of emissions
NMVOC,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

NOx, SOx		

SNAP 040416		OTHER Al- and Fe-chemicals manufacturing Number of plants <5 Production capacity: ~30 000t/a Al-salts
Emissions		Source of emissions
TSP, PM_{10}. $PM_{2.5}$, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of ion exchange and chromatographic resins and special polymers Number of plants <5 Production capacity ~1000 m3/a ion exhange resins
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Pigments manufacturing Number of plants <5 Production capacity: ~50 000t/a Al-silicate and silicone dioxide pigments
Emissions		Source of emissions
TSP, PM10, PM2.5, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of explosives Number of plants <5 Production capacity: not availble
Emissions		Source of emissions
NMVOC, NOx	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Fertilizer manufacturing Number of plants <5 Production capacity: not available
Emissions		Source of emissions
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of cobolt based special chemicals Number of plants <5 Production capacity: not available
Emissions		Source of emissions
Cu, Ni, NMVOC, SOx	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER

		Hydrogen peroxide plant Number of plants <5 Production capacity: ~130 000 t/a hydrogen peroxide
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of natrium silicate Number of plants <5 Production capacity: ~45 000t/a silicate
Emissions		Source of emissions
TSP, PM_{10}, $PM_{2.5}$, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of synthetic fibre Number of plants – none in 2010 century Production capacity: not availble

SNAP 040416		OTHER Potassium sulphate manufacturing Number of plants <5 Production capacity: ~200 000 t/a potassium sulphate
Emissions		Source of emissions
HCB, PCDD/F	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of fine chemicals Number of plants <5 Production capacity: not available
		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040416		OTHER Manufacturing of PCC (Precipitated calcium carbonate) Number of plants<5 Production capacity: not availble The plant was closed down in 2011.
Emissions		Source of emissions
NOx, SOx	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040501		ETHYLENE Number of plants <5 Production capacity: ~400 000 t/a
Emissions		Source of emissions
NMVOC, SO_x, TSP,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

PM_{10}, $PM_{2.5}$, BC		

SNAP 040506		POLYETHYLENE LOW DENSITY Number of plants <5 Production capacity: not available
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040507		POLYETHYLENE HIGH DENSITY Number of plants <5 Production capacity ~350 000 t/a
Emissions		Source of emissions
NMVOC, SO_x	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM10, PM2.5	T3	emissions 1996-1998 reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040508		PVC Polyvinylchloride has been manufactured in Finland in 1969-2006 Number of plants Production capacity
Emissions		Source of emissions
NMVOC, TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040509		POLYPROPYLENE Number of plants <5 Production capacity: ~200 000 t/a
Emissions		Source of emissions
NMVOC, NOx	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits. Nox emissions occured only in 2002 due the experimentatation in the facility.

SNAP 040510		STYRENE Number of plants <5
Emissions		Source of emissions
NMVOC	T3	reported by the plant 1994-2000.

SNAP 040511		POLYSTYRENE Number of plants <5 Production capacity ~50 000 t/a
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040512		STYRENE-BUTADIENE Number of plants <5 Production capacity ~300 000 t/a

Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040513		STYRENE-BUTADIENE LATEX Number of plants <5 Production capacity; 180 000 t synthetic rubberlatex
Emissions		Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
SOx	T3	emissions from 1997 reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040527		OTHER (PHYTOSANITARY,...) Entzyme production Number of plants <5 Production capacity: not available
Emissions		Source of emissions
TSP, PM_{10}, $PM_{2.5}$	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040527		OTHER (PHYTOSANITARY,...) Manufacturing of techno-chemical products Number of plants 12 Production capacity: not available
Emissions		Source of emissions
SO_x, TSP, PM_{10}, $PM_{2.5}$, NMVOC, BC, PCB, diox, PAH4, Cr, Ni, NH3	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

NFR 2B10a is a key category for SO_x, NMVOC, BC, Hg, PCDD/F and HCB, see Table 4.21.

Table 4.21. Key categories and tier level of methods for the Other chemical industry.

Process	SOx	Tier	NMVOC	Tier	BC	Tier	Hg	Tier	PCDD/F	Tier	HCB	Tier
Manufacturing of potassioum sulphate									T1	3	L1, T1	T3
Production of oxygen, nitrogen and hydrogen Manufacturing of ion exchange and chromatographic resins and special polymers Manufacturing of explosives Manufacturing of cobolt based special chemicals Hydrogen peroxide plant Manufacturing of fine chemicals Production of polyethylene low-density, high-density polypropylene, polystyrene Production of styrene butadiene and styrene-butadiene latex Pesticide production Manufacturing of techno-chemical products			L1	T3	T1	1						
Production of sulphuric acid Production of fertilizers Prodcution of cobolt based chemicals Production of pigments used in paper making Production of techno-chemical products	L1, T1	T3										

Production of sulphuric acid Production of fertilizers Production of phosphates Production of PVC Production of inorganic chemicals, ethylene, polyethylene, other organic chemicals and												
Chlorine production using the mercury process							L1, T1	T3				

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.22.

Table 4.22. Contribution of Chemical Industry: other (NFR 2B10a) to total emissions in 2023.

Pollutant	Emissions from other chemical industry in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NO_x (as NO2)	0.108	90.3	Gg	0.1	29.4
NMVOC	2.129	72.51	Gg	2.9	100
SO_x (as SO2)	0.804	20.536	Gg	3.9	98.9
NH_3	0.204	30.16	Gg	0.7	100
$PM_{2.5}$	0.154	13.108	Gg	1.2	0
PM_{10}	0.357	25.728	Gg	1.4	0
TSP	0.408	39.531	Gg	1.0	100
BC	0.003	3.063	Gg	<0.1	0
Pb	0.001	12.089	Mg	<0.1	0
Hg	0.035	0.493	Mg	7.1	0.7
Cu	0.003	37.478	Mg	<0.1	100
Ni	0.010	8.793	Mg	0.1	100
Zn	0.250	119.511	Mg	0.2	0
PCDD/PCDF	0.190	8.651	g I-Teq	2.2	100
HCB	8.800	16.24	kg	54.2	100

Emission trend

NH_3 emissions are generated in production of fertilizers. Particle emissions originate in production of sulphuric acid, fertilizers, phosphates, and PVC as well as from the production of inorganic chemicals, ethylene, polyethylene, other organic chemicals and chemicals products. BC emissions originate from Al- and Fe-chemicals and pigments manufacturing, manufacturing of natrium silicate and techno-chemical products. Chromium emissions are related to lignin manufacturing which occurred only in 1993-2008. The emissions are reported by the plants.

PCDD/F emissions originate in the manufacturing of potassium sulphate but due the improvements the refining methods, the emissions decreased in 2017, were under the ELV in 2018 and in 2019. From 2020 onwards the plant again reported PCDD/F emissions. Due to the fluctuations of the production process it is not possible to make a calculation model to estimate these emissions and therefore only reported data is included in the inventory.HCB emissions originate in the manufacturing of potassium sulphate, which is a major source of HCB emissions in the Finnish HCB inventory).

Methodological issues

The emissions falling under this category are reported by the plants according to the monitoring and reporting obligations in their environmental permits (T3). When no plant specific data is available emissions have been calculated as presented below.

Particles

Particle emissions from this sector in the inventory are based on TSP emission data reported by the plants (YLVA). PM_{10} and $PM_{2.5}$ emissions are calculated from TSP emissions using size fraction factors as follows:

- Production of sulphuric acid: 100 % for both PM2.5 and PM10 (TNO, 2002).
- Production of fertilizers 98% for PM10 and 66 %, PM2.5 (IIASA, 2001/AEAT, 2000)
- Production of phosphates: 80% for PM10 and 60 %, PM2.5 (Guidebook 2023)
- Production of PVC: 38% for PM10 and 1.9 %, PM2.5 (EEA/EMEP Guidebook 2023)

- Production of inorganic chemicals, ethylene, polyethylene, other organic chemicals and chemicals products: 80 % for PM10 and 50 % for PM2.5 (national expert estimate, Karvosenoja, 2002).

Black carbon (Key category for BC, trend)
For black carbon, the EMEP/EEA Guidebook 2023 (Table 3-1) Tier 1 emission factor have been used for the following sources: Al- and Fe-chemicals and pigments manufacturing, manufacturing of natrium silicate and techno-chemical products.

NOx
Nitrogen dioxide emissions from this sector in the inventory are based on emission data reported by the plants (YLVA) from the following sectors:
- Production of sulfuric acid
- Manufacturing of ammunition
- Production of pigments used in paper making

SO_x (Key category for SO_x, level and trend)
Sulphur dioxide emissions (reported mostly as TRS, total reduced sulphur, and converted into SO_2) from this sector in the inventory are based on emission data reported by the plants (YLVA) from the following sectors:
- Production of sulphuric acid
- Production of fertilizers
- Prodcution of cobolt based chemicals
- Production of pigments used in paper making
- Production of techno-chemical products

NH_3
Ammonia emissions are generated in production of fertilizers and are based on emission data reported by the plants (YLVA).

NMVOC (Key category for NMVOC, level)
NMVOC emissions from this sector in the inventory are based on data reported by the plants according to their environmental permits to the YLVA database from the following sectors:
- Production of oxygen, nitrogen and hydrogen
- Manufacturing of ion exchange and chromatographic resins and special polymers
- Manufacturing of explosives
- Manufacturing of cobolt based special chemicals
- Hydrogen peroxide plant
- Manufacturing of fine chemicals
- Production of polyethylene low density, high density polypropylene, polystyrene
- Production of styrene butadiene and styrene-butadiene latex
- Pesticide production
- Manufacturing of techno-chemical products

Heavy metals (Key category for Hg, level and trend)
- Nickel and copper emissions are generated in manufacturing of cobolt based special chemicals and reported by the operators according to their environmental permits.
- Chromium emissions are related to lignin manufacturing which occurred only in 1993-2008.
- Mercury is emitted from chlorine production using the mercury process. There is also chlorine-alkali production, which uses the membrane method, however, no mercury emissions are generated from this process.

POPs
Emissions of HCB, PCDD/Fs and PAHs from the manufacturing of potassium sulphate, as well as PCDD/F emissions from the manufacturing of organic fine chemicals are reported by the plants and available in YLVA for the use in the inventory.

HCB (Key category for HCB, level and trend)

- Manufacturing of potassium sulphate is a key category for HCB emissions. The NFR 2B10a is thus a key category for HCB emissions. The emissions are reported by the plant based on site-specific measurements.
- HCB emissions vary strongly due to the fluctuating quality and volume of auxiliary chemicals used in the process. The raw material quality and emissions in the potassium production process, from which the emissions originate, are monitored closely. Annual HCB emissions are reported by plant operators to the environmental authorities. However, for the years 1990-2000, i.e. before the emissions were discovered in connection with other research, no data on the emission levels is available. The plant has estimated the emissions during these years to be at the level of 29 kg annully, and thus these figures are used in the inventory as there are no other methods to estimate these historical emissions. Work to find and install a suitable flue gas abatement technology is underway.

PCDD/F emissions (key category, trend) have been reported by one plant and for the first time in 2000. Emissions between 1990-1999 are expert estimates based on the reported emission value in 2000. In 2001 a new activated carbon filter was taken in use at the plant resulting in 97% reduction of dioxine emissions. The emissions decreased in 2017 due to improvements in the refining methods. In 2018 and in 2019 PCDD/F emissions were under the ELV. Since 2020 PCDD/F emissions have been reported. Due to the fluctuation of the process, it is not possible to calculate the emissions and therefore only reported emissions are included in the inventory.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2018-2019

- The emissions were reallocated between the Energy sector and the IPPU sector as far as possible and in a consistent manner over the time series. The reallocation did not introduce changes into total emission levels.
- Between the 2018 and 2019 submissions SO2 emissions for 2B10a were recalculated since emissions from one plant for 2001 were incorrectly reported in the YLVA system (YLVA is the national data system for data reported by operators to environmental authorities). The error was discovered when preparing the 2019 submission. The SO2 emissions reported for 2001 belong under category 1A2b and the emissions were reallocated there. Unfortunately, the explanation for this was missing from the IIR 2019.

Source-specific planned improvements

None

Storage, handling and transport of chemical products (NFR 2B10b)

Changes in chapter	
Ferbuary 2025	JMP, TF

Source category description

SNAP 040415 and 040522 No key category for any pollutants		STORAGE AND HANDLING OF INORGANIC CHEMICAL PRODUCTS, STORAGE AND HANDLING OF ORGANIC CHEMICAL PRODUCTS Chemical and fuel storages, storage and handling of phosphates.
Emissions	Tier	Emission source
TSP, PM_{10}, $PM_{2.5}$	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits, calculated
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

Particle and NMVOC emissions from Storage and handling of phosphates are included in this category. The emissions include both data reported by the plants and data calculated, and the shares of these fluctuate annually. The shares in the 2023 submission are presented in Table. 4.23.

Table 4.23. Contribution of Storage, handling and transport of chemical products (NFR 2B10b) to total emissions in 2023.

Pollutant	Emissions in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.033	72.51	Gg	<0.1	89.2
$PM_{2.5}$	0.001	13.108	Gg	<0.1	0
PM_{10}	0.011	25.728	Gg	<0.1	0
TSP	0.033	39.531	Gg	<0.1	0

Emission trend

The emission trends are impacted by annual production volumes.

Methodological issues

Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available emissions have been calculated.

Particles

Particulate emissions from storage and handling of phosphates are calculated with emission factors: $PM_{2.5}$ 0.0000016 t/t, PM_{10} 0.0000128 t/t and TSP 0.00004 t/t (TNO, 2002). There are no methods in the Guidebook. Production of phosphates used as activity data provided by the Customs statistics (ULJAS) is presented in Table 4.24.

Table 4.24. Activity data for storage and handling of phosphates (Customs Statistics ULJAS).

Year	Production (t)
1990	584 000
1995	762 000
2000	824 000
2005	823 000
2010	765 000
2015	810 309
2016	813 889
2017	917 418
2018	933 197
2019	925 934
2020	944 533
2021	970 079
2022	880 050
2023	826 820

NMVOC

Emissions are data reported by the plants according to their environmental permits.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2021

- Facility reported TSP emissions were corrected for one plant for 2010. As result, emissions of $PM_{2.5}$ and PM_{10} were also recalculated for this plant.

Source-specific planned improvements

None.

4.4 Metal Production (NFR 2C)

Changes in chapter	
February 2025	JMP, TF

Metal Production activities in Finland include iron and steel production, copper products, refined steel, zinc, nickel and alloys.

NFR	Processes	Description	Emissions reported
2C1	Iron and steel production	Iron and steel plants (< 5 plants), both emissions reported by the plant and calculated at the inventory agency	NMVOC, SO_X, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/F, PAH-4, HCB, PCB
2C2	Ferroalloys production	Ferrochromium production plants (< 5 plants) are part of integrated stainless steel plants, emissions reported by the plants	NMVOC, SOx, TSP, PM_{10}, $PM_{2.5}$, BC, Pb, Cd, Hg, Cr, Cu, Ni, Zn, As, PAH-4
2C3	Aluminium production	There is no primary aluminium production in Finland. Secondary aluminium production and aluminium casting (<5 plants)	NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC, Pb, Cd, As, Zn, PCDD/F, HCB, PCB
2C4	Magnesium production	No magnesium production ocuurs	Not Occuring
2C5	Lead production	No lead production occurs	Not Occuring
2C6	Zinc production	< 5 zinc production plants, emissions both reported by the plants and calculated at the inventory agency	TSP, PM_{10}, $PM_{2.5}$ Pb, Cd, Hg, As, Cu, Ni, Zn, PCDD/F
2C7a	Copper production	Copper production plants (< 5 plants) and production of upgraded copper products. Emissions both calculated or reported by the plants	NMVOC, SO_X, TSP, PM_{10}, $PM_{2.5}$, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCB, PCB, PCDD/F
2C7b	Nickel production	< 5 plants	NMVOC, SOx, NH_3, Ni
2C7c	Other metal production		NMVOC, SO_X, NH_3, TSP, PM_{10}, $PM_{2.5}$, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCB
	040307 Galvanizing		
	040309 Other	Recycling of waste and scrap	
	040309 Other	Aluminium foundry	
	040309 Other	Handling of FeCr slag	
	040309 Other	Surface treatment of metals	
	040309 Other	Secondary aluminium production	
	040309 Other	Manufacturing of furniture (zinc electroplating)	
	040309 Other	Manufacturing of metallic construction mountings	
	040309 Other	Cable manufacturing	
	040309 Other	Manufacturing of nails	
	040309 Other	Lock manufacturing	
2C7d	Storage, handling and transport of metal products	Storage and handling of iron ore.	TSP, PM_{10}, $PM_{2.5}$

Emission trend

Air pollutant emissions from metal production depend on the annual production volumes, which depend e.g. on markets, as well as on chemicals' use volumes over the years. There have also been changes in the production and emission abatement technologies over time. Detailed trend explanations are provided separately for each of the NFR sub-categories.

Iron and steel production (NFR 2C1)

Changes in chapter	
February 2025	JMP TF

Source category description

SNAP 040202, 040203, 040205, 040206, 040207, 040208, 040209, 040210 Key category for SOx (L1, T1) TSP, PM_{10}, $PM_{2.5}$ (T1) Hg, Cr, Ni (L1, T1) As (L1) Pb, Zn (T1) PCDD/F (L1, T1) PAH-4 (T1) PCB (L1, T1) Method for all T3	IRON AND STEEL PRODUCTION The first blast furnace in Finland was built in 1616 in Mustio. In 1916 the first smelter plant was established. Currently steel is produced at three plants in Finland with an annual total capacity of about 5 million tonnes. Both ore and recycled steel (about 2 million tonnes annually) are used. Sintering unit – 1994 - December 2011, expanded in 1971 Sintering unit - 2013- Blast furnace – 1961-2012 Blast furnace - 1964, renovated in 1995 Blast furnace – 1975, renovated in 1996 and 2011 The plants included in this sector are: • One iron and steel plant including coke oven, blast furnace, lime production plant and steel converter • One iron and steel plant including blast furnace and steel converter (closed down in 2012) • One integrated ferrochromium and stainless steel plant • One steel plant with electronic arc furnace, using scrap iron only The Finnish plants use both iron ore and scrap metal and produce iron ore, iron pellets, steel, hot and cold rolled coils/sheets, steel bars, strips, plates, billets, wire rod products. Emissions from iron and steel plants are both reported by the plants according to their monitoring and reporting requirements in the environmental permits, and also calculated at the inventory agency. Tier 3 / 2 Emissions related to fuel combustion are mainly reported under NFR 1A2a.

