



National Institute for Public Health  
and the Environment  
*Ministry of Health, Welfare and Sport*

# Informative Inventory Report 2026

Emissions of transboundary air pollutants  
in the Netherlands 1990–2024

RIVM report 2026-0024





## **Informative Inventory Report 2026**

Emissions of transboundary air pollutants  
in the Netherlands 1990–2024

RIVM report 2026-0024

## Colophon

© RIVM 2026

Parts of this publication may be reproduced, provided acknowledgement is given to: National Institute for Public Health and the Environment, along with the title and year of publication.

DOI 10.21945/RIVM-2026-0024

N. Staats (author), RIVM  
M. Bolech (author), TNO  
S.N.C. Dellaert (author), TNO  
R. Dröge (author), TNO  
E. van Eijk (author), TNO  
E. Honig (author), RIVM  
B. van Huet (author), RWS  
S.E.H. van Mil (author), TNO  
R.A.B. te Molder (author), RIVM  
A.J. Plomp (author), PBL  
D. Wever (author), RIVM  
H. Witt (author), RIVM  
M.C. van Zanten (author), RIVM  
T. van der Zee (author), RIVM

### Contact:

Natascha Staats  
Milieukwaliteit\Emissies, Data en Burgermetingen  
natascha.staats@rivm.nl

This investigation has been performed by order and for the account of the Ministry of Infrastructure and Water Management, within the framework of Sustainable Environment and Circular Economy

Published by:

**National Institute for Public Health  
and the Environment, RIVM**

P.O. Box 1 | 3720 BA Bilthoven

The Netherlands

[www.rivm.nl/en](http://www.rivm.nl/en)

## Synopsis

### **Informative Inventory Report 2026**

Emissions of transboundary air pollutants in the Netherlands 1990–2024

This Informative Inventory Report (IIR) describes the emission of air pollutants in 2024 compared to 2023. The report also indicates the extent to which the Netherlands has met the European obligations to reduce emissions compared to 2005, the baseline year. It shows that all targets (as laid down in the EU NEC Directive) were met in 2024, as they were in 2020, 2021, 2022 and 2023.

In 2024, 112.6 kilotons of ammonia were emitted, which was 4.6 kilotons less than in 2023. It was also 27 per cent lower than in the baseline year (the NEC target is a 13 per cent reduction). The decrease in 2024 was mainly caused by fewer animals being kept on farms and a decrease in the use of urea as N fertiliser.

The emission of PM<sub>2.5</sub> (Particulate Matter) fell further to 13.9 kilotons in 2024, which was 51 per cent lower than in the baseline year (the NEC target is a reduction of 37 per cent).

The emission of nitrogen oxides decreased by 4.9 kilotons in 2024 compared to 2023, and was 62 per cent lower than in the baseline year (the NEC target is a 45 per cent reduction). The decrease in 2024 was mainly due to the fact that the number of modern cars, with lower emission, increased, and because less electricity was generated using coal.

In 2024, the emission of sulphur oxides was 1.6 kilotons lower than in 2023. This was mainly due to lower emissions by refineries. The emission of sulphur dioxides was 77 per cent lower than in the baseline year (compared to the NEC target of 28 per cent reduction).

The emission of volatile organic compounds was 3.1 kilotons lower in 2024 than in 2023. The total emission was 26 per cent lower than in the baseline year (compared to the NEC target of 8 per cent reduction).

The Dutch government uses the analyses to make national policy and to report on emission developments at the international level. RIVM prepares this report for the Ministry of Infrastructure and Water Management each year. By submitting the report, the Netherlands meets the national reporting obligations for 2026 of the Convention on Long-Range Transboundary Air Pollution (CLRTAP) and the National Emission Ceilings Directive (NECD).

Keywords: emissions, air pollutants, emission inventory



## Publiekssamenvatting

### **Informative Inventory Report 2026**

#### Emissies van grootschalige luchtverontreiniging 1990-2024

Deze Informative Inventory Report rapportage (IIR) beschrijft de uitstoot van luchtverontreinigende stoffen over de periode 1990-2024. Het rapport geeft ook weer in hoeverre Nederland aan de Europese verplichtingen heeft voldaan om de uitstoot te laten dalen ten opzichte van 2005, het zogeheten basisjaar. Uit deze inventarisatie blijkt dat in 2024, net als in 2020, 2021, 2022 en 2023, alle doelen van de EU NEC-Directive om de uitstoot te laten dalen, zijn gehaald.

In 2024 is 112,6 kiloton ammoniak uitgestoten, 4,6 kiloton minder dan in 2023. Daarmee is de uitstoot 27 procent lager dan in het basisjaar (het NEC-doel is 13 procent minder ammoniak). De afname in 2024 komt vooral doordat er in de landbouw minder dieren zijn gehouden en er minder kunstmest met ureum is gebruikt.

De uitstoot van fijnstof PM<sub>2.5</sub> is verder gedaald tot 13,9 kiloton in 2024, 51 procent minder dan in het basisjaar (het NEC-doel is 37 procent minder).

De uitstoot van stikstofoxiden is in 2024 ten opzichte van 2023 met 4,9 kiloton afgenomen en is 62 procent lager dan in het basisjaar (het NEC-doel is 45 procent minder). De uitstoot daalde in 2024 doordat er steeds meer moderne auto's zijn, die minder stikstofoxiden uitstoten. Ook is er minder elektriciteit opgewekt met steenkool.

De uitstoot van zwaveloxiden is in 2024 1,6 kiloton lager dan in 2023. Dat komt vooral doordat raffinaderijen minder zwaveldioxide uit hebben gestoten. Ten opzichte van het basisjaar is de uitstoot van zwaveldioxide 77 procent lager (het NEC-doel is 28 procent minder).

De uitstoot van vluchtige organische stoffen is in 2024 3,1 kiloton lager dan in 2023. Dat komt vooral doordat minder schoonmaakmiddelen, handdesinfectiemiddelen en cosmetica zijn gebruikt. Ten opzichte van het basisjaar is de totale uitstoot 26 procent lager (het NEC-doel is 8 procent minder).

De Nederlandse overheid gebruikt de analyses in haar nationale beleid en om internationaal over de ontwikkeling van de uitstoot te rapporteren. Het RIVM stelt dit rapport elk jaar op voor het ministerie van Infrastructuur en Waterstaat (IenW). Hiermee voldoet Nederland aan de nationale rapportageverplichtingen voor 2026 van de Convention on Long-Range Transboundary Air Pollution (CLRTAP) en de Nationale Emissieplafondrichtlijn (National Emission Ceilings Directive, NECD).

Kernwoorden: emissies, luchtverontreinigende stoffen, emissieregistratie



## Contents

### **Executive summary — 11**

#### **1 Introduction — 21**

- 1.1 National inventory background — 22
- 1.2 Institutional arrangements for inventory preparation — 22
- 1.3 The process of inventory preparation — 24
- 1.4 Archiving and documentation — 31
- 1.5 Quantitative uncertainty — 31
- 1.6 Explanation of the use of notation keys — 33
- 1.7 Explanation of 'Other' emission sources — 33

#### **2 Trends in Emissions — 37**

- 2.1 National emissions of the main pollutants and particulate matter — 37
- 2.2 National emissions of priority heavy metals — 44
- 2.3 National emissions of persistent organic pollutants — 48

#### **3 Energy — 51**

- 3.1 Overview of the sector — 51
- 3.2 Public electricity and heat production (1A1a) — 53
- 3.3 Industrial combustion (1A1b, 1A1c and 1A2) — 60
- 3.4 Other stationary combustion (1A4ai, 1A4bi, 1A4ci and 1A5a) — 73
- 3.5 Fugitive emissions (1B) — 83

#### **4 Transport — 89**

- 4.1 Overview of the sector — 89
- 4.2 Civil aviation — 94
- 4.3 Road transport — 98
- 4.4 Railways — 114
- 4.5 Waterborne navigation and recreational craft — 117
- 4.6 Non-road mobile machinery (NRMM) — 123
- 4.7 National fishing — 132

#### **5 Industrial Processes and Product Use — 135**

- 5.1 Overview of the sector — 135
- 5.2 Mineral products (2A) — 138
- 5.3 Chemical industry (2B) — 142
- 5.4 Metal production (2C) — 145
- 5.5 Solvents and product use (2D) — 149
- 5.6 Other product use (2G) — 154
- 5.7 Other production industry (2H) — 156

#### **6 Agriculture — 161**

- 6.1 Overview of emissions from the sector — 161
- 6.2 Manure management (3B) — 166
- 6.3 Crop production and agricultural soils (3D) — 176

#### **7 Waste — 185**

- 7.1 Overview of the sector — 185
- 7.2 Overview of shares and trends in emissions — 187
- 7.3 Solid waste disposal on land (5A) — 191

7.4	Composting and anaerobic digestion (5B) — 197
7.5	Waste incineration (5C) — 200
7.6	Wastewater handling (5D) — 207
7.7	Other waste (5E) — 208
<b>8</b>	<b>Other — 213</b>
8.1	Overview of the sector — 213
8.2	Other sources (6A) — 213
<b>9</b>	<b>Large Point Sources — 217</b>
<b>10</b>	<b>Response to the Reviews — 219</b>
10.1	CLRTAP review 2024 and 2025 — 219
10.2	NECD review 2021 and 2025 — 219
<b>11</b>	<b>Recalculations and Other Changes — 221</b>
11.1	Recalculations and improvements of certain elements of the IIR — 221
11.2	Planned improvements — 229
11.3	Status of implementation of review recommendations — 229
<b>12</b>	<b>Projections — 231</b>
12.1	Projected trends in emissions of air pollutants for the Netherlands — 231
12.2	Projections have been prepared in the framework of the Netherlands Climate and Energy Outlook 2024 — 231
12.3	National report with projections for air pollutants — 232
12.4	Measures and policies — 232
12.5	Projection totals for compliance checking NEC-targets 2030 — 237
12.6	Emissions uncertainty range for 2030 — 237
12.7	Model descriptions — 238
12.8	Role of biomass in the projection — 242
12.9	Role of waste in the projection — 243
<b>13</b>	<b>Adjustments and Compliance — 245</b>
13.1	Compliance with the emission reduction targets — 245
13.2	Adjustment under the Gothenburg Protocol — 246
<b>14</b>	<b>Spatial Distributions — 249</b>
14.1	Background for reporting — 249
14.2	Methodology for disaggregation of emission data — 249
14.3	Method changes in spatial distribution — 250
14.4	Maps with geographically distributed emission data — 251
	<b>Acknowledgements — 257</b>
	<b>References — 259</b>
	<b>Appendix 1 The use of notation keys 'IE' and 'NE' — 267</b>
	<b>Appendix 2 Key category analysis results — 272</b>
	<b>Appendix 3 NECD and EMEP review 2024; Status on implementation of recommendations — 289</b>

**Appendix 4 Additional information to be considered as part of the IIR submission – 312**

**Appendix 5 Combined NFR source category KCA uncertainty analysis – 313**

**Appendix 6 Data applied for the NMVOC adjustment 3B1a – 321**

**Appendix 7 Verification activities of nitrogen oxides and ammonia emissions with satellite observations – 322**



## Executive summary

### *ES1 Summary of trends in national emissions*

Total national emissions for all pollutants have decreased substantially since 1990 (see Table ES1). The major overall drivers for these trends are:

- for the agricultural sector, the introduction in the nineties of a ban on surface spreading of manure, direct incorporation of manure into the soil and covering of outdoor slurry manure storage; the introduction of low-emission animal housing and precision feeding aiming to reduce N excretion; and the slow decrease of livestock numbers (cattle and swine);
- emission reductions in the industrial sectors due to the introduction of cleaner production technologies and flue gas treatment technologies;
- the use of cleaner fuels through desulphurisation of fuels and reduced use of coal and heavy oils;
- cleaner cars due to EU emission regulations for new road vehicles.

Table ES1 Total emissions of pollutants for the years 1990 and 2020–2024

Pollutant	Unit	National total emissions EMEP/NECD					
		1990	2020	2021	2022	2023	2024
NO <sub>x</sub>	Gg	675.3	212.2	207.3	194.9	185.8	180.7
NMVOG	Gg	600.0	253.2	240.0	240.7	238.0	234.1
SO <sub>x</sub>	Gg	197.6	19.7	20.9	19.6	17.5	15.8
NH <sub>3</sub>	Gg	346.6	125.4	123.8	121.2	117.2	112.6
PM <sub>2.5</sub>	Gg	56.9	14.9	15.1	14.8	14.4	13.9
PM <sub>10</sub>	Gg	80.3	27.4	27.6	27.4	27.0	26.3
TSP	Gg	101.9	31.9	32.2	31.9	31.1	30.7
BC	Gg	14.0	2.6	2.5	2.4	2.3	2.2
CO	Gg	1187.8	439.2	434.1	418.2	400.9	396.9
Pb	Mg	335.6	6.0	5.1	4.7	4.1	4.6
Cd	Mg	4.1	2.1	0.97	0.88	0.55	0.58
Hg	Mg	3.7	0.48	0.46	0.48	0.42	0.38
As	Mg	1.5	0.29	0.27	0.31	0.24	0.27
Cr	Mg	12.0	3.2	3.5	3.5	3.5	4.1
Cu	Mg	92.5	103.9	100.5	106.5	110.8	113.9
Ni	Mg	75.7	1.8	1.7	1.7	1.9	2.7
Se	Mg	0.41	0.21	0.19	0.19	0.13	0.11
Zn	Mg	225.8	178.2	149.7	155.6	70.1	86.7
PCDD/ PCDF (dioxins/furans)	g I-TEQ	745.0	30.1	30.4	30.4	32.1	29.7
benzo(a) pyrene	Mg	5.5	1.5	1.6	1.6	1.6	1.5
benzo(b) fluoranthene	Mg	8.1	1.4	1.5	1.6	1.5	1.5
benzo(k) fluoranthene	Mg	4.2	0.71	0.80	0.84	0.81	0.78
indeno (1,2,3-cd) pyrene	Mg	2.9	0.75	0.84	0.80	0.76	0.73
HCB	kg	66.7	3.7	3.6	3.6	3.4	3.3
PCBs	kg	38.4	0.14	0.19	0.18	0.13	0.14

1 International Toxic Equivalent, a unit that is used to summarise the toxicity of different dioxins and dioxin-like substances into a single value. Not all dioxins are equally toxic, so their amounts are converted to the equivalent of the most toxic form: 2,3,7,8-TCDD

### ES2 Compliance with the NECD and the Gothenburg Protocol

For both the Gothenburg Protocol and the NECD, the Netherlands has opted to calculate the compliance totals on the basis of fuel sold.

The emission reduction targets for both the NECD and the Gothenburg Protocol are the same percentage for each pollutant. However, for NO<sub>x</sub> and NMVOG, the calculation of emission totals for compliance checking differs between the NECD and the Gothenburg Protocol. Under the NECD, the emissions of NO<sub>x</sub> and NMVOG from manure management and agricultural soils (NFR 3B and 3D – Agriculture Sector) are exempted from the compliance total; whereas under the Gothenburg Protocol, these emissions are included in the compliance total.

Under the NECD, the emissions of NO<sub>x</sub>, NMVOG, NH<sub>3</sub>, SO<sub>x</sub> and PM<sub>2.5</sub> comply with the 2020–2029 reduction targets (2021 and 2022 are not shown in the table). In 2024, the targets for 2030 are being met for all five pollutants as well (Table ES2).

Table ES2 Emission reductions and compliance under the NECD

Pollutant	Compliance total (Gg)				Target 2020-2029	Achieved reduction			Target 2030
	2005	2020	2023	2024		2020	2023	2024	
<b>NO<sub>x</sub></b>	391.3	178.1	153.6	148.7	<b>45%</b>	54%	61%	62%	61%
<b>NMVOG</b>	202.4	165.7	152.5	149.3	<b>8%</b>	18%	25%	26%	15%
<b>SO<sub>2</sub></b>	67.6	19.7	17.5	15.8	<b>28%</b>	71%	74%	77%	53%
<b>NH<sub>3</sub></b>	155.3	125.4	117.2	112.6	<b>13%</b>	19%	24%	27%	21%
<b>PM<sub>2.5</sub></b>	28.5	14.9	14.4	13.9	<b>37%</b>	48%	50%	51%	45%

Under the Gothenburg Protocol, the Netherlands is not in compliance with the NMVOC reduction target in 2020 (Table ES3, highlighted in orange) without an adjustment.

With regard to the reduction targets that have been set for 2030, in 2024 these are being met for SO<sub>2</sub>, NH<sub>3</sub> and PM<sub>2.5</sub> but not yet for NO<sub>x</sub> and NMVOC (Table ES3).

Table ES3 Emission reductions and compliance under the Gothenburg Protocol, without adjustments

Pollutant	Compliance total (Gg)				Target 2020-2029	Achieved reduction			Target 2030
	2005	2020	2023	2024		2020	2023	2024	
<b>NO<sub>x</sub></b>	426.9	212.2	185.8	180.7	<b>45%</b>	50%	56%	58%	61%
<b>NMVOG</b>	268.3	253.2	238.0	234.1	<b>8%</b>	6%	11%	13%	15%
<b>SO<sub>2</sub></b>	67.6	19.7	17.5	15.8	<b>28%</b>	71%	74%	77%	53%
<b>NH<sub>3</sub></b>	155.3	125.4	117.2	112.6	<b>13%</b>	19%	24%	27%	21%
<b>PM<sub>2.5</sub></b>	28.5	14.9	14.4	13.9	<b>37%</b>	48%	50%	51%	45%

#### ES3 Adjustment application

As becomes clear from Table ES3, the Netherlands is not in compliance with the reduction commitment for NMVOC under the Gothenburg Protocol. However, Decision 2012/3 (UNECE, 2012) of the Executive Body states that adjustments may be made to the national emission inventories under specific circumstances for the purpose of comparing the inventories with emission reduction commitments.

The 2013 EMEP/EEA Guidebook implemented a default methodology and default EFs for NMVOC from animal husbandry and manure management. This resulted in the inclusion of the NMVOC emissions from agriculture in the emission inventory in 2017, as described in Chapter 6. Thus, the NMVOC emissions from these sources were not accounted for at the time when emission reduction commitments were set. Therefore, the Netherlands applied for an inventory adjustment for an NMVOC source in NFR category 3B, more specific 3B1a (Manure management – Dairy cattle) for 2020. When the inventory is adjusted for this source, the Netherlands is in compliance, as presented in Table ES4.

Table ES4 Compliance under the Gothenburg Protocol with inventory adjustment

Year	Inventory total (Gg)	Reduction target	Unadjusted reduction	Adjustment NFR-3B1a (Gg)	Adjusted compliance total (Gg)	Reduction with adjustment
<b>2005</b>	<b>268.3</b>	-	-	24.2	244.0	-
<b>2020</b>	253.2	8%	6%	43.6	209.6	14%
<b>2021</b>	240.0	8%	11%	-	-	-
<b>2022</b>	240.7	8%	10%	-	-	-
<b>2023</b>	238.0	8%	11%	-	-	-
<b>2024</b>	234.1	8%	13%	-	-	-

*ES4 Other information**Completeness of the national inventory*

The Netherlands NFR inventory includes all sources and is generally considered to be complete. For some NFR source categories, no methods are available or they are regarded as negligible (see Table A1.2).

*Methodological changes, recalculations and improvements*

Several recalculations were made in this inventory. Most are small and deal with changes in methodology, error corrections, new data sources or changes in allocation.

The most noticeable changes are:

*Energy*

- EC<sub>2.5</sub> emissions from individual companies have been recalculated for the full time series. In previous submissions, EC<sub>2.5</sub> emissions were calculated based on the EC<sub>k</sub>/PM<sub>10</sub> ratio. Now, EC<sub>2.5</sub> emissions are calculated based on EC<sub>2.5</sub>/PM<sub>2.5</sub> fractions, based on the EMEP/EEA 2023 Guidebook. This leads to recalculations for sectors where PM<sub>2.5</sub>/PM<sub>10</sub> fractions do not follow standard ratios, often because of the use of company reported data under e-AERs. This affects emissions under 1A1, 1A2, 1A4ai, 1A4bi.
- Under 1A1a, 1A2gviii, 1A3ai and 1A4ci, emissions of Cd, Hg, and Pb have increased due to the addition of these emissions from combustion of biogas and solid biomass, from 2009 onwards.
- The activity data of wood combustion has been corrected for the complete time series, leading to recalculations of emissions under 1A2gviii, 1A4ai, and 1Aci.
- Under 1A2gviii, the NO<sub>x</sub> emission factor for wood combustion in the wood industries has been updated to match the EMEP/EEA Guidebook.
- For 1A2b, dioxin emissions from 2006 and 2009 have been corrected.
- NMVOC emissions from gasoline service stations (under 1B2av) have been recalculated for 2015-2023, as the amount of fuel used for road transport was updated in the energy statistics.

Specifically for transport:

- Aviation:
  - o Minor corrections in aircraft – engine pairings and updated emission factors, leading to small recalculations.

- o Increase of NMVOC emissions as now also HC emissions from engine starts for turbofan engines are calculated.
- Road transport:
  - o PAH emissions increased from 2011 onwards for all vehicle types except mopeds and motorcycles. This is due to an error correction in the calculation.
  - o Recalculation of kilometres driven results in minor changes in all emissions from 2022-2023.
  - o An error correction in the allocation of emissions of POPs from cold starts and cooling units of heavy-duty vehicles, leading to an increase of emissions of POPs in 1A3bi-iii.
  - o Recalculation of diesel fuel for non-road mobile machinery has decreased the diesel fuel usage and related emissions for heavy-duty vehicles (1A3biii), for the full time series.
  - o NO<sub>x</sub> emissions of heavy duty vehicles (1A3biii) have increased for 2018-2023, due to a recalculation of ageing of SCR systems.
- Railways
  - o Recalculation of energy use by CBS has led to a small decrease in electricity use of railways in 2023. This has led to a slight decrease in (wear) emissions from electric trains in 2023.
- Non-road mobile machinery (NRMM)
  - o For most machine types, previous estimates of historical machine sales have been re-assessed. Furthermore, lifetimes and machinery-specific scrappage functions have been adjusted. This has led to significant changes to the modelled fuel consumption and emissions.
  - o The modelled inflow of electric machinery has been changes substantially, leading to changes of emissions.
  - o The distribution of machinery types over economic sectors has been updated, leading to an update of emissions for different machine types. Especially the public services sector has received a larger share, while the allocation to industry has decreased.
  - o For 2022 and 2023, an updated diesel fuel use was provided for the agricultural sector, resulting in a decrease of emissions.
  - o The NO<sub>x</sub> emission factor for diesel engines of STAVE IV and V have been lowered based on new measurements.
  - o Emissions from petrol evaporation are now also estimated, using a Tier 2 method.

### *IPPU*

- As also listed under 'Energy' - EC<sub>2.5</sub> emissions from individual companies have been recalculated for the full time series. In previous submissions, EC<sub>2.5</sub> emissions were calculated based on the EC<sub>2.5</sub>/PM<sub>10</sub> ratio. Now, EC<sub>2.5</sub> emissions are calculated based on EC<sub>2.5</sub>/PM<sub>2.5</sub> fractions, based on the EMEP/EEA 2023 Guidebook. This leads to recalculations for sectors where PM<sub>2.5</sub>/PM<sub>10</sub> fractions do not follow standard ratios, often because of the use of company reported data under e-AERs. This affects emissions under 2A, 2B, 2C, 2H.

- For 2A5b Construction and demolition, particulate matter emissions were recalculated for the full time series, resulting from the reversion of an error correction in the previous submission (of a supposed double counting).
- PM emissions under 2A5c Storage, handling and transport of mineral products were recalculated for 2023, due to new data becoming available.
- Emissions of NMVOC, PM<sub>10</sub>, PM<sub>2.5</sub>, benzene, PAH, and cadmium under 2A6 Asphalt production were recalculated due to newly available activity data.
- Emission estimates for HCB emissions under 2C1 Iron and steel production have been added, leading to emissions for the full time series.
- NMVOC emissions from chemical laundries (2D3a and 2D3f) were updated due to the introduction of new machines, leading to an update of the EF, and an update of the activity data.
- Under 2G Other product use, there are two recalculations:
  - Increase of emissions from smoking of cigarettes for the full time series, as activity data increased due to the addition of cigarettes bought abroad and illegally produced.
  - Recalculation of NMVOC emissions from stationary refrigeration for 2021-2023. This is due to a delay in activity data availability and an error correction for 2021.

### *Agriculture*

- The amount of treated manure has been harmonised for the calculations regarding storage and treatment. This leads to recalculations (increases) of NO<sub>x</sub> emissions under 3B. For dairy cattle (3B1a), emissions are recalculated from 2006 onwards. For non-dairy cattle (3B1b), this led to an increase in NO<sub>x</sub> emissions for the full time series. For swine (3B3), emissions are recalculated for all years since 2006, which was the first year with swine manure treatment. It also leads to minor recalculations in NH<sub>3</sub> emissions for cattle (3B1a and 3B1b).
- NH<sub>3</sub> emissions for 3B1a Manure management – Dairy cattle increased for 2022 and 2023, due to an error correction.
- For 3B4d Manure management – Goats, PM and NH<sub>3</sub> emissions increased, due to updated emission factors.
  - For PM, emissions increased for all years since 1991. The new EF has been applied for all years since 2018. The old one is used for 1990. For the years 1991-2017, constant linear interpolations has been applied to create a consistent time series.
  - For NH<sub>3</sub>, the new EF has been applied from 2018 onwards. The old EF is applied to 1990-1998. For 1999-2017, constant linear interpolation has been applied.
- NMVOC emissions from manure management have been recalculated for all sectors and years for which NH<sub>3</sub> were recalculated. This leads to minor increases in NMVOC emissions from dairy cattle (3B1a Manure management – Dairy cattle), and to decreases of NMVOC emissions from goats (3B3), from 1999 to 2023.
- NH<sub>3</sub> and NO<sub>x</sub> emissions from Inorganic N-fertilisers (3Da1) increased for 2019-2023, resulting from the updated emission

factor for NH<sub>3</sub> from goat housing. This updated EF results in higher N concentrations of rinsing liquid from air scrubbers on goat houses, leading to higher NH<sub>3</sub> and NO<sub>x</sub> emissions when applied to soils.

- NH<sub>3</sub>, NO<sub>x</sub> and therefore also NMVOC emissions from 3Da2a 'Animal manure applied to soils' decrease for the full time series, resulting from the recalculations under 3B. These recalculations in 3B affect the amount of Total Applied Nitrogen available for application.
- The NO<sub>x</sub> emissions related to agricultural use of organic soils have been recalculated based on new insights on the area of peat and peaty soils in the Netherlands. This leads to NO<sub>x</sub> increases under 3Da4 for 1990-2020 and decreases in 2021-2023.
- The preliminary figures for the application of inorganic fertilisers compost, pesticides and the grassland renewal rate in 2023 have been updated to final figures, leading to small changes in NO<sub>x</sub> and NH<sub>3</sub> emissions under 3Da2c and HCB emissions from 3Df.
- Emissions from grassland renewal have been reallocated from 3Da2a (animal manure applied to soils) to 3Da4 (crop residues applied to soils).

#### *Waste*

- All emissions under 5A Solid waste disposal on land have been recalculated for 2021, 2022 and 2023 due to newly available activity data. This leads to a decrease of emissions.
- NH<sub>3</sub> emissions of 5B2 Anaerobic digestion at biogas facilities has increased for 2005 up until 2023, increasing from 8 tons in 2005 to around 370 tons in 2023. This is due to the addition of emissions from waste processed in co-digesters.
- For 5E Other waste, emissions of PCDD/PCDF (dioxins/furans) and particulate matter species have been recalculated for 2014-2023. The ratio between car fires and the number of incidents reported to insurers has been adjusted for this period, leading to a decrease of emissions from car fires.

A complete list of methodological changes, recalculations and improvements is presented in each specific sector chapter.

#### *Condensables*

The condensable component of PM is included in the PM emission estimates of transport and domestic wood burning.

#### *ES5 Background information on the air pollutions inventory*

This report documents the Netherlands' submission for 2026 of its air Pollutant Release and Transfer Register (PRTR), in line with the annual reporting requirements under the Convention on Long Range Transboundary Air Pollution (CLRTAP) and its implementation under the European Monitoring and Evaluation Programme (EMEP), directed by the United Nations Economic Commission for Europe (UNECE) and in line with the European National Emission Ceilings (NECD).

This report has been prepared in line with the reporting guidelines provided by the CLRTAP Executive Body's decisions

ECE/EB.AIR/150/Add.1 that were accepted at the meeting of the Executive Body in December 2022.

#### *Institutional arrangements for inventory preparation*

The CLRTAP/NECD emission inventory process of the Netherlands is an integral part of the national Pollutant Release and Transfer Register (NL-PRTR). Figure ES.1 represents the structure of the inventory process and the bodies responsible for each stage.

The National Institute for Public Health and the Environment (RIVM) has been contracted by the Dutch Ministry of Infrastructure and Water Management (IenW) and the Ministry of Climate Policy and Green Growth (KGG) to maintain a high-quality PRTR that complies with the agreed international guidances on emission inventories, and to compile and coordinate the annual preparation of the IIR and the completion of the NFR tables.

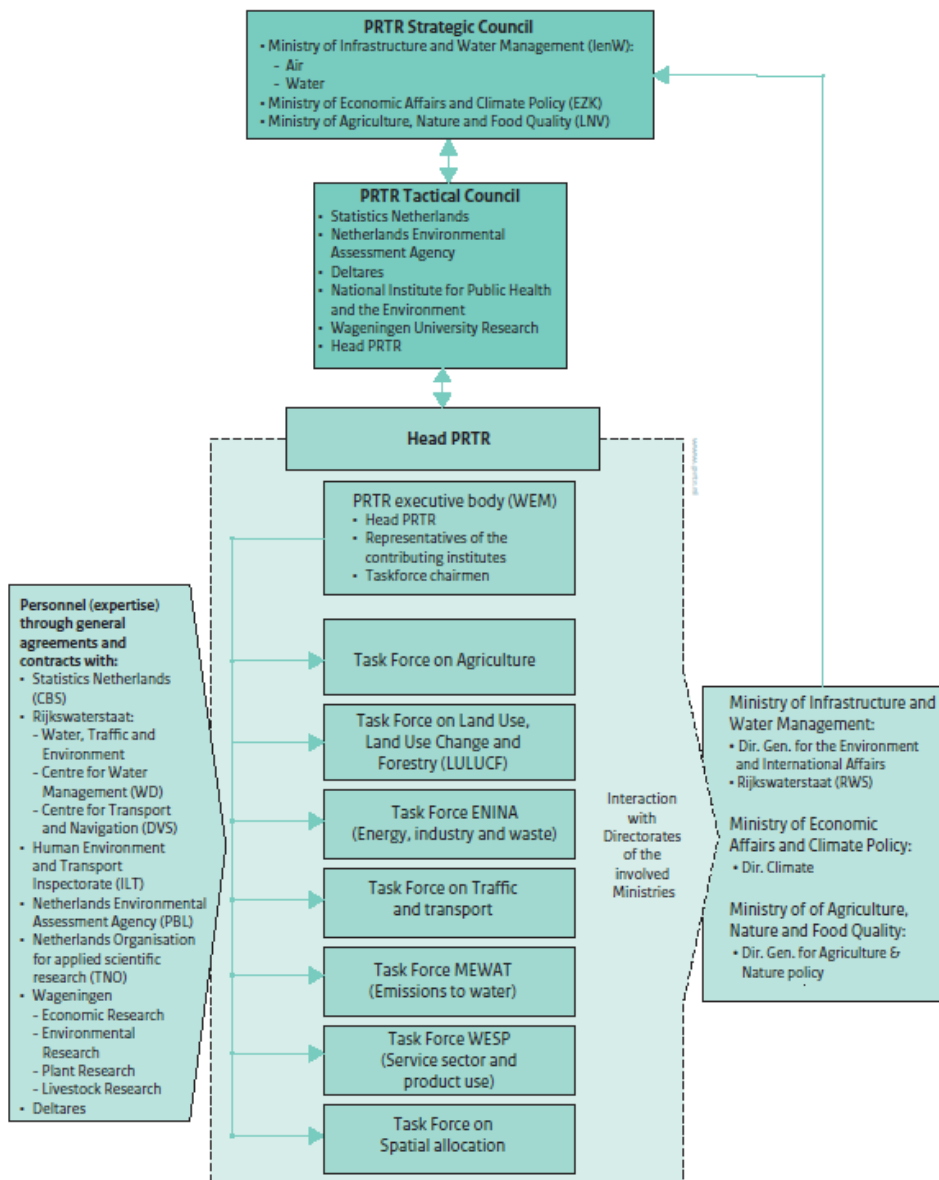
#### *Methodology reports*

Emissions data are compiled from the PRTR in accordance with the 2023 EMEP/EEA air pollutant emission inventory guidebook (EEA, 2023).

Methodologies are described in detail in four separate sectoral methodology reports that form an integral part of the IIR reporting:

- Methodology for the calculation of emissions to air from the sectors Energy, Industry and Waste (Honig et al., 2026);
- Methodology for the calculation of emissions from the transport sector (Witt et al., 2026a; Witt et al., 2026b);
- Methodology for the calculation of emissions from product usage by consumers, construction and services (Visschedijk et al., 2026);
- Methodology for the calculation of emissions from agriculture (Van der Zee et al., 2026).

Figure ES.1 Main elements in the emissions inventory compilation process



**Base year**

In line with the reporting guidelines, the Netherlands uses 1990 as the base year for all pollutants.

**Uncertainty estimates**

The Approach 2 uncertainty estimate method (Monte Carlo analysis) is used to calculate uncertainties that are updated annually as emission factors and activity data are updated. Most uncertainty estimates are based on the judgement of emission experts from the various task forces.

The expert elicitation was set up following the expert elicitation guidance in the 2006 IPCC Guidelines (motivation, structuring, conditioning, encoding and verification). The uncertainties of the individual source-

specific activity data and the EFs were assessed separately using expert judgement. This approach is more detailed than the uncertainty assessment at the level of NFR categories. The Monte Carlo analysis takes correlations of the activity data and/or EFs into account. Table ES5 represents the Approach 2 method uncertainties at the level of NFR categories.

*Table ES5 Uncertainty (95% confidence level) for NH<sub>3</sub>, NO<sub>x</sub>, SO<sub>x</sub>, NMVOC, PM<sub>10</sub> and PM<sub>2.5</sub> for each NFR category and for the national total, calculated with the Approach 2 method*

<b>Approach 2 uncertainties IIR 2026 submission</b>						
<b>NFR sector</b>	<b>NH<sub>3</sub></b>	<b>NO<sub>x</sub></b>	<b>SO<sub>x</sub></b>	<b>NMVOC</b>	<b>PM<sub>10</sub></b>	<b>PM<sub>2.5</sub></b>
1 Energy	119%	15%	22%	33%	48%	54%
2 Industry	52%	77%	80%	37%	40%	55%
3 Agriculture	29%	106%	-	139%	37%	32%
5 Waste	77%	71%	70%	160%	173%	179%
6 Other	279%	-	-	-	-	-
<b>Total</b>	<b>28%</b>	<b>18%</b>	<b>21%</b>	<b>52%</b>	<b>28%</b>	<b>40%</b>

#### *Key categories*

Key sources were identified according to Approach 1, which consists of ranking the list of source category/pollutant combinations according to their contribution to national total annual emissions and to the national total trend. Key categories are those whose emissions add up to 80% of the national total (Appendix 2). No Approach 2 key source analysis was carried out on the level of NFR categories. An Approach 2 KSA was performed, however, on the level of PRTR emission sources with the objective of identifying priority issues for improvement.

#### *Planning inventory improvements*

With limited annual budget, there is a need to prioritise annual improvements. Several factors are taken into account in this prioritisation process; for instance (*not in order of importance*) the availability of new science and/or new data sources, review recommendations or current policy issues. Additionally, a tool is used that identifies emission source categories in the Dutch PRTR that contribute >5% to the national total emissions and have an Approach 2 uncertainty of >50% (Appendix 5).

## 1 Introduction

The United Nations Economic Commission for Europe's 1979 Geneva Convention on Long-Range Transboundary Air Pollution (CLRTAP) was accepted by the Netherlands in 1982, and the amendments on the text and annexes to the protocol were accepted in 2017. The European Community adopted the Revised National Emission Ceiling Directive (NECD) in 2016 to set national emission reduction commitments for EU Member States (EU, 2016).

Parties to the CLRTAP and European Member States are obligated to report their emission data annually. Under the CLRTAP, this data is reported to the Convention's Executive Body in accordance with the implementation of the Protocols to the Convention (accepted by the Netherlands), and for the NECD, they are reported to the European Commission. For both the CLRTAP and the NECD, reports must be prepared using the 2023 Guidelines for reporting emissions and projections data under the Convention (UNECE, 2023).

Additionally, the emission reduction commitments under both the Gothenburg Protocol (UNECE, 2012) and the NECD (EU, 2016) are reported using the Technical guidance (UNECE, 2015).

The Informative Inventory Report 2026 (IIR 2026) comprises the national emission reporting obligation for both the CLRTAP and the NECD with respect to:

- the main pollutants SO<sub>x</sub>, NO<sub>x</sub>, NMVOC and NH<sub>3</sub>;
- particulate matter: PM<sub>2.5</sub>, PM<sub>10</sub>, total suspended particulate (TSP) and black carbon (BC));
- CO;
- priority heavy metals (Hg, Pb and Cd);
- additional heavy metals (As, Cr, Cu, Ni, Se and Zn);
- and several persistent organic pollutants (POPs).

The IIR contains information on the Netherlands' emission inventories for the years 1990 to 2024, with descriptions of methods, data sources and annual QA/QC activities (including the trend analysis workshop).

This report is structured as follows:

- Chapter 1 documents the compiling of the NFR and IIR from the PRTR database.
- Chapter 2 summarises the emissions trends, which are further described and documented in the subsequent chapters.
- Chapters 3–8 document emissions and trends for the following sectors, respectively:
  - o Energy;
  - o Transport.
  - o Industrial Processes and Product Use;
  - o Agriculture;
  - o Waste;
  - o Other.

- Chapter 9 documents the 2025 submission of the large point sources (LPS).
- Chapter 10 documents the response to the CLRTAP and NECD reviews.
- Chapter 11 documents recalculations and improvements since the previous report (IIR 2025).
- Chapter 12 documents the 2025 submission of emission projections.
- Chapter 13 documents compliance with emission reduction targets and the adjustment applied for under the Gothenburg Protocol.
- Chapter 14 documents the spatial distribution of the Netherlands' PRTR emission data.
- Appendices that provide information about key categories, uncertainty analysis and other detailed information. As from the IIR 2025, a first attempt to verify the inventory data by inverse modelling results (provided by the PARIS project) is also added as an appendix to the document (see Appendix 7).

Note that this report provides no specific information on government policies for reducing emissions. Such information can be found, for example, in the Netherlands Monitoring Report Target scope for the Clean Air Agreement. Second progress assessment (Ruysenaars et al., 2024, in Dutch).

The Nomenclature For Reporting (NFR) contains the data on emissions and activity data that form the basis for this report.

## **1.1 National inventory background**

Emission estimates in the Netherlands are registered in the PRTR, which is the national database for sectoral monitoring of pollutant and greenhouse gas emissions to air and water. The database was set up to support national environmental policy, as well as to meet the requirements of the EU National Emission Ceilings Directive (NECD), CLRTAP, the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (national system). This policy covers the annual PRTR updates, the process of data collection, processing and registration, and the reporting of emission data for some 375 compounds. Emission data and documentation can be found at [www.emissieregistratie.nl](http://www.emissieregistratie.nl).

Instead of using the defaults from the EMEP/EEA air pollutant emission inventory guidebook 2023 (EEA, 2023), the Netherlands often applies country-specific methods, with associated activity data (AD) and emission factors (EFs). The emission estimates are based on the official statistics of the Netherlands (e.g. on energy, industry and agriculture) and on environmental reports issued by companies in the industrial sectors. Both nationally developed and internationally recommended EFs have been used.

## **1.2 Institutional arrangements for inventory preparation**

The Dutch Ministry of Infrastructure and Water Management (IenW) bears overall responsibility for the emission inventory and submissions

made to the CLRTAP and the NECD. The PRTR system has been in operation in the Netherlands since 1974. Since 2004, IenW has outsourced the full coordination of the PRTR to the Emission Registration team (ER team) at the National Institute for Public Health and the Environment (RIVM).

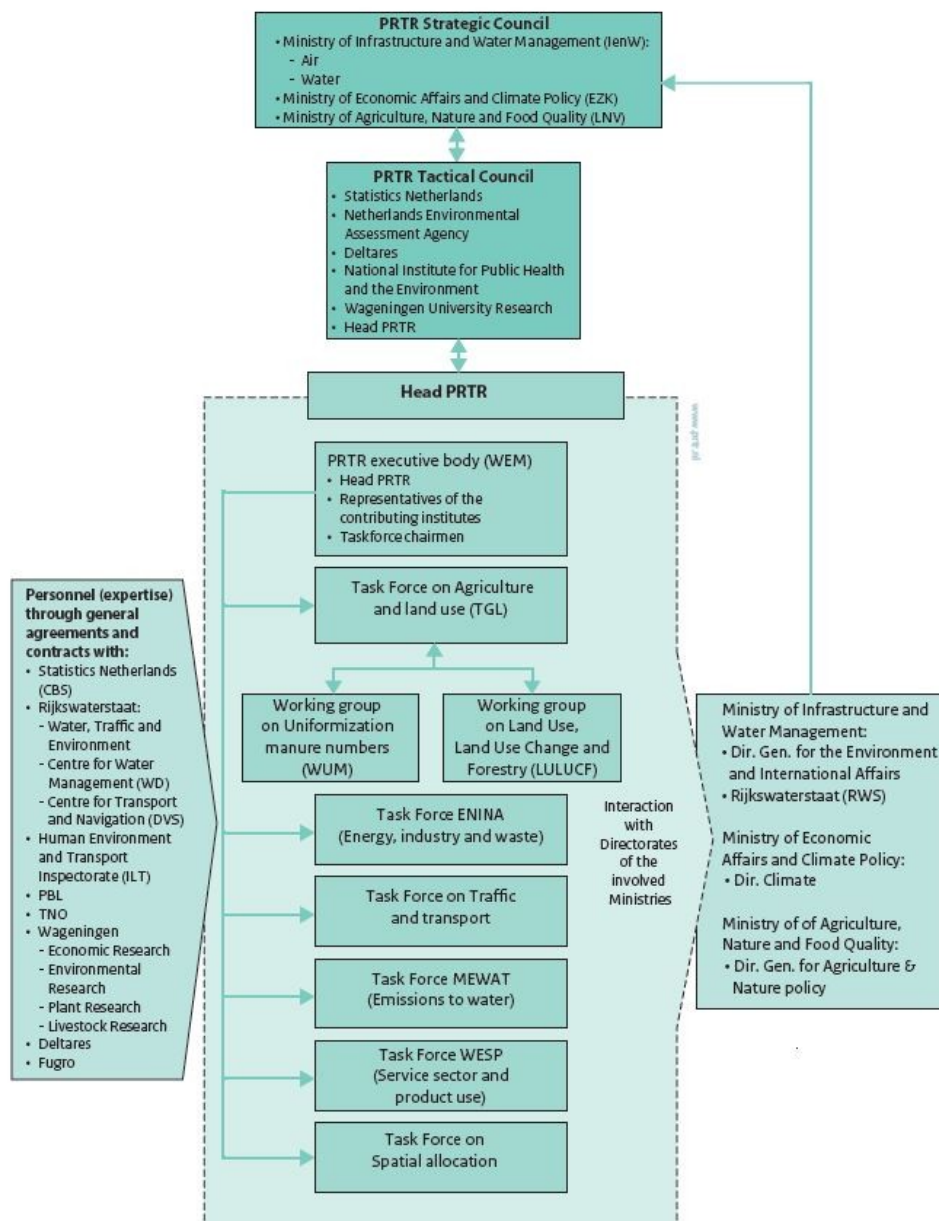
The main objective of the PRTR is to annually produce a set of unequivocal emission data that is up to date, complete, transparent, comparable, consistent and accurate. This forms the basis of all the Netherlands' international emission reporting obligations and is used for national policy purposes.

Emission data is produced in annual (project) cycles. In addition to RIVM, various external agencies/institutes contribute to the PRTR by performing calculations or submitting activity data:

- Netherlands Environmental Assessment Agency (PBL);
- Statistics Netherlands (CBS);
- Netherlands Organisation for applied scientific research (TNO);
- Rijkswaterstaat; Water, Traffic and Environment (RWS-WVL);
- Deltares;
- Wageningen University & Research (WUR), Statutory research tasks:
  - Wageningen Environmental Research (WEnR);
  - Wageningen UR Livestock Research (WLR);
  - Wageningen Social and Economic Research (WSER);
  - Wageningen Plant Research (WPR).

Each of the contributing institutes has its own responsibility and role in the data collection, emission calculations and quality control. These are laid down in general agreements with RIVM and in the annual project plan. Figure 1.1 presents the organisational structure of the Netherlands PRTR.

Figure 1.1 Organisational structure of the Netherlands PRTR



## 1.3 The process of inventory preparation

### 1.3.1 Data collection

Task forces are set up to collect and process the data (according to pre-determined methods) for the PRTR. The task forces consist of sector experts from the participating institutes. Methods are compiled based on the best available scientific knowledge. Changes in scientific knowledge result in changes in methods and in the recalculation of historical emissions. The following task forces are recognised (see Figure 1.1):

- agriculture;
- ENINA: energy, industry and waste;
- traffic and transport;
- MEWAT: emissions to water;

- WESP: service sector and product use;
- spatial allocation.

In addition, LULUCF (Land Use, Land Use Change and Forestry) is now a task force separate from agriculture (not depicted in Figure 1.1).

Once the emission data has been collected, several quality control checks are performed by the task forces during an annual 'trend analysis' workshop. When the task forces have approved the data (relevant sector data), the head of the PRTR endorses the complete dataset. The participating institutes are requested to agree to the dataset to establish a unique set of emission data. Subsequently, the emission data is released for publication ([www.emissieregistratie.nl](http://www.emissieregistratie.nl)). Then, this data is disaggregated into regional emission data for national use (e.g. 1 x 1 km grid, municipality scale, provincial scale and water authority scale). This is the responsibility of the task force on spatial allocation.

### 1.3.2 *Point source emissions*

As of 1 January 2010, companies that are legally obliged under Dutch law to report their emission data can only do so electronically as part of an Annual Environmental Report (AER). These companies have emission monitoring and registration systems in place, with specifications that correspond to those of the competent authority. The licensing authorities (e.g. provinces, central government) validate and verify the reported emissions. Information from the AERs is stored in a separate database at RIVM and remains the property of the companies involved.

Data on point source emissions in the AER database is checked for consistency by the ENINA task force. The result is a set of validated data on point source emissions and activities (ER-I), which is then stored in the PRTR database (Honig et al., 2026).

As a result of the Dutch implementation of the EU Directive on the European Pollutant Release and Transfer Register (E-PRTR), about a thousand facilities have been legally obligated since 2011 to submit data on their emissions of air pollutants if these exceed the reporting threshold. To include emissions from facilities in a particular subsector that do not exceed the threshold (small and medium-sized enterprises – SMEs), supplementary estimates are added to the emissions inventory. For these supplementary estimates, known EFs from research and implied factors from the reported emissions and production are used. Also, statistical information, such as production indexes and sold fuels, is used. The methods for these supplementary estimates are explained in detail in Chapters 3 and 5.

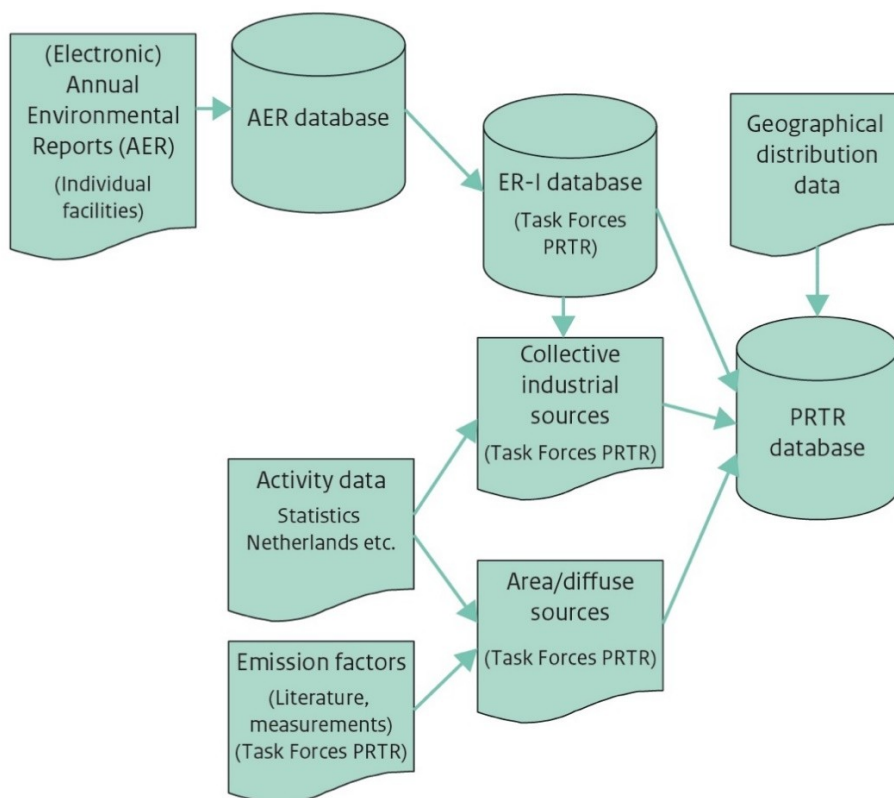
To ensure that the supplementary estimates do not add to the uncertainty of the subsectors' total emissions, the Dutch implementation of the E-PRTR directive ([List of thresholds PRTR reporting](#)) has set lower thresholds for major pollutants, so that a minimum of approximately 80% of the subsectors' total emissions is covered by facility emission reports.

### 1.3.3 Data storage

In cooperation with the contributing research institutes, all emission data is collected and stored in the PRTR database managed by RIVM (Figure 1.2).

This database, consisting of many geographically distributed emission sources, contains complete annual records of emissions in the Netherlands. Each emission source includes information on the NACE code (*Nomenclature statistique des Activités économiques dans la Communauté Européenne*). The industrial subsector includes separate information on location, process and combustion emissions and the relevant environmental compartment and location. These emission sources can be selectively aggregated per Nomenclature for Reporting (NFR) category.

Figure 1.2 The data flow in the Netherlands Pollutant Release and Transfer Register (PRTR)



### 1.3.4 Methods and data sources

Methods used in the Netherlands are annually documented in several methodology reports that are available from [www.emissieregistratie.nl](http://www.emissieregistratie.nl). All methodology reports are in English. However, some background reports are only available in Dutch.

The methodology reports are an integral part of, and submitted together with, this Informative Inventory Report (see also Appendix 4).

In general, two data models are used in the Netherlands:

- A model for emissions from large point sources (e.g. large industrial and power plants), which are registered separately and supplemented by emission estimates for the remainder of the companies within a subsector (based mainly on IEFs from the individually registered companies). This is the so-called bottom-up method.
- Several sector-related models for emissions from 'diffuse sources' (e.g. road transport, agriculture), which are calculated from activity data and EFs from sectoral emission inventory studies in the Netherlands.

It should also be noted that:

- The condensable component of PM is included in the PM emission estimates of transport and domestic wood burning;
- Road transport emissions have been calculated using 'on-road' measured emission factors, so emission data is impervious to 'the diesel scandal'.

### 1.3.5 *Key category analysis*

A key category is defined as an emission source that significantly influences the national total emission for a given pollutant in terms of the absolute emission level, the emission trend or both. The key categories are the sources whose total emissions, when summed in descending order of magnitude, add up to 80% of the total level (EEA, 2023). The key source analysis follows the methodologies as explained in Chapter 2 of the EMEP/EEA inventory guidebook 2023 (EEA, 2023). Key sources were identified using the Approach 1 method of identifying key categories.

The Approach 1 method consists of a level assessment that ranks the list of source categories according to their contribution to national total annual emissions. As the inventories of the latest year (2024) and the base year (1990) are available, the level assessment is performed for both years. This also enables the assessment of the contribution each category makes to the trend of the national inventory. A trend assessment aims to find the categories for which the trend (i.e. the change in emission over time) differs most from the trend of the overall inventory. See Appendix 2 for the analysis results.

An Approach 2 key source analysis was not performed on the level of NFR categories. Instead, a key source analysis according to the Approach 2 method was carried out on the level of the Dutch PRTR emission source categories. The Approach 2 method requires uncertainty estimates for the source categories to identify the key categories. The uncertainty estimates are applied as weights to each of the source categories before ordering the list of shares. As recommended by the IPCC guidelines, the uncertainty estimates are based on Monte Carlo uncertainty analysis (see Section 1.5 for details).

Applying the Approach 2 method to the PRTR emission source categories allows for a more precise identification of inventory improvement actions. By not only ranking emission sources by their contribution to the national total, but also adding their uncertainty as a weight in that

ranking, the key category analysis at this level provides a more accurate listing and is used as an instrument to prioritise improvements by the task forces. Results are reported in appendix 5.

### 1.3.6 *Reporting*

The IIR is prepared by the inventory compiling team at RIVM and includes contributions by experts from the PRTR task forces.

### 1.3.7 *QA/QC*

RIVM has an ISO 9001:2015 QA/QC system in place. PRTR quality management is fully in line with the RIVM QA/QC system. External agencies (other institutes) carry out part of the work for the PRTR. QA/QC arrangements and procedures for the contributing institutes are described in an annual project plan. The general QA/QC activities meet the international inventory QA/QC requirements described in part A, Chapter 6 of the EMEP inventory guidebook (EEA, 2023).

There are no sector-specific QA/QC procedures in place within the PRTR. In general, the following QA/QC activities are performed:

#### **Quality assurance (QA)**

QA activities can be summarised as follows:

- For the Energy, Industry and Waste sectors, emission calculations in the PRTR are mainly based on AERs submitted by companies (facilities). The companies themselves are responsible for the data quality; the competent authorities (in the Netherlands, mainly provinces and local authorities) are responsible for checking and approving the reported data, as part of their annual quality assurance programmes.
- As part of the RIVM quality system, internal audits are performed at the Department for Emissions, Data and Citizen Science (EDB) of the RIVM Centre for Environmental Quality (MIL).
- Annual external QA checks are also conducted on selected areas of the PRTR system.

#### **Quality control (QC)**

Several general QC checks have been introduced as part of the annual work plan of the PRTR (see Table 1.1). The QC checks built into the work plan focus on issues such as the consistency, completeness and accuracy of the emission data. Following an automated first check of the emission files by the Data Exchange Module (DEX) for internal and external consistency, the data was made available to the task forces for the checking of consistency and trends (error checking, comparability, accuracy). The task forces have access to information on all emissions in the database by means of a web-based emission reporting system while the ER team provides them with comparable information on trends and time series. Several weeks before a final dataset is adopted, RIVM conducts a trend verification workshop (see Text Box 1.1) and documents its results, including any actions to be taken by the task forces to resolve the identified clarification issues. The task forces then make the requisite changes to the database.

Table 1.1 Key items of the verification actions on times series 1990–2024 data processing and NFR 2026

QC item/action	Date	Who	Result	Documentation*
Automated initial check on internal and external data consistency	During each upload	Data Exchange Module (DEX)	Acceptance or rejection of uploaded sector data	Result logging in the PRTR database
Inventory of methodological issues and new insights	27-10-2025	Task Forces	List of methodological issues and recalculations for the upcoming IIR	Definitief OVERZICHT Methodewijzigingen reeks 1990-2024.xlsx on Microsoft Teams ER Consortium channel
Comparison sheets with concept data	20-11-2025	RIVM	Input for data checks	Verschiltabel_LUCHT_68_70 on Microsoft Teams ER Consortium channel
Centralized session of data checks by end users	20-11-2025	RIVM	Identification of errors	Actiepunten Definitieve Emissiecijfers 1990-2023 on Microsoft Teams ER Consortium channel
Desk data checks by task forces	21-11-2024/ 26-11-2024	RIVM	Identification and solving of errors	Actiepunten Definitieve Emissiecijfers 1990-2024 on Microsoft Teams ER Consortium channel
Emission data for this inventory plus list of outstanding issues made available for trend analysis	27-11-2025	RIVM	Input for trend analysis	Actiepunten Definitieve cijfers 1990-2024 on Microsoft Teams ER Consortium channel
Compilation of the allocation table for the NFR Annex I)	28-11-2025	RIVM	List of allocations of PRTR emission sources for compiling the NFR tables	NFR-Koppeltabel-2025-11-28_100123-dtt70 NS3

QC item/action	Date	Who	Result	Documentation*
Trend analysis workshop	4-12-2024	Task Forces	Explanations of observed trends and actions to resolve before finalising the PRTR dataset	Actiepunten Definitieve cijfers 1990-2024 on Microsoft Teams ER Consortium channel Trend analysis Powerpoint presentations for each Task Force on Microsoft Teams ER Consortium channel
Resolving the final actions before finalising the PRTR dataset	5-12-2025/ 15-12-2025	Task forces	Updated action list and final dataset	Actiepunten Definitieve cijfers 1990-2024 on Microsoft Teams ER Consortium channel
Request to the individual task force chairs to approve the data produced by the task force	15-12-2025	RIVM-PRTR	Updated action list	Email (15-12-2025 10:21) with the request to endorse the PRTR 1990-2024 emissions dataset
Formal adoption of the emission dataset	17-12-2025	Head PRTR	Fixed emission dataset 1990–2023	Email (17-12-2025 16:47) from the head of the PRTR formalizing the 1990–2024 emissions dataset
Preparation of NFR Annex I	Until 15-2-2026	RIVM, sector experts	NFR Annex I	R:\...\II Informative Inventory Report\IIR 2026\Berekeningen
Writing of IIR report	Until 15-3-2026	RIVM, sector experts	IIR final report	Microsoft Teams ER Consortium channel and R:\...\II Informative Inventory Report\IIR 2026\IIR hoofdstukken

\* All documentation (emails, data sheets and checklists) is stored electronically on a data server at RIVM

*Text Box 1.1 Trend verification workshops*

About a week before a trend analysis workshop, RIVM makes a snapshot of the database available in a web-based application (Emission Explorer, EmEx) for checks by the institutes involved, sectoral and other experts (PRTR task forces) and the RIVM PRTR team. Thus, the task forces can check for level errors and consistency in the algorithm/method used for calculations throughout the time series. The task forces perform checks on the relevant gases and sectors. The sectors are then compared to the previous year's dataset. Where significant differences are found, the task forces check the emission data in more detail. The results of these checks form the subject of discussion at the trend analysis workshop and are subsequently documented.

The PRTR team also provides the task forces with time series of emissions for each substance in each subsector. The task forces examine these time series. During the trend analysis for this inventory, the emission data was checked in two ways: (1) 2024 emissions from the new time series were compared to those of last year's inventory; and (2) the data for 2024 was compared to the trend development for each gas since 1990. The checks of outliers are performed on a more detailed level of the sub sources in all sector background tables:

- annual changes in emissions;
- annual changes in activity data;
- annual changes in implied emission factors (IEFs); and
- level values of IEFs.

Exceptional trend changes and observed outliers are noted and discussed at the trend analysis workshop and included in the action list. Items on this list must be processed before the formal adoption of the dataset or dealt with in next year's inventory.

#### **1.4 Archiving and documentation**

Internal procedures are agreed on for general data collection and the storage of fixed datasets in the PRTR database, including the documentation/archiving of QC checks (e.g. in the PRTR work plan). As of 2010, sector experts can store related documents (i.e. interim results, model runs, etcetera) on a central server at RIVM. These documents then become available through a limited-access website. Updating monitoring protocols for substances under CLRTAP is one of the priorities within the PRTR system. Emphasis is placed on the documentation of methodologies for calculating SO<sub>x</sub>, NO<sub>x</sub>, NMVOC, NH<sub>3</sub>, PM<sub>10</sub> and PM<sub>2.5</sub>. Methodologies, protocols and emission data (including emissions from large point sources based on AERs, as well as emission reports such as the National Inventory Report and the IIR, are made available on the website of the PRTR: [www.emissieregistratie.nl](http://www.emissieregistratie.nl).

#### **1.5 Quantitative uncertainty**

Uncertainty estimates of total national emissions are calculated using an Approach 2 method (Monte Carlo analysis). The uncertainties of the individual source-specific activity data and emission factors (EF's) needed in this analysis, are based on expert judgement from emission experts of the task forces. This approach is more detailed than the uncertainty assessment at the level of the NFR categories. The expert

elicitation was set up in accordance with the expert elicitation guidance in the 2006 IPCC Guidelines (motivation, structuring, conditioning, encoding and verification). The Monte Carlo analysis takes correlations of the activity data and/or EFs into account.

The following correlations are included:

- **Activity data:**  
The energy statistics<sup>[1]</sup> are more accurately registered on an aggregated level (e.g. for Industry) than on a detailed level (e.g. for the separate Industrial sectors). Therefore, uncertainties are assigned to the aggregated categories, for which good estimates are available, rather than trying to estimate uncertainties for the subcategories. This type of correlation is also used for several Transport source categories (such as Shipping and Aviation). For Agriculture, the number of animals in one emission source is equal and therefore, positively correlated to the number of animals of the same type in another emission source. This type of dependency is considered where the identifier of the activity (number of animals or inhabitants) is equal in different emission sources.
- **Emission factors:**  
Within the stationary combustion sector, the estimated uncertainty of an EF for a specific fuel is assumed to be equal for all the emission sources that use this type of fuel. This type of positive correlation is also used for several Transport categories (such as Shipping and Aviation). For Agriculture, the EFs for the various categories of cows (meat or dairy cows) are positively correlated, as the input data is the same (e.g. chickens, pigs), or because the EFs are derived from another animal category (e.g. ducks and chickens, horses and asses).

The results of the Monte Carlo analysis are presented in Table 1.2.