Units	Emissions	Emission data reported by the plants	Calculated for
Steel production, < 5 plants (the other of the remaining blast furnaces was closed down in 2012)	NMVOC	75% (< 5 plants)	25% (< 5 plants)
	PAH-4	50% (< 5 plants)	50% (< 5 plants)
	PCDD/F	75% (< 5 plants)	25% (< 5 plants)
	PCB	25% (< 5 plants)	75% (< 5 plants)
	As, Cd, Pb, Zn	100% (< 5 plants)	-
	Cr, Cu, Hg, Ni	100% (< 5 plants)	-
	CO	100% (< 5 plants)	-
	NOx, SOx	100% (< 5 plants)	-
	TSP	100% (< 5 plants)	PM_{10}, $PM_{2.5}$, BC
Pig iron tapping	PAH-4	-	100% (< 5 plants)
Sinter processes,< 5 plants (last unit was closed down in December 2011 and a new one started operation in 2012)	NMVOC	100% (< 5 plants)	-
	PAH-4	100% (< 5 plants)	-
	PCDD/F	100% (< 5 plants)	-
	PCB	-	100% (< 5 plants)
	HCB	-	100% (< 5 plants)
	TSP	100% (< 5 plants)	PM_{10}, $PM_{2.5}$
	Cd, Cr	100% (< 5 plants)	-
	Pb	100% (< 5 plants)	-
	SOx, NOx	100% (< 5 plants)	-
Rolling mills, < 5 plants	As, Cr, Cu, Pb, Ni	100% (< 5 plants)	-

	Hg, Cd	100% (< 5 plants)	-
	Zn	100% (< 5 plants)	-
	TSP	100% (< 5 plants)	PM_{10}, $PM_{2.5}$, BC
	NMVOC	100% (< 5 plants)	-
	SOx	100% (< 5 plants)	-
	NOx	100% (< 5 plants)	-
Other, 26 plants	NH3	100% (< 5 plants)	-
	As	100% (5 plants)	-
	Hg	<5 plants	-
	CO	<5 plants	-
	TSP	10-20 plants	PM_{10}, $PM_{2.5}$, BC
	Cd	5-10 plants	-
	Cr, Cu, Zn	10-20 plants	-
	Pb	10-20 plants	-
	Ni	10-20 plants	-
	NMVOC	10-20 plants	-
	SOx, NOx	<5 plants	-

Steel producers in Finland

Producers of steel and non-ferrous metals in Finland in 2023 is presented in Figure 4.5.

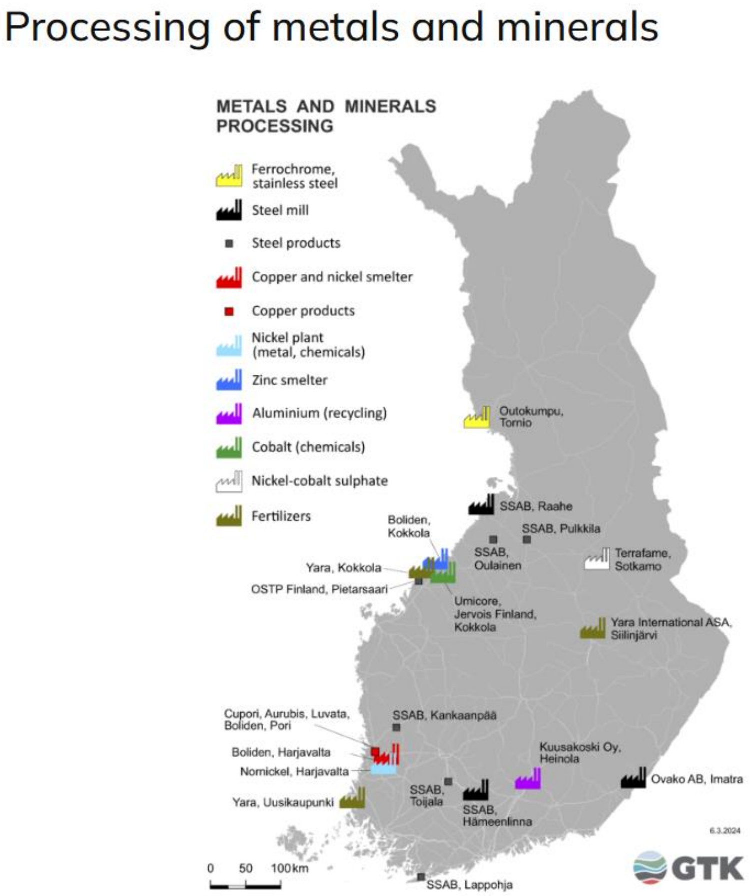

Figure 4.5. Producers of steel and non-ferrous metals in Finland in 2023 (GTK 2025) https://www.gtk.fi/en/current/mining-and-deposit-maps/

Production of steel[2]

Processes used in the production of steel from iron ore and scrap metal in Finland are described below (Figure 4.6).

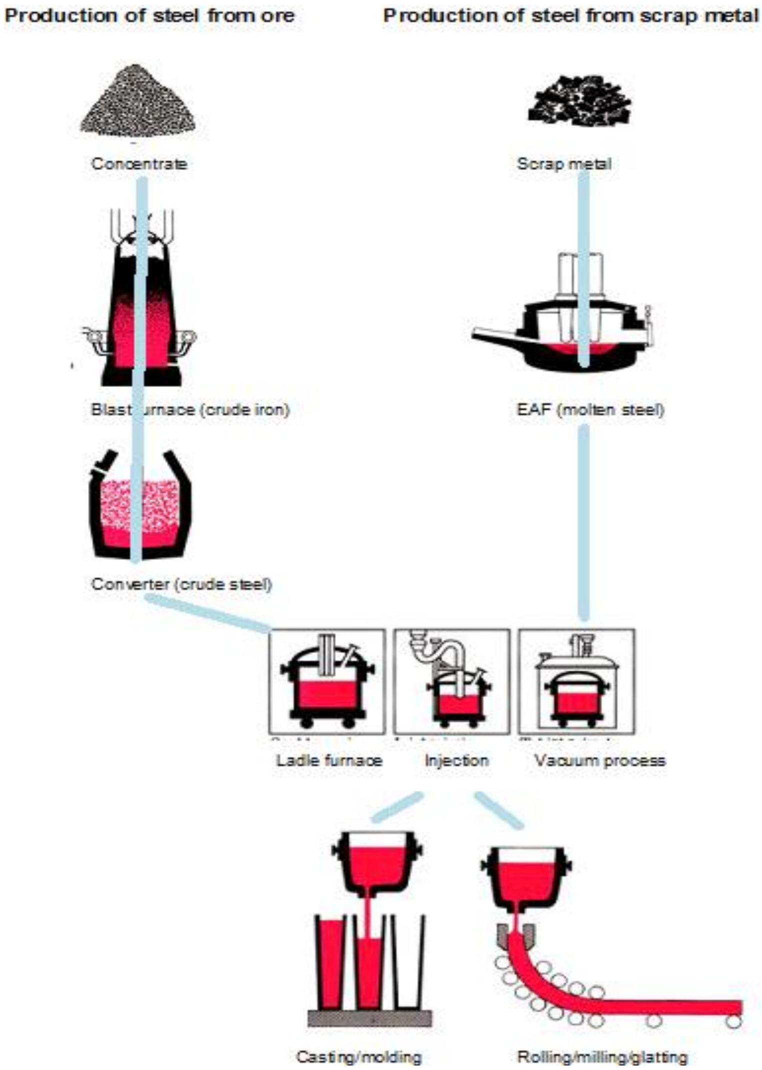

Figure 4.6. Production of steel from iron ore and scrap metal in Finland according to Teräskirja (Book of Steel in Hiilitieto, 2017).

Production from ore

Steel production processes in Finland include oxygen injection, EAF (Electric Arc Furnace) and AOD (Argon Oxygen Decarburization) methods. In 2023 two blast furnaces were in operation. The blast furnaces are small but belong to the most efficient ones in Europe regarding production volumes and fuel use as well as the use of coal per steel tonne produced.

Process units for iron and ferrochrome production use coal and coke and utilise carbon monoxide and hydrogen containing process gases as energy sources. Processes include coking plant, blast furnace, sinter plant, sulphur removal, ladle furnace, BOF (Basic Oxygen Furnace) converters, LD converter, casting, hot and cold rolling.

[2] http://www.outokumpu.com/en/products-properties/more-stainless/producing-stainless-steel/Pages/default.aspx
http://www.ovako.com/en/Products/Standard-steel-grades/
http://usa.amegroup.com/Website/Content/GuestInformation/SiteDetail/Steel/8766/FNsteel_-_Koverhar
https://hiilitieto.fi/hiilitietoa/perustietoa-hiilesta/hiili-terasteollisuudessa/

In the production of carbon steel iron ore is reduced in blast furnaces using coke and oil into crude iron. Coke and oil are added to reduce the oxygen present in the iron ore. Crude iron contains 4.5% coal and the iron turns into steel in the converter (steel is iron where the coal content is below 2%). Combustion gases from coking are used as energy sources in the processes of the steel mill and contribute to 60% of the energy demand.

In the production of ferrochrome which is rawmaterial for stainless steel, coal is used to reduce chrome concentrate and combustion gases from this are used as fuel.

Processing of steel from scrap and alloys

Electric arc furnace (EAF) is used for steel production from scrap metal in Finland. Molten ferro chromium smelting is used in addition to EAF. The steps in processing metal scrap include

1) Melting of raw materials in an electric arc furnace (EAF)
   During the melting process, the arc reaches temperatures of up to 3,500 °C, and the molten steel can reach up to 1,800 °C. The additional injection of chemical energy, in the form of carbon, ferrosilicon, oxygen, or fuel gas mixtures, speeds up the melting process.

2) Removal of carbon, sulfur, and possibly nitrogen, in a steel converter
   After melting, the steel is further processed in an AOD converter or through a VOD (Vacuum Oxygen Decarburization).
   In the AOD the carbon content is reduced to a target amount and to supply additional alloying elements. When liquid ferrochrome is used, an iron-rich scrap mix with low alloy content is melted in the arc furnace. Nickel and molybdenum, together with the liquid ferrochrome, are then added to the AOD converter.
   The VOD (Vacuum Oxygen Decarburization) is used to produce very low carbon or nitrogen content for high chromium ferritic stainless steels.

3) Tuning of the steel composition and temperature
   Secondary metallurgical treatment is done in a ladle station, ladle furnace, or as a vacuum treatment of the liquid steel to adjust and to homogenize both the temperature and chemistry of the molten material.

4) Casting of slabs or ingots
   The liquid steel ladle is transported to casting.

Hot rolling

In hot rolling the cast microstructure of semi-finished casting products is broken down maintaining but maintaining a structure to prevent the steel from hardening. The finished product’s surface is covered with an iron- and chromium-rich oxide that forms at high temperatures. It is usually removed in the annealing and pickling line, which restores the smooth metallic surface.

Cold rolling, annealing, and pickling

a) Small-diameter working rolls work out the strip profile and flatness. Restoring the material properties after cold rolling is carried out in a heat treatment and all oxide scale is removed in acid pickling baths, and then finishing off with high pressure water rinsing. Alternatively, a bright annealing line (BA-line) is used to restore the material properties hydrogen or a mixture of hydrogen and nitrogen. As no oxygen is available inside the furnace, no additional oxide scale is formed and whatever oxide remains on the strip is reduced to metal.
b) Skin pass rolling (temper rolling) is a light cold-rolling treatment with low reduction (0.5–1%) to improve the strip shape, finish, and mechanical properties.

Final processing

To tailor coils and plates to customer requirements the following processes are used:
- Roller or stretch leveler
- Edge trimming to the desired width
- Slitting into narrow coils
- Cutting into desired length sheets/plates
- Shearing/cutting into an order-sized shapes.
- Coating and preparing edges for special welding requirements

Emission trend

In surface preparation such as grinding, brushing, pattern rolling, or embossing the emissions are impacted by annual production rates, which depend on the markets. Technological changes in production and abatement techniques have occurred over the time.

Heavy metal emissions have decreased strongly from the early 1990s or early and mid-2000s (Ni, Hg) mainly due to process changes and changes in the used raw materials. The main reason for fluctuation in SOx, NMVOC and CO emissions over the years is the changes in used raw materials.

Dip in HCB emissions in 2011 is due to closing of one sintering unit (high HCB emission level), while a new sintering unit was started in 2012 (low HCB emission level). PAH emissions originate from sintering. However, an explanation has not yet been found for the lower emission level since 2006. PAH emissions are only based on few measurements made at the plant. PCB emissions originate in sintering and production of crude steel. The fluctuation of emissions in 2008-2011 is related to the fluctuation of the production volumes of iron in the same years.

Contribution of iron and steel production to total emissions is presented in Table 4 25.
The sector contributed more than 10% of the total Cr and Hg emissions and approximately 5% of total As, Ni emissions, for PCB emissions thies sector contributed almost 60% of total emissions.

Table 4.25. Contribution of Iron and Steel production (NFR 2C1) to total emissions in 2023.

Pollutant	Emissions iron and steel industry in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.183	72.510	Gg	0.3	100
SOx (as SO_2)	0.947	20.536	Gg	4.6	100
NH_3	0.037	30.16	Gg	0.1	100
$PM_{2.5}$	0.165	13.108	Gg	1.3	0
PM_{10}	0.182	25.728	Gg	0.7	0
TSP	0.217	39.531	Gg	0.5	100
BC	<0.001	3.063	Gg	<0.1	0
CO	0.096	298.374	Gg	<0.1	100
Pb	0.375	12.089	Mg	3.1	100
Cd	0.006	0.767	Mg	0.8	100
Hg	0.080	0.493	Mg	16.3	100
As	0.050	1.632	Mg	3.1	100
Cr	1.967	13.473	Mg	14.6	100
Cu	0.381	37.478	Mg	1.0	100
Ni	0.654	8.793	Mg	7.4	100
Zn	1.682	119.511	Mg	1.4	100
PCDD/F	0.239	8.651	g I-Teq	2.8	100
PAH-4	0.011	19.315	Mg	<0.1	0
HCB	0.013	16.24	kg	<0.1	0
PCB	8.495	14.315	kg	59.3	29.6

Methodological issues

Activity data
Activity data for production of coke, steel and iron, is presented in Table 4.26.

Table 4.26 Production of coke, steel and iron as reported by plants to the YLVA-database.

Year	Production of coke (1000t)	Production of crude steel (1000t)	Production of sinter (t)	Production of iron (t)
1990	487	2 861	2 992 000	2 280 000
1995	920	3 176	2 832 000	3 242 000
2000	910	4 096	2 780 000	3 903 000
2005	894	4 738	2 857 000	3 056 165
2010	828	4 040	2 256 069	2 564 451
2015	876	3 939	457 000	2 270 261
2016	882	4 048	469 000	2 308 774
2017	864	3 953	416 000	2 196 276
2018	861	4 074	493 000	2 356 386
2019	836	3 444	515 000	1 813 106
2020	761	3 440	495 000	1 770 483
2021	835	4 279	515 000	2 007 573
2022	808	3 495	424 600	1 539 655
2023	811	3 778	395 400	1 823 380

Emissions are either reported by the plants or calculated using activity data.

Sulphur dioxide, nitrogen dioxide and heavy metals (Key category for SOx, Pb, Hg, As, Cr, Ni, Zn)
Sulphur dioxide, nitrogen dioxide and heavy metal emissions from the iron and steel industry are based on data reported by the plants.

Particle emissions (Key category for TSP, PM_{10} and $PM_{2.5}$)
Particle emissions are generated in the foundries and sinter plants. TSP emissions are reported by the plants to the supervising authorities and are available in YLVA to be used in the inventory. PM_{10} and $PM_{2.5}$ emissions have been calculated with fraction factors as follows:
- Foundries: 80% for PM_{10} and 50 % for $PM_{2.5}$ (EMEP/EEA Guidebook 2023) (Table3-8)
- Sinter plants: 50% for PM_{10} and 40% for $PM_{2.5}$ (EMEP/EEA Guidebook 2023) (Table3-2)
- Steelworks (BOF): 91% for PM_{10} and 80% for $PM_{2.5}$ (EMEP/EEA Guidebook 2023) (Table3-14)
- Steelworks (EF) and rolling of steel: 80% for PM_{10} and 70% for $PM_{2.5}$ (EMEP/EEA Guidebook 2023) (Table3-15)

Black carbon
BC emissions are calculated usingemission factors presented in EMEP/EEA Guidebook2023 for basic oxygen furnace, electric furnace steel plant, rolling mills and foundries in Table3-1 and for Sinter and pelletizing plant in Table 3-2.

NMVOC
Emission data from steel plants are reported by the plants to the supervising authorities. For those plants, which do not report their NMVOC emissions, the emissions are calculated with activity data and emission factors as follows:

Basic oxygen furnace steel plant
- Emission factor 0.08 kg/t (EEA/EMEP Guidebook 2002) is used for the years 1990-2013.

Note: Guidebook 2002 is used as it provides a T2 EF while the later Guidebooks, including the 2023 version, provide only a T1 EF which we consider to over-estimate emissions.

Electric arc furnace steel plant
- A plant specific EF of 0.09271 kg/t, which was calculated for the years 1990-2007 based on emissions reported to the YLVA database from 2008 onwards. No changes have occurred in the steel plant process since 1990.

NH_3
Emissions are reported by the plants according to their monitoring and reporting requirements in the environmental permits to the YLVA database.

PAH
Iron and steel industry is a key category for PAH-4 emissions.

PAH emissions originate in sintering and iron and steel production processes:

(1) Sintering - there have been two sintering units operating in since 1990.

One of the units was in operation in 1990-2011, after that the unit was closed down and a new unit started operation in 2012.

Emissions in 1990-2000 have been calculated using production data and the country specific EF of 0.04 g/t which is based on measurements and is thus considered to better reflect the techniques used in the 1990s, while the EMEP/EEA Guidebook 2023 EFs would correspond better to the more recent years.

Emissions in 2001-2011 are reported by the plants and here the years 2001-2005 are based on measurements carried out in 1999, while the years 2006-2011 are based on measurements carried out in 2006. The sintering plant was shut down in 2011.

Emissions since 2012: The emissions from the new unit that started the operation in 2012 are reported by the plant and are low compared to the emissions from the earlier unit that was closed in 2011. The reason for the strong decreases is the actual changes in the activities.

(2) Iron and steel production units, which have been operating all the years.

From iron production the emissions are calculated using the country specific EF of 4.3 mg/t based on B(a)P-, benzo(b)-, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene measurements at the plant, and production data.
Note that the default EF of 2.5 g/t provided in the EMEP/EEA 2023 Guidebook is very high and only appropriate if tar-containing coating material is used. The Guidebook EF does not correspond to Finnish conditions. Therefore, the EF suitable for the Finnish conditions and corresponding to modern techniques' performance is used.

From steel production, emissions of 2 of the 3 plants are based on information from the plants for the whole time series. For the third plant, the emissions have been calculated using the EF 0.07 mg/t (UBA, 1998) because the processes at the third plant differed from the two other ones so that an IEF of the other plants could not be used. Emissions from the third plant occured in 1990-2003.

The split of PAH-4 emissions into the 4 PAH species has been carried out according to the results from a survey to the plants.

PCB and HCB (Table 4.35) (Key category for PCB)
Most of the steel mills report their POP emissions to the environmental authorities.

PCB
For those plants which do not report their emissions, PCB emissions from the production of steel (electric arc furnaces) are calculated using EF in theEEA/EMEP Guidebook 2023 (Table 3-15) for years 1990-2016. In the 2022 submission a new country-specific emission factor for one plant was taken in use for emissions from year 2017-2019. This EF (0,4 mg/Mg) is based on measurements done in 2017 at the plant, where abatement technology is based on activated carbon. Emissions from 2020 onwards are reported by the plant. For the other plant emissions are calculated for whole time series using emission factor from the EMEP/EEA Guidebook 2023.

Emission factors used for production of sinter
- HCB 32 µg/t (EMEP/EEA Guidebook 2023)
- PCB 0.09 mg/t (EMEP/EEA Guidebook 2023)

PCDD/F (Key category for PCDD/F)
The emissions from sintering in 1990-2001 have been calculated using production data and the country specific EF based on expert estimate 0.36 µg *I-TEQ*/t which is considered to better reflect the techniques used in the 1990s, while the EMEP/EEA Guidebook 2023 EFs correspond better to the more recent years. However, country-specific EFs are used for all years. The emissions were reported by plants in 2002-2011. These sintering units were shut down in 2011. Since 2013 PCDD/F emissions from sintering are reported by one plant which started operation in 2013.

PCDD/F emissions from steel production are reported by plants.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2018
- The whole time series was recalculated.
- National emission factors were checked and new emission factors calculated based on site specific information on emissions and production volumes while recalculating the time series.
- PAH4 emissions were split into the PAH indicator species for whole time series based on information received from the plants.
- Use of Guidebook 2016 EFs was checked.

2020
- Update to Guidebook 2019 EFs

2020-2021
- PAH emissions from iron production were missing from the 2019 submission and were included in the 2020 submission while information on the issue was not included in the 2020 IIR (related to ERT finding)

PAH emissions were erroneous and duplicated for 2008-2016 for one plant and for 2014-2015 for another plant in submission 2020. These were corrected for submission 2021.

2022
- Change of EF for PCB emissions for one plant (country-spesific EF) from year 2017 onwards.

2023
- Update of the method to calculate NMVOC emissions: implementation of an IEF for one plant for years 1990-2007.

Source-specific planned improvements

None.

Ferroalloys production (2C2)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040302 Key category for Cr (L1)		FERRO ALLOYS Ferrochromium production plants (< 5 plants) are part of integrated stainless steel plants, emission reported by the plants Production capacity: 600 000t
Emissions	Tier	Source of emissions
NMVOC, SOx, PAHs	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM_{10}, $PM_{2.5}$, BC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits, calcualted
Pb, Cd, Hg, As, Cr, Cu, Ni, Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

Ferrochromium production occurs in the integrated stainless steel plants.

The emissions are either allocated under NFR 2C2 or NFR 2C1 according to information of the main activity of the plant as stated in their environmental permits.

Emission trend

Ferroalloys production is a major source of chromium emissions. In 2016, 2014 and also in 2002 several malfunction situations occurred at a production unit during the year, which could be seen as an increase in the level of zinc, nickel and chrome (also in 2007-2008) emissions. PAH emissions are related to ferrochrome production, and a new unit duplicating the production rate was started in 2013.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.27.

Table 4.27. Contribution of Ferroalloys production (NFR 2C2) to total emissions in 2023.

Pollutant	Emissions ferroalloys production in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.001	72.510	Gg	<0.1	100
SOx (as	0.001	20.536	Gg	<0.1	100
PM2.5	0.055	30.16	Gg	0.4	0
PM10	0.078	13.108	Gg	0.3	0
TSP	0.091	25.728	Gg	0.2	100
BC	0.005	39.531	Gg	0.2	0
Pb	0.024	12.089	Mg	0.2	100
Cd	<0.001	0.767	Mg	<0.1	100
Hg	0.002	0.493	Mg	0.4	100
As	0.001	1.632	Mg	<0.1	100
Cr	0.972	13.473	Mg	7.2	100
Cu	0.022	37.478	Mg	<0.1	100
Ni	0.054	8.793	Mg	0.6	100
Zn	0.904	119.511	Mg	0.8	100
PAHs	<0.001	19.315	Mg	<0.1	0

Methodological issues

As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, TSP, SOx, and NMVOC

Emissions are reported according to requirements for monitoring and reporting in the environmental permits of the plants.

PM_{10} and $PM_{2.5}$
Emissions are calculated using size fraction factors of 85% for PM_{10} and 60% for $PM_{2.5}$ (EMEP/EEA Guidebook 2023, Table 3-1) from TSP emissions that are reported by the plants.

Black carbon
Emissions have been calculated using the EF presented in Table 3-1 EMEP/EEA Guidebook 2023.

PAH
Emissions originate from ferrochrome production, where a new unit started operation in 2013. Emissions are reported according to requirements for monitoring and reporting in the environmental permits of the plants.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2019
- Change of particle fraction factors according to Guidebook 2019.

2021
- PAH emissions were erroneous and duplicated for 2013 and 2015 for one plant in submission 2020. These were corrected for submission 2021.

Source-specific planned improvements

The possibility to calculate emissions related to ferrochrome production before 2012 will be studied for next submission.

Aluminium production (NFR 2C3)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040301 Not a key category for any pollutants		OTHER Secondary aluminium production and aluminium casting Number of plants < 5 Production capacity: ~50 000 t/a aluminium profiles
Emissions	Tier	Source of emissions
NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC, Pb, Cd, As, Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits and calulated
PCDD/F, HCB, PCB	T3/T2	calculated (EF*AD)

There is no primary aluminium production in Finland.

The contribution of aluminium production to national total emissions and the share of emissions reported by the operators is presented in Table 4.28.

Table 4.28 Contribution of Aluminium production (NFR 2C3) to total emissions in 2023.

Pollutant	Emissions ferroalloys production in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.002	72.510	Gg	<0.1	100
$PM_{2.5}$	<0.001	13.108	Gg	<0.1	0
PM_{10}	<0.001	25.728	Gg	<0.1	0
TSP	<0.001	39.531	Gg	<0.1	94.7
BC	<0.001	3.063	Gg	<0.1	0
Pb	0.010	12.089	Mg	<0.1	100
Cd	0.003	0.767	Mg	0.4	100
As	0.002	1.632	Mg	0.1	100
Zn	0.042	119.511	Mg	<0.1	100
PCDD/F	0.042	8.651	g I-Teq	0.5	0
HCB	0.034	16.24	kg	0.2	0
PCB	0.088	14.315	kg	0.6	0

Emission trend

Emissions vary yearly depending on production rates and the quality of the aluminium. The increase in Zn emissions in 2019 was related to the aluminium quality that year.

Methodological issues

NMVOC
NMVOC emissions are reported by the plants according to their monitoring and reporting obligations.

Particles
TSP emissions are reported by the plants according to their monitoring and reporting obligations. PM_{10} and $PM_{2.5}$ emissions from the production of secondary aluminium are calculated using size fraction factors of 70 % for PM_{10} and of 27.5 % for $PM_{2.5}$ (Table 3-4, EEA/EMEP Guidebook 2023).

Heavy metals
Arsenic, cadmium, lead and zinc emissions are reported by the plants according to their monitoring and reporting obligations. Heavy metal emissons are quite small but the quality of the used raw material in the process impacts to the emissions.

POP emissions
PCB, HCB and PCP emissions from production of secondary aluminium as well as PCB emissions from aluminium casting are calculated for plants using emission factors listed in Table 4.29 and activity data presented in Table 4.30.

PCDD/F emissions were calculated for the whole times series using the IEF of 1.707 ug I-TEQ/ calculated from data reported by the plant for years when measured data reported by the plant has not been available. The peak in emissions in 1993 is reported by the plant.

Table 4.29. Emission factors for POP emissions.

Pollutant	Process	EF	Reference
PCDD/F	secondary aluminium	1.71 ug I-TEQ/t	SYKE, 2022
HCB	secondary aluminium	1.365 mg/t	SYKE, 2007
PCB	secondary aluminium	3.4 mg/t	BiPRO, 2006 No method in the Guidebook
PCP	secondary aluminium	0.128 mg/t	SYKE, 2007
PCB	aluminium casting	0.135325 mg/t	Toda, 2005. No method in the Guidebook

Table 4.30. Secondary aluminium production and aluminium casting volumes.

Production of secondary aluminium (t) (YLVA)		Aluminium casting (t) Expert estimate at SYKE 1990-1997, Statistics Finland from 1998 onwards	
1990	23 926	1990	13 000
1995	33 539	1995	13 000
2000	43 361	2000	17 799
2005	20 242	2005	22 602
2010	22 477	2010	33 896
2015	20 490	2015	31 521
2016	22 071	2016	31 385
2017	25 298	2017	33 810
2018	25 709	2018	34 013
2019	24 724	2019	34 638
2020	24 406	2020	32 128
2021	28 884	2021	37 664
2022	26 552	2022	42 073
2023	24 712	2023	30 145

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2018
- The allocation of secondary aluminium production was partly reallocated to NFR 2C3 from NFR 2C7c according to the recommendations from the NECD 2017 review.
- Small particle distribution factors were updated according to the recommendations from the NECD 2017 review.

2019
- The allocation of one plant is corrected and moved to NFR 2C3 in the 2019 submission.

2020
- The allocation of PCDD/PCDF were corrected for years 2009, 2013 and 2016 from category 2C7c to category 2C3.

2021
- PCDD/F emissions were calculated for years before before 2017 using an IEF derived from data reported by the plants.

2022
- Activity data for aluminium casting has been updated for 2014-2019.

2023
- PCDD/F emissions has been updated using IEF and measurement data provided by the plant. The whole timeseries has been updated.

Source-specific planned improvements

None.

Magnesium production (2C4)

No magnesium production has occurred in Finland.

Lead production (2C5)

No lead production has occurred in Finland.

Zinc production (NFR 2C6)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040309c Key category for Zn (L1)		Zinc production plants (< 5 plants), emissions both reported by the plants and calculated
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits and calculated
Pb, Cd, Hg, As, Cu, Ni, Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
PCDD/F	T2	calculated

Special high-grade zinc is produced in Finland by an electrolytic process in a smelter. The electrolytic process includes four main stages: 1) Roasting of zinc concentrate in temperature of more than 900 ^oC (ZnO as product), 2) Leaching stage, where the zinc oxide is separated from the other calcines 3) Impurities elimination 4) Electrolysis. According to 2006 IPCC Guidelines this process does not result in non-energy CO_2 emissions. (Finland's NID 2025)

Emission trend

Zinc production is a source of heavy metals, and PCDD/F. Process emissions fluctuate annually (e.g. zinc) depending on operation, raw material and products. Zn emissions from this sector contribute from 5% to 10% of the total emissions annually. There is slight increase in emission levels in 2019 due to disturbances in the electrolytics process. Ni emissions occurred in 1992-1996, whereafter the process causing these emissions was closed down (emissions in 1990-1991 are included in the energy sector).

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.31.

Table 4.31. Contribution of Zinc production (NFR 2C6) to total emissions in 2023.

Pollutant	Emissions from zinc production in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
Pb	0.023	12.089	Mg	0.2	100
Cd	0.009	0.767	Mg	1.2	100
Hg	0.003	0.493	Mg	0.7	100
As	0.012	1.632	Mg	0.8	100
Cu	0.012	37.478	Mg	<0.1	100
Zn	8.012	119.511	Mg	6.7	100
PCDD/F	0.064	8.651	g I-Teq	0.7	0

Methodological issues

SO_x
Zinc production occurs alongside sulphur productios and SO_2 emissions from zinc production are utilised in the sulphur production. Therefore, SO_2 emissions are not emitted from zinc production except in exceptional situations such as malfunctioning or during start-up and shut-down periods.

Adding the above explanation for the non-occurring SO_2 emissions was recommended by the NECD 2017 review. In addition, the TERT recommended to replace the notation key "NA" with "NO". However, the notation key has not been changed, because the use of "NO" means that the activity does not exist and the use of the notation key "NA" means that the emission is not relevant/occurring.

Heavy metals (As, Hg, Cd, Cu, Pb, Zn) (Key category for Cd and Zn)
The plants report these emissions according to the monitoring programmes in the environmental permits to the environmental authorities and the data are available in YLVA for use in the inventories.

Cd emissions starting from 2002 are related to zinc production.
Ni emissions occurred in 1992-96 from zinc white production which occurred in these years. Ni emissions from 1990 to 1991 are included in the energy sector emissions.

Particles
TSP emissions are reported by the plants according to their monitoring and reporting obligations in their environmental permits. The reported figures are the total emissions including both the fuel based and process related emissions. The process related emissions are estimated as the difference between the total reported emissions and the default emissions calculated on basis of fuel consumption. Hence, the difference is reported under NFR 2C6. Under NFR 2C6, PM_{10} and $PM_{2.5}$ emissions are calculated using size fraction factors of 91% for PM_{10} and 81% or $PM_{2.5}$ from TSP emissions (EMEP/EEA Guidebook 2023, Table 3-5). Particle emissions in 2016-2017, 2019-2021 and 2023 are included in NFR 1A2b.

NMVOC and PCDD/F
An implied emission factor of 0.218 t/t for PCDD/F (SYKE, 2021) has been used for the years 1990 onwards and production data presented in Table 4.41. The IEF for PCDD/F was updated to the 2022 submission based on new information received from the plant, because the old IEF of 0.098 t/t was based on an incorrect emission value in the YLVA database.

In the earlier submissions, NMVOC emissions were included. In consultation with the plant during 2022 it was discovered that NMVOC emisisons they reported for 2007 did not originate from the process itself but from maintenance work at the plant. Therefore, to the 2023 submission, NMVOC emissions were removed for the whole time-series and replaced by the notation key NA.

Production volumes are available either at plant level in YLVA or from the Federation of Finnish Technology Industries (Table 4.32).

Table 4.32. Production of zinc (reported by plants to the YLVA database).

Year	Zinc production (t)
1990	175 000
1995	176 583
2000	222 881
2005	281 904
2010	307 144
2015	305 717
2016	290 599
2017	284 992
2018	295 029
2019	290 843
2020	297 257
2021	292 648
2022	294 122
2023	293 960

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2017
- NMVOC emissions for whole time series added to the inventory in 2017 submission.

2018
- For the not occurring SO2 emissions, the 2017 NECD review TERT recommended to replace the notation key "NA" with "NO". However, the notation key has not been changed, because the use of "NO" means that the activity does not exist and the use of the notation key "NA" means that the emission is not relevant/occurring.

2019
- The allocation of emissions between the energy/processes sectors was checked.

2020
- Particle fractions updated according to Guidebook 2019.

2022
- The IEF for PCDD/F emissions has been corrected.

2023
- NMVOC emissions for whole time series have been removed and replanced with the notation key NA.

Source-specific planned improvements

None

Copper production (NFR 2C7a)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040309a Key category for As (L1,) PCDD/F (L1) HCB (L1, T1)		SNAP-NAME Secondary copper production plants (< 5 plants) and production of upgraded copper products. Emissions both calculated or reported by the plants Production capacity see table 4.39
Emissions	Tier	Source of emissions
SO_X, CO, NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM_{10}, $PM_{2.5}$	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits, calculated
Pb, Cd, Hg, As, Cu, Ni, Se, Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
PCDD/F, HCB, PCB, BC	T2	calculated

Emission trend

Primary copper production is a major source of HCB emissions. Also, heavy metal (arsenic and selene) and PCDD/F emissions occur form copper production. Other pollutants contribute less than 1% of the total emissions as presebted in table 4.38. Emission trends are mainly decreasing due to increased abatement. PCDD/F emissions have increased since 2014 due to commence of secondary copper production, earlier only primary copper have been produced.

Contribution of secondary copper production to total emissions is presented in Table 4.33.

Table 4.33. Contribution of Secondary copper production (NFR 2C7a) to total emissions in 2023.

Pollutant	Emissions from copper production in 2023	Total emissions in	Unit	Share of total emissions %	% reported by the plants
NMVOC	<0.001	72.510	Gg	<0.1	0
SOx (as SO2)	0.111	20.536	Gg	0.5	1.7
$PM_{2.5}$	<0.001	13.108	Gg	<0.1	0
PM_{10}	<0.001	25.728	Gg	<0.1	0
TSP	<0.001	39.531	Gg	<0.1	27.5
BC	<0.001	3.063	Gg	<0.1	0
CO	0.0014	298.374	Gg	<0.1	100
Pb	0.003	12.089	Mg	<0.1	51.7
Cd	<0.001	0.767	Mg	<0.1	100
Hg	<0.001	0.493	Mg	<0.1	0
As	0.068	1.632	Mg	4.2	84.1
Cr	<0.001	13.473	Mg	<0.1	100
Cu	0.003	37.478	Mg	<0.1	100
Ni	<0.001	8.793	Mg	<0.1	0
Se	0.106	0.440	Mg	24.1	100
Zn	0.006	8.651	Mg	<0.1	100
PCDD/F	0.209	19.315	g I-Teq	2.4	1.3
HCB	6.108	16.24	kg	37.6	0
PCB	<0.001	14.315	kg	<0.1	0

Methodological issues

Total suspended particles, heavy metals (As, Cd, Cu, Pb, Zn, Ni, Hg) and sulphur dioxide (Key category for As)
Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available emissions has been calculated.

Small particle emissions and black carbon
PM_{10} and $PM_{2.5}$ emissions are calculated using size fraction factors 78% for PM_{10} and 59% for $PM_{2.5}$ (EMEP/EEA Guidebook 2023, Table 3-3) from TSP emissions. Black carbon emissions are calculated using the EF presented in Table 3-3 in EMEP/EEA Guidebook 2023.

POPs (Key category for HCB)

PCDD/F, PCB and HCB emissions from production of copper as well as PCB and HCB emissions from wrought copper manufacturing are calculated separately for each plant. For PCDD/F emissions emission factors from EEA/EMEP Guidebook 2023 has been used; for production of copper Table 3-2 and for production of secondary copper Table 3-3. For HCB emissions production of copper EF 39 mg/t (Pacyna, 2003) and for wrought copper production 17.5235 mg/t (Toda 2005) has been used. For PCB emissions EF's from EMEP/EEA Guidebook 2023 from Table 3-1 (production of copper) and from Table 3-3 (wrought copper production) has been used.

Activity data used in the calculation is presented in Table 4.34.

Table 4.34. Copper production volumes 1990-2023 (reported by plants to the YLVA-database).

Year	Copper production (t)	Wrought copper production (t)
1990	90 200	113 941
1995	88 300	113 941
2000	155 400	126 287
2005	157 933	110 707
2010	117 900	69 189
2015	137 682	36 713
2016	146 871	36 947
2017	149 605	41 486
2018	147 203	45 984
2019	132 668	36 900
2020	156 157	32 463
2021	148 531	40 202
2022	132 717	44 884
2023	136 418	44 977

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2014
- Activity data for copper production was corrected.

2018
- Emissions from this NFR category were checked to include all plants according to the recommendation of the NECD 2017 review.
- PCB and PCDD/F – the emission factosr was updated to correspond to the revised EF in Guidebook 2016. The change increased the PCDD/F emissions to be 10-fold.

2019
- Sox and PM2.5 emissions for 2015 and 2014 are now corrected (the emission values had accidentally been transposed in the 2017 submission.)
- Re-check of Guidebook 2016 EFs

2020
- In the 2019 submission PCDD/F emissions from copper production were allocated to an incorrect NFR by a mistake. The allocation was corrected to the 2020 submission.
- Guidebook 2019 EFs adopted.

2021
- Activity data updated for years 2016 and 2017.

Source-specific planned improvements

None

Nickel production (NFR 2C7b)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040305 Key category for Ni (L1, T1)		NICKEL PRODUCTION < 5 plants Production capacity 60 000- 90 000 tonnes nickel and nickel chemicals per year
Emissions	Tier	Source of emissions
SO_2, NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NH_3, Ni	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

Emission trend

Nickel production is a major source of Ni emissions, while other pollutants contribute less than 1% of the total emissions. Nickel emissions fluctuate in the time series and there has been exceptional emissions e.g. in 2018 due to malfunctioning of abatement techniques. The peak in NMVOC emissions in 2016 and the peak in SO_x emission in 2017 were due to malfunctioning of abatement techniques.