*Table 1.2 Uncertainty (95% confidence level) for NH<sub>3</sub>, NO<sub>x</sub>, SO<sub>x</sub>, NMVOC, PM<sub>10</sub> and PM<sub>2.5</sub> for each NFR sector and for the national total, calculated for emissions in the IIR 2026 submission*

<b>Approach 2 uncertainties IIR 2026 submission</b>						
<b>NFR sector</b>	<b>NH<sub>3</sub></b>	<b>NO<sub>x</sub></b>	<b>SO<sub>x</sub></b>	<b>NMVOC</b>	<b>PM<sub>10</sub></b>	<b>PM<sub>2.5</sub></b>
1 Energy	119%	15%	22%	33%	48%	54%
2 Industry	52%	77%	80%	37%	40%	55%
3 Agriculture	29%	106%	-	139%	37%	32%
5 Waste	77%	71%	70%	160%	173%	179%
6 Other	279%	-	-	-	-	-
<b>Total</b>	<b>28%</b>	<b>18%</b>	<b>21%</b>	<b>52%</b>	<b>28%</b>	<b>40%</b>

The uncertainty estimates from the Monte Carlo analysis (see Table 1.3) differ from the uncertainty estimates as presented in the IIR 2025 using the same method (see Table 1.3).

<sup>[1]</sup> The energy statistics are available on the website of Statistics Netherlands. The following link relates to the energy statistics for 2018: <https://opendata.cbs.nl/>. By means of the 'Change selection' button on the website, it is possible to select the data for another year.

Table 1.3 Uncertainty (95% confidence level) for NH<sub>3</sub>, NO<sub>x</sub>, SO<sub>x</sub>, NMVOC, PM<sub>10</sub> and PM<sub>2.5</sub> for each NFR sector and for the national total, calculated for emissions in the IIR 2025 submission

Approach 2 uncertainties IIR 2025 submission						
NFR sector	NH <sub>3</sub>	NO <sub>x</sub>	SO <sub>x</sub>	NMVOC	PM <sub>10</sub>	PM <sub>2.5</sub>
1 Energy	124%	16%	23%	41%	50%	56%
2 Industry	53%	96%	83%	30%	40%	58%
3 Agriculture	28%	110%	-	132%	38%	35%
5 Waste	70%	69%	73%	154%	170%	175%
6 Other	277%	-	-	-	-	-
<b>Total</b>	<b>27%</b>	<b>19%</b>	<b>22%</b>	<b>48%</b>	<b>29%</b>	<b>42%</b>

At NFR category level, this comparison shows some changes in uncertainty for all shown pollutants. Generally, changes in the total uncertainty of a sector/pollutant can result from changes in absolute emissions, reallocations or updated uncertainty estimates of activity data or emission factors.

## 1.6 Explanation of the use of notation keys

The Dutch emission inventory covers all sources specified in CLRTAP that are relevant to emissions to air in the Netherlands. Because of the long history of the inventory, it is not always possible to specify all subsectors in detail. This is why notation keys are used in the NFR emission tables. The use of the notation keys is explained in Tables A1.1 and A1.2 in Appendix 1. The notation key 'IE' (Included Elsewhere) is generally used when activity data cannot be split or is confidential. For most cases where 'NE' (Not Estimated) was used as a notation key, the respective source is assumed to be negligible, or there is no method available for estimating this source.

## 1.7 Explanation of 'Other' emission sources

Several source categories in the NFR format are used for allocating emission sources that are related to an NFR category, but that cannot be allocated to a specific source category in the relevant source sector. In the NFR format, these source categories are named starting with 'Other'. Table 1.4 represents which source sectors for the Netherlands are allocated to the various 'Other' NFR source categories. These emission sources and their emissions are explained in the relevant chapters for each source sector.

Table 1.4 Sub-sources accounted for in reporting of NFR 'Other' codes

NFR code	Substance(s) reported	Sub-source description
1A2gviii	NO <sub>x</sub> , NMVOC, SO <sub>x</sub> , NH <sub>3</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> , TSP, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, dioxins, PAHs and HCBs	Stationary combustion from production industries in: <ul style="list-style-type: none"> <li>• construction</li> <li>• textiles and clothing</li> <li>• leather and fur preparation</li> <li>• rubber and plastic products</li> <li>• metal products</li> <li>• machine construction</li> <li>• electronic and electric equipment production</li> <li>• computers, electronics and optical equipment production</li> <li>• cars industry</li> <li>• other transport production</li> <li>• furniture production</li> <li>• rug and carpet production</li> <li>• wood products</li> <li>• concrete, gypsum and cement production</li> <li>• construction materials and glass production</li> <li>• synthetic fibre production</li> <li>• ceramics, bricks and roofing tile production</li> <li>• waste preparation for recycling</li> <li>• mineral extraction</li> <li>• shipbuilding</li> </ul>
1A5b	NO <sub>x</sub> , NMVOC, SO <sub>x</sub> , NH <sub>3</sub> , CO, PM <sub>2.5</sub> , PM <sub>10</sub> , TSP, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, dioxins, PAHs, HCBs and PCBs	Recreational navigation and ground machinery at airports
2A6	NO <sub>x</sub> , NMVOC, SO <sub>x</sub> , NH <sub>3</sub> , CO, PM <sub>2.5</sub> , PM <sub>10</sub> , TSP, Cd, Hg and PAHs	Process emissions by product industries, excl. combustion, in building activities and production of building materials
2B10a	NMVOC, SO <sub>x</sub> , NH <sub>3</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> , TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, dioxins and PAHs	Process emissions from production of chemicals, fertilisers, paint, pesticides, pharmaceuticals, soap, detergents, glues and other chemical products

NFR code	Substance(s) reported	Sub-source description
2D3i	NMVOC, NH <sub>3</sub> , dioxins and PAHs	Air conditioning, fumigation of ship holds, use of pesticides and cosmetics, fireworks, preservation and cleaning of wood and other materials
2G	NO <sub>x</sub> , NMVOC, SO <sub>x</sub> , NH <sub>3</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> , TSP, CO, Pb, Cd, Cu, Ni, Zn and PAHs	Smoking of tobacco products, burning of candles, cooling and refrigerating in industry and fireworks
2H3	NO <sub>x</sub> , SO <sub>x</sub> , NH <sub>3</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> , Pb, Cd, Hg, Cr, Cu, Ni and Zn	Process emissions from: <ul style="list-style-type: none"> <li>• services sector</li> <li>• textiles and clothing</li> <li>• leather and fur preparation</li> <li>• rubber and plastic products</li> <li>• metal products</li> <li>• machine construction</li> <li>• electronic and electric equipment production</li> <li>• computers, electronics and optical equipment production</li> <li>• car industry</li> <li>• other transport production</li> <li>• furniture production</li> <li>• rug and carpet production</li> <li>• mineral extraction</li> <li>• transshipping, storage and handling</li> <li>• ship building and painting</li> </ul>
3B4giv	NO <sub>x</sub> , NH <sub>3</sub> , TSP, PM <sub>10</sub> , PM <sub>2.5</sub>	Ducks
3B4h	NO <sub>x</sub> , NH <sub>3</sub> , TSP, PM <sub>10</sub> , PM <sub>2.5</sub>	Rabbits and furbearing animals
3Da2c	NO <sub>x</sub> , NH <sub>3</sub>	Use of compost
5E	NO <sub>x</sub> , NMVOC, SO <sub>x</sub> , NH <sub>3</sub> , CO, PM <sub>2.5</sub> , PM <sub>10</sub> , TSP, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, dioxins, PAHs, HCBs and PCBs	Process emissions from: accidental building and car fires, waste preparation for recycling, scrapping of fridges and freezers
6A	NH <sub>3</sub>	Human transpiration and respiration; domestic animals (pets)



## 2 Trends in Emissions

### 2.1 National emissions of the main pollutants and particulate matter

Total national emissions of the main pollutants and particulate matter have decreased substantially since 1990. Table 2.1 provides an overview of these emissions with respect to the time series. The major overall drivers for this trend are:

- for the agricultural sector, introducing a ban on surface spreading of manure, direct incorporation of manure in the soil, covering of outdoor slurry storage and lately, the introduction of low-emission animal housing, introduction of precision feeding aiming to reduce N excretion and slowly decreasing livestock numbers (mainly cattle and swine);
- emission reductions in the industrial sectors due to the introduction of cleaner production technologies and flue gas treatment technologies;
- use of cleaner fuels through the desulphurisation of fuels and reduced use of coal and heavy oils;
- increasingly cleaner cars due to EU emission regulations for new road vehicles.

Table 2.1 Total national emissions of main pollutants and particulate matter, 1990–2024

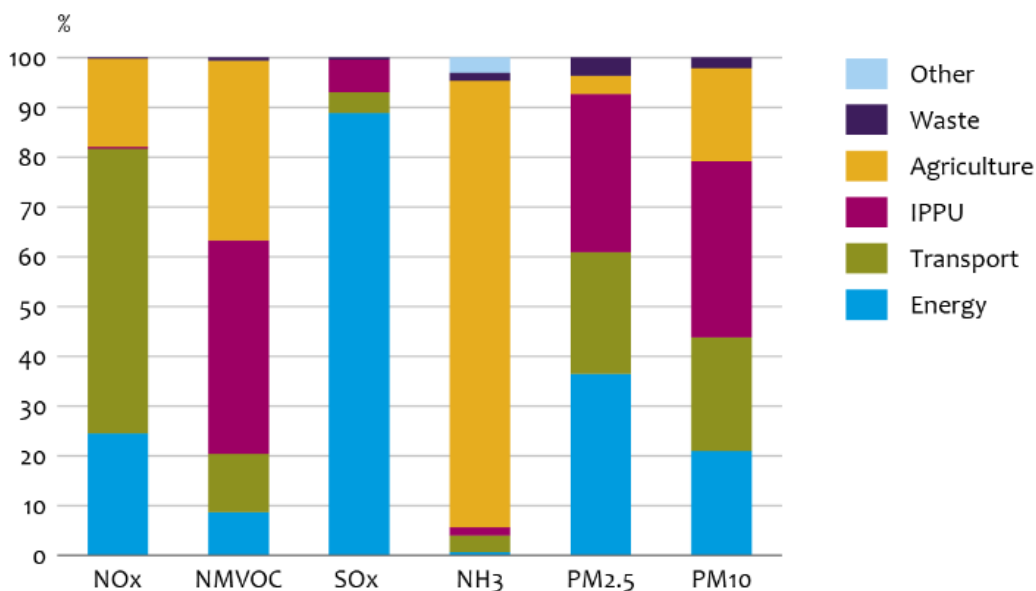
Year	Main Pollutants				Particulate Matter			
	NO <sub>x</sub>	NM VOC	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>675</b>	<b>600</b>	<b>198</b>	<b>347</b>	<b>57</b>	<b>80</b>	<b>102</b>	<b>14</b>
1995	573	432	136	220	45	63	79	12
2000	484	334	78	175	35	50	57	10
2005	427	268	68	155	29	43	51	8.4
2010	345	273	36	135	22	36	44	5.1
2015	271	257	31	130	18	32	38	3.5
2020	212	253	20	125	15	27	32	2.6
2021	207	240	21	124	15	28	32	2.5
2022	195	241	20	121	15	27	32	2.4
2023	186	238	17	117	14	27	31	2.3
<b>2024</b>	<b>181</b>	<b>234</b>	<b>16</b>	<b>113</b>	<b>14</b>	<b>26</b>	<b>31</b>	<b>2.2</b>
1990-2024 <sup>1)</sup>	-495	-366	-182	-234	-43	-54	-71	-11.8
1990-2024 <sup>2)</sup>	-73%	-61%	-92%	-68%	-76%	-67%	-70%	-84%

1. Absolute difference in Gg

2. Relative difference from 1990 in %

Figure 2.1 presents the contributions made by the individual sectors to the total emissions of the main pollutants and particulate matter in 2024.

Figure 2.1 Relative contributions of the individual sectors to emissions of the main pollutants and particulate matter in 2024



The Energy sector is the main source of SO<sub>x</sub>. The Agriculture sector is the dominant sector with regard to NH<sub>3</sub> emissions. For emissions of NO<sub>x</sub>, NMVOC and PM various sectors are important contributors.

### **Adjustment for NMVOC**

As a result of following the 'best science', several sources of NMVOC were added to the inventory after setting the targets in 2013. As a result of this, the Netherlands' 2022 submission was not in compliance with the reduction target for NMVOC in the year 2020. For the purpose of demonstrating compliance with the 2013 targets, the Netherlands applied for an inventory adjustment in its 2022 submission. After being reviewed, this adjustment was approved by the EMEP-EB (EMEP-Executive Body).

In the current IIR-submission for 2026, non-compliance continues for the 2020 unadjusted NMVOC emissions. For the purpose of demonstrating compliance, this will be adjusted in line with the adjustment already approved in 2022.

A complete discussion and justification for this adjustment can be found in Chapter 13 (Adjustments).

#### **2.1.1 Trends in nitrogen oxides (NO<sub>x</sub>)**

The Netherlands' NO<sub>x</sub> emissions decreased by 495 Gg in the 1990–2024 period to 181 Gg, a 73% decline compared to the national total in 1990 (Table 2.1; Figure 2.2).

Although all sectors show a decrease over this period, the main driver for the decrease in NO<sub>x</sub> emissions was the Transport sector, with a 58% share in the 1990 emissions and a 74% reduction from 1990 tot 2024. Within the Transport sector, Road Transport was the main contributor to

the decline in NO<sub>x</sub> emissions; emissions per vehicle decreased substantially over this period due to increasingly cleaner vehicles. However, this was partially negated by an increase in the number of vehicles and total mileage.

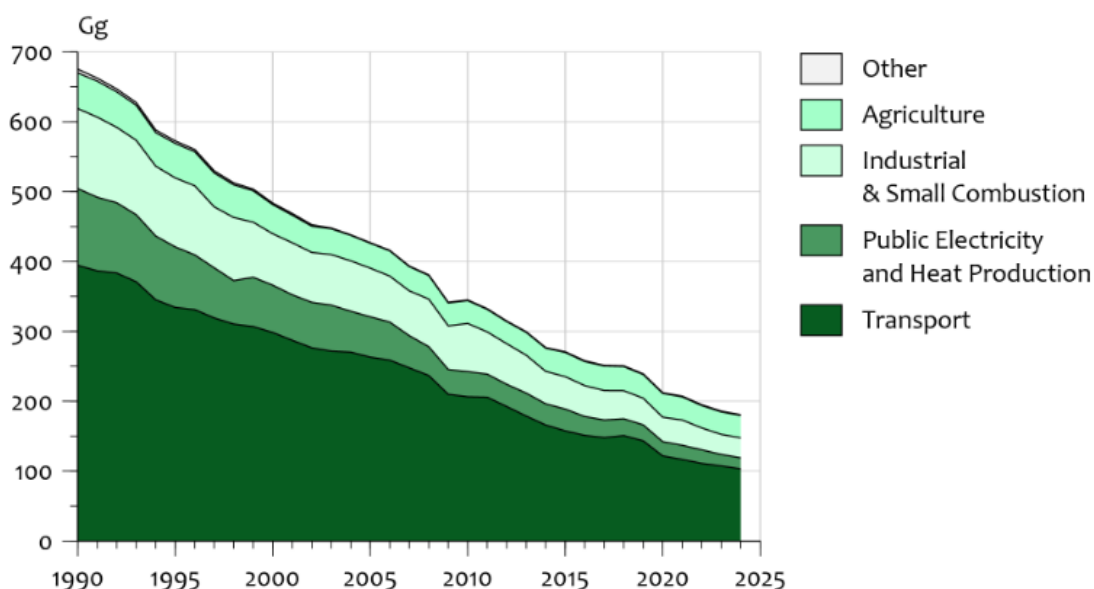
Emissions also decreased in the source category Public Electricity and Heat Production and the Industrial & Small Combustion source categories, due to flue gas cleaning technologies like SCR and low NO<sub>x</sub> burners.

Especially In Road transport and Civil aviation, the effects of the COVID-19 pandemic caused NO<sub>x</sub> emissions to drop in 2020 and 2021. For Road transport, this is the result of the fact that fewer kilometres were driven as most people worked from home. For Civil aviation, there was a strong decrease in landing and take-off cycles (LTO), due to flight cancellations and travel restrictions.

Total NO<sub>x</sub> emissions in 2024 decreased by 5.2 Gg compared to 2023. This is the result of increasingly modern road transport vehicles and reduced coal use for electricity production.

In 2024, the Transport sector still is the main contributor to NO<sub>x</sub> emissions, with a 57% share of the national total (Figure 2.1). The relative share of Agriculture has increased from 8% in 1990 to 18% in 2024.

Figure 2.2 NO<sub>x</sub> emission trends, 1990–2024



### 2.1.2

#### Trends in sulphur oxides (SO<sub>x</sub>)

Dutch SO<sub>x</sub> emissions (reported as SO<sub>2</sub>) decreased by 182 Gg in the 1990–2024 period to 16 Gg, a 92% decline compared to the national total in 1990 (Table 2.1; Figure 2.3).

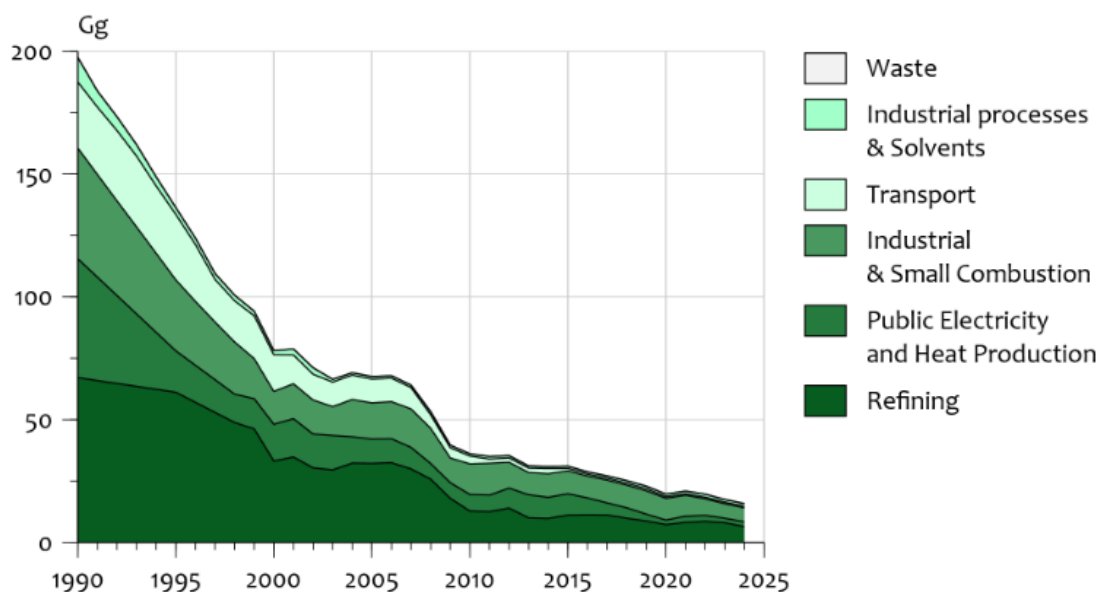
The main contributors to the decline in SO<sub>x</sub> emissions were the Refining, Public Electricity and Heat Production, Industrial & Small Combustion and Transport source categories. Combined, these sources were responsible for 95% of national SO<sub>x</sub> emissions in 1990 and showed a reduction of 92% from 1990 tot 2024.

The use of coal decreased, and major coal-fired electricity producers installed flue-gas desulphurisation plants. In addition, the sulphur content in fuels for the (chemical) industry and traffic was reduced.

Over the 1990–2018 period, oil refining was the main contributor to total SO<sub>x</sub> emissions, with shares between 31% and 49% of the national total. During the 2019–2021 period, Combustion source categories became the main contributor to SO<sub>x</sub> emissions. In 2022–2024, Refineries were the main source of SO<sub>x</sub> again, as a result of the high oil and gas prices due to the war in Ukraine.

Compared to 2023, SO<sub>x</sub> emissions in 2024 decreased by 1.6 Gg, mainly in Refining.

Figure 2.3 SO<sub>x</sub> emission trends, 1990–2024



### 2.1.3 Trends in ammonia (NH<sub>3</sub>)

The NH<sub>3</sub> emissions decreased by 68% between 1990 and 2024, from 346.6 Gg to 112.6 Gg (Table 2.1; Figure 2.4).

The main driver for the decline in NH<sub>3</sub> emissions are agricultural sources, with a share of 97% in NH<sub>3</sub> emissions in 1990 and a reduction of 70% from 1990 to 2024.

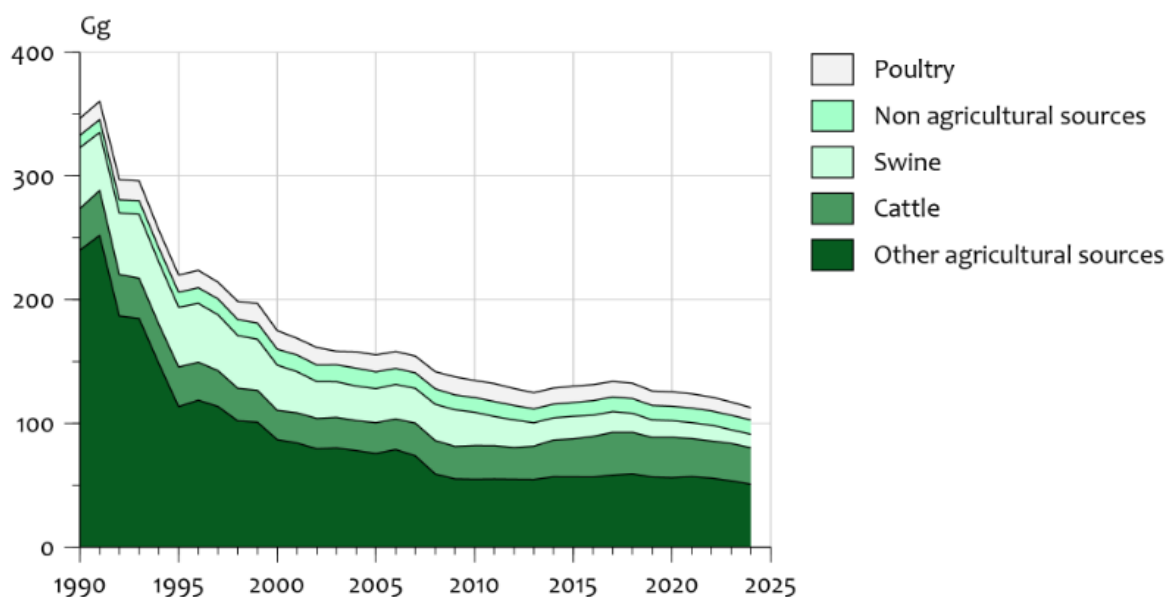
During the 1990–2013 period, the decrease in NH<sub>3</sub> emissions was due to a decrease in livestock numbers, low-protein feed, covering manure storage, low-emission fertilisation, and low-emission stables. Between 2014 and 2017, after years of decline, NH<sub>3</sub> emissions increased again. This was mainly caused by a rise in animal numbers due to the abolition

of the milk quota and the changed composition of feed for livestock. The increase in emissions was partially mitigated by cleaner stable systems for pigs and poultry. From 2018 onwards, NH<sub>3</sub> emissions have decreased again. This was due to declining animal numbers resulting from the introduction of the policy to limit phosphate production, a further increase in the use of low-emission pig stables, and the mandatory dilution of manure when applying it to clay and peat grasslands.

In 2024, NH<sub>3</sub> emissions decreased by 4.6 Gg compared to 2023. This was caused by a further decrease in livestock numbers and reduced use of urea as N fertiliser.

Agriculture remains the largest source of NH<sub>3</sub> emissions in 2024. The relative shares of other sectors in the national total have increased over the 1990-2024 period, but they remain much lower than that of Agriculture (Figures 2.1 and 2.4).

Figure 2.4 NH<sub>3</sub> emission trends, 1990–2024



#### 2.1.4

##### *Trends in non-methane volatile organic compounds (NMVOC)*

In the 1990–2024 period, NMVOC emissions decreased from 600 to 234 Gg, a decline by 61% (Table 2.1; Figure 2.5).

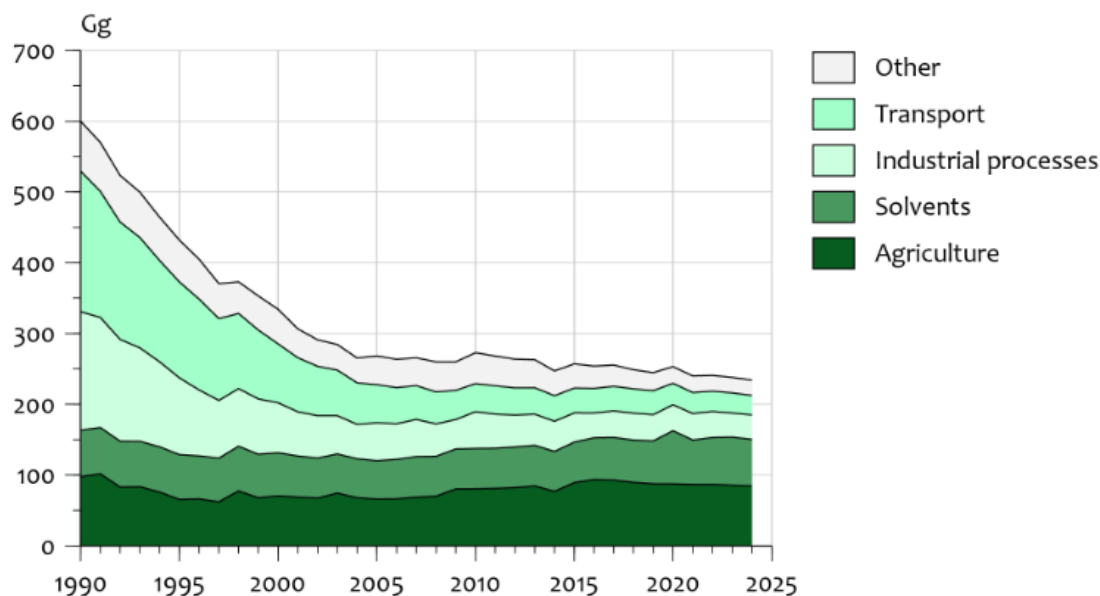
The main contributing sectors to the decline of NMVOC emissions were Transport (with a 33% share in emissions in 1990 and a reduction of 86% from 1990 to 2024) and Industrial Processes (with a 28% share in 1990 and a 79% reduction from 1990 to 2024). In the Transport sector, this was due to the introduction of catalysts and cleaner engines. Emissions from Industrial Processes decreased as a result of the introduction of emission abatement techniques specifically for NMVOC. In Agriculture NMVOC emissions from soils initially decreased in the 1990–1995 period because of changes in the method of manure application. However, emissions from agricultural soils remained constant over the 1996–2024 period, while the NMVOC emissions from

live stock in the 1990–2017 period increased, mainly as result of the increased use of silage.

In 2020, there was a peak in total NMVOC emissions due to the increased use of hand sanitisers during the COVID-19 pandemic. After that, total NMVOC emissions decreased again. Emissions specifically from hand sanitisers showed an upward trend between 2020 and 2023, but in 2024 these emissions are slightly lower than in 2023.

In 2024 total NMVOC emissions were 3.9 Gg lower than in 2023, mainly due to lower use of consumer cleaning products, hand sanitisers and cosmetics.

Figure 2.5 NMVOC emission trends, 1990–2024



### 2.1.5 Trends in PM<sub>2.5</sub>

In the 1990–2024 period, PM<sub>2.5</sub> emissions decreased by 43 Gg to 13.9 Gg, a decline by 76% (Table 2.1; Figure 2.6).

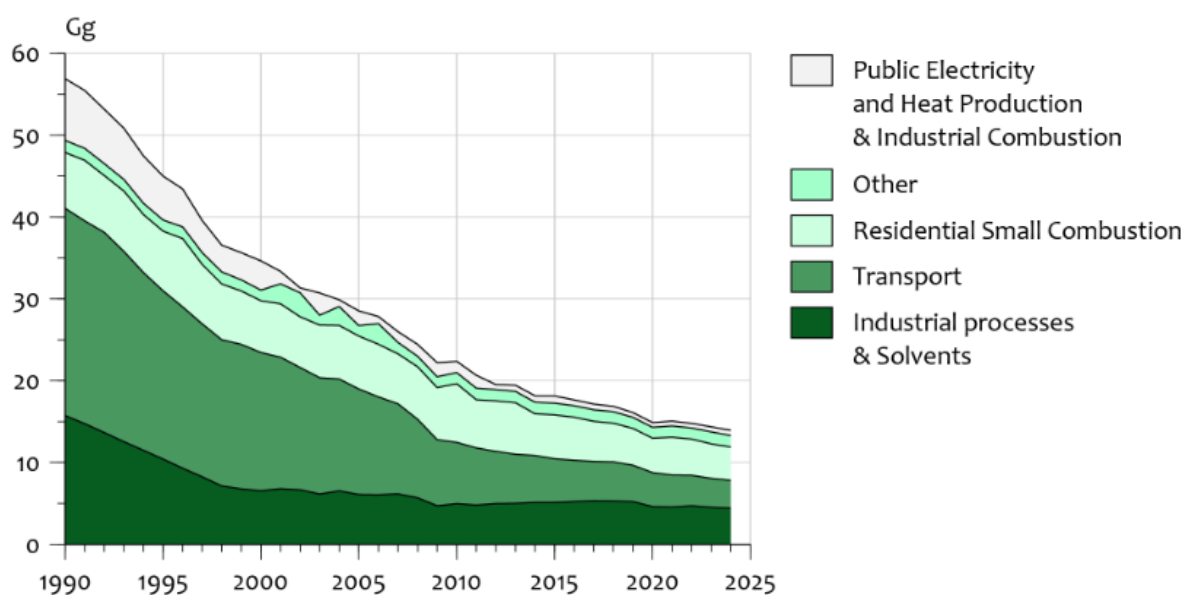
The sectors contributing most to this decrease were the Transport sector, with a 45% share in 1990 emissions and a reduction of 87% from 1990 to 2024; and Industrial Processes & Solvents source categories, with a 28% share in 1990 emissions and a 72% reduction from 1990 to 2024.

In addition, source categories Public Electricity and Heat Production and Industrial Combustion combined showed a marked decline in PM<sub>2.5</sub> emissions of 92%.

The refineries use increasingly cleaner fuels, and in both the Industry and the Energy sectors, abatement technology has been installed. Emission reduction in the Transport sector (mainly Road Transport) is the result of increasingly stringent EU emissions standards that led to better engine management and particulate filters.

Compared to 2023, PM<sub>2.5</sub> emissions in 2024 decreased by 0.4 Gg. This decrease is caused mainly by lower emissions from wood stoves. Less wood has been burned, and old stoves have been replaced with newer models that emit less PM<sub>2.5</sub>. The Transport sector also contributes to this decrease, due to the replacement of old vehicles with new ones and stricter emission standards.

Figure 2.6 PM<sub>2.5</sub> emission trends, 1990–2024



### 2.1.6 Trends in PM<sub>10</sub>

Over the 1990–2024 period, PM<sub>10</sub> emissions decreased from 80.3 to 26.3 Gg, a decline by 67% (Table 2.1; Figure 2.7).

The sectors contributing most to this decrease were the Industrial Processes & Solvents source categories, with a 37% share in 1990 emissions and a reduction of 68% from 1990 to 2024; and the Transport sector, with a 34% share in 1990 emissions and a 78% reduction from 1990 to 2024.

In addition, combined source categories Public Electricity and Heat Production and Industrial Combustion showed a marked decline in PM<sub>10</sub> emissions of 92%.

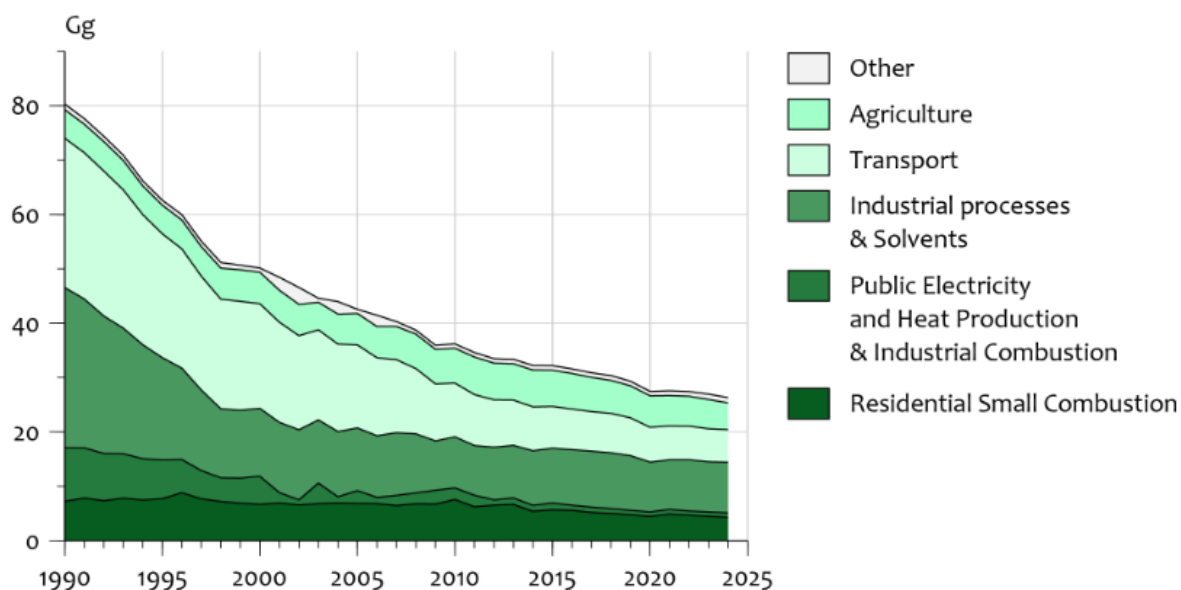
Refineries increasingly use cleaner fuels, and in both the Industry and the Energy sectors, abatement technology has been installed. Emission reductions in the Transport sector (road transport) are the result of increasingly stringent EU emissions standards that led to better engine management and particulate filters.

From 1990 to 2011, PM<sub>10</sub> emissions from agriculture gradually increased. This was mainly caused by a change in housing systems (a shift from liquid manure to solid manure systems), especially for laying hens. Since 2012, PM<sub>10</sub> emissions from Agriculture have been decreasing

due to the increased usage of abatement techniques for PM removal and a lower number of poultry.

In 2024, total PM<sub>10</sub> emissions decreased by 0.6 Gg compared to 2023.

Figure 2.7 PM<sub>10</sub> emission trends, 1990–2024



## 2.2 National emissions of priority heavy metals

Under the Protocol to the Convention on Long-range Transboundary Air Pollution on Heavy Metals and the Gothenburg Protocols, the Netherlands is committed to reducing its total annual emissions of priority heavy metals (lead, cadmium and mercury). The base year for this commitment is 1990. In 2024, all priority heavy metal emissions comply.

Table 2.2 Total national emissions of priority heavy metals, 1990–2024

Year	Priority Heavy Metals		
	Pb	Cd	Hg
	Mg	Mg	Mg
<b>1990</b>	<b>336</b>	<b>4.1</b>	<b>3.7</b>
1995	155	3.1	1.6
2000	29	3.1	1.2
2005	30	3.8	1.0
2010	38	4.8	0.77
2015	8.8	2.9	0.69
2020	6.0	2.1	0.48
2021	5.1	1.0	0.46
2022	4.7	0.9	0.48
2023	4.1	0.5	0.42
<b>2024</b>	<b>4.6</b>	<b>0.6</b>	<b>0.38</b>
1990-2024 <sup>1)</sup>	-331	-3,5	-3,3
1990-2024 <sup>2)</sup>	-99%	-86%	-90%

1. Absolute difference

2. Relative difference from 1990 in %

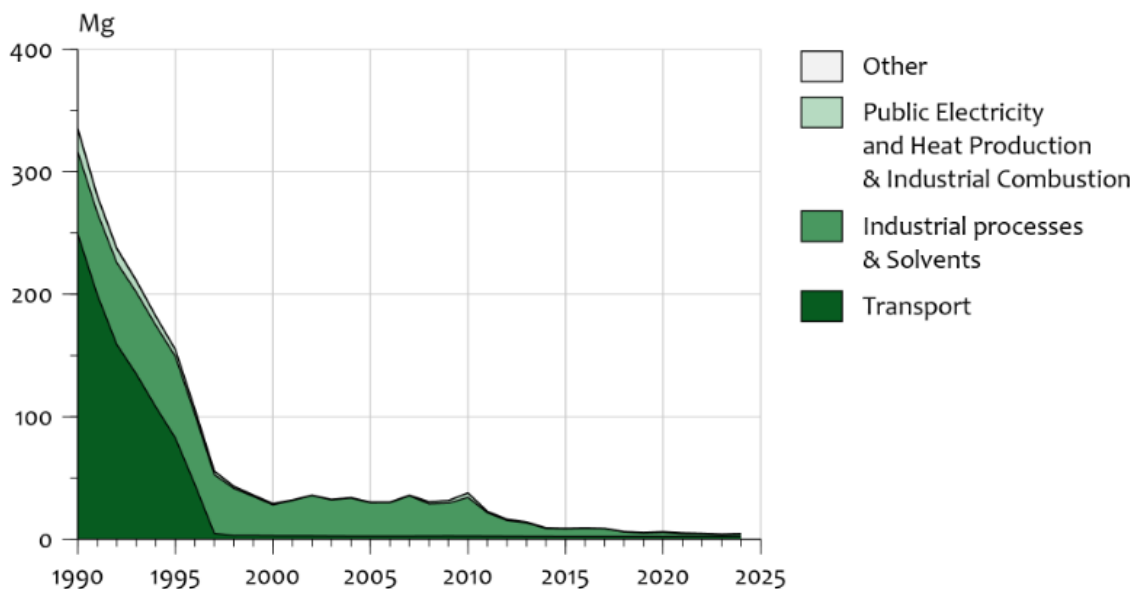
### 2.2.1

#### *Trends in lead (Pb)*

Over the 1990–2024 period, lead (Pb) emissions in the Netherlands decreased from 336 Mg to 4.6 Mg, a 99% decline (Figure 2.8). This decrease is primarily attributable to the Transport sector, where, due to the removal of Pb from gasoline, Pb emissions collapsed. Other sources contributing to this decrease are industrial process emissions, particularly from the iron and steel industry (due to the introduction of electrostatic filters and the optimisation of various other reduction technologies at Tata Steel).

In 2024, Pb emissions were 0.5 Mg higher than in 2023, due to higher reported company emissions in 2C1 Iron and steel production.

Figure 2.8 Pb emission trends, 1990–2024



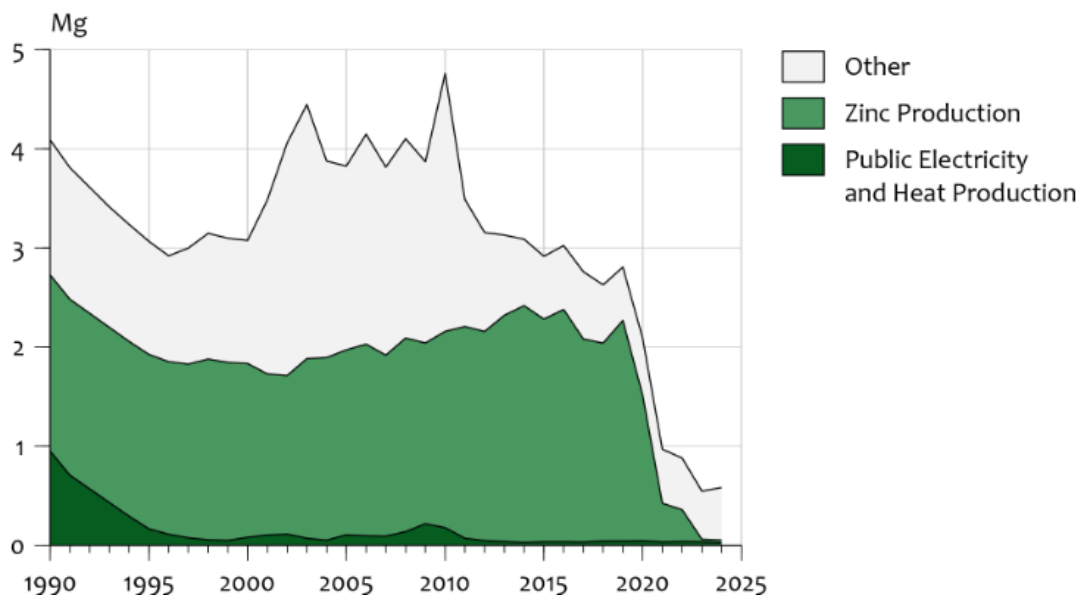
### 2.2.2

#### *Trends in cadmium (Cd)*

Over the 1990–2024 period, cadmium (Cd) emissions in the Netherlands decreased from 4.1 Mg to 0.6 Mg, an 86% decline (Figure 2.9). This decrease is primarily attributable to the Energy sector and Other sources, where cadmium emissions from the only zinc production plant (Nystar) were the main source. The emissions from zinc production gradually increased until 2014. After 2019 the Cd emissions from zinc production decreased sharply. The reason reported by the zinc production plant was that the gases coming from a venturi scrubber sometimes contain aerosols with high concentrations of zinc. This affects the measurements of zinc concentration in the emitted gas as the aerosol is not always captured in the sampling. New measurements in 2021 resulted in significantly lower emission factors.

The Cd emissions over the 2000–2010 period in Other sources result from the activities of one operator in the Chemical industry (ThermPhos). This operator ended production in 2011.

Figure 2.9 Cd emission trends, 1990–2024

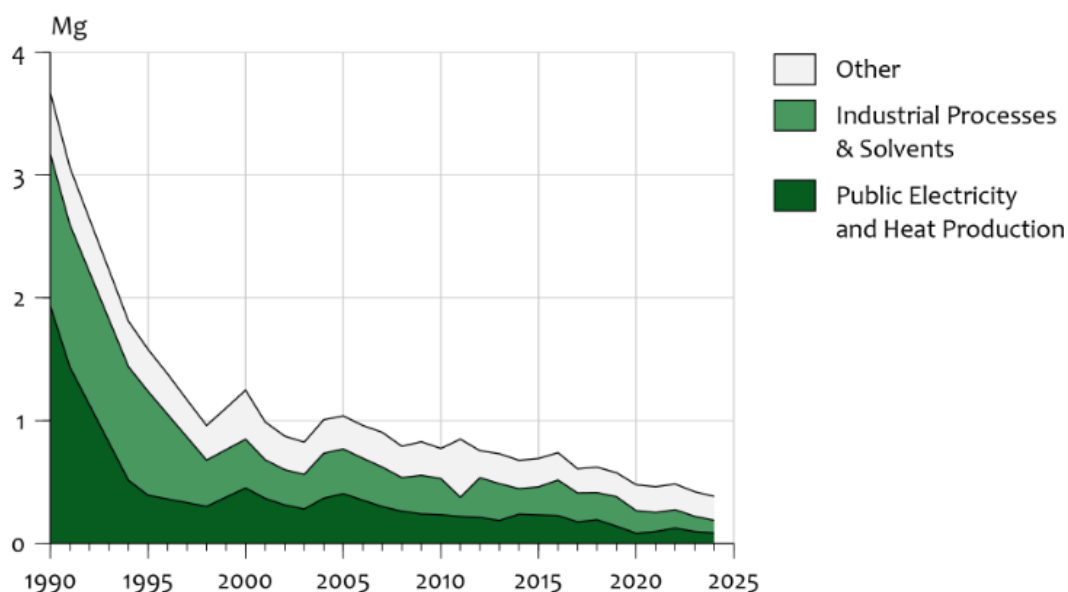


### 2.2.3

#### Trends in mercury (Hg)

Over the 1990–2024 period, mercury (Hg) emissions in the Netherlands decreased from 3.7 Mg to 0.4 Mg, an 90% decline (Figure 2.10). In 1990, the Energy and Industry sectors were the main sources of Hg with emissions of 1.9 Mg and 1.2 Mg, respectively, and had a combined total Hg emission of 86% of the national total. In 2024, these sectors reduced their combined Hg emissions to 0.2 Mg (49% of the 2024 national total).

Figure 2.10 Hg emission trends, 1990–2024



## 2.3 National emissions of persistent organic pollutants

On the basis of the Protocol on Persistent Organic Pollutants (POPs), the Netherlands is committed to reducing its total annual emissions of polycyclic aromatic hydrocarbons (PAHs), dioxins/furans (PCDDs/PCDFs), hexachlorobenzene (HCB) and polychlorinated biphenyls (PCBs). The base year for the POP commitment is 1990 for PAHs, PCDDs/PCDFs and HCB and 2005 for PCBs. In 2024, all POP emissions comply.

Table 2.3 Total national emissions of POPs, 1990–2024

Year	POPs			
	DIOX	PAH	HCB	PCB
	g I-Teq	Mg	kg	kg
<b>1990</b>	<b>745</b>	<b>21</b>	<b>67</b>	<b>38</b>
1995	70	12	41	22
2000	38	6.3	17	0.26
2005	35	6.4	3.7	0.27
2010	40	7.2	3.7	0.27
2015	32	5.9	4.4	0.33
2020	30	4.7	3.7	0.14
2021	30	5.2	3.6	0.19
2022	30	5.2	3.6	0.18
2023	32	4.9	3.4	0.13
<b>2024</b>	<b>30</b>	<b>4.7</b>	<b>3.3</b>	<b>0.14</b>
1990-2024 <sup>1)</sup>	-715	-16.4	-63.4	-38.3
1990-2024 <sup>2)</sup>	-96%	-78%	-95%	-100%

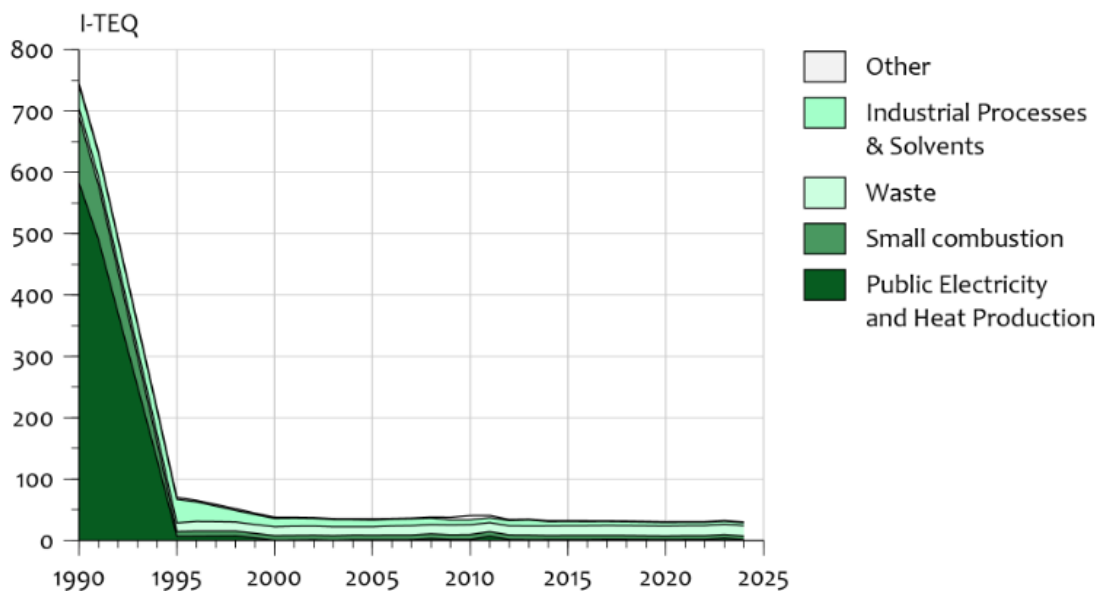
1. Absolute difference

2. Relative difference from 1990 in %

### 2.3.1 Trends in dioxins/furans (PCDD/PCDF)

In the Netherlands, emissions of dioxins/furans mainly result from waste combustion, in the Energy sector, residential wood combustion and accidental car and building fires. Over the 1990–2024 period, emissions of dioxins/furans in the Netherlands decreased from 745 g I-TEQ to 30 g I-TEQ, a 96% decline (Figure 2.11). This decrease is primarily attributable to reduced emissions from waste incineration, in the Energy sector. The rapid decrease of dioxins/furans emissions in this sector is due to both better incinerator management (temperature) and the introduction of abatement technology at waste incinerators.

Figure 2.11 Dioxins/furans emission trends, 1990–2024

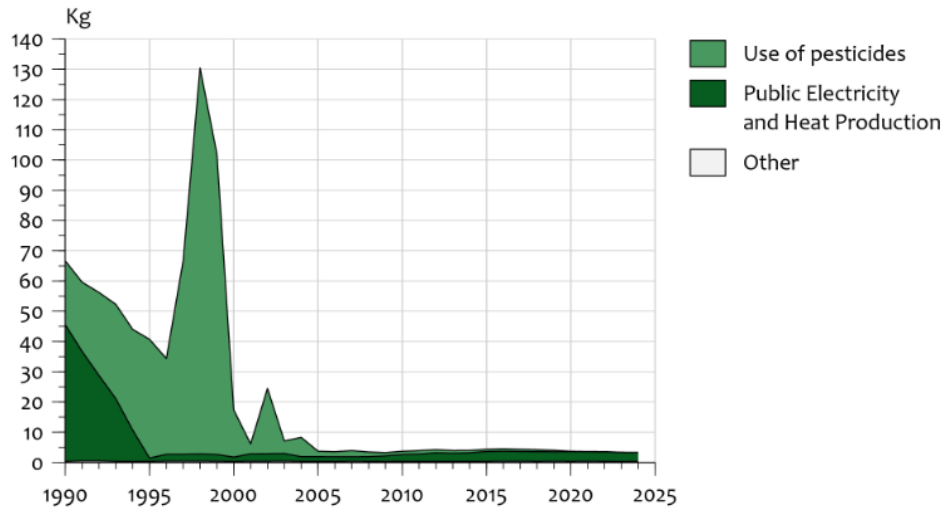


### 2.3.2

#### *Trends in hexachlorobenzene (HCB)*

Over the 1990–2024 period, emissions of hexachlorobenzene (HCB) in the Netherlands decreased from 67 kg to 3.3 kg, a 95% decline (Figure 2.12). This decrease is primarily attributable to the Energy sector (waste incineration for energy) and the Agricultural sector (use of pesticides). The decrease in the Agricultural sector is due to the reduction in the number of applied pesticides containing HCB as well as to a reduction in the maximum amount of HCB allowed as a contaminant in pesticides. HCB from agriculture is calculated from the annual sales of HCB-containing pesticides. The increased HCB emissions from agriculture from 1997 to 1999 were the result of increased sales of the chlorothalonil fungicide that contained HCB as an impurity.

Figure 2.12 HCB emission trends, 1990–2024

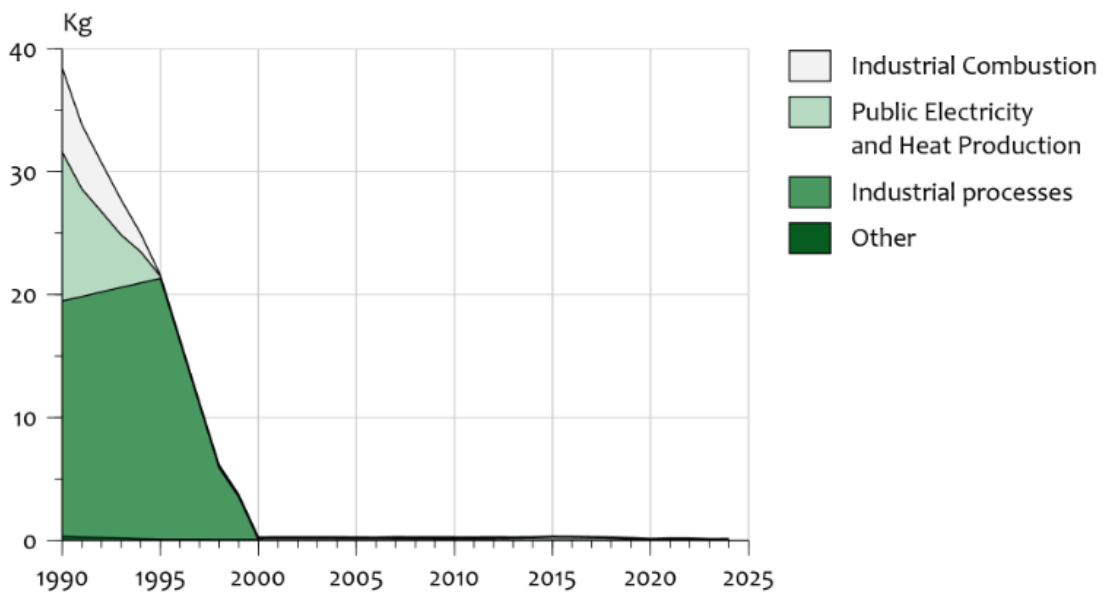


### 2.3.3

#### Trends in polychlorinated biphenyls (PCBs)

Over the 1990–2024 period, polychlorinated biphenyl (PCB) emissions in the Netherlands collapsed from 38 kg to 0.14 kg, a 100% decline (Figure 2.13). This decrease is attributable to all sectors and is due to the ban on the production and use of PCBs. This ban resulted in a relatively fast decrease of PCB use in (electronic) products and oil in electrical transformers.

Figure 2.13 PCB emission trends, 1990–2024



## 3 Energy

### 3.1 Overview of the sector

Emissions from the Energy sector include all energy-related emissions from stationary combustion, as well as fugitive emissions from the Energy sector.

The majority of the emissions from stationary combustion for electricity production and industry (NFR categories 1A1 and 1A2) are reported in the AERs (Annual Environmental Reports) submitted by large industrial companies. For SO<sub>x</sub> in 2024, in the categories 1A1 and 1A2 (excluding 1A2gvii), 98% of the emissions were based on company data (AERs and other company data), while for other pollutants, the proportions were 92% (NH<sub>3</sub>), 82% (NMVOC), 90% (NO<sub>x</sub>) and 82% (PM<sub>10</sub>). The emission data from individual companies comes from direct emission measurements or from calculations using fuel input and EFs. Most of the emission data from 'other' stationary combustion (categories 1A4 and 1A5) was calculated using energy statistics and default EFs.

As in most other developed countries, the energy system in the Netherlands is largely driven by the combustion of fossil fuels. In 2024, the total of primary fuels used in the Netherlands consisted of natural gas (36%), liquid fuels (40%), biogenic fuels (16%), solid fuels (7%) and waste (3%). Figures 3.1 and 3.2 represent the energy supply and energy demand in the Netherlands. The energy consumption is directly related to the temperature during the winter. The natural gas consumption is higher in cold winters (e.g. 1996 and 2010) and lower in warm winters (e.g. 2014). The decrease in natural gas consumption in 2022 is due to the high natural gas prices in 2022.

Figure 3.1 Energy supply by fuel in the Netherlands, 1990–2024 ('Electricity' refers to imported electricity only)

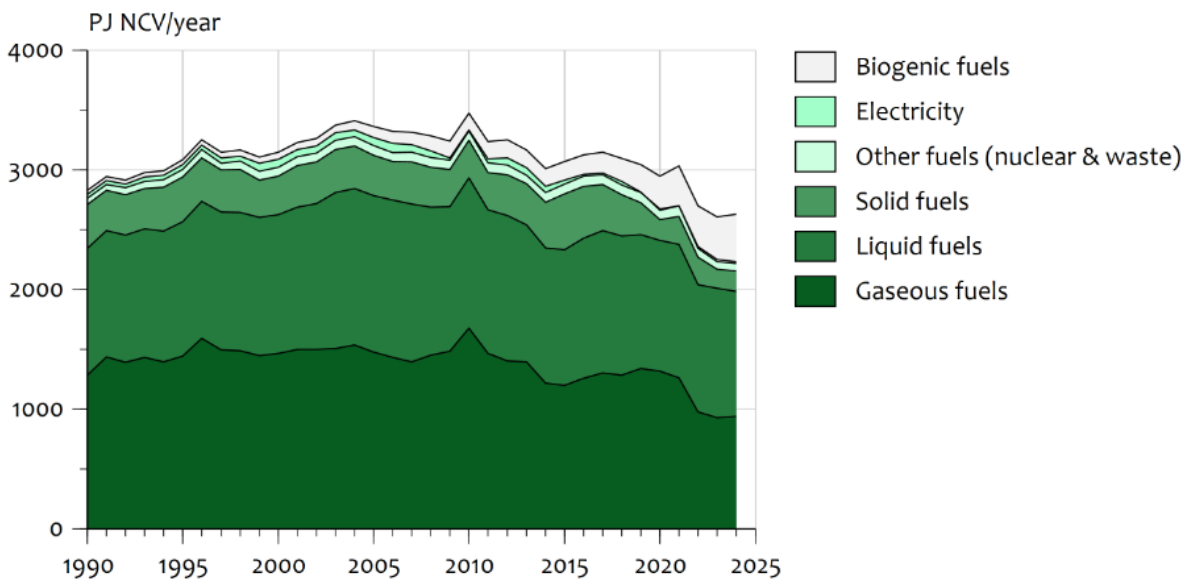
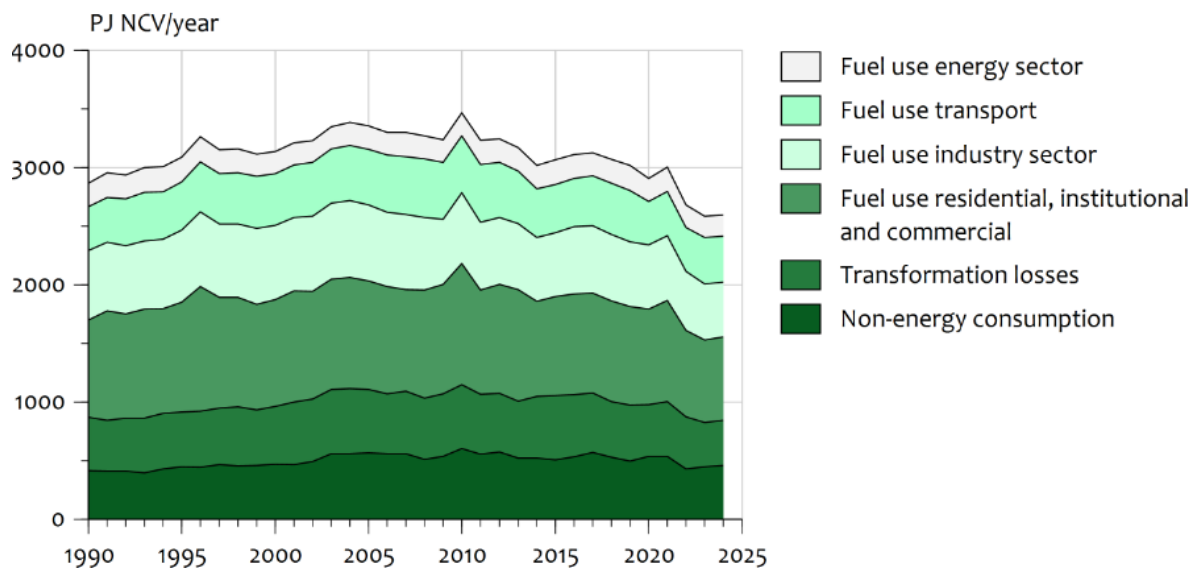


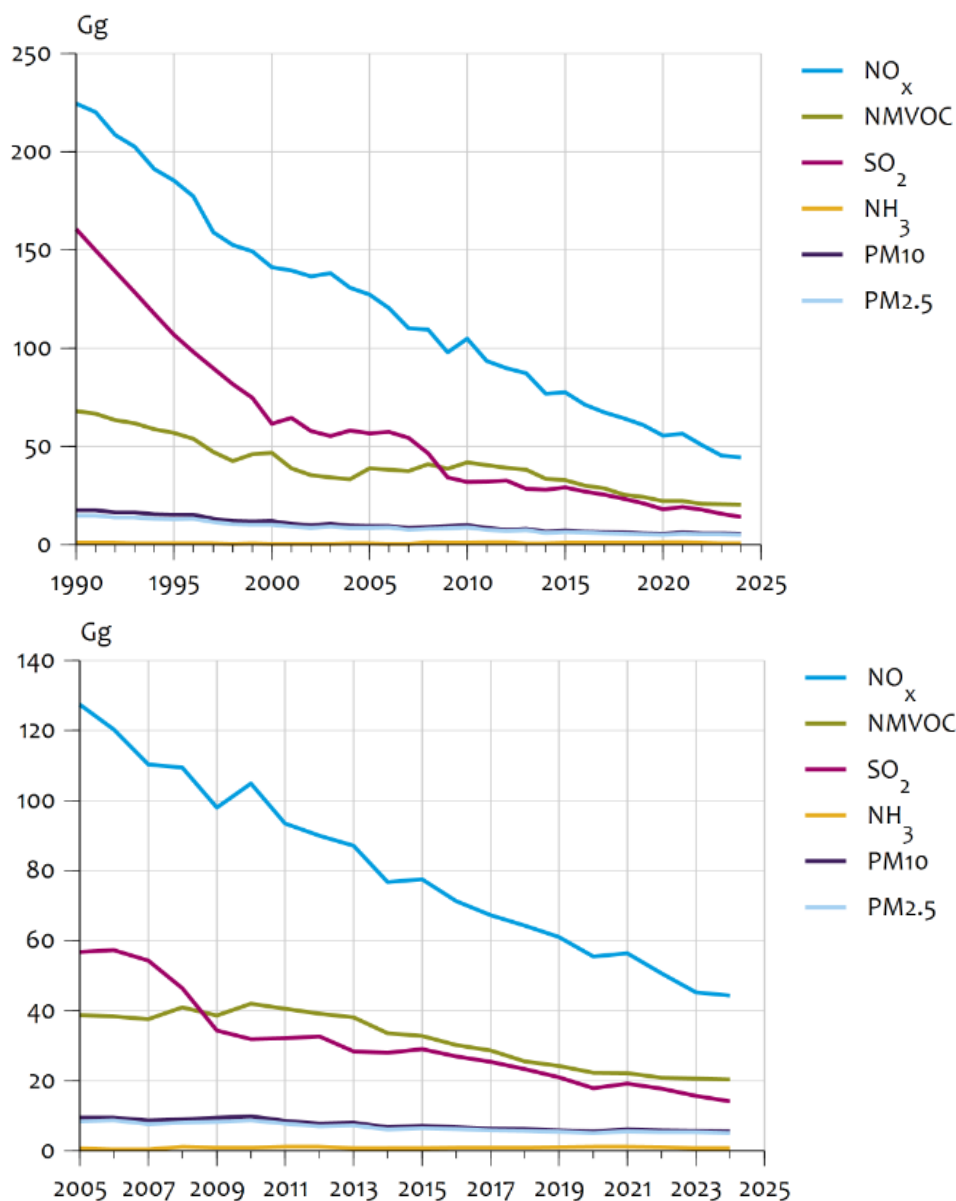
Figure 3.2 Energy demand in the Netherlands, 1990–2024



The full energy statistics are available on the website of Statistics Netherlands. The following link refers to the energy statistics for 2024: <https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dl=CD128>. On this website, it is also possible to access data for other years.

Figure 3.3 shows the trend in the emissions of the main pollutants from the Energy sector between 1990–2024 and 2005–2024.

Figure 3.3 Emission trends for the main pollutants in NFR 1 – Energy (excluding transport source categories) between 1990-2024 (upper panel) and 2005-2024 (lower panel)



In 2024, 89% of total SO<sub>x</sub>, 37% of total PM<sub>2.5</sub>, 25% of total NO<sub>x</sub>, 21% of total PM<sub>10</sub>, 9% of total NMVOC and 1% of total NH<sub>3</sub> emissions in the Netherlands originated from the Energy sector (Figure 2.1).

## 3.2 Public electricity and heat production (1A1a)

### 3.2.1 Source category description

In this section, one source category is included: Public electricity and heat production (1A1a). Electricity in the Netherlands was first mainly produced by gas-fired cogeneration plants and coal-fired power stations, but this has declined in more recent years. Coal combustion peaked in 2015/2016 with the start-up of new coal-fired power plants, but decreased after that due to the closure of older coal-fired power plants.

Natural gas combustion decreased with the start-up of these coal-fired power plants in 2015/2016, increased again with the closure of some power plants in 2017-2020, and has decreased since 2021 due to the high natural gas prices in 2021 and due to the increasing amount of electricity from renewable sources. Electricity from renewable sources (biomass, solar and wind) used to be small in the Netherlands, but the share in electricity production from biomass, solar and wind has increased to 50% in 2024. Waste incineration plants with energy recovery generate a relatively small share (~2-3%) of electricity in the Netherlands. All waste incineration plants recover energy and are included in source category 1A1a. The share in electricity per fuel type, and the fuel input in power plants are reported by Statistics Netherlands (<https://opendata.cbs.nl/#/CBS/en/dataset/80030eng/table?dl=CF283>).

### 3.2.2 Key sources

In 2024, the source category 1A1a is a key source of the pollutants listed in Table 3.1.

Table 3.1 Pollutants for which the Public electricity and heat production sector (NFR 1A1a) is a key source

Category / Subcategory	Pollutant	Contribution to national total of 2024 (%)
1A1a Public electricity and heat production	SO <sub>x</sub>	12.3
	NO <sub>x</sub>	5.5
	Hg	22.2
	Cd	4.1
	Pb	3.7
	HCB	87.9
	PCB	31.8

### 3.2.3 Overview of shares and trends in emissions

An overview of the trends in emissions is provided in Table 3.2. For nearly all pollutants, emissions decreased between 1990 and 2024. Over the same period, total fuel consumption increased in source category 1A1a.

Table 3.2 Overview of trends in emissions in sector 1A1a Public electricity and heat production

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NM VOC	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>83</b>	<b>0.89</b>	<b>48</b>	<b>0.00</b>	<b>1.8</b>	<b>2.2</b>	<b>2.5</b>	<b>0.05</b>	<b>8.3</b>
1995	62	1.7	17	0.04	0.39	0.63	0.99	0.01	7.6
2000	51	2.1	15	0.04	0.25	0.33	0.33	0.00	15
2005	43	0.91	9.9	0.26	0.40	0.54	0.82	0.01	8.3
2010	26	0.67	6.7	0.07	0.22	0.29	0.60	0.01	4.8
2015	20	0.70	8.6	0.09	0.30	0.40	0.78	0.01	4.6

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOC	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
2020	14	0.68	1.8	0.11	0.09	0.12	0.20	0.00	3.5
2021	14	0.64	2.6	0.10	0.12	0.16	0.25	0.00	4.6
2022	13	0.63	2.4	0.11	0.13	0.16	0.25	0.00	4.4
2023	11	0.65	1.8	0.10	0.11	0.13	0.21	0.00	3.6
<b>2024</b>	<b>9.9</b>	<b>0.68</b>	<b>1.9</b>	<b>0.06</b>	<b>0.11</b>	<b>0.14</b>	<b>0.24</b>	<b>0.00</b>	<b>3.3</b>
1990-2024 <sup>1)</sup>	-73.0	-0.21	-46.5	0.06	-1.7	-2.1	-2.2	-0.05	-5.0
1990-2024 <sup>2)</sup>	-88%	-24%	-96%		-94%	-94%	-90%	-94%	-60%
% 2024 <sup>3)</sup>	5%	0%	12%	0%	1%	1%	1%	0%	1%

Table 3.2 Overview of trends in emissions in sector 1A1a Public electricity and heat production (continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>16</b>	<b>0.95</b>	<b>1.9</b>	<b>583</b>	<b>0.18</b>	<b>0.53</b>	<b>0.68</b>	<b>2.1</b>	<b>2.5</b>	<b>0.02</b>	<b>41</b>
1995	1.6	0.16	0.39	6.1	0.06	0.23	0.37	0.47	1.4	0.06	3.3
2000	0.34	0.08	0.45	0.13	0.01	0.24	0.24	0.24	0.31	0.72	0.56
2005	0.35	0.11	0.40	0.79	0.01	0.26	0.35	0.34	2.0	1.9	0.75
2010	0.34	0.18	0.23	1.2	0.02	0.17	0.14	0.19	0.16	1.3	3.9
2015	0.16	0.03	0.23	1.1	0.03	0.09	0.16	0.20	0.17	0.91	4.1
2020	0.14	0.05	0.08	1.1	0.04	0.08	0.10	0.15	0.08	0.10	0.82
2021	0.12	0.03	0.10	1.2	0.03	0.06	0.09	0.11	0.07	0.07	0.26
2022	0.09	0.04	0.12	1.3	0.04	0.06	0.09	0.10	0.19	0.07	1.18
2023	0.19	0.03	0.09	3.3	0.03	0.06	0.12	0.14	0.24	0.02	0.41
<b>2024</b>	<b>0.17</b>	<b>0.02</b>	<b>0.08</b>	<b>1.0</b>	<b>0.02</b>	<b>0.06</b>	<b>0.27</b>	<b>0.16</b>	<b>0.22</b>	<b>0.01</b>	<b>0.31</b>
1990-2024 <sup>1)</sup>	-16.2	-0.93	-1.8	-582	-0.16	-0.47	-0.41	-1.9	-2.3	-0.02	-40.4
1990-2024 <sup>2)</sup>	-99%	-98%	-96%	-100%	-88%	-89%	-61%	-92%	-91%	-71%	-99%
% 2024 <sup>3)</sup>	4%	4%	22%	3%	0%	22%	7%	0%	8%	6%	0%

1. Absolute difference

2. Relative difference compared to 1990 in %

3. % of national total 2024

Between 1990 and 2024, NO<sub>x</sub> and SO<sub>x</sub> emissions from source category 1A1a decreased by 88% and 96%, respectively. Other pollutant emissions decreased by at least 80%, except for CO (-60%), NMVOC (-24%), Se (-71%), Cr (-61%) and NH<sub>3</sub>. The overall decrease in emissions was caused by a shift in fuel type, and by technological improvements (especially the large decrease in dioxin emissions). The increases in NH<sub>3</sub> and Se were due to a possible underestimation of emissions in 1990,

which improved once individual companies started submitting annual environmental reports (AERs) from 2000 onwards.

### 3.2.4 Activity data and (implied) emission factors

Emission data is based on emissions reported in AERs and on calculated emissions for the companies that did not report their emissions in an AER. For this source category, a large part of the 2024 emission figures is based on AERs: NO<sub>x</sub> (97%), NMVOC (86%), SO<sub>x</sub> (98%), NH<sub>3</sub> (94%) and PM<sub>2.5</sub> (79%). To estimate emissions from other emission sources in this sector (for which no emissions were reported in AERs), national energy statistics (from Statistics Netherlands) are combined with IEFs from the AERs or with default EFs (see Table 3.3).

The activity data in the NFR tables is based on the reported activity data in the AERs of the individual companies, and the energy statistics data that is used for the emission calculation of the non-reporting companies. Please note that activity data reported in the AERs could be incomplete (especially in earlier years). Therefore, the activity data in the NFR could also be incomplete, but this does not affect the reported emissions.

Table 3.3 Default EFs for electricity production, used only for fuel consumption and emissions that were not reported by individual companies

Substance name	Unit	Natural gas	Biogas	Wood
NMVOC	g/GJ	2.6 <sup>1</sup>	2.6 <sup>4</sup>	1.33 <sup>5</sup>
Sulphur dioxide	g/GJ	0.281 <sup>1</sup>	0.281 <sup>4</sup>	10.8 <sup>6</sup>
Nitrogen oxides as NO <sub>2</sub>	g/GJ	19.1 <sup>2</sup>	89 <sup>4</sup>	70 <sup>5</sup>
Ammonia	g/GJ			1.2 <sup>7</sup>
Carbon monoxide	g/GJ	15.0 <sup>2</sup>	39 <sup>4</sup>	150 <sup>5</sup>
PM <sub>10</sub>	g/GJ	0.2 <sup>3</sup>	0.89 <sup>4</sup>	10 <sup>5</sup>
PM <sub>2.5</sub>	g/GJ	0.15 <sup>8</sup>	0.5 <sup>8</sup>	7.5 <sup>8</sup>
Cd	mg/GJ	0.00025 <sup>9</sup>	0.002 <sup>11</sup>	0.176 <sup>12</sup>
Hg	mg/GJ	0.01 <sup>10</sup>	0.12 <sup>11</sup>	0.98 <sup>12</sup>
Pb	mg/GJ	0.0015 <sup>9</sup>	0.005 <sup>11</sup>	2.06 <sup>12</sup>

1. EMEP/EEA Guidebook (2019), 1A1, Table 4.6, default value

2. Specific EFs derived from reported emissions in e-AERs

3. EMEP/EEA Guidebook (2019), 1A1, Table 3.17, default value

4. EMEP/EEA Guidebook (2019), 1A1, Table 3.4, default value

5. Koppejan and De Bree. (2018)

6. EMEP/EEA Guidebook (2019), 1A1, Table 3.7, default value

7. EMEP/EEA Guidebook (2019), 1A2, Table 3.5, default value

8. PM<sub>10</sub> emission factor, combined with PM<sub>2.5</sub> fraction from Visschedijk & Dröge (2019)

9. EMEP/EEA Guidebook (2023), 1A1, Table 3.4, default value

10. Based on a study by the Dutch gas transmission company Gasunie. Value used from 2017 onwards. For earlier years, see Table 3.5

11. EMEP/EEA Guidebook (2023), 1A1, Table 3.9, default value

12. EMEP/EEA Guidebook (2023), 1A1, Table 3.8, default value, combined with an abatement efficiency of 90% (for Cd and Pb) and 35% (for Hg)

Emission data in AERs is calculated by companies on the basis of stack measurements or (default or technology-specific) emission factors combined with fuel consumption data. When emissions in AERs are calculated on the basis of stack measurements, they are calculated using

uncorrected measurement data (i.e. no correction for the confidence interval). To calculate industrial emissions, Dutch companies are obligated to follow the guidance given in the Netherlands' PRTR regulations. The relevant documents are to be found on the government website <https://iplo.nl/thema/lucht/stookinstallaties/> (in Dutch only). These documents explicitly state that emissions shall be calculated by the companies using uncorrected measurement data, and that the confidence interval may not be subtracted. Additionally, the calculations shall include emissions during stops, starting-up and incidents. The competent authorities confirmed that they check whether companies use uncorrected measurement data for calculating emissions.

The AERs might be incomplete when a company does not report emissions that are below the reporting threshold. Additional estimates are made for these missing emissions:

- Since PCB emissions are not reported by individual companies, they are calculated for the entire sector. The emissions are calculated by multiplying the energy statistics (Statistics Netherlands: <https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dI=CF288>) with emission factors (see Table 3.4).
- Since heavy metal emissions from the use of natural gas are not reported by individual companies either, they are calculated for the entire sector. The emissions are calculated by multiplying the energy statistics (Statistics Netherlands: <https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dI=CF288>) with emission factors (see Table 3.5).
- PAH, dioxin and HCB emissions are not always reported by individual companies. Individual estimates of these emissions have been made for all industrial stationary combustion sectors and for solid fuels, liquid fuels (except diesel and LPG), gaseous fuels (except natural gas) and biomass (except biogas). The emissions have been calculated as a fraction of the reported hydrocarbon emission. The fraction is based on the ratio between the Tier 1 emission factors of PAH/dioxin/HCB/PCB with NMVOC from Chapters 1A1 and 1A2 of the EMEP/EEA Guidebook (2023) and an assumed abatement efficiency of 90%. If the individual emission is higher than the reporting threshold, it is assumed that the emission is equal to the reporting threshold (assuming that a company would have reported these emissions if they exceeded the reporting threshold). If a company has already reported a certain emission, the individual emission estimate for that company is discarded, and only the reported emission is used.
- Since HCB emissions from incineration plants are not reported by individual companies, they are calculated with an EF of 0.2 mg/Mg waste (lower value of the EF from the EMEP/EEA Guidebook 2019, Chapter 5.C.1.a, Table 3.2).
- PM<sub>2.5</sub> emissions are either reported by individual companies or calculated using default PM<sub>2.5</sub>/PM<sub>10</sub> ratios. These ratios are based on PM<sub>10</sub> and PM<sub>2.5</sub> emissions reported by individual companies (differing per sector, activity and fuel) or literature (e.g. Visschedijk et al. (2004) and Ehrlich et al. (2007)). A

complete list of the PM<sub>2.5</sub>/PM<sub>10</sub> ratios, including references, is presented in Honig et al. (2026) and in Visschedijk & Dröge (2019). The latter report can be downloaded via: [Visschedijk & Dröge \(2019\)](#).

Table 3.4 List of PCB emission factors of solid fuels (microgram/GJ)

Year	Solid fuels <sup>1</sup>	Waste <sup>2</sup>	Biomass <sup>3</sup>
1990	52.4	0.0034	0.06
1991	42.1	0.0034	0.06
1992	31.7	0.0034	0.06
1993	21.4	0.0034	0.06
1994	11.0	0.0034	0.06
from 1995	0.67	0.0034	0.06

1. Based on the correlation between the dioxin and PCB EFs in the Guidebook and the reported dioxin emissions in the Dutch emission inventory. This results in an EF of 52.4 µg/GJ in 1990 and 0.67 µg/GJ from 1995 onwards.

2. EMEP/EEA Guidebook (2019), Chapter 5C1a, Table 3.1

3. EMEP/EEA Guidebook (2019), Chapter 1A2, Table 3.5

Table 3.5 List of heavy metal EFs of natural gas (mg/GJ)

Pollutant	1990-2009	2010-2016	from 2017
Hg <sup>1</sup>	0.039	0.023	0.01
Pb <sup>2</sup>		0.0015	
Cd <sup>2</sup>		0.00025	
As <sup>2</sup>		0.12	
Cr <sup>2</sup>		0.00076	
Cu <sup>2</sup>		0.076	
Ni <sup>2</sup>		0.00051	
Se <sup>2</sup>		0.0112	
Zn <sup>2</sup>		0.0015	

1. Based on a study by the Dutch gas transmission company Gasunie

2. EMEP/EEA Guidebook 2019 (1A1, Table 3.4) are used for the other metals

### 3.2.5

#### Methodological issues

Emissions are based on data in the AERs relating to individual facilities (Tier 3 methodology). A company needs to submit an environmental report if one or more of the activities of the company is included in annex 1 of the E-PRTR regulation. These companies need to report emissions that exceed the reporting threshold. For some pollutants, the Dutch reporting thresholds are lower than the European reporting thresholds (see the list of thresholds (in Dutch): [https://www.e-mjv.nl/sites/default/files/2018-07/stoffenlijst\\_integraal\\_prtr-verslag.pdf](https://www.e-mjv.nl/sites/default/files/2018-07/stoffenlijst_integraal_prtr-verslag.pdf)). Emissions and fuel consumption data in the AERs are systematically examined for inaccuracies by checking the resulting IEFs. If the AERs provide data of sufficient quality, the information is used to calculate an IEF for a cluster of reporting companies (aggregated by NACE code). These IEFs are fuel- and sector-specific and are used to calculate emissions by companies that are not individually assessed.

$$\text{IEF}_{\text{ER-I (NACE. fuel)}} = \frac{\text{Emissions}_{\text{ER-I (NACE. fuel)}}}{\text{Energy use}_{\text{ER-I (NACE. fuel)}}$$

where:

IEF = Implied emission factor from individual companies  
 ER-I = Emission Registration database for individual companies

Next, combustion emissions by companies that are not individually assessed in this NACE category are calculated from their energy use according to the energy statistics (from Statistics Netherlands), multiplied by the IEF. If the data from the individual companies is insufficient to calculate an IEF, a default EF is used (see Table 3.3).

**ER-C<sub>emission</sub> (NACE, fuel) = IEF<sub>ER-I</sub> (NACE, fuel) \* energy statistics (NACE, fuel)**

where:

ER-C = Emission Registration database for emission data that is not based on emissions reported in an AER

Total combustion emissions are the sum of emissions by the individual companies (ER-I) plus emissions by the companies that are not individually assessed (ER-C).

### 3.2.6 *Uncertainties and time series consistency*

Uncertainties are explained in Section 1.7.

### 3.2.7 *Source-specific QA/QC and verification*

Emissions and fuel consumption data in the AERs are systematically examined for inaccuracies by checking the resulting IEFs, the emission trends and the IEF trends. If the AERs provide data of high enough quality (see Section 1.6 on QA/QC), the information is used. Section 3.1 of the ENINA methodology report (Honig et al., 2026) provides a more detailed description of the AER quality checks.

### 3.2.8 *Source-specific recalculations*

The following recalculations were performed:

#### *Recalculation of EC<sub>2.5</sub> emissions from individual companies*

In the previous submission, EC<sub>2.5</sub> emissions were calculated based on the ratio EC<sub>2.5</sub>/PM<sub>10</sub>. This sometimes resulted in EC<sub>2.5</sub> emissions that were higher than PM<sub>2.5</sub> emissions, when a company has reported relatively low PM<sub>2.5</sub> emissions. In this submission, the EC<sub>2.5</sub> emissions are now calculated based on the ratio EC<sub>2.5</sub>/PM<sub>2.5</sub>. The ratios are based on the EMEP/EEA 2023 Guidebook. This has been implemented for the complete time series. Table 3.6 shows the resulting changes in EC<sub>2.5</sub> emissions over the time series.

Table 3.6 Overview of changes in EC<sub>2.5</sub> emissions (tonne)

Year	1A1a
1990	+18.23
1995	-1.20
2000	-5.63
2005	-2.45
2010	-0.55

Year	1A1a
2015	-0.63
2020	+0.25
2021	+0.24
2022	+0.17
2023	+0.31

*Recalculation of emissions in 2015-2023 due to improved activity data*

A very small correction in the activity data of natural gas combustion has been implemented (for the calculation of heavy metal emissions that are not reported by individual companies). This results in changes of less than 0.005 kg.

*Heavy metal emissions from combustion of biogas and solid biomass*

In response to review recommendation NL-1A4ci-2018-0001, emissions from Cd, Hg and Pb have also been calculated for the combustion of biogas and solid biomass, based on the energy statistics (of the companies that have not reported their emissions) and default emission factors (see Table 3.3). This has been calculated from 2009 onwards (for biogas combustion) and from 2012 onwards (for solid biomass combustion). Table 3.7 shows the resulting changes in emissions.

*Table 3.7 Overview of change in emissions in 2009-2023 as a result of heavy metal emission calculation of biogas and solid biomass*

Year	Unit	Cd	Hg	Pb
2009	kg	+0.00	+0.01	+0.00
2010	kg	+0.00	+0.01	+0.00
2015	kg	+0.15	+0.86	+1.79
2020	kg	+0.58	+3.26	+6.84
2021	kg	+0.76	+4.21	+8.84
2022	kg	+0.69	+3.86	+8.09
2023	kg	+0.58	+3.22	+6.75

*Correction of emissions reported by individual companies*

Some corrections in the AERs of 2023 were reported, and these have been corrected in the NFR tables. This resulted in a change in emissions of +0.27 kg PAH, -27.8 kg mercury and -0.011 kg dioxin. The change in dioxin emission is equal to the revised estimate that was submitted during the 2025 NECD review (recommendation number NL-1A1a-2025-0002).

**3.2.9** *Source-specific planned improvements*

There are no planned source-specific improvements.

**3.3 Industrial combustion (1A1b, 1A1c and 1A2)**

**3.3.1** *Source category description*

This section comprises the following source categories:

- 1A1b Petroleum refining;
- 1A1c Manufacture of solid fuels and other energy industries;
- 1A2a Iron and steel;

- 1A2b Non-ferrous metals;
- 1A2c Chemicals;
- 1A2d Pulp, paper and print;
- 1A2e Food processing, beverages and tobacco;
- 1A2f Non-metallic minerals;
- 1A2gviii Other.

The 1A2gviii sector includes industries for: mineral products (cement, bricks, other building materials, glass), textiles, wood and wood products and machinery.

### 3.3.2 Key sources

In 2024, the source categories 1A1b, 1A2a, 1A2b, 1A2c and 1A2gviii are key sources of the pollutants listed in Table 3.8.

*Table 3.8 Pollutants for which the Industrial combustion sector (NFR 1A1b, 1A1c and 1A2) is a key source*

Category / Subcategory		Pollutant	Contribution to total of 2024 (%)
1A1b	Petroleum refining	SO <sub>x</sub>	40.6
1A1c	Manufacture of solid fuels and other energy industries	PCB	10.7
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	SO <sub>x</sub>	18.8
		CO	15.0
		NO <sub>x</sub>	2.8
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	PCB	44.8
		NO <sub>x</sub>	4.1
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	SO <sub>x</sub>	5.6
		Hg	6.2
			11.3

### 3.3.3 Overview of shares and trends in emissions

An overview of the trends in emissions is provided in Table 3.9. Since 1990, emissions have been reduced for most pollutants, except for dioxins. Reduction in the emissions of the main pollutants has been due to an improvement in the abatement techniques used. Fluctuations in dioxin emissions have been caused by differences in the fuels used and/or incidental emissions. The reduction in emissions of SO<sub>x</sub> and PM<sub>10</sub> is mainly due to a shift in fuel use by refineries, i.e. from oil to natural gas.

Table 3.9 Overview of trends in emissions in the Industrial combustion sectors  
1A1b, 1A1c and 1A2

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOG	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>100</b>	<b>6.2</b>	<b>110</b>	<b>0.57</b>	<b>5.7</b>	<b>7.7</b>	<b>8.1</b>	<b>0.55</b>	<b>266</b>
1995	78	6.6	89	0.32	5.0	6.5	6.7	0.54	215
2000	50	2.0	46	0.05	3.3	4.8	4.9	0.29	162
2005	49	2.0	46	0.11	1.4	1.8	2.0	0.13	156
2010	40	4.6	25	0.46	1.2	1.8	3.9	0.06	127
2015	35	2.9	20	0.41	0.59	0.83	1.1	0.05	99
2020	28	2.1	16	0.65	0.49	0.70	0.99	0.05	83
2021	27	2.0	16	0.60	0.47	0.70	0.86	0.05	79
2022	26	2.1	15	0.42	0.43	0.61	0.71	0.04	80
2023	24	1.8	13	0.26	0.51	0.67	0.79	0.05	69
<b>2024</b>	<b>24</b>	<b>1.9</b>	<b>12</b>	<b>0.27</b>	<b>0.52</b>	<b>0.68</b>	<b>0.80</b>	<b>0.05</b>	<b>79</b>
1990-2024 <sup>1)</sup>	-77	-4.2	-98	-0.30	-5.2	-7.0	-7.3	-0.50	-187
1990-2024 <sup>2)</sup>	-77%	-69%	-89%	-53%	-91%	-91%	-90%	-90%	-70%
% 2024 <sup>3)</sup>	13%	1%	85%	0%	4%	3%	3%	2%	17%

Table 3.9 Overview of trends in emissions in the Industrial combustion sectors  
1A1b, 1A1c and 1A2 (continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>2.0</b>	<b>0.14</b>	<b>0.20</b>	<b>0.01</b>	<b>1.0</b>	<b>0.23</b>	<b>2.6</b>	<b>1.5</b>	<b>67</b>	<b>0.05</b>	<b>3.2</b>
1995	4.0	0.17	0.10	1.0	0.37	0.22	3.2	2.2	81	0.06	3.7
2000	0.65	0.06	0.16	0.39	0.01	0.56	0.57	0.23	19	0.05	1.1
2005	0.06	0.02	0.03	0.85	0.01	0.81	0.10	0.14	6.6	0.10	0.61
2010	3.1	0.02	0.06	5.8	0.13	0.05	0.17	1.2	0.05	0.14	9.9
2015	0.14	0.02	0.09	0.12	0.03	0.03	0.04	0.04	0.05	0.02	1.3
2020	0.15	0.02	0.08	0.07	0.03	0.04	0.22	0.79	0.45	0.02	0.54
2021	0.33	0.03	0.08	0.05	0.03	0.04	0.50	0.10	0.45	0.03	0.26
2022	0.19	0.02	0.07	0.05	0.02	0.03	0.11	0.04	0.20	0.02	1.3
2023	0.20	0.03	0.06	0.04	0.02	0.03	0.21	0.16	0.35	0.03	0.40
<b>2024</b>	<b>0.10</b>	<b>0.02</b>	<b>0.06</b>	<b>0.04</b>	<b>0.02</b>	<b>0.03</b>	<b>0.02</b>	<b>0.03</b>	<b>0.20</b>	<b>0.02</b>	<b>0.53</b>
1990-2024 <sup>1)</sup>	-1.9	-0.12	-0.14	0.03	-1.0	-0.20	-2.6	-1.5	-66.9	-0.03	-2.6
1990-2024 <sup>2)</sup>	-95%	-86%	-71%	333%	-98%	-86%	-99%	-98%	-100%	-54%	-83%
% 2024 <sup>3)</sup>	2%	4%	15%	0%	0%	12%	0%	0%	8%	21%	1%

1. Absolute difference

2. Relative difference compared to 1990 in %

3. % of national total 2024

### 3.3.4 *Activity data and (implied) emission factors*

Emission data is based on emissions reported in AERs (Annual Environmental Reports) and on calculated emissions for the companies that did not report their emissions in an AER.

The activity data in the NFR tables is based on the reported activity data in the AERs of the individual companies, and the energy statistics data that is used for the emission calculation of the non-reporting companies. Please note that activity data reported in the AERs could be incomplete (especially in earlier years). Therefore, the activity data in the NFR could also be incomplete, but this does not affect the reported emissions.

#### ***Petroleum refining (1A1b)***

All emission data is based on emissions reported in AERs. Emissions from all refineries are included in 1A1b, with the exception of one industrial plant that refines and processes oil and that combusts refinery gas. On the basis of its main economic activity, this company is either included in 1A1b Petroleum Refining (from 2009 onwards) or in 1A1c Manufacture of Solid Fuels and Other Energy Industries (2005–2008).

#### ***Manufacture of solid fuels and other energy industries (1A1c)***

Emission data is based on emissions reported in AERs and calculated emissions for the companies that did not report their emissions in an AER. Emissions from the combined coke plant / iron and steel plant are allocated in 1A2a and/or in 2C1. Therefore, 1A1c only includes the emissions from oil/gas production and from the stand-alone coke plant that closed in 1999.

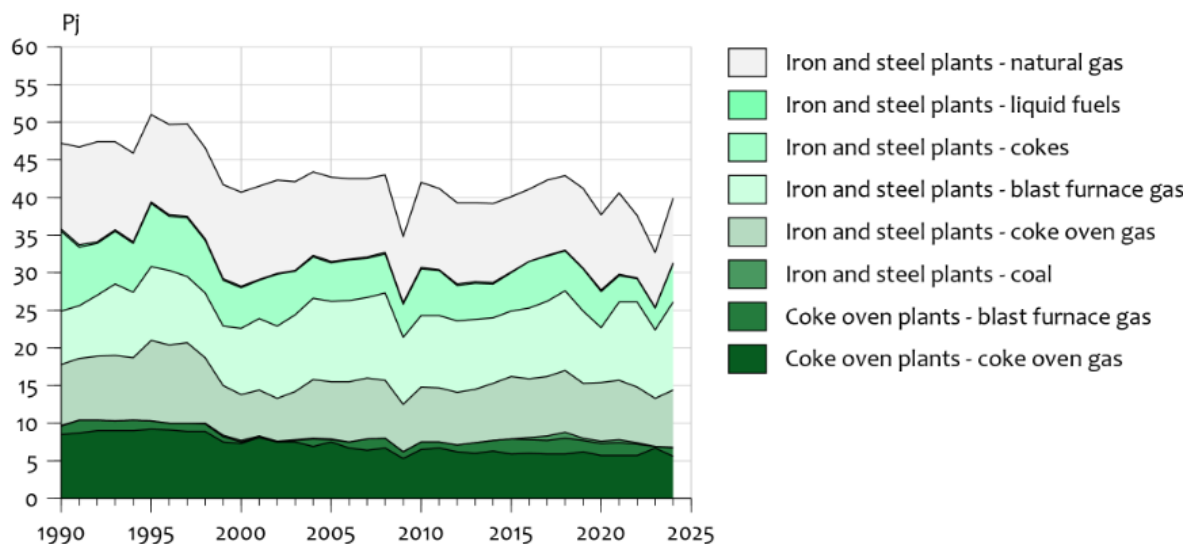
#### ***Iron and steel (1A2a)***

Emission data is mainly based on emissions reported in the AER of the combined coke plant / iron and steel plant. A small part consists of calculated emissions for the companies that did not report their emissions in an AER (6% of CO emissions, 1% of SO<sub>x</sub> emissions and <0.1% NO<sub>x</sub> emissions in 2024).

The combined coke plant / iron and steel plant in the Netherlands report their emissions in an AER. The emissions are based on stack measurements at several emission points with combined flue gases from incineration of fuels and process emissions. It is therefore not possible to provide a good split between the combustion emissions (that should be reported in 1A2a) and the process emissions (that should be reported in 2C1).

The activity data in the NFR tables for 1A2a is based on the reported activity data in the AER of the combined coke plant / iron and steel plant, and the energy statistics data that is used for the emission calculation of the non-reporting companies. For 1A2a, the activity data in the NFR tables is incomplete. For transparency reasons, Figure 3.4 provides the final energy consumption and the own use of fuels of the iron and steel sector (including blast furnaces) and coke plants, as reported in the energy statistics. The low fuel consumption in 2023 is the result of large maintenance at the iron/steel plant.

Figure 3.4 Final energy consumption and own use of energy in the iron and steel sector (including blast furnaces) and own use of energy in coke oven plants (PJ)



#### **Non-ferrous metals (1A2b)**

Emission data is based on emissions reported in AERs and calculated emissions for the companies that did not report their emissions in an AER. Aluminium production stopped in the Netherlands in 2023, resulting in a decrease of emissions in 2023. For this source category, 1% of the NMVOC emissions, 11% of the NO<sub>x</sub> emissions, 0.2% of the SO<sub>x</sub> emissions, and 4% of PM<sub>2.5</sub> emissions were not reported in AERs (in 2024).

#### **Chemicals (1A2c)**

Emission data is based on emissions reported in AERs and calculated emissions for the companies that did not report their emissions in an AER. For this source category, 3% of the NMVOC emissions, 3% of the NO<sub>x</sub> emissions, 5% of the SO<sub>x</sub> emissions, and 1% of the PM<sub>2.5</sub> emissions were not reported in AERs (in 2024).

#### **Pulp, paper and print (1A2d)**

Emission data is based on emissions reported in AERs and calculated emissions for the companies that did not report their emissions in an AER. For this source category, 79% of the NMVOC emissions, 10% of the NO<sub>x</sub> emissions, 1% of the SO<sub>x</sub> emissions, and 100% of the PM<sub>2.5</sub> emissions were not reported in AERs (in 2024).

#### **Food processing, beverages and tobacco (1A2e)**

Emission data is based on emissions reported in AERs and calculated emissions for the companies that did not report their emissions in an AER. For this source category, 32% of the NMVOC emissions, 42% of the NO<sub>x</sub> emissions, 53% of the SO<sub>x</sub> emissions, and 30% of the PM<sub>2.5</sub> emissions were not reported in AERs (in 2024).

#### **Non-metallic minerals (1A2f)**

Emissions from non-metallic minerals are allocated to 1A2gviii.

**Other (1A2gviii)**

This sector includes all combustion emissions from the industrial sectors that do not belong to the categories 1A2a to 1A2e. Emission data is based on emissions reported in AERs and calculated emissions for the companies that did not report their emissions in an AER. For this source category, 18% of the NMVOC emissions, 10% of the NO<sub>x</sub> emissions, 2% of the SO<sub>x</sub> emissions, and 19% of the PM<sub>2.5</sub> emissions were not reported in AERs (in 2024).

For some of the above-mentioned categories, emissions were not entirely available from the AERs, as not all of the companies need to report their emissions. The remaining part of the emissions were calculated using national energy statistics and default EFs or IEFs from other companies that did report their emission in an AER (see Table 3.10).

Table 3.10 Emission factors for the Industrial sector

Substance name	Unit	Natural gas	Biogas	Coal	Fuel oil	Wood (wood industries)	Wood (other industry)
NMVOC	g/GJ	1	2.6 <sup>11</sup>	10 <sup>7</sup>	50 <sup>8</sup>	8.4 <sup>10</sup>	1.33 <sup>10</sup>
Sulphur dioxide	g/GJ	0.281 <sup>2</sup>	0.281 <sup>11</sup>	450 <sup>7</sup>	47 <sup>9</sup>	11 <sup>12</sup>	11 <sup>12</sup>
Nitrogen oxides as NO <sub>2</sub>	g/GJ	3	89 <sup>11</sup>	150 <sup>7</sup>	64 <sup>6</sup>	91 <sup>12</sup>	75 <sup>10</sup>
Ammonia	g/GJ					1.2 <sup>12</sup>	1.2 <sup>12</sup>
Carbon monoxide	g/GJ	4	39 <sup>11</sup>	150 <sup>7</sup>	66 <sup>9</sup>	750 <sup>10</sup>	16 <sup>10</sup>
PM <sub>10</sub>	g/GJ	0.297 <sup>5</sup>	0.89 <sup>11</sup>	60 <sup>7</sup>	20 <sup>9</sup>	27 <sup>10</sup>	12 <sup>10</sup>
PM <sub>2.5</sub>	g/GJ	17	17	17	17	17	17
Cd	mg/GJ	0.00025 <sup>13</sup>	0.002 <sup>15</sup>	0.8 <sup>6</sup>	0.934 <sup>6</sup>	6.5 <sup>16</sup>	6.5 <sup>16</sup>
Hg	mg/GJ	0.01 <sup>14</sup>	0.012 <sup>15</sup>	0.089 <sup>6</sup>	0.56 <sup>6</sup>	0.28 <sup>16</sup>	0.28 <sup>16</sup>
Pb	mg/GJ	0.0015 <sup>13</sup>	0.005 <sup>15</sup>	70 <sup>6</sup>	9.34 <sup>6</sup>	13.5 <sup>16</sup>	13.5 <sup>16</sup>

1. For 1A2c, an EF from the Guidebook is used of 2.6 g/GJ (EMEP/EEA Guidebook (2019), 1A1, Table 3.4, default value). For 1A2b, 1A2d, 1A2e and 1A2g, a specific EF is used of 5.2, 5.2, 3.8 and 5.2 g/GJ, respectively (derived from emissions reported in e-AERs)
2. EMEP/EEA Guidebook (2019), 1A1, Table 4.6, average value
3. For 1A2b, 1A2c, 1A2d, 1A2e and 1A2g, a specific EF is used of 40, 55, 43, 30 and 37 g/GJ, respectively (derived from emissions reported in AERs)
4. For 1A2b, 1A2c, 1A2d, 1A2e and 1A2g, a specific EF is used of 35, 40, 35, 40 and 35 g/GJ, respectively (derived from emissions reported in AERs)
5. EMEP/EEA Guidebook (2019), 1A1, Table 4.6, minimum value
6. Methodology report by Guis (2006)
7. EMEP/EEA Guidebook (2019), 1A2, Table 3.2, minimum value
8. EMEP/EEA Guidebook (2019), 1A4, Table 3.31, default value
9. EMEP/EEA Guidebook (2019), 1A2, Table 3.4, default value
10. Koppejan and De Bree (2018)
11. EMEP/EEA Guidebook (2019), 1A1, Table 3.4, default value
12. EMEP/EEA Guidebook (2019), 1A2, Table 3.5, default value
13. EMEP/EEA Guidebook (2023), 1A1, Table 3.4, default value
14. Based on a study by the Dutch gas transmission company Gasunie. Value used from 2017 onwards. For earlier years, see Table 3.12
15. EMEP/EEA Guidebook (2023), 1A1, Table 3.9, default value
16. EMEP/EEA Guidebook (2023), 1A2, Table 3.5, default value, combined with an abatement efficiency of 50%
17. PM<sub>2.5</sub> fraction differs per sector. See Visschedijk & Dröge (2019) or Honig et al. (2026) for a complete list of PM<sub>2.5</sub> fractions

The AERs may be incomplete when a company does not report emissions that are below the reporting threshold. Additional estimates are made for these missing emissions:

- Since PCB emissions are not reported by individual companies, they are calculated for the entire sector. The emissions are calculated by multiplying the energy statistics (Statistics Netherlands: <https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dI=CF288>) with emission factors (see Table 3.11).
- Since heavy metal emissions from the use of natural gas are not reported by individual companies either, they are calculated for the entire sector. The emissions are calculated by multiplying the energy statistics (Statistics Netherlands: <https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dI=CF288>) with emission factors (see Table 3.12).
- Heavy metal emissions from other fuels (other than natural gas) are not always reported by individual companies. Individual estimates of these metal emissions have been made for the refineries (1A1b), the non-ferro sector (1A2b), the chemical sector (1A2c) and the mineral products sector (1A2gviii). The EFs are from the EMEP/EEA Guidebook (2019), combined with an abatement of 50% for mercury, 90% for selenium and 95% for the other metals (from: EMEP/EEA Guidebook 2019, Chapter 1A1, page 78). The emissions are calculated for the entire sector and then allocated to the relevant companies. If a company has already reported metal emissions, these reported emissions are used in the inventory (instead of the calculated emission). If the allocated emission exceeds the reporting threshold, it is assumed that the emission by that company is equal to the reporting threshold. Details of the emission calculation are available in Chapter 3.1.2.2 of the ENINA methodology report (Honig et al., 2026). For 1A2a, no additional heavy metals are calculated. All emissions in this sector are reported by the iron and steel company in the Netherlands, and these emissions are reported in 1A2a and 2C1. Since it is not always possible to correctly allocate the heavy metal emissions between 1A2a and 2C1, the emissions are only reported in 2C1 for most years.
- PAH, dioxin and HCB emissions are not always reported by individual companies either. Individual estimates of these emissions have been made for all industrial stationary combustion sectors and for solid fuels, liquid fuels (except diesel and LPG), gaseous fuels (except natural gas) and biomass (except biogas). The emissions have been calculated as a fraction of the reported hydrocarbon emission. The fraction is based on the ratio between the Tier 1 emission factors of PAH/dioxin/HCB/PCB with NMVOC from Chapters 1A1 and 1A2 of the EMEP/EEA Guidebook (2019) and an assumed abatement efficiency of 90%. If an individual emission exceeds the reporting threshold, it is assumed that the emission is equal to the reporting threshold (assuming that a company would have reported these emissions if they were above the reporting threshold). If a company has

already reported a certain emission, the individual emission estimate for that company is discarded, and only the reported emission is used.

- PM<sub>2.5</sub> emissions are either reported by individual companies or calculated using default PM<sub>2.5</sub>/PM<sub>10</sub> ratios. These ratios are based on PM<sub>10</sub> and PM<sub>2.5</sub> emissions reported by individual companies (differing per sector, activity and fuel) or on literature (e.g. Visschedijk, et al. (2004) and Ehrlich et al. (2007)). A complete list of the PM<sub>2.5</sub>/PM<sub>10</sub> ratios, including references, is presented in Honig et al. (2026) and in Visschedijk & Dröge (2019). The latter report can be downloaded via: [Visschedijk & Dröge. 2019.](#)

Table 3.11 List of PCB emission factors of solid fuels (µg/GJ)

Year	Solid fuels <sup>1</sup> µg/GJ	Biomass <sup>2</sup> µg/GJ
1990	52.4	0.06
1991	42.1	0.06
1992	31.7	0.06
1993	21.4	0.06
1994	11.0	0.06
from 1995	0.67	0.06

1. Based on the correlation between the dioxin and PCB EFs in the Guidebook and the reported dioxin emissions in the Dutch emission inventory. This results in an EF of 52.4 µg/GJ in 1990 and 0.67 µg/GJ from 1995 onwards

2. EMEP/EEA Guidebook (2019), Chapter 1A2, Table 3.5

Table 3.12 List of heavy metal EFs of natural gas (mg/GJ)

Pollutant	1990-2009	2010-2016	from 2017
Hg <sup>1</sup>	0.039	0.023	0.01
Pb <sup>2</sup>		0.0015	
Cd <sup>2</sup>		0.00025	
As <sup>2</sup>		0.12	
Cr <sup>2</sup>		0.00076	
Cu <sup>2</sup>		0.076	
Ni <sup>2</sup>		0.00051	
Se <sup>2</sup>		0.0112	
Zn <sup>2</sup>		0.0015	

1. Based on a study by the Dutch gas company Gasunie

2. EMEP/EEA Guidebook 2019 (1A1, Table 3.4) are used for the other metals

### 3.3.5

#### Methodological issues

Emissions are based on data in the AERs relating to individual facilities (Tier 3 methodology). A company needs to submit an environmental report if one or more of the activities of the company is included in annex 1 of the E-PRTR regulation. These companies need to report emissions that exceed the reporting threshold. For some pollutants, the Dutch reporting thresholds are lower than the European reporting thresholds (see the thresholds in Dutch: [https://www.e-mjv.nl/sites/default/files/2018-07/stoffenlijst\\_integraal\\_prtr-verslag.pdf](https://www.e-mjv.nl/sites/default/files/2018-07/stoffenlijst_integraal_prtr-verslag.pdf)). The emission and fuel consumption data in the AERs is systematically examined for inaccuracies by checking the resulting IEFs.

If environmental reports provide data of high enough quality, the information is used to calculate an IEF for a cluster of reporting companies (aggregated by NACE code). These IEFs are fuel- and sector-dependent and are used to calculate the emissions by companies that are not individually assessed.

$$\mathbf{IEF}_{ER-I} (NACE, fuel) = \frac{\mathbf{Emissions}_{ER-I} (NACE, fuel)}{\mathbf{Energy\ use}_{ER-I} (NACE, fuel)}$$

where:

EF = Implied emission factor from individual companies

ER-I = Emission Registration database for individual companies

Next, combustion emissions by the companies that are not individually assessed in this NACE category are calculated from the energy use according to the energy statistics (from Statistics Netherlands), multiplied by the IEF. If the data from the individual companies is insufficient to calculate an IEF, a default EF is used (see Table 3.10).

$$\mathbf{ER-C\_emission}_{(NACE, fuel)} = \mathbf{IEF}_{ER-I} (NACE, fuel) * \mathbf{energy\ statistics}_{(NACE, fuel)}$$

where:

ER-C = Emission Registration database for emission data that is not based on emissions reported in an AER

The total combustion emissions are the sum of emissions by the individual companies (ER-I) plus emissions by the companies that are not individually assessed (ER-C).

The AERs contain emission data from individual plants at the level of individual installations (or sometimes a group of installations). The AER data is not always sufficiently detailed to indicate whether the emissions are resulting from combustion or from processes (for example when emissions are calculated from stack measurements that include concentrations from both combustion and processes). Therefore, the emissions are split into combustion emissions (allocated in NFR 1A2) and process emissions (allocated in NFR2), on the basis of the question whether the consumption of fuels is reported in an installation in the AER. Because of this split, emissions are sometimes only included in the energy sector, or only in the IPPU sector. The emissions in the energy sector should best be viewed together with the emissions in the corresponding IPPU sector.

The notation key 'IE' (Included Elsewhere) is used in the energy sector when the complete emission by a company is included in the industrial processes sector (as described in the section above). This is valid for the following subcategories:

- 1A1c: Emissions from the coke plant in the Netherlands are included in 1A2a and/or 2C1, as it is part of the combined coke / iron and steel plant.
- 1A2a: Emissions from the combined coke plant / iron and steel plant are allocated in 1A2a and/or in 2C1.

- 1A2b: Emissions from the non-ferrous metals industry are included in 1A2b, 2C3 and/or 2C6.
- 1A2f: Emissions from the non-metallic minerals industry are reported in 1A2gviii.

The notation key 'NE' (Not Estimated) is used for several subcategories for various reasons:

- Emissions are sometimes not estimated, because these emissions are not reported by the individual companies in their AERs (below the reporting threshold). The reporting thresholds are presented in Table 3.13, including a comparison to the 2024 national emission. For most pollutants, the reporting threshold is less than 0.1% of the national total. For heavy metals and PAH, the reporting threshold is often more than 0.1% of the national total; for that reason, an additional estimate for the not reported heavy metal and PAH emissions has been made (as described in Section 3.3.4).
- Emissions of NH<sub>3</sub> from gaseous, liquid and solid fuels and emissions of PCB and HCB from gaseous and liquid fuels are not estimated, because the EMEP/EEA Guidebook (2019) does not contain a methodology.

Table 3.13 Comparison between the reporting threshold in annual environmental reports (AERs) and the national emissions in 2024

Pollutant	Unit	National emission in 2024	Reporting threshold in AERs	Relative contribution (%)
NO <sub>x</sub> (as NO <sub>2</sub> )	Gg	180.68	0.01	0.01%
NMVOG	Gg	234.06	0.01	0.00%
SO <sub>x</sub> (as SO <sub>2</sub> )	Gg	15.83	0.02	0.13%
NH <sub>3</sub>	Gg	112.65	0.01	0.01%
PM <sub>10</sub>	Gg	26.31	0.005	0.02%
CO	Gg	396.90	0.01	0.00%
Pb	Mg	4.57	0.05	1.09%
Cd	Mg	0.58	0.001	0.17%
Hg	Mg	0.38	0.001	0.26%
As	Mg	0.27	0.02	7.53%
Cr	Mg	4.09	0.1	2.44%
Cu	Mg	113.92	0.1	0.09%
Ni	Mg	2.68	0.05	1.87%
Zn	Mg	86.71	0.2	0.23%
PCDD/ PCDF (dioxins/ furans)	g I-TEQ	29.69	0.01	0.03%
benzo(a) pyrene	Mg	1.48	0.001	0.07%
benzo(b) fluoranthene	Mg	1.45	0.001	0.07%
benzo(k) fluoranthene	Mg	0.78	0.001	0.13%
indeno (1.2.3-cd) pyrene	Mg	0.73	0.001	0.14%
Total 1-4	Mg	4.72	0.001	0.02%
HCB	kg	3.31	0.01	0.30%

The relative contribution indicates how the reporting threshold compares to the national emission

### 3.3.6 *Uncertainties and time series consistency*

Uncertainties are explained in Section 1.7.

#### *Time series consistency*

A large part of the emission inventory is built from emission data reported by individual companies. If a company does not report any emissions at all, the emissions are calculated on the basis of the energy statistics of these non-reporting companies.

The companies do not have to report their emissions when they are below a certain threshold. This is often the case for the emissions of heavy metals and PAHs. In order to ensure a consistent time series, metal emissions have also been calculated from the energy statistics combined with EFs from the EMEP/EEA Guidebook (2019), and PAH emissions have been calculated from the ratio between the reported hydrocarbon emissions and the PAH emissions. A more detailed description of the methodology is available in Chapter 3.1.2.2 of the ENINA methodology report (Honig et al., 2026).

### 3.3.7 *Source-specific QA/QC and verification*

Emission and fuel consumption data in the AERs was systematically examined for inaccuracies by checking the resulting IEFs. If the environmental reports provided data of high enough quality (see Section 1.6 on QA/QC), the information was used.

### 3.3.8 *Source-specific recalculations*

The following recalculations were performed:

#### *Recalculation of EC<sub>2.5</sub> emissions from individual companies*

In the previous submission, EC<sub>2.5</sub> emissions were calculated based on the ratio EC<sub>2.5</sub>/PM<sub>10</sub>. This sometimes resulted in EC<sub>2.5</sub> emissions that were higher than PM<sub>2.5</sub> emissions, when a company has reported relatively low PM<sub>2.5</sub> emissions. In this submission, the EC<sub>2.5</sub> emissions are now calculated based on the ratio EC<sub>2.5</sub>/PM<sub>2.5</sub>. The ratios are based on the EMEP/EEA 2023 Guidebook. This has been implemented for the complete time series. Table 3.14 provides an overview of the resulting change in EC<sub>2.5</sub> emissions.

Table 3.14 Overview of change in EC<sub>2.5</sub> emissions (tonne)

Year	1A1b	1A1c	1A2a	1A2b	1A2c	1A2d	1A2e	1A2g viii
1990	-29.63	-0.93	+0.01					
1995	-19.63	-0.38	-0.31		+0.00		+0.00	
2000	-61.69		-0.01					
2005	-7.59		+0.00	+0.14	+0.56	+0.00		+0.00
2010	-1.95		-8.00	+0.03	+1.75		-0.11	-4.75
2015	-0.11		-0.44	-0.99	+0.76	+0.00	+1.22	-0.09
2020	0.30		-0.01	+0.01	+0.28		+0.25	+0.04
2021	-0.14		-0.01	+0.02	+0.23		+0.18	-0.39
2022	0.21		-0.01	+0.09	+0.22		+0.21	-0.13
2023	0.32		-0.01	+0.09	+1.22		+0.36	+0.07

*Recalculation of emissions in 2022-2023 due to improved activity data of natural gas*

Activity data for the non-reporting companies (i.e. energy statistics) in 2022-2023 has been updated. Table 3.15 shows the resulting changes in emissions of the main pollutants. Please note that emissions of heavy metals and PAHs have also been recalculated (<1 kg differences).

*Table 3.15 Overview of change in emissions in 2022–2023 as a result of improved activity data (tonne)*

<b>NFR</b>	<b>Pollutant</b>	<b>2022</b>	<b>2023</b>
1A2d	NO <sub>x</sub>	-6.3	+11.6
	NMVOG	-0.9	+1.5
	SO <sub>x</sub>	-0.0	+0.1
	TSP	-0.1	+0.1
	PM <sub>10</sub>	-0.1	+0.1
	PM <sub>2.5</sub>	-0.1	+0.1
	BC	0.0	+0.0
	CO	-6.0	+10.4
1A2gviii	NO <sub>x</sub>		-7.6
	NMVOG		-0.9
	SO <sub>x</sub>		-0.1
	TSP		-0.1
	PM <sub>10</sub>		-0.1
	PM <sub>2.5</sub>		-0.1
	BC		-0.0
	CO		-6.4

*Recalculation for combustion of biogas and solid biomass in 1A2gviii*

The emissions from biomass combustion in 1A2gviii have been corrected for three issues:

- The activity data of wood combustion has been corrected for the complete time series in 1A2gviii
- In response to review recommendation NL-1A4ci-2018-0001, emissions from Cd, Hg and Pb have also been calculated for the combustion of biogas and solid biomass, based on the energy statistics (of the companies that have not reported their emissions) and default emission factors (see Table 3.10).
- The NO<sub>x</sub> emission factor for wood combustion in the wood industries has been updated to match the default EF from the EMEP/EEA Guidebook (see Table 3.10)

Table 3.16 shows the resulting changes in emissions.

Table 3.16 Overview of change in emissions in 1990-2023 as a result of corrections in the emission calculation of biogas and solid biomass

Pollutant	Unit	1990	1995	2000	2005	2010	2015	2020	2023
NO <sub>x</sub>	Tonne	-0.0			-60.6	-53.0	-1.7	+95.0	+69.0
NM VOC	Tonne	-0.0				+0.0	+5.0	+11.5	+6.8
SO <sub>x</sub>	Tonne	-0.0				+0.1	+6.6	+15.1	+11.4
TSP	Tonne	-0.0				+0.9	+16.2	+36.9	+24.0
PM <sub>10</sub>	Tonne	-0.0				+0.9	+16.2	+36.9	+24.0
PM <sub>2.5</sub>	Tonne	-0.0				+0.9	+15.0	+34.2	+22.5
BC	Tonne	-0.0				+0.2	+4.2	+9.6	+6.3
CO	Tonne	-0.0				+0.5	+450.2	+1025.3	+579.5
Cd	Kg	+0.4	+0.4	+0.4	+10.0	+8.8	+12.4	+13.9	+12.2
Hg	Kg	+0.0	+0.0	+0.0	+0.4	+0.4	+0.5	+0.6	+0.5
Pb	Kg	+0.8	+0.8	+0.8	+20.8	+18.4	+25.8	+28.9	+25.3

#### Correction of emissions reported by individual companies

Several corrections have been implemented in the reporting from individual companies:

- 1995, 2000: A completeness check for the years 1995 and 2000 for sector 1A2c, resulted in a correction of missing emissions in these years. In 1995, this resulted in an increase of NO<sub>x</sub> emissions of +0.5 tonne NO<sub>x</sub>. In 2000, this resulted in an increase of NO<sub>x</sub> emissions (+337.2 tonne NO<sub>x</sub>), SO<sub>x</sub> emissions (+3.2 tonne SO<sub>x</sub>), CO emissions (+150.9 tonne CO) and dioxin emissions (+0.03 gram dioxin)
- 2006, 2009: dioxin emissions in 1A2b in 2006 and 2009 have been corrected, as recommended in NECD review recommendation NL-1A2b-2019-0001. This results in an emission reduction of -0.40 gram dioxin in 2006 and -1.65 gram dioxin in 2009.
- 2019-2023: Error correction in the CO emission of one paper plant in 1A2d. This results in an emission reduction of -12.1 tonne CO in 2019, -11.6 tonne CO in 2020, -11.5 tonne CO in 2021, -20.7 tonne CO in 2022 and -10.4 tonne CO in 2023.
- 2022-2023: Several companies have updated the emissions they reported in their AERs for 2022 and 2023. This results in the changes as presented in Table 3.17. Also some small corrections in metals and PAHs were implemented. Table 3.17 only shows the correction for Hg in 1A2gviii. The other corrections for metals and PAH were much smaller (<1 kg) and are not presented in the table.

Table 3.17 Overview of change in emissions in 2022–2023 as a result of updated environmental reports from individual companies

NFR	Pollutant	Unit	2022	2023
1A1b	NM VOC	Tonne	-11.4	-10.2
	NO <sub>x</sub>	Tonne		+0.3
1A1c	NM VOC	Tonne		<0.00
	NO <sub>x</sub>	Tonne		+1.2
1A2a	NM VOC	Tonne		+4.6
1A2c	PM <sub>10</sub>	Tonne		-0.4
	PM <sub>2.5</sub>	Tonne		-0.04
	CO	Tonne		-6.1
	NM VOC	Tonne		-0.3
	NO <sub>x</sub>	Tonne		-44.4
	SO <sub>x</sub>	Tonne		-14.9
	1A2e	CO	Tonne	
1A2g	NM VOC	Tonne		+35.2
	NO <sub>x</sub>	Tonne		+0.003
	1A2gviii	CO	Tonne	+131.2
1A2gviii	NO <sub>x</sub>	Tonne		+87.3
	Hg	Kg		+9.0

### 3.3.9 Source-specific planned improvements

There are no planned source-specific improvements.

## 3.4 Other stationary combustion (1A4ai, 1A4bi, 1A4ci and 1A5a)

### 3.4.1 Source category description

This section describes the following source categories:

- 1A4ai Commercial/Institutional: Stationary. This source category comprises commercial and public services (banks, schools and hospitals, trade, retail, communication). It also includes military, the production of drinking water and miscellaneous combustion emissions from waste handling activities and from wastewater treatment plants.
- 1A4bi Residential: Stationary. This source category refers to domestic fuel consumption for space heating, water heating and cooking. About three-quarters of the sector's consumption of natural gas is used for space heating.
- 1A4ci Agriculture/Forestry/Fisheries: Stationary. This source category comprises stationary combustion emissions from agriculture, horticulture, greenhouse horticulture, cattle breeding and forestry.
- 1A5a Other: Stationary. There are no emissions reported in this sector. Emissions from military are included in 1A4ai.

### 3.4.2 Key sources

The Small stationary combustion sector is a key source of the pollutants listed in Table 3.18.

Table 3.18 Pollutants for which the Small combustion sector (NFR 1A4 and 1A5) is a key source

Category / Subcategory	Pollutant	Contribution to total of 2024 (%)
1A4ai Commercial/institutional: Stationary	PM <sub>2.5</sub>	2.3
1A4bi Residential: Stationary	NO <sub>x</sub>	2.6
1A4bi Residential: Stationary	NMVOC	3.4
1A4bi Residential: Stationary	CO	14.3
1A4bi Residential: Stationary	PM <sub>10</sub>	16.3
1A4bi Residential: Stationary	PM <sub>2.5</sub>	29.1
1A4bi Residential: Stationary	BC	22.4
1A4bi Residential: Stationary	dioxins	20.2
1A4bi Residential: Stationary	PAH	60.9
1A4bi Residential: Stationary	Hg	9.3
1A4bi Residential: Stationary	Cd	9.6
1A4ci Agriculture/Forestry/Fishing: stationary	Cd	4.1

### 3.4.3

#### *Overview of shares and trends in emissions*

An overview of the trends in emissions is provided in Table 3.19. Emissions of almost all pollutants have decreased since 1990 (except for NH<sub>3</sub> and Cd), while fuel use has increased slightly.

The decrease of Hg and Pb emissions between 1990 and 1991 in NFR 1A4ai was caused by the fact that from 1991 onwards, no hard coal has been used in the Services sector. The steady slow increase of HCB from 2007 onwards has been caused by the use of wood in the Services sector.

Table 3.19 Overview of trends in emissions in the Other stationary combustion sectors

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOG	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>41</b>	<b>13</b>	<b>2.2</b>	<b>0.35</b>	<b>7.1</b>	<b>7.6</b>	<b>8.2</b>	<b>0.91</b>	<b>78</b>
1995	45	15	1.2	0.38	7.4	7.8	8.4	0.98	88
2000	40	13	0.69	0.30	6.4	6.8	7.3	0.83	78
2005	35	15	0.55	0.28	6.6	7.0	7.4	0.84	85
2010	39	21	0.70	0.34	7.3	7.8	8.3	0.91	107
2015	22	15	0.51	0.33	5.6	5.9	6.2	0.67	81
2020	14	11	0.53	0.44	4.5	4.8	5.1	0.57	67
2021	15	12	0.59	0.50	5.0	5.3	5.6	0.64	76
2022	12	11	0.52	0.45	4.7	5.0	5.3	0.60	70
2023	11	11	0.48	0.40	4.6	4.9	5.2	0.62	66
<b>2024</b>	<b>11</b>	<b>10</b>	<b>0.45</b>	<b>0.39</b>	<b>4.5</b>	<b>4.7</b>	<b>4.9</b>	<b>0.60</b>	<b>64</b>
1990-2024 <sup>1)</sup>	-30	-3	-1.7	0.04	-2.7	-2.9	-3.3	-0.32	-14
1990-2024 <sup>2)</sup>	-73%	-22%	-79%	11%	-38%	-38%	-40%	-35%	-18%
% 2024 <sup>3)</sup>	6%	4%	3%	0%	32%	18%	16%	27%	16%

Table 3.19 Overview of trends in emissions in the Other stationary combustion sectors (continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>0.93</b>	<b>0.07</b>	<b>0.14</b>	<b>108</b>	<b>3.5</b>	<b>0.19</b>	<b>3.5</b>	<b>0.83</b>	<b>2.1</b>	<b>0.01</b>	<b>2.4</b>
1995	0.16	0.05	0.07	8.2	4.0	0.12	0.05	0.41	0.39	0.01	0.86
2000	0.09	0.05	0.05	7.5	3.6	0.09	0.01	0.35	0.02	0.01	0.69
2005	0.09	0.05	0.05	7.7	4.0	0.08	0.00	0.39	0.01	0.01	0.75
2010	0.15	0.08	0.06	8.2	4.9	0.10	0.01	0.52	0.02	0.01	1.0
2015	0.14	0.08	0.05	7.0	3.7	0.07	0.00	0.42	0.00	0.01	0.81
2020	0.19	0.10	0.04	6.1	3.0	0.06	0.00	0.38	0.00	0.01	0.72
2021	0.22	0.12	0.04	6.5	3.4	0.07	0.00	0.44	0.00	0.01	0.86
2022	0.20	0.11	0.04	6.4	3.3	0.05	0.00	0.43	0.00	0.00	0.84
2023	0.18	0.10	0.04	6.2	3.1	0.05	0.00	0.42	0.00	0.00	0.82
<b>2024</b>	<b>0.18</b>	<b>0.10</b>	<b>0.04</b>	<b>6.0</b>	<b>2.9</b>	<b>0.05</b>	<b>0.00</b>	<b>0.41</b>	<b>0.00</b>	<b>0.00</b>	<b>0.81</b>
1990-2024 <sup>1)</sup>	-0.75	0.03	-0.10	-102	-0.6	-0.14	-3.5	-0.42	-2.1	-0.01	-1.6
1990-2024 <sup>2)</sup>	-81%	47%	-71%	-94%	-17%	-76%	-100%	-50%	-100%	-59%	-66%
% 2024 <sup>3)</sup>	4%	17%	10%	20%	62%	17%	0%	0%	0%	4%	1%

1. Absolute difference

2. Relative difference compared to 1990 in %

3. % of national total 2024

#### 3.4.4 Activity data and (implied) emission factors

Emission data is based on emissions reported in AERs (Annual Environmental Reports) and on calculated emissions for the companies that did not report their emissions in an AER. In this source category, the share of emissions reported in AERs is relatively small (compared to the industrial combustion sector):

- 1A4ai: 6% of the SO<sub>x</sub> emissions, 10% of the NO<sub>x</sub> emissions, 23% of the NMVOC emissions and 0.3% of the PM<sub>2.5</sub> emissions were reported in AERs (in 2024);
- 1A4bi: no emission data from AERs is used in the residential sector;
- 1A4ci: 0.6% of the NO<sub>x</sub> and 0.2% of SO<sub>x</sub> emissions were reported in AERs in 2024.