The shares of emissions of total emissions and shares reported by the plants are presented Table 4.35.

Table 4.35. Contribution of Nickel production (NFR 2C7b) to total emissions in 2023.

Pollutant	Emissions from nickel production in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.018	72.510	Gg	<0.1	100
SOx (as SO_2)	0.028	20.536	Gg	0.1	100
NH_3	0.009	30.16	Gg	0.1	100
Ni	0.912	8.793	Mg	10.4	100

Methodological issues

(Key category for Ni emissions)
NMVOC, NH_3, SO_x and nickel emissions are reported by the plants according to the monitoring requirements in the environmental permits.

Uncertainty and time series’ consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

None.

Source-specific planned improvements

None.

Other metal production (NFR 2C7c)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040306		ALLIED METAL MANUFACTURING Number of plants <5 Production capacity:~1000 t casting products
Emissions	Tier	Source of emissions
Cu, Pb, Zn, Ni	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
SNAP 040307		GALVANIZING Number of plants 7 Production capacity: varies, in smaller plants ~10 000 t steel structures is hot galvanized in a year, in bigger plant ~1 000 000 tonnes of steel in coils is reprocessed in a year
Emissions		Source of emissions
Zn, Cr	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Recycling of waste and scrap Number of plants <5 Production capacity: waste metals and waste containing metals 200 000 t/a, decomissioned vechicles 80 000 t/a .
Emissions	Tier	Source of emissions
As, Cd, Pb, Zn,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
PCB, PCP	T1	calculated (EF*AD)
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Surface treatment of metals Number of plants<5 Production capacity: not available, plenty of small plants, supply and demand varies yearly
Emissions	Tier	Source of emissions
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Pb, Zn, Cr, Ni,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC, NH3,	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Cable manufacturing Number of plants <5 Production capacity: ~500 000 t/a cables
Emissions	Tier	Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER

		Zinc wire manufacturing Number of plants <5 Production capacity: ~10 000 t/a wire
Emissions	Tier	Source of emissions
Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Lock Manufacturing Number of plants <5 Production capacity: not available
Emissions	Tier	Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
Zn, Cr	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Chromite mine and concentration plant Number of plants <5 Production capacity: not available
Emissions	Tier	Source of emissions
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Handling of FeCr slag Number of plants <5 Production capacity: not availble
Emissions	Tier	Source of emissions
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Manufacturing of small caliber cartridges Number of plants <5 Production capacity: ~80 000 000 catridges, ~60 000 000 bullets
Emissions	Tier	Source of emissions
Pb	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Handling of noble metals Number of plants <5 Production capacity: not available
Emissions	Tier	Source of emissions
PCB	T1	calculated (EF*AD)

SNAP 040309z		OTHER Handling of copper and nickel concentrates Number of plants <5 Production capacity ~70 000 t/a raw nickel matte

Emissions	Tier	Source of emissions
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
As, Cu, Pb	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
NMVOC	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

SNAP 040309z		OTHER Manufacturing of nails Number of plants <5 Production capacity: ~5000 t/a nails
Emissions	Tier	Source of emissions
Pb, Zn	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits
TSP, PM10, PM2.5	T3	reported by the plants according to the monitoring and reporting obligations in their environmental permits

Around thirty industrial installations that report their emissions to the authorities and for which data is available in YLVA database are included under NFR 2C7c. The installations work in recycling of waste and scrap metals, surface treatment, galvanizing, metallic construction mountings, cable manufacturing, and manufacturing of nails and locks. Due to the competitive position of the installations it is difficult to publish production capacities in the list presented above and in many cases there is only one installation working in a specific field. The category Other metal production is key category for Cd, As, Ni according to the level and trend (Approach 1) and according to the trend (Approach 1) for the following pollutants: Cu, Pb, and Zn.

Emission trend

Emissions in NFR 2C7c originate from several activities. Heavy metals, ammonia, particles and PCB emission are reported from NFR 2C7c. The peak in NH_3 emissions in 1999 is related to a malfunction in NO_x abatement

The shares of emissions of total emissions and shares reported by the plants are presented Table 4.36.

Table 4.36. Contribution of Other metal production (NFR 2C7c) to total emissions 2023.

Pollutant	Emissions from other metal production in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.005	72.510	Gg	<0.1	100
SOx (as SO_2)	<0.001	20.536	Gg	<0.1	100
NH_3	<0.001	30.16	Gg	<0.1	100
$PM_{2.5}$	0.005	13.108	Gg	<0.1	0
PM_{10}	0.006	25.728	Gg	<0.1	0
TSP	0.009	39.531	Gg	<0.1	100
Pb	0.300	12.089	Mg	2.5	100
Cd	0.035	0.767	Mg	4.6	100
Hg	0.005	0.493	Mg	1.0	100
As	0.063	1.632	Mg	3.9	100
Cr	0.007	13.473	Mg	<0.1	100
Cu	0.318	37.478	Mg	0.8	100
Ni	0.3419	8.793	Mg	4.8	100
Se	0.002	0.440	Mg	0.4	0
Zn	1.034	119.511	Mg	0.9	100
PCB	0.005	14.315	kg	<0.1	0

The process emissions fluctuate annually according to operation, e.g. copper emissions originate from smelting.

Methodological issues

Heavy metals (Key category for Pb, Cd, As, Cu, Ni and Zn emissions)
As, Cd, Cr, Cu, Pb, Ni, Hg and Zn emissions are reported by the plants according to the monitoring requirements in the environmental permits.

Ammonia
Use of ammonium chloride in hot galvanizing causes ammonia emissions. Only one plant uses ammonium chloride, the other plants are using electrolytic resurfing. The emissions are reported by the plants.

The peak NFR2 (Industry) in 1999 is due to an accidental emission reported by the plant to the environmental authorities.

Particles
TSP emissions are reported by the plants according to their monitoring and reporting obligations.

PM_{10} and $PM_{2.5}$ emissions are calculated using size fraction factors of 60 % for PM_{10} and of 50 % for $PM_{2.5}$ (AEAT, 2000). There is no method in the EMEP/EEA Guidebook 2023.

For galvanizing (SNAP 040307) size fraction factors of 92 % for PM_{10} and of 82 % for $PM_{2.5}$ (AEAT, 2000).

HCB
In discussion with the plant in 2020 it was confirmed that HCB emissions do not occur from the processes. The notation key NA is reported for the whole time series.

PCB
PCB emissions are calculated from production of gold and silver metals with the emission factor of 159.795 mg/t (Toda, 2005) and using activity data presented in Table 4.37.

Table 4.37. Precious metals; production of gold and silver (t) (Statistics Finland).

Year	Production of gold and silver (t) (Statistics Finland)
1990	31.8
1995	29.1
2000	28.6
2005	38.2
2010	70.6
2015	137
2016	112
2017	78
2018	93
2019	75
2020	73
2021	94
2022	94
2023	32

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2018

- Check of Guidebook 2016 EFs

2020

- In the 2019 submission PCDD/F emissions from copper production were allocated to NFR 2C7c by mistake, the allocation was corrected.

2021

- In 2020 it was confirmed with the plant that HCB emissions donot occur from the processes. The notation key revised into NA for the whole time series.
- Erroneous facility reported As, Cd, Cr, Cu, Ni, Pb and Zn emisssions were corrected for one plant for 2017-2018. In addition, erroneous facility reported Zn emissions were corrected for another plant for 2018.
- Ammonia emissions from one plant were incorrectly allocated under category 1A2b in submission 2020. The allocation of these emissions under category 2C7c was corrected in submission 2021.

2022

- Activity data for 2017-2019 updated for production of silver and gold.

Source-specific planned improvements

None.

Storage, handling and transport of metal products (NFR 2C7d)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040211 Not a key category for any pollutants		Storage, handling and transport of metal products storage and handling of iron ore.
Emissions	Tier	Emission source
TSP, PM_{10}, $PM_{2.5}$	T2	calculated (EF*AD)

Emission trend

Storage, handling and transport of metal products causes particle emissions. Emissions follow the fluctuating trend of the activity data.

The shares of emissions of total emissions and shares reported by the plants are presented in Table 4.38.

Table 4.38 Contribution of Storage, handling and transport of metal products (NFR 2C7d) to total emissions 2023.

Pollutant	Emissions from Storage. handling and transport of metal products in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	<0.001	13.108	Gg	<0.1	0
PM_{10}	0.006	25.728	Gg	<0.1	0
TSP	0.011	39.531	Gg	<0.1	0

Methodological issues

Particle emissions from storage, handling and transport of iron ore are calculated with emissions factors presented in EMEP/EEA Guidebook 2023 (Table 3-4) for whole timeseries.4 g/t, (TSP); 2 g/t (PM_{10}) and 0.2 g/t ($PM_{2.5}$). Production of iron ore is presented in Table 4.39. For the year 2023, activity data from 2022 has been used.

Table 4.39. Activity data for iron ore (Customs Statistics ULJAS).

Year	Iron ore (t))
1990	3 058 362
1995	2 964 994
2000	3 917 135
2005	4 215 633
2010	3 055 661
2015	3 428 486
2016	3 519 551
2017	3 169 204
2018	3 806 107
2019	2 617 816
2020	2 546 974
2021	3 630 977
2022	2 759 738
2023	2 759 738

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

None.

Source-specific planned improvements

None.

4.5 Solvent and other product use (NFR 2D-2G)

Changes in chapter	
February 2025	JMP, TF

NFR	Processes	Description	Emissions reported
2D3a	Domestic solvent use including fungicides	Personal care and cosmetics, household cleaning, car care and other products	NMVOC
2D3b	Road paving with asphalt		NMVOC, BC, TSP, PM_{10}, $PM_{2.5}$, PCDD/PCDF
2D3c	Ashalt roofing	Aspahlt mixing plants	NMVOC
2D3d	Coating applications	Decorative, industrial and other coating	NMVOC, TSP, PM_{10}, $PM_{2.5}$
2D3e	Degreasing	Chlorinated organic solvents are not produced in Finland, all the used solvents are imported.	NMVOC, NH_3
2D3f	Dry cleaning	Included in degreasing (2D3e)	NMVOCs included in degreasing, all other emissions NA
2D3g	Chemical Products	- pharmaceutical industry - textile and leather industry - plastics manufacturing and handling - rubber conversion - manufacture of paints, inks and glues - manufacturing adhevise, tapes and films	NMVOC, TSP, PM_{10}, $PM_{2.5}$, NH_3, Sox, Cd, As, Cr, Ni
2D3h	Printing	printing	NMVOC, Sox
2D3i	Other solvent use	- glass and mineral wool enduction - fat, edible oil extraction - preservation of wood - industrial application of glues and adhesives	NMVOC, Sox, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, PAHs, HCB
2G	Other product use	Use of fireworks and tobacco	As, Cd, Cr, Cu, Hg, Pb, CO, NH_3, Nox, Sox, NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC, PCDD/PCDF, PAHs

Domestic solvent use including fungicides (NFR 2D3a)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 060408 SNAP 060411 Key category for NMVOC (L1, T1)		Domestic solvent use (other than paint application) Domestic use of pharmaceutical products Use of personal care and cosmetics, household cleaning products, car care prodcuts and other products
Emissions	Tier	
NMVOC	T2	NMVOC (calculated)
Hg		Hg emissions from fluorescent tubes are reported under 1A1a by the hazardous waste incineration plant (with energy recovery)

Emission trend

Domestic solvent use is a key category for NMVOC emissions (level and trend, Approach 1). The emission trend has been stable until 2020 when the global pandemic caused emissions to peak, i.e. in

Finland the use and emissions of desinfectants increased to 6.8 kt in 2020 from the earlier level of 0.5-1 kt in 1990-2019. In 2021, the use of desinfectants was still at a considerably higher level compared to the situation prior to the pandemic, but in 2022 the use of desinfectants decreased to the level of 2019.

The shares of emissions of national totals and shares reported by the operators are presented in Table 4.40.

Table 4.40. Contribution of domestic solvent use (NFR 2D3a) to total NMVOC emissions in 2023.

Pollutant	Emissions from domestic solvent use in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	6.633	72.510	Gg	9.1	0

Methodological issues

NMVOC emissions are calculated with a methodology that corresponds with a Tier 2 level methodology.

Emissions have been calculated using different calculation sub-models:

1. Calculation of emissions from household product use
2. Calculation of emissions from pharmaseutic, adhesives and filling agents
3. Calculation of emissions from the use of desinfectants

Finland received a recommendation in the 2024 CLRTAP Stage 3 Review to report activity data for category 2D3a in the Annex I NFR tables instead of reporting a notation key 'NA'. As Finland stated in the review response, all activity data cannot be expressed in just one unit and reporting only part of the activity data is not reasonable. In addition, activity data for household product use that is based on sales data from companies, is confidential. For phamaseutic, adhesives and filling agents, population has been used as activity data (Table 4.42) and for use of desinfectants activity data is based on volume of volatile organic substances in desnfectant (Table 4.43).

The following sections summarise the activity data used in all the three calculation sub-models.

1.Calculation of emissions from household product use

The calculation of household product use is based on the calculation model developed in 2015 and described in the publication Rantanen et al. 2015 (in Finnish only, not publicly available). The model was updated in 2022, and it covers years from 1990-2023. In the model, NMVOC emissions are calculated for certain base years based on sales data of different product categories. The base years are 2014, 2015 or 2020, depending on the product category. The other years are estimated with the surrogate method using GDP as the surrogate data, and in the case of car care products, vehicles in traffic use. In addition, in the case of cosmetics and toiletries, also the years 2018 to 2022 are calculated based on actual sales data. The purpose is to update the model (the emission estimates, including the sales data) every 5 years with a new base year. The next update is scheduled to be reported in the 2028 submission.

Sales volumes of different products from different product categories (in litres) have been derived from information received from selected large retail companies and then scaled to the whole country according to the sales shares[3] (Finnish Grocery Trade Association, 2022) of the retailers taking into account the specific sales profiles of the different retailers. The information (sales volumes) received from selected large retail companies is confidential. NMVOC emissions have been estimated based on the sales volumes and the contents and volatilization rates of NMVOC compounds typically present in the products (see Appendix I and II of the IPPU IIR). The product mix of different product categories may vary a little from year to year in the data received from the retail companies. The product categories and their product mixes included in the NMVOC emissions calculations for the year 2020 are presented in Table 4.41.

[3] https://www.pty.fi/wp-content/uploads/2022/08/EN_2022_vuosijulkaisu.pdf

Table 4.41. Product categories in 2020 emission calculations.

Product category	Products
Cosmetics and toiletries	deodorants (spray), deodorants (roll-on) parfymes mounthwash, toothpaste sun care products self-tan products aftersaves hair removal products nail polish nail polish removals bubble paths soaps skin care products shampoons hair car products hair aerosols hair foams hair dyes
Househould clening	all-purpose cleaners washing-up liquids kitchen and bathroom cleaners window cleaners surface cleaners special cleaners (abrasives, antiliming agents) laundry detergents fabric conditioners stain removers aerosols toilet fresheners
Car care	windsshiled washer fluids (concentrate) windshield washer fluids (for summers) windshield washer fluids (ready to use) boat waxes car waxes wax shampoons car shampoos de-icers degreasants
Other products	water-proof preservers of protective co impregnation sprays lighter fluids insect repalleants

The emissions for the years between, before or after the base years of the model, have been estimated with the surrogate method using GDP as the surrogate data (cosmetics, househould and other products). In the case of car care products, in addition to GDP[4] (Statistics Finland, 2024), also information about the vehicles in traffic use (Statistics Finland, Motor vehicle stock[5], 2024) were used. NMVOC emissions were calculated based on sales data for the years 2014 and for 2018-2022 in the case of cosmetics and toiletries. In the case of household clening products and car care products, emissions were calculated based on sales data for the years 2014, 2015 and 2020. In the case of other products, emissions were calculated based on sales data for the years 2014 and 2020.

Typical concentrations of NMVOCs in selected products are presented in Appendix II of the IPPU IIR. The concentrations are mainly based on information from the material safety data sheets (MSDS) available for different products. In the MSDSs, the concentrations are generally expressed as percentage intervals, for

[4] https://stat.fi/en/statistics/vtp
[5] https://stat.fi/en/statistics/mkan

example “contains 10-20 per cent ethanol”. Mainly the average concentration values were used in the calculations.

The product-specific emission factors used in calculation are based on literature and expert estimations. The emission factors take into account that not all NMVOCs contained in the product are emitted to ambient air because they may (1) remain in the product, (2) rather end up in the sewage than emit into the air, or (3) are partly destroyed while the product remains in a waste container (Tebert, et al., 2009). Product-specific emission factors used in the calculations [kg/tonn (product)] are listed in the Appendix I of the IPPU IIR.

2.Calculation of emissions from pharmaseutic, adhesives and filling agents

Calculation of NMVOC emissions from pharmaseutic, adhesives and filling agents is based on EMEP/EEA Guidebook 2023 Tier 2 method. For adhensives and filling agents, emission factors presented in the Guidebook 2023 (Table 3.5 on page 17) have been used. For pharmaceuticals, the used EF (48 g/person) has been taken from Switzerlands IIR 2012 (table 5-11, p. 112) instead of the Guidebook. Since the Guidebook EF (Table 3.5) for phamaceuticals may also include to use of desinfectants, the Switzerland’s EF has been considered more representative. Population is used as activity data (Table 4.42).

Table 4.42. Population 1990-2023 (Statistics Finland, 2024).

Year	Population
1990	4 998 478
1995	5 116 826
2000	5 181 115
2005	5 255 580
2010	5 375 276
2015	5 487 308
2016	5 503 297
2017	5 513 130
2018	5 517919
2019	5 525292
2020	5 533 793
2021	5 548 241
2022	5 563 970
2023	5 603 851

3.Calculation of emissions from the use of desinfectants

NMVOC emissions from desinfectants are based volumes of used desinfectants. Finnish Safety and Chemicals Agency TUKES receives annually data from the companies on the volumes of hazardous chemicals in products. This information has been used to sort out products used as desinfectants for professional, domestic and industrial purposes or their combinations. Out of the ingredients of the products, only NMVOC species are included in the calculation of the total volume of volatile organic substances in desinfectants. Volume data (Table 4.43) on chemicals in products is available only since 2001. The earlier years were estimated as a specific average of years 2003-2007 in proportion to population. The evaporation rate of 100% was used in the calculation.

Table 4.43. Volume of volatile organic substances in desinfectants 1990-2023 (Finnish Safety and Chemicals Agency TUKES, 2024).

Year	Volume of volatile organisc substances in desinfectants (t)
1990	483
1995	495
2000	501
2005	539
2010	564
2015	673
2016	762

Year	Volume of volatile organisc substances in desinfectants (t)
2017	813
2018	801
2019	818
2020	6 820
2021	2 551
2022	852
2023	687

Mercury emissions from fluorescent tubes

Mercury emissions from disposal of fluorescent tubes are included under 1A1a and cannot be reported separately. The disposed tubes are collected and treated at a hazardous waste incineration plant with energy recover, thus the plant falling under 1A1a. The emissions are reported by the plant according to the monitoring requirements of the plant's environmental permit.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of magnitude and trends have been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2016

- The calculation of NMVOC emissions from domestic solvent use was revised for the whole time series. The earlier estimates for the use of personal care, adhesive and sealant, household cleaning and car care products were prepared by the Finnish Cosmetic, Toiletry and Detergent Association at the beginning of the 2000's. The aggregate estimate of 4.66 kt/a covering all these sources was based on a questionnaire sent to members of the Association and covered the different NMVOC compounds and their volatilation rates from the different product types. The estimate was used as a constant value for all years and thus this estimate did not include product development or changes in the use of products or in the legislation. (Finnish Cosmetics, 2002). During summer 2015 a project was carried out at SYKE to get more accurate information of the level and trend of NMVOC emisisons from domestic sourses.