The following texts describe the calculation methods for the emissions that are not reported in an AER.

#### **Commercial/institutional (1A4ai)**

Combustion emission data from the commercial and institutional sectors is based on emissions reported by individual companies and an additional emission calculation from fuel consumption data (from Statistics Netherlands) and EFs (see Table 3.20).

Table 3.20 Emission factors for stationary combustion emissions from the Services sector

Substance name	Unit	Natural gas	Biogas	Diesel	Coal	Wood
NM VOC	g/GJ	2.0 <sup>1</sup>	23 <sup>9</sup>	20 <sup>4</sup>	10 <sup>3</sup>	5 <sup>8</sup>
Sulphur dioxide	g/GJ	0.2 <sup>2</sup>	0.67 <sup>9</sup>	94 <sup>4</sup>	450 <sup>3</sup>	8 <sup>8</sup>
Nitrogen oxides as NO <sub>2</sub>	g/GJ	19.3 <sup>6</sup>	74 <sup>9</sup>	60 <sup>5</sup>	150 <sup>3</sup>	91 <sup>7</sup>
Ammonia	g/GJ					37 <sup>7</sup>
Carbon monoxide	g/GJ	15 <sup>2</sup>	29 <sup>9</sup>	93 <sup>4</sup>	150 <sup>3</sup>	50 <sup>8</sup>
PM <sub>10</sub>	g/GJ	0.27 <sup>2</sup>	0.78 <sup>9</sup>	21 <sup>4</sup>	60 <sup>3</sup>	91 <sup>8</sup>
PM <sub>2.5</sub>	g/GJ	10	10	10	10	10
Cd	mg/GJ	0.00025 <sup>11</sup>	0.002 <sup>13</sup>	0.93 <sup>15</sup>	0.8 <sup>15</sup>	6.5 <sup>14</sup>
Hg	mg/GJ	0.01 <sup>12</sup>	0.012 <sup>13</sup>	0.56 <sup>15</sup>	0.089 <sup>15</sup>	0.28 <sup>14</sup>
Pb	mg/GJ	0.0015 <sup>11</sup>	0.005 <sup>13</sup>	9.3 <sup>15</sup>	70 <sup>15</sup>	13.5 <sup>14</sup>

1. EMEP/EEA Guidebook (2019), 1A4, Table 3.27, default value
2. EMEP/EEA Guidebook (2019), 1A4, Table 3.27, minimum value
3. EMEP/EEA Guidebook (2019), 1A4, Table 3.7, minimum value
4. EMEP/EEA Guidebook (2019), 1A4, Table 3.9, default value
5. Van Soest-Vercammen et al. (2002)
6. Visschedijk, Dröge & Hulskotte (2026). From 2005 onwards, the NO<sub>x</sub>-emission factor has decreased due to the further implementation of low-NO<sub>x</sub> technologies (EF2005: 42.5 to EF2024: 19.3)
7. EMEP/EEA Guidebook (2019), 1A4, Table 3.10, default value
8. EMEP/EEA Guidebook (2019), 1A4, Table 3.10, minimum value
9. EMEP/EEA Guidebook (2019), 1A4, Table 3.8, default value
10. PM<sub>2.5</sub> fraction differs per sector. See Visschedijk & Dröge (2019) or Honig et al. (2026) for a complete list of PM<sub>2.5</sub> fractions
11. EMEP/EEA Guidebook (2023), 1A1, Table 3.4, default value
12. Based on a study by the Dutch gas company Gasunie. Value used from 2017 onwards. For earlier years, see Table 3.5
13. EMEP/EEA Guidebook (2023), 1A1, Table 3.9, default value
14. EMEP/EEA Guidebook (2023), 1A4, Table 3.10, default value, combined with an abatement efficiency of 50%
15. Methodology report by Guis (2006)

### Residential (1A4bi)

Combustion emission data from central heating, hot water and cooking is based on fuel consumption data (from Statistics Netherlands) and EFs (see Table 3.21). The fuel used most in this category is natural gas. The use of wood in stoves and fireplaces for heating is very small compared to the amount of natural gas used.

Combustion emissions from (wood) stoves and fireplaces were calculated by multiplying the fuel consumption per appliance type and fuel type (Statistics Netherlands) by EFs (Jansen, 2016; Visschedijk & Dröge, 2020). Particulate matter emissions from wood combustion include the emission of condensables (see Table 3.22). EFs for charcoal combustion in barbecues are also included in this table. Wood consumption per appliance type is presented in Table 3.23.

Table 3.21 Emission factors for combustion emissions from households (g/GJ)

Substance name	Natural gas (heating)	Natural gas (cooking)	Diesel	LPG	Petroleum	Coal
NM VOC	1.8 <sup>1</sup>	2.0 <sup>2</sup>	0.69 <sup>3</sup>	1.9 <sup>5</sup>	0.69 <sup>3</sup>	300 <sup>4</sup>
Sulphur dioxide	0.3 <sup>1</sup>	0.3 <sup>2</sup>	70 <sup>3</sup>	0.3 <sup>5</sup>	70 <sup>3</sup>	450 <sup>4</sup>
Nitrogen oxides as NO <sub>2</sub>	12.4 <sup>6</sup>	57 <sup>6</sup>	51 <sup>3</sup>	40 <sup>5</sup>	51 <sup>3</sup>	150 <sup>4</sup>
Carbon monoxide	22 <sup>1</sup>	30 <sup>2</sup>	57 <sup>3</sup>	26 <sup>5</sup>	57 <sup>3</sup>	2,000 <sup>4</sup>
PM <sub>10</sub>	0.281	2.2 <sup>2</sup>	1.9 <sup>3</sup>	1.2 <sup>5</sup>	1.9 <sup>3</sup>	240 <sup>4</sup>
PM <sub>2.5</sub>	0.2 <sup>7</sup>	2.2 <sup>7</sup>	1.9 <sup>7</sup>	1.2 <sup>7</sup>	1.9 <sup>7</sup>	216 <sup>7</sup>

1. EMEP/EEA Guidebook (2019), 1A4, Table 3.16, default value
2. EMEP/EEA Guidebook (2019), 1A4, Table 3.13, default value
3. EMEP/EEA Guidebook (2019), 1A4, Table 3.5, default value
4. EMEP/EEA Guidebook (2019), 1A4, Table 3.19, default value
5. EMEP/EEA Guidebook (2019), 1A4, Table 3.4, default value
6. See Visschedijk, Dröge and Hulskotte (2026)
7. PM<sub>10</sub> emission factor, combined with PM<sub>2.5</sub> fraction from Visschedijk & Dröge (2019)

Table 3.22 Emission factors for wood combustion in households

Pollutant	Unit	Fire-place	Conventional stove	Improved stove	Eco-label stove	Eco-design stove	Pellet	Barbecues (charcoal)
NM VOC	g/GJ	1,290	774	387	252	250	10	250
SO <sub>x</sub>	g/GJ	12.9	12.9	12.9	12.9	12.9	12.9	10
NO <sub>x</sub>	g/GJ	77.4	129.0	129.0	129.0	95.0	80.0	50
NH <sub>3</sub>	g/GJ	29.4	29.4	1.47	1.47	1.47	0.29	
CO	g/GJ	3,226	6,452	3,871	2,903	2,000	300	6,000
PM <sub>10</sub>	g/GJ	670	534	233	97.0	97.0	30.0	150
PM <sub>2.5</sub>	g/GJ	637	507	221	93.0	93.0	30.0	75
EC <sub>2.5</sub>	g/GJ	76.4	73.3	27.5	10.3	25.9	9.0	
Pb	mg/GJ	4.71	4.71	4.71	4.71	4.71	4.71	
Cd	mg/GJ	3.23	3.23	3.23	3.23	3.23	3.23	
Hg	mg/GJ	1.94	1.94	1.94	1.94	1.94	1.94	
Dioxin	ng/GJ	1,613	174	174	174	174	100	150
PAH4	mg/GJ	193.5	343.9	221.3	172.3	35.0	35.0	143.4

Note: PM EFs include both the filterable and the condensable fraction  
Source: Jansen (2016); Visschedijk & Dröge (2020); EF from charcoal use in barbecues from Visschedijk et al. (2026)

Table 3.23 Wood combustion per application type in NFR 1A4bi (TJ)

Appliance	1990	2005	2010	2015	2020	2024
Fireplace	3,834	2,972	2,700	2,322	1,917	1,650
Conventional stove	7,120	5,496	5,520	3,235	1,879	1,706
Improved stove	768	4,649	5,931	3,717	2,710	2,227
Eco-labelled stove	0	1,937	6,017	6,874	6,550	6,859
Eco-design stove	0	0	0	77	212	1,720
Pellet	0	0	0	166	1,218	2,672

### Agriculture/forestry/fishing (1A4ci)

Stationary combustion emission data is based on default EFs (Table 3.24) combined with fuel consumption data obtained from Statistics Netherlands, whose figures are, in turn, based on data from Wageningen Economics Research.

Table 3.24 EF's for the Agriculture/Forestry/Fishing sectors

Substance name	Unit	Natural gas (gas engines)	Natural gas (boilers)	Biogas	LPG	Wood
NM VOC	g/GJ	25.6 <sup>9</sup>	2.0 <sup>1</sup>	23 <sup>4</sup>	1.3 <sup>5</sup>	1.33 <sup>3</sup>
Sulphur dioxide	g/GJ	0.2 <sup>2</sup>	0.2 <sup>2</sup>	0.67 <sup>4</sup>	0.22 <sup>5</sup>	11 <sup>1</sup>
Nitrogen oxides as NO <sub>2</sub>	g/GJ	35 <sup>9</sup>	24.2 <sup>9</sup>	74 <sup>4</sup>	40 <sup>5</sup>	80 <sup>3</sup>
Ammonia	g/GJ					37 <sup>7</sup>
Carbon monoxide	g/GJ	56 <sup>9</sup>	15 <sup>2</sup>	29 <sup>4</sup>	10 <sup>5</sup>	170 <sup>3</sup>
PM <sub>10</sub>	g/GJ	0.2 <sup>6</sup>	0.27 <sup>2</sup>	0.78 <sup>4</sup>	2.0 <sup>5</sup>	17 <sup>3</sup>
PM <sub>2.5</sub>	g/GJ	0.2 <sup>10</sup>	0.27 <sup>10</sup>	0.78 <sup>10</sup>	2.0 <sup>10</sup>	16 <sup>10</sup>
Cd	mg/GJ	0.00025 <sup>11</sup>	0.00025 <sup>11</sup>	0.002 <sup>13</sup>		6.5 <sup>14</sup>
Hg	mg/GJ	0.01 <sup>12</sup>	0.01 <sup>12</sup>	0.12 <sup>13</sup>		0.28 <sup>14</sup>
Pb	mg/GJ	0.0015 <sup>11</sup>	0.0015 <sup>11</sup>	0.005 <sup>13</sup>		13.5 <sup>14</sup>

- EMEP/EEA Guidebook (2019), 1A4, Table 3.27, default value
- EMEP/EEA Guidebook (2019), 1A4, Table 3.27, minimum value
- From 'Kennisdokument Houtstook in Nederland' (Koppejan and De Bree, 2018)
- EMEP/EEA Guidebook (2019), 1A4, Table 3.8, default value
- Methodology report Zonneveld (Guis, 2006)
- EMEP/EEA Guidebook (2019), 1A4, Table 3.28, default value
- EMEP/EEA Guidebook (2019), 1A4, Table 3.10, default value
- Visschedijk, Dröge and Hulskotte (2026). For natural gas in gas engines, the NO<sub>x</sub> EF decreases from 200 g/GJ in 2005 to 35 g/GJ in 2024. For natural gas in boilers, the NO<sub>x</sub> EF decreases from 63 g/GJ in 2005 to 23.9 g/GJ in 2024
- PM<sub>10</sub> emission factor, combined with PM<sub>2.5</sub> fraction from Visschedijk & Dröge (2019)
- EMEP/EEA Guidebook (2023), 1A1, Table 3.4, default value
- Based on a study by the Dutch gas company Gasunie. Value used from 2017 onwards. For earlier years, see Table 3.5
- EMEP/EEA Guidebook (2023), 1A1, Table 3.9, default value
- EMEP/EEA Guidebook (2023), 1A4, Table 3.10, default value, combined with an abatement efficiency of 50%

Since PCB emissions are not reported by individual companies, they are calculated for the entire sector. The emissions are calculated by multiplying the energy statistics (Statistics Netherlands):

<https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dl=CF288>) with emission factors (see Table 3.25).

Table 3.25 List of PCB emission factors of solid fuels (Microgram/GJ)

Appliance	EF
Solid fuels <sup>1</sup>	170
Biomass non-residential <sup>2</sup>	0.06
Biomass residential <sup>3</sup>	
Fireplace	0.06
Conventional stove	0.06
Improved stove	0.045
Eco-label stove	0.03
Eco-design stove	0.007
Pellet	0.01

1. EMEP/EEA Guidebook (2019), Chapter 1A4, Table 3.7.

2. EMEP/EEA Guidebook (2019), Chapter 1A4, Table 3.10.

3. EMEP/EEA Guidebook (2019), Chapter 1A4, Tables 3.39-3.43. The EF of the improved stove is an average of the conventional and the high-efficiency stove

Since emissions of heavy metals from the use of natural gas are not reported by individual companies either, they are calculated for the entire sector. The emissions are calculated by multiplying the energy statistics (Statistics Netherlands:

<https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dl=CF288>) with emission factors (see Table 3.26).

Table 3.26 List of heavy metal EFs of natural gas (mg/GJ)

Pollutant	1990-2009	2010-2016	from 2017
Hg <sup>1</sup>	0.039	0.023	0.01
Pb <sup>2</sup>		0.0015	
Cd <sup>2</sup>		0.00025	
As <sup>2</sup>		0.12	
Cr <sup>2</sup>		0.00076	
Cu <sup>2</sup>		0.076	
Ni <sup>2</sup>		0.00051	
Se <sup>2</sup>		0.0112	
Zn <sup>2</sup>		0.0015	

1. Based on a study by the Dutch gas company Gasunie

2. EMEP/EEA Guidebook 2019 (1A1, Table 3.4) are used for the other metals

The PM<sub>2.5</sub> emissions are either reported by individual companies or calculated using default PM<sub>2.5</sub>/PM<sub>10</sub> ratios, which are based on several data sources:

- PM<sub>10</sub> and PM<sub>2.5</sub> emissions reported by individual companies (differing per sector, activity type and fuel);
- ratios from literature, e.g. Visschedijk et al. (2004) and Ehrlich et al. (2007).

See Honig et al. (2026) for the complete list of PM<sub>2.5</sub>/PM<sub>10</sub> ratios. A complete list of the PM<sub>2.5</sub>/PM<sub>10</sub> ratios, including references, is presented in Visschedijk & Dröge (2019). This report can be downloaded via: [Visschedijk & Dröge. 2019.](#)

### 3.4.5 *Methodological issues*

A Tier 2 methodology was used to calculate sectoral emissions by multiplying the activity data (fuel consumption) by the EFs (see previous section).

The notation key 'IE' (Included Elsewhere) is used for all pollutants in source category 1A5a. Emissions from military stationary combustion are included in 1A4ai.

### 3.4.6 *Uncertainties and time series consistency*

Uncertainties are explained in Section 1.7.

#### *Time series consistency*

The activity data in the NFR tables is based on data reported by individual companies and on energy statistics for the companies that did not submit AERs. Most of the emissions are likewise calculated from these activity data.

There are two exceptions: Both the emissions of PCB from solid fuels and solid biomass and the emissions of heavy metals from natural gas are calculated from the energy statistics. The energy statistics differ from the activity data in the NFR tables because the activity data from individual companies is allocated to their main economic activities, which can differ from the allocation of the energy statistics. The energy statistics can be accessed here:

<https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dl=CD128>

This also explains why activity data is included in the NFR for 1A4ai, while no PCB emissions have been reported in 1A4ai from 1995 onwards. These emissions have been allocated to other NFR categories (following the sectors in the energy statistics).

### 3.4.7 *Source-specific QA/QC and verification*

General QA/QC is explained in Section 1.3.

### 3.4.8 *Source-specific recalculations*

The following recalculations were performed:

#### *Recalculation of EC<sub>2.5</sub> emissions from individual companies*

In the previous submission, EC<sub>2.5</sub> emissions were calculated based on the ratio EC<sub>2.5</sub>/PM<sub>10</sub>. This sometimes resulted in EC<sub>2.5</sub> emissions that were higher than PM<sub>2.5</sub> emissions, when a company has reported relatively low PM<sub>2.5</sub> emissions. In this submission, the EC<sub>2.5</sub> emissions are now calculated based on the ratio EC<sub>2.5</sub>/PM<sub>2.5</sub>. The ratios are based on the EMEP/EEA 2023 Guidebook. This has been implemented for the complete time series. Since only a limited amount of company data is used in this sector, this only has a minor effect on the EC<sub>2.5</sub> emissions. The largest recalculation was in 2003 (+34 kg).

*Recalculation for combustion of biogas and solid biomass in 1A4ai and 1A4ci*

The emissions from biomass combustion in 1A4ai and 1A4ci have been corrected for two issues:

- the activity data of wood combustion and biogas combustion has been corrected for the complete time series in 1A4ai and 1A4cii;
- in response to review recommendation NL-1A4ci-2018-0001, emissions from Cd, Hg and Pb have also been calculated for the combustion of biogas and solid biomass, based on the energy statistics (of the companies that have not reported their emissions) and default emission factors (see Tables 3.31 and 3.24).

Table 3.27 shows the resulting changes in emissions.

*Table 3.27 Overview of change in emissions in 1990-2023 as a result of corrections in the emission calculation of biogas and solid biomass*

<b>NFR</b>	<b>Pollutant</b>	<b>Unit</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2023</b>
1A4ai	NO <sub>x</sub>	Tonne	-0.01	-9.06	-10.92	-10.85	-11.51	+22.98	+39.15	+59.22
	NMVOG	Tonne	-0.00	-0.50	-0.60	-0.60	-14.38	+1.26	+2.15	+4.09
	SO <sub>x</sub>	Tonne	-0.00	-0.80	-0.96	-0.95	+1.40	+2.02	+3.44	+4.95
	TSP	Tonne	-0.01	-9.06	-10.92	-10.85	+18.71	+22.98	+39.15	+55.98
	PM <sub>10</sub>	Tonne	-0.01	-9.06	-10.92	-10.85	+18.71	+22.98	+39.15	+55.98
	PM <sub>2.5</sub>	Tonne	-0.01	-8.82	-10.64	-10.56	+18.21	+22.37	+38.12	+54.50
	BC	Tonne	0.00	-2.47	-2.98	-2.96	+5.18	+6.26	+10.67	+15.25
	CO	Tonne	-0.01	-4.98	-6.00	-5.96	-1.51	+12.63	+21.51	+32.02
	Cd	Kg	+2.14	+1.65	+1.52	+1.36	+3.97	+5.49	+11.14	+23.21
	Hg	Kg	+0.09	+0.07	+0.07	+0.06	+0.17	+0.24	+0.48	+1.00
	Pb	Kg	+4.45	+3.42	+3.16	+2.83	+8.24	+11.41	+23.14	+48.20
1A4ci	NO <sub>x</sub>	Tonne	0.00	+2.70	+1.91	-12.82	-48.19	+26.72	+34.65	+80.74
	NMVOG	Tonne	0.00	+0.05	+0.03	-0.21	-0.80	+0.44	+0.58	+8.19
	SO <sub>x</sub>	Tonne	0.00	+0.37	+0.26	-1.76	-6.63	+3.67	+4.76	+8.11
	TSP	Tonne	0.00	+0.57	+0.41	-2.72	-10.24	+5.68	+7.36	+12.46
	PM <sub>10</sub>	Tonne	0.00	+0.57	+0.41	-2.72	-10.24	+5.68	+7.36	+12.46
	PM <sub>2.5</sub>	Tonne	0.00	+0.54	+0.38	-2.56	-9.64	+5.34	+6.93	+11.74
	BC	Tonne	0.00	+0.17	+0.12	-0.82	-3.07	+1.70	+2.21	+3.67
	CO	Tonne	0.00	+5.75	+4.06	-27.24	-102.41	+56.78	+73.64	+131.22
	Cd	Kg	+0.56	+0.82	+0.76	+0.65	+7.39	+18.25	+40.95	+23.49
	Hg	Kg	+0.02	+0.04	+0.03	+0.03	+1.02	+1.43	+2.27	+1.40
	Pb	Kg	+1.17	+1.71	+1.58	+1.35	+15.35	+37.91	+85.06	+48.80

*Recalculation as a result of updated energy statistics in 1A4ai, 1A4bi and 1A4ci (other than biogas and wood in 1A4ai and 1A4ci, which are described above)*

Energy statistics have been improved for 1A4ai, 1A4bi and 1A4ci:

- 1A4ai: Energy statistics have been updated for natural gas (2023), lignite (2023), diesel (2015-2023) and LPG (2015-2023)
- 1A4bi: Energy statistics have been updated for natural gas (2022-2023), LPG (2022-2023), petroleum (2023) and coal (2022)

- 1A4ci: Energy statistics have been updated for natural gas (2023)

Table 3.28 shows the change in emissions for the main pollutants. Also, emissions of heavy metals and PAHs have been recalculated (<1 kg difference).

*Table 3.28 Overview of recalculations as a result of updated activity data for the additional emissions by non-reporting companies (in tonne)*

<b>NFR</b>	<b>Pollutant</b>	<b>2015</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>
1A4ai	NO <sub>x</sub>	-13.77	-15.22	-31.53	-23.56	-39.91
	NMVOC	-0.64	-0.72	-1.50	-1.12	-3.09
	SO <sub>x</sub>	-0.70	-0.11	-0.24	-0.18	-0.39
	TSP	-0.54	-0.46	-0.95	-0.71	-0.84
	PM <sub>10</sub>	-0.54	-0.46	-0.95	-0.71	-0.84
	PM <sub>2.5</sub>	-0.51	-0.46	-0.95	-0.71	-0.84
	EC <sub>2.5</sub>	-0.06	-0.00	-0.00	-0.00	-0.01
	CO	-9.30	-9.89	-20.50	-15.31	-28.42
1A4bi	NO <sub>x</sub>				-206.39	-33.35
	NMVOC				-27.81	-4.65
	SO <sub>x</sub>				-4.76	-0.78
	TSP				-3.20	-0.52
	PM <sub>10</sub>				-3.15	-0.52
	PM <sub>2.5</sub>				-3.15	-0.52
	EC <sub>2.5</sub>				-0.17	-0.03
	CO				-339.39	-56.87
1A4ci	NO <sub>x</sub>					-12.29
	NMVOC					27.15
	SO <sub>x</sub>					-0.21
	TSP					-0.37
	PM <sub>10</sub>					-0.37
	PM <sub>2.5</sub>					-0.37
	EC <sub>2.5</sub>					-0.01
	CO					34.94

**3.4.9** *Source-specific planned improvements*  
No source-specific improvements are planned.

### **3.5 Fugitive emissions (1B)**

#### **3.5.1** *Source category description*

This category includes fuel-related emissions from non-combustion activities in the energy production and transformation industries:

- 1B2aiv Fugitive emissions oil: refining / storage;
- 1B2av Fugitive emissions oil: products distribution;
- 1B2b Fugitive emissions from natural gas;
- 1B2c Venting and flaring;
- 1B2d Other fugitive emissions from energy production.

For the 1990–1999 period, source category 1B1b included fugitive emissions from an independent coke production facility, which closed in

1999. The emissions from coke production from the only combined iron and steel plant in the Netherlands have been included in category 1A2a because emissions reported by this company cannot be split into iron/steel and coke production. Therefore, from 2000 onwards, no emissions have been allocated to 1B1b, and the notation key 'IE' has been used.

### 3.5.2 Key sources

The Fugitives emissions sector is for some years a key source of NMVOC. In 2024, this source sector is a key source of NMVOC in 1B2av Distribution of oil products (see Table 3.29). Other main sectors (but not key sources) are 1B2aiv Refining and 1B2b Fugitive emissions from natural gas.

Table 3.29 Pollutants for which the Fugitives emissions sector (NFR 1B) is a key source

Category / Subcategory	Pollutant	Contribution to total of 2024 (%)
1B2av Distribution of oil products	NMVOC	1.6

### 3.5.3 Overview of shares and trends in emissions

An overview of the trends in emissions is provided in Table 3.30. NMVOC emissions decreased between 1990 and 2024.

Table 3.30 Overview of trends in emissions in sector 1B Fugitive emissions

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOC	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>0.00</b>	<b>48</b>	<b>0.00</b>	<b>0.01</b>	<b>0.11</b>	<b>0.19</b>	<b>0.57</b>	<b>0.00</b>	<b>0.00</b>
1995	0.00	34	0.02	0.01	0.14	0.21	0.38	0.00	0.00
2000	0.00	30	0.00	0.00	0.07	0.10	0.10	0.00	0.00
2005	0.00	21	0.00	0.00	0.07	0.10	0.11	0.00	0.00
2010	0.00	16	0.00	0.00	0.00	0.00	0.01	0.00	0.00
2015	0.00	15	0.00	0.00	0.05	0.05	0.05	0.00	0.00
2020	0.00	8.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2021	0.00	7.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2022	0.00	7.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2023	0.00	7.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>2024</b>	<b>0.00</b>	<b>7.3</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
1990-2024 <sup>1)</sup>	0.00	-40.5	0.00	-0.01	-0.11	-0.18	-0.56	0.00	0.00
1990-2024 <sup>2)</sup>		-85%		-96%	-99%	-99%	-100%		
% 2024 <sup>3)</sup>	0%	3%	0%	0%	0%	0%	0%	0%	0%

Table 3.30 Overview of trends in emissions in sector 1B Fugitive emissions  
(continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.01</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
1995	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2005	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00
2010	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
2015	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
2020	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
2021	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>2024</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
1990-2024 <sup>1)</sup>	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
1990-2024 <sup>2)</sup>					-100%						
% 2024 <sup>3)</sup>	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%

1. Absolute difference

2. Relative difference compared to 1990 in %

3. % of national total 2024

### 3.5.4 Activity data and (implied) emission factors

Emissions from source category 1B2aiv are available from environmental reports. Activity data for categories 1B2av and 1B2b is available from Statistics Netherlands.

### 3.5.5 Methodological issues

Fugitive NMVOC emissions from source category 1B2aiv comprise process emissions from oil refining and storage. The emissions are derived from the companies' e-AERs (electronic Annual Environmental Reports), in which the companies report their annual emissions (Tier 3 methodology). The reported emission data is based on both measurements and calculations and is checked by the competent authority. They include emissions from venting and flaring by refineries. The companies report emissions per fuel type (including the amount of fuel), and process emissions (without any activity data). Emissions reported with fuel are assumed to be combustion emissions and are included in 1A1b. while emissions reported without fuel are assumed to be fugitive emissions and are reported in 1B2aiv. When this results in zero emissions in source category 1B2aiv, the notation key 'IE' (Included Elsewhere) is used.

Flaring emissions are sometimes reported with fuel (and allocated to 1A1b), and sometimes without fuel (and allocated to 1B2aiv).

Fugitive NMVOC emissions from category 1B2av comprise dissipation losses from gasoline service stations, leakage losses during vehicle and aircraft refuelling and refinery process losses:

- Emissions from gasoline service stations are based on the amount of fuel used for road transportation (as reported by Statistics Netherlands: <https://opendata.cbs.nl/#/CBS/en/dataset/84596ENG/table?dl=C F235>) combined with country-specific EFs. A detailed description of the methodology is available in Chapters 24 and 27 of the WESP methodology report (Visschedijk et al., 2026).
- Emissions from aircraft refuelling are based on the total quantity of jet fuel tanked, with an EF that is based on the environmental report by the company that handles all aircraft fuelling and fuel handling at Amsterdam Airport Schiphol. A detailed description of the methodology is available in the Transport methodology report (Witt et al., 2026a).
- Emissions from refinery processes are based on environmental reports from individual companies. The companies report emissions per fuel type (including the amount of fuel) and process emissions (without any activity data). The process emissions have been allocated to 1B2av. For the years when the company in question did not submit an environmental report, a supplemental emission estimate has been made.

Fugitive NMVOC emissions from category 1B2b comprise emissions from oil and gas extraction (exploration, production, processing, flaring and venting), gas transmission (all emissions including storage) and gas distribution networks (pipelines for local transport):

- Emissions from the extraction of oil and gas are reported by operators in their e-AER (Tier 3 methodology).
- NMVOC emissions from gas transmission were derived from data in the annual reports by the gas transmission company Gasunie (Tier 3 methodology).
- NMVOC emissions from gas distribution were calculated on the basis of an NMVOC profile with CH<sub>4</sub> emissions from annual reports by the distribution sector as input (Tier 2 methodology).

Detailed information on activity data and emissions can be found in Honig et al. (2026).

Emissions from venting and flaring are not included in 1B2c, because it is not possible to separate the venting and flaring emissions from the company emission data. Instead, the emissions are included in 1B2aiv (venting and flaring in refineries) and in 1B2b (venting and flaring from oil and gas extraction). The notation key 'IE' (Included Elsewhere) is used in source category 1B2c.

Oil and Gas extraction companies report the emission data in their e-AERs on the basis of a covenant (NOGEPA, 2012). Under the covenant, there are no reporting thresholds, and the operators report aggregated totals for all emissions except for greenhouse gas emissions, for which an obligation to report venting, flaring, combustion and process separately is agreed on. Emissions of PM<sub>2.5</sub>, heavy metals and POPs are not estimated because the amount is expected to be a negligible part of

the total NL emissions. Further information on operators' reports on the emissions to air can be found in a guideline (NOGEPa, 2018).

Other fugitive emissions from category 1B2d are not estimated. Whilst the EMEP/EEA (2019) Guidebook provides Tier 1 EFs for geothermal power emissions, these are not applicable, because the geothermal power projects in the Netherlands are not combined with electricity production.

**3.5.6** *Uncertainties and time series consistency*  
Uncertainties are explained in Section 1.5.

**3.5.7** *Source-specific QA/QC and verification*  
General QA/QC is explained in Section 1.3.7.

**3.5.8** *Source-specific recalculations*  
Emissions from gasoline service stations (reported in 1B2av) have been recalculated. The activity data for this sector (the amount of fuel used for road transportation) has been corrected for the years 2015-2023, and is consistent to the fuel consumption in the energy statistics (as reported by Statistics Netherlands: <https://opendata.cbs.nl/#/CBS/en/dataset/84596ENG/table?dl=CF235>). See Table 3.31 for the resulting change in NMVOC emissions.

*Table 3.31 Change in NMVOC emission for 1B2av (in tonne)*

<b>Pollutant</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>
NMVOC	26.0	26.0	31.2	32.3	41.2	28.2	29.0	31.5	40.8

**3.5.9** *Source-specific planned improvements*  
There are no source-specific planned improvements.



## 4 Transport

### 4.1 Overview of the sector

The Transport sector is a major contributor to emissions of NO<sub>x</sub>, NMVOC, CO, TSP, PM<sub>10</sub> and PM<sub>2.5</sub>. Transport emissions of most substances have decreased throughout the time series (see Figure 4.1), mainly due to the introduction of increasingly stringent European emission standards for new road vehicles.

The Transport sector (1A3) comprises the following subcategories:

- Civil aviation (1A3a);
- Road transport (1A3b);
- Railways (1A3c);
- Waterborne navigation (1A3d);
- Pipeline transport (1A3ei).

This chapter also covers emissions from non-road mobile machinery (NRMM), recreational craft and national fishing of which emissions are reported in other sectors.

Table 4.1 provides an overview of the source categories within the Transport sector and other transport-related source categories and the methodologies used for calculating emissions within the sector. For the first four source categories, national activity data and (mostly) country-specific EFs were used. Emissions from Civil aviation and Waterborne navigation were based on data about fuel consumption (fuel used), whereas emissions from Railways and Road transport were calculated using fuel sales data (fuel sold).

Table 4.1 Source categories and methods for 1A3 Transport and for other transport-related source categories

NFR code	Source category description	Method	AD	EF	Basis
1A3a	Civil aviation	Tier 3	NS	CS	Fuel used
1A3b	Road transport	Tier 3	NS	CS	Fuel sold
1A3c	Railways	Tier 2	NS	CS	Fuel sold
1A3d	Waterborne navigation	Tier 3	NS	CS	Fuel used
1A2gvii	Mobile combustion in manufacturing industries and construction	Tier 3	NS	CS	Fuel used
1A4aai	Commercial/Institutional: Mobile	Tier 3	NS	CS	Fuel used
1A4bii	Residential: Household and gardening (mobile)	Tier 3	NS	CS	Fuel used
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Tier 3	NS	CS	Fuel used
1A4ciii	National fishing	Tier 3	NS	CS	Fuel sold
1A5b	Other, mobile (including military, land-based and recreational boats)	Tier 3	NS	CS	Fuel used

AD = Activity data; EF = Emission Factor; NS = National Statistics; CS = Country-specific

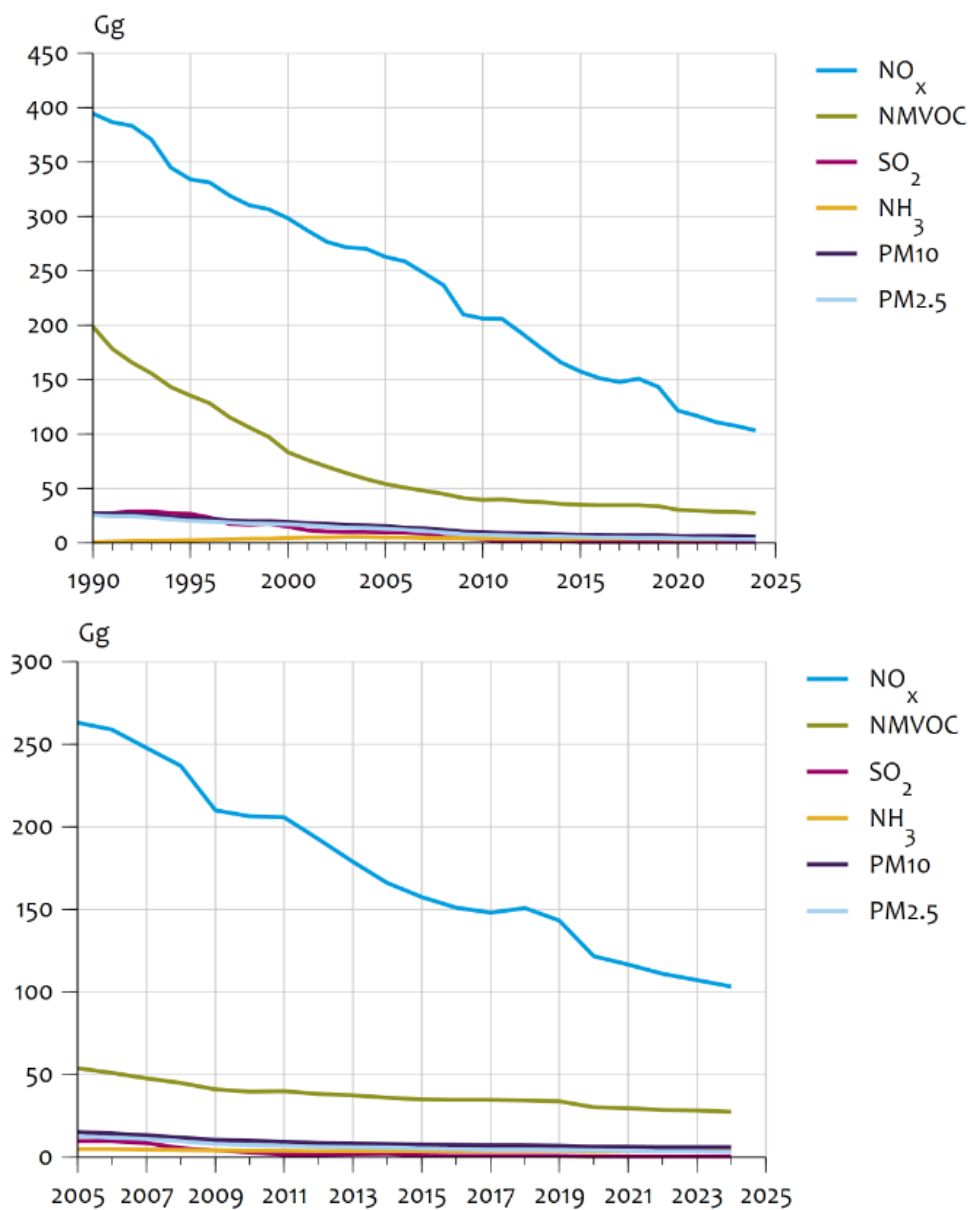
For the main pollutants, the Netherlands reports both fuel-sold and fuel-used emissions. The difference between fuel-used and fuel-sold emissions is described in Section 4.3.4.

Emissions from NRMM are reported in several source categories within the inventory (i.e. 1A2gvii, 1A4aai, 1A4bii, 1A4cii), as shown in Table 4.1. Emissions from NRMM were calculated using a Tier 3 methodology based on fuel used, comprising both national activity data and a combination of country-specific and default EFs. Emissions from recreational craft and vehicles operating at airports are reported under 1A5b (Other, mobile) and were calculated using Tier 3 and Tier 2 methodology, respectively. Emissions from fisheries are reported under 1A4ciii National fishing; they were calculated using a Tier 3 methodology. Notation key 'IE' is used for sector 1A3ei pipeline transport, these emissions are calculated in the energy sector.

This chapter describes shares and trends in emissions for the various source categories within the Transport sector. The methodologies used for emission calculations are also described briefly. A detailed description of these methodologies is provided in Witt et al. (2026a), supplemented by tables with detailed emission and activity data, and the EFs used in the emission calculations (Witt et al., 2026b).

Figure 4.1 shows the trend in the emissions of the main pollutants from the Transport sector between 1990-2024 and 2005-2024.

Figure 4.1 Emission trends for the main pollutants for the total of all transport source categories in NFR 1 between 1990-2024 (upper panel) and 2005-2024 (lower panel)



The figures show a large decrease for all major pollutants. For NMVOC the main reduction was between 1990-2005, with a total reduction of a factor 4 to 50 kton in 2005. In the past 20 years the emissions have decreased steadily to about 25 kton in 2024. NO<sub>x</sub> emissions have decreased through the whole time series, starting at over 250 kton in 1990 until 100 kton in 2024. This is mainly caused by the introduction of new and more stringent emission limits for different source categories.

In 2024, 57% of total NO<sub>x</sub>, 24% of total PM<sub>2.5</sub>, 23% of total PM<sub>10</sub>, 12% of total NMVOC, 4% of total SO<sub>x</sub> and 3% of total NH<sub>3</sub> emissions in the Netherlands originated from the Transport sector (Figure 2.1).

#### 4.1.1

##### *Key sources*

The source categories within the Transport sector are key sources of various pollutants, as presented in Table 4.2. The percentages in Table 4.2 relate to the 2024 **level** assessment and the 1990–2024 **trend** assessment (marked with \*). The full results of the Approach 1 key source analysis are presented in Appendix 2.

Table 4.2 Key source analysis for the Transport sector

NFR code	Source category description	SO <sub>x</sub>	NO <sub>x</sub>	NH <sub>3</sub>	NMVO C	CO	PM <sub>10</sub>	PM <sub>2.5</sub>	BC	Pb	Cd	Hg
1A3a(ii)	Domestic aviation LTO (civil)		1							16.3%		
1A3bi	Passenger cars		9.6%		3.9%	30.9%	9.0%*	1	1	11.1%	18.3%	16.7%
			24.7%*		18.7%*	55.9%*		12.3%*	20.4%*	69.3%*		
1A3bii	Light duty vehicles		4.9%			5.1%*	6.1%*	8.4%*	4.9%			
									16.3%*			
1A3biii	Heavy duty vehicles and buses	5.1%*	12.3%		1.9%			1.9%	6.1%			
			21.3%*		2.6%*		12.5%*	17.1%*	31.1%*			
1A3biv	Mopeds and motorcycles					4.5%						
1A3bv	Gasoline evaporation				7.0%*							
1A3bvi	Automobile tyre and brake wear						6.1%	2.1%		7.4%		
1A3bvii	Automobile road abrasion						5.1%					
1A3c	Railways									7.4%		
1A3di(ii)	International inland waterways		5.9%					2.5%	7.1%			
1A3dii	National navigation (shipping)		4.0%					2.2%	6.2%			
1A2gvii	Mobile Combustion in manufacturing industries and construction		6.4%				1.6%	2.8%	9.0%			
			3.3%* <sup>2</sup>				3.9%*	5.1%*	9.5%*			
1A4a(ii)	Commercial/institutional: mobile					3.9%		1.6% <sup>2</sup>	4.9% <sup>2</sup>			
1A4b(ii)	Residential: household and gardening (mobile)					5.2% <sup>2</sup>						
1A4cii	Agriculture/forestry/fishing: off-road vehicles and other machinery		4.4%			6.2% <sup>2</sup>	1.9% <sup>2</sup>	3.4%	10.7%			
							2.1%* <sup>2</sup>		4.9%*			
1A4ciii	Agriculture/forestry/fishing: National fishing		2.7%									
			3.2%*									
1A5b	Other, Mobile (including military, land based and recreational boats)					3.0%		1.6%	4.1%			

Percentages are from the 2024 level contribution calculation, percentages marked with \* are from the 1990-2024 trend contribution calculation

1. No longer a key source 2. New key source

## 4.2 Civil aviation

### 4.2.1 *Source category description*

The source category Civil aviation (1A3a) includes emissions from all landing and take-off (LTO) cycles of domestic and international civil flights in the Netherlands (i.e. emissions occurring up to an altitude of 3000 feet). This includes emissions from both scheduled and charter flights, passenger and freight transport, aircraft taxiing and general aviation (non-commercial). Emissions from helicopters are also included. Emissions from civil aviation result from the combustion of jet fuel (jet kerosene) and aviation gasoline (avgas) and from wear on tyres and brakes. They also include emissions from auxiliary power units (APU) on board of large aircraft. All Dutch airports are included in the calculations. Most civil aviation in the Netherlands is based on Amsterdam Airport Schiphol, which is by far the largest airport in the country. But some regional airports have grown quite considerably since 2005.

The source category Civil aviation does not include emissions from ground support equipment (GSE) at airports. This equipment is classified as mobile machinery, and the resulting emissions are reported under source category Other, mobile (1A5b). Emissions from the storage and transfer of jet fuel are reported under source category Fugitive emissions oil: Refining/storage (1B2aiv).

Cruise emissions from domestic and international aviation (i.e. emissions occurring above 3000 feet) are calculated and reported as memo items as they are not part of the national emission totals.

Due to the small size of the country, there is hardly any commercial domestic aviation in the Netherlands. The split of LTO-related fuel consumption and the resulting emissions between domestic and international aviation was made using flight statistics per airport. Emissions from fuel storage, tyre and brake wear, and auxiliary power units are all reported under International aviation (1A3i) in the NFR and do not distinguish between domestic and international aviation. Condensables are included in PM<sub>10</sub> and PM<sub>2.5</sub> emissions.

The notation key 'NE' is used for NH<sub>3</sub> and Hg. For Domestic aviation (1A3a(ii)) NE is also used for Cd and additional heavy metals. HCB and PCBs are indicated as 'NA', following the 2019 EMEP/EEA Guidebook. NH<sub>3</sub> emissions from Civil aviation are not estimated due to lack of EFs. Emissions are expected to be negligible.

### 4.2.2 *Key sources*

Domestic aviation (1A3a(ii)) is a 2024 level key source of Pb in the emissions inventory.

### 4.2.3 *Overview of shares and trends in emissions*

Fuel consumption in civil aviation, including fuel use for auxiliary power units, almost tripled between 1990 and 2019, increasing from 4.5 to 12.4 PJ. Amsterdam Airport Schiphol is responsible for over 90% of total fuel consumption in civil aviation in the Netherlands (specific activity data and IEFs for Amsterdam Airport Schiphol and for regional airports are provided in Witt et al. (2026a and 2026b)). Fuel consumption (LTO) at

Amsterdam Airport Schiphol more than doubled between 1990 and 2008. After a 9% decrease in 2009 due to the financial crisis, fuel consumption increased again in 2010 and 2011 and was approximately at pre-crisis levels in 2011. Since 2012, fuel consumption of LTO in civil aviation has continued to increase by an average of 0.3 PJ per year. Due to the COVID-19 pandemic, fuel consumption halved to 6.2 PJ in 2020. It increased again to 7.0 PJ in 2021, 10.0 PJ in 2022 and was almost at pre-COVID levels with 11.6 PJ in 2024.

The trends in emissions from civil aviation in the Netherlands are presented in Table 4.3. The increase in air transport and related fuel consumption has resulted in an increase in the emissions of NO<sub>x</sub>, SO<sub>x</sub>, TSP, PM<sub>10</sub> and PM<sub>2.5</sub> and CO. While for most other pollutants fleet average EFs decreased throughout the time series, fleet average NO<sub>x</sub> EFs increased by about 13% - 25% (see Table 8.4 in Witt et al. (2026b)). As a result, NO<sub>x</sub> emissions more than tripled between 1990 and 2019. PM<sub>10</sub> emissions from civil aviation have also increased throughout the period. This increase was due to the significant increase in tyre and brake wear emissions, which increased in line with the increase in the maximum permissible take-off weight (MTOW) of aircraft (which is used to estimate wear emissions). Fleet average PM<sub>10</sub> exhaust EFs (per unit of fuel) have decreased since 1990. As a result, the relative contribution of wear emissions to total PM<sub>10</sub> emissions from civil aviation has increased. Emissions in 2020–2022 were substantially lower than in 2019 due to the COVID-19 pandemic. In 2023 and especially 2024, emissions of most pollutants are again getting closer to pre-COVID levels.

The PM<sub>2.5</sub>/PM<sub>10</sub> ratio for brake and tyre wear emissions from civil aviation is assumed to be 0.2 and 0.15, respectively, whereas the ratio for exhaust emissions is assumed to be 1 (PM<sub>2.5</sub> ≈ PM<sub>10</sub>). Consequently, the relative contribution of wear emissions to PM<sub>2.5</sub> emissions is smaller than its contribution to PM<sub>10</sub> emissions. This also means that the trend in total PM<sub>2.5</sub> emissions from civil aviation has been influenced more heavily by the trend in the fleet average EF for the exhaust emissions, leading to a more modest increase in PM<sub>2.5</sub> emissions compared to PM<sub>10</sub> over the time-series.

Aviation gasoline (avgas) still contains lead, whereas petrol for other transport purposes has been unleaded for quite some time. With lead emissions from other source categories decreasing substantially, the relative share that civil aviation contributed to lead emissions in the Netherlands has increased substantially.

#### 4.2.4 *Activity data and (implied) emission factors*

The exhaust emissions of CO, NMVOC, NO<sub>x</sub>, PM, SO<sub>x</sub> and heavy metals from civil aviation LTO in the Netherlands were calculated using a flight-based Tier 3 methodology. Specific data was used for the number of aircraft movements per aircraft type and per airport, which were derived from the airports and from Statistics Netherlands. This data was used in the CLEO model (Dellaert & Hulskotte, 2017) to calculate fuel consumption and resulting emissions from aviation. The CLEO model was modelled after the method that the US Environmental Protection Agency (EPA) uses to calculate aircraft emissions. The EFs used in CLEO were mostly adapted from the ICAO Engine Emissions DataBank. A

detailed description of the methodology can be found in Chapter 8 of Witt et al. (2026a).

Table 4.3 Trends in emissions from 1A3a Civil aviation

Year	Main Pollutants				Particulate Matter				Other	HM
	NO <sub>x</sub>	NMVOG	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO	Pb
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Mg
<b>1990</b>	<b>1.2</b>	<b>0.40</b>	<b>0.10</b>	<b>0.00</b>	<b>0.03</b>	<b>0.03</b>	<b>0.03</b>	<b>0.01</b>	<b>3.6</b>	<b>1.9</b>
1995	1.8	0.36	0.14	0.00	0.03	0.04	0.04	0.01	4.1	2.0
2000	2.3	0.31	0.19	0.00	0.04	0.04	0.04	0.02	4.0	1.6
2005	2.8	0.39	0.24	0.00	0.04	0.05	0.05	0.02	4.3	1.2
2010	2.8	0.37	0.23	0.00	0.04	0.05	0.05	0.02	4.3	1.3
2015	3.3	0.40	0.25	0.00	0.03	0.04	0.04	0.01	4.1	0.8
2020	2.1	0.22	0.14	0.00	0.02	0.02	0.02	0.01	2.5	0.7
2021	2.4	0.24	0.16	0.00	0.02	0.03	0.03	0.01	2.8	0.8
2022	3.2	0.33	0.23	0.00	0.03	0.04	0.04	0.01	3.8	0.9
2023	3.5	0.35	0.25	0.00	0.03	0.04	0.04	0.01	3.9	0.8
<b>2024</b>	<b>3.7</b>	<b>0.39</b>	<b>0.27</b>	<b>0.00</b>	<b>0.03</b>	<b>0.04</b>	<b>0.04</b>	<b>0.01</b>	<b>4.4</b>	<b>0.8</b>
1990-2024 <sup>1)</sup>	2.5	-0.02	0.17	0.00	0.01	0.01	0.01	0.00	0.8	-1.1
1990-2024 <sup>2)</sup>	203%	-4%	163%		21%	42%	42%	-15%	23%	-57%
% 2024 <sup>3)</sup>	2%	0%	2%	0%	0%	0%	0%	0%	1%	18%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

#### 4.2.5 Methodological issues

Due to the small size of the country, there is hardly any domestic aviation in the Netherlands, with the exception of general aviation (non-commercial air transport). Therefore, the split of fuel consumption and resulting emissions into domestic and international aviation was not made for the emissions from brake and tyre wear, APUs and fuel storage and fuelling. All fuel consumption and emissions from these sources are reported under International aviation (1A3i).

The Dutch PRTR does not currently have suitable activity data available to calculate aviation cruise emissions. For this reason, the emission data as provided annually by Eurocontrol is used. For domestic aviation, the data provided by Eurocontrol is not complete, as it does not include flights that did not submit a flight plan (which is more common for domestic flights over the Netherlands). This is why domestic cruise emissions are estimated on the basis of the domestic LTO emissions (as calculated using the CLEO model). Year- and pollutant-specific LTO phase/cruise phase emission ratios are then derived from the Eurocontrol data and applied to the LTO emissions to estimate total emissions (LTO + cruise).

#### 4.2.6 *Uncertainties and time series consistency*

Consistent methodologies have been used throughout the time series. In 2016, an experts' workshop was conducted to discuss and estimate the uncertainties in the activity data and EFs used for the emission calculations for the Transport sector (Dellaert & Dröge, 2017). The resulting uncertainty estimates for civil aviation are provided in Table 4.4.

Table 4.4 *Uncertainty estimates for civil aviation (%)*

Type	Fuel	Activity data	Emission factor						
			NO <sub>x</sub>	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	EC <sub>2.5</sub>	NMVOG
LTO	Jet kerosene	10	35	50		200	200	200	200
LTO	Aviation gasoline	35	100	50		100	100	100	500
APU	Jet kerosene	50	50	50		100	100	100	200
Fuelling and fuel handling		20							100
GSE	Diesel	10	50	20	200	100	100	100	
Tyre wear		10					100		
Brake wear		10					100		

Source: Dellaert & Dröge (2017), updated in 2019 by PRTR

#### 4.2.7 *Source-specific QA/QC and verification*

Every year, Eurocontrol performs a calculation of aviation emissions for each of their member countries, using the Eurocontrol FEIS (Fuel burn and emission inventory system) model (Eurocontrol, 2022). For CO<sub>2</sub> and NO<sub>x</sub>, there is a fairly good agreement between the two models (see Table 4.5, a value above 100% means the Dutch national inventory is higher than the value calculated by Eurocontrol). For emissions of CO and NMVOG, the difference is largest for domestic aviation. This can be explained by the incomplete coverage of the Eurocontrol data (i.e. not including flights without a flight plan) and the larger contribution from smaller piston engine aircraft – involving more uncertainty and limited availability of engine-specific emission factors.

Table 4.5 *Aviation emissions (LTO domestic + LTO international) compared to the Eurocontrol FEIS model*

Pollutant	2018	2019	2020	2021	2022	2023	2024
CO	201%	198%	256%	235%	219%	207%	209%
CO <sub>2</sub>	111%	111%	119%	113%	112%	110%	113%
N <sub>2</sub> O	115%	115%	122%	116%	116%	113%	117%
NMVOG	160%	159%	205%	189%	182%	183%	189%
NO <sub>x</sub>	101%	102%	107%	104%	103%	102%	103%
PM <sub>2.5</sub>	102%	101%	117%	114%	107%	102%	106%
SO <sub>x</sub>	134%	134%	142%	135%	135%	132%	136%

#### 4.2.8 *Source-specific recalculations*

In the calculation of civil aviation LTO emissions, there have been recalculations following minor corrections in aircraft – engine pairings and updating engine emission factors to the latest ICAO EEDB (v.31).

Furthermore, HC emissions from engine start are now calculated for turbofan engines using the methodology described in ICAO (2020) and included with the LTO emissions.

#### 4.2.9 *Source-specific planned improvements*

There are no source-specific planned improvements for civil aviation.

### 4.3 **Road transport**

#### 4.3.1 *Source category description*

The source category Road transport (1A3b) comprises emissions from road transport in the Netherlands, including emissions from passenger cars (1A3bi), light-duty vehicles (1A3bii), heavy-duty vehicles and buses (1A3biii), and mopeds and motorcycles (1A3biv). It also includes evaporative emissions from road vehicles (1A3bv), PM emissions from tyre and brake wear (1A3bvi), and emissions from road abrasion (1A3bvii). PM emissions caused by the resuspension of previously deposited material are not included. Condensables are included in PM<sub>10</sub> and PM<sub>2.5</sub> emissions.

The notation key 'NA' is used for BC emissions from tyre and brake wear (1A3bvi). Although both brake and tyre wear emissions are optically dark and will show up in light absorption measurements (as used for Black Carbon), they contain little to no elemental carbon in the small particles. With Black Carbon set equal to Elemental Carbon in the inventory, the Netherlands uses the better defined Elemental Carbon standard (EUSAAR protocol (Cavalli & Puteaud, 2008)). Consequently, non-exhaust emissions are no source of Black Carbon (i.e. Elemental Carbon).

The notation key 'NE' is used for HCB emissions. 'NA' is used for PCB emissions in the NFR tables. Although the EMEP/EEA Guidebook provides emission factors for these pollutants, they do not reflect development over time. The usage of PCBs in lubrication oil has been prohibited since 1985 and the usage of chlorine-containing scavengers in motor fuels has been discontinued, following the ban on leaded fuels, in 2000. For this reason, emissions of PCB are decreasing constantly and are considered negligible.

Historically, emissions from road transport in the Netherlands have been calculated and reported on the basis of the number of vehicle kilometres driven per vehicle type. The resulting emission totals are referred to as *fuel-used* (FU) emissions, since they correspond to the amount of fuel used by road transport on Dutch territory. Starting with the IIR 2017, reported emissions from road transport have been based on *fuel sold* (for the entire time series) in accordance with UNECE guidelines. Fuel-used emissions are still reported as a memo item in the NFR, per source category.

### 4.3.2 Key sources

The various source categories within Road transport are key sources of many substances in both the 1990–2024 trend assessment and the 1990 and 2024 level assessments, as presented in Table 4.6.

Table 4.6 Key source analysis for road transport sub-categories

Source category	Name	1990 level	2024 level	1990–2024 trend
1A3bi	Passenger cars	NO <sub>x</sub> , NMVOC, CO, PM <sub>10</sub> , PM <sub>2.5</sub> , BC, Pb <sup>1</sup> , PAH	NO <sub>x</sub> , NMVOC, CO, Pb <sup>1</sup> , Cd <sup>1</sup> , Hg <sup>1</sup>	NO <sub>x</sub> , NMVOC, CO, PM <sub>10</sub> , PM <sub>2.5</sub> , BC, Pb <sup>1</sup> , PAH
1A3bii	Light-duty vehicles	NO <sub>x</sub> , CO, PM <sub>10</sub> , PM <sub>2.5</sub> , BC	NO <sub>x</sub> , BC	CO, PM <sub>10</sub> , PM <sub>2.5</sub> , BC
1A3biii	Heavy-duty vehicles and buses	SO <sub>x</sub> , NO <sub>x</sub> , NMVOC, PM <sub>10</sub> , PM <sub>2.5</sub> , BC	NO <sub>x</sub> , NMVOC, PM <sub>2.5</sub> , BC	SO <sub>x</sub> , NO <sub>x</sub> , NMVOC, PM <sub>10</sub> , PM <sub>2.5</sub> , BC, PAH
1A3biv	Mopeds and motorcycles		CO	
1A3bv	Gasoline evaporation	NMVOC		NMVOC
1A3bvi	Tyre and brake wear		PM <sub>10</sub> , PM <sub>2.5</sub> , Pb <sup>1</sup> , Cu <sup>1</sup>	Cu <sup>1</sup>
1A3bvii	Road abrasion		PM <sub>10</sub>	

1. Based on fuel used

### 4.3.3 Overview of shares and trends in emissions

Road transport is a major contributor to air pollutant emissions in the Netherlands. Taken together, the various source categories within Road transport accounted for 27% of NO<sub>x</sub> emissions (national totals), 14% of PM<sub>10</sub>, 8% of PM<sub>2.5</sub>, 15% of BC, 8% of NMVOC and 38% of CO emissions in 2024.

The trends in emissions from road transport are presented in Table 4.7. Emissions of the main pollutants and particulate matter decreased significantly throughout the time series with the exception of NH<sub>3</sub>. This decrease in emissions can mainly be attributed to the introduction of increasingly stringent European emission standards for new road vehicles. Even though emission totals decreased throughout the time series, the share that Road transport contributed to the national emission totals for NO<sub>x</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> decreased only slightly between 1990 and 2024, as emissions in other sectors decreased as well. Therefore, Road transport is still a major source of pollutant emissions in the Netherlands.

Table 4.7 Trends in emissions from 1A3b Road transport

Year	Main Pollutants				Particulate Matter				Other	HM
	NO <sub>x</sub>	NMVOG	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO	Pb
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Mg
<b>1990</b>	<b>292</b>	<b>176</b>	<b>16</b>	<b>0.94</b>	<b>18</b>	<b>19</b>	<b>19</b>	<b>8.5</b>	<b>695</b>	<b>246</b>
1995	232	114	15	2.4	13	15	15	6.7	512	80
2000	192	63	3.6	4.4	9.8	12	12	5.8	389	0.78
2005	171	37	0.25	5.0	7.0	9.0	9.0	4.4	367	0.84
2010	128	26	0.21	3.9	3.4	5.5	5.5	2.0	312	0.84
2015	84	23	0.17	3.5	1.9	4.1	4.1	0.91	234	0.85
2020	59	19	0.16	3.3	1.3	3.4	3.4	0.49	181	0.86
2021	57	19	0.16	3.3	1.3	3.5	3.5	0.44	170	0.90
2022	53	18	0.16	3.3	1.2	3.5	3.5	0.40	158	0.94
2023	52	19	0.17	3.6	1.2	3.6	3.6	0.37	160	0.95
<b>2024</b>	<b>49</b>	<b>18</b>	<b>0.16</b>	<b>3.6</b>	<b>1.2</b>	<b>3.6</b>	<b>3.6</b>	<b>0.33</b>	<b>150</b>	<b>0.96</b>
1990-2024 <sup>1)</sup>	-243	-158	-15.7	2.7	-16.4	-15.7	-15.7	-8.1	-545	-245
1990-2024 <sup>2)</sup>	-83%	-90%	-99%	286%	-93%	-81%	-81%	-96%	-78%	-100%
% 2024 <sup>3)</sup>	27%	8%	1%	3%	8%	14%	12%	15%	38%	21%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

Between 1990 and 2024, emissions of SO<sub>x</sub> decreased by 99%, due to increasingly stringent EU fuel quality standards regulating the maximum allowable sulphur content of fuels used in (road) transport. Currently, all road transport fuels are 'sulphur free' (sulphur content <10 parts per million).

Emissions of NH<sub>3</sub> by road transport increased significantly between 1990 and 2005 due to the introduction and subsequent market penetration of the three-way catalyst for petrol-driven passenger cars. Since 2005, NH<sub>3</sub> emissions from road transport have decreased until 2020. Since 2020 the introduction of the SCR (Selective Catalytic Reduction) system for diesel vehicles has caused NH<sub>3</sub> emissions to increase slightly. Despite the increase in emissions since 1990, road transport is only a minor source of NH<sub>3</sub> emissions in the Netherlands, with a share of 3.2% in national emission totals in 2024.

Emissions of heavy metals have increased, except for Pb. Those emissions decreased significantly with the introduction of unleaded petrol.

### **Passenger cars (1A3bi)**

The number of kilometres driven by passenger cars in the Netherlands steadily increased from approximately 82 billion km in 1990 to 109 billion km in 2018 (see Figure 4.2). Due to the COVID-19 pandemic it fell to 92 billion in 2020, from 2021 it steadily increased to 110 billion in 2024, reaching the pre-pandemic level.

Since 1995, the share of diesel-powered passenger cars in the Dutch car fleet has grown significantly, resulting in an increase in diesel mileage by 95% between 1990 and 2012. Since 2017, the diesel mileage of passenger cars has been decreasing from 32 billion kilometres in 2017 to 13 billion in 2024. Petrol mileage increased by 34% between 1990 and 2019. The share of LPG in the passenger car fleet decreased significantly, from 16% in 1990 to almost 1% in 2024. In 2020, the decrease in passenger vehicle kilometres due to the pandemic was relatively high for diesel cars (-28%) compared to petrol cars (-11%). Since 2018 full electric (FEV) and plug-in hybrid (PHEV) passenger cars have entered the fleet rapidly, accounting for 9% of total kilometres driven on electricity in 2024. Figure 4.2 makes clear that, even though the number of diesel kilometres increased significantly, petrol has always dominated passenger car transport. Throughout the time series, petrol was responsible for approximately two-thirds of the total number of kilometres driven by passenger cars. In recent years the decrease of diesel kilometres has increased the share of petrol kilometres to 78%.

NO<sub>x</sub> emissions from passenger cars decreased significantly throughout the time series, even though traffic volumes increased. This decrease can mainly be attributed to the introduction of the three-way catalyst (TWC), which led to a major decrease in NO<sub>x</sub> emissions from petrol-powered passenger cars. Between 1995 and 2007, NO<sub>x</sub> emissions from diesel-powered passenger cars increased by more than 60%. This increase resulted from the major increase in the kilometres driven by diesel cars combined with less stringent emission standards and the disappointing real-world NO<sub>x</sub> emission performance of diesel-powered passenger cars. Due to the decrease of NO<sub>x</sub> emissions from petrol-powered passenger cars, NO<sub>x</sub> has mostly become a diesel-related issue. Since 2007, NO<sub>x</sub> emissions from diesel cars have decreased with the introduction of SCR systems.

The introduction of the TWC for petrol-powered passenger cars also led to a major reduction in NMVOC and CO emissions. NMVOC exhaust emissions from petrol-powered passenger cars decreased by more than 80% throughout the time series, whereas CO emissions decreased by more than 60%. NMVOC and CO emissions from diesel- and LPG-powered passenger cars also decreased significantly, but both are minor sources of NMVOC and CO. In 2023, passenger cars were responsible for 3.9% of NMVOC emissions – not including evaporative NMVOC emissions (down from 16% in 1990) and 31% of CO emissions (down from 48% in 1990) in the Netherlands.

In 2024, Passenger cars (source category 1A3bi, including exhaust emissions only) were responsible for 1.6% of PM<sub>2.5</sub> emissions and 0.8% of PM<sub>10</sub> emissions in the Netherlands. PM<sub>10</sub> exhaust emissions from passenger cars decreased by more than 95% throughout the time series. Emissions from both petrol- and diesel-powered cars decreased significantly throughout the time series, due to increasingly stringent EU emission standards for new passenger cars. The continuing decrease of PM<sub>10</sub> and PM<sub>2.5</sub> exhaust emissions in recent years is primarily due to the increasing market penetration of diesel-powered passenger cars equipped with *diesel particulate filters* (DPF). DPFs are required to comply with the Euro 5 PM emission standard, which came into force by 2011. DPFs

entered the Dutch fleet much earlier, though, helped by a subsidy that was introduced by the Dutch government in 2005. In 2007, more than 60% of all new diesel-powered passenger cars were equipped with a DPF. In 2008, the share of new diesel passenger cars with a DPF exceeded 90%. PM<sub>2.5</sub> exhaust emissions from passenger cars (and other road transport) are assumed to be equal to PM<sub>10</sub> exhaust emissions.

Passenger cars are a key source of Cd emissions, as they are responsible for 18% of total national Cd emissions. Between 1990 and 2024, Cd emissions from passenger cars increased by 46% with the use of motor fuels and engine oil. NH<sub>3</sub> emissions from passenger cars increased significantly from 1990 to 2006, from 0.9 to 4.7 Gg, as a result of the introduction of the TWC. From 2007 onwards, emissions have started to decrease, from 4.4 Gg in 2007 to 2.9 Gg in 2024. The increase in vehicle kilometres driven since 2007 has been compensated by the introduction of newer generations of TWCs with lower NH<sub>3</sub> emissions per vehicle kilometre driven, resulting in a decrease of the fleet average NH<sub>3</sub> EF. Lead emissions from passenger cars decreased by more than 99% throughout the time series due to the phase-out of leaded petrol.

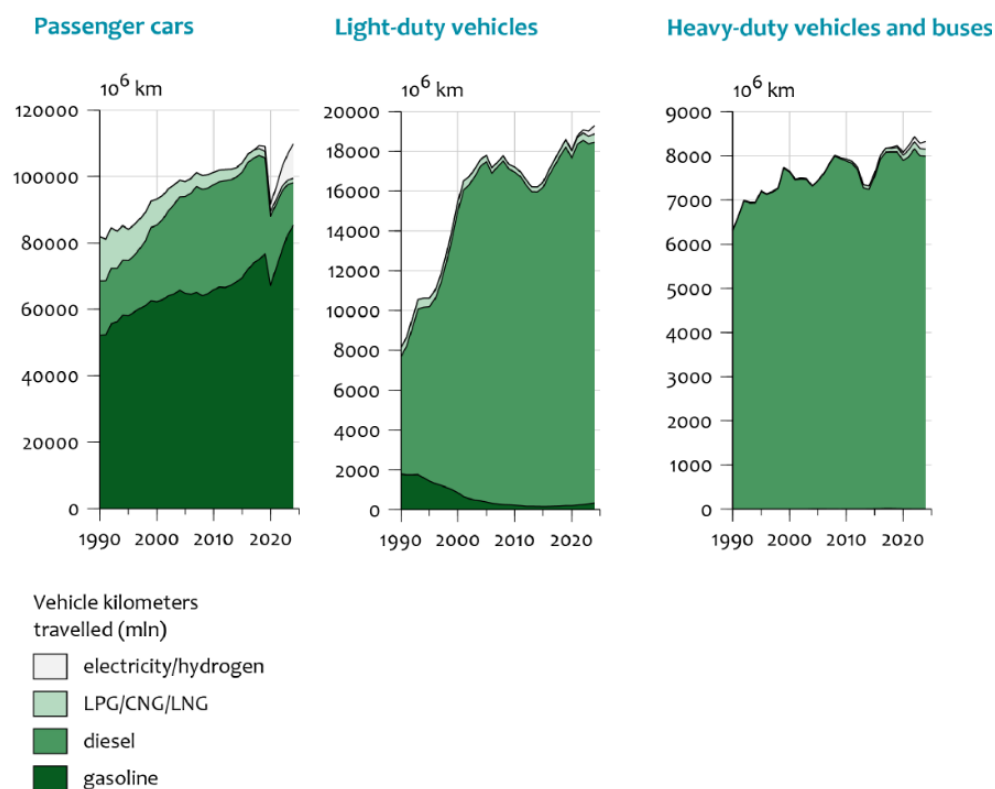
### ***Light-duty vehicles (1A3bii)***

Between 1990 and 2005, the light-duty truck (or light commercial vehicles) fleet in the Netherlands grew significantly, leading to a major increase in vehicle kilometres driven (see Figure 4.2). In 2005, private ownership of light-duty trucks became less attractive due to changes in the tax scheme. As a result, the size of the vehicle fleet has more or less stabilised since then. The number of vehicle kilometres driven varied between 17 and 18 billion between 2005 and 2011, decreasing somewhat in 2012 and 2013, and again increasing slightly after 2015. It is likely that the fluctuations in these years can mainly be attributed to the economic situation. The proportion of petrol-powered trucks in the fleet decreased steadily throughout the time series. Until recent years, diesel engines have dominated the light-duty truck market and were responsible for more than 98% of new-vehicle sales. In recent years electric vehicles have been introduced in the fleet, accounting for only 2% of the total kilometres driven but nearly 10% of the new sales in 2024. Still, nearly 95% of the fleet is diesel-powered. In 2022, following the corona pandemic, vehicle kilometres driven by light-duty trucks increased by 3% compared to 2021, and has since remained constant at nearly 19 billion kilometres.

In the 1990–2016 period, NO<sub>x</sub> emissions from light-duty trucks fluctuated between 17 and 22 Gg. Since 2016, the emissions have decreased to 10.3 Gg in 2023. In that year, the emissions were 46% lower than in 1990, even though the number of vehicle kilometres driven more than doubled during this period. The EU emission standards for light-duty trucks and the subsequent market penetration of light-duty diesel engines with lower NO<sub>x</sub> emissions caused a decrease in the fleet average NO<sub>x</sub> emissions per vehicle kilometre. However, because of the poor NO<sub>x</sub> emission performance of Euro 5 light-duty trucks, the fleet average NO<sub>x</sub> EF for diesel light-duty trucks has stabilised until 2018. After 2018, with the introduction of Euro 6 emission standards in combination with the RDE (Real Driving Emissions) test method, emissions have further decreased to just under 9 Gg in 2024.

Light-duty trucks are a minor source of both CO and NMVOC emissions, accounting for approximately 1.1% and 0.4% of the national totals for both substances in 2024, respectively. Exhaust emissions of NMVOC and CO from light-duty trucks decreased significantly throughout the time series. Increasingly stringent EU emission standards for both substances have led to a major (85–87%) decrease in the fleet average EFs for both petrol and diesel trucks between 1990 and 2024. Petrol-powered vehicles emit far more NMVOC and CO per kilometre than diesel-powered vehicles. As a result, the decrease in the number of petrol-driven vehicles has also contributed significantly to the decrease in NMVOC and CO emissions.

Figure 4.2 Kilometres driven per vehicle and fuel type in the Netherlands (source: Statistics Netherlands)



The exhaust emissions of  $PM_{10}$  and  $PM_{2.5}$  from light-duty trucks decreased throughout the time series. The fleet average  $PM_{10}$  EF decreased consistently throughout the time series, but this decrease was initially offset by the increase in vehicle kilometres driven. Diesel-powered vehicles are dominant in  $PM_{10}$  exhaust emissions, with a share of over 99%. The average  $PM_{10}$  exhaust EF for diesel-powered light-duty trucks has decreased significantly in recent years, due to the market penetration of diesel-powered light-duty trucks with DPFs. Even though the number of vehicle kilometres driven has stabilised since 2005,  $PM_{10}$  exhaust emissions decreased by 92% between 2005 and 2024.

#### **Heavy-duty vehicles and buses (1A3biii)**

Between 1990 and 2008, the number of vehicle kilometres driven by heavy-duty vehicles (rigid trucks, tractor-trailer combinations) and buses

in the Netherlands increased by approximately 30% (see Figure 4.2). Following a decrease during the financial crisis between 2008 and 2014, transport volumes increased again to pre-crisis levels. Diesel has dominated the heavy-duty vehicle and bus fleet, with a share of 99%. In recent years gas-powered (LNG/CNG) vehicles and electric vehicles have entered the fleet, both accounting for about 2% of kilometres driven in 2024.

NO<sub>x</sub> emissions from heavy-duty vehicles and buses decreased from 130 Gg in 1990 to 20 Gg in 2024. Emissions have decreased significantly in recent years, due to the decrease in vehicle kilometres between 2008 and 2014 (Figure 4.2) and the decrease in the fleet average NO<sub>x</sub> EF. The latter decreased significantly throughout the time series, mainly due to increasingly stringent EU emission standards for heavy-duty engines. With second-generation Euro-V trucks showing better NO<sub>x</sub> emission performance during real-world driving, the fleet average NO<sub>x</sub> EF for heavy-duty vehicles has decreased significantly since 2008. The current generation of Euro-VI trucks, which entered the market in 2013, is fitted with a combination of Exhaust Gas Recirculation (EGR) and a Selective Catalytic Reduction (SCR) system, resulting in very low real-world NO<sub>x</sub> emission levels (Kadijk et al., 2015).

NMVOC exhaust emissions decreased by around 73% throughout the time series while PM<sub>10</sub> and PM<sub>2.5</sub> exhaust emissions decreased by more than 95%. These decreases were also caused by changes to EU emission legislation. In the most recent year, heavy-duty vehicles and buses were only a minor source of NMVOC emissions.

Heavy-duty vehicles and buses are a minor source of NH<sub>3</sub> emissions in the Netherlands (0.5% of national totals). However, NH<sub>3</sub> emissions from heavy-duty vehicles and buses increased significantly between 2005 and 2023. This increase was caused by the rising use of SCR catalysts in heavy-duty trucks and buses. High SCR conversion rates may yield NH<sub>3</sub> slip, as described in detail by Stelwagen and Ligterink (2015). NH<sub>3</sub> EFs for Euro-V trucks and buses are approximately six times higher than EFs for previous Euro classes, as presented in Table 3.11 of Witt et al. (2026b). Emission factors for Euro-VI trucks and buses are estimated to be 30 times higher than those for previous Euro classes. Therefore, NH<sub>3</sub> emissions from heavy-duty vehicles and buses have increased tremendously due to the market introduction of Euro-VI vehicles. In 2024, emissions amounted to 0.6 Gg, up from 0.2 Gg in 2012.

### **Motorcycles and mopeds (1A3biv)**

Motorcycles and mopeds are a minor emission source in the Netherlands, being responsible for less than 1% of national totals for most substances. In 2024, motorcycles and mopeds were responsible for 0.9% of NMVOC emissions and 4.5% of CO emissions in the Netherlands. Even though the number of vehicle kilometres driven almost doubled between 1990 and 2024, exhaust emissions of NMVOC decreased significantly, due to increasingly stringent EU emission standards for two-wheelers. In 2024, the share of motorcycles and mopeds in NO<sub>x</sub> emissions in the Netherlands was still small, amounting to 0.3%, as was the share in PM<sub>2.5</sub> emissions, amounting to approximately 0.3%.

### **Petrol evaporation (1A3bv)**

Evaporative NMVOC emissions from road transport have decreased significantly, due to EU emission legislation for evaporative emissions and the subsequent introduction of carbon canisters for petrol-powered passenger cars. Total evaporative NMVOC emissions decreased by 95% throughout the time series. As a result, evaporative emissions are no longer a key source in the level assessment, accounting for <1% of total NMVOC emissions in the Netherlands in 2024 (down from 6% in 1990). Petrol-powered passenger cars are by far the largest source of evaporative NMVOC emissions from road transport in the Netherlands, although their share has decreased from more than 90% in 1990 to 63% in 2024. Motorcycles and mopeds were mainly responsible for the rest of evaporative NMVOC emissions; other road vehicles contributed below 3%.

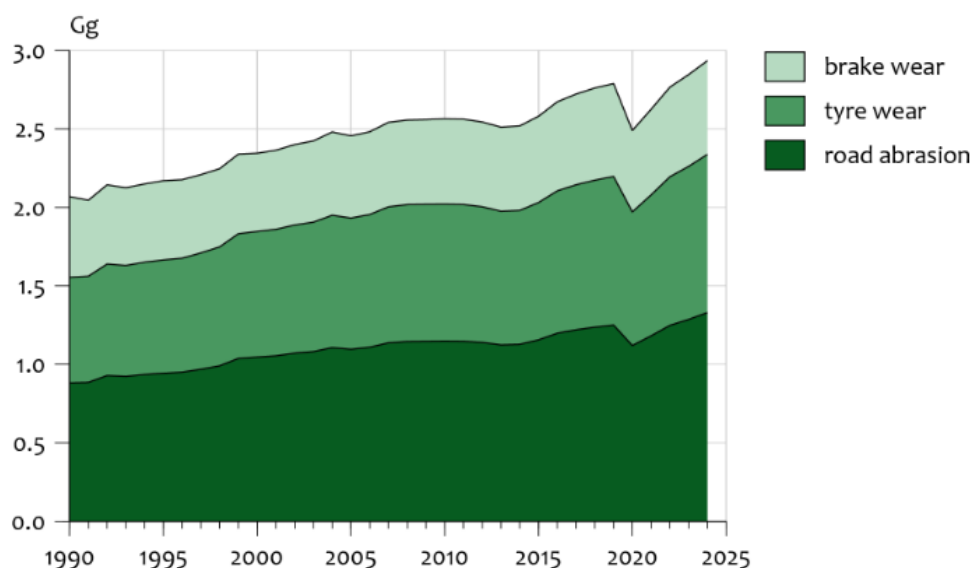
### **PM emissions from tyre and brake wear and road abrasion (1A3bvi and 1A3bvii)**

Vehicle tyre and brake wear (1A3bvi) and road abrasion (1A3bvii) were responsible for 6% and 5% of PM<sub>10</sub> emissions in the Netherlands in 2024, respectively. PM<sub>10</sub> emissions from brake wear, tyre wear and road abrasion increased throughout most of the time series, as presented in Figure 4.3, due to the increase in vehicle kilometres driven by light- and heavy-duty vehicles. PM<sub>10</sub> EFs increased slightly throughout the time series due to increasing vehicle masses.

PM<sub>2.5</sub> emissions were derived from PM<sub>10</sub> emissions using PM<sub>2.5</sub>/PM<sub>10</sub> ratios of 0.2 for tyre wear and 0.15 for both brake wear and road abrasion. Therefore, the trend in PM<sub>2.5</sub> wear emissions was similar to the trend in PM<sub>10</sub> emissions. The shares of tyre and brake wear (2%) and road abrasion (1%) in total PM<sub>2.5</sub> emissions in the Netherlands were smaller than their shares in total PM<sub>10</sub> emissions.

Figure 4.3 Emissions of PM<sub>10</sub> resulting from brake and tyre wear and road abrasion in Gg

#### **PM<sub>10</sub>**



#### 4.3.4 *Activity data and (implied) emission factors*

Emissions from road transport were calculated using a Tier 3 methodology. Exhaust emissions of CO, NMVOC, NO<sub>x</sub>, NH<sub>3</sub> and PM from road transport were calculated, using statistics on vehicle kilometres driven and EFs expressed in grams per vehicle kilometre (g/km). Emissions of SO<sub>x</sub> and heavy metals were calculated using fuel consumption estimates combined with the sulphur and heavy metal content of various fuel types, taking into account the tightening of the EU fuel quality standards regulating the maximum allowable sulphur and lead content of fuels used in road transport. The resulting emissions for CO, NMVOC, NO<sub>x</sub>, NH<sub>3</sub> and PM were subsequently corrected for differences between the fuel used and the fuel sold to derive fuel-sold emission totals from road transport.

##### **Activity data on vehicle kilometres driven**

The data on the number of vehicle kilometres driven in the Netherlands was derived from Statistics Netherlands. Statistics Netherlands calculates total vehicle kilometrage per vehicle type using data on:

- the size and composition of the Dutch vehicle fleet;
- the average annual kilometrage for various vehicle types; and
- the number of kilometres driven by foreign vehicles in the Netherlands.

Since 2018, a bottom-up methodology has been implemented on the basis of vehicle kilometres driven per individual vehicle. Data per licence plate number is available from RDW (the Dutch Driver and Vehicle Licensing Agency). Subsequently, each licence plate number was matched to a vehicle class, as defined by vehicle type, weight class, fuel type, emission legislation and specific exhaust gas technologies. More than 350 vehicle classes are distinguished. For each vehicle class, the road type distribution is estimated on the basis of annual vehicle kilometres driven and manufacture year.

Starting with the IIR 2024, a new approach was used to calculate the activity data for the period from 2004 until 2017. The fleet information from the bottom-up years was used to reconstruct the fleet in the 2009–2017 period. The fleet composition between 2004 and 2009 was estimated through interpolation. After a correction by the total number of vehicle kilometres a more accurate estimate of activity data and resulting emissions could be calculated. More detailed information on activity data is presented in Witt et al. (2026b), Table 3.12.

##### **VERSIT+ emission factors**

The CO, NMVOC, NO<sub>x</sub> and PM exhaust EFs for road transport were calculated using the VERSIT+ model (Ligterink & de Lange, 2009). Using VERSIT+, EFs can be calculated for various transport situations and scale levels. The EFs follow from several analyses fed by various kinds of measuring data. VERSIT+ LD (light-duty) has been developed for passenger cars and light-duty trucks. The model is used to estimate emissions under specific traffic situations. To determine the EFs, the effect of various types of driving behaviour and the statistical variation per vehicle are investigated. Next, the results are used in a model that currently includes more than 50 light-duty vehicle categories for each of the emission components. The resulting model separates driving

behaviour from vehicle category dependencies. Emission factors for recent passenger cars and light-duty vehicles (Euro 5 and 6) are based on real-world measurements and monitoring campaigns.

VERSIT+ HD (Spren et al., 2016) was used to estimate the EFs of heavy-duty vehicles (i.e. trucks, road tractors and buses). For older vehicles, VERSIT+ HD uses European measurement data. For newer vehicles (Euro-III – Euro-VI), measurement data is available that closely resembles the real-world use of the vehicles. This new data is based on driving behaviour, taken from both on-road measurements and measurements on test stands, and this data has been used in a model to represent emissions during standard driving behaviour. The EFs for buses often originate from test stand measurements, which include realistic driving behaviour for regular service buses.

Detailed emission factors per vehicles category (VERSIT+ class) for the most recent historical year can be found in Witt et al. (2026b), Table 3.11. Sources for the emission factors are reported in Witt et al. (2026a).

#### ***Fuel dependent emission factors***

Emissions of SO<sub>x</sub> and heavy metals (and CO<sub>2</sub>) are dependent on fuel consumption and fuel type. These emissions were calculated by multiplying fuel consumption by fuel- and year-specific EFs (grams per litre of fuel). Heavy metal emissions were calculated on the basis of *fuel used*. The EFs for SO<sub>x</sub> and heavy metals were based on the sulphur, carbon and heavy metal content of the fuels, as described in Witt et al. (2026a). NMVOC evaporative emissions are estimated using the methodology from the EEA Emission Inventory Guidebook (EEA, 2007). The NH<sub>3</sub> EFs were derived from Stelwagen et al. (2015).

#### ***PM emission factors***

PM<sub>10</sub> EFs and PM<sub>2.5</sub>/PM<sub>10</sub> ratios for brake and tyre wear and for road abrasion were derived from literature (Broeke ten et al., 2008; Denier van der Gon et al., 2008; RWS, 2008). An overview of these EFs is provided in Witt et al. (2026b: Tables 3.3 and 3.13). For tyre wear, the EFs are calculated as the total mass loss of tyres resulting from the wear process and the number of tyres per vehicle category. The emissions are based on fuel used, as they are unrelated to fuel sold.

#### ***Lubricant oil***

Combustion of lubricant oil is estimated on the basis of vehicle kilometres driven and consumption per kilometre. Consumption factors per vehicle type are provided in Table 3.4 of Witt et al. (2026b). The resulting emissions are included in the EFs for transport and are not estimated separately, with the exception of heavy metals. These are considered to be extra emissions, which is why they are calculated separately by multiplying the consumption of lubricant oil and the lubricant oil profile (see Table 3.9 of Witt et al., 2026b).

#### ***Deriving fuel-sold emissions from road transport***

In order to derive fuel-sold emissions from road transport, the fuel-used emissions per fuel type are adjusted for differences between the fuel used by road transport in the Netherlands and the fuel sold as reported

by Statistics Netherlands. The differences between fuel used and fuel sold can most likely be attributed to price differences between neighbouring countries leading to cross-border fuelling. The trends are described and explained elaborately in the IIR 2020, section 4.3.4.

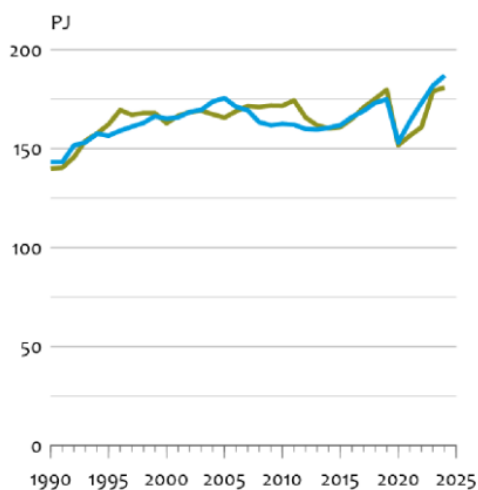
Figure 4.4 represents both the bottom-up estimates for fuel used by road transport and the reported fuel sold to road transport per fuel type for the time series.

Because fuel-sold emissions for gasoline vehicles are estimated using a generic correction to fuel-used emissions per fuel type, the difference between fuel-used and fuel-sold emissions depends solely on the share of the various fuel types in emission totals per substance. For diesel vehicles, the difference between fuel used and fuel sold is allocated to heavy-duty trucks (dashed lines in Figure 4.4).

Diesel trucks are a major source of NO<sub>x</sub> and PM emissions; fuel-used emissions of NO<sub>x</sub> and PM for diesel trucks are adjusted upwards, especially in the earlier years of the time series, as can be seen in Figure 4.5. In recent years fuel-used and fuel-sold emissions have been comparable. NMVOC emissions from road transport mostly stem from petrol-powered vehicles. Since the difference between fuel used and fuel sold for petrol vehicles is small, fuel-used and fuel-sold NMVOC emission totals do not differ much, as presented in Figure 4.5. PM emissions from brake and tyre wear and from road abrasion were not adjusted for differences between fuel used and fuel sold, since these emissions are not directly related to fuel use.

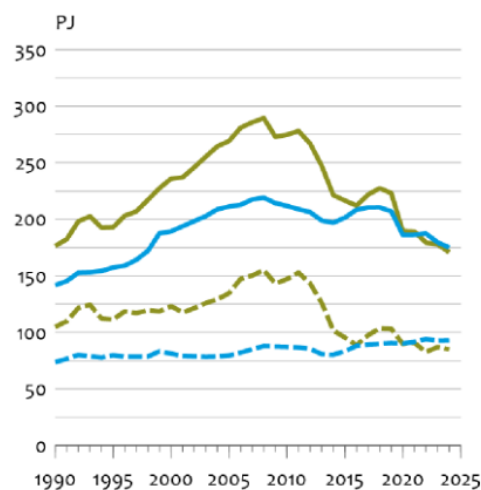
Figure 4.4 Amount of fuel sold and fuel used for road transport in the Netherlands for gasoline and diesel. For diesel the amount of fuel supplied to heavy duty vehicles (HDV) is shown separately

**Gasoline**



— Fuel sold  
— Fuel used

**Diesel**

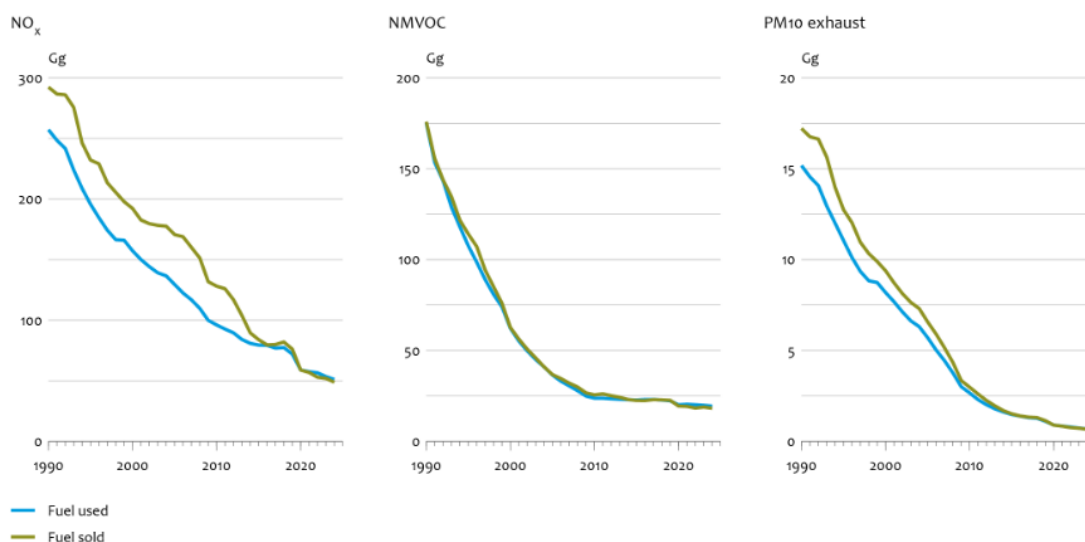


— Fuel sold  
— Fuel used  
- - Fuel sold HDV  
- - Fuel used HDV

**Biofuels**

Emissions resulting from the use of biofuels in road transport are not reported separately in the NFR. Emission measurements are based on representative fuel samples, including a share of biofuels; therefore, resulting EFs are representative of the market fuels used in the Netherlands. Activity data for biofuels is included under liquid fuels.

Figure 4.5  $\text{NO}_x$ , NMVOC and  $\text{PM}_{10}$  exhaust emissions from road transport in the Netherlands based on fuel used and fuel sold



#### 4.3.5 Methodological issues

Several parts of the emission calculations for road transport require improvement:

- The  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$  EFs for brake and tyre wear and for road abrasion are rather uncertain due to lack of recent measurements.
- The road type distribution of all vehicle categories was last updated in 2010 and needs to be verified.

#### 4.3.6 Uncertainties and time series consistency

Consistent methodologies have been used throughout the time series. Uncertainties were estimated in two studies. In 2013, TNO carried out a study to improve knowledge of the uncertainties concerning pollutant emissions from road transport (Kraan et al., 2014). Using a jackknife approach, the variation in the input variables used for estimating total  $\text{NO}_x$  emissions from Euro-4 diesel passenger cars was examined, including the emission behaviour of the vehicles, on-road driving behaviour and the total vehicle kilometres driven. From this case study, it was concluded that the 95% confidence interval lies at a 100% variation in emission totals if all aspects are added up. It is unclear whether these results hold for more recent generations of (diesel) passenger cars. Testing procedures have improved in recent years, but the number of vehicles tested has decreased over time. This method of determining uncertainties has proven to be very time-consuming. For that reason, a decision was made to use an expert-based approach to estimate uncertainties for NFR categories.

In 2016, an experts' workshop was conducted to discuss and estimate the uncertainties in the activity data and EFs used for the emission calculations for the Transport sector (Dellaert & Dröge, 2017). The resulting uncertainty estimates for road transport are presented in Table 4.8.

Table 4.8 Uncertainty estimates for road transport (%)

NFR	Fuel	Uncertainty: activity data	Uncertainty: emission factor						
			NO <sub>x</sub>	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	EC <sub>2.5</sub>	NMVOG
1A3bi	Petrol	5	20	20	200	200	200	500	100
Passenger cars	Diesel	5	20	20	100	50	50	50	100
	LPG	5	20		200	200	200	500	50
	Petrol	5	20	20		200	200	500	50
1A3bii	Petrol	5	20	20		200	200	500	50
Light-duty vehicles	Diesel	5	20	20		50	50	50	100
	LPG	5				200	200	500	
	Petrol	10	20	20		200	200	500	
1A3biii Heavy-duty vehicles	Diesel	10	20	20	100	50	50	50	100
	LPG	10				200	200	500	
	Petrol	10	20	20		200	200	500	
1A3biii Buses	Natural gas	5							
	Petrol	5	20	20		200	200	500	
	Diesel	5	20	20		50	50	50	
	LPG	5				200	200	500	
1A3biv Mopeds/motorcycles	Petrol	20	200	20		500	500	500	500
	Diesel	20	100	20		500	500	500	
1A3bv	Petrol, passenger cars								200
	Petrol, mopeds/ motorcycles								500
1A3bvi	Tyre wear					100	200		
1A3bvi	Brake wear					100	200		
1A3bvii	Road surface wear					200	500		

Source: Dellaert &amp; Dröge (2017)

#### 4.3.7 *Source-specific QA/QC and verification*

Trends in the number of vehicle kilometres driven in the Netherlands, as calculated by Statistics Netherlands using odometer readings, were compared to trends in traffic intensities on the Dutch motorway network, as reported by Rijkswaterstaat. In general, both time series tend to be in agreement, with some annual fluctuations. Trends in fuel sales data compare with trends in fuel used, as described in Section 4.3.4.

For the most part, emission factors for road transport are derived from national measurement programmes. TNO discusses resulting EFs with international research institutions, e.g. the ERMES group (<https://www.ermes-group.eu/web/>).

#### 4.3.8 *Source-specific recalculations*

There are several recalculations in this year's inventory for road transport emissions (for references to the various test/measurement programmes, see Witt et al. (2026a and 2026b)).

##### **Recalculations for road traffic**

Several improvements in the calculation of road traffic emissions were applied:

- General
  - Correction in the calculation (removal of a double reduction factor) of PAH from tire wear resulted in an increase in PAH from 2011 onwards for all vehicles types except mopeds and motorcycles.
  - Recalculation of kilometres driven resulted in minor changes in all emissions from 2022-2023
  - An error was found in the allocation of emissions of POPs from 'cold start' and from cooling units of heavy-duty vehicles. The allocation was corrected, resulting in higher emissions of POPs in 1A3bi-iii. Table 4.9 shows the resulting changes in emissions over the time series (only selected years shown in table).
- Heavy-duty vehicles (1A3biii)
  - Recalculation of diesel fuel for non-road mobile machinery (see Chapter 4.6) has decreased the share of diesel fuel and related fuel-sold emissions for heavy-duty vehicles
  - Recalculation of ageing of SCR systems has increased NOX emissions from 2018 onwards.

Table 4.9 Overview of change in emissions in 1990-2023 as a result of corrections in the emission calculation of POPs from road transport

<b>NFR</b>	<b>Pollutant</b>	<b>Unit</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2023</b>
1A3bi	benzo(a)pyrene	Mg	-	-	-	-	0.0084	0.0074	0.0066	0.0062
	benzo(b)fluoranthene	Mg	-	-	-	-	0.0084	0.0075	0.0066	0.0062
	benzo(k)fluoranthene	Mg	-	-	-	-	0.0077	0.0069	0.0062	0.0060
	indeno (1,2,3-c,d)pyrene	Mg	-	-	-	-	0.0086	0.0078	0.0071	0.0068
	dioxins (PCDD/PCDF)	g I-TEQ	-	-	-	-	0.0342	0.0304	0.0274	0.0260
1A3bii	benzo(a)pyrene	Mg	-	-	-	-	0.0008	0.0007	0.0007	0.0006
	benzo(b)fluoranthene	Mg	-	-	-	-	0.0008	0.0007	0.0007	0.0006
	benzo(k)fluoranthene	Mg	-	-	-	-	0.0004	0.0003	0.0003	0.0003
	indeno (1,2,3-c,d)pyrene	Mg	-	-	-	-	0.0001	0.0001	0.0001	0.0001
	dioxins (PCDD/PCDF)	g I-TEQ	-	-	-	-	0.0016	0.0013	0.0013	0.0013
1A3biii	benzo(a)pyrene	Mg	0.0039	0.0043	0.0050	0.0051	0.0055	0.0055	0.0063	0.0069
	benzo(b)fluoranthene	Mg	0.0033	0.0036	0.0042	0.0043	0.0046	0.0046	0.0053	0.0058
	benzo(k)fluoranthene	Mg	0.0016	0.0018	0.0021	0.0021	0.0023	0.0023	0.0026	0.0029
	indeno (1,2,3-c,d)pyrene	Mg	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	dioxins (PCDD/PCDF)	g I-TEQ	0.0714	0.0786	0.0913	0.0926	0.0975	0.0989	0.1145	0.1254

#### 4.3.9 *Source-specific planned improvements*

In response to the recommendation from the IIR 2023 review (NL-1A3bvi-2023-0001) the ratio of PM<sub>10</sub> and PM<sub>2.5</sub> from brake and tyre wear will be updated as soon as specific measurement results are available. Following updates in the EMEP guidebook we have planned improvements on these ratios for the IIR 2027.

The profiles used to calculate PCDD/PCDF (dioxins/furans) from road traffic will be updated in due course.

Kilometres driven by motorcycles have been kept constant as no new statistics were released for more than a decade. Recent registration of odometer readings by RDW allows for bottom-up calculation of the kilometres driven.

Emission factors for (new) mopeds and motorcycles will be updated on the basis of new measurement data.

## 4.4 **Railways**

### 4.4.1 *Source category description*

The source category Railways (1A3c) includes exhaust emissions from diesel-powered rail transport in the Netherlands from both passenger transport and freight transport. Most railway transport in the Netherlands uses electricity. Emissions resulting from electricity generation for railways are not included in this source category. Diesel is used mainly for freight transport, although there are still some diesel-powered passenger lines as well. Besides exhaust emissions from diesel trains, this source category also includes emissions of particulate matter, copper and lead (among others) from trains, trams and metros due to wear, which results from friction and spark erosion of the current collectors and the overhead contact lines. Condensables are included in PM<sub>10</sub> and PM<sub>2.5</sub> emissions. The notation key NE is used for HCB and PCB emissions as the emission levels are assumed to be negligible.

### 4.4.2 *Key sources*

Railways (1A3d) is a 2024 level key source of Pb and a 1990 level, 2024 level 2024 and 1990-2024 trend key source of Cu in the emissions inventory.

### 4.4.3 *Overview of emission shares and trends*

In 2024, railways are a small source of emissions in the Netherlands, accounting for less than 1% of national totals for all substances except lead, BC and copper. Between 1990 and 2000, diesel fuel consumption by railways increased from 1.2 to 1.5 PJ due to an increase in freight transport. Between 2001 and 2011, fuel consumption fluctuated around 1.4 PJ and since 2012 it has dropped to 0.8 PJ in 2021. Since then it has increased slightly to around 1 PJ in 2024. Transport volumes have increased since 2001, especially freight transport, but this has been compensated by the ongoing electrification of rail transport. The share of passenger transport in diesel fuel consumption in the Railway category was estimated at approximately 30–35% until 2010 and have since increased to around 50%. The remainder is used for freight transport.

The trends in emissions from railways are presented in Table 4.10. NO<sub>x</sub> and PM<sub>10</sub> emissions from railways follow trends in activity data because EFs are similar for all years of the time series. Pb emissions increased between 1990 and 2024. Pb emissions from railways result from the wear on carbon brushes; they are estimated on the basis of the total electricity use by railways (in kWh). Thus, trends in Pb emissions follow trends in electricity use for railways. Railways are also an important source of copper emissions, amounting to 78 Mg (around 68% of total copper emissions in the Netherlands). Emissions of other heavy metals are very low. SO<sub>x</sub> emissions from railways decreased by almost 100% between 2007 and 2012 due to the decrease in the sulphur content of diesel fuel for non-road applications and the early introduction of sulphur-free diesel fuel in the Netherlands (obligatory from 2011 onwards but already applied in 2009 and 2010).

Table 4.10 Trends in emissions from 1A3c Railways

Year	Main Pollutants				Particulate Matter				Other	HM	
	NO <sub>x</sub>	NMVOG	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO	Pb	Cu
	Gg	Gg	Gg	Mg	Gg	Gg	Gg	Gg	Gg	Mg	Mg
<b>1990</b>	<b>1.9</b>	<b>0.07</b>	<b>0.10</b>	<b>21.5</b>	<b>0.12</b>	<b>0.15</b>	<b>0.15</b>	<b>0.02</b>	<b>0.34</b>	<b>0.26</b>	<b>61</b>
1995	1.9	0.07	0.10	22.2	0.13	0.16	0.16	0.02	0.36	0.30	70
2000	2.3	0.09	0.12	27.0	0.15	0.19	0.19	0.03	0.43	0.33	78
2005	2.1	0.08	0.11	25.0	0.14	0.18	0.18	0.02	0.40	0.32	76
2010	2.1	0.08	0.01	25.1	0.15	0.19	0.19	0.03	0.40	0.35	82
2015	1.5	0.07	0.00	21.7	0.12	0.15	0.15	0.02	0.35	0.33	77
2020	0.8	0.05	0.00	15.5	0.08	0.11	0.11	0.01	0.25	0.33	75
2021	0.7	0.05	0.00	14.5	0.08	0.11	0.11	0.01	0.23	0.33	75
2022	0.8	0.05	0.00	15.5	0.08	0.11	0.11	0.01	0.25	0.34	78
2023	0.8	0.06	0.00	17.4	0.08	0.11	0.11	0.01	0.28	0.33	78
<b>2024</b>	<b>0.7</b>	<b>0.05</b>	<b>0.00</b>	<b>16.5</b>	<b>0.08</b>	<b>0.11</b>	<b>0.11</b>	<b>0.01</b>	<b>0.28</b>	<b>0.34</b>	<b>78</b>
1990-2024 <sup>1)</sup>	-1.2	-0.02	-0.10	-4.9	-0.04	-0.04	-0.04	-0.01	-0.07	0.08	17
1990-2024 <sup>2)</sup>	-61%	-23%	-100%	-23%	-33%	-26%	-26%	-65%	-20%	33%	28%
% 2024 <sup>3)</sup>	0%	0%	0%	15%	1%	0%	0%	0%	0%	7%	69%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

#### 4.4.4 Activity data and (implied) emission factors

A detailed description of the methodology used for the calculation of emissions related to rail transport can be found in (Ligterink and Van Eijk, 2024). Updates to the methodology are reported in Chapter 4 of Witt et al. (2026a). Currently used emission factors are reported in Witt et al. (2026b).

In 2023, the source of track, wheel, and brake wear emissions were added as they had been lacking up to that year. Across Europe, several

studies on PM emissions from railways have been carried out. These studies were used to derive the wear emission factors.

The NO<sub>x</sub> and PM exhaust emission factors are based on tailpipe emission measurements on diesel passenger trains and diesel locomotives (Ligterink et al., 2017 and 2023). With the introduction of new trains, which have to comply with more stringent emission limits, some minor reductions of the emission factors have been implemented on the basis of the various legislative classes (e.g. Stage IIIA/B) that have been measured. The change in fleet composition over time is based on the typical lifetime for locomotives of thirty years and passenger railcars of twenty years and on the introduction dates of new legislative classes.

The NH<sub>3</sub> emission factors are based on emission results of similar engines used in non-road mobile machines. These emission factors are considered better because they are based on more recent emission measurements than the standard emission factors, even if they are much higher. The difference in NH<sub>3</sub> emission factors is likely to be related to the use of oxidation catalysts to meet particulate matter emission limits (Ligterink et al., 2021). Likewise, the sulphur content of diesel fuel for railways is assumed to be equal to the sulphur content of other off-road applications.

PM<sub>10</sub> emissions due to wear of overhead contact lines and carbon brushes from railways are calculated on the basis of a study conducted by NS-CTO (1992) on the wear of overhead contact lines and the carbon brushes of the collectors on electric trains. For trams and metros, wear on overhead contact lines has been assumed to be identical to that on railways. Emissions from wear on current collectors have not been included, because no information was available on this topic. Besides copper, carbon brushes contain 10% lead and 65% carbon. On the basis of the NS-CTO study, the percentage of particulate matter in the total quantity of wear debris was estimated at 20%. Because of their low weight, it is assumed that these particles remain airborne. It is estimated that approximately 65% of the wear debris ends up in the immediate vicinity of the railway, while 5% is deposited in ditches along the railway line (Coenen & Hulskotte, 1998). According to the NS-CTO study, the remainder of the wear debris (10%) does not enter the environment but attaches itself to the train surface and is captured in the train washing facilities.

#### 4.4.5 *Methodological issues*

As most emission factors for railways have not been updated recently (except for NO<sub>x</sub>), they are rather uncertain.

#### 4.4.6 *Uncertainties and time series consistency*

Consistent methodologies have been used throughout the time series. In 2016, an experts' workshop was conducted to discuss and estimate the uncertainties in the activity data and EFs used for the emission calculations for the Transport sector (Dellaert & Dröge, 2017). The resulting uncertainty estimates for railways are presented in Table 4.11.

Table 4.11 Uncertainty estimates for activity data and emission factors for railways (%)

NFR	Type	Fuel	Uncertainty: activity data	Uncertainty: emission factor						
				NO <sub>x</sub>	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	EC	NMVOC
1A3c	Freight transport	Diesel	5	100	20	-	100	100	100	-
	Passenger transport	Diesel	5	100	20	-	100	100	100	-
	Pantograph wear <sup>1</sup>	Electricity	-	-	-	-	200	200	-	

Dellaert & Dröge (2017)

1. Overhead line for power supply to electric rail transport

#### 4.4.7 Source-specific QA/QC and verification

The current figures are compared to bottom-up results of the number of trains and typical operation hours (Van Mensch et al., 2022). These comparisons hold well.

#### 4.4.8 Source-specific recalculations

Recalculation of energy use by CBS has led to a small decrease in electricity use of railways in 2023. This has led to a slight decrease in (wear) emissions from electric trains in 2023.

#### 4.4.9 Source-specific planned improvements

Emission factors remain uncertain, but since railways are a small emission source and not a key source of any substance, updating the EFs is currently not a priority.

### 4.5 Waterborne navigation and recreational craft

#### 4.5.1 Source category description

The source category Waterborne navigation (1A3d) includes emissions from National navigation (1A3dii), International (1A3di(ii)) inland navigation in the Netherlands and from International maritime navigation (1A3di(i)) on the Dutch Continental Shelf. Emissions from international maritime navigation are reported as a memo item and are not part of the national emission totals. National (domestic) inland navigation includes emissions from all trips that both depart from and arrive in the Netherlands, whereas international inland navigation includes emissions from trips that either depart from or arrive abroad. Only emissions on Dutch territory are reported. For maritime navigation, this includes emissions on the Dutch Continental Shelf. All three categories include both passenger and freight transport. From 2022 onwards, emissions from recreational craft have been reported under Inland Shipping as well. Emissions resulting from degassing of inland ships are included under 2D3i. Condensables are included in PM<sub>10</sub> and PM<sub>2.5</sub> emissions.

For inland navigation (1A3di(ii) and 1A3dii), the notation key NE is used for HCB and PCB emissions. The reason is that there are no representative emission factors for these substances. The default emission factors in the EMEP/EEA Guidebook are based on emission measurements on seagoing vessels and cannot be used for inland shipping.

For 1A5b, the notation key NE is used for HCB and PCB emissions.

#### 4.5.2 *Key sources*

The source categories 1A3di(ii) – International inland waterways – and 1A3dii – National navigation (shipping) – are both 2024 level key sources of NO<sub>x</sub>, PM<sub>2.5</sub> and BC emissions; 1A3di(ii) is also a 1990 level key source for NO<sub>x</sub>. Recreational craft is a significant source of CO, PM 2.5 and BC. 1A5b is a level 2024 key source of PM<sub>2.5</sub> and BC.

#### 4.5.3 *Overview of emission shares and trends*

In 2023, the total (inter)national inland navigation was responsible for 10% of NO<sub>x</sub> emissions, 5% of PM<sub>2.5</sub> emissions and 14% of BC emissions in the Netherlands. With emissions from road transport decreasing rapidly, the share of inland navigation in national totals increased throughout the time series. In 2023, the share of inland navigation as a percentage of national emissions of NMVOC, CO and SO<sub>x</sub> was small (0.9, 0.4 and 0.04% respectively).

Emissions from international maritime navigation are not included in the national totals, but maritime navigation is a major emission source in the Netherlands, the Port of Rotterdam being one of the world's largest seaports and the North Sea being one of the world's busiest shipping regions. Total NO<sub>x</sub> emissions from international maritime shipping on Dutch territory (including the Dutch Continental Shelf) amounted to almost 86 Gg in 2024 and were higher than the combined NO<sub>x</sub> emissions from all road transport in the Netherlands. PM<sub>10</sub> emissions amounted to 2.2 Gg in 2024. By contrast, recreational craft were a small emission source, with 3.2 Gg of NO<sub>x</sub> and 0.24 Gg of PM<sub>10</sub> emitted in 2024.

The trends in emissions from inland navigation in the Netherlands (both category 1A3dii and 1A3di(ii)) are presented in Table 4.12. Since the year 2000, fuel consumption in inland navigation has fluctuated between 20 and 28 PJ. The financial crisis led to a decrease in transport volumes and fuel consumption in 2009. Since then, transport volumes have increased again, resulting in an increase in fuel consumption. For the most part, emissions of NO<sub>x</sub>, CO, NMVOC and PM from inland navigation follow the trends in the activity data. The introduction of emission standards for new ship engines (CCR stages I and II) has led to a slight decrease in the fleet average NO<sub>x</sub> EF (per kilogram of fuel) in recent years, but since fuel consumption has increased significantly, total NO<sub>x</sub> emissions still increased between 2009 and 2022.

Between 2009 and 2024, SO<sub>x</sub> emissions from inland navigation decreased by 99.5%, due to the decrease in the maximum allowable sulphur content of diesel fuel for non-road applications. As of 2011, EU regulation requires all diesel fuel for inland navigation to be sulphur-free. Since sulphur-free diesel fuel was introduced to inland navigation in the Netherlands in 2009, SO<sub>x</sub> emissions have decreased significantly. The decrease in sulphur content also affects PM emissions, as some of the sulphur in the fuel is emitted as PM (Denier van der Gon & Hulskotte, 2010). PM<sub>2.5</sub> and PM<sub>10</sub> emissions from waterborne navigation likewise decreased between 2009 and 2023.

Between 1990 and 2008, energy use and resulting emissions from maritime navigation showed an upward trend. Since the start of the financial crisis, transport volumes have decreased, resulting in a reduction in energy use and emissions. This decrease was enhanced by 'slow steaming' (a decrease in speed), resulting in lower energy use and thus further lowering emissions (MARIN, 2011). In 2023, total fuel consumption by maritime navigation on Dutch territory decreased by 1% compared to 2022 and was 3% lower than in 2020.

Recreational shipping is reported under source categories 1A3dii Inland Shipping. Recreational shipping is an important source of CO emissions, amounting to 3.0% of total national CO emissions. The share of recreational shipping in National PM<sub>2.5</sub> and BC emissions were 1.6 and 4.1%. In 2024, the share of emissions of other pollutants from recreational shipping in total emissions in the Netherlands was small.

*Table 4.12 Trends in emissions from Inland navigation in the Netherlands (combined emissions from national and international inland navigation)*

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOC	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>29</b>	<b>2.0</b>	<b>1.8</b>	<b>0.01</b>	<b>1.2</b>	<b>1.3</b>	<b>1.3</b>	<b>0.56</b>	<b>2.2</b>
1995	23	1.7	1.7	0.01	1.2	1.2	1.2	0.52	2.0
2000	25	1.6	1.8	0.01	1.1	1.2	1.2	0.50	1.9
2005	24	1.3	1.7	0.01	0.98	1.0	1.0	0.44	1.6
2010	20	1.3	0.4	0.00	0.76	0.81	0.81	0.38	1.5
2015	21	1.2	0.01	0.00	0.72	0.77	0.77	0.39	1.5
2020	19	1.1	0.01	0.00	0.71	0.75	0.75	0.32	1.6
2021	19	1.1	0.01	0.00	0.72	0.76	0.76	0.33	1.6
2022	19	1.1	0.01	0.00	0.68	0.72	0.72	0.31	1.6
2023	18	1.1	0.01	0.00	0.63	0.67	0.67	0.29	1.5
<b>2024</b>	<b>18</b>	<b>1.1</b>	<b>0.01</b>	<b>0.00</b>	<b>0.64</b>	<b>0.68</b>	<b>0.68</b>	<b>0.29</b>	<b>1.5</b>
1990-2024 <sup>1)</sup>	-11	-0.9	-1.8	0.00	-0.60	-0.63	-0.63	-0.27	-0.7
1990-2024 <sup>2)</sup>	-38%	-47%	-100%	-16%	-48%	-48%	-48%	-48%	-33%
% 2024 <sup>3)</sup>	10%	0%	0%	0%	5%	3%	2%	13%	0%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

#### 4.5.4 Activity data and (implied) emission factors

Fuel consumption and resulting emissions from inland navigation (both national and international) were calculated using a Tier 3 methodology. The methodology was developed as part of the Emissieregistratie en -Monitoring Scheepvaart (EMS) project. The EMS methodology distinguishes between 31 vessel classes. For these vessel classes, the power demand (kW) is calculated for the various inland waterway types and rivers in the Netherlands by means of a model described by Bolt

(2003). The main variable parameters within this model that determine the power demand per vessel class are the vessel's draught, its speed through water and the stream velocity. The vessel's draught is calculated by interpolating between the draught of an unloaded vessel and that of a fully loaded vessel. Starting from the reporting year 2022, the speed per vessel per geographical water segment has been calculated from vessel movement data derived from AIS (Automatic Identification System). The average cargo situation (partial load) per vessel class for one specific year (2016) was provided by Statistics Netherlands.

The resulting fleet average EFs throughout the time series are reported in Witt et al. (2026a). The formula used to estimate the impact of lower sulphur content on PM emissions is described in Hulskotte & Bolt (2013).

In the emission calculation for inland shipping, a distinction is made between primary engines intended for propelling the vessel and auxiliary engines. Auxiliary engines are used for manoeuvring the vessel (bow propellers) and generating electricity for the operation of the vessel and the residential compartments (generators). Fuel consumption by auxiliary engines is estimated at 13% of the fuel consumption of the primary engines.

No recent information was available on the fuel consumption of passenger ships and ferries in the Netherlands; for this reason, fuel consumption data for 1994 was applied to all subsequent years of the time series.

Emissions by recreational craft were calculated by multiplying the number of recreational craft (open/cabin motorboats and open/cabin sailing boats) by the average fuel consumption per boat type, times the EF per substance, expressed in emissions per engine type per quantity of fuel (Hulskotte et al., 2024). The EFs depend on the engine types per vessel. They are reported in the same report and will be cited in the method report as well (Witt et al., 2026a).

Since 2008, emissions from maritime shipping on the Dutch Continental Shelf and in the Dutch port areas have been calculated annually, using vessel movement data derived from AIS (Automatic Identification System).

To estimate emissions from a specific ship in Dutch waters, the ship's IMO number is linked to a ship characteristics databases acquired from Lloyd's List Intelligence (LLI) and Clarksons. Emission factors for each ship are determined using information on the construction year and the design speed of the ship, the engine type and power, the type of fuel used and, for engines built since 2000, the engine's maximum revolutions per minute (rpm). Methodologies and resulting emissions for recent years are described in detail in Kauffman, Hulskotte and Koch, 2025.

A detailed description of the methodology for inland navigation (Chapter 5), recreational craft (Chapter 5) and maritime shipping (Chapter 7) can be found in Witt et al. (2026a).

#### 4.5.5 *Methodological issues*

There are several points requiring improvement in the emission calculations for inland navigation, international maritime navigation and recreational craft:

1. Data on fuel consumption and EFs for passenger ships and ferries has not been updated for some time.
2. Data on the number of recreational craft and their average usage rates is rather uncertain and need to be verified.
3. The methodology for calculating the required engine power vs. speed and other ship characteristics needs to be verified for inland navigation.
4. Estimates of NMVOC emissions due to cargo fumes are rather uncertain and need to be improved.

Due to problems with data processing, inland navigation emissions for 2024 were calculated using the method for preliminary emissions, which is based on scaling the emissions for 2023 with the volume of inland shipping transportation in the new year compared to the previous one.

#### 4.5.6 *Uncertainties and time series consistency*

Consistent methodologies have been used for waterborne navigation throughout the time series. For inland navigation, AIS data has only become available since 2020. For the earlier years in the time series, emission totals were scaled back from 2020 using the annual fuel consumption attributed to the Netherlands as reported by SAB. The methodology for constructing the historic series will be described in full detail in an upcoming TNO report that is still in preparation.

For maritime navigation, AIS data has only become available since 2008. For the earlier years in the time series, emission totals were estimated using vessel movement data from Lloyd's, combined with assumptions about average vessel speeds (Hulskotte et al., 2003a, -b and -c).

In 2016, an experts' workshop was conducted to discuss and estimate the uncertainties in the activity data and EFs used for the emission calculations for the Transport sector (Dellaert & Dröge, 2017). The resulting uncertainty estimates for waterborne navigation and recreational craft are presented in Table 4.13. In the IIR 2020, the uncertainty estimates for NMVOC emissions from degassing cargo had been adjusted upwards from 100% to 250% compared to Dellaert & Dröge (2017).

Table 4.13 Uncertainty estimates for waterborne navigation and recreational craft (%)

NFR	Type	Fuel	Uncertainty: activity data	Uncertainty: emission factor						
				NO <sub>x</sub>	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	EC	NMVOC
1A3di(i)	Anchored DCS2F <sup>1</sup>	HFO	20	50	50	500	50	50	200	200
1A3di(i)	Anchored DCS	MDO	20	50	50	500	50	50	200	200
1A3di(i)	Sailing DCS	HFO	20	50	50	500	50	50	200	200
1A3di(i)	Sailing DCS	LNG	50	100	100	-	-	100	200	-
1A3di(i)	Sailing DCS	MDO	20	50	50	500	50	50	200	200
1A3di(i)	Moored NL		50	50	50	500	50	50	200	200
1A3di(i)	Sailing NL	HFO	20	50	50	500	50	50	200	200
1A3di(i)	Sailing NL	LNG	50	100	100	-	-	100	200	-
1A3di(i)	Sailing NL	MDO	20	50	50	500	50	50	200	200
1A3di(ii)	Inland, international	Diesel	10	20	15	400	35	35	35	75
1A3dii	Inland, national	Diesel	10	20	15	400	35	35	35	75
1A3dii	Passenger and ferryboats	Diesel	100	50	20	500	100	100	100	200
1A3dii	Recreational shipping, exhaust gases	Petrol	200	50	20	100	100	100	100	50
1A3dii	Recreational shipping, exhaust gases	Diesel	200	200	20	100	100	100	100	100
1A3dii	Recreational shipping, petrol evaporation		100	-	-	-	-	-	-	200
2D3i	Inland shipping, degassing cargo		100	-	-	-	-	-	-	250

Dellaert & Dröge (2017)  
1. Dutch Continental Shelf

#### 4.5.7 *Source-specific QA/QC and verification*

The trends in activity data for waterborne navigation (national and international) were compared to trends in transport volumes (Mg-kms of inland shipping within and across borders) and are reasonably comparable.

#### 4.5.8 *Source-specific recalculations*

There were no source-specific recalculations for waterborne navigation.

#### 4.5.9 *Source-specific planned improvements*

For inland navigation, it is planned to collect additional insights into the age of the employed engines. Furthermore, there are improvements planned to the calculations of ships at berth.

### 4.6 **Non-road mobile machinery (NRMM)**

#### 4.6.1 *Source category description*

Non-road mobile machinery (NRMM) covers a variety of equipment that is used in various economic sectors and by households in the Netherlands. Mobile machinery is defined as all machinery equipped with a combustion engine which is not primarily intended for transport on public roads, and which is not attached to a stationary unit. The main deployment of NRMM in the Netherlands is within agriculture and construction. The largest volumes of fuel are used in tillage, harvesting and earthmoving. NRMM is also used in forest, park and garden maintenance, including lawn mowers, chain saws, forest mowers and leaf blowers.

Emissions from NRMM are reported under:

1. 1A2gvii Mobile combustion in manufacturing industries and construction.
2. 1A4aii Commercial/ institutional: Mobile.
3. 1A4bii Residential: Household and gardening (mobile).
4. 1A4cii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery
5. 1A5b Other, mobile.

Source category 1A5b is used for emissions from ground support equipment at airports. 1A5b also includes emissions from recreational craft (see Section 4.5). Condensables are included in PM<sub>10</sub> and PM<sub>2.5</sub> emissions.

#### 4.6.2 *Key sources*

Mobile machinery in manufacturing industries and construction (1A2gvii) is a 1990 level, 2024 level and 1990-2024 trend key source of NO<sub>x</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> and BC emissions. Source category 1A4aii – Commercial/institutional: Mobile – is a 2024 level key source of NO<sub>x</sub>, PM<sub>2.5</sub>, BC and CO emissions. Source category 1A4bii – Residential: Household and gardening (mobile) – is a 1990 level key source of CO emissions. Source category 1A4cii – Agriculture/Forestry/Fishing: Off-road vehicles and other machinery – is a 2024 level key source of NO<sub>x</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, BC and CO emissions, a 1990 level key source of PM<sub>10</sub>, PM<sub>2.5</sub> and BC emissions and a 1990-2024 trend key source of PM<sub>10</sub> and BC

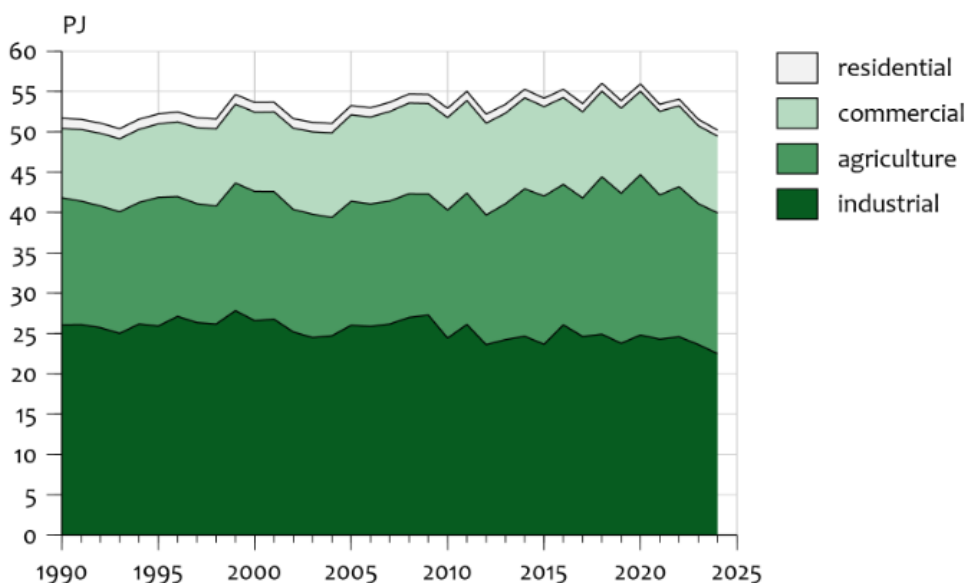
emissions. Source category 1A5b - Other, Mobile is a 2024 level key source of PM<sub>2.5</sub> and BC.

#### 4.6.3 Overview of shares and trends in emissions

In 2024, NRMM was responsible for 17% of CO emissions, 13% of NO<sub>x</sub> emissions, 8% of PM<sub>2.5</sub> emissions and 5% of PM<sub>10</sub> emissions in the Netherlands (see Table 4.14). CO emissions mainly resulted from the use of petrol-driven equipment by households (e.g. lawn mowers) and of machinery for public green space maintenance. NO<sub>x</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> emissions can be primarily attributed to diesel machinery being used in agriculture (e.g. tractors) and construction.

Total energy use in NRMM has fluctuated between 50 PJ and 60 PJ throughout the time series. Figure 4.6 represents total energy use in the various sectors where mobile machinery is applied. Industrial (including construction) and agricultural machinery were responsible for around 80% of total energy use by NRMM in 2024.

Figure 4.6 Fuel consumption in non-road mobile machinery in various sectors in the Netherlands



The trends in emissions from NRMM in the Netherlands are presented in Table 4.14. With the introduction of EU emission standards for NRMM in 1999 and the tightening of emission standards in subsequent years, NO<sub>x</sub> emissions from NRMM have steadily decreased, as presented in Figure 4.7. Since 1990, NO<sub>x</sub> emissions have decreased by 49%, while fuel consumption has decreased by 3%.