2019

- Inclusion of mercury emissions from fluorescen tubes using a Tier 1 methodology. The emissions from disposal are included as explained above.

2020

- Inclusion of NMVOC emissions from pharmaceuticals, adhesives and filling agents using a Tier 1 methodology (Guidebook 2019) due the 2019 NECD Review.

2021

- For 1988-1989 the emissions in categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i were split from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.

2022

- The calculation of emissions from the use of desinfectants were revised and a new data collection established.

2024

- The calculation of NMVOC emission from from household product use was revised for the whole time series based on new activity data.

Source-specific planned improvements

None.

Road paving with asphalt (2D3b)

Changes in chapter	
February 2025	JMP, TF

Source Category description

SNAP 040611 Not a key category for any pollutants		Asphalt roofing Asphalt mixing plants
Emissions	Tier	Source of emissions
TSP, PM_{10}, $PM_{2.5}$, BC, NMVOC, PCDD/F	T3/T2	calculated
PCB		PCB emissions are not estimated into air, only through solubility to water and soil
PAH-4		Coal tar is not used in road work in Finland (impact the reuse of asphalt material) and therefore PAH emissions are estimated not to occur in the mainlad of Finland. However, in the Aland Islands (as in Sweden) coal tar has been used since 1973. The emissions from Aland are not currently included in the inventory.

Approximately twenty asphalt mixing plants have an environmental permit and report their emissions according to their monitoring requirements. The majority of asphalt mixing plants do not fall under IED but are regulated by the local environmental authorities and are part of the notification procedure, i.e. new plants are required to report to a register. The register covers technical information (e.g. construction of the plant, stack height, process techniques, storage of liquids).

Emission trend

Road paving with asphalt is a minor source of NMVOC, particle and PCDD/F. The emissions from road paving with asphalt vary according to the production volumes over the years.

Emissions from bitumen oils, bitumen emulsions and industry bitumens are allocated under NFR 2D3c Asphalt roofing, while road bitumens and road bitumen solutions are allocated under NFR 2D3b Road paving with asphalt.

Process emissions from asphalt mixing plants are reported under NFR 2D3b and fuel combustion related emissions under NFR 1A2gviii.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.44.

Table 4.44. Contribution of road paving with asphalt (NFR 2D3b) to total emissions in 2023.

Pollutant	Emissions from road paving with asphalt in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.174	72.510	Gg	0.2	0
$PM_{2.5}$	0.038	13.108	Gg	0.3	0
PM_{10}	0.042	25.728	Gg	0.2	0
TSP	0.056	39.531	Gg	0.1	0
BC	0.002	3.063	Gg	<0.1	0
PCDD/ F	0.007	8.651	g I-Teq	<0.1	0

Methodological issues

Particles and black carbon

Particle emissions are calculated using the following emission factors; 0.000016 t/t (TSP), 0.000012 t/t (PM_{10}) and 0.000011t/t ($PM_{2.5}$). These emission factors by TNO (2002) are considered to reflect better national circumstances than the default EFs in the EMEP/EEA Guidebook 2023. The unit of the method presented in the Guidebook is likely incorrect (0.014 t/t).

Black carbon emissions are calcuted using the emission factor presented in EMEP/EEA Guidebook 2023 (Table3-1).

Activity data used in the calculation is presented in Table 4.45.

Table 4.45. Amount of used asphalt (1990-2023), Confederation of Finnish Construction Industries RT Infra Division (Infra ry, 2024).

Year	Amount of used asphalt (1000 t)
1990	7 900
1995	6 400
2000	4 500
2005	6 200
2010	5 000
2015	5 300
2016	5 900
2017	6 400
2018	6 200
2019	5 500
2020	7 500
2021	6 100
2022	5 000
2023	3 500

POP emissions

The emission factor used for PCDD/F is 2 ng I-TEQ/t (UNEP 1999). There is no method in the EMEP/EEA Guidebook 2023. Used activity data is presented in Table 4.45.

NMVOC

NMVOC emissions from road paving with aphalt (NFR 2D3b) and asphalt roofing (NFR 2D3c) are calculated from bitumen use, which is confidential data. Data on bitumen use is received from the domestic bitumen producer (Nynas Oy, previously Fortum Oil and Gas Ltd., Ref. Blomberg, 2006, Remes. H., 2023). This bitumen use data is divided into five groups: road bitumens, road bitumen solutions, bitumen oils, bitumen emulsions and industry bitumens. For these VOC fractions for the different years are provided by Nynäs Oy (Table 4.46). To this, the imported amount of bitumen from customs statistics database ULJAS is added and divided in corresponding five groups as an expert estimation at Syke.

VOC fractions from bitumen are measured annually by the producer. Bitumen emulsions are applied cold, they are water-based and do not contain solvents. For bitumen solutions and oils, the NMVOC emission rate corresponds to the actual solvent content. The NMVOC rate of road bitumen and industrial bitumens is determined using the heating weight loss in the thin layer test (5 hours, 163 ºC). Development of NMVOC fractions is presented in Table 4.46.

Table 4.46. NMVOC fractions of bitumens (Nynäs Oy).

Year	Production group	VOC fraction %	Year	Production group	VOC fraction %
1988-1990	Road bitumen	0-0.1	2004-2010	Road bitumen	0-0.1
	Road bitumen solutions	10-50		Road bitumen solutions	10-50
	Bitumen oils	~10		Bitumen oils	~10
	Bitumen emulsions	0*		Bitumen emulsions*	0
	Industry bitumen solutions	40-60		Industry bitumens	0.1
1991-	Road bitumen	0-0.1	2012 onwards	Road bitumen	0-0.1

Year	Production group	VOC fraction %	Year	Production group	VOC fraction %
2003	Road bitumen solutions	10-50		Road bitumen solutions	10-50
	Bitumen oils	~10		Bitumen oils	~5**
	Bitumen emulsions*	0		Bitumen emulsions*	0
	Industry bitumen	0.1		Industry bitumens	0.1
	Industry bitumen solutions	30-65			

*bitumen emulsions are applied cold, they are water-based and do not contain solvents
**new biobased degrable solvent

Activity data

Activity data used in the inventory for 2006-2023 is based on the sum of production and import data, which are confidential, and cannot be published. Activity data for the years 1990-2005 is based on confidential production data, because for these years the import has been estimated negligible (Blomberg, 2006). The production of bitumen ended in March 2021. In 2020 the production volume was higher than in the previous years.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of magnitude and trends have been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2018

- The allocation of activities has been harmonized due to the recalculation of point source data.

2020

- Use of Guidebook 2019 methods for particles
- NMVOC emissions from 2017 were updated.

2021

- For 1998-1989 the emissions were split into categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.
- Activity data for particle calculation have been updated for years 2016-2018.

2022

- Activity data for particles and PCDD/F was corrected for the year 2019.

2024

Activity data for particles and PCDD/F has been updated from year 2015 onwards.

Source-specific planned improvements

None.

Asphalt roofing (NFR 2D3c)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP 040610 Key category for NMVOC (T1)		Roof covering with asphalt materials Emissions from the use of bitumen oils, bitumen emulsions and industry bitumens are reported under this category.
Emissions	Tier	Source of emissions
NMVOC	T3	Calculated

Emission trend

Asphalt roofing is a minor source of NMVOC emissions and the emissions vary according to the production volumes over the years.

The shares of emissions reported under the NFR category are presented in Table 4.47.

Table 4.47. Contribution of asphalt roofing (NFR 2D3c) to total emissions in 2023.

Pollutant	Emissions from asphalt roofing in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.039	72.510	Gg	<0.1	0

Methodological issues

NMVOC (Key category for NMVOC according to the trend in Approach 1)
The same calculation method is used for road paving with aphalt (NFR 2D3b) and asphalt roofing (NFR 2D3c). NMVOC emissions asphalt roofing are calculated based on data from the domestic bitumen producer (Nynas Oy, previously Fortum Oil and Gas Ltd., Ref. Blomberg, 2006, Remes., H. 2023 and the imported amount of bitumen (information from customs statistics database ULJAS).

The data presented in Table 4.46 of the previous chapter represent NMVOC emission rates from the use of bitumen products, not from manufacture of products. The emitted NMVOCs are based on annual meaurements by the producer.

The domestic production data is divided between the different product groups and for each group the specific NMVOC content is determined. The product groups are road bitumes, road bitumen solution, bitumen oils, bitumen emulsions and industry bitumens. Emissions from bitumen oils, bitumen emulsions and industry bitumens are allocated under NFR 2D3c Asphalt roofing, while road bitumens and road bitumen solutions are allocated under NFR 2D3b Road paving with asphalt. The division of the activity data between the product groups is based on information from Customs statistics and on expert estimation at SYKE as also for the imported amount of bitumen.

Activity data used in the inventory for the years 2006-2021 is based on the sum of production and import data, which is confidential, and cannot be published. Activity data for 1990-2005 is based on only confidential production data, because for these years import has been estimated (Blomberg, 2006) negligible.

In Finland bitumen has been produced only in one plant, in which the production of bitumen ended in March 2021. From 2022 onwards all NMVOC emissions originated from use of imported bitumen.

Particles and CO
Particle emissions are reported by the plants according to the monitoring requirements of the monitoring programme included in their environmental permits. Process emissions do not occur because the dust emitted is removed and treated through a specifically designed equipment (dust filters with continuous

operation control) and are monitored through continuous mesurements. All particle and carbon monoxide emissions from asphalt roofing result from the use of LFO and terefore they are reported NA and allocated under NFR 1A2f.

The 2021 TERT (NECD review) noted that the notation key 'NA' (not applicable) is used for particles and CO whilst a Tier 1 method is available in the Guidebook and asked to provide an estimate. To the question, Finland referred to the existing information in the IIR (see the chapter above) that process emissions do not occur. This was explained also to the 2018 the TERT (NECD review), which agreed that the correct notation key is NA.

It should be noted that the EF tables in the Guidebook are not always accurately separating process and fuel-based emissions. The Reporting Guidelines[6] determine the use of NA as follows: *"NA" (not applicable), for activities under a given source category that do occur within the Party but do not result in emissions of a specific pollutant."*

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends have been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2018
- Particle emissions, which are very low, around 0.0001 kt/a, and earlier reported as NA were included in the inventory due to the recommendation of the NECD 2017 Review.

2019
- To notation keys for all particles for all years were changed back to NA from the accidentially inserted IE during the recalculation of the time series (NECD Review 2018).

2020
- NMVOC emissions from 2017 were updated.

Source-specific planned improvements

None.

Coating applications (NFR 2D3d)

Changes in chapter	
February 2025	JMP, TF

Source category description

Source	Description	Emissions reported
Decorative coating application	Non-industrial paint application in construction and buildings (SNAP 060103) and domestic use (SNAP 060104)	NMVOC
Indistial coating application	Paint application in car repairing (SNAP 060102), manufacturing of automobiles (SNAP 060101), coil coating (SNAP 060105), boat building (SNAP 060106), painting of wood (SNAP 060107) and other industrial coating (SNAP 060108).	NMVOC, TSP, PM_{10}, $PM_{2.5}$
Other coating applications	Road marking paints, non-decorative floor paints (SNAP 060109). Usually other coating applications are reported under industrial coating applications because the allcoation between sectors is difficult.	NMVOC

[6] https://www.ceip.at/fileadmin/inhalte/ceip/00_pdf_other/2022/emissions_reporting_guidelines_2023_final.pdf

According EMEP/EEA Guidebook 2023 NFR 2D3d coating applications consists of decorative, industrial and other coating applications. Industrial activities in Finland falling under NFR 2D3d Coating applications are presented above.

The allocation of emissions between decorative and industrial coating apllications in the Finnish inventory is consistent over the years.

NMVOC emissions for other coating applications are included under decorative and industrial coating as it is not possible to calculate these separately based on the current activity data detail level. Attempts are made to improve activity data collection in the next inventory rounds in order to receive more detailed information for other coating applications.

This category is a key category for NMVOC emissions according to the level and trend of emissions (Approach 1).

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.48.

Table 4.48. Contribution of coating applications (NFR 2D3d) to total emissions in 2023.

Pollutant	Emissions from coating applications in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	4.284	72.510	Gg	5.9	19.6
$PM_{2.5}$	<0.001	13.108	Gg	<0.1	0
PM_{10}	<0.001	25.728	Gg	<0.1	0
TSP	<0.001	39.531	Gg	<0.1	100

Coating applications is a key category in NMVOC emissions (level and trend, Approach 1).

Emission trend

The decrease in NMVOC emissionsin the beginning of the 1990s is due to the recession and fall in the consumption of paints. The consumption of paints started to grow again in 1994. Despite of the growth, NMVOC emissions have been decreasing due to lower content of volatile organic compounds in the various paints and coatings. In 2022 the sales of solvent based paints decreased by 20 % compared to the sales in 2021. Particle emissions are reported by the plants and depends on yearly production volumes.

Methodological issues

The paint sales and product statistics are divided into decorative (DIY/architectural) and industrial sectors.

Under decorative coating application SNAP categories 060103 and 060104 are reported.

It is not possible to separate emissions falling under industrial coating applications (SNAP 060101, 060102, 060105, 060106, 060107 and 060108) and other coating application (SNAP 060109) due to lack of detailed information. Part of the emissions falling under these sources is interconnected with emission data reported by the plants, which have reporting obligations only for their total emissions and not at activity level. Information sources for industrial and other coating applications are presented in Table 4.49. Paint application on *Wood* and *Other coating application* included in the table are included in industrial paint coating SNAP 060100 and cannot be reported separately.

Table 4.49 Information sources for the industrial and other coating applications

Sector	Paint application in	Reference
Industrial coating application	Manufacture of automobiles	Reported by operators, questionnaire to operators and Association of Finnish Paint Industry
	Coil coating	Reported by operators, questionnaire to operators and Association of Finnish Paint Industry
	Car repair	Reported by operators, questionnaire to operators and Association of Finnish Paint Industry
	Wood	Questionnaire to operators and Association of Finnish Paint Industry
	Other industrial paint application	Reported by operators, questionnaire to operators and Association of Finnish Paint Industry
Other coating application	Questionnaire to operators and the Association of Finnish Paint Industry (road marking paints)	

As presented in Table 4.49 NMVOC emissions from industrial and other coating applications are reported by operators or are obtained from responses to questionnaire to operators or estimated by Association of Finnish Paint Industry (VTY). Emissions from decorative coating application are from questionnaires and from VTY’s estimates. The diviation between decorative and industrial coating application has been made since 2001 emissions reported in 2003 submission.

Emissions from application of paints of VTY members

Emissions from the application of paints produced by companies that are members of the Association of Finnish Paint Industry (VTY), are estimated by VTY, which compiles national statistics on the annual sales of paint products of its members. It covers about 90% of the paints produced in Finland. In the calculation of 2023 emissions, 97% of emissions are based on estimates by VTY.

Basis of calculation by VTY for the members

NMVOC emissions from decorative and industrial coating applications are calculated on the basis of the use volumes and solvent content of paints that develop over the years. The calculation is based on the actual formulations and the VOC content of raw materials used in the different formulations annually and on daily sales volumes of each product collected in each company’s data system.

According to information from 2003 (Riala, 2003) 75% of paints used for construction and 90% of paints used for indoor painting were waterborne already then. According to the statistics collected by the members of the Association of Finnish Paint Industry the share of waterborne paints has been increased especially in the sector of industrial coatings since 2001.

For the baseline year 1988 for NMVOC emissions, the statistics of water and solvent based paints were further divided into subgroups of several types of products and various types of surfaces to be painted, such as “waterborne decorative indoor paints“ or “solvent borne decorative indoor paints“. For each of these subgroups the average NMVOC content and the average density have been estimated by the expert group set by the Member Companies of the Association of Finnish Paint Industry (VTY).

Emissions from application of paints of non-VTY members

VTY members produce about 90% of paints in Finland. Emissions from the application of paints of those paint manufacturers that are not members of VTY were 3% of total emissions in 2023. The calculation is based on data acquired from annual questionnaires sent out by Finnish Environment Institute Syke (since the 2003 submission). Information on paint production and sales of the companies as well as the likely use of paints (decorative/industrial) are collected from the companies. The questionnaire was earlier based on a mailed questionnaire and from 2011 an e-mail inquiry has been used, in addition. The response rate to the questionnaire varies from year to year. The collection of emission data for 2023 was carried out sending out questionnaires (excel-sheet) by e-mail to 5 companies, out of which 3 responded. All of the responses were provided in the excel sheet. In 2005 the questionnaires were sent by mail to 14 companies, out of which 12 responded. The number of companies has decreased over the years, in 2008 questionnaries were send to 10 companies while in 2011 only for 6 companies.

Basis of calculation by SYKE for non-VTY members

Information on the volume of paints/solvents used and their content of volatile organic compounds by CAS number and concentration are used in the calculation. The default volatility rate of 100% is used for the VOC compounds unless the operators provide a more accurate rate in their response. The questionnaire includes guidance for the operators if they choose to calculate the VOC emissions themselves. In any case, they report the details needed for the national inventory.

Particle emissions

Particulate matter emissions (TSP, PM_{10} and $PM_{2.5}$) from industrial coating application are based on TSP data reported by the plants which are available in YLVA. Particle emissions are mainly generated during spray painting for example in a shipyard. PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions based on national fraction factors 80% for PM10 and 50% for PM2.5 (Karvosenoja, 2002). In 2023 particle emission from paint applications were less than 0.1 % of total emissions.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2018-2019

- The differences in NMVOC and particle emissions between the submissions in 2017 and 2018 was due the reallocation of emissions, which were corrected.

2020

- During the preparation of the 2019 submission, incorrect record of data reported by the plants in the YLVA system was identified and is corrected to the 2020 submission.

2021

- For 1988-1989 the emissions were split into categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.

Source-specific planned improvements

In the next 5 years

- Separation of emissions between other coating applications and decorative and industrial coating

Degreasing (NFR 2D3e)

Changes in chapter	
February 2025	JMP. TF

Source category description

Product group	Activity where used	Reference
Chlorinated solvents in products	Metal degreasing SNAP 060201	Customs statistics and expert estimate
	Other industrial cleaning SNAP 060204	Customs statistics and expert estimate
	Electronic components manufacturing SNAP 060203	Customs statistics and expert estimate

There is no production of chlorinated organic solvents in Finland, all the used solvents are imported.

Degreasing and dry cleaning is a source of NMVOC emissions. Chlorinated organic solvents are used in the metal and electronic industries to clean surfaces of different components and in dry cleaners.

Degreasing in the Finnish inventory includes part of the emissions from Dry cleaning (NFR 2D3f) which can not currently be reported separately. Degreasing is not a key category for any pollutants.