Emissions of most other substances have also decreased significantly throughout the time series. For PM<sub>10</sub> and NMVOC, this can be attributed to the EU's NRMM emission legislation. SO<sub>x</sub> emissions have decreased due to the EU's fuel quality standards; sulphur-free diesel has been obligatory in NRMM since 2011.

Table 4.14 Trends in emissions from Non-road mobile machinery in the Netherlands

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NM/VO	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>48</b>	<b>17</b>	<b>3.9</b>	<b>0.01</b>	<b>5.1</b>	<b>5.4</b>	<b>5.4</b>	<b>2.5</b>	<b>112</b>
1995	49	16	3.8	0.01	4.6	4.9	4.9	2.3	99
2000	51	14	3.9	0.01	4.4	4.6	4.6	2.2	89
2005	45	12	3.9	0.01	3.8	4.0	4.0	1.9	83
2010	39	9.3	0.44	0.01	2.4	2.5	2.5	1.2	77
2015	35	8.3	0.02	0.02	1.9	2.0	2.0	0.95	77
2020	30	7.0	0.03	0.10	1.6	1.7	1.7	0.77	75
2021	28	6.6	0.02	0.11	1.4	1.5	1.5	0.69	75
2022	27	6.4	0.03	0.11	1.4	1.4	1.4	0.66	74
2023	25	5.9	0.02	0.12	1.2	1.3	1.3	0.60	72
<b>2024</b>	<b>24</b>	<b>5.5</b>	<b>0.02</b>	<b>0.12</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	<b>0.55</b>	<b>69</b>
1990-2024 <sup>1)</sup>	-23	-11.9	-3.9	0.11	-4.0	-4.2	-4.2	-2.0	-43
1990-2024 <sup>2)</sup>	-49%	-68%	-99%	1344%	-78%	-78%	-78%	-78%	-38%
% 2024 <sup>3)</sup>	13%	2%	0%	0%	8%	5%	4%	25%	17%

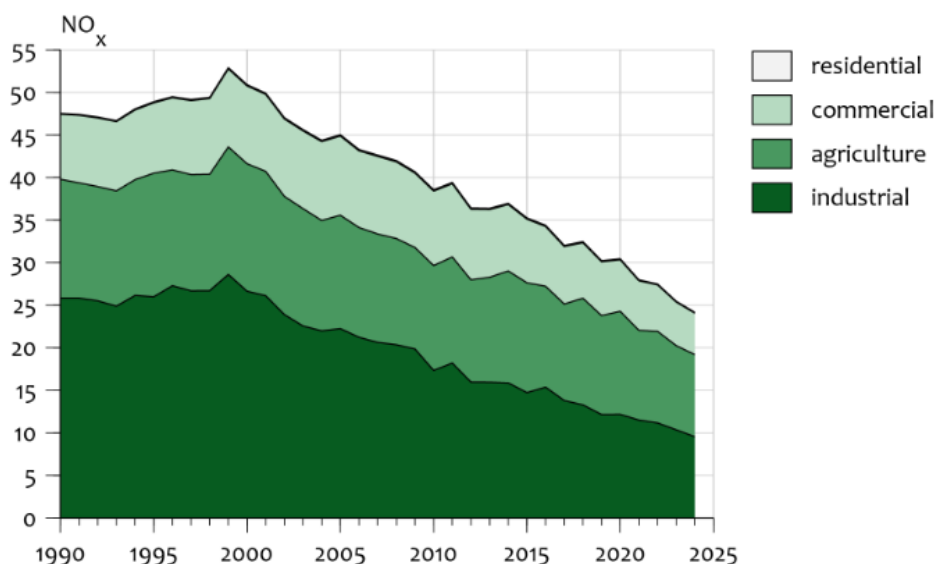
1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

Emissions from ground service equipment (GSE) at airports are reported under source category Other, mobile (1A5b). The share of emissions from GSE at airports as a percentage of the total emissions in the Netherlands in 2020 amounted to less than 1% for all pollutants.

Figure 4.7  $\text{NO}_x$  emissions by non-road mobile machinery in various sectors in the Netherlands



#### 4.6.4 Activity data and (implied) emission factors

Fuel consumption by mobile machinery in the various economic sectors is not reported separately in the Energy Balance. Therefore, fuel consumption and resulting emissions from NRMM are calculated using a Tier 3 modelling approach (Hulskotte & Verbeek, 2009; Dellaert et al., 2023). The so-called EMMA model uses sales data and survival rates for various types of machinery to estimate the size and composition of the NRMM fleet in any given year. Total annual fuel consumption by NRMM is estimated on the basis of combined assumptions about the average usage rate (annual operating hours) and the fuel consumption per hour of operation of the various types of machinery. Emission factors have been compiled on the basis of factors from the TREMOD-MM model (Lambrecht et al., 2004; Helms et al., 2010) and updated on the basis of real-world measurements by TNO. They are described in more detail in Witt et al. (2026a) and Dellaert et al. (2023).

Annual sales data for the various types of NRMM is derived from trade organisations, such as BMWT and Fedecom, and from Off-Highway Research, a commercial consulting company. Since 2022, any mobile machinery that accesses public roads with a speed over 6 km/h also needs to be registered and receives a license plate. The registration database maintained by the National Road Traffic Agency (RDW) is now also used as a data source to complement the inflow rates of machinery and validate the size and composition of the Dutch machinery fleet.

Fuel consumption and  $\text{CO}_2$  emissions are calculated using a Willans line approach that is explained in Chapter 9 of Witt et al. (2026a).

Emissions of  $\text{CO}$ ,  $\text{NO}_x$ ,  $\text{NH}_3$ ,  $\text{PM}$  and  $\text{NMVOC}$  are calculated using the following formula:

Emission = Number of machines x active time x Share of time in load range x Rated power x Load and power dependent emission factor

In which:

- Emission = Emission or fuel consumption (grams);
- Number of machines = the number of machines of a certain year of construction with emission factors applicable to the machine's year of construction;
- Active time = the average annual running time for this type of machinery in seconds;
- Share of time in load range = the average fraction of time that the machine engine is in a specific load range;
- Rated power = the average full power for this type of machinery (kW);
- Load- and power-dependent emission factor = Specific load-dependent emission factors, per kW of rated power for various technology levels relating to the year of construction and the emission standards, in grams/second\*kW (rated).

Emissions of SO<sub>x</sub> are calculated on the basis of total fuel consumption and sulphur content per fuel type, as provided by Witt et al. (2026a). Base EFs for NH<sub>3</sub> were derived from the EMEP/EEA Guidebook 2023 (EEA, 2023) but were increased for modern stage-IV and -V engines that use SCR technology to reduce NO<sub>x</sub> emissions, while increasing emissions of NH<sub>3</sub>.

The distribution of total fuel consumption by NRMM across various economic sectors was estimated using various data sources. First, the various types of machinery in EMMA were distributed across the different sectors. Total fuel consumption by NRMM in the commercial and industrial sector and by households was derived directly from EMMA. Fuel consumption in agriculture and construction, as reported by EMMA, was adjusted. Fuel consumption by NRMM in the agricultural sector (excluding agricultural contractors) was derived from Wageningen Economic Research of Wageningen University and Research. Fuel consumption by agricultural contractors was derived from the trade organisation for agricultural contractors in the Netherlands (CUMELA). Both data sources were combined to estimate total fuel consumption by mobile machinery in the agricultural sector.

The modelled fuel consumption in the construction sector was subsequently adjusted to take into account the impact of economic fluctuations. Statistics Netherlands also reports the resulting fuel consumption (energy use) by NRMM in the Energy Balance. The annual correction factors used to adjust the energy use as reported by EMMA are provided in Witt et al. (2026a).

Emissions from ground support equipment and vehicles used for ground transport at airports were estimated using data on diesel use and emissions for ground operations at Amsterdam Airport Schiphol that were provided by KLM Equipment Services (KES). Since KES is responsible for the refuelling and maintenance of the equipment at Amsterdam Airport Schiphol, it has precise knowledge of the types of

machinery used and the amount of energy used per year. The resulting emissions were also used to derive an average EF per MTOW at Amsterdam Airport Schiphol, which was subsequently used to estimate emissions at regional airports. A detailed description of the methodology can be found in Chapter 9 of Witt et al. (2026a).

The notation key NE is used for all HCB and PCB emissions from NRMM as no emission factor is available and no information is available from the 2023 EMEP/EEA Guidebook chapter on NRMM.

#### 4.6.5 *Methodological issues*

The current methodology for estimating emissions from NRMM could be improved in the following areas:

- Recent model updates have led to relatively large changes in the modelled fuel consumption and related emissions for the full time series. Independent (time-series) data on sectoral fuel consumption is limited or unavailable, limiting opportunities for validation of the model on the basis of fuel consumption.
- Fuel use in the construction sector is susceptible to relatively strong economic fluctuations that are not captured well by the dynamics of the annual active machinery fleet. At present, correcting for this phenomenon is based on economic indicators derived from Statistics Netherlands rather than on physical indicators, which may be preferred.
- There is a lack of input data for several types of machinery and sectors. In the garden sector and private households, scarce data sources have been extrapolated to estimate the size of the fleet, leading to substantial uncertainty.
- Annual activity of machinery is uncertain as it is not publicly registered, in contrast to road transport. Current estimates of annual running hours are based on literature and a questionnaire with a limited sample size.
- While more and more engine load profiles and real-world emission factors have been collected, they do not cover all machinery types and technology levels, meaning that their representativeness is not always guaranteed. There has also been limited investigation into the effect of transient engine loads in the machines' daily practice on emission levels.
- The effects of (postponed) maintenance and/or retrofitting on the emissions from machinery are not well known.

#### 4.6.6 *Uncertainties and time series consistency*

The EMMA model was used to calculate fuel consumption and emissions for the time series since 1990.

In 2016, an experts' workshop was conducted to discuss and estimate the uncertainties in the activity data and the EFs used for the emission calculations for the transport sector (Dellaert & Dröge, 2017). The resulting uncertainty estimates for NRMM are presented in Table 4.15.

The uncertainty in activity data for industry (LPG), public services (diesel) and container handling (diesel) was later adjusted upwards from 35% to 50%. The reason is that a survey held among companies using mobile machinery revealed significant divergences from our current

understanding, indicating a higher uncertainty in the reported emission numbers.

#### 4.6.7 *Source-specific QA/QC and verification*

In the past few years, significant effort was invested into checking and verifying NRMM modelling and outcomes. In 2021, a survey was held among users of mobile machinery across multiple sectors (e.g. construction, agriculture, services) that focussed on gathering data on the fleet composition (e.g. construction year, power rating, fuel types), usage (e.g. annual operating hours, typical lifespan) and fleet size. The results allowed a comparison between the composition and usage parameters of the modelled machine fleet and the machine fleet of the respondents, giving rise to improvements in the modelling on several points.

As of 1 January 2022, all vehicles, including mobile machinery, that access the public road with a speed over 6 km/h must be registered in a national database and obtain a licence plate, similar to the existing registration of passenger cars and other road transport vehicles. This public database, maintained by RDW (Dienst Wegverkeer, an administrative body of the Dutch government), can be queried and provides a relatively complete overview of the Dutch NRMM fleet. As the registry contains information on machine type, fuel type, and date of entry, this allowed a further comparison with and validation of the modelled machine fleet, again resulting in several substantial changes to the model, especially to the estimated machine sales for some machinery types.

#### 4.6.8 *Source-specific recalculations*

Following the QA/QC and verification steps described above, and thanks to the availability of a national registry of NRMM in the Netherlands since 2022, a number of updates have been incorporated into the model and the input data. The new insights have led to the following improvements in the modelling of NRMM energy use and emissions:

- For most machine types, previous estimates of the historical machine sales have been re-assessed by analysing the size and composition (including the construction year) of the current fleet for these machines, as registered in the RDW database on NRMM. For many machinery types, year-to-year additions of machinery to the registration database are now used directly as inflow to the modelled fleet. Average lifetimes and machinery-specific scrappage functions have also been adjusted. This has led to significant changes to the modelled fuel consumption and emissions of most sectors.
- The age-dependent annual active hours correction function has been changed, leading to relatively fewer active hours for individual machines at a specific age.
- The modelling of inflow of electric machinery has been changed substantially. The RDW data is now used for the machinery types available. For other machinery, the RDW data is averaged by sector and power category and used as proxy to estimate annual levels of electric machinery introduced into the fleet.
- In 2025, Statistics Netherlands performed an analysis using a link between the RDW machine registry and the sector

designation of the companies to which the machinery was registered. This allowed a more detailed distribution of machinery types over economic sectors, leading to a reallocation of fuel consumption and emissions between sectors. Especially the public services sector has received a larger share, while the allocation to industry has decreased.

- For 2022 and 2023 an updated diesel total was provided for the agricultural sector, resulting in a decrease of emissions.
- For 2023, the correction factors for the construction sector were updated using newly available statistical data.
- The NO<sub>x</sub> emission factor for diesel engines of STAGE IV and V have been lowered based on a real-world measurement campaign.
- Emissions from petrol evaporation are now calculated using the Tier 2 methodology described in the 2023 EMEP/EEA Guidebook on gasoline evaporation (1.A.3.b.v) for L-Cat vehicles (EEA, 2023), assuming similar emission rates between mobile machinery and mopeds and motorcycles.

Together, the changes described above result in substantial changes in the fuel use and emissions for most NRMM sectors that are estimated using the EMMA model (1A2gvii, 1A4aai, 1A4bii and 1A4cii) for the full time series.

Table 4.15 Uncertainty estimates for NRMM (%)

NFR	Sector	Fuel	Uncertainty: activity data	Uncertainty: emission factor						
				NO <sub>x</sub>	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	EC <sub>2.5</sub>	NMVOC
1A2gvii	Construction	Petrol	100	50	20	200	100	100	100	100
1A2gvii	Construction	Diesel	50	50	20	200	100	100	100	100
1A2gvii	Construction	LPG	100	50	20	200	100	100	100	100
1A2gvii	Industry	Petrol	200	100	20	200	200	200	200	200
1A2gvii	Industry	Diesel	50	50	20	200	100	100	100	100
1A2gvii	Industry	LPG	50	50	20	200	100	100	100	100
1A4aii	Public services	Petrol	100	50	20	200	100	100	100	100
1A4aii	Public services	Diesel	50	50	20	200	100	100	100	100
1A4aii	Public services	LPG	100	50	20	200	100	100	100	100
1A4aii	Container handling	Diesel	50	50	20	200	100	100	100	100
1A4bii	Consumers	Petrol	100	100	20	200	200	200	200	200
1A4cii	Agriculture	Petrol	200	100	20	200	200	200	200	200
1A4cii	Agriculture	Diesel	35	50	20	200	100	100	100	100
1A4cii	Agriculture	LPG	100	50	20	200	100	100	100	100

Dellaert & Dröge (2017), with additional uncertainties added for new sector/fuel combinations

#### 4.6.9 Source-specific planned improvements

As a major new source of information on the NRMM fleet has become available in 2022 (see previous sections), additional analysis of the new RDW registry is likely to lead to further updates and model improvements in the NRMM calculation.

### 4.7 National fishing

#### 4.7.1 Source category description

The source category National fishing (1A4ciii) covers emissions resulting from all fuel sold to fisheries in the Netherlands. Condensables are included in PM<sub>10</sub> and PM<sub>2.5</sub> emissions.

#### 4.7.2 Key sources

National fishing (1A4ciii) is a 1990 level, 2024 level and 1990-2024 trend key source of NO<sub>x</sub> emissions.

#### 4.7.3 Overview of emission shares and trends

National fishing is a small emission source in the Netherlands. In 2024, national fishing was responsible for 1.0% of SO<sub>x</sub> and 1.7% of NO<sub>x</sub> emissions. The contribution to the national totals of PM<sub>10</sub>, PM<sub>2.5</sub> and BC was 1–3%, and for other substances it was less than 1%. Fuel consumption by national fishing has been decreasing since 1999. The trends in emissions from national fishing are presented in Table 4.16.

Table 4.16 Trends in emissions from National fishing in the Netherlands

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOC	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>21</b>	<b>1.4</b>	<b>5.0</b>	<b>0.00</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	<b>0.33</b>	<b>1.5</b>
1995	23	1.4	5.9	0.00	1.2	1.3	1.3	0.36	1.5
2000	23	1.3	5.2	0.00	1.1	1.2	1.2	0.34	1.4
2005	16	0.81	3.4	0.00	0.70	0.74	0.74	0.22	0.92
2010	12	0.52	1.8	0.00	0.52	0.54	0.54	0.15	0.63
2015	9.0	0.36	0.54	0.00	0.32	0.34	0.34	0.10	0.46
2020	7.4	0.30	0.32	0.00	0.24	0.25	0.25	0.08	0.38
2021	6.2	0.25	0.27	0.00	0.20	0.21	0.21	0.07	0.32
2022	4.8	0.20	0.21	0.00	0.15	0.16	0.16	0.05	0.25
2023	4.9	0.18	0.19	0.00	0.14	0.15	0.15	0.05	0.23
<b>2024</b>	<b>4.8</b>	<b>0.18</b>	<b>0.19</b>	<b>0.00</b>	<b>0.14</b>	<b>0.14</b>	<b>0.14</b>	<b>0.05</b>	<b>0.22</b>
1990-2024 <sup>1)</sup>	-16	-1.2	-4.8	0.00	-0.97	-1.02	-1.02	-0.29	-1.25
1990-2024 <sup>2)</sup>	-77%	-87%	-96%	-72%	-88%	-88%	-88%	-86%	-85%
% 2024 <sup>3)</sup>	3%	0%	1%	0%	1%	1%	0%	2%	0%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

For the most part, emissions from national fishing show similar trends to emissions from fuel consumption. NO<sub>x</sub> emissions decreased significantly between 1990 and 2024, as did PM<sub>10</sub> emissions. SO<sub>x</sub> emissions decreased due to the use of sulphur-free diesel fuel.

#### 4.7.4 *Activity data and (implied) emission factors*

Fuel consumption in fishing was derived from fuel-sold statistics in the Netherlands, and emissions from all national fishing were estimated according to the fuel sold in the country and IEFs calculated on the basis of AIS data. From 2016 onwards, two methodologies based on AIS data have been applied. For deep-sea trawlers, the methodology used for maritime navigation was applied (see Section 4.5.4) because it is assumed that no fishing activities take place on Dutch national territory. This means that these vessels essentially are only sailing to and from their fishing grounds. As a result, energy use can be calculated in the same manner as for maritime shipping. For the other fishing vessel categories (smaller vessels, mostly cutters), the methodology is described in detail by Hulskotte & ter Brake (2017). This is essentially an energy-based method whereby the energy rates of fishing vessels are broken down by activity (sailing and fishing), with a distinction made in the available power of propulsion engine(s). The methodology is described in greater detail in Chapter 6 of Witt et al. (2026a).

#### 4.7.5 *Methodological issues*

The emissions by fishing vessels have not been measured. Basing EFs on measurements for most common fishing vessels during various operational conditions could improve emission estimates.

#### 4.7.6 *Uncertainties and time series consistency*

As of 2016, the AIS-based approach to calculating emissions from fishing has been applied to the calculation of emissions. The IEFs for 2016 were subsequently adjusted to create a consistent time series for 1990–2015, using the trend in EFs for inland shipping. This trend is based on fleet renewal data and the age class of engines for inland shipping.

In 2016, an experts' workshop was conducted to discuss and estimate the uncertainties in the activity data and EFs used for the emission calculations for the Transport sector (Dellaert & Dröge, 2017). The resulting uncertainty estimates for national fishing are provided in Table 4.17.

Table 4.17 *Uncertainty estimates for national fishing (%)*

NFR	Type	Fuel	Uncertainty: activity data	Uncertainty: emission factor					
				NO <sub>x</sub>	SO <sub>x</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	EC	NMVOG
1A4ciii	National fishing	Diesel	15	30	20	50	50	50	100

Dellaert & Dröge (2017)

Note that the uncertainty in the activity data for fisheries applies to the bottom-up approach, using AIS data, and does not apply to the top-down approach, which uses the fuel sales from the energy statistics to

estimate the activity data. The top-down approach is used for the reports of emissions for the National Emission Ceilings Directive (NECD).

**4.7.7** *Source-specific QA/QC and verification*

This year, no source-specific QA/QC and verification procedures were carried out for national fishing.

**4.7.8** *Source-specific recalculations*

There were no source-specific recalculations for national fishing.

**4.7.9** *Source-specific planned improvements*

The emission calculations for heavy metals, PCBs/HCBs and dioxins and for PAHs are based on activity data that is not in line with the scope of other emissions in the inventory. Instead of on fuel sold, emissions are based on the AIS data for fishing ships on Dutch national territory. Due to technical implementation difficulties, translation to fuel-sold emissions has not yet been performed. The AIS data-based emissions are estimated to be twice as high as fuel-sold emissions. Therefore, we expect an overestimation of these emissions in the current inventory. This issue is on the list of inventory improvements.

## 5 Industrial Processes and Product Use

### 5.1 Overview of the sector

Emissions from the Industrial processes and product use (IPPU) sector include all non-energy-related emissions from industrial activities and product use. Data on the emissions from fuel combustion relating to industrial activities and product use is included in the data on the Energy sector (Chapter 3). Fugitive emissions in the Energy sector (i.e. not relating to fuel combustion) are included in NFR sector 1B (Section 3.5).

The IPPU sector (NFR 2) consists of the following source categories:

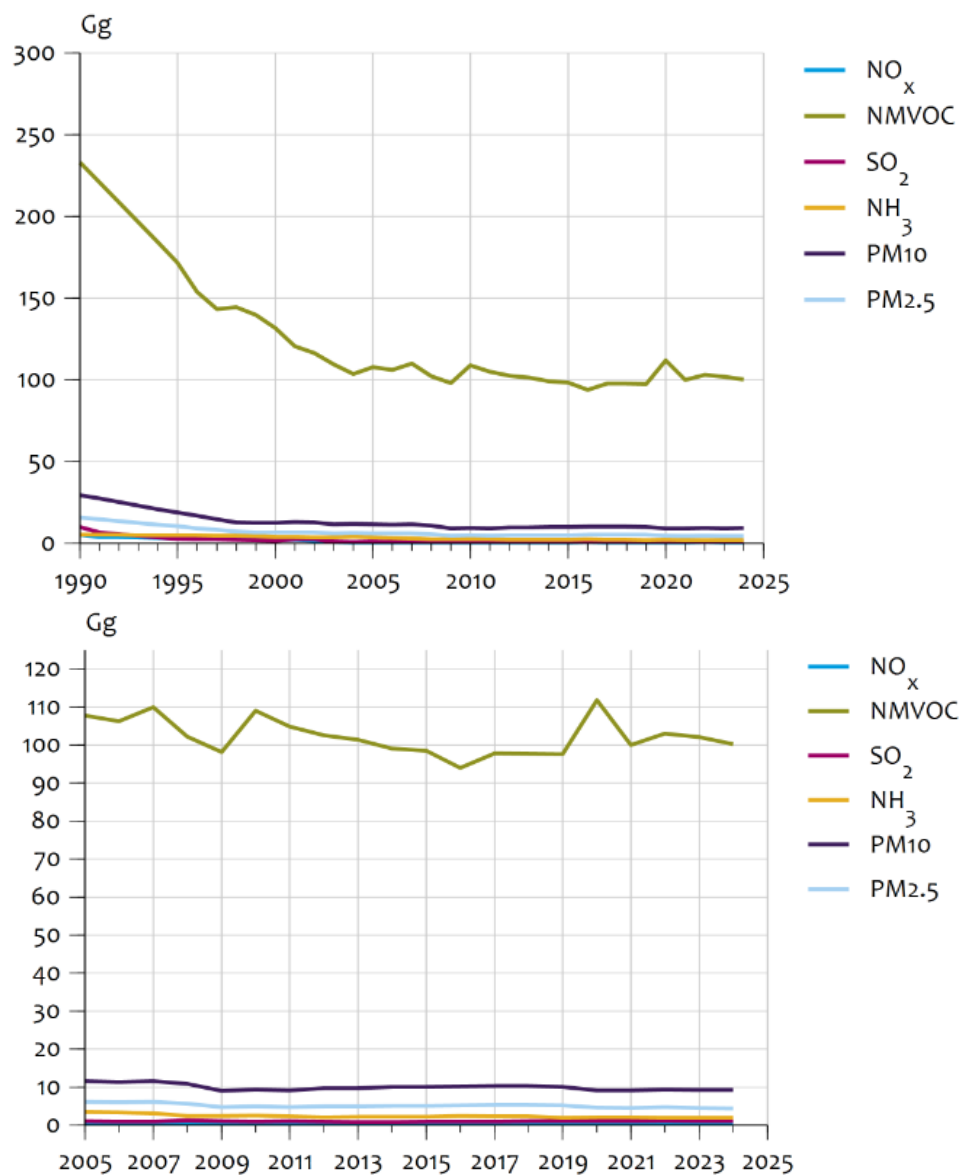
- 2A Mineral products;
- 2B Chemical industry;
- 2C Metal production;
- 2D Product and solvent use;
- 2G Other product use;
- 2H Other production industry;
- 2I Wood processing;
- 2J Production of POPs;
- 2K Consumption of POPs and heavy metals;
- 2L Other production, consumption, storage, transport or handling of bulk products.

No emissions are reported for 2I, 2J, 2K, and 2L.

- *Source category 2I (Wood processing)* includes the primary processing and conservation of wood for industry and the building and construction sector, as well as for the construction of wooden objects and floors. Because of minor emissions, no emissions are reported under source category 2I.
- *Source categories 2J and 2K (Production and consumption of POPs)*: Since 1998, the Netherlands has banned the production and consumption of Persistent Organic Pollutants (POPs). Emissions from the consumption of heavy metals are considered insignificant. Therefore, no emissions are reported in source categories 2J and 2K.
- *Source category 2L*: Because the 2019 Guidebook is not clear about which sources belong to source category 2L, emissions from other industrial processes are included in source category 2H3 (Other industrial processes).

Figure 5.1 shows the trend in the emissions of the main pollutants from the IPPU sector between 1990-2024 and 2005-2024.

Figure 5.1 Emission trends for the main pollutants in NFR 2 – Industrial Processes and Product Use between 1990-2024 (upper panel) and 2005-2024 (lower panel)



In 2024, 43% of total NMVOC, 35% of total PM<sub>10</sub>, 32% of total PM<sub>2.5</sub>, 7% of total SO<sub>x</sub> and 2% of total NH<sub>3</sub> emissions in the Netherlands originated from the IPPU sector (Figure 2.1).

#### 5.1.1 Key sources

The key sources of this sector are discussed in Sections 5.2 to 5.7.

#### 5.1.2 Methodological issues

##### **Industrial processes**

The emission totals of categories and subcategories consist of the sum of the data from individual facilities, complemented by estimated emissions from the non-reporting (small and medium-sized) facilities. To estimate these emissions, the following method is used:

Up to 2000, the emissions from non-reporting facilities were calculated as follows:

$$\text{Em non\_IF} = \text{IEF} * (\text{TP} \text{ -/- } \text{P\_IF})$$

where:

IEF = implied emission factor;

TP = total production in (sub)category (Production Statistics, Statistics Netherlands);

P\_IF = production in individual facilities (Production Statistics, Statistics Netherlands).

The IEFs were calculated as follows:

$$\text{IEF} = \text{Em\_IF} / \text{P\_IF}$$

where:

Em\_IF = the sum of the emission data on the individual facilities.

Since 2000, due to a lack of production figures and emission data on individual facilities, the emission totals of the categories and subcategories have been calculated as follows:

$$\text{Em Total (sub)category}_{(n)} = \text{Em Total (sub)category}_{(n-1)} * (\text{PI}_{(n)} / \text{PI}_{(n-1)})$$

where:

n = year;

PI = production indices (Statistics Netherlands).

Finally, the supplemental emissions (Em\_sup) from these emission sources are calculated as follows:

$$\text{Em\_sup}_{(n)} = \text{Em Total (sub)category}_{(n)} - \text{EmComp}_{(n)}$$

where:

Em Total (sub)category<sub>(n)</sub> = total emissions by the (sub)categories;

EmComp<sub>(n)</sub> = emissions by individually registered companies (PRTR-I).

If reduction measures are known to have been implemented, the emissions will be reduced by the reduction percentage achieved by these measures.

### **Product use**

For product use, specific methodologies have been applied. Therefore, the methodological issues of the product use categories are included in Section 5.5, Solvents and product use (2D).

#### **5.1.3** *Uncertainties and time series consistency*

Consistent methodologies were used throughout the time series for the sources in this sector.

The Netherlands implements an Approach 2 methodology for uncertainty analyses. This methodology was used for uncertainty analyses on the pollutants NH<sub>3</sub>, NO<sub>x</sub>, SO<sub>x</sub>, and PM. Table 5.1 provides an overview of the results for the Approach 2 uncertainties at NFR source category level.

Table 5.1 Overview of Approach 2 uncertainties for IPPU NFR source categories

NFR source category	Pollutants uncertainty					
	NH <sub>3</sub>	NO <sub>x</sub>	SO <sub>x</sub>	NMVOC	PM <sub>10</sub>	PM <sub>2.5</sub>
2A	77%	82%	83%	131%	79%	123%
2B	92%	NA	NA	54%	60%	62%
2C	92%	NA	NA	109%	106%	110%
2D	71%	NA	NA	36%	52%	52%
2G	89%	81%	114%	36%	91%	80%
2H	154%	51%	50%	152%	69%	65%
2I	NA	NA	NA	100%	194%	202%
2J	NA	NA	NA	NA	NA	NA
2K	NA	NA	NA	NA	NA	NA
2L	NA	NA	NA	NA	NA	NA
<b>Total IPPU sector</b>	<b>52%</b>	<b>77%</b>	<b>80%</b>	<b>37%</b>	<b>40%</b>	<b>55%</b>

#### 5.1.4 Source-specific QA/QC and verification

The source categories of this sector are covered by the general QA/QC procedures, as discussed in Section 1.6.2.

#### 5.1.5 Source-specific planned improvements

Source-specific planned improvements are discussed per subcategories below.

## 5.2 Mineral products (2A)

### 5.2.1 Source category description

This category comprises emissions relating to the production and use of non-metallic minerals in:

- 2A1 Cement production;
- 2A2 Lime production;
- 2A3 Glass production;
- 2A5a Quarrying and mining of minerals other than coal;
- 2A5b Construction and demolition;
- 2A5c Storage, handling and transport of mineral products;
- 2A6 Other mineral products.

Remarks:

- Due to allocation problems, emissions from 2A2 are included in the subcategory of Other mineral products (2A6).
- Emissions from 2A5a are currently assigned to 1A2gvii, 2A1, and 2H3. This is because companies that undertake these activities are responsible for various processes and thus for emissions from various categories. For now, it is unclear how to split emissions from Quarrying and mining of minerals other than coal (2A5a) from others.
- Only emissions from Glass production (2A3) and Cement production (2A1) could be reported separately, because

emissions in these categories could be derived from the AERs of the relevant companies.

- 2A3 is not a key source of Cd emissions. However, the Cd series for 2A3 shows a few strong outliers: especially in 2017 and 2020 strong peaks in emissions occur. These emission peaks are caused by a single glass production company, which reported a failure of its emission reduction measures for those years.
- The emission totals of 2A3 and 2A6 consist of the sum of the reported emissions from individual facilities, supplemented by estimated emissions from the non-reporting facilities. Most of the data on emissions from 2A (more than 90%) is obtained from the AERs of individual facilities (Tier 3 methodology), which are validated and approved by their competent authorities. According to the Aarhus Convention, only total emissions need to be included in the AERs. This means that production levels, if they are included, are confidential information. However, most companies do not include any production data. For this reason, it is not possible to provide activity data and determine/calculate IEFs.

The emissions from non-reporting facilities are calculated from production indices of the mineral industry from Statistics Netherlands.

- The EMEP/EEA air pollutant emission inventory guidebook does not provide methods for calculating emissions from asphalt production. Because asphalt production plants in the Netherlands are sometimes located close to populated areas, there were requests for emission data. To calculate this data, a Tier 1 method was developed on the basis of US-EPA emission factors. This concerns emissions of MNVOC, PM<sub>10</sub>, PM<sub>2.5</sub>, benzene, PAH and cadmium, which are reported under 2A6.

### 5.2.2 Key sources

The key sources in this category are presented in Table 5.2.

Table 5.2 Level 2024 key sources in Mineral products (2A)

Category / Subcategory		Pollutant	Contribution to total of 2024 (%)
2A3	Glass production	Pb	8.7
2A5b	Construction and demolition	PM <sub>10</sub>	6.3
		PM <sub>2.5</sub>	4.0
2A5c	Storage, handling, transport mineral products	PM <sub>10</sub>	2.7
2A6	Other mineral products	PM <sub>10</sub>	4.4
		PM <sub>2.5</sub>	7.5
		Hg	18.0

### 5.2.3 Overview of emission shares and trends

Table 5.3 provides an overview of the emissions from category 2A.

Table 5.3 Overview of emissions from Mineral products (2A)

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOG	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>1.3</b>	<b>1.1</b>	<b>7.5</b>	<b>0.64</b>	<b>2.6</b>	<b>5.4</b>	<b>13</b>	<b>0.00</b>	<b>3.9</b>
1995	1.3	0.44	2.7	0.57	2.2	4.2	9.6	0.00	2.6
2000	1.0	0.21	1.5	0.48	1.5	2.9	3.0	0.00	1.7
2005	0.51	0.15	0.99	0.43	1.6	3.2	5.3	0.00	1.9
2010	0.51	0.15	0.87	0.08	1.5	3.1	5.2	0.00	2.6
2015	0.53	0.11	0.84	0.07	1.5	3.1	5.2	0.00	3.1
2020	0.62	0.14	0.98	0.05	1.8	3.3	4.9	0.00	3.0
2021	0.62	0.12	1.0	0.05	1.9	3.5	5.4	0.00	3.1
2022	0.65	0.13	1.2	0.06	2.0	3.8	5.6	0.00	3.3
2023	0.54	0.11	1.0	0.05	1.7	3.4	4.9	0.00	2.8
<b>2024</b>	<b>0.60</b>	<b>0.10</b>	<b>1.0</b>	<b>0.04</b>	<b>1.7</b>	<b>3.6</b>	<b>5.3</b>	<b>0.00</b>	<b>2.6</b>
1990-2024 <sup>1)</sup>	-0.7	-1.0	-6.5	-0.59	-0.9	-1.8	-8.1	0.00	-1.2
1990-2024 <sup>2)</sup>	-54%	-91%	-87%	-93%	-33%	-33%	-60%	-100%	-32%
% 2024 <sup>3)</sup>	0%	0%	6%	0%	13%	14%	17%	0%	1%

Table 5.3 Overview of emissions from Mineral products (2A) (continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>7.4</b>	<b>0.01</b>	<b>0.11</b>	<b>0.00</b>	<b>0.41</b>	<b>0.12</b>	<b>0.19</b>	<b>1.2</b>	<b>0.53</b>	<b>0.00</b>	<b>1.2</b>
1995	6.6	0.00	0.10	0.00	0.40	0.00	0.00	1.2	0.00	0.00	0.47
2000	2.9	0.00	0.10	0.00	0.42	0.00	0.00	1.2	0.00	0.00	0.47
2005	1.4	0.01	0.10	0.00	0.40	0.09	0.13	1.2	0.02	0.60	0.00
2010	0.84	0.00	0.10	0.00	0.46	0.14	0.06	1.2	0.01	0.06	0.00
2015	0.98	0.00	0.10	0.00	0.40	0.15	0.07	1.3	0.01	0.05	0.00
2020	1.58	0.07	0.11	0.00	0.35	0.04	0.09	1.4	0.01	0.07	0.00
2021	0.47	0.01	0.10	0.00	0.35	0.02	0.05	0.25	0.00	0.07	0.00
2022	0.48	0.01	0.09	0.00	0.37	0.09	0.17	0.00	0.00	0.07	0.20
2023	0.36	0.00	0.08	0.00	0.30	0.01	0.05	0.00	0.01	0.06	1.9
<b>2024</b>	<b>0.40</b>	<b>0.00</b>	<b>0.07</b>	<b>0.00</b>	<b>0.28</b>	<b>0.01</b>	<b>0.01</b>	<b>0.21</b>	<b>0.00</b>	<b>0.06</b>	<b>0.28</b>
1990-2024 <sup>1)</sup>	-7.1	0.00	-0.04	0.00	-0.13	-0.11	-0.18	-1.0	-0.52	0.05	-0.9
1990-2024 <sup>2)</sup>	-95%	-52%	-35%		-31%	-94%	-94%	-83%	-100%	1312%	-76%
% 2024 <sup>3)</sup>	9%	1%	19%	0%	6%	3%	0%	0%	0%	52%	0%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

The reduction of Pb emissions from 2A3 between 1990 and 2023 was mainly caused by the implementation of technical measures.

The most important source of PM<sub>10</sub> and PM<sub>2.5</sub> emissions is 2A6, and within this category the ceramic industry (Production of bricks, roof tiles, etcetera) is the main contributor. An initial strong reduction of PM<sub>10</sub> emissions from 2A6 in the early years (1990–2000) was a result of the implementation of technical measures. More recently, slight changes in emissions result from changes in production.

#### 5.2.4 *Methodological issues*

See Section 5.1.2 for the calculation method for emissions from Glass production (2A3) and Other mineral products (2A6). Emissions from non-reporting facilities are calculated from production indices of the mineral industry from Statistics Netherlands.

As described above, a Tier 1 method was developed to calculate emissions from asphalt production. Calculation is based on US-EPA emission factors, and asphalt production data. This concerns emissions of MNVOC, PM<sub>10</sub>, PM<sub>2.5</sub>, benzene, PAH and cadmium.

#### 5.2.5 *Source-specific recalculations*

- For category 2A6, Asphalt production, emissions of NMVOC, PM<sub>10</sub>, PM<sub>2.5</sub>, benzene, PAH and cadmium were recalculated as result of availability of new activity data.
- For category 2A5b, Construction and demolition, particulate matter emissions (PM<sub>10</sub>, PM<sub>2.5</sub>) were recalculated for the entire time series because the previous correction of a supposed double counting was reversed.
- In the previous submissions, for category 2A1, 2A2 and 2A3 EC<sub>2.5</sub> emissions were calculated based on the ratio EC<sub>2.5</sub>/PM<sub>10</sub>. This sometimes resulted in EC<sub>2.5</sub> emissions that were higher than PM<sub>2.5</sub> emissions, when a company has reported relatively low PM<sub>2.5</sub> emissions. In this submission, the EC<sub>2.5</sub> emissions are now calculated based on the ratio EC<sub>2.5</sub>/PM<sub>2.5</sub>. The ratios are based on the EMEP/EEA 2023 Guidebook. This has been implemented for the complete time series.
- For category 2A3 and years 2022 and 2023, NMVOC recalculations result from one company updating their AER.
- For category 2A5c Storage, handling and transport of mineral products, particulate matter emissions (PM<sub>10</sub>, PM<sub>2.5</sub>, and TSP) were recalculated for 2023 result of availability of new data.

#### 5.2.6 *Source-specific planned improvements*

For 2A5a, PM<sub>2.5</sub> and PM<sub>10</sub> are currently included elsewhere (IE). Emissions by companies responsible for these PM emissions are now reported under 1A2gvii, 2A1, and 2H3. It is currently unclear which contribution of these PM emissions actually belongs to 2A5a. Also, it needs to be investigated to what extent emissions from 2A5a are reported at all. This will be examined for future submissions.

## 5.3 Chemical industry (2B)

### 5.3.1 Source category description

This category comprises emissions from the following sources:

- 2B1 Ammonia production;
- 2B2 Nitric acid production;
- 2B3 Adipic acid production;
- 2B5 Carbide production;
- 2B6 Titanium dioxide production;
- 2B7 Soda ash production;
- 2B10a Chemical industry: Other;
- 2B10b Storage, handling and transport of chemical products.

Remarks:

- Adipic acid (2B3) is not produced in the Netherlands. As such, emissions do not occur (NO).
- For carbide production (2B5), only silicon carbide is produced in the Netherlands, but no calcium carbide.
- Because of allocation problems and for confidentiality reasons, emissions from 2B1, 2B2, Silicon carbide (2B5), 2B6 and 2B7 are included in 2B10a, Chemical industry: Other. The emission total for the chemical sector consists of the sum of the reported emissions from individual facilities, supplemented by estimated emissions from the non-reporting facilities. Most of the data on emissions from the chemical sector (ca. 80–90%) is obtained from the AERs of individual facilities (Tier 3 methodology), which are validated and approved by their competent authority. The majority of those facilities produce several products. Generally, therefore, the emission total is the sum of the emissions from all production processes. According to the Aarhus Convention, only total emissions need to be included in the AERs. This means that production levels and amounts of solvents used, if they are included, are confidential information. However, most companies do not include any production data or amounts of solvents used. For this reason, it is not possible to provide activity data or to determine/calculate IEFs. By this same reasoning, emissions from 2D3g are also included in 2B10a. The emissions from non-reporting facilities are calculated from production indices of the chemical sector from Statistics Netherlands.
- Energy-related emissions are included under combustion emissions (categories 1A1c).

### 5.3.2 Key sources

The key sources of this category are presented in Table 5.4.

Table 5.4 Level 2024 key sources in Chemical industry (2B)

	Category / Subcategory	Pollutant	Contribution to total of 2024 (%)
2B10a	Chemical industry: Other	PM <sub>10</sub> /PM <sub>2.5</sub>	2.4/2.8
		Cd	13.3
		Pb	3.7

## 5.3.3

*Overview of emission shares and trends*

Table 5.5 provides an overview of the emissions from category 2B.

*Table 5.5 Overview of emissions from Chemical industry (2B)*

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOC	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>2.9</b>	<b>33</b>	<b>0.00</b>	<b>2.9</b>	<b>2.6</b>	<b>4.1</b>	<b>6.0</b>	<b>0.05</b>	<b>0.05</b>
1995	1.8	18	0.00	2.9	1.9	3.0	4.9	0.03	0.01
2000	0.80	13	0.09	1.8	0.32	0.60	1.1	0.01	0.10
2005	0.00	7.9	0.00	1.4	0.71	1.2	2.5	0.01	0.01
2010	0.00	5.7	0.00	0.63	0.87	1.3	2.0	0.01	0.01
2015	0.00	4.7	0.00	0.52	0.69	1.1	1.6	0.01	0.01
2020	0.00	4.4	0.00	0.41	0.45	0.72	1.1	0.00	0.00
2021	0.00	4.4	0.00	0.40	0.52	0.80	1.2	0.00	0.00
2022	0.00	3.7	0.00	0.34	0.43	0.68	1.0	0.00	0.00
2023	0.00	3.3	0.00	0.40	0.42	0.67	1.0	0.00	0.00
<b>2024</b>	<b>0.00</b>	<b>3.2</b>	<b>0.00</b>	<b>0.34</b>	<b>0.39</b>	<b>0.62</b>	<b>1.0</b>	<b>0.00</b>	<b>0.00</b>
1990-2024 <sup>1)</sup>	-2.9	-30	0.00	-2.6	-2.2	-3.5	-5.0	-0.04	-0.05
1990-2024 <sup>2)</sup>	-100%	-90%	-100%	-88%	-85%	-85%	-83%	-93%	-94%
% 2024 <sup>3)</sup>	0%	1%	0%	0%	3%	2%	3%	0%	0%

Table 5.5 Overview of emissions from Chemical industry (2B) (continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>3.0</b>	<b>0.03</b>	<b>0.70</b>	<b>0.04</b>	<b>0.65</b>	<b>0.00</b>	<b>0.32</b>	<b>0.02</b>	<b>0.65</b>	<b>0.00</b>	<b>29</b>
1995	1.3	0.06	0.38	0.00	0.01	0.00	0.14	0.03	0.57	0.00	5.0
2000	1.8	0.13	0.20	1.1	0.00	0.00	0.21	0.59	0.22	0.00	9.4
2005	2.2	0.80	0.05	0.00	0.00	0.01	0.07	0.06	0.03	0.19	5.0
2010	0.24	1.4	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.00	1.7
2015	0.19	0.08	0.00	0.00	0.01	0.00	0.01	0.00	0.06	0.00	0.87
2020	0.20	0.09	0.00	0.00	0.01	0.00	0.01	0.01	0.06	0.00	1.4
2021	0.21	0.09	0.00	0.00	0.01	0.00	0.01	0.01	0.06	0.00	1.4
2022	0.19	0.09	0.00	0.00	0.01	0.00	0.01	0.01	0.06	0.00	1.6
2023	0.17	0.08	0.00	0.00	0.01	0.00	0.01	0.01	0.06	0.00	1.5
<b>2024</b>	<b>0.17</b>	<b>0.08</b>	<b>0.00</b>	<b>0.00</b>	<b>0.01</b>	<b>0.00</b>	<b>0.01</b>	<b>0.01</b>	<b>0.05</b>	<b>0.00</b>	<b>1.2</b>
1990-2024 <sup>1)</sup>	-2.8	0.05	-0.70	-0.04	-0.64	0.00	-0.32	-0.02	-0.60	0.00	-27.4
1990-2024 <sup>2)</sup>	-94%	146%	-100%	-97%	-99%		-98%	-77%	-92%		-96%
% 2024 <sup>3)</sup>	4%	13%	0%	0%	0%	0%	0%	0%	2%	3%	1%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

Between 1990 and 2024, the reductions in NMVOC and PM emissions were mainly caused by the implementation of technical measures.

#### 5.3.4 Methodological issues

See Section 5.1.2 for the calculation method for emissions from Other chemical industry (2B10a). The production indices of the Chemical sector are obtained from Statistics Netherlands and used to calculate the emissions from the non-reporting facilities.

#### 5.3.5 Source-specific recalculations

For category 2B:

- In the previous submission, EC<sub>2.5</sub> emissions were calculated based on the ratio EC<sub>2.5</sub>/PM<sub>10</sub>. This sometimes resulted in EC<sub>2.5</sub> emissions that were higher than PM<sub>2.5</sub> emissions, when a company has reported relatively low PM<sub>2.5</sub> emissions. In this submission, the EC<sub>2.5</sub> emissions are now calculated based on the ratio EC<sub>2.5</sub>/PM<sub>2.5</sub>. The ratios are based on the EMEP/EEA 2023 Guidebook. This has been implemented for the complete time series.
- A completeness check for the years 1990 - 2010 resulted in a correction of missing dioxin emissions in these years.

### 5.3.6 *Source-specific planned improvements*

Some improvements are still planned:

- Improving transparency for this sector by assigning emissions to more subcategories of NFR 2B, instead of mostly to 2B10a, as is the current state of affairs.
- As described before, most of the data on emissions from the chemical sector (ca. 80-90%) is obtained from the AERs of individual facilities, which are validated and approved by their competent authorities. However, most emissions originate from one large chemical site that produces many different chemical products but only reports total emissions from the site. This makes it impossible to disaggregate emissions into different NFR categories, but improvements are being made in providing more detailed data from that AER.
- Furthermore, there are plans to add a more extensive summary of the industries included in 2B10a in future submissions in order to improve transparency on the emissions and industries included here.

## 5.4 **Metal production (2C)**

### 5.4.1 *Source category description*

This category comprises emissions relating to the following sources:

- 2C1 Iron and steel production;
- 2C2 Ferroalloys production;
- 2C3 Aluminium production;
- 2C4 Magnesium production;
- 2C5 Lead production;
- 2C6 Zinc production;
- 2C7a Copper production;
- 2C7b Nickel production;
- 2C7c Other metal production;
- 2C7d Storage, handling and transport of metal products.

Remarks:

- For confidentiality reasons, emissions from 2C4 are included in the subcategory 2H3.
- There is one lead, one copper and one zinc producer in the Netherlands (2C5–2C7a). As a result of a review question, Cd emissions measurement reports were requested at the copper producing company. This resulted in a Cd emission of 0.68 kg for one year, which is below the EPRTR reporting threshold and the threshold of significance. Therefore, NE is reported. Also, the company promised to undertake further measurement actions.
- Emissions for categories 2C2 and 2C7b are not occurring (NO), as both ferroalloys and nickel production are non-existent in the Netherlands.
- Since only emissions from the storage and handling of bulk products companies are available, emissions from 2C7d are included in the category of Other industrial processes (2H3).

### 5.4.2 *Key sources*

The key sources of this category are presented in Table 5.6.

Table 5.6 Level 2024 key sources in Metal production (2C)

Category / Subcategory	Pollutant	Contribution to total of 2024 (%)
2C1 Iron and steel production	PM <sub>10</sub>	3.5
	PM <sub>2.5</sub>	3.8
	Pb	23.3
	Cd	14.0
	Hg	7.5
2C6 Zinc production	Cd	4.9

### 5.4.3 Overview of emission shares and trends

Table 5.7 provides an overview of the process emissions from category 2C.

Table 5.7 Overview of emissions from Metal production (2C)

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NM VOC	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>0.00</b>	<b>3.8</b>	<b>0.00</b>	<b>0.07</b>	<b>6.8</b>	<b>10</b>	<b>11</b>	<b>0.15</b>	<b>0.00</b>
1995	0.00	2.9	0.00	0.03	3.7	5.5	6.3	0.08	0.01
2000	0.00	1.9	0.00	0.04	2.0	2.8	2.8	0.05	0.05
2005	0.00	1.4	0.00	0.05	1.5	2.1	4.6	0.03	0.00
2010	0.00	0.9	0.00	0.01	0.60	0.83	1.0	0.01	0.00
2015	0.00	1.4	0.00	0.03	0.81	1.2	2.5	0.02	0.00
2020	0.00	1.4	0.00	0.03	0.70	1.2	2.4	0.01	0.00
2021	0.00	1.2	0.00	0.02	0.70	1.2	2.4	0.01	0.00
2022	0.00	1.2	0.00	0.02	0.62	1.0	2.1	0.01	0.00
2023	0.00	0.87	0.00	0.02	0.50	0.86	1.9	0.01	0.00
<b>2024</b>	<b>0.00</b>	<b>1.3</b>	<b>0.00</b>	<b>0.02</b>	<b>0.53</b>	<b>0.91</b>	<b>2.0</b>	<b>0.01</b>	<b>0.00</b>
1990-2024 <sup>1)</sup>	0.00	-2.5	0.00	-0.05	-6.3	-9.2	-9.1	-0.14	0.00
1990-2024 <sup>2)</sup>		-67%		-68%	-92%	-91%	-82%	-92%	
% 2024 <sup>3)</sup>	0%	1%	0%	0%	4%	3%	7%	1%	0%

Table 5.7 Overview of emissions from Metal production (2C) (continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>56</b>	<b>2.6</b>	<b>0.39</b>	<b>23</b>	<b>8.6</b>	<b>0.43</b>	<b>2.1</b>	<b>2.0</b>	<b>1.4</b>	<b>0.31</b>	<b>109</b>
1995	58	2.3	0.35	26	3.3	0.49	1.8	1.9	1.7	0.22	96
2000	20	2.4	0.09	1.4	0.23	0.77	1.8	1.6	0.26	0.00	48
2005	24	2.5	0.21	1.4	0.22	0.29	1.1	1.0	0.86	0.00	33
2010	30	2.8	0.19	0.00	0.12	0.34	0.80	1.7	1.1	0.00	39
2015	4.6	2.4	0.13	0.27	0.09	0.44	0.58	0.62	0.89	0.00	47
2020	1.7	1.5	0.08	0.26	0.07	0.06	0.26	0.28	0.36	0.00	127
2021	1.5	0.4	0.06	0.22	0.13	0.07	0.28	0.27	0.29	0.00	99
2022	1.3	0.35	0.06	0.17	0.12	0.05	0.39	0.29	0.35	0.00	100
2023	0.75	0.05	0.04	0.13	0.10	0.06	0.27	0.23	0.25	0.00	14
<b>2024</b>	<b>1.2</b>	<b>0.11</b>	<b>0.03</b>	<b>0.27</b>	<b>0.09</b>	<b>0.10</b>	<b>0.96</b>	<b>3.1</b>	<b>1.2</b>	<b>0.00</b>	<b>32</b>
1990-2024 <sup>1)</sup>	-55	-2.5	-0.36	-22.8	-8.5	-0.34	-1.2	1.1	-0.2	-0.31	-76
1990-2024 <sup>2)</sup>	-98%	-96%	-92%	-99%	-99%	-77%	-55%	56%	-12%	-100%	-70%
% 2024 <sup>3)</sup>	27%	19%	8%	1%	2%	37%	23%	3%	46%	0%	37%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

### **Iron and steel production (2C1)**

The Netherlands has one integrated iron and steel plant (Tata Steel, formerly known as Corus and Hoogovens). Integrated steelworks convert iron ore into steel by means of sintering, produce pig iron in blast furnaces and subsequently convert this pig iron into steel in basic oxygen furnaces.

Energy-related emissions are included under combustion emissions (categories 1A1c and 1A2a) and fugitive emissions (category 1B2).

Over the 1990–2000 period, the emission reductions from this source were mainly caused by the implementation of technical measures. Over the 2000–2010 period, emissions remained fairly stable. Because of the replacement of electrostatic filters and the optimisation of some other emission reduction technologies at Tata Steel, most emissions decreased again after 2010. Dioxin emission fluctuations were mainly caused by the varying process conditions. As a result of a review question, HCB emissions were estimated for the Tata Steel plant.

### **Aluminium production (2C3)**

Formerly, the Netherlands had two primary aluminium smelters, of which the last one closed in 2022. Since then, no aluminium production has taken place in the Netherlands. Aluminium production caused PAH emissions, originating from 'producing anodes' and the 'use of anodes' during primary aluminium production. Over the 1990–2021 period, PAH

emissions decreased from 6.9 Mg to 0.01 Mg. This reduction was mainly caused by

- the closure of one of the anode production plants; and
- the installation of three modern fume treatment plants at the other production plant.

### **Lead production (2C5), zinc production (2C6) and copper production (2C7a)**

The following remarks can be made:

- Since 2009, the single copper production company has not reported PM<sub>10</sub> emissions because the emissions are far below the reporting threshold of 5000 kg. For this reason, PM<sub>10</sub> emissions are reported as 'NE' in 2C7a. Normally, the reported PM<sub>10</sub> emissions are used to calculate PM<sub>2.5</sub> emissions, but that is not possible in this case. Therefore, PM<sub>2.5</sub> emissions are also reported as 'NE' in 2C7a. See Section 5.4.5, Source-specific planned improvements, for more information.
- For 2C7a, multiple compounds are reported as 'IE', as they are included in NFR category 1A2b. This is the case for NO<sub>x</sub>, SO<sub>x</sub>, CO, Hg, As, and dioxins. As a result of a review question, Cd emissions for the copper producing company were investigated and these are reported as 'NE' (see section 5.4.1).
- The lead production company reports no SO<sub>x</sub> emissions because the emissions are below the reporting threshold of 20,000 kg. For this reason, no SO<sub>x</sub> emissions are reported in 2C5.
- Because it is not possible to split SO<sub>x</sub> emissions from 2C6, all SO<sub>x</sub> emissions are reported in 1A2b.
- Hg emissions from lead production have remained fairly stable since 2012, while Pb emissions from zinc production doubled between 2010 and 2014.
- The zinc production company does not report any Hg emissions. This company reports that annual measurements at the chimney reveal that no, or very little mercury is emitted. This is also because the mercury present in the ore is removed by forming a mercury-selenium compound before the ore gets in contact with sulphuric acid in the process.
- Because of high energy prices, the zinc production company has a temporary shutdown as of 2023. This results in a strong decrease in emissions in 2023.

#### **5.4.4 Methodological issues**

See Section 5.1.2 for the calculation method for emissions from iron and steel, aluminium, lead and zinc production. In cases without a complete registration for the four individual PAHs, a set of factors was used to calculate the emissions of the missing PAHs. These factors were obtained from a study conducted by Visschedijk et al. (2007).

#### **5.4.5 Source-specific recalculations**

- As a result of review questions, HCB emissions are estimated for 2C1.
- In the previous submission, for category 2C1 and 2C3, EC<sub>2.5</sub> emissions were calculated based on the ratio EC<sub>2.5</sub>/PM<sub>10</sub>. This sometimes resulted in EC<sub>2.5</sub> emissions that were higher than PM<sub>2.5</sub> emissions, when a company has reported relatively low

PM<sub>2.5</sub> emissions. In this submission, the EC<sub>2.5</sub> emissions are now calculated based on the ratio EC<sub>2.5</sub>/PM<sub>2.5</sub>. The ratios are based on the EMEP/EEA 2023 Guidebook. This has been implemented for the complete time series.

- For category 2C1, company updates of their AER result in recalculations of dioxin emissions for years 2019 - 2023, and NMVOC emissions for year 2023.

#### 5.4.6 *Source-specific planned improvements*

For 2C5, TSP emissions have been reported, but PM<sub>2.5</sub> and PM<sub>10</sub> are currently under 'NE'. Emissions for this category originate from the lead producer in the Netherlands, that does not report PM emissions in its Annual Emission Reporting (AER), as these emissions are below the E-PRTR reporting threshold. We plan to estimate PM<sub>2.5</sub> and PM<sub>10</sub> emissions from the TSP reporting. This will be revised for future submission.

For 2C7a, there are currently no PM<sub>2.5</sub> or PM<sub>10</sub> emissions included in the reporting. As explained before, there is currently one copper-producing operator in the Netherlands, which does not report PM emissions in their Annual Emission Reporting (AER) as these emissions are below the E-PRTR reporting threshold. We plan to improve our reporting by estimating these emissions for future submissions.

## 5.5 **Solvents and product use (2D)**

### 5.5.1 *Source category description*

Solvents and product use comprises the following categories:

- 2D3a Domestic solvent use, including fungicides;
- 2D3b Road paving with asphalt;
- 2D3c Asphalt roofing;
- 2D3d Coating applications;
- 2D3e Degreasing;
- 2D3f Dry cleaning;
- 2D3g Chemical products;
- 2D3h Printing;
- 2D3i Other solvent use.

Emissions NMVOC, PM, TSP and BC from Road paving have been included in the inventory since the 2023 submission, calculated using the Tier 1 method from the guidebook as described in the ENINA methodology report (Honig et al., 2026).

Emissions from Asphalt roofing (2D3c) were not estimated because no activity data was available.

Emissions from Chemical products (category 2D3g) are included in 2B10a (see Section 5.3.1).

34% of the total NMVOC emissions in the Netherlands originate from Solvents and product use.

### 5.5.2 *Key sources*

The key sources in this category are presented in Table 5.8.

Table 5.8 Level 2024 key sources in Solvents and product use (2D)

Category / Subcategory		Pollutant	Contribution to total of 2024 (%)
2D3a	Domestic solvent use, including fungicides	NMVOc	19.7
2D3d	Coating applications	NMVOc	5.9
2D3i	Other solvent use	NMVOc	6.0
		dioxins/furans	15.6

## 5.5.3

## Overview of emission shares and trends

Table 5.9 provides an overview of the emissions from category 2D.

Table 5.9 Overview of emissions from Solvents and product use (2D)

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOc	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>0.00</b>	<b>158</b>	<b>0.00</b>	<b>0.97</b>	<b>0.00</b>	<b>0.02</b>	<b>0.13</b>	<b>0.00</b>	<b>0.00</b>
1995	0.00	129	0.00	1.0	0.00	0.02	0.13	0.00	0.00
2000	0.00	102	0.00	1.1	0.00	0.02	0.14	0.00	0.00
2005	0.00	80	0.00	1.1	0.00	0.02	0.13	0.00	0.00
2010	0.00	84	0.00	1.1	0.00	0.03	0.16	0.00	0.00
2015	0.00	76	0.00	1.1	0.00	0.02	0.14	0.00	0.00
2020	0.00	90	0.00	1.1	0.00	0.02	0.12	0.00	0.00
2021	0.00	78	0.00	1.1	0.00	0.02	0.12	0.00	0.00
2022	0.00	81	0.00	1.1	0.00	0.02	0.12	0.00	0.00
2023	0.00	81	0.00	1.1	0.00	0.02	0.10	0.00	0.00
<b>2024</b>	<b>0.00</b>	<b>79</b>	<b>0.00</b>	<b>1.1</b>	<b>0.00</b>	<b>0.02</b>	<b>0.10</b>	<b>0.00</b>	<b>0.00</b>
1990-2024 <sup>1)</sup>	0.00	-79	0.00	0.1	0.00	-0.01	-0.03	0.00	0.00
1990-2024 <sup>2)</sup>		-50%		12%	-24%	-24%	-24%	-24%	
% 2024 <sup>3)</sup>	0%	34%	0%	1%	0%	0%	0%	0%	0%

Table 5.9 Overview of emissions from Solvents and product use (2D) (continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>15</b>	<b>2.5</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
1995	0.00	0.00	0.00	13	1.0	0.00	0.00	0.00	0.00	0.00	0.00
2000	0.00	0.00	0.00	11	0.06	0.00	0.00	0.00	0.00	0.00	0.00
2005	0.00	0.00	0.00	9.6	0.05	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.00	0.00	0.00	8.1	0.04	0.00	0.00	0.00	0.00	0.00	0.00
2015	0.00	0.00	0.00	6.8	0.03	0.00	0.00	0.00	0.00	0.00	0.00
2020	0.00	0.00	0.00	5.6	0.03	0.00	0.00	0.00	0.00	0.00	0.00
2021	0.00	0.00	0.00	5.3	0.03	0.00	0.00	0.00	0.00	0.00	0.00
2022	0.00	0.00	0.00	5.1	0.03	0.00	0.00	0.00	0.00	0.00	0.00
2023	0.00	0.00	0.00	4.9	0.03	0.00	0.00	0.00	0.00	0.00	0.00
<b>2024</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>4.6</b>	<b>0.03</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
1990-2024 <sup>1)</sup>	0.00	0.00	0.00	-10.1	-2.5	0.00	0.00	0.00	0.00	0.00	0.00
1990-2024 <sup>2)</sup>				-69%	-99%						
% 2024 <sup>3)</sup>	0%	0%	0%	16%	1%	0%	0%	0%	0%	0%	0%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

### **Domestic solvent use, including fungicides (2D3a)**

The emission sources within this key source are:

- cosmetics (and toiletries);
- cleaning agents;
- car products;
- others.