Emission trend

NH_3 emissions from electronic components manufacturing were subject to many changes in the production activities which are reflected in the emission trend and also originate from different activities in the 1990's and in the 2000's. Between 1990-2002 there were less than five companies manufacturing electronic components, in 2003 none, and in 2004 a new company started manufacturing. NMVOC emissions are mainly from the use of chlorinated organic solvents, the use of organic solvents has decreased over the years. The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.50.

Table 4.50. Contribution of Degreasing (NFR 2D3e) to total emissions in 2023.

Pollutant	Emissions from degreasing in 2023	Total emissions	Unit	Share of total emissions %	% reported by plants
NMVOC	0.581	72.510	Gg	0.8	3.0
NH_3	0.004	30.16	Gg	<0.1	0

Methodological issues

NMVOC
Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits.

When no plant specific data is available emissions has been calculated based on import statistics of pure chlorinated solvents and products containing chlorinated organic solvents and the volume of solvent waste processed in the hazardous waste treatment plants.

There is no production of chlorinated organic solvents in Finland. All the solvents used are imported and the amounts are obtainable from the Customs Statistics (ULJAS), but the split of their use between metal degreasing and dry cleaning is not available resulting in aggregated reporting.

Estimation of emissions from degreasing is based on the assumption that all purchased chemicals are used during the year of import. Activity data used in the calculation is presented in Table 4.51. The emission factor 0.7 kg/kg used in the calculation is an expert estimate by VTT Technical Research Centre of Finland since 2001 (YM, 1992). For the years 1990-2000 it is not possible to split the solvent volumes between solvents imported or solvents in imported products, so the solvent use is presented as a sum and it is based on an expert estimate. (SYKE, 2002)

Table 4.51. Activity data for NMVOC emissions under NFR 2D3e (sum, based on expert estimate)*

Year	Chlorinated organic solvents import (t) from ULJAS	Chlorinated organic solvents import in products (t) Expert estimate	Chlorinated organic solvents processed in the waste treatment plants (expert estimate) (t)
1990	2600*		
1995	1500*		
2000	1200*		
2005	1317	150	140
2010	595	150	140
2015	603	150	140
2016	524	150	140
2017	702	150	140
2018	576	150	140
2019	725	150	140
2020	613	150	140
2021	832	150	140
2022	815	150	140
2023	795	150	140

NH_3

Ammonia emissions (SNAP 060203, electronic components manufacturing) originate from production of silicon wafers, circuit boards and other electronic components where NH_3 is used as a process chemical. The emissions are based on data reported by the plants according to their monitoring and reporting requirements in the environmental permits.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2021
- For 1988-1989 the emissions were split into categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.

2022
- Particle emissions reported under this category (emissions reported by the plants) were previously incorrectly allocated under this category. The allocation of emissions was corrected under category 2D3i or 1A2gviii (depending on the plant). In addition, the allocation of NMVOC emissions from one plant previously reported under 2D3e were corrected under 2D3i.

2023
- Information on the source of ammonia emissions in electronic components manufacturing has been included.

Source-specific planned improvements

None.

Dry cleaning (NFR 2D3f)

Changes in chapter	
January 2020	KS & JMP

NMVOC emissions from dry cleaning are included in the emissions calculated from the use of chlorinated organic solvents as presented in the previous chapter. In the inventory they are allocated under Degreasing (NFR 2D3e). The emissions cannot be reported separately due to missing tools to estimate the share of solvents used for dry cleaning.

Chemical products (NFR 2D3g)

Changes in chapter	
February 2025	JMP, TF

Source category description

Activities allocated under NFR 2D3g	Emissions
Pharmaceutical industry SNAP 060306 Textile and leather industry SNAP 060312 and 060313 Plastics manufacturing and handling of polymer plastics (e.g. polyester, polyvinylchloride, polystyrene foam processing) SNAP 060301, 060302, 060303 and 060304 Rubber conversion SNAP 060305 Manufacture of paints, inks and glues SNAP 060307, 060308 and 060309 Adhesive, magnetic tapes, films and photographs manufacturing SNAP 060311 1988-2004 Asphalt blowing	NMVOC, TSP, PM_{10}, $PM_{2.5}$, NH_3, SOx, Cd, As, Cr, Ni

Chemical products is a key category in NMVOC emissions according to the level of emissions (Approach 1). NMVOC emissions are calculated with Tier 2 methods.

Emission trend

NFR category Chemical products is a minor source of NMVOC emissions, the share of total emissions in NH_3 and particles is less than 0.1 %. Chemicals products NFR category consist of many minor activites in which solvents have been used. The reported emissions depend on the use volumes of solvents in different activities.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.52.

Table 4.52. Contribution of chemical products (NFR 2D3g) to total emissions in 2023.

Pollutant	Emissions from chemical products in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.336	72.510	Gg	1.8	84.7
SOx	<0.001	20.536	Gg	<0.1	100
NH_3	0.002	30.16	Gg	<0.1	42.9
$PM_{2.5}$	<0.001	13.108	Gg	<0.1	0
PM_{10}	<0.001	25.728	Gg	<0.1	0
TSP	<0.001	39.531	Gg	<0.1	100

Methodological issues

Air pollutant emissions from chemical products depend on the use volumes of solvents. The allocation of activities has been changed over the years but is consistent in the current time series.

Methodologies used in the calculation of solvent use in the different chemical products manufacture and processing are presented in Table 4.53. Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available, emissions have been calculated.

Table 4.53. Information sources for the NMVOC inventory under NFR 2D3g.

Activity	Methodology
Polyester processing	Reported by operators + questionnaire to operators
Polyvinylchloride processing	Reported by operators
Polyurethane foam processing	Reported by operators
Polystyrene foam processing	Reported by operators
Rubber processing	Reported by operators
Pharmaceutical products manufacturing	Reported by operators + questionnaire to operators
Paints manufacturing	Reported by operators + questionnaire to operators
Inks manufacturing	Reported by operators
Glues manufacturing	Reported by operators
Adhesive, magnetic tapes, films &	Reported by operators
Textile finishing	Reported by operators + questionnaire to operators
Leather tanning	Reported by operators + questionnaire to operators
Other	Reported by operators + questionnaire to operators
Asphalt blowing	Calculated

NMVOC

NMVOC emissions reported under chemical products include emission data reported by the plants and calculated emissions based on information from questionnaires to small and medium sized companies in the paint manufacturing, plastic and leather industries, which are not obligated to report their emissions to the environmental authorities.

In pharmaceutical industry the number of companies is 5-10 and all emission data is reported by the plants. In plastic industry (includes polyester, polyvinylchloride, polystyrene foam processing and other, 50 companies) 65% of the emissions are reported by plants and 35% of emissions are based on questionnaire sent to companies. Textile and leather industry is minor source of emissions based on questionnaire (only less than 10 companies). Emissions from rubber conversion are included to the plastic industry due to confidentiality reasons. Emissions from manufacture of paints, inks and glues are based on data reported by plants (10-20 plants).

Plastic industries

Emissions are calculated on the basis of data from replies to the questionnaires (see also information under section 2D3d Coating applications) and data reported by the plants. Information on the volume of solvent containing substances used and their content of volatile organic compounds by CAS number and concentration are used in the calculation. The default volatility rate of 100% is used for the VOC compounds unless the operators provide a more accurate rate in their response.

For the year 2023 inventory, a questionnaire was sent to 35 companies, out of which 15 responded. In order to estimate emissions from those activities not covered by the replies, it was assumed that in 40% of those activities not covered by the responses, had emissions.

Paint production

Majority of paint producers report emissions to the supervising authority and this emission data is thus available from YLVA. Questionnaires are sent to those companies that are not obligated to report emissions from their production processes. These emissions are calculated with the help of responses to the questionnaire mentioned above using the emission data and/or data on solvent use from the replies.

For the year 2023 inventory, a questionnaire was sent out to 7 companies, from which 4 responded. To estimate emissions from those companies that did not respond, it was assumed that only 40 % of those activities not included in the responses, generated emissions.

Particle emissions
Emissions are mainly generated during the manufacturing of pharmaceutical products and inks. TSP emissions are reported by the plants. PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions based on fraction factors of 80 % for PM_{10} and of 50% for $PM_{2.5}$ (Karvosenoja, 2002).

Leather tanning

NH_3 emissions are calculated according to EMEP/EEA Guidebook 2023 using the emission factor presented in Table 3-14. As activity data, 2000 t raw hid/year for 1990-2023 is used and it is based on an estimate of production volumes provided in the companies' environmental permits. The same emission estimate is used for whole time series due to lack of better data. The whole calculation will be updated for future submissions.

Asphalt blowing
Asphalt blowing occurred in 1988-2004. The existence of the source was only recognized after the NECD Review in 2018, and preliminary estimates were prepared for the related PAH emissions. However, in autumn 2018 the TERT Secretary informed that the Tier 2 EFs in the Guidebook 2016 (Tables 3-9 and 3-10 of 2.D.3.g Chemical products) were incorrect. NMVOC, TSP, PM_{10}, $PM_{2.5}$ and heavy metal (Cd, As, Cr, Ni, Se) emissions has been calculated for 1988-2004 according to the EMEP/EEA Guidebook 2023 in 2024 submission.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2015
- In the submission in 2015 NH_3 emissions from leather tanning were included for the first time.

2019
- NMVOC emissions were recalculated for the years 1990-2004 (the years when the activity existed) to the 2019 submission using the method in the 2019 Guidebook.

2021
- For 1988-1989 the NMVOC emissions were split into 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.
- Facility reported NH_3 emissions for 1990 from one plant were erroneously missing from 2020 submission. These were included in submission 2021.

2022
- An error in calcuation formula was corrected in calculation of NH_3 emissions from leather tanning.

2023
- NMVOC, TSP, PM10, PM2.5 and heavy metal (Cd, As, Cr, Ni, Se) emissions from asphalt blowing from 1988-2004 were included in.

2024
- An error in calculation formula was corrected in calcution of NMVOC emission from plastic industry from 2008 onwards.

Source-specific planned improvements

- Calculation of NH_3 emissions from leather tanning will be revised to the future submissions.
- PAH emissions from leather tanning to be estimated in the next submissions.

Printing (NFR 2D3h)

Changes in chapter	
February 2025	JMP, TF

Source category description

Printing inks used in Finland vary widely in the composition, but they consist of three major components: pigments, binders and solvents. The type of ink which is used is usually the most important factor in estimating emissions from printing operations. Table 4.54 shows typical compositions of traditional printing inks in 2008.

Table 4.54 Typical compositions of traditional printing inks (Antson, 2008).

Composition of printing inks	Offset			Other pinting inks		
	newspaper %	sheet %	heatset %	Flexographic inks %	gravure printing %	screen printing %
pigments	10—20	15-25	10-20	5-30	5-15	5-8
binders	10-35	20-40	20-40	15-30	20-35	30-40
solvent	25-75	30-50	30-50	40-70	50-70	54-60
additives	0-5	0-5	0-6	0-8	0-5	1-2

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.55.

Table 4.55. Contribution of Printing (NFR 2D3h) to total emissions in 2023.

Pollutant	Emissions from printing in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0264	72.510	Gg	0.4	78.2

Printing is a key category in NMVOC emissions according to the trend of emissions (Approach 1). Emissions are calculated with T2/T3 methods.

Emission trend

NMVOC emission trend from printing activities is decreasing due to increased recovery of solvents and VOC compounds and cleaning of process emissions through e.g. incineration. The larger plants carry out NMVOC measurements from flue gases.

Methodological issues

NMVOC
Emissions from printing industry are based on emission reported by the plants as well as on information received as response to the questionnaire sent out by Syke to printing houses that are not obligated to report their emissions to the supervising authority according to their environmental permits.

The largest printing houses that report their emissions account more than 80% of total NMVOC emissions from the printing industry. The remaining 20% of emissions are estimated on basis of data collected through the questionnaire (see for details under “Coating appliations”). For calculation of the year 2023 emissions, the questionnaire was sent to 37 companies, from which 12 responded. In order to estimate emissions from those companies that did not reply, it was assumed that only 40% of the emissions from those activities not included in the responses of the questionnaire, do not have emissions.

The volume of VOC containing substances, their VOC content by CAS numbers and a default volatility rate of 100% were used in the calculation, in case a more accurate volatility rate was not available.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2021
- For 1988-1989 NMVOC emissions were split into categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogate.

2022
- Activity data for printing for the year 2019 was corrected.

Source-specific planned improvements

In the next years
- SO_x emissions are reported under NFR 2D3h for 1990-1994. The possibly to reallocate the emissions to the energy sector will be studied.

Other solvent use (NFR 2D3i)

Changes in chapter	
February 2025	JMP, TF

Source category description

NFR	Activity	Description	Emissions
2D3i	Other product use Key category for NMVOC (L1)	Glass and mineral wool enduction (SNAP 060401-02), fat, edible oil extraction (SNAP 060404), preservation of wood (SNAP 060406), industrial application of glues and adhesives (SNAP 060405) *Not estimated*: domestic application of glues and adhesives	NMVOC, SO_X, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, PAHs, HCB

Other solvent and product use is a key category in NMVOC emissions according to the level of emissions (Approach 1). Emissions are calculated with T3/T2 methods.

Emission trend

Emissions from other solvents use have been quite constat over the years. Other solvent and products use is a minor source of NMVOC, SO_x, particles, NH_3, HCB and PAHs. HCB emissions are generated from the use of chlorinated solvents, which varies from year to year. SOx emissions are generated from manufacturing of rock and mineral wool. The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.56.

Table 4.56. Contribution of Other solvent and product use (NFR 2D3i) to total emissions 2023.

Pollutant	Emissions from other solvent and product use in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.289	72.510	Gg	1.8	7.2
SOx (as SO_2)	<0.001	20.536	Gg	<0.1	100
NH_3	0.128	30.16	Gg	0.4	100

Pollutant	Emissions from other solvent and product use in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
$PM_{2.5}$	0.054	13.108	Gg	0.4	0
PM_{10}	0.059	25.728	Gg	0.2	0
TSP	0.063	39.531	Gg	0.2	95.6
BC	<0.001	3.063	Gg	<0.1	0
PAHs	0.010	19.315	Mg	<0.1	0
HCB	0.002	16.24	kg	<0.1	0

Methdological issues

A compilation of activites and estimation methods regarding NMVOC emissions reported under NFR Other solvent use as presented in Table 4.57.

Table 4.57. Methods to estimate emissions by sub-category under NFR 2D3i.

Activity	Method
Glass wool enduction	Reported by operators
Mineral wool enduction	Reported by operators
Fat, edible and not edible oil exraction	Reported emissions by operators
Application of glues and adhesives	Domestic application: Finnish Cosmetics, Toiletry and Detergents Association (inclusion in the current emisions from Domestic solvent use needs to be checked) Industrial application: YLVA database (emissions allocated to different sectors, for example 2I)
Preservation of wood	Calculation
Underseal treatment and conservation of vehicles	Finnish Cosmetics, Toiletry and Detergents Association (included in Domestic solvent use)
Vehicles dewaxing	Finnish Cosmetics, Toiletry and Detergents Association (inclusion in Domestic solvent use needs to be checked)
Other (preservation of seeds,...): use of pesticides in cultivations and in construction	Calculation

Glass and Mineral Wool Enduction

NMVOC
Emissions from glass and mineral wool enduction activities are reported by the plants.

SO_x and NH_3
Emissions are generated during manufacturing of rock and mineral wool and are based on data reported by the plants.

Particles
TSP emissions are reported by the plants and PM_{10} and $PM_{2.5}$ emissions have been calculated from the TSP emissions based on fraction factors 95 % for PM_{10} and 91% for $PM_{2.5}$ (AEAT, 2000).

Black carbon emissions are calculated using the emission factor 0.06 % of PM2.5 (Aasestad, 2013). There is no method for BC in the EMEP/EEA Guidebook 2023.

Solvent Extraction of edible oils

NMVOC
Emissions from solvent extraction of edible oils from oilseeds are based on emission data reported by the plants. In past years also a questionnaire was sent to companies that do not report their emissions. In 2012 it was discovered that these companies produce cold-drown vegetable oils and no NMVOCs are emitted during the production process.

Industrial and domestic application of glues and adhesives

NMVOC
Emissions from industrial application of glues and adhesives are included in the total NMVOC emissions reported by the plants, and aggregated under the main activity of the plant, for instance under NFR 2I.

Domestic use of adhesive and sealants fall under NFR 2D3a.

Impregnation of wood

NMVOC
Part of emissions from wood impregnation activities is reported by the plants and available in YLVA database. Emissions from the remaining impregnation activities are calculated with and the NMVOC emission factor for impregnation of wood 100 kg/t. (SYKE, 2001). Activity data for impregnation of wood is received from Finnish Safety and Chemicals Agency as the amount of sold creosote oil.

PAH-4
Part of emissions from wood impregnation activities is reported by the plants and available in YLVA database. Emissions from impregnation of wood and the use of impregnated wood have been calculated using the emission factors presented in EMEP/EEA Guidebook 2023 (Table 3-5). Annual volumes of impregnation of wood are presented in Table 4.58. Data on the use of impregnated wood, which is the activity data for both impregnation of wood and for the use of impregnated wood (all PAHs are assumed to be released during one year).

Use of pesticides

Use of pesticides covers all use purposes from agriculture to domestic use. The data is confidential in most recent years and can therefore not be presented in the IIR.

PAH-4
Emissions from the use of pesticides are calculated using the sales data of pesticides presented in Table 4.58 and the emission factor of 80 kg/t (SYKE, 2001). The amount of pesticides sold is received from the Finnish Food Safety Authority (TUKES).

Table 4.58. Acitivty data: Use of pesticides and impregnation of wood 1988-2023.

Year	Use of pesticides	Impregnation of wood
1988	NE	7 800 t creosote sold***
1989	NE	NE
1990	4 789 t pesticides sold	7 500 t creosote sold***
1995	2 767 t pesticides sold	4 600 t creosote sold***
2000	3 161 t pesticides sold	7 800 t creosote sold***
2005	4 726 t pesticides sold	6 120 t creosote sold***
2010	7 412 t pesticides sold	C****
2015	11 547 t pesticides sold	C****
2016	13 223 t pesticides sold	C****
2017	12 600 t pesticides sold	C****
2018	14 375 t pesticides sold	C****
2019	11 800 t pesticides sold	C****
2020	14 600 t pesticides sold	C****
2021	12 200 t pesticides sold	C****
2022	12 400 t pesticides sold	C****
2023	9 700 t pesticides sold	C****

****reference Finnish Safety and Chemicals Agency
***** reference National Institute for Health and Welfare

Use of chlorinated solvents

HCB
Emissions from the use of chlorinated solvents have been calculated with the emission factor 2 mg/ t from an earlier version of the EMEP/EEA Guidebook (EEA, 2005) (no method in EMEP/EEA Guidebook 2023) and information from customs statistics (ULJAS) on the imports of chlorinated chemicals as presented in Table 4.59. Chlorinated solvents are not produced in Finland.

Table 4.59. Use of chlorinated solvents (Custom Statistics)

Year	Use of chlorinated solvents (t)
1990	2 200 t
1995	1 700 t
2000	1 250 t
2005	1 317 t
2010	557 t
2015	603 t
2016	524 t
2017	702 t
2018	576 t
2019	726 t
2020	613 t
2021	832 t
2022	814 t
2023	795 t

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2018
- Guidebook 2016 emission factors have been taken in use for calculation PAHs from preservation of wood.

2020
- The time-series have been double-checked due the false data for the use of pesticides from year 2002 in 2019 submission. The value has for an unknown reason changed for 2002 to equal the value for 2001. The correct value for the year 2002 is 1.364 (the incorrect 1.320).
- The sales data of creosote oil (not pesticides as stated in 2020 submission) as activity data for 2017 were updated.

2021
- For 1988-1989 NMVOC emissions were split into categories 2D3a, 2D3b, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h and 2D3i from the sum of these categories earlier reported under 2D3d using the relation of these categories in years 1990-1994 as a surrogant.

2022
- The sales data of pestisides for 2019 were updated.

- Allocation of particle emissions from some facilities were corrected from 2D3e to 2D3i. In addition, NMVOC emissions from one facility were corrected from 2D3e to 2D3i.
- One mineral wool plant ceased operation during 2017. Ammonia emissions for 2018-2019 and NMVOC emissions for 2018 from this plant were previously incorrectly included in the inventory. These emissions were removed from the inventory.
- Activity data for the calculation of NMVOC emissions from solvent extraction of edible oils in 2004 was corrected.

Source-specific planned improvements

There is need to check and possibly recalculate NMVOC emissions from solvent extraction of edible oils as the emissions may be double counted in the 1990s.

Other product use (NFR 2G)

Changes in chapter	
February 2025	JMP, TF

Source category description

NFR	Activity	Description	Emissions
2G	Other product use	Use of fireworks and tobacco Key categpry for Pb (L1, T1)	NO_X, NMVOC, SO_X, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, CO, Pb, Cd, Hg, As, Cr, Cu, PCDD/F, PAH-4, HCB

Emission trend

The emission trends follow the annual sales of tobacco and fireworks.

The shares of emissions reported under the NFR category are presented in Table 4.61.

4.61. Contribution of Other product use (NFR 2G) to total emissions 2023.

Pollutant	Emissions from other product use in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NOx (as NO2)	0.008	90.300	Gg	<0.1	0
NMVOC	0.020	72.510	Gg	<0.1	0
SOx (as SO2)	0.004	20.5306	Gg	<0.1	0
NH3	0.017	30.160	Gg	<0.1	0
PM2.5	0.011	13.108	Gg	0.9	0
PM10	0.011	25.728	Gg	0.4	0
TSP	0.012	39.531	Gg	0.3	0
BC	<0.001	3.0603	Gg	<0.1	0
CO	0.237	298.374	Gg	<0.1	0
Pb	1.053	12.089	Mg	8.7	0
Cd	0.024	0.767	Mg	3.2	0
Hg	<0.001	0.493	Mg	<0.1	0
As	0.002	1.632	Mg	0.1	0
Cr	0.021	13.473	Mg	0.2	0
Cu	0.623	37.478	Mg	1.7	0
Ni	0.051	8.793	Mg	0.6	0
Zn	0.360	119.511	Mg	0.3	0
PCDD/ PCDF	<0.001	8.651	g I-Teq	<0.1	0
PAHs	0.001	19.315	Mg	<0.1	0

Methdological issues

Tobacco smoking

The annual sales statistics of cigars and cigarettes are used as activity data (Table 4.62), The activity data has been updated for whole time series in 2025 submission according statistics from National Institute for Heath and Welfare (2024).

Table 4.62. Activity data for tobacco smoking (National Institute for Healt and Welfare, 2024).

Year	Sales of cigars and cigarettes National Institute for Health and Welfare (THL)
1990	8 899 t
1995	7 059 t
2000	6 700 t
2005	6 856 t
2010	6 958 t
2015	6 676 t
2016	6 645 t
2017	6 381 t
2018	6 305 t
2019	4 975 t
2020	4 830 t
2021	5 500 t
2022	5 016 t
2023	4 125 t

Emissions from tobacco smoking are calculated with emission factors presented in EMEP/EEA Guidebook 2023 (Table 3-15).

Use of fireworks

The amount of imported fireworks is used as activity data provided by Custom Statistics for the whole time series since 1990. The emission factors are from EMEP/EEA Guidebook 2023 (Table 3-14). The amount of imported fireworks is presented in Table 4.63.

Table 4.63. Amount of imported fireworks (tonnes) (Custom Statistis)

Year	Imported fireworks (t)
1990	396
1995	1418
2000	1370
2005	1859
2010	1702
2015	1497
2016	1506
2017	1303
2018	1420
2019	1136
2020	466
2021	803
2022	1354
2023	1343

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2004
- Particle emissions from the use of fireworks were included to the 2004 inventory for the first time.

2008
- NMVOC emissions from tobacco smoking were included.

2015
- NH3 emissions were included.

2017
- The calculation of the use of fireworks was revised for the whole time series. In the previous calculations the number of inhabitants was used as acitivty data. In the new calculation the amount of imported fireworks (tonnes) is used as activity data for whole time series since 1990.

2018
- The calcution of tobacco smoking was revised for the whole time series using emission factors from Guidebook 2016.

2019
- NH_3 emissions from tobacco smoking were corrected for the whole time series.

2022
- Activity data for tobacco combustion in 2019 were updated.

2025
- Activity data for tobacco combustion has been updated for whole time series.

Source-specific planned improvements

The possibility to include emissions from tobacco use since 1980 will be investigated.

4.6 Other industrial production (NFR 2H)

Changes in chapter	
February 2025	JMP, TF

NFR	Processes	Description	Emissions reported
2H1	Pulp and paper industry	Pulp and paper mills	NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, SOx, HCB, PCB
2H2	Food and beverages industry	Food and drink industry	NMVOC, TSP, PM_{10}, $PM_{2.5}$, SOx
2H3	Other industrial processes	Not Occuring	

Pulp and paper (NFR 2H1)

Changes in chapter	
February 2025	JMP, TF

Source category description

A typical feature for the Finnish pulp and paper industry is the integrated pulp and paper mills, where the use of energy can be optimized between the energy intensive paper production and the energy sources produced in the pulp processes.

All Finnish chemical pulp mills use sulphate process. The last sulphite-based processes were closed in 1991.

The industry has been subject to large changes and efficiency improvements during the last decades. The number of mills has continuously been decreasing since the 1980s while the production volumes significantly increased until 2006-2007 as presented in Figure 4.7 and in Table 4.64. In 2023 there were 12 pulp mills, 13 paper mills, 9 paper convertings mills and 19 paper board mills in Finland.

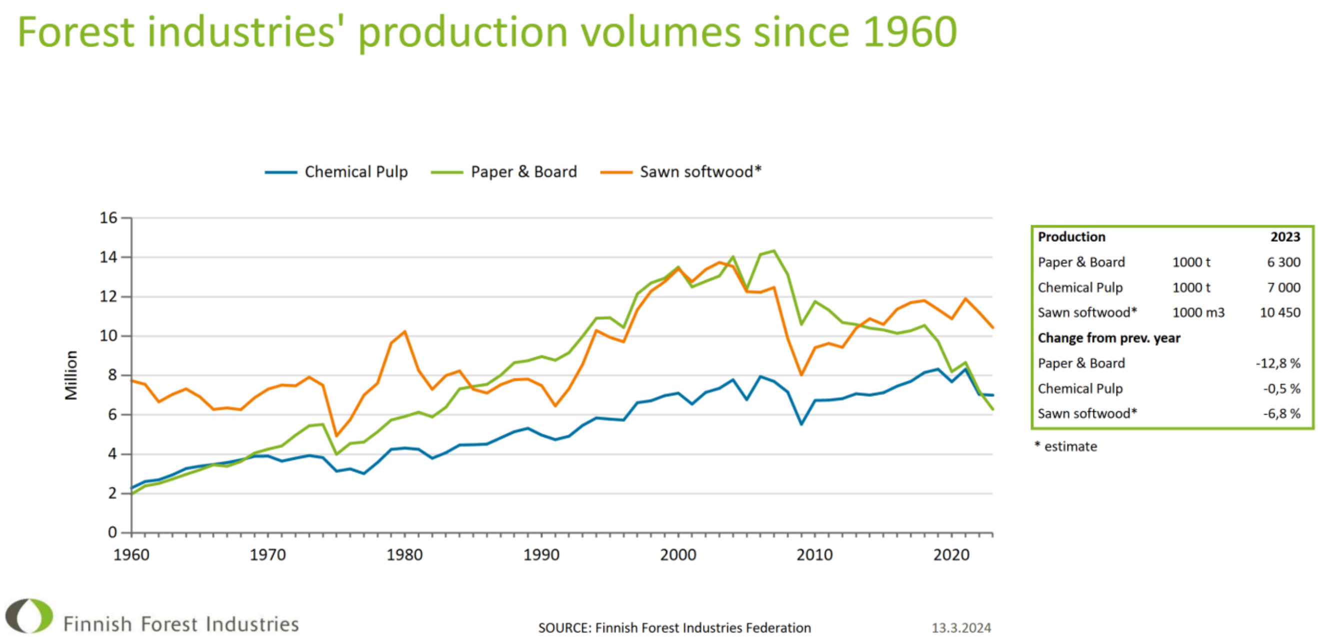

Figure 4.7. Production volumes (below) in Finland since 1960. Source Finnish Forest Industries Federation (2024)

Table 4.64. Pulp and paper production since 1988 (Finnish Forest Industries Federation).

Year	Produced pulp (mill t)	Produced mechanical pulp (mill t)	Produced paper (mill t)
1988	5.3	3.2	8.8
1989	5.0	3.8	9.0
1990	4.7	4.1	9.0
1995	5.8	4.4	10.9
2000	7.1	4.8	13.5
2005	6.7	4.4	12.4
2010	10.7	incl. in produced pulp	11.9
2015	10.8	incl. in produced pulp	11.5
2016	10.5	incl. in produced pulp	9.9
2017	11.6	incl. in produced pulp	10.3
2018	12.1	incl. in produced pulp	10.5
2019	11.9	incl. in produced pulp	9.5
2020	10.5	incl. in produced pulp	8.2
2021	8.3	incl. in produced pulp	8.7
2022	7.1	incl. in produced pulp	7.2
2023	7.0	incl. in produced pulp	6.3

Emission trend

Emissions reported under NFR category 2H1 include process-based SO_x emissions calculated from reduced sulphur compounds (TRS), ammonia, particle and NMVOC emissions. Also, from the early 1990s HCB and PCB emissions have been reported due the use of chlorinated solvents. The emission trends are impacted by annual production volumes.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.65.

Table 4.65. Contribution of Pulp and paper industry (2H1) to total emissions in 2023 (Note: NOx emissions are allocated in 1A2d).

Pollutant	Emissions from 2H1 in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.044	72.510	Gg	1.4	13.3
SOx (as SO_2)	0.552	20.536	Gg	2.7	100
NH_3	0.155	30.16	Gg	0.5	100
$PM_{2.5}$	0.173	13.108	Gg	1.3	0
PM_{10}	0.262	25.728	Gg	1.0	0
TSP	0.288	39.531	Gg	0.7	100
BC	0.005	3.063	Gg	0.1	0

Pulp and paper industry is a key category in Approach 1 uncertainty analysis for SOx (L1, T1), $PM_{2,5}$ (T1), PM_{10} (T1) and TSP (T1) emissions. All these emissions are reported by the plants (T3).

Methodological issues

Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available emissions has been calculated.

Nitrogen dioxide
Nitrogen dioxide emissions from the pulp and paper industry are based on data reported by the plants to the supervising authorities according to the monitoring requirements in their environmental permits. NO_2 emissions from the pulp and paper industry are fuel-based emissions and result from the combustion of black liquor and other residue fuels. Thus, the emissions are reported under the energy sector in NFR 1A2d. In category 2H1, the notation key NA in used in the NFR tables.

Sulphur emissions reported as SO_2
Sulphur dioxide emissions are based on data reported by the plants to the supervising authorities according to the monitoring requirements in their environmental permits. SO_2 emissions are allocated in the inventory as fuel-based emissions under NFR 1A2d and as process-based emissions under 2H1. The fuel-based emissions originate from the combustion of black liquor and other residue fuels.

The process-based emissions include different sulphur compounds such as TRS (total reduced sulphur) and these are calculated into SO_2 equivalents. Most of the smelly gases are nowadays collected and incinerated due to the requirements for odour abatement in the environmental permits.

Particles
The plants report total suspended particle emissions to the supervising authorities and this data is used in the calculation of PM_{10} and $PM_{2.5}$ particle size fractions with factors 99.3% (PM_{10}) and 86.3 % ($PM_{2.5}$) for recovery boiler and with factors 98 % (PM10) and 96% ($PM_{2.5}$) for lime kiln. Size factors for recovery boiler are based on expert estimate, Karvosenja (2001) and factors for lime kiln are taken from USEPA AirChief (1988). Black carbon emissions are calculated using the emission factor presented in EMEP/EEA Guidebook 2023 (Table 3-2).

Heavy metals
As, Cr, Ni, V, Pb, Cd and Hg emissions from process boilers are based on data reported by the plants and are included and reported under NFR 1A2d.

NMVOC
NMVOC emissions from the pulp and paper industry are partly included in the compliance reporting of the plants and thus available in YLVA. For plants, which are not obligated to report their NMVOC emissions, these are calculated by using plant specific activity data and emission factor based on

information from the Finnish Forest Industries Federation FIFF. The emission factors presented in Table 4.66 are based on the actual levels observed at the plants (Reino Lammi, 2000).

Table 4.66. NMVOC emission factors kg/t of pulp (Finnish Forest Industries Federation).

<table>
<tr><th>Year</th><th>chemical pulp</th><th>mechanical pulp</th><th>paper</th><th>Year</th><th>chemical pulp</th><th>mechanical pulp</th><th>paper</th></tr>
<tr><td>1988</td><td>0.7</td><td rowspan="12">0.2</td><td rowspan="12">0.01</td><td rowspan="2">2000-2005</td><td rowspan="2">0.1</td><td rowspan="2">0.2</td><td rowspan="2">0.01</td></tr>
<tr><td>1989</td><td>0.65</td></tr>
<tr><td>1990</td><td>0.4</td><td rowspan="2">from 2006 onwards</td><td rowspan="2" colspan="2">0.14</td><td rowspan="2">0.01</td></tr>
<tr><td>1991</td><td>0.37</td></tr>
<tr><td>1992</td><td>0.34</td><td rowspan="8" colspan="4"><u>Pulping</u>:
chemical: between 1988-1999 is based on written information by Reino Lammi, FFIF
Since 2006 chemical and mechanical pulp production statistics have not been available separately. Therefore, a combined EF has been used</td></tr>
<tr><td>1993</td><td>0.31</td></tr>
<tr><td>1994</td><td>0.28</td></tr>
<tr><td>1995</td><td>0.25</td></tr>
<tr><td>1996</td><td>0.22</td></tr>
<tr><td>1997</td><td>0.19</td></tr>
<tr><td>1998</td><td>0.16</td></tr>
<tr><td>1999</td><td>0.13</td></tr>
</table>

POP emissions
PCDD/F emissions originate from combustion of bark in grate ovens and are reported by the plants to the supervising authorities and allocated under NFR 1A2d.

PCB and HCB emissions in the timeseries are due to the use of elemental chlorine in the bleaching process, which ended by 1994. Thereafter no PCB or HCB compounds are used or generated in pulp and paper processes. Emissions in between 1980-1989 are not estimated but are reported for 1990-1994 by the plants according to their monitoring requirements in their permits.

NH_3
Ammonia emissions may occur related to fumes from solvents, extinguishers, causticizing and smelly gases in cases when there are exceptional situations in the normal collection of these gases. NH_3 emissions are reported by the plants to the supervising authorities. Ammonia emissions in the early 1990s are expert estimates at that time and cannot be recalculated.

Since 2018 NH_3 emissions have increased due the use of ammonium sulphite liquid in manufacturing of packing board.

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2024
- During 2023, research was conducted regarding the missing emissions reporting data of pulp and paper plants especially from 1990s and 2000s in the YLVA system. The missing data were collected directly from the plants and included in the 2024 submission. As a result of the data collection, the following emissions were recalculated in category 2H1:
    - SO_X for 1990-2021
    - NH_3 for 1990-2015 and 2018-2021

- Particle emissions for 1990-2000, 2002-2003, 2005-2006, 2008-2009, 2012 and 2021

Source-specific planned improvements

Not scheduled
For the future inventories, it will be studied, if ammonia is released in all processes and if it is necessary to establish an inventory for ammonia emissions covering all pulp and paper plants.

Food and beverages industry (NFR 2H2)

Changes in chapter	
February 2025	JMP, TF

Source category description

Product	Number of plants in YLVA allocated to this sector	Emissions reported by plants	Emissions calculated
Bread, bisquits	-		NMVOC
Wine	-		NMVOC
Beer	-		NMVOC
Spirits	< 5	NMVOC	NMVOC
Sugar production	-		TSP, PM_{10}, $PM_{2.5}$, NMVOC
Meat, fish etc. frying/curing	-		TSP, PM_{10}, $PM_{2.5}$
Coffee	-		NMVOC
Yeast	-		NMVOC
Dairies	< 5	TSP	PM_{10}, $PM_{2.5}$
Animal feed and raw material for animal feed	< 5	TSP, NMVOC	PM_{10}, $PM_{2.5}$, NMVOC
Food production	< 5	TSP	PM_{10}, $PM_{2.5}$

Food and drink industries in Finland include production of coffee, sugar, yeast, dairies, production of wine and beer as well as production of animal feed.

Air pollutant emissions from food and drink depend on the production and use volumes over the years.

Food and beverages industry is a key category in Approach 1 uncertainty analysis for NMVOC (L1), $PM_{2.5}$ (L1, T1) and PM_{10} (L1) emissions. Emission estimation is based on T2/T3 methods.

The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.67.

Table 4.67. Contribution of Food and beverages industry (NFR 2H2) to total emissions in 2023.

Pollutant	Emissions from food and drink industry in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.812	72.510	Gg	2.5	2.6
$PM_{2.5}$	0.377	13.108	Gg	2.9	0
PM_{10}	0.386	25.728	Gg	1.5	0
TSP	0.4000000	39.531	Gg	1.0	13.8

Emission trend

Food and beverages industry is a minor source of NMVOC and particle emissions, the share of total emissions is only 1-3 %. Emissions depend on production rates, that have been quite constant over the timeseries. NMVOC emissions in 1988-1989 are based on expert estimates at the time of original reporting.

Methodological issues

NMVOC
NMVOC emissions are reported by some plants from the production of spirits and food production to the supervising authorities and available for the inventory from the YLVA database. NMVOC emissions from animal rendering are reported by plants and are included under NFR 2L.

NMVOC emissions from those plants that do not report the emissions are calculated from production data using national or EMEP/EEA Guidebook 2023 emission factors as follows wholemeal breads (Table 3-16), animal feeds (Table 3-22), other breads (Table 3-14), cakes and bisquits (Table 3-18), sugar production (Table 3-20), wine production (Table 3-24) and bear production (3-27).

The emission factor for roasting of coffee (0,6 kg/t) is an expert estimated based on environmental permits (Paulig, 2005). Emission factor for yeast production (18 kg/t) is based an expert knowledge (Syke, 2007).

Fish meal production is included under NFR 2H2 and the data is reported by the plants.

Production volumes used in the calculation of NMVOC emissions are presented in Table 4.68.