The increase in NMVOC emissions over the 1990–2019 period was caused mainly by cosmetics (and toiletries). The strong increase in emissions for 2020 and 2021 is due to COVID-19: the use of disinfecting hand gels increased strongly. In the submission of 2023, recalculations have been performed for this subsector due to a change of activity data. Originally, data from a survey on the use of disinfecting hand gels was used for 2020 and 2021, whereas for other years, data on the use of disinfection products was estimated on the basis of work hours in hospitals. Since that submission, sales statistics from the Dutch association of soap manufacturers has been used for all years.

### **Coating applications (2D3d)**

The emission sources within this key source are:

- industrial paint applications;
- domestic use;
- construction and buildings;
- car repairing;
- boat building.

Mainly due to the lower average NMVOC content of the paints used, the NMVOC emissions from coating applications decreased from 93 Gg in 1990 to 25 Gg in 2007. As a result of the financial crisis, paint consumption decreased in 2008 and 2009, causing NMVOC emissions to decrease to 19 Gg in 2009. In 2010, the largest market segment, i.e. construction paints, continued to decrease, while car repairs and industry overall made a modest recovery. Because car repairs and the industry are market segments with generally high NMVOC levels, total NMVOC emissions increased to 28 Gg in 2010.

During the 2010–2013 period, paint consumption decreased again, which resulted in a decline in NMVOC emissions to 19 Gg in 2013. A slight increase in paint consumption led to an increase in NMVOC emissions by 1 Gg in 2014. In 2015, a lower NMVOC content of paints resulted in a decrease in NMVOC emissions. Following decreased paint consumption from 2016 onwards (mainly in the market segments of Car repairs and Industry), NMVOC emissions have been relatively constant, only showing slight variations due to changes in paint consumption.

#### **Other solvent use (2D3i)**

For NMVOC, the following activities are included in 2D3i in the Netherlands:

- 060405 Application of glues and adhesives;
- 060406 Preservation of wood;
- 060407 Underseal treatment and conservation of vehicles;
- 060409 Vehicle dewaxing;
- 060412 Other:
  - o Cosmetics sector: Trade and services;
  - o Car products (mainly windscreen cleaning fluid);
  - o Detergents sector: Trade and services;
  - o Industrial cleaning of road tankers;
  - o Office products sector: Trade and services;
- 060508 Other: Use of HFCs, N<sub>2</sub>O, PFCs and HCFCs.

Remarks:

- Emissions from the use of HFCs, PFCs and HCFCs as refrigerants and other uses of HFCs, PFCs and HCFCs are obtained from the National Inventory Report (Van der Net et al., 2026).
- For a complete survey of all emission sources and the used activity data see section 3 of the WESP methodology report (Visschedijk et al., 2026).

#### 5.5.4

##### *Methodological issues*

For a detailed description of the methodology of the emission sources, see Visschedijk et al. (2026).

#### **Domestic solvent use, including fungicides (2D3a)**

Total NMVOC emissions were calculated by multiplying NMVOC emissions per product by the number of products sold. NMVOC emissions per product were calculated by multiplying the fraction of the NMVOC content that is emitted to the air by the NMVOC content of the product.

#### **Coating applications (2D3d)**

NMVOC emissions from paint use were calculated from national statistics on annual sales of paint that was both produced and sold within the

Netherlands provided by the Dutch Association for Paint and Ink Producers (VVF) and from VVF estimations relating to imported paints. Through its members, the VVF directly monitors NMVOC in domestically produced paints and estimates the NMVOC content of imported paints. Estimates have also been made for the use of flushing agents and the reduction effect of afterburners. For more information on these estimates, see the WESP methodology report (Visschedijk et al., 2026).

#### **Other solvent use (2D3i)**

Total NMVOC emissions were calculated by multiplying NMVOC emissions per product by the number of products sold. NMVOC emissions per product were calculated by multiplying the fraction of the NMVOC content that is emitted to the air by the NMVOC content of the product.

#### **Other solvent non-key categories (2D3e, 2D3f, 2D3g, 2D3h)**

As a response to a review question, the non-key categories are outlined here:

- 2D3e: degreasing in the metallurgical industry: The production index of this sector is used;
- 2D3f: NACE 96.012: washing and (dry) cleaning and painting: Described in Chapters 3, 32 and 33 of Visschedijk et al. (2026);
- 2D3g is included in 2B10a;
- 2D3h: emissions from printing: These are calculated from annual ink sales statistics, provided by the Dutch Paint and Ink Manufacturers Association (VVF).

#### 5.5.5 *Activity data and (implied) emission factors*

##### **Domestic solvent use, including fungicides (2D3a)**

Sales data on products and the NMVOC content of products were obtained from annual reports by branch organisations, while the fraction of the NMVOC content that is emitted to the air was derived from studies, as described in the WESP methodology report.

##### **Coating applications (2D3d)**

In the paint application sector, annual statistics on sales are provided by the Dutch Paint and Ink Producers Association (VVF). The NMVOC content of the paint decreased from 30% in 1990 to 12% in 2015. From that submission onwards, no NMVOC content figures have been made available. Therefore, the NMVOC content is maintained at the 2015 value.

##### **Other solvent use (2D3i)**

Sales data on products and the NMVOC content of products were obtained from annual reports issued by branch organisations, while the fraction of the NMVOC content that is emitted to the air was derived from studies.

Dioxin emissions from wooden house frames were determined for 1990 on the basis of Bremmer et al. (1993). Because PCP was banned in 1989, a linear reduction in dioxin emission was assumed.

#### 5.5.6 *Source-specific recalculations*

- NMVOC emissions (tetrachloroethane) were recalculated for emission source Chemical laundries, category 2D3f:

- o as a result of the introduction of new machines, the emission factor was updated;
- o activity data was updated for chemical cleaning with use of perchloroethylene.
- For categories 2D3a and 2D3i minor recalculations performed as result of AD corrections.
- For category 2D3b (Road paving with asphalt), emissions of NMVOC, PM<sub>10</sub> and PM<sub>2.5</sub> were recalculated as result of availability of new activity data.

#### 5.5.7 *Source-specific planned improvements*

There are no planned improvements for NFR category 2D.

## 5.6 **Other product use (2G)**

### 5.6.1 *Source category description*

The following activities are included in 2G in the Netherlands:

- Use of fireworks;
- Use of tobacco;
- Refrigeration and air conditioning equipment;
- Other: Burning of candles;
- Anaesthetic gasses.

### 5.6.2 *Key sources*

The key sources in this category are presented in Table 5.10.

Table 5.10 Level 2024 key sources in Other product use (2G)

Category / Subcategory		Pollutant	Contribution to total of 2024 (%)
2G	Other product use	PM <sub>10</sub>	6.7
		PM <sub>2.5</sub>	8.0
		Cd	13.8

### 5.6.3 *Overview of emission shares and trends*

Table 5.11 provides an overview of the emissions from category 2G.

Table 5.11 Overview of emissions from Other product use (2G)

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOG	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>0.07</b>	<b>0.58</b>	<b>0.01</b>	<b>0.16</b>	<b>1.3</b>	<b>1.5</b>	<b>1.5</b>	<b>0.14</b>	<b>2.2</b>
1995	0.07	0.54	0.03	0.15	1.4	1.8	1.9	0.14	2.1
2000	0.07	0.55	0.04	0.15	1.6	2.3	2.4	0.15	2.0
2005	0.06	0.47	0.04	0.12	1.5	2.1	2.3	0.13	1.7
2010	0.05	0.44	0.04	0.11	1.4	1.9	2.1	0.12	1.6
2015	0.04	0.72	0.05	0.09	1.5	2.3	2.4	0.11	1.3
2020	0.04	0.55	0.03	0.08	0.96	1.4	1.5	0.08	1.1
2021	0.03	0.56	0.01	0.08	0.73	0.93	0.98	0.07	1.1
2022	0.03	0.52	0.03	0.07	0.92	1.3	1.4	0.08	1.0
2023	0.03	0.51	0.04	0.07	1.2	1.9	2.0	0.09	1.0
<b>2024</b>	<b>0.03</b>	<b>0.49</b>	<b>0.04</b>	<b>0.06</b>	<b>1.1</b>	<b>1.8</b>	<b>1.9</b>	<b>0.08</b>	<b>0.91</b>
1990-2024 <sup>1)</sup>	-0.04	-0.09	0.03	-0.10	-0.2	0.3	0.4	-0.05	-1.2
1990-2024 <sup>2)</sup>	-57%	-16%	219%	-62%	-12%	20%	26%	-39%	-58%
% 2024 <sup>3)</sup>	0%	0%	0%	0%	8%	7%	6%	4%	0%

Table 5.11 Overview of emissions from Other product use (2G) (continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>0.05</b>	<b>0.21</b>	<b>0.00</b>	<b>0.00</b>	<b>0.02</b>	<b>0.01</b>	<b>0.01</b>	<b>2.6</b>	<b>0.10</b>	<b>0.00</b>	<b>0.23</b>
1995	0.05	0.20	0.00	0.00	0.02	0.01	0.01	5.0	0.10	0.00	0.34
2000	0.08	0.19	0.00	0.00	0.03	0.01	0.01	7.6	0.09	0.00	0.47
2005	0.09	0.16	0.00	0.00	0.03	0.00	0.01	7.7	0.08	0.00	0.46
2010	0.10	0.15	0.00	0.00	0.03	0.00	0.01	7.0	0.07	0.00	0.42
2015	0.10	0.11	0.00	0.00	0.03	0.00	0.01	9.6	0.06	0.00	0.54
2020	0.11	0.10	0.00	0.00	0.03	0.00	0.01	5.1	0.05	0.00	0.31
2021	0.11	0.10	0.00	0.00	0.03	0.00	0.01	2.5	0.05	0.00	0.18
2022	0.12	0.09	0.00	0.00	0.03	0.00	0.01	4.9	0.05	0.00	0.30
2023	0.13	0.09	0.00	0.00	0.03	0.00	0.01	8.0	0.04	0.00	0.45
<b>2024</b>	<b>0.13</b>	<b>0.08</b>	<b>0.00</b>	<b>0.00</b>	<b>0.03</b>	<b>0.00</b>	<b>0.01</b>	<b>7.7</b>	<b>0.04</b>	<b>0.00</b>	<b>0.43</b>
1990-2024 <sup>1)</sup>	0.07	-0.13	0.00	0.00	0.01	0.00	-0.01	5.1	-0.06	0.00	0.20
1990-2024 <sup>2)</sup>	140%	-62%	-62%	-62%	34%	-62%	-62%	196%	-62%		89%
% 2024 <sup>3)</sup>	3%	14%	0%	0%	1%	1%	0%	7%	1%	0%	0%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

#### 5.6.4 *Source-specific recalculations*

- NMVOC emissions from stationary refrigeration were recalculated for 2022 and 2023. This is due to a time-lag for data availability from this sector. In this submission, the 2022 data was replaced by the newly calculated value. In the previous submission, the 2023 emission was assumed to be equal to the 2022 submission. Due to the update in this submission, the 2023 and 2024 emissions are assumed to be equal to the 2022 emissions. Also, due to an error the 2021 value was recalculated.
- The 1990-2024 emission series from smoking of cigarettes was recalculated as result of an adjustment of the activity data: cigarettes bought abroad and illegal produced were added.

#### 5.6.5 *Source-specific planned improvements*

There are no planned improvements for NFR category 2G.

### 5.7 **Other production industry (2H)**

#### 5.7.1 *Source category description*

This category comprises emissions from the following sources:

- 2H1 Pulp and paper industry;
- 2H2 Food and beverages industry;
- 2H3 Other industrial processes.

The following activities are included in category 2H2:

- NACE 10.1: processing and preserving of meat and poultry;
- NACE 10.3: processing and preserving of fruit and vegetables;
- NACE 10.4: manufacture of oils and fats;
- NACE 10.5: dairy industry;
- NACE 10.6: manufacture of grain mill products, excluding starches and starch products;
- NACE 10.9: manufacture of prepared animal feeds;
- NACE 10.8 (excluding NACE 10.81 and 10.82): other manufacture of food products.

These NACE activities include all activities listed in the 2019 EMEP/EEA Guidebook (production of bread, wine, beer, spirits, sugar, flour, meat, fish, etcetera, and frying/curing).

Since 2000, it has not been possible to provide activity data and to determine/calculate IEFs, due to the lack of production figures and emission data on individual facilities (see also Section 5.3.1).

#### 5.7.2 *Key sources*

The key sources in this category are presented in Table 5.12.

Table 5.12 Level 2024 key sources in Other production industry (2H)

	<b>Category / Subcategory</b>	<b>Pollutant</b>	<b>Contribution to total of 2024 (%)</b>
2H2	Food and beverages industry	NMVOC	2.6
		PM <sub>10</sub>	5.0
		PM <sub>2.5</sub>	2.0
2H3	Other industrial processes	NMVOC	4.3
		PM <sub>10</sub>	2.0

## 5.7.3

*Overview of emission shares and trends*

Table 5.13 provides an overview of the emissions from category 2H.

*Table 5.13 Overview of emissions from Other production industry (2H)*

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOG	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>1.1</b>	<b>36</b>	<b>2.5</b>	<b>0.53</b>	<b>2.4</b>	<b>7.9</b>	<b>17</b>	<b>0.00</b>	<b>3.7</b>
1995	0.00	20	0.00	0.33	1.1	3.8	11	0.00	0.00
2000	0.00	14	0.00	0.34	0.95	3.5	8.9	0.00	0.00
2005	0.00	18	0.00	0.39	0.73	2.6	3.9	0.00	0.00
2010	0.03	17	0.00	0.59	0.56	2.0	3.3	0.00	0.00
2015	0.00	16	0.00	0.37	0.61	2.2	2.5	0.00	0.01
2020	0.01	16	0.00	0.43	0.64	2.4	2.8	0.00	0.00
2021	0.01	16	0.00	0.41	0.67	2.4	2.9	0.00	0.00
2022	0.01	16	0.00	0.43	0.64	2.4	2.9	0.00	0.00
2023	0.01	16	0.00	0.40	0.61	2.3	2.8	0.00	0.00
<b>2024</b>	<b>0.01</b>	<b>16</b>	<b>0.00</b>	<b>0.36</b>	<b>0.60</b>	<b>2.2</b>	<b>2.7</b>	<b>0.00</b>	<b>0.00</b>
1990-2024 <sup>1)</sup>	-1.1	-20	-2.5	-0.17	-1.8	-5.7	-14	0.00	-3.7
1990-2024 <sup>2)</sup>	-99%	-55%	-100%	-32%	-75%	-72%	-84%	-100%	-100%
% 2024 <sup>3)</sup>	0%	7%	0%	0%	4%	8%	9%	0%	0%

Table 5.13 Overview of emissions from Other production industry (2H) (continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>0.34</b>	<b>0.00</b>	<b>0.04</b>	<b>0.02</b>	<b>1.4</b>	<b>0.00</b>	<b>0.30</b>	<b>1.2</b>	<b>0.17</b>	<b>0.00</b>	<b>6.8</b>
1995	0.28	0.01	0.02	0.03	0.15	0.00	0.84	0.66	0.44	0.00	1.1
2000	0.16	0.00	0.00	0.00	0.12	0.00	0.27	0.75	0.03	0.00	0.53
2005	0.00	0.00	0.00	0.01	0.08	0.00	0.27	0.75	0.03	0.00	0.53
2010	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.78	0.03	0.00	0.46
2015	0.46	0.01	0.00	0.00	0.00	0.00	0.23	0.18	0.06	0.00	0.63
2020	0.02	0.00	0.00	0.00	0.00	0.00	0.19	0.58	0.09	0.00	0.35
2021	0.02	0.00	0.00	0.00	0.00	0.00	0.19	0.89	0.09	0.00	0.28
2022	0.01	0.00	0.00	0.00	0.00	0.00	0.18	0.33	0.08	0.00	0.06
2023	0.01	0.00	0.00	0.00	0.00	0.00	0.24	0.60	0.17	0.00	0.20
<b>2024</b>	<b>0.04</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.21</b>	<b>0.61</b>	<b>0.15</b>	<b>0.00</b>	<b>0.26</b>
1990-2024 <sup>1)</sup>	-0.31	0.00	-0.04	-0.02	-1.4	0.00	-0.10	-0.6	-0.02	0.00	-6.6
1990-2024 <sup>2)</sup>	-89%	-82%	-100%	-100%	-100%	-100%	-31%	-49%	-14%	-100%	-96%
% 2024 <sup>3)</sup>	1%	0%	0%	0%	0%	0%	5%	1%	5%	0%	0%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

### **Food and beverages industry (2H2)**

The reductions in PM<sub>10</sub> emissions between 1990 and 2023 were mainly caused by strong reductions in the early years (1990–2000) resulting from the implementation of technical measures. Since that decrease, emissions have been relatively constant through the years.

### **Other industrial processes (2H3)**

The 2H3 subcategory in the Dutch PRTR covers emissions from a wide range of activities. The reductions in NMVOC and PM<sub>10</sub> emissions between 1990 and 2020 were mainly caused by the implementation of technical measures. After 2005, PM<sub>10</sub> emission fluctuations were caused by the varying volume of products handled.

#### 5.7.4

#### *Methodological issues*

See Section 5.1.2 for the calculation method for emissions from the production of food and drink (category 2H2) and from storage and handling (2H3). Emissions from non-reporting facilities are calculated from production indices of the food and beverages industry from Statistics Netherlands.

There is one exception: NMVOC emissions from bread bakeries occur as a result of using yeast in the bakery process. Since the 2020 submission, these emissions have been calculated separately by multiplying the activity data by the guidebook EF of 4.5 kg NMVOC per Mg bread produced, for European bread. The activity data is obtained by using data from the Dutch Bakery Centre (NBC). It is assumed that the import

and export of bread can be ignored, because bread is a highly perishable product. As stated by the NBC, no emission reduction measures are taken.

**5.7.5** *Source-specific recalculations*

As a result of minor corrections, recalculations were performed for:

- Category 2H1, year 2000, NMVOC;
- Category 2H3, year 2003, BC.

**5.7.6** *Source-specific planned improvements*

There are no planned improvements for NFR category 2H.



## 6 Agriculture

### 6.1 Overview of emissions from the sector

The agricultural sector includes all anthropogenic emissions from agricultural activities. Emissions from fuel combustion (mainly relating to heating in horticulture and the use of agricultural machinery) are included in the source categories Agriculture/Forestry/Fishing: Stationary (1A4ci) and Agriculture/Forestry/Fishing: Off-road vehicles and other machinery (1A4cii).

Emission sources in the agricultural sector consist of the following NFR categories:

- 3B Manure management;
- 3D Crop production and agricultural soils;
- 3F Field burning of agricultural residues.

This Informative Inventory Report (IIR) focuses on emissions of ammonia ( $\text{NH}_3$ ), nitrogen oxides ( $\text{NO}_x$ ), particulate matter ( $\text{PM}_{10}$ ,  $\text{PM}_{2.5}$ ), non-methane volatile organic compounds (NMVOC), hexachlorobenzene (HCB) and zinc (Zn) from the NFR source categories of 3B Manure management and 3D Crop production and agricultural soils. The source category 3F Field burning of agricultural residues is reported as Not Occurring (NO), since field burning was prohibited in the Netherlands throughout the time series (article 10.2 of the Environmental Management Act, or 'Wet Milieubeheer' in Dutch).

Emissions of the greenhouse gases methane ( $\text{CH}_4$ ), nitrous oxide ( $\text{N}_2\text{O}$ ) and carbon dioxide ( $\text{CO}_2$ ) from the agricultural sector are reported in the annual National Inventory Report (NIR). All emissions from manure management and crop production are calculated according to the methods described in Van der Zee et al. (2026). All activity data is summarised in Van der Most et al. (2026), except the activity data on N excretion, which is reported by CBS (2025). The method and activity data for the calculation of the NMVOC and Zn emissions from the use of pesticides are provided in Section 6.3 and in Kruijne et al. (2025).

In 2024, the agricultural sector was responsible for 90% of all  $\text{NH}_3$  emissions in the Netherlands. Emissions of  $\text{NO}_x$  from agriculture amounted to 18% of the national total. Agriculture contributed 36% of the national NMVOC emissions, 19% of the national  $\text{PM}_{10}$  emissions, 4% of the national  $\text{PM}_{2.5}$  emissions and 1% of the national HCB emissions in 2024. Although Zn is not a priority heavy metal, emissions from drift following pesticide use are reported for the sake of completeness (3% of the national total).

The currently reported time series (1990–2024) differs from the previous time series (1990–2023) as nine recalculations have been implemented.

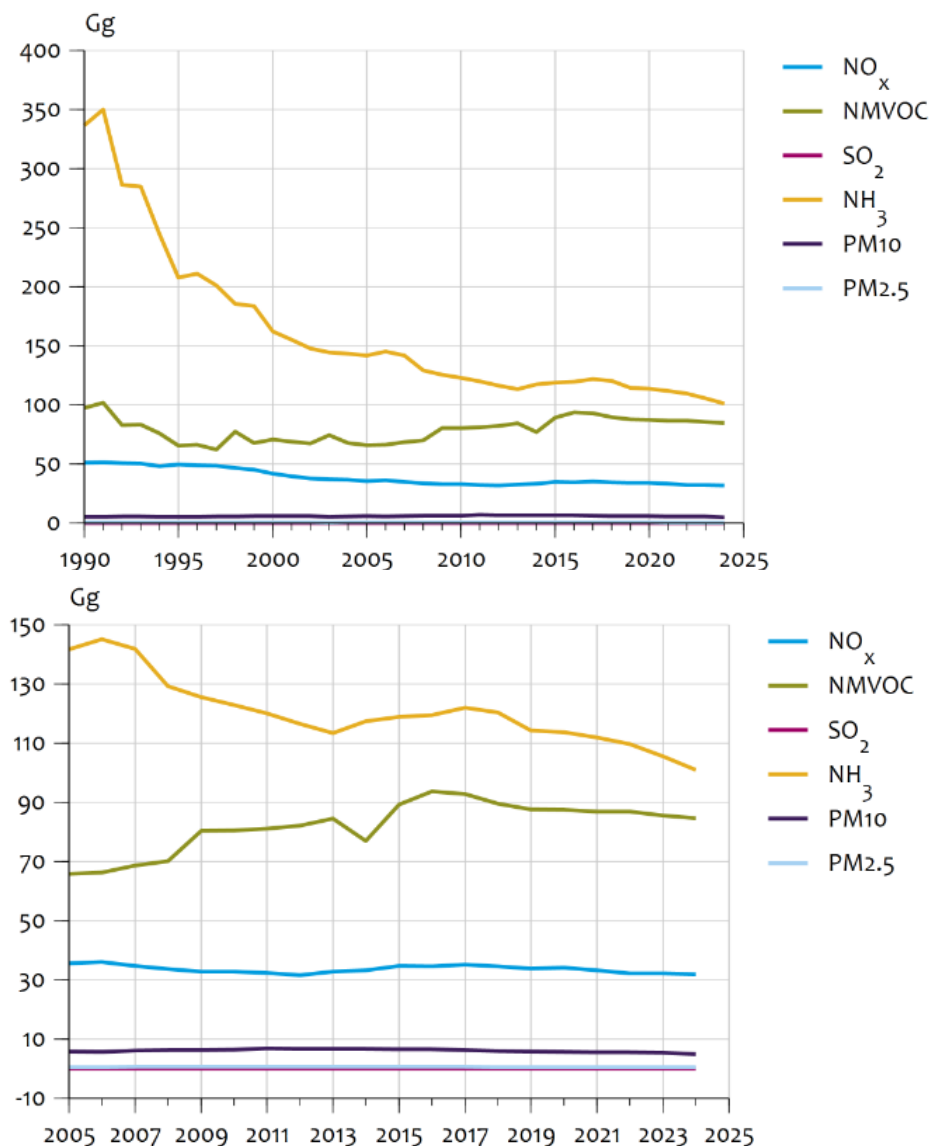
- The first recalculation concerns the emission of  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$  from goats. Based on new measurements the EF of  $\text{PM}_{10}$  increased from 19 g per goat to 170 g per goat. The EF of  $\text{PM}_{2.5}$  increased at the same rate from 5.7g to 51 g per goat. The new emission factors have been applied from 2018 onwards. The old

emission factors have been applied to 1990. Constant linear interpolation has been applied to the years 1991-2017 to create a consistent timeseries.

- The second recalculation concerns the emission of NH<sub>3</sub> from goats. Based on the same new measurements, the NH<sub>3</sub> EF of goats was increased from 1.9 kg NH<sub>3</sub> per goat to 4.3 kg NH<sub>3</sub> per goat. The new emission factor has been applied from 2018 onwards. The old emission factor has been applied to the years 1990-1998. Constant linear interpolation has been applied to the years 1999-2017 to create a consistent timeseries.
- The third recalculation is caused by the second recalculation. NH<sub>3</sub> and NO<sub>x</sub> emissions from inorganic N fertiliser application have been recalculated for the years 2019-2023. This is caused by the higher emission factor for NH<sub>3</sub> from goat housing. Rinsing liquid from air scrubbers on goat houses contains more N resulting in higher emissions when it is applied to soils.
- The fourth recalculation concerns the amount of treated manure which has been harmonised for all emissions ensuing from manure storage and treatment. This affects the NH<sub>3</sub> and NO<sub>x</sub> emissions from manure management from cattle and swine as well as the subsequent N-emissions from manure application (3B1a, 3B1b, 3B3 and 3D).
- The fifth recalculation results from the previous recalculations. As the emissions of NH<sub>3</sub> from storage and manure application change, NMVOC emissions from manure storage and manure application change, too.
- The sixth recalculation concerns the NH<sub>3</sub> emission from manure management of dairy cattle in 2022 and 2023. Small mistakes have been corrected in the input files with housing resulting in higher NH<sub>3</sub> emissions.
- The seventh recalculation concerns NO<sub>x</sub> emissions related to the agricultural use of organic soils. These emissions have been recalculated based on new insights on the area of peat and peaty soils in the Netherlands. This recalculation increases NO<sub>x</sub> emissions in 1990-2020 and decreases the emissions in 2021-2023.
- The eighth recalculation is caused by the usage of the final application rates of inorganic fertilisers, compost, pesticides and grassland renewal rates instead of the preliminary figures in 2023.
- The ninth recalculation concerns the allocation of emissions from grassland renewal. These emissions have been reallocated from 3Da2 (animal manure applied to soils) to 3Da4 (crop residues applied to soils).

Figure 6.1 shows the trend in the emissions of the main pollutants from the Agriculture sector between 1990-2024 and 2005-2024.

Figure 6.1 Emission trends for the main pollutants in NFR 3 – Agriculture between 1990-2024 (upper panel) and 2005-2024 (lower panel)



In 2024, 90% of total NH<sub>3</sub>, 36% of total NMVOC, 19% of total PM<sub>10</sub>, 18% of total NO<sub>x</sub> and 4% of total PM<sub>2.5</sub> emissions in the Netherlands originated from the Agriculture sector (Figure 2.1).

#### 6.1.1 Key sources

In 2024, several key sources were identified, as presented in Table 6.1 (see Appendix 2 for details).

#### 6.1.2 Trends

##### **Ammonia**

Ammonia emissions decreased between 1990 and 2024. The largest reduction took place in the first few years of the time series (Tables 6.2 and 6.9). This was mainly caused by a ban on surface spreading of manure enforced in the 1991–1995 period, which made it mandatory to

incorporate manure into the soil either directly or shortly after application. In addition, it became mandatory to cover outdoor slurry manure stores. More recently, the introduction of low-emission housing for animals further decreased ammonia emissions.

Maximum application standards for manure and fertiliser (in accordance with the Nitrates Directive) and systems of livestock production rights have increased efficiency in animal production. One example of this is the ongoing improvement in nutritional management (precision feeding), where a reduction of dietary crude protein in concentrate feed has resulted in a lower N intake per animal and thus in a lower N excretion, and has consequently reduced NH<sub>3</sub> emissions. Between 1990 and 2024, however, the N excretion of dairy cattle increased as more grass was fed instead of maize. Grass has a higher N content than maize, resulting in overall higher N excretion. The increase is due to the derogation system, which allows dairy farmers to apply more manure on their land than the maximum set by the EU in the Nitrates Directive. Until 2014, one of the eligibility requirements for derogation was to use a minimum of 70% of the land as grassland. In 2014, this minimum was increased to 80% of the land. In 2023, the N excretion of dairy cattle increased as the N content of the roughages increased. As of 2023, the amount of manure that can be applied under the derogation is being gradually reduced until 2026, when the derogation will be completely abolished.

Table 6.1 All NFR categories that were identified as key sources of the agricultural sector on level (L) and/or trend (T)

<b>NFR Category</b>	<b>NH<sub>3</sub></b>	<b>NO<sub>x</sub></b>	<b>PM<sub>10</sub></b>	<b>PM<sub>2.5</sub></b>	<b>NMVOC</b>	<b>HCB</b>
<b>3B Manure management</b>						
Cattle						
<i>Dairy cattle</i>	L				L, T	
<i>Non-dairy cattle</i>	L				L	
Swine	L, T		L			
Poultry						
<i>Laying hens</i>	L		L			
<i>Broilers</i>			L			
<b>3D Crop production and agricultural soils</b>						
Inorganic N fertilisers	L	L				
Animal manure applied to soils	L, T	L			L, T	
Cultivated crops			L			
Farm-level agricultural operations including storage, handling and transport of agricultural products					L	
Urine and dung deposited by grazing animals						
Use of pesticides						T

The milk quota set by the EU (1984–2015) led to an increase in milk production per dairy cow. Increased production per animal led to a decrease in animal numbers and consequently lower emissions. Due to the abolishment of the milk quota in 2015, more dairy cattle have been kept from 2014 onwards, resulting in a further increase in milk production and an increase in manure. The increased manure production caused the national phosphate production ceiling, as set in European agreements, to be exceeded. In turn, this led to an introduction of phosphate quota for dairy cattle as of 1 January 2018. This quota limited the number of dairy cattle a farmer may keep and resulted in a decreasing trend in animal numbers from 2017 onwards. An additional effect of the phosphate quota was an increase in average body weight, milk yield and N uptake. These changes are the result of farmers keeping their biggest and most productive cows and culling smaller cows with lower productivity.

The amount of manure exported increased fourfold in the 1990–2016 period, after which it decreased in 2017 and 2018, increased again in 2019, but has decreased in the years since. The increase can be explained by stricter Dutch application requirements resulting in a decreased demand for manure in the Netherlands. From 1997 onwards, part of the NH<sub>3</sub> emissions from animal housing have been contained in the washing liquid of air scrubbers, which was used as an inorganic N fertiliser, shifting some N to category 3D Crop production and agricultural soils.

As of 1 January 2019, the application of liquid manure using a trailing shoe on peat and clay soils has only been allowed if the manure was diluted with one part water to two parts manure. This reduces the emission of NH<sub>3</sub>.

Since most of the Netherlands' total NH<sub>3</sub> emissions originate from the agricultural sector, the trend in agricultural NH<sub>3</sub> emissions seen from 1990 to 2023 was reflected in a decreasing trend in the national total.

### ***Nitrogen oxides***

Nitrogen oxide emissions decreased over the 1990–2024 period, due to a lower inorganic N fertiliser use, a decrease in N excretion during grazing, less manure N being applied to soil and, in recent years, a decrease in cattle numbers (Tables 6.2 and 6.9).

### ***Particulate matter***

Particulate matter emissions for most animal categories decreased slightly over the 1990–2024 period, due to decreased animal numbers (Tables 6.6 and 6.7); however, PM emissions from laying hen houses almost tripled for PM<sub>10</sub> and doubled for PM<sub>2.5</sub>. This was caused by a shift from battery cage systems with liquid manure to floor housing or aviary systems, with solid manure and higher associated emissions of PM<sub>10</sub> and PM<sub>2.5</sub>. This gradual transition between 1990 and 2012 was initiated by a ban on battery cage systems from 2012, and led to an overall increase in PM emissions from manure management (Table 6.2). PM emissions peaked in 2014, after which they decreased.

**NMVOOC**

Overall, NMVOOC emissions from agriculture decreased over the 1990–2024 period (Tables 6.2 and 6.9). However, the emissions reported under manure management increased significantly, due to an increased share of silage feeding and its NMVOOC emissions in animal housing. A decrease in emissions from animal manure applied to soils compensated for the increase in manure management emissions. This decrease was caused by low-ammonia-emission application techniques.

**HCB**

Hexachlorobenzene (HCB) emissions from agriculture decreased over the 1990–2024 period (Table 6.9). This is due to the reduction in the amount of applied pesticides containing HCB, as well as to a reduction in the maximum amount of HCB allowed as a contaminant in pesticides.

**6.2 Manure management (3B)****6.2.1***Source category description*

The category Manure management (3B) includes emissions from the treatment and storage of animal manure. Emissions were allocated to the following NFR subcategories:

- 3B1a Dairy cattle;
- 3B1b Non-dairy cattle;
- 3B2 Sheep;
- 3B3 Swine;
- 3B4d Goats;
- 3B4e Horses;
- 3B4f Mules and asses;
- 3B4gi Laying hens;
- 3B4gii Broilers;
- 3B4giii Turkeys;
- 3B4giv Other poultry;
- 3B4h Other animals: fur-bearing animals;
- 3B4h Other animals: rabbits.

Category 3B4a (Buffalo) does occur in the Netherlands. However, these emissions are included with 3B1a and 3B1b according to the purpose of the buffalo. Emissions from the category 3B4giv Other poultry include emissions from ducks. Emissions resulting from the application of animal manure or during grazing were related to land use; they are not reported under 3B Manure management, but are included in 3D Crop production and agricultural soils.

**6.2.2***Key sources*

In 2024, within sector 3B, dairy cattle (3B1a) made the largest contribution to NH<sub>3</sub> emissions, amounting to 18% of the national total. Swine (3B3, 10%), non-dairy cattle (3B1b, 8%) and laying hens (3B4gi, 7%) were also key NH<sub>3</sub> sources. The largest source in 2024 of PM<sub>10</sub> emissions within sector 3B was laying hens (3B4gi), contributing 7% to the national total. Broilers (3B4gii, 3%) and swine (3B3, 3%) were also level 2024 key sources of PM<sub>10</sub>. For NMVOOC emissions, dairy cattle (3B1a) made the largest contribution to the 2024 national total, with 19%. The category non-dairy cattle (3B1b) was also a level 2024 key

source, with a contribution of 5%. For emissions of PM<sub>2.5</sub> and NO<sub>x</sub>, the manure management sector had no key sources.

### 6.2.3 Overview of emission shares and trends

Table 6.2 presents an overview of emissions of the main pollutants NMVOC, NO<sub>x</sub> and NH<sub>3</sub>, together with the emissions of PM<sub>10</sub> and PM<sub>2.5</sub>, originating from sector 3B Manure management.

Table 6.2 Emissions of main pollutants and particulate matter from sector 3B Manure management

Year	Main Pollutants			Particulate Matter		
	NO <sub>x</sub>	NMVOC	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP
	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>3.9</b>	<b>42</b>	<b>100</b>	<b>0.46</b>	<b>4.1</b>	<b>4.1</b>
1995	4.0	41	97	0.46	4.1	4.1
2000	3.4	45	78	0.49	4.6	4.6
2005	3.0	42	69	0.46	4.6	4.6
2010	3.3	59	71	0.50	5.3	5.3
2015	3.8	66	66	0.52	5.5	5.5
2020	3.9	65	63	0.46	4.8	4.8
2021	3.8	64	60	0.45	4.6	4.6
2022	3.7	64	59	0.43	4.4	4.4
2023	3.7	64	57	0.43	4.3	4.3
<b>2024</b>	<b>3.7</b>	<b>63</b>	<b>55</b>	<b>0.40</b>	<b>3.9</b>	<b>3.9</b>
1990-2024 <sup>1)</sup>	-0.2	21	-44	-0.05	-0.1	-0.1
1990-2024 <sup>2)</sup>	-5%	51%	-45%	-12%	-3%	-3%
% 2024 <sup>3)</sup>	2%	27%	49%	3%	15%	13%

1. Absolute difference in Gg

2. Relative difference from 1990 in %

3. % of national total 2024

### **N emissions**

The Netherlands uses an N-flow model, the National Emission Model for Agriculture (NEMA), to calculate N emissions (Van der Zee et al., 2026). Figure 6.2 presents a schematic overview of the N-flows.

Between 1990 and 2024, NH<sub>3</sub> emissions from manure management were reduced by 45% (Table 6.2). Higher production rates per animal and restrictions through quotas resulted in a decreasing trend in the numbers of cattle, sheep, and swine. Nitrogen excretions per animal decreased in the course of the time series, due to a decrease in dietary crude protein in all animal categories. In 2017 and 2018, N excretion increased again for cattle, which can be explained by an increase in nutrient requirements through a higher average milk production and body weight. In 2019, N excretion decreased as a lower amount of N was fed. In 2020, N excretion increased due to a higher amount of N

fed. N excretions fluctuated in the years 2021-2024, according to the N-content of the roughages

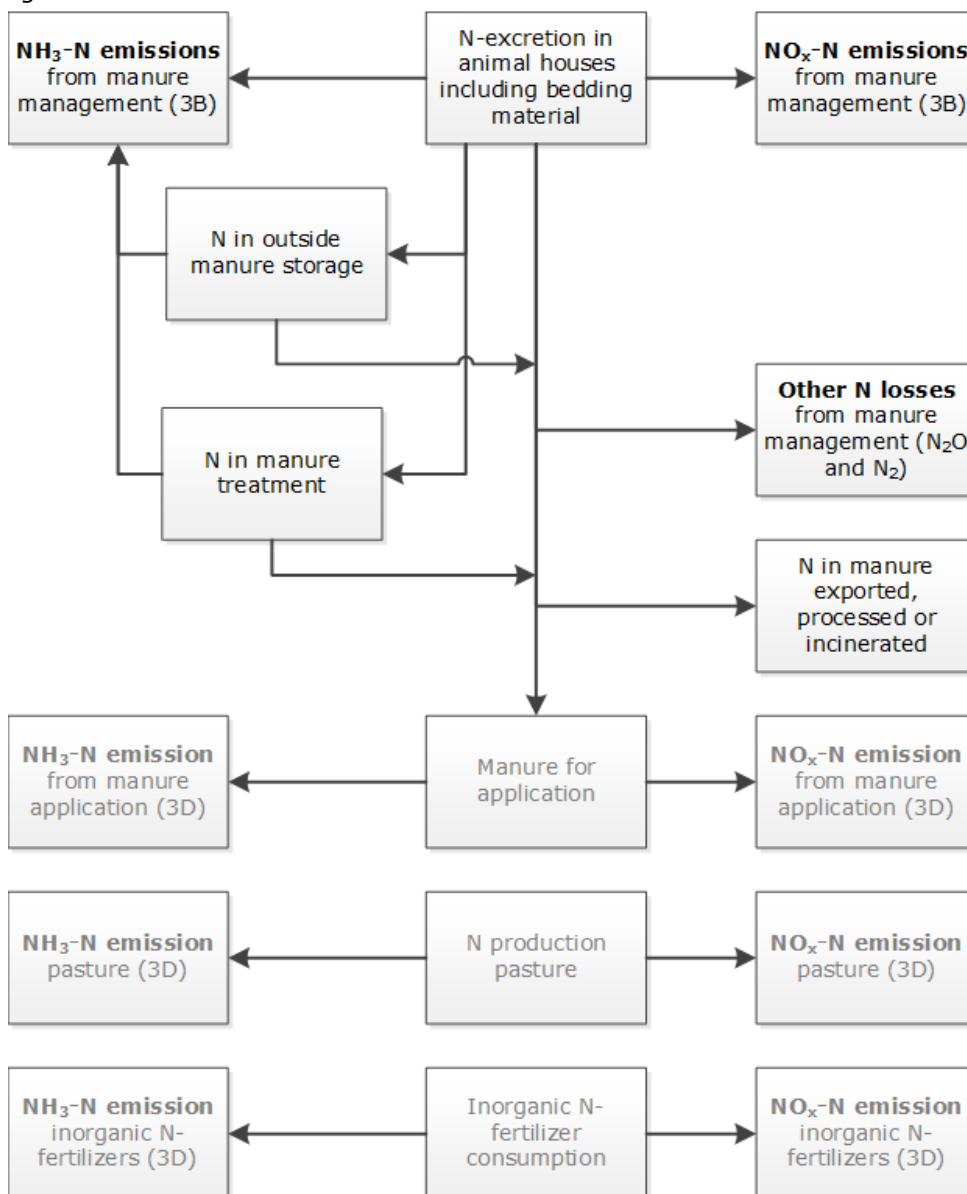
A study published by Statistics Netherlands shows that some forms of low-emission housing did not reach the emission reduction targets (Van Bruggen & Geertjes, 2019). Therefore, it was decided to adjust the NH<sub>3</sub> emissions on the basis of the Nitrogen:Phosphate ratio in the manure. A complete description of the method applied to calculate the EFs of all housing types is included in the methodology report (Van der Zee et al., 2026).

As NO<sub>x</sub> emissions were also influenced by the above-mentioned developments, NO<sub>x</sub> emissions decreased by 5% from 1990 to 2024.

### ***Particulate matter***

PM<sub>10</sub> emissions from animal housing showed an increasing trend in the time series, which was caused mainly by the increased proportion of solid manure housing systems for poultry. The increased available floor space per animal added to this effect. In recent years, the increased usage of abatement techniques for PM removal and a lower number of poultry resulted in a decrease in PM. PM<sub>2.5</sub> emissions decreased over the entire time period as a result of lower animal numbers.

Figure 6.2 Nitrogen flows in relation to  $\text{NH}_3$  and  $\text{NO}_x$  emissions, where the boxes with black type show the emissions included in 3B Manure management and the boxes with grey type show emissions included in 3D Crop production and agricultural soils



### NM VOC

Emissions of NMVOC from source category 3B increased by 51% between 1990 and 2024, mostly caused by an increase in silage feeding to dairy cattle in animal housing, resulting in more NMVOC emissions from animal housing. The increase in poultry numbers also added to this increasing trend.

#### 6.2.4

##### *Activity data and (implied) emission factors*

Activity data includes animal numbers as determined by the annual agricultural census and the I&R system (see the summary in Table 6.3 and, for a full list of subcategories and years, Van der Most et al.

(2026)). More information on the collection of animal numbers can be found in section 2.2.1 of Van der Zee et al. (2026). Animals were distributed over the various housing types using information from the agricultural census (Van der Most et al., 2026).

### ***N emissions***

Emissions of NH<sub>3</sub> and NO<sub>x</sub> from manure in animal housing, manure treatment and outdoor manure storages were calculated using the NEMA model at a Tier 3 level. N excretions per animal are calculated annually by the Working Group on the Uniformity of Calculations of Manure and Mineral Data (WUM; CBS, 2012). The historical data was recalculated in 2019 (CBS, 2019) and has since been supplemented annually, ensuring consistency (publication series CBS, 2019 to 2025).

The Total Ammoniacal Nitrogen (TAN) in manure was calculated from the faecal digestibility of the N in the various components of animal feed. From the N excretion data, the TAN excretion per animal type and NH<sub>3</sub> EF per housing type were calculated, taking into account mineralisation and immobilisation. The Tier 1 default N<sub>2</sub>O EFs from the IPCC 2006 Guidelines were applied to both N<sub>2</sub>O and NO<sub>x</sub> emissions, following research from Oenema et al. (2000), which set NO<sub>x</sub> emissions equal to N<sub>2</sub>O emissions. According to this same study, N<sub>2</sub> losses were set to a factor of 5 (solid manure) or 10 (liquid manure) of the N<sub>2</sub>O/NO<sub>x</sub> factors, all expressed as percentages of the total N available.

NH<sub>3</sub>, N<sub>2</sub>O, NO<sub>x</sub> and N<sub>2</sub> emissions from animal housing were calculated and subtracted from the excreted N. Subsequently, the amount of manure stored outside of animal housing, and its corresponding NH<sub>3</sub> emissions, were calculated. NH<sub>3</sub>, N<sub>2</sub>O and NO<sub>x</sub> emissions from manure that was treated (manure separation, nitrification/denitrification, mineral concentrates, incineration, pelleting/drying and digesting of manure) were calculated (Melse and Groenestein, 2016). The sums of emissions from animal housing, manure treatment and outdoor manure storage per livestock category were reported under their respective subcategories in sector 3B Manure management, except for emissions associated with the digesting of manure, which are allocated to 5B2 Biological treatment of waste – Anaerobic digestion at biogas facilities. The amount of N available for application was calculated by subtracting all N emissions during manure management, the N removed from agriculture by manure treatment and the net export of manure. The N in applied manure is used to calculate emissions from manure application, allocated to sector 3D. As a result of new insights into the feed intake of horses and ponies, N excretion increased in 2018 (Bikker et al., 2019).

Table 6.3 Animal numbers over the 1990–2024 period (in 1,000 heads)

<b>Animal type</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2023</b>	<b>2024</b>
Cattle	4,926	4,654	4,069	3,797	3,975	4,134	3,719	3,755	3,646
<i>dairy cattle</i>	1,878	1,708	1,504	1,433	1,479	1,622	1,593	1,563	1,539
<i>non-dairy cattle</i>	3,048	2,946	2,565	2,364	2,497	2,512	2,126	2,193	2,107
Sheep <sup>1</sup>	1,702	1,674	1,305	1,361	1,130	946	954	888	780
Swine	13,915	14,397	13,118	11,312	12,255	12,603	11,860	10,770	10,418
Goats	61	76	179	292	353	470	633	647	636
Horses <sup>1</sup>	370	400	417	433	441	417	410	419	424
Mules and asses <sup>1</sup>	1	1	1	1	1	1	1	1	1
Poultry	91,680	88,243	102,579	91,726	99,880	104,760	96,431	87,258	83,957
<i>laying hens</i>	51,592	45,734	53,078	48,418	56,500	57,656	50,828	50,314	47,976
<i>broilers</i>	38,086	40,542	47,118	41,160	41,393	45,426	44,325	35,961	35,101
<i>turkeys</i>	1,052	1,207	1,544	1,245	1,036	863	566	530	502
<i>other poultry</i>	950	760	839	902	951	816	712	453	378
Other animals	1,340	951	981	1,058	1,261	1,404	770	265	263
<i>Fur-bearing animals</i>	554	463	589	697	962	1023	435	NO	NO
<i>Rabbits</i>	786	488	392	360	299	381	335	265	263

1. Including privately held animals

Source: Van der Most et al. (2026)

IEFs for NH<sub>3</sub> emissions in sector 3B Manure management were calculated for the main NFR categories (Table 6.4). The NH<sub>3</sub> emission per animal decreased for all animal species (except cattle) due to improved efficiency, low-NH<sub>3</sub> emission housing systems and covering outside manure stores. The IEF of cattle increased due to an increased living area per animal, as well as due to an increase in productivity per animal, and thus in N intake and N excretion. This resulted in a net increase in cattle IEF. Although the living area per animal was also increased for swine and poultry, emission reduction techniques, such as air scrubbers and manure drying, more than counterbalanced the effect of the increased living area. The fluctuating N-content of grass silage caused annual changes in the IEF for cattle.

Table 6.4 IEFs for NH<sub>3</sub> from sector 3B Manure management (in kg NH<sub>3</sub>/animal)

Animal type	1990	1995	2000	2005	2010	2015	2020	2023	2024
Cattle	6.8	6.9	5.8	6.5	6.9	7.4	8.8	8.0	8.1
Dairy cattle	11.9	12.0	9.6	11.7	12.0	12.4	14.6	13.7	13.4
Non-dairy cattle	3.7	3.9	3.6	3.4	3.8	4.3	4.4	4.0	4.2
Sheep	0.4	0.4	0.4	0.3	0.1	0.1	0.1	0.1	0.1
Swine	3.5	3.4	2.8	2.4	2.2	1.5	1.1	1.0	1.0
Goats	1.7	1.7	1.7	1.9	2.4	3.0	4.0	4.0	4.1
Horses	4.8	4.8	4.8	4.7	4.4	4.4	5.3	5.3	5.3
Mules and asses	3.6	3.6	3.6	3.5	3.3	3.3	3.7	3.7	3.7
Poultry	0.15	0.16	0.15	0.15	0.14	0.13	0.12	0.12	0.12
Laying hens	0.16	0.17	0.17	0.18	0.17	0.17	0.17	0.16	0.16
Broilers	0.11	0.12	0.10	0.09	0.08	0.06	0.06	0.06	0.06
Turkeys	0.80	0.79	0.80	0.85	0.95	0.95	0.81	0.68	0.61
Other poultry	0.33	0.32	0.29	0.26	0.23	0.19	0.18	0.16	0.13
Other animals	0.40	0.38	0.32	0.28	0.22	0.24	0.24	0.32	0.35
Fur-bearing animals	0.37	0.36	0.29	0.22	0.17	0.19	0.16	NO	NO
Rabbits	0.42	0.39	0.37	0.40	0.36	0.38	0.34	0.32	0.35

Table 6.5 IEFs for NO<sub>x</sub> from sector 3B Manure management (in kg NO<sub>x</sub>/animal)

Animal type	1990	1995	2000	2005	2010	2015	2020	2023	2024
Cattle	0.32	0.35	0.33	0.31	0.33	0.38	0.43	0.40	0.42
Dairy cattle	0.46	0.49	0.44	0.46	0.47	0.52	0.57	0.55	0.55
Non-dairy cattle	0.23	0.28	0.27	0.23	0.25	0.30	0.32	0.29	0.32
Sheep	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Swine	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Goats	0.26	0.26	0.23	0.22	0.24	0.25	0.30	0.29	0.30
Horses	0.29	0.29	0.29	0.29	0.26	0.26	0.35	0.34	0.34
Mules and asses	0.15	0.15	0.15	0.15	0.14	0.14	0.17	0.17	0.17
Poultry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Laying hens	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Broilers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkeys	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other poultry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other animals	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01
Fur-bearing animals	0.02	0.02	0.02	0.01	0.01	0.01	0.01	NO	NO

<b>Animal type</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2023</b>	<b>2024</b>
<i>Rabbits</i>	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

### **Particulate matter**

Emissions of PM<sub>10</sub> and PM<sub>2.5</sub> from agriculture mainly consist of animal skin, manure, feed and bedding particles originating from animal housing. Animal housing produces a large amount of PM<sub>10</sub> compared to PM<sub>2.5</sub>. The general input data used for these calculations related to animal numbers and housing systems taken from the annual agricultural census and environmental permits. From 2015 onwards, farmers have also implemented additional measures to decrease PM emissions from poultry housing. IEFs for PM<sub>10</sub> and PM<sub>2.5</sub> are shown in Table 6.6 and Table 6.7.

Table 6.6 IEFs for PM<sub>10</sub> from sector 3B Manure management (in g PM<sub>10</sub>/animal)

<b>Animal type</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2023</b>	<b>2024</b>
Cattle	85.4	82.8	78.3	78.7	77.8	80.3	82.2	81.3	82.2
<i>Dairy cattle</i>	114.8	114.8	114.8	119.9	123.7	127.4	125.1	125.4	126.6
<i>Non-dairy cattle</i>	67.3	64.3	56.9	53.7	50.6	50.0	50.0	49.9	49.9
Sheep	4.2	4.2	4.2	3.9	1.8	1.8	1.8	1.8	1.8
Swine	113.3	112.2	112.4	109.9	103.8	77.3	69.3	65.9	64.4
Goats	19.0	46.0	72.9	99.9	126.9	153.8	168.6	166.8	165.9
Horses	220.0	220.0	220.0	220.0	220.0	220.0	220.0	220.0	220.0
Mules and asses	IE	IE	IE	IE	160.0	160.0	124.1	121.7	120.9
Poultry	21.8	22.9	26.4	32.0	35.2	38.7	35.6	35.3	33.1
<i>Laying hens</i>	14.9	16.1	22.8	33.6	39.3	46.8	43.9	42.6	40.1
<i>Broilers</i>	26.8	26.8	26.8	26.7	26.6	26.3	24.3	23.4	22.0
<i>Turkeys</i>	100.2	98.1	95.1	95.1	95.1	95.1	94.1	93.5	91.9
<i>Other poultry</i>	104.5	104.5	104.5	104.5	104.5	101.8	100.1	97.1	96.1
Other animals	4.2	4.7	5.4	5.8	6.5	6.3	5.1	1.2	1.3
<i>Fur-bearing animals</i>	8.1	8.1	8.1	8.1	8.1	8.1	8.1	NO	NO
<i>Rabbits</i>	1.4	1.4	1.4	1.4	1.4	1.4	1.2	1.2	1.3

Table 6.7 IEFs for PM<sub>2.5</sub> from sector 3B Manure management (in g PM<sub>2.5</sub>/animal)

<b>Animal type</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2023</b>	<b>2024</b>
Cattle	23.5	22.8	21.6	21.7	21.4	22.1	22.6	22.4	22.7
<i>Dairy cattle</i>	31.7	31.7	31.7	33.1	34.1	35.1	34.5	34.6	34.9
<i>Non-dairy cattle</i>	18.5	17.7	15.7	14.8	13.9	13.8	13.8	13.7	13.7
Sheep	1.2	1.2	1.2	1.2	0.5	0.5	0.5	0.5	0.5
Swine	5.8	5.7	5.7	5.4	5.1	3.7	3.3	3.1	3.0
Goats	5.7	13.8	21.9	30.0	38.1	46.1	50.6	50.0	49.8
Horses	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0
Mules and asses	IE	IE	IE	IE	100.0	100.0	77.6	76.0	75.6
Poultry	2.2	2.4	2.5	2.7	2.7	2.8	2.5	2.5	2.4
<i>Laying hens</i>	1.4	1.5	1.7	2.1	2.5	2.9	2.7	2.6	2.4
<i>Broilers</i>	2.0	2.0	2.0	2.0	2.0	2.0	1.8	1.8	1.6
<i>Turkeys</i>	47.0	46.0	44.6	44.6	44.6	44.6	44.1	43.8	43.1
<i>Other poultry</i>	5.0	5.0	5.0	5.0	5.0	4.9	4.8	4.6	4.6
Other animals	1.9	2.2	2.6	2.9	3.3	3.1	2.5	0.2	0.3

<b>Animal type</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2023</b>	<b>2024</b>
<i>Fur-bearing animals</i>	4.2	4.2	4.2	4.2	4.2	4.2	4.2	NO	NO
<i>Rabbits</i>	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.3

### **NMVOG**

The NMVOG emissions reported under Manure management include emissions from manure in animal housing, manure in outside stores and silage feed in animal housing. Most NMVOG emissions occur during the feeding of silage. The increase in IEF that can be seen with cattle is caused by increased feeding of silage (Table 6.8). NMVOG is also released from the storage of manure in animal housing and outside manure storage. All NMVOG emissions were calculated at a Tier 2 level on the basis of default EFs from the 2016 EMEP Guidebook (EEA, 2016), using the NEMA model. The activity data used for these calculations consist of animal numbers and feeding data as reported by the WUM (CBS, 2025).

Table 6.8 IEFs for NMVOG from 3B Manure management (in kg NMVOG/animal)

<b>Animal type</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2023</b>	<b>2024</b>
Cattle	5.98	6.17	7.96	8.41	12.14	13.28	14.54	14.52	14.91
<i>Dairy cattle</i>	8.15	7.96	15.07	16.92	24.13	25.67	27.38	27.96	28.39
<i>Non-dairy cattle</i>	4.64	5.14	3.78	3.24	5.05	5.28	4.93	4.94	5.07
Sheep	0.05	0.05	0.05	0.05	0.02	0.02	0.02	0.02	0.02
Swine	0.42	0.39	0.35	0.32	0.29	0.27	0.28	0.23	0.23
Goats	0.86	0.79	0.42	0.81	0.86	0.85	0.95	0.47	0.47
Horses	0.61	0.61	0.61	0.59	0.59	0.59	0.59	0.59	0.58
Mules and asses	IE	IE	IE	IE	0.25	0.25	0.25	0.25	0.25
Poultry	0.06	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.07
<i>Laying hens</i>	0.05	0.06	0.05	0.05	0.06	0.06	0.06	0.06	0.07
<i>Broilers</i>	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07
<i>Turkeys</i>	0.08	0.08	0.08	0.07	0.07	0.07	0.12	0.14	0.14
<i>Other poultry</i>	0.03	0.04	0.04	0.04	0.04	0.03	0.07	0.08	0.08
Other animals	0.14	0.17	0.21	0.23	0.26	0.25	0.19	0.01	0.01
<i>Fur-bearing animals</i>	0.34	0.34	0.34	0.34	0.34	0.34	0.34	NO	NO
<i>Rabbits</i>	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

#### 6.2.5 *Uncertainties and time series consistency*

A propagation of error analysis on NH<sub>3</sub> emissions was performed in 2022. Using reassessed uncertainty estimates of activity data and the judgement of experts (Van der Zee et al., 2026), an uncertainty of 21% in total NH<sub>3</sub> emissions from sector 3B Manure management was calculated. Including the emissions in sector 3D Crop production and agricultural soils, the combined uncertainty in NH<sub>3</sub> emissions from the Agriculture sector was 23%. A Monte Carlo analysis of uncertainties of the total inventory (including sectors outside of agriculture) was performed in 2026 and the results are presented in Section 1.5.

When available, the same information sources were used throughout the time series. The agricultural census was the most important information source. This census has been conducted in the same way for decades.

The same methodology for emission calculations was used throughout the time series, ensuring the consistency of the emission calculations.

#### 6.2.6 *Source-specific QA/QC and verification*

This source category is covered in Chapter 1, under general QA/QC procedures. QA/QC measures taken for the sector Agriculture are described in the methodology report (Van der Zee et al., 2026).

#### 6.2.7 *Source-specific recalculations*

Five recalculations have been implemented for the Manure management sector.

- The amount of treated manure has been harmonised for the calculations regarding storage and treatment. Previously, for the calculation of emissions from storage, the fraction of manure in terms of P<sub>2</sub>O<sub>5</sub> going to treatment was subtracted (P<sub>2</sub>O<sub>5</sub> excreted / P<sub>2</sub>O<sub>5</sub> treated). The emissions of manure treatment were based on the fraction of manure in terms of N. These fractions differ as there are N losses in housing whereas there are no P<sub>2</sub>O<sub>5</sub> losses. The change affects NO<sub>x</sub> emissions from manure management from cattle and swine (3B1a, 3B1b and 3B3). Emissions from swine were recalculated from 2006 onwards (the first year with swine manure treatment). Emissions increased by between 1171 kg NO<sub>x</sub> (2006) and 83617 kg NO<sub>x</sub> in 2022. Emissions from non-dairy cattle were recalculated for the entire timeseries. Emissions from non-dairy cattle increased by between 90 kg (1999) and 7,426 kg NO<sub>x</sub> (2021). Emissions from dairy cattle were recalculated from 2006 onwards (the first year with dairy cattle manure treatment). NO<sub>x</sub> emissions from dairy cattle increased by between 2,119 kg (2006) and 16,415 kg (2016). The recalculation causes slight changes to the division of NH<sub>3</sub> emissions from cattle manure treatment over Dairy cattle and Non-dairy cattle (less than 100 kg NH<sub>3</sub>)
- The emission factor of PM<sub>10</sub> and PM<sub>2.5</sub> from goats has been updated. Based on new measurements the EF of PM<sub>10</sub> increased from 19 g per goat to 170 g per goat (Mosquera et al. 2025). The EF of PM<sub>2.5</sub> increased at the same rate from 5.7g to 51 g per goat. The new emission factors have been applied from 2018 onwards. The old emission factors have been applied to 1990. Constant linear interpolation has been applied to the years 1991-2017 to create a consistent timeseries.
- Based on the same new measurements, the NH<sub>3</sub> EF of goats was increased from 1.9 kg NH<sub>3</sub> per goat to 4.3 kg NH<sub>3</sub> per goat. The new emission factor has been applied from 2018 onwards. The old emission factor has been applied to the years 1990-1998. Constant linear interpolation has been applied to the years 1999-2017 to create a consistent timeseries.
- The fourth recalculation concerns the NH<sub>3</sub> emission from manure management of dairy cattle in 2022 and 2023. Small mistakes have been corrected in the input files with housing resulting in lower NH<sub>3</sub> emissions. NH<sub>3</sub> emissions from 3B1a decreased by 54 kg NH<sub>3</sub> in 2022 and by 40,044 kg NH<sub>3</sub> in 2023.
- The fifth recalculation results from the previous recalculations. As the emissions of NH<sub>3</sub> from storage and manure application change, NMVOC emissions from manure management change,

too. NMVOC emissions from goats decrease by between 295 kg in 1999 to 9656 kg NMVOC in 2023. NMVOC emissions from dairy cattle increase by 1 kg in 2022 and by 459 kg in 2023.

#### 6.2.8 *Source-specific planned improvements*

The nutrients that bedding material incorporate into the manure and the corresponding emissions have been estimated taking only straw into account. In the Netherlands, various types of bedding material are used, such as straw, wood shavings, but also the dry fraction of separated manure. The Tier 1 method does not account for the latter type of bedding material, and it is expected that the emissions from this type of bedding material are higher than from straw and wood shavings. The agricultural census will include a question on the use of bedding material, thus enabling the calculation of emissions from the various types of bedding material for the IIR of 2027.

According to the EMEP guidelines manure digestion causes N to mineralise to TAN, resulting in higher NH<sub>3</sub> emissions when the digestate is subsequently applied as a fertiliser. Currently this is not accounted for in the calculations. Due to the complexity of the way the NEMA model accounts for manure digestion and time constraints this improvement, which was brought up during the 2025 NECD inventory review, could not be implemented in the current IIR. All efforts will be made to address this issue in the 2027 submission.

### 6.3 **Crop production and agricultural soils (3D)**

#### 6.3.1 *Source category description*

The category Crop production and agricultural soils (3D) includes emissions relating to the agricultural use of land. Emissions were allocated to the following NFR subcategories:

- 3Da1 Inorganic N fertilisers;
- 3Da2a Animal manure applied to soils;
- 3Da2b Sewage sludge applied to soils;
- 3Da2c Other organic fertilisers applied to soils;
- 3Da3 Urine and dung deposited by grazing animals;
- 3Da4 Crop residues applied to soils;
- 3Db Indirect emissions from managed soils;
- 3Dc Farm-level agricultural operations including storage, handling and transport of agricultural products;
- 3Dd Off-farm storage, handling and transport of bulk agricultural products;
- 3De Cultivated crops;
- 3Df Use of pesticides.