Table 4.68. Bread, cakes, bisquits production volumes, roasting of coffee and sugar, yeast, wine and beer production (Finnish Food and Drink Indusriries' Federation, Finnish Coffee Roasters' Association, Suomen Hiiva and National Supervisory Authority for Welfare and Health, Finnish Food Authority).

Year	Bread (wholemeal) products (million kg)	Bread (other) products (million kg)	Cakes, bisquits etc (million kg)	Roasting of coffee (t)	Sugar beet production (t)
1990	52.1*	108.7*	19.9*	50 678	1125
1995	52.1*	108.7*	19.9*	40 715	1110
2000	57.4*	118.9*	21.5*	44 991	1046
2005	95.2*	120.9*	29.7*	46 871	1181
2010	94	94	31.7	46 442	542
2015	93.2	93.2	31.2	46 000	407
2016	93.2	93.2	31.2	46 000	434
2017	92.5	99.6	30.9	43 000	430
2018	92.5	99.6	30.9	43 400	356
2019	85.0	104	32.7	43 300	501
2020	85.0	104	32.7	40 500	242
2021	80.5	107	30.6	39 700	403
2022	80.5	107	30.6	31 000	380
2023	80.5	107	30.6	36 735	421

Year	Yeast production (t)	Wine production (m3)	Beer production (m3)	Animal feeding (t)	
1990	7 540	18 111	413 130	1 112 992	
1995	9 610	40 383	454 468	1 121 858	
2000	7 640	67 500	465 000	1 342 224	

Year	Yeast production (t)	Wine production (m3)	Beer production (m3)	Animal feeding (t)	
2005	7 750	66 159	456 544	1 469 987	
2010	7 897	59 008	395 072	1 349 811	
2015	5 832	55 818	407 119	1 433 117	
2016	7 465	55 392	410 443	1 405 647	
2017	7 800	51 710	403 630	1 417 957	
2018	6 400	47 592	392 401	1 411 486	
2019	6 850	47 305	381 416	1 426 000	
2020	8 970	44 628	376 528	1 450 341	
2021	8 372	41 460	369 568	1 463 454	
2022	9 522	41 011	355 203	1 424 535	
2023	9 993	40 000	326 000	1 376 886	

* For 1990-1993 and 1995, 1996 years 1994 value was used, for 1998-2002 years 1997 value was used, for 2004-2009 years 2003 value, for 2011 and 2012 years 2010 value and for 2014 years 2013 value.

Particles

The plants report total suspended particle emissions according to monitoring requirements in their environmental permits and this data is available in YLVA. PM_{10} and $PM_{2.5}$ particle size fraction emissions are calculated from TSP emissions with factors 75 % (PM_{10}) and 60 % ($PM_{2.5}$) from USEPA Air Chief, 1998.

Particle emissions are also calculated from the commercial and residential meat frying and barbeque reported since year 2001. Emission factors are from TNO database (2002) and from MacDonald., J etc (2012) and activity data from Finnish Food and Drink Industries' Federation, ETL (2024). For meat frying emission factor 0.0013 t/t meat consumed is used for TSP, PM_{10} and $PM_{2.5}$ as well as for barbeques factor 8.9 kg/ton meat is used for TSP, PM_{10} and $PM_{2.5}$.

Activity data

Activity data are presented in Table 4.69 provied by Finnish Food and Drink Industries' Federation (ETL). T It is estimated that from the total meat consumption (beef, pork and poultry) 40% is consumed as pure meat and 60% as processed food. 90% of pure meat is fried and 15% of that in barbeques (Anttonen, ETL, 2000).

Table 4.69. Activity data for commercial and residential meat frying and barbeque (ETL, 2024).

Year	Meat consumption (1000t)
1990	306.5
1995	313.5
2000	336.7
2005	357.5
2010	384.2
2015	397
2016	404
2017	399
2018	394
2019	401
2020	412
2021	412
2022	405
2023	391

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2017

- NMVOC emissions from bread manufacturing and particles from barbeque were recalculated for the whole time series.

2018

- Improvement of the time series consistency depends on the allocation of emissions under the NFRs and can be corrected when the time series recalculation is finalized. (Recommendation of the NECD 2017 Review for particles in 2015).
- Annual sugar production volumes are no more available from the industry due to the integration of the domestic plant into an international corporation. The production volumes have been updated for the whole time series using different data sources: (1) LUKE's beet production statistics) and (2) assumptions on raw material/production rates. It is assumed that for the production on one kilogramme of sugar 8 kilogrammes of sugar beet are needed (Dansukker website 25.10.2017). The updated method enables to follow the annual production rates in stead fo the constant figure used for the earlier years.

2019

- Between the 2018 and the 2019 submissions NMVOC emissions from alcoholic beverages were recalculated due to new information from Valvira (National Supervisory Authority for Welfare and Health

2021

- SO_x emissions in 2001-2 were reallocated under the Energy sector and the notation key was changed into NA for all years.

2023

- Activity data for wine and beer consumption updated for years 2019 and 2020.

Source-specific planned improvements

None.

Other industrial processes (NFR 2H3)

No sources are included under NFR 2H3. Other industrial activities not falling under the NFR2 categories are reported under NFR 2L "Other production, consumption, storage, transportation or handling of bulk products".

Wood processing (NFR 2I)

Changes in chapter	
February 2025	JMP, TF

Source category description

Activities reported under NFR 2I include mechanical wood processing, such as sawmills and production of plywood, chipboard and fibreboard.

Emission trends

Mechanical wood processing is a minor source of NMVOC and particle emissions. NMVOC emissions have slightly decreased over the years, particle emission have decreased clearly ovet the years. Mechanical wood processing is not a key category for any pollutants. The shares of emissions for each air pollutant reported under the NFR category are presented in Table 4.70.

Table 4.70 Contribution of Mechanical wood processing (NFR 2I) to total emissions in 2023.

Pollutant	Emissions from mechanical wood processing in 2023	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	1.049	72.510	Gg	1.4	33.2
$PM_{2.5}$	<0.001	13.108	Gg	<0.1	0
PM_{10}	0.015	25.728	Gg	<0.1	0
TSP	0.079	39.531	Gg	0.2	100

Methodological issues

Particle emissions

The plants report total suspended particle according to monitoring requirements in their environmental permits and this data is available in YLVA. PM_{10} and $PM_{2.5}$ emissions are calculated from TSP emissions with a fraction factor for PM_{10} of 18% and for $PM_{2.5}$ 0% (zero) according to information from US EPA Air Chief database

NMVOC emissions

NMVOC emissions from mechanical wood industry are calculated with activity data from Finnish Forest Federation (FFIF) presented in Table 4.71 and several emission factors. For chipboard production an emission factor 0.2 kg/m^3 (NPI, 2002) has been used, for sawn timber 235 g/t (FFIF, 200), for plywood 0.15 kg/m^3 (NPI, 1999) and for fibreboard 1.3 kg/m^3 (NPI, 1999). In addition, NMVOCs are reported by several plants according to their monitoring requirements to supervising authorities and available in YLVA database.

Table 4.71. Activity data for wood processing industries (Finnish Forest Federation, FFIF).

	Production rates, Finnish Forest Federation (FFIF)			
Year	Chipboard (m^3)	Sawn timber (m^3)	Plywood (m^3)	Fibreboard (m^3)
1988	650 000	3 239 000	600 000	90 000
1989	650 000	3 239 000	600 000	80 000
1990	600 000	3 075 000	650 000	100 000
1995	485 000	4 042 600	778 000	79 000
2000	462 000	5 461 200	1 167 000	100 000
2005	452 000	4 997 900	1 305 000	101 000
2010	220 000	3 854 000	980 000	57 000
2015	*	4 346 000	1 150 000	*
2016	*	4 653 500	1 150 000	*
2017	*	4 797 000	1 250 000	*
2018	*	4 842 100	1 230 000	*
2019	*	4 653 500	1 100 000	*
2020	*	4 469 000	1 090 000	*

	Production rates, Finnish Forest Federation (FFIF)			
Year	Chipboard (m³)	Sawn timber (m³)	Plywood (m³)	Fibreboard (m³)
2021	*	4 879 000	1 150 000	*
2022	*	4 592 000	1 100 000	*
2023	*	4 280 400	870 000	*

*NOTE: * Since 2013 chipboard and fibreboard manufacture volumes are in included in the plywood manufacture volumes.*

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

None.

Source-specific planned improvements

None.

Production of POPs (NFR 2J)

There is no production of POPs in Finland.

Consumption of POPs and heavy metals (NFR 2K)

Changes in chapter	
February 2021	KS, JMP

We consider the methods presented in the Guidebook for PCB and Hg emissions from consumption of POPs and heavy metals to highly overestimate the emission levels in Finland and thus to not be applicable for Finnish conditions.

In Finland, use of PCBs in open systems was banned already in the 1970s and PCB containing products have been banned since the 1990s.

Mercury releases from products is mostly a waste management issue and mercury containing products have been regarded as hazardous waste and treated as such already in the 1990s. Mercury in products has been restricted since the 2000s due to national legislation concerning Hg in products (batteries, electrical, measurement/control devices, lighting, paint, amalgam) and waste management of such products. Finland is party to international mercury agreements such as the EU regulations on restricting/banning Hg use in products and the recent Minamata Convention.

Emissions from consumption of F-gases are available from the Finnish greenhouse gas inventory available at https://stat.fi/en/statistics/khki

Other industrial production including production, consumption, storage, transportation or handling of bulk products (NFR 2L)

Changes in chapter	
February 2025	JMP, TF

Source category description

SNAP code	SNAP	Detailed description	Emissions reported
040617	Other	Light gravel manufacturing	NMVOC, SO_x, NH_3, TSP, PM_{10}, $PM_{2.5}$, PCDD/F
040617	Other	Talc manufacturing	
040617	Other	Ceramic household and decorative products manufacturing	
040617	Other	Tile (brick) manufacturing	
040617	Other	Gypsum product manufacturing	
040617	Other	Quarrying and crushing	
040617	Other	Manufacturing of electricity distribution and monitoring devices	
040617	Other	Starch modification	
		Animal feed production	

NFR 2L “Other sector” includes emissions from tile, light gravel, talc, gypsum products and ceramic household and decorative products manufacturing, quarrying and crushing, manufacturing of electricity distribution and monitoring devices, animal renderingand starch modification. No emissions are reported under NFR 2H3.

The annual variations in the emissions are caused by fluctuation of production or the activity volume over the years. The shares of emissions of total emissions and shares of data reported by the plants are presented in Table 4.72. Category 2L is not a key category for any pollutants.

Table 4.72. Contribution of Other production, consumption, storage, transportation or handling of bulk products (NFR 2L) to total emissions in 2023.

Pollutant	Emissions from other processes	Total emissions	Unit	Share of total emissions %	% reported by the plants
NMVOC	0.022	72.510	Gg	<0.1	100
SO_x (as SO_2)	0.004	20.536	Gg	<0.1	100
NH_3	0.017	30.16	Gg	<0.1	100
$PM_{2.5}$	0.007	13.108	Gg	<0.1	0
PM_{10}	0.011	25.728	Gg	<0.1	0
TSP	0.015	39.531	Gg	<0.1	100
PCDD/F	0.006	8.651	g I-Teq	<0.1	0

Methodological issues

Emissions are mainly reported by the plants according to the monitoring requirements in the environmental permits. When no plant specific data is available emissions has been calculated.

NMVOC, SOx, NH_3, and particles
Emissions are based on emission data reported by the plants and available in YLVA database.

PCDD/F
Emissions from the production of bricks are calculated using the emission factor 87 ng I-TEQ/ t (UNEP, 1999) and activity data presented in Table 4.73. It is assumed that one brick weights 3 kg.

Table 4.73. Activity data for brick production (Confederation of Finnish Construction Industries, YLVA database (from 2013 onwards)).

Year	Brick production (t)
1990	339 000
1995	156 000
2000	188 715
2005	162 000
2010	111 600
2015	41 200
2016	72 900
2017	70 980
2018	74 060
2019	166 240
2020	169 400
2021	153 060
2022	79 829
2023	66 832

Uncertainty and time series' consistency

The results of the uncertainty analysis are presented in Annex 6 of the IIR.

Source-specific QA/QC and verification

Normal statistical quality checks related to the assessment of the magnitude and trends has been carried out. At present, no verification has been carried out for the specific source-sector emissions.

Source-specific recalculations including changes made in response to the review process

2022
- Brick production activity data for 2013-2019 was revised.

2024
- Brick production activity data for 2016 onwards was revised.

Source-specific planned improvements

None.

APPENDIX I. NFR 2D3a, Emission factors for household products.

THE MAIN PRODUCT GROUPS AND THEIR PRODUCTS	EMISSION FACTOR [%]	LITERATURE REFERENCE
CAR CARE PRODUCTS		
Car wax	100	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Windscreen washing agents (concentrate)	70	(Expert estimate by industry, 2015)
Windscreen washing agents (ready-to-use)	90	(Expert estimate by industry, 2015)
De-icing	100	(Pearson & Brossier, 2015)
Radiator fluid	0	(Expert estimate by industry, 2015)
Brake fluid	0	(Expert estimate by industry, 2015)
Transmission oil	0	(Expert estimate by industry, 2015)
Motor oil	0	(Expert estimate by industry, 2015)
Vehicle and boat shampoo	0	(Expert estimate by industry, 2015)
Wax shampoo	3	(Expert estimate by industry, 2015)
Degreasing agents (3 types)	85	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Engine detergent	85	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
OTHER PRODUCTS		
Lighter fluid for grill	100	(Expert estimate by industry, 2015)
Repellent (for example on tarpaulin)	85	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
COSMETICS AND TOILETRIES		
Hair spray (aerosol)	95	95 (Terbert *et al.*, 2009), 1 (Staats *et al.*, 2005)
Hair spray (pump)	95	95 (Terbert *et al.*, 2009), 1 (Staats *et al.*, 2005)
Deodorant / Antiperspirant (Aerosol)	95	95 (Terbert *et al.*, 2009), 1 (Staats *et al.*, 2005)
Deodorant / Antiperspirant (Roll-on alcohol type)	95	95 (Terbert *et al.*, 2009), 85 (Staats *et al.*, 2005)
Perfume	85	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Shampoo	5	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Soaps (shower gel, liquid soap, bath foam)	5	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Styling mousse	100	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
HOUSEHOLD CLEANING PRODUCTS		
Glass and window cleaner	100	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Air freshener (aerosol)	100	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Universal cleaning product	10	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)
Surface cleaners	10	(Expert estimate by Noora Rantanen, 2015)
Special cleaning agents	5	(Terbert *et al.*, 2009), (Staats *et al.*, 2005)

APPENDIX II. NFR 2D3a, Typical concentrations of NMVOC compounds in household products.

MAIN PRODUCT GROUP AND PRODUCTS	NMVOC COMPOUNDS	CAS-NUMBER OF THE COMPOUND	CONCENTRATION [%]	USED CONCENTRATION IN CALCULATIONS [%]
CAR CARE PRODUCTS				
Windscreen washing agent (Dilute)	Ethanol	64-17-5	1-5	5
Windscreen washing agent (Concentrate)	Ethanol	64-17-6	> 80	80
	Butanol	71-36-3	< 2	2
	Ethylene glycol	107-21-1	0-5	3
Car wax	Distillates (petroleum), hydrotreated light	647-47-8	10-20	15
Shine wax	Distillates (petroleum), hydrotreated light	647-47-8	5-10	5
	Dipentene	138-86-3	< 0,1	0,1
De-icing	Ethylene glycol	107-21-1	1-5	3
	2-Propanol	67-63-0	5-10	8
	2-Butanone	78-93-3	< 0,5	0,5
	Ethanol	64-17-6	30-60	50
	4-Methyl-2-pentanone	108-10-1	1-5	3
Radiator fluid	Ethylene glycol	107-21-1	30-50	40
Brake fluid	Diethylene glycol	111-46-6	10-20	15
	2-(2-butoksietoksi)Ethanol	112-34-5	0,5-1	1
	2-(2-metoksietoksi)Ethanol	111-77-3	1-3	2
Transmission oil	1,2,4-Trimethylbenzene	95-63-6	< 0,1	0,1
Motor oil (mineral oil)	Ethylenediamine	107-15-3	0,0001-0,1	0,01
Vax shampoo	Dietyleeniglykoli	111-46-6	0,0001-0,1	0,01
Caravan shampoo	Dipropyleneglycolmethylether	34590-94-8	1-3	2
Degreasing agent	Dipropyleneglycolmethylether	34590-94-8	1-5	3

	2-Butoxyethanol	111-76-2	1-5	3
Engine detergent	Dipropyleneglycolmethylether	34590-94-8	1-5	3
	Butane	106-97-8	10-30	20
	Propane	74-98-6	10-30	20
	Pentane	109-66-0	< 1	1
	Naphtha (petroleum), hydrotreated heavy	64742-48-9	60-100	80
OTHER PRODUCTS				
Lighter fluid for grill	Naphtha (petroleum), hydrotreated heavy	64742-48-9	100	100
Repellent (for example on tarpaulin)	Naphtha (petroleum), hydrotreated light	64742-49-0	10-25	12
	2-Propanol	67-63-0	10-25	12
	Acetic acid, 1-methylethyl ester	108-21-4	1-5	3
	Pentane	109-66-0	< 1	1
	Propane	74-98-6	10-25	12
	Acetic acid, butyl ester	123-86-4	10-25	12
	Butane	106-97-8	10-25	12
Boat wax	Diethanolamine	111-42-2	≤ 1	1
	Diethylene glycol	111-46-6	≤ 1	1
	Naphtha (petroleum), hydrodesulfurized light, dearomatized	92045-53-9	5-10	7
	Naphtha (petroleum), hydrotreated heavy	64742-48-9	10-30	20
Boat shampoo	Dipropyleneglycolmethylether	34590-94-8	1-3	2
COSMETICS AND TOILETRIES				
Hair spray (Aerosol)	Dimethylether	115-10-6	55	55
	2-Propanol	67-63-0	40	40
Hair spray (Pump)	Isopropyl alcohol	67-63-1	95	95
Deodorant (Aerosol)	Butane	106-97-8	95	95
Deodorant (Roll-on, alcohol type)	Ethanol	64-17-6	40 / 20 / 10	40 / 20 / 10

Perfume	Ethanol	64-17-7	80	80
Shampoo	Perfumes	N/A	0,1-1	1
Soaps (Shower gel, Liquid soap, Bath foam)	Perfumes	N/A	1	1
Styling mousse	Propane	74-98-6	30 / 5	30 / 5
	Ethanol	64-17-7	30 / 5	30 / 5
HOUSEHOLD CLEANING PRODUCTS				
Glass and window cleaner (Ready for use)	Ethanol	200-578-6	< 5	5
Glass and window cleaner (Concentrate)	Ethanol	200-578-6	15-30	25
Air freshener (Aerosol)	Propane	200-827-9	10-25	20
	Ethanol	200-578-6	10-25	20
	Butane	200-857-2	> 50	50
Universal cleaning product	2-Propanol	67-63-0	5-10	7
Surface cleaners	Ethanol	64-17-5	< 10	7
Special cleaning agents (Stain remover from surface)	Naphtha (petroleum), hydrotreated heavy	64742-48-9	65-75	70
	Butane	106-97-8	10-15	12
	Propane	74-98-6	10-15	12
Special cleaning agents (Antiliming agent)	Ethanol	64-17-5	1-3	2