Category 3Dc contains PM emissions from the use of inorganic N fertilisers and pesticides, the supply of concentrate feed to farms, haymaking and crop harvesting. NMVOC emissions from silage storage are also reported under 3Dc. NMVOC emissions are allocated to the categories 3Da2a, 3Da3, 3Dc 3De and 3Df. Zinc and HCB emissions are allocated to category 3Df.

#### 6.3.2 *Key sources*

Within sector 3D, Animal manure applied to soils (3Da2a) was the largest 2024 level key source of NH<sub>3</sub> emissions, amounting to 27% of the national total. Inorganic N fertilisers (3Da1) were also a 2024 level key source of

NH<sub>3</sub>, making up 8% of the national total. For NO<sub>x</sub>, animal manure applied to soils (3Da2a, 8%) and inorganic N fertilisers (3Da1, 5%) were level 2024 key sources. For NMVOC emissions, Farm-level agricultural operations including storage, handling and transport of agricultural products (3Dc, 5%) and Animal manure applied to soils (3Da2a, 4%) were level 2024 key sources. For emissions of PM<sub>10</sub>, Cultivated crops (3De, 3%) is the only key source from the crop production sector. For PM<sub>2.5</sub>, the crop production and agricultural soils sector contained no key sources. HCB emissions from the use of pesticides (3Df) were not a key source.

### 6.3.3 Overview of shares and trends in emissions

Table 6.9 presents an overview of emissions of the main pollutants NH<sub>3</sub>, NMVOC and NO<sub>x</sub>, together with the particulate matter fractions PM<sub>10</sub> and PM<sub>2.5</sub>, the other heavy metal, Zn, and the persistent organic pollutant HCB, originating from sector 3D Crop production and agricultural soils (3D).

Table 6.9 Emissions of main pollutants and particulate matter from the category of Crop production and agricultural soils (3D)

Year	Main Pollutants			Particulate Matter			POP	HM
	NO <sub>x</sub>	NMVOC	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	HCB	Zn
	Gg	Gg	Gg	Gg	Gg	Gg	kg	Mg
<b>1990</b>	<b>47</b>	<b>56</b>	<b>237</b>	<b>0.11</b>	<b>1.2</b>	<b>1.2</b>	<b>21</b>	<b>0.00</b>
1995	45	25	110	0.11	1.1	1.1	39	0.00
2000	38	26	84	0.11	1.2	1.2	16	0.00
2005	33	23	72	0.11	1.2	1.2	1.8	6.8
2010	30	21	52	0.11	1.2	1.2	1.1	4.5
2015	31	23	53	0.11	1.1	1.1	0.75	4.4
2020	30	23	51	0.10	1.0	1.0	0.14	4.4
2021	29	23	52	0.11	1.0	1.0	0.03	2.2
2022	28	23	51	0.11	1.1	1.1	0.05	2.2
2023	29	22	48	0.11	1.1	1.1	0.04	2.2
<b>2024</b>	<b>28</b>	<b>22</b>	<b>46</b>	<b>0.10</b>	<b>1.0</b>	<b>1.0</b>	<b>0.04</b>	<b>2.2</b>
1990-2024 <sup>1)</sup>	-19	-34	-191	-0.01	-0.2	-0.2	-21.1	2.2
1990-2024 <sup>2)</sup>	-40%	-61%	-81%	-10%	-17%	-17%	-100%	
% 2024 <sup>3)</sup>	16%	9%	41%	1%	4%	3%	1%	3%

1. Absolute difference in Gg, except for HCB (kg) and Zn (Mg)

2. Relative difference from 1990 in %

3. % of national total 2024

### **N emissions**

Emissions of NH<sub>3</sub> from crop production and agricultural soils decreased by 81% between 1990 and 2024, with an initial sharp fall between 1990 and 1995. This was mainly the result of changed manure application methods, which were enforced during this period (i.e. incorporation of manure into the soil instead of surface spreading). The use of inorganic N fertiliser also decreased during the time series, following policies

aimed at reducing the nutrient supply to soils (i.e. implementation of the EU Nitrates Directive).

NO<sub>x</sub> emissions decreased by 40% between 1990 and 2024, mainly because of lower N input through the use of inorganic N fertiliser and reductions in grazing time and manure application.

### **Particulate matter**

The particulate matter emissions reported in this source category originate from the use of inorganic N fertiliser and pesticides, the supply of concentrate feed to farms, haymaking and crop harvesting. The decreasing trend in PM emissions is entirely explained by fluctuations in the acreage of crops.

### **NMVOC**

NMVOC emissions from crop production and agricultural soils show a 61% decrease between 1990 and 2024, as a result of changing manure application methods to reduce emissions of ammonia between 1990 and 1995. The increase in emissions from farm-level agricultural operations was caused by an increase in silage feeding, and thus silage storage.

### **Zinc**

Zinc emissions decreased by 67% from 2005 to 2024, due to a reduction in pesticide use. Before 2005, there were no zinc emissions relating to the pesticides used.

### **HCB**

From 1990 to 2024, HCB emissions decreased by almost 100%, due to a reduction in pesticide use, more stringent requirements for the allowed HCB impurity in pesticides and a ban on some pesticides containing HCB impurities.

## 6.3.4 *Activity data, (implied) emission factors and methodological issues*

### **N emissions**

For N emission calculations in sector 3D, activity data was calculated from N excretion including bedding material in sector 3B minus N emissions from animal housing, manure treatment and outside storage (Figure 6.3). After subtracting the N in manure removed from agriculture (exported, incinerated or otherwise used outside of agriculture), the remaining N was allocated to grassland and arable land. Implementation percentages of application techniques were derived from the agricultural census. The associated NH<sub>3</sub> EFs were reported in Van der Zee et al. (2026). NO<sub>x</sub> emissions relating to manure, inorganic N fertiliser and sewage sludge application, compost use and the grazing of animals were calculated using the EMEP default EF.

NH<sub>3</sub> emissions from the use of inorganic N fertilisers were calculated using data on the amount of inorganic N fertiliser used in agriculture. Several types of inorganic N fertiliser were distinguished – each with a specific NH<sub>3</sub> EF. In recent years, the amount of applied urea fertiliser has increased, and a growing share is used in liquid form or coated with urease inhibitors to reduce NH<sub>3</sub> emissions and/or is applied with NH<sub>3</sub> low-emission techniques. To account for this development, additional subcategories of urea fertiliser were specified for the 1990–2024 time

series, as described in the methodology report by Van der Zee et al. (2026). The subcategories and the EFs for each subcategory can be found in Van der Most et al. (2026).

Calculations of NH<sub>3</sub> emissions from crop residues were based on activity data taken from the agricultural census. Given the large uncertainty in the emissions from crop ripening, a fixed estimate of 1.8 Gg NH<sub>3</sub>/year was reported (De Ruijter et al., 2013).

IEFs for sector 3D in kg NH<sub>3</sub>/kg N supply were calculated for the NFR categories, as depicted in Table 6.10. IEFs for animal manure and sewage sludge application dropped considerably between 1990 and 1995 due to mandatory incorporation into the soil. The reduction in emissions from urine and dung deposited by grazing animals was mainly explained by a reduction in cattle grazing.

Figure 6.3 Nitrogen flows in relation to  $NH_3$  and  $NO_x$  emissions, where boxes with black type show the emissions included in 3D Crop production and agricultural soils and boxes with grey type show emissions included in 3B Manure management

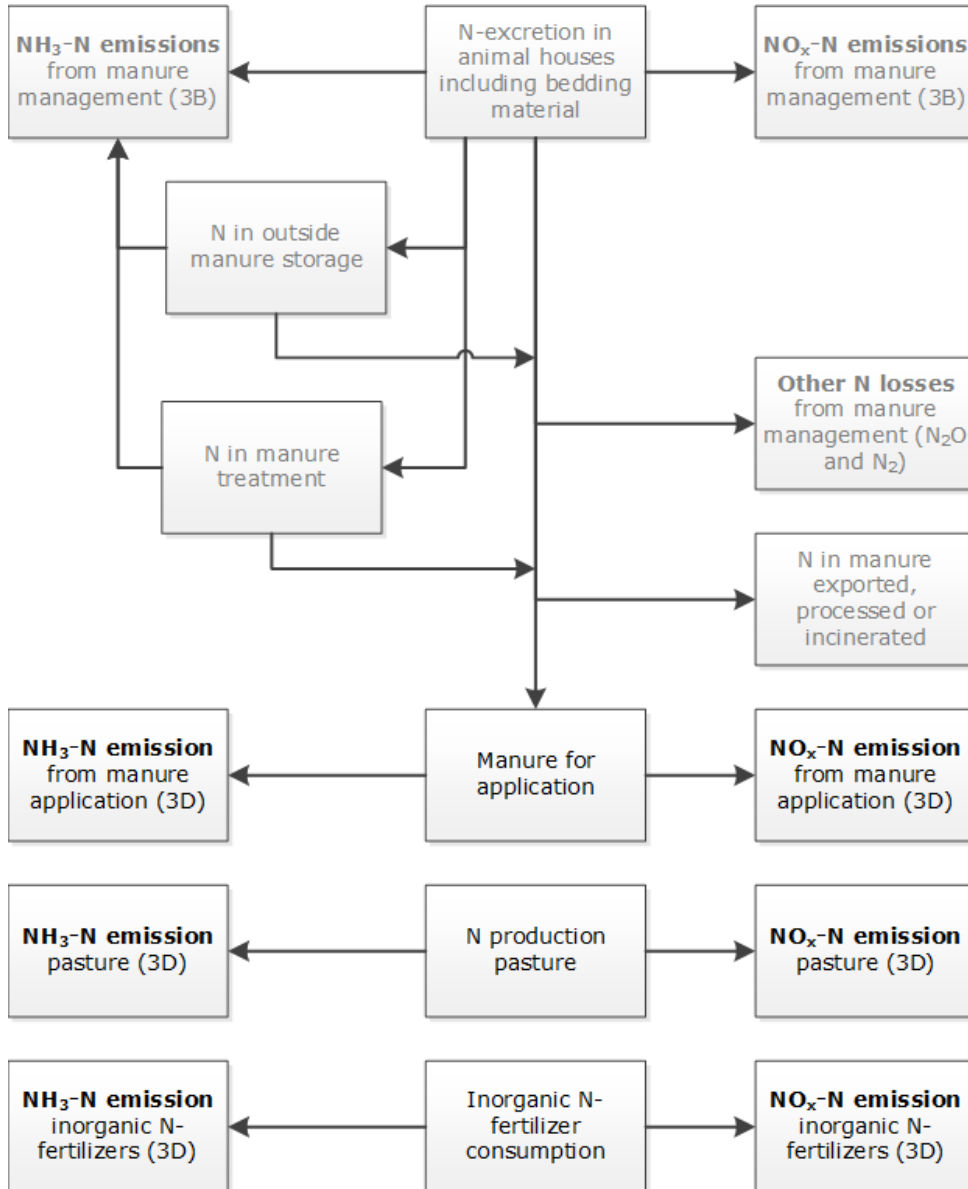


Table 6.10 IEFs for NH<sub>3</sub> from 3D Crop production and agricultural soils (in kg NH<sub>3</sub>/kg N supply)

Supply source	1990	1995	2000	2005	2010	2015	2020	2023	2024
Application of inorganic N fertilisers	0.03	0.03	0.04	0.05	0.04	0.04	0.04	0.04	0.04
Application of animal manure	0.49	0.19	0.18	0.17	0.12	0.11	0.10	0.10	0.10
Application of sewage sludge	0.29	0.08	0.09	0.10	0.10	0.10	0.10	0.09	0.08
Application of other organic fertilisers (compost)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Urine and dung deposited by grazing animals	0.08	0.08	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Crop residues	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Crop ripening	NA	NA	NA	NA	NA	NA	NA	NA	NA

### **Particulate matter**

Small sources of PM<sub>10</sub> and PM<sub>2.5</sub> emissions reported under category 3D were the application of inorganic N fertilisers and pesticides, the supply of concentrate feed to farms, and haymaking. To calculate PM emissions, both EMEP default and country specific EFs were applied (Van der Zee et al., 2026). PM emissions from other agricultural processes (e.g. the supply of concentrate feed to farms, the use of pesticides and haymaking) were estimated using fixed factors (Van der Zee et al., 2026). Crop harvesting was calculated from agricultural census acreage data and EMEP default EFs (EEA, 2019).

### **NMVOC**

The NMVOC emissions reported under category 3D were from animal manure applied to soils, urine and dung deposited by grazing animals, farm-level agricultural operations including storage, handling and transport of agricultural products, cultivated crops and use of pesticides. All were calculated on the basis of EMEP default EFs, using a Tier 2 method. Only the emissions from cultivated crops were calculated using a Tier 1 method. The emissions from the use of pesticides were calculated using a Tier 3 method.

NMVOC emissions from the use of pesticides originate from the use of mineral oil, metaldehyde and formic acid. Usage of and emissions from these pesticides were calculated by the National Environmental Indicator Pesticides (NMI4) (Kruijne et al., 2025). Subsequently, it is assumed that 20% of the mineral oil emissions are NMVOC and 100% of the metaldehyde and formic acid emissions are NMVOC.

### **Zinc**

Zinc emissions were based on the amount of pesticides used in agriculture as calculated by the National Environmental Indicator Pesticides (NMI4) model (Kruijne et al., 2025).

**HCB**

Hexachlorobenzene has been prohibited for use as a pesticide for the entire time series. However, HCB can still be found in certain pesticides as an impurity. The sales figures of the pesticides containing HCB are presented in Table 6.11. The impurity factor was based on the maximum amount that is allowed (EMEP, 2019).

*Table 6.11 Sales figures of pesticides containing HCB impurities in 1,000 kg active substance*

<b>Year</b>	<b>Lindane</b>	<b>Atrazine</b>	<b>Simazine</b>	<b>Chloro-thalonil</b>	<b>Clopy-ralid</b>
1990	19.5	172.3	60.5	62.3	0.0
1991	20.6	189.1	63.0	67.6	0.0
1992	25.9	201.5	52.7	80.9	0.0
1993	25.0	205.3	52.9	93.9	0.0
1994	19.6	221.5	50.4	102.4	0.0
1995	19.3	218.4	50.7	126.7	2.9
1996	21.3	209.3	48.5	101.2	1.9
1997	22.5	183.7	48.1	209.0	1.5
1998	22.9	154.6	52.1	420.8	2.4
1999	44.3	134.6	71.4	323.1	2.2
2000	0.0	0.0	30.2	388.5	4.8
2001	0.0	0.0	19.8	81.5	3.3
2002	0.0	0.0	0.0	539.2	3.3
2003	0.0	0.0	1.2	102.7	2.1
2004	0.0	0.0	0.0	159.5	2.2
2005	0.0	0.0	0.0	179.6	2.3
2006	0.0	0.0	0.0	164.6	1.8
2007	0.0	0.0	0.0	206.4	2.2
2008	0.0	0.0	0.0	153.6	1.8
2009	0.0	0.0	0.0	105.3	1.2
2010	0.0	0.0	0.0	106.2	1.6
2011	0.0	0.0	0.0	113.9	1.8
2012	0.0	0.0	0.0	104.6	1.6
2013	0.0	0.0	0.0	90.2	2.3
2014	0.0	0.0	0.0	77.1	4.6
2015	0.0	0.0	0.0	73.4	6.2
2016	0.0	0.0	0.0	82.2	5.8
2017	0.0	0.0	0.0	68.0	18.7
2018	0.0	0.0	0.0	63.9	18.1
2019	0.0	0.0	0.0	43.6	19.9
2020	0.0	0.0	0.0	9.5	18.1
2021	0.0	0.0	0.0	0.0	13.3
2022	0.0	0.0	0.0	0.0	19.0
2023	0.0	0.0	0.0	0.0	15.6
2024 <sup>1</sup>	0.0	0.0	0.0	0.0	15.6

1. Sales figures from 2023 were used as preliminary figures for 2024

### 6.3.5 *Uncertainties and time series consistency*

A propagation of error analysis of NH<sub>3</sub> emissions was performed in 2022. Using reassessed uncertainty estimates of activity data and expert judgement, an uncertainty of 31% was calculated for NH<sub>3</sub> emissions from animal manure application, 36% for inorganic N fertiliser use and 48% for grazing emissions. The total uncertainty in the ammonia emissions from sector 3D Crop production and agricultural soils then amounts to 25%. Including the emissions in sector 3B Manure management, the combined uncertainty in total NH<sub>3</sub> emissions from agriculture amounts to 23%. A Monte Carlo analysis on the uncertainties of the total inventory was performed in 2026 and the results are presented in Section 1.5.

When available, the same information sources were used throughout the time series. The agricultural census was the most important information source. This census has been conducted in the same way for decades. The same methodology for emission calculations was used throughout the time series, ensuring consistency of the emission calculations. A propagation of error analysis of HCB emissions was performed in 2021. The EMEP Guidebook estimates the uncertainty of the emission factor to range between 15 and 30%. For the calculations, the HCB contamination was set at the maximum allowed under the regulations, while producers have an incentive to ensure their products remain below the threshold. Therefore, the uncertainty was set at 30%.

The amount of pesticides sold was derived from the confidential 'RAG list' (Regeling administratievevoorschriften gewasbeschermingsmiddelen) for the 1990–2009 period. For the 2010–2023 period, the data was provided by the Dutch Food and Consumer Safety Authority; this data is publicly available. For 2024, the value of 2023 was used, as no new value had been provided in time (NVWA, 2025). Both sources provide the same information: the quantity of pesticides sold in kg active substance. Both sources used sales figures submitted by companies selling pesticides. No time series inconsistency is caused by the two sources.

### 6.3.6 *Source-specific QA/QC and verification*

This source category is covered in Chapter 1 under general QA/QC procedures. QA/QC measures taken for the sector Agriculture are described in section 2.5 of the methodology report (Van der Zee et al., 2026).

### 6.3.7 *Source-specific recalculations*

Six recalculations have been implemented for the sector Crop production and agricultural soils.

- The first recalculation concerns NH<sub>3</sub> and NO<sub>x</sub> emissions from inorganic N fertiliser application. These emissions have been recalculated for the years 2019-2023. This is caused by the higher emission factor for NH<sub>3</sub> from goat housing (Mosquera et al. 2025). Rinsing liquid from air scrubbers on goat houses contains more N resulting in higher emissions when it is applied to soils. The increase varies from 127 to 391 kg NH<sub>3</sub> and 150 to 452 kg NO<sub>x</sub>.

- The second recalculation is caused by the different changes in sector 3B, affecting the amount of TAN available for application. NH<sub>3</sub> emissions decrease by between 519 kg NH<sub>3</sub> (1998) and 856,857 kg in 2023. Most of the change can be explained by the higher NH<sub>3</sub> emissions from goat housing.
- The third recalculation results from the previous recalculations. As the emissions of NH<sub>3</sub> from storage and manure application change, NMVOC emissions from manure storage and manure application change as well. NMVOC emissions have been recalculated for the entire timeseries. NMVOC emissions from manure application decreased by between 110 kg (1998) and 167,268 kg NMVOC (2022).
- The NO<sub>x</sub> emissions related to the agricultural use of organic soils have been recalculated based on new insights on the area of peat and peaty soils in the Netherlands. This increases NO<sub>x</sub> emissions in 1990-2020 and decreases the emissions in 2021-2023. More information on the calculation of organic soils in the Netherlands can be found in the LULUCF report; Van Baren et al. (2026).
- The preliminary figures of the application of inorganic fertilisers compost, pesticides and the grassland renewal rate in 2023 have been replaced by the final figures. This causes small changes in NH<sub>3</sub>, NO<sub>x</sub> and HCB emissions.
- The allocation of emissions from grassland renewal has been changed from 3Da2 (animal manure applied to soils) to 3Da4 (crop residues applied to soils). This does not affect the total emissions from 3D.

#### 6.3.8 *Source-specific planned improvements*

The IIR 2027 will include the sales figures of pesticides in 2024 instead of using sales figures from 2023 as a proxy.

## 7 Waste

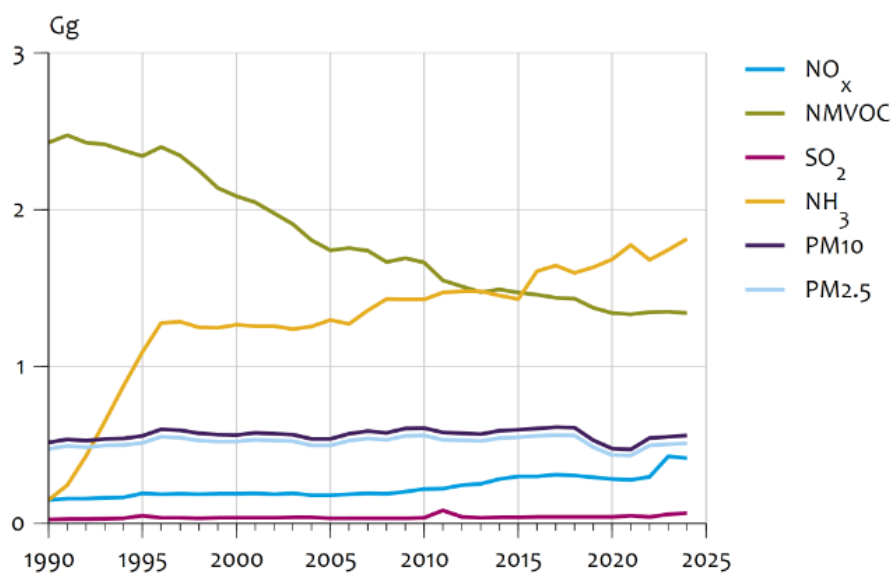
### 7.1 Overview of the sector

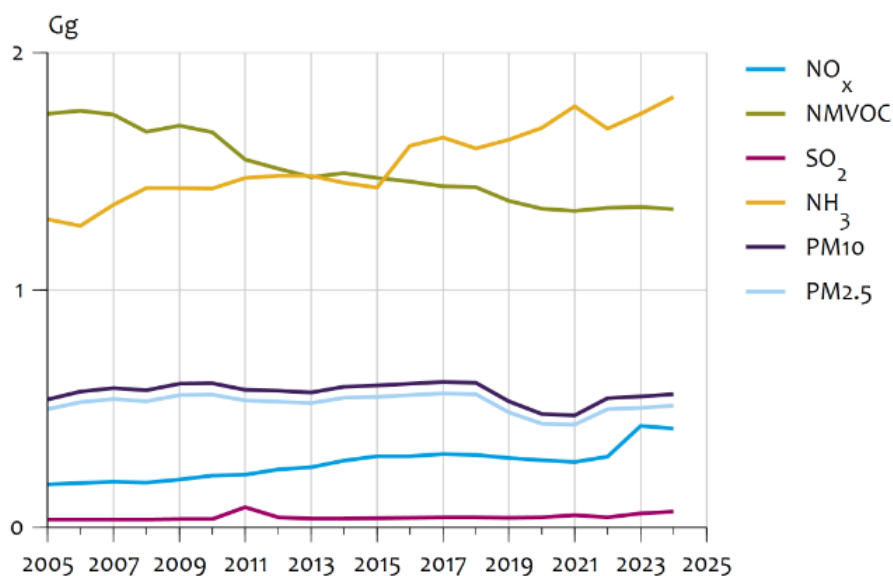
Waste sector emissions include emissions from companies that process waste (water) flows in industrial installations. The waste sector (NFR 5) consists of the following source categories:

- 5A Solid waste disposal on land;
- 5B Anaerobic digestion and composting;
- 5C Waste incineration;
- 5D Wastewater handling;
- 5E Other waste.

Figure 7.1 shows the trend in the emissions of the main pollutants from the Waste sector between 1990-2024 and 2005-2024.

Figure 7.1 Emission trends for the main pollutants in NFR 5 – Waste between 1990-2024 (upper panel) and 2005-2024 (lower panel)





In 2024, 4% of total PM<sub>2.5</sub>, 2% of total NH<sub>3</sub>, 2% of total PM<sub>10</sub> and 1% of total NMVOC emissions in the Netherlands originated from the Waste sector (Figure 2.1).

#### 7.1.1 Solid waste disposal on land (5A)

Emissions in this source category comprise those from landfills and those from recovered and flared landfill gas. Part of the recovered landfill gas is used for energy purposes, and these emissions are allocated to the Energy sector (source category Other: Stationary (1A1a)). If landfill gas is only flared off, the emissions are allocated to 5A.

Mineral waste may be disposed of in landfills, recycled or recovered as backfill material, depending on its composition and origin. Landfilling of mineral waste is more likely for inert materials, or for disposal of waste after primary, such as chemical, treatment. In all cases, mineral waste treatment implies multiple handling activities, such as unloading/loading activities. Emissions of particulate matter occur during mineral waste handling activities.

#### 7.1.2 Composting and anaerobic digestion (5B)

Emissions in this source category comprise those from facilities for the composting and/or fermenting of manure and from separately collected organic waste for composting and/or biogas production (sometimes also used as co-substrate in manure digestion).

During processing, emissions of NH<sub>3</sub>, SO<sub>x</sub> and NO<sub>x</sub> occur that are relevant to the total national emission, which are reported in NFR 5B. The biogas produced is used for energy purposes, so these emissions are allocated to the Energy sector (source category Small combustion (1A4)).

#### 7.1.3 Waste incineration (5C)

Emissions in this source category are emissions from municipal, industrial, hazardous and clinical waste incineration, from the

incineration of sewage sludge, from crematoria and from the open burning of waste. Since all waste incineration plants for mixed municipal waste in the Netherlands produce electricity and/or heat that is used for energy purposes, emissions from these source categories are explained and included in the Energy sector (source category Public electricity and heat production (1A1a)).

NO<sub>x</sub> and SO<sub>x</sub> emissions from crematoria (category 5C1bv) only includes the emissions from the cremation of human remains. The emissions from natural gas used in crematoria are included in the source category Commercial/Institutional: Stationary (1A4ai).

#### 7.1.4 *Wastewater handling (5D)*

In the Netherlands, all wastewater is treated in municipal wastewater treatment plants (5D1) or in industrial treatment plants (5D2), both in a biological process. During the water treatment, small amounts of NMVOC are emitted.

The produced wastewater sludge is often used for methane production in an anaerobic digester and dried afterwards for transport to a wastewater sludge processor where the sludge is usually incinerated.

Natural gas, on-site produced biogas from anaerobic sludge digestion and very small amounts of domestic fuel oil are used in the sludge drying installations. The emissions from incineration of fuels are reported under Commercial/Institutional: Stationary (1A4ai).

In pursuit of waste minimisation and circular use of raw materials, WWTP operators and sludge processors are working on new ways of treating the wastewater and processing the produced sludge (for instance producing Kaumera Nereda® gum, alginates, cellulose, struvite, etcetera). Developments relating to emissions from these new processes are closely monitored.

#### 7.1.5 *Other waste (5E)*

Emissions in the source category Other waste (5E) comprise emissions from waste preparation for recycling, scrapped fridges/freezers and accidental building and car fires.

#### 7.1.6 *Key sources*

The source category Other waste (5E) is a:

- level 2024 key source of PM<sub>10</sub>, PM<sub>2.5</sub>, BC, dioxins and total PAH;
- No key source for trend and level 1990.

All sources in this NFR category are calculated with a CS methodology.

## 7.2 **Overview of shares and trends in emissions**

An overview of the trends in emissions is presented in Table 7.1.

Emissions of most pollutants from the waste sector are low compared to national total emissions (Figure 2.1; Table 7.1). This is mainly because most emissions from waste incineration are reported under the Energy sector. The exceptions are dioxins (from building fires) and PAHs (from building and car fires) (Table 7.1).

With the exception of NMVOC, emissions of the main pollutants have increased since 1990. This increase has been caused by gradually increased activity. The increase is sometimes dampened by the implementation of abatement technologies for some sources.

Table 7.1 Overview of emissions in the Waste sector (NFR 5)

Year	Main Pollutants				Particulate Matter				Other
	NO <sub>x</sub>	NMVOC	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	BC	CO
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
<b>1990</b>	<b>0.15</b>	<b>2.4</b>	<b>0.03</b>	<b>0.15</b>	<b>0.48</b>	<b>0.52</b>	<b>0.55</b>	<b>0.11</b>	<b>7.2</b>
1995	0.19	2.3	0.05	1.1	0.51	0.56	0.59	0.12	8.6
2000	0.19	2.1	0.04	1.3	0.52	0.56	0.59	0.12	8.7
2005	0.18	1.7	0.03	1.3	0.50	0.54	0.57	0.11	8.1
2010	0.22	1.7	0.04	1.4	0.56	0.61	0.64	0.13	8.8
2015	0.30	1.5	0.04	1.4	0.55	0.60	0.64	0.13	8.5
2020	0.28	1.3	0.04	1.7	0.44	0.48	0.51	0.11	7.8
2021	0.28	1.3	0.05	1.8	0.43	0.47	0.51	0.11	7.7
2022	0.30	1.3	0.04	1.7	0.50	0.54	0.60	0.12	8.5
2023	0.43	1.3	0.06	1.7	0.50	0.55	0.61	0.12	8.5
<b>2024</b>	<b>0.42</b>	<b>1.3</b>	<b>0.07</b>	<b>1.8</b>	<b>0.51</b>	<b>0.56</b>	<b>0.62</b>	<b>0.13</b>	<b>8.6</b>
1990-2024 <sup>1)</sup>	0.27	-1.1	0.04	1.7	0.04	0.04	0.07	0.02	1.4
1990-2024 <sup>2)</sup>	177%	-45%	154%	1098%	8%	9%	14%	16%	19%
% 2024 <sup>3)</sup>	0%	1%	0%	2%	4%	2%	2%	6%	2%

Table 7.1 Overview of emissions in the Waste sector (NFR 5) (continued)

Year	Priority Heavy Metals			POPs		Other Heavy Metals					
	Pb	Cd	Hg	DIOX	PAH	As	Cr	Cu	Ni	Se	Zn
	Mg	Mg	Mg	g I-Teq	Mg	Mg	Mg	Mg	Mg	Mg	Mg
<b>1990</b>	<b>0.05</b>	<b>0.02</b>	<b>0.09</b>	<b>13</b>	<b>0.79</b>	<b>0.02</b>	<b>0.03</b>	<b>0.01</b>	<b>0.00</b>	<b>0.00</b>	<b>1.1</b>
1995	0.05	0.02	0.10	14	0.83	0.02	0.04	0.02	0.00	0.00	1.5
2000	0.05	0.02	0.10	14	0.85	0.02	0.04	0.02	0.00	0.00	1.2
2005	0.05	0.02	0.09	14	0.83	0.02	0.04	0.02	0.00	0.00	1.1
2010	0.06	0.03	0.04	16	0.93	0.02	0.04	0.02	0.00	0.00	1.3
2015	0.05	0.03	0.01	16	0.92	0.02	0.04	0.02	0.00	0.00	1.3
2020	0.05	0.02	0.01	16	0.60	0.00	0.04	0.01	0.00	0.00	0.9
2021	0.05	0.02	0.00	16	0.59	0.00	0.04	0.01	0.00	0.00	0.9
2022	0.05	0.02	0.01	16	0.82	0.01	0.04	0.01	0.00	0.00	1.2
2023	0.05	0.03	0.01	17	0.84	0.01	0.04	0.01	0.00	0.00	1.2
<b>2024</b>	<b>0.05</b>	<b>0.03</b>	<b>0.01</b>	<b>17</b>	<b>0.85</b>	<b>0.01</b>	<b>0.04</b>	<b>0.02</b>	<b>0.00</b>	<b>0.00</b>	<b>1.2</b>
1990-2024 <sup>1)</sup>	0.01	0.00	-0.08	4	0.06	0.00	0.01	0.00	0.00	0.00	0.1
1990-2024 <sup>2)</sup>	16%	18%	-93%	29%	8%	-19%	23%	6%	7%	-17%	10%
% 2024 <sup>3)</sup>	1%	4%	2%	56%	18%	5%	1%	0%	0%	3%	1%

1. Absolute difference

2. Relative difference from 1990 in %

3. % of national total 2024

### 7.2.1 Methodological issues

The methodology used to calculate most of the emissions from the source categories in the Waste sector is described by Honig et al. (2026). The exceptions are emissions from cremations, accidental building and car fires, and from bonfires, the methodologies of which are explained in Visschedijk et al. (2026), and from the source Livestock manure digestion, which is explained in Van der Zee et al. (2026).

In 2025, emissions that occur during the processing of organic waste in industrial digesters is included for the first time, due to the use of an existing data source. Waste from food production, expired products from supermarkets and the catering industry are sometimes digested separately in mono-digesters for other organic waste. Organic waste streams are also digested together with manure in so-called co-digesters. These plants were established from 2005 onwards to produce green gas, heat and electricity. It is assumed that the number of mono-digesters and co-digestion facilities were negligible in the period before 2005.

The emission factors for CH<sub>4</sub> and N<sub>2</sub>O from the digestion process of the organic waste are derived from a study on the processing of organic waste in Germany (Cuhls et al., 2015).

### 7.2.2 Uncertainties and time series consistency

As explained in Section 1.6.3, the Netherlands implemented an Approach 2 methodology for uncertainty analysis in 2018. This

methodology is used for uncertainty analysis of the pollutants NH<sub>3</sub>, NO<sub>x</sub>, SO<sub>x</sub> and PM. Table 7.2 provides an overview of the results for the Approach 2 uncertainties at NFR source category level.

Table 7.2 Overview of the Approach 2 uncertainties for Waste NFR source categories

NFR source category	Pollutants uncertainty					
	NH <sub>3</sub>	NO <sub>x</sub>	SO <sub>x</sub>	NMVOC	PM <sub>10</sub>	PM <sub>2.5</sub>
5A	NA	99%	99%	89%	70%	86%
5B	82%	101%	102%	NA	NA	NA
5C	312%	115%	117%	258%	381%	378%
5D	NA	NA	NA	133%	NA	NA
5E	208%	89%	95%	198%	195%	200%
<b>Total Waste sector</b>	<b>77%</b>	<b>71%</b>	<b>70%</b>	<b>160%</b>	<b>173%</b>	<b>179%</b>

The Approach 2 uncertainty analysis shows relatively high uncertainties at the level of the source categories. However, since these source categories either have no key sources for these pollutants or their contribution to the uncertainty at national level will be relatively small, there is no reason for prioritising methodological improvements.

#### 7.2.3 Source-specific QA/QC and verification

There are no source-specific QA/QC procedures. The categories in this sector are covered by the general QA/QC procedures, as discussed in Chapter 1.

#### 7.2.4 Source-specific recalculations

The source category 5A has been recalculated for the years 2021, 2022 and 2023 as new activity data has become available.

The source category 5B has been recalculated, due to the introduction of the new method for waste processed in co-digesters. The recalculation causes the NH<sub>3</sub> emissions from waste digestion to increase by 8 tons in 2005 to 351 tons in 2024.

Emissions for particulate matter and dioxins have been adjusted in category 5E. The ratio between car fires and the number of incidents reported to insurers has been adjusted for the period 2014-2023. Consequently, the number of car fires for the period 2014-2023 has been adjusted downwards. Statistics Netherlands (CBS) reported the number of car fires until 2013.

#### 7.2.5 Source-specific planned improvements

In 2024, a model was created to calculate propellant emissions (CFCs) from insulation panels in the waste phase. CFCs are part of the reported NMVOC emissions. In 2026, the model will be validated with information from literature (plausibility checks of emission factors) and checked for double counting with CFC emission sources, such as the production and use phase of the panels.

Some companies process their own industrial waste streams in their own incineration plants. Efforts are underway to gain more insight into the composition of these waste streams. This doesn't directly affect the total

emissions, as companies already report these emissions in their annual environmental reports (AERs).

### 7.3 Solid waste disposal on land (5A)

#### 7.3.1 Source category description

The source category Solid waste disposal on land (5A) comprises direct emissions from landfills and from recovered and flared landfill gas and PM emissions from the landfilling process.

This source category includes all waste landfill sites in the Netherlands that have been managed and monitored since 1945, i.e. both historical and current public landfills, and waste landfill sites on private land. These waste sites are considered to be responsible for most of the emissions in this source category. Emissions from landfill sites before 1945 are regarded as negligible (Van Amstel et al., 1993).

The total amount of landfill gas produced in the Netherlands is calculated using a first-order degradation model that calculates the degradation of degradable organic carbon (DOC) in waste (Table 7.3). From this information, the amount of methane is calculated using a methane conversion factor (Table 7.4).

It is assumed that 10% of the non-recovered methane will be oxidised in the top layer of the landfill.

Table 7.3 Amounts of waste landfilled and degradable organic carbon content

Year	Amount landfilled (Tg)	Degradable organic carbon (kg/Mg)	Degradable organic carbon that dissimilates (%)
1990	13.9	131	58
1995	8.2	125	58
2000	4.8	110	58
2005	3.5	62	41
2010	2.1	33	34
2015	2.3	43	40
2016	2.8	52	40
2017	2.9	56	39
2018	3.2	51	38
2019	2.8	49	34
2020	2.4	43	32
2021	2.1	38	31
2022	2.1	37	31
2023	2.2	37	30
2024	2.1	43	33

The amount of recovered and combusted landfill gas (mainly for energy purposes) is collected by the Working Group on Waste Registration (WAR). All landfill operators report this data to WAR (Table 7.6).

Part of the recovered landfill gas is used as an energy source (combined heat and power production or transferred to the natural gas network); emissions from this source are reported under 1A1a. The remainder of the recovered landfill gas is flared and the emissions from flaring are reported under sector 5A.

Flaring of landfill gas also emits small amounts of NMVOC to the atmosphere. The individual compounds that form NMVOCs mainly originate from volatile organic compounds that were dumped as waste in the past. A small part is produced as a by-product during the biodegradation of organic materials within the waste. Direct NMVOC emissions from landfills are calculated on the basis of individual pollutants in the landfill gas (see section 7.3.3).

*Table 7.4 Input parameters used in the landfill degradation model*

Parameter	Parameter values	References
Oxidation factor (OX)	0.1 (10%)	Coops et al. (1995)
DOC <sub>f</sub> = fraction of degradable organic carbon	0.58 from 1945 to 2004; from 2005 onwards, annually determined on the basis of the composition of waste disposed. This is an elaboration of the refinement points from the 2019 IPCC refinements	Oonk et al. (1994)
Degradable speed constant k	0.094 from 1945 to 1989 (half-life 7.5 yrs); from 1990 reducing to 0.0693 in 1995; thereafter constant at 0.0693 (half-life 10 yrs); from 2000 reducing to 0.05 in 2005; thereafter constant at 0.05 (half-life 14 yrs)	Oonk et al. (1994)
DOC <sub>(x)</sub> = concentration of biodegradable carbon in waste that was dumped in year x	132 kg C/Mg dumped waste from 1945 to 1989; from 1990 through a linear gradient reducing to 125 kg C/Mg in 1995; 120 kg/Mg in 1996 and 1997, and after 1997 determined annually by Rijkswaterstaat	Based on De Jager & Blok (1993) determined by Spakman et al. (1997) and published in Klein Goldewijk et al. (2004)
F = fraction of CH <sub>4</sub> in landfill gas	0.574 from 1945 to 2004; thereafter constant at 0.5	Oonk (2016)
MCF <sub>(x)</sub> = Methane correction factor for management	1	
Delay time	6 months	

### 7.3.2 Overview of shares and trends in emissions

NMVOC emission levels relating to this source category are relatively low, at 1.48 Gg and 0.21 Gg in 1990 and 2024, respectively.

PM<sub>2.5</sub> emissions are also relatively low, at 0.0039 Gg and 0.0048 Gg in 1990 and 2024, respectively.

The landfilling of waste, particularly of combustible waste products and biodegradable material, is discouraged in the Netherlands. For this reason, the amount of waste landfilled has dropped considerably (see Table 7.3), from 13.9 Tg in 1990 to only 2.1 Tg in 2024 (-85%). Moreover, due to the separation of degradable materials, the amount of degradable carbon in the waste has dropped from 131 kg C per Mg waste in 1990, to 43 kg C per Mg in 2024 (-67%). Additionally, the separated collection of household organic waste led to a decrease in the fraction of organic carbon that dissimilates from 58% in 1990 to 33% in 2024. These two developments have had a clear effect on methane (and also NMVOC) production by landfill sites, which has decreased over 80% during the same period. This downward trend is expected to continue in future.

PM<sub>2.5</sub> emissions are related to the amount of mineral waste treated. Important factors in the emission factor are the moisture content and the average wind speed. Especially the last factor fluctuates over the years and contribute a lot to an in- or decrease of PM<sub>2.5</sub> emissions.

### 7.3.3 *Emissions, activity data and (implied) emission factors*

Emissions of the individual compounds of NMVOC have been calculated as fractions of the emission total, using a landfill gas emission model for methane that is based on the IPCC Guidelines. The fractions were based on measurements of the composition of landfill gas. An overview of the EFs used is provided in Table 7.5.

Table 7.7 provides the emission factors used for the combustion of recovered landfill gas.

For each waste site, landfill site operators systematically monitor the amount of waste that is dumped (weight and composition). Since 1993, monitoring has been conducted by weighing the amount of dumped waste using weighbridges. Since 2005, landfill operators have been obliged to register their waste on the basis of European Waste List (EWL) codes (Decision 2000/532/EC). Table 7.8 represents the EFs used for calculating the PM emissions during treatment of mineral waste.

Table 7.5 Emission factors used for the free emission of landfill gas

<b>Pollutant</b>	<b>Free emitted landfill gas mg/m<sup>3</sup></b>
Benzene	7
Toluene	120
Trichlorofluoromethane (R-11)	5
1,1,2-Trichloro-1,2,2-trifluoroethane (R-113)	1
1,2-Dichlorotetrafluoroethane (R-114)	2
Chloropentafluoroethane (R-115)	1
Dichlorodifluoromethane (R-12)	20
Dichlorofluoromethane (R-21)	10
Chlorodifluoromethane (R-22)	10
1,2-Dichloroethene	1
Dichloromethane	20
Tetrachloroethylene (Perc)	10
1,1,1-Trichloroethane	2
Trichloroethylene (Tri)	10
Chloroform (trichloromethane)	1
Vinyl chloride (chloroethene)	10
Methanethiol (methyl mercaptan)	10
Hydrogen sulphide	100
Other hydrocarbons	700

Table 7.6 Overview of the amounts of landfill gas and methane recovered and combusted

<b>Year</b>	<b>Free emission of landfill gas (million m<sup>3</sup>)</b>	<b>Free emission of methane (Gg)</b>	<b>Recovered landfill gas (million m<sup>3</sup>)</b>	<b>Amount used for energy purposes (million m<sup>3</sup>)</b>	<b>Amount combusted in flares (million m<sup>3</sup>)</b>	<b>Percentage of methane in recovered landfill gas (%)</b>	<b>Amount recovered methane (Gg)</b>	<b>Amount recovered methane useful applied (Gg)</b>	<b>Amount recovered methane flared (Gg)</b>
1990	1,564	547	63.7	47.8	15.9	57.4	24.8	18.6	6.19
1995	1,367	478	182	136	45.4	57.4	70.6	52.9	17.6
2000	1,055	369	162	119	43.0	57.4	62.8	46.1	16.7
2005	770	233	130	97.9	32.5	53.2	47.0	35.3	11.7
2010	532	162	102	79.1	22.4	51.3	35.3	27.5	7.79
2015	376	115	60.4	43.4	16.9	49.6	20.3	14.6	5.69
2016	349	107	61.7	36.0	25.7	45.5	19.0	11.1	7.90
2017	321	98.2	62.1	36.1	26.0	48.0	20.2	11.7	8.47
2018	308	94.6	54.2	27.9	26.3	45.3	16.6	8.55	8.06
2019	292	89.7	48.9	23.4	25.5	45.7	15.1	7.26	7.88
2020	270	82.8	50.8	22.5	28.3	46.1	15.9	7.04	8.84
2021	254	78.0	46.3	20.0	26.3	45.6	14.3	6.18	8.13
2022	236	72.4	45.8	22.4	23.4	45.4	14.1	6.90	7.20
2023	219	68.0	46.8	24.3	22.5	41.0	13.0	6.75	6.24
2024	205	63.4	44.0	22.6	21.4	41.8	12.5	6.40	6.05

Table 7.7 Emission factors used for the combustion of landfill gas

Pollutant	Combusted landfill gas	
	Flared	Gas engine
Total hydrocarbons (incl. methane)	0.389763 kg/m <sup>3</sup>	0.389763 kg/m <sup>3</sup>
Hydrocarbons (C <sub>x</sub> H <sub>y</sub> )	0.27% hydrocarbons	6 g/m <sup>3</sup>
Dioxins	0.9E <sup>-9</sup> g/m <sup>3</sup>	0.3E <sup>-9</sup> g/m <sup>3</sup>
SO <sub>x</sub> (based on all sulphur)	104 mg/m <sup>3</sup>	104 mg/m <sup>3</sup>
NO <sub>x</sub> (as NO <sub>2</sub> )	0.3 g/m <sup>3</sup>	3 g/m <sup>3</sup>
CO	2.7% C	3.4 g/m <sup>3</sup>
Soot	0.05% hydrocarbons	0.05% hydrocarbons

Particulate matter emissions are calculated on the basis of the amount of processed mineral waste. The emissions are calculated using the Tier 3 method from the 2023 guidebook. Important parameters are the quantities of processed mineral waste, the moisture content of the waste stream and the average wind speed.

Member States report quantities of waste produced and processed biannually to Eurostat in the context of EU Regulation 2150/2002. The amount of mineral waste is reported in the categories:

- Soils;
- Dredging spoils;
- Mineral waste from construction and demolition;
- Mineral wastes from waste treatment and stabilised wastes;
- Other mineral waste.

The last three categories have been combined in Table 7.8, because the same moisture percentage is used in the calculations for these categories. The wind speed is measured by the KNMI at the Cabauw weather station, located in the centre of the Netherlands.

Table 7.8 Activity data used for emissions of PM during mineral waste handling

Year	Amount contaminated soil (Tg)	Amount dredging spoils (Tg)	Amount other mineral waste (Tg)	Average wind speed (m/s)
1990	5.987	48.182	21.080	4.9
1995	5.019	40.395	17.673	4.4
2000	5.902	47.504	20.784	4.5
2005	6.910	50.872	24.332	4.1
2010	7.327	46.730	25.801	3.9
2015	6.727	64.852	25.113	4.5
2016	7.279	68.394	24.929	4.0
2017	7.500	68.937	25.914	4.1
2018	7.721	69.479	26.898	4.1
2019	7.495	60.080	26.395	4.2
2020	7.270	50.681	25.892	4.5
2021	7.279	49.791	25.452	4.0
2022	7.288	48.900	25.012	4.1
2023	7.288	48.900	25.012	4.5
2024	7.288	48.900	25.012	4.2

## 7.4 Composting and anaerobic digestion (5B)

### 7.4.1 Source category description

The source category Composting and anaerobic digestion (5B) comprises emissions from the following source categories:

- 5B1;
  - o Composting of organic waste from households;
  - o Composting of organic waste from gardens and horticulture;
- 5B2;
  - o Anaerobic digestion of organic waste from households;
  - o Anaerobic digestion of other organic waste.

Emissions in this source category originate from facilities for the composting and/or fermenting of separately collected organic household, garden and horticultural waste and the anaerobic digestion of livestock manure. During processing, emissions of NH<sub>3</sub>, SO<sub>x</sub> and NO<sub>x</sub> occur.

Since 1994, it has been a statutory requirement for municipalities in the Netherlands to collect all biodegradable organic waste (i.e. garden waste, horticulture waste and household waste such as fruits and vegetables) separately from other (domestic) waste. The main part of this waste is then treated by composting or digestion (for biogas production). Additionally, part of the manure produced by pigs and cattle is used in anaerobic digesters (biogas production), sometimes together with other organic waste in so called 'co-digesters'.

#### **Composting (5B1)**

During composting, organic household waste is converted into compost. This process is carried out in enclosed facilities (industrial halls and tunnels), allowing waste gases to be filtered through a biobed before being emitted into the air. The material in the biobed is renewed periodically.

The processes for composting organic garden and horticulture waste are mostly carried out in the open air, in rows that are regularly turned over to optimise aeration.

#### **Anaerobic digestion (5B2)**

Emissions from anaerobic digestion originate from the digestion of biodegradable organic waste. Feedstocks used in the Netherlands are: livestock manure; domestic organic waste; crops and crop residue from agriculture; food waste from food processing industries, households and restaurants; and organic waste from municipalities. In this submission, emissions from industrial digesters (co-digesters) are added to the inventory. In addition to manure, these digesters treat predominantly waste from the food processing industry and expired organic product from supermarkets and catering industry.

The process of anaerobic digestion takes place in gas-tight processing plants that do not release any emissions. Relatively small emissions of NH<sub>3</sub>, NO<sub>x</sub> and SO<sub>x</sub> come mainly from storage of feedstocks and digestates. The most relevant feedstock as to emissions of NH<sub>3</sub> is livestock manure.

The biogas from anaerobic digesters is used for energy production or is processed and transferred to the natural gas network. Emissions from this use are included in the Energy sector (source category Small combustion (1A4)).

#### 7.4.2 *Overview of shares and trends in emissions*

##### **Composting**

With the introduction of the new emission source for composting of organic garden and horticulture waste, the total emissions of NH<sub>3</sub> relating to composting became substantial (0.05 Gg and 100 Gg for 1990 and 2024, respectively). Since 1996, emission levels from this source have been relatively constant in time.

##### **Anaerobic digestion**

Emissions relating to anaerobic digestion date from 1994, when the first domestic organic waste digestion plants started operations. These digestion plants treated only organic waste from households. Manure digesters and co-digesters were introduced from 2005 onwards. This explains the increase of NO<sub>x</sub>, SO<sub>x</sub> and especially NH<sub>3</sub> emissions after 2005. NO<sub>x</sub>, SO<sub>x</sub> and NH<sub>3</sub> emission levels relating to anaerobic digestion are relatively low (0.002 Gg, 0.0001 Gg and 0.0003 Gg, respectively, in 1994, and 0.081 Gg, 0.005 Gg and 0.68 Gg, respectively, in 2024). Emissions are small, which is why shares and trends are not elaborated here.

#### 7.4.3 *Emissions, activity data and (implied) emission factors*

##### **Composting**

The amounts of biodegradable waste processed by composting and digestion plants (per year) are taken from the annual report by WAR, which is based on questionnaires completed by operators. When an operator does not complete a questionnaire, the estimated amount processed is based on data from the National Waste Notification Bureau ('Landelijk meldpunt afvalstoffen', LMA). LMA tracks all waste transport in the Netherlands. Most separately collected organic waste is used in composting. Table 7.9 provides an overview of the total amounts of separately collected organic household and other organic waste from operators in the composting and digestion industry.

Table 7.9 Overview of separately collected organic waste for composting and digestion

Year	Organic waste from households (Tg)		Other organic waste (Tg)	
	Composted	Digested	Composted	Digested
1990	228	-	-	-
1995	1,566	44	1,900	-
2000	1,602	72	2,370	-
2005	1,688	55	2,370	24
2010	1,269	167	2,221	365
2015	1,093	560	1,782	758
2017	1,163	572	2,199	808
2018	1,179	542	2,241	697
2019	1,222	541	2,073	870
2020	1,351	534	2,066	922
2021	1,387	487	2,139	1,027
2022	1,178	495	1,852	1,080
2023	1,272	449	1,862	1,130
2024	1,333	471	2,094	1,064

The EFs used for composting have been derived from the sparse literature on emissions from the composting of separated biodegradable and other organic waste. It appears that hardly any monitoring is conducted on biobed reactors. The literature cannot be considered relevant, due to the diverse operational methods used in the Netherlands. The EFs for NH<sub>3</sub> from composting are taken from the environmental effect report for the Dutch national waste management plan 2002–2012 (VROM, 2002). The information in this report is based on a monitoring programme in the Netherlands (DHV, 1999). The EF for other organic waste composted in the open air is derived from a study by the Austrian Umweltbundesamt (Lampert et al., 2011).

For composting of organic waste, the following EFs have been used:

- For NH<sub>3</sub> from composting of household organic waste, an EF of 200 g/Mg is used;
- For NH<sub>3</sub> from composting of other organic waste, an EF of 350 g/Mg is used.

### **Anaerobic digestion**

The anaerobic digestion of biodegradable domestic waste (i.e. garden waste, horticultural waste and household waste, such as fruits and vegetables) and of livestock manure is carried out in various specialised plants. As digester installations differ per type of waste, the emissions are calculated per waste type. Most of the NH<sub>3</sub> emissions originate from the digestion of livestock manure (as manure digesters themselves are air tight containers, the emissions mainly originate from feedstock and digestate storage).

Table 7.10 provides an overview of the amounts of manure used for anaerobic digestion. Activity data on the anaerobic digestion of livestock manure are based on registered manure transports (data from the Netherlands Enterprise Agency, RVO) and their N content.

Table 7.10 Overview of manure used in anaerobic digesters

Year	Wet weight (Gg)	Nitrogen (Mg)
2005	NO	NO
2006	214	1,310
2010	1,243	7,620
2015	1,582	10,328
2020	2,056	12,827
2023	2,860	16,681
2024	2,903	16,519

The EFs used for the anaerobic digestion of livestock manure have been derived from a literature study carried out by Melse and Groenestein (2016) aimed at compiling the most suitable EFs for the various manure treatments used under conditions in the Netherlands. For the anaerobic digestion of livestock manure, the following EFs have been used:

- NH<sub>3</sub> from anaerobic digestion of pig manure, 0.02 kg/kg N;
- NH<sub>3</sub> from anaerobic digestion of cattle manure (excluding veal calves), 0.01 kg/kg N.

The emission calculation methodology can be found in Van der Zee et al. (2026). The calculations are performed using the NEMA model for calculating agricultural emissions (Van der Most et al., 2026).

The EFs used for the anaerobic digestion of biodegradable domestic waste have been derived from the environmental effect report for the Dutch national waste management plan 2002–2012 (VROM, 2002). The information in this report was based on a monitoring programme in the Netherlands (DHV, 1999).

The EF used for the anaerobic of other organic waste has been derived from a study on the processing of organic waste in Germany (Cuhls et al., 2015).

For the anaerobic digestion of biodegradable domestic waste, the following EFs have been used:

- NH<sub>3</sub> from digestion, 2.3 g/Mg of biodegradable domestic waste;
- NO<sub>x</sub> from digestion, 180 g/Mg of biodegradable domestic waste;
- SO<sub>x</sub> from digestion, 10.7 g/Mg of biodegradable domestic waste.

For the anaerobic digestion of other organic waste, the following EF has been used:

- NH<sub>3</sub> from digestion, 330 g/Mg of biodegradable domestic waste;

## 7.5 Waste incineration (5C)

### 7.5.1 Source category description

The source category Waste incineration (5C) comprises emissions from the following categories:

- 5C1a Municipal waste incineration;
- 5C1bi Industrial waste incineration;
- 5C1bii Hazardous waste incineration;
- 5C1biii Clinical waste incineration;
- 5C1biv Sewage sludge incineration;

- 5C1bv Cremations;
- 5C1bvi Other waste incineration;
- 5C2 Open burning of waste.

In the Netherlands, municipal waste, industrial waste, hazardous waste, clinical waste and sewage sludge are incinerated. The heat generated by waste incineration is used to produce electricity and heat buildings. These categories, therefore, are reported under the Energy sector (source category Public electricity and heat production (1A1a)) and the notation key 'IE' (Included Elsewhere) is used for all pollutants in source categories 5C1a-biv.

Emissions from cremations (category 5C1bv) originate from the incineration of human remains (process emissions) and from natural gas combustion. The emissions from natural gas combustion are reported under the Energy sector (source category Commercial and institutional services (1A4ai)). Since 2012, all cremation centres have complied with the Dutch Atmospheric Emissions Guideline (NeR), using a special filter (cloth or electrostatic).

There is no incineration of carcasses or slaughter waste in the Netherlands. Carcasses and slaughter waste are processed into reusable products, including biofuels.

Because of a ban on other waste incineration (5C1bvi) and open waste burning (5C2), these emission sources are assumed not to occur in the Netherlands. The open burning of waste has been banned in the Netherlands since the beginning of the 1980s. The Netherlands is a densely populated country, and any burning of wastes is likely to cause nuisance in the surrounding area and result in complaints to the authorities. Therefore, the ban on stoking unreported fires is strictly enforced by the local authorities. However, local authorities can lawfully make an exception for the burning of pruning wood, on condition that any fire must be reported to the local fire brigade in advance, to enable supervision and enforcement. Unfortunately, these individual reports are not registered. Such exemptions by local authorities have been under discussion recently, and more and more authorities now stop granting them. Additionally, most local municipalities accept pruning wood free of charge to be shredded for composting or used for energy purposes, and nowadays, if the amounts of these pruning woods are big enough to make it economically viable, they are also commercially collected and shredded to be used for energy purposes. Also, part of pruning wood is used in bonfires, which are reported in the IIR. Mostly, these pruning activities have to do with maintaining cultural landscapes (hedges and so on) and as such are no agricultural activity. With regard to pruning, only commercially operated orchards are regarded as agricultural activity. However, this situation is complex as most of the pruned orchard wood is being used for domestic (fireplaces and stoves) as well as commercial energy purposes (whole trees are shredded and used as biomass). The use of biomass for energy purposes is reported in the sector Energy. Using the tier1 approach would lead to double counting and a (substantial) overestimation for this source. Therefore, with the exception of bonfires, emissions from these sources are assumed not to occur in the Netherlands.

### 7.5.2 *Overview of shares and trends in emissions*

Emission levels in this source category are relatively low. Therefore, the shares and trends in these emissions are not elaborated here.

### 7.5.3 *Emissions, activity data and (implied) emission factors*

#### **Municipal waste incineration (5C1a)**

All waste incineration plants (WIPs) report the emission of pollutants in their annual environmental reports (AERs). Table 7.11 shows the quantities and the amount of energy generated by waste incineration plants that process mixed municipal waste. As mentioned earlier, all emissions from WIPs are reported in the category Public electricity and heat production (1A1a).

*Table 7.11 Amount of waste and energy generated in waste incineration plants*

Year	Total waste incinerated	
	kton	TJ
1990	2,780	22,746
1995	2,913	27,903
2000	4,896	51,904
2005	5,503	55,058
2010	6,459	63,818
2015	7,564	75,299
2020	7,572	71,742
2021	7,504	70,605
2022	7,392	69,762
2023	6,841	65,665
2024	6,422	61,715

#### **Cremations (5C1bv)**

The number of cremations in the Netherlands is published online by the Dutch National Association of Crematoria (LVC), at [www.lvc-online.nl](http://www.lvc-online.nl) (LVC, 2024). An overview of the number of cremations in compliance with the NeR is provided in Table 7.12.

Emission factors from the EMEP/EEA guidebook were used for calculating emissions from crematoria that do not have any emission reducing technology in place.

Table 7.12 Overview of the number of cremations in compliance with NeR

Year	Deceased	Cremated	% cremated	% cremated in compliance with NeR
1990	128,790	57,130	44	0
1995	135,675	63,237	47	0
2000	140,527	68,700	49	5
2005	136,402	70,766	52	18
2010	136,058	77,465	57	75 <sup>1</sup>
2011	135,741	78,594	59	86 <sup>2</sup>
2012	140,813	83,379	59	100
2015	147,134	93,177	63	100
2020	168,537	111,881	66	100
2021	170,802	115,135	67	100
2022	169,937	114,438	68	100
2023	169,320	115,757	68	100
2024	171,945	116,670	68	100

1. Interpolation from year 2011

2. Calculation is based on list of crematoria under the NeR (LVC, 2025)

For crematoria equipped with emission reducing technology, an evaluation of the effectivity of the use of this technology was performed. To this end, the substances emitted by crematoria are considered to be gaseous, vaporous, particulate or particle-bound. On the basis of measurements at crematoria in Geleen and Bilthoven (Visschedijk et al. 2026), a 71% effectiveness for particulates and particle-bound substances was calculated. For Hg, the emission factor with technology in place is based on the reported Hg emissions for the Netherlands in EC (2012) Annex L and OsPar (2011) (Visschedijk et al., 2026). Table 7.13 provides an overview of emission factors without and with emission reducing technology in place.

Table 7.13 Overview of emission factors used for calculating emissions from cremations without and with emission reducing technology in place

Pollutant	State	Emission factor before introduction NeR <sup>1</sup> (kg per cremation)	Emission factor with NeR <sup>2,3</sup> (kg per cremation)
NO <sub>x</sub>	Gaseous	0.825	0.825
CO	Gaseous	0.14	0.14
NM VOC	Gaseous	0.013	0.013
SO <sub>x</sub>	Gaseous	0.113	0.113
PCB	Particle bound	4.1 10 <sup>-7</sup>	1.18 10 <sup>-7</sup>
PCDD/F	Particle bound	2.7 10 <sup>-11</sup>	7.8 10 <sup>-12</sup>
B(a)P	Particle bound	1.32 10 <sup>-8</sup>	3.80 10 <sup>-9</sup>
B(b)FA	Particle bound	7.21 10 <sup>-9</sup>	2.08 10 <sup>-9</sup>
B(b)FK	Particle bound	6.44 10 <sup>-9</sup>	1.86 10 <sup>-9</sup>
I-pyrene	Particle bound	6.99 10 <sup>-9</sup>	2.01 10 <sup>-9</sup>
HCB	Particle bound	1.5 10 <sup>-7</sup>	4.32 10 <sup>-8</sup>
Pb	Particle bound	3.0 10 <sup>-5</sup>	8.65 10 <sup>-6</sup>

Pollutant	State	Emission factor before introduction NeR <sup>1</sup> (kg per cremation)	Emission factor with NeR <sup>2,3</sup> (kg per cremation)
Cd	Particle bound	5.03 10 <sup>-6</sup>	1.45 10 <sup>-6</sup>
As	Particle bound	1.36 10 <sup>-5</sup>	3.92 10 <sup>-6</sup>
Cr	Particle bound	1.36 10 <sup>-5</sup>	3.91 10 <sup>-6</sup>
Cu	Particle bound	1.24 10 <sup>-5</sup>	3.58 10 <sup>-6</sup>
Ni	Particle bound	1.73 10 <sup>-5</sup>	4.99 10 <sup>-6</sup>
Se	Particle bound	1.98 10 <sup>-5</sup>	5.70 10 <sup>-6</sup>
Zn	Particle bound	1.6 10 <sup>-4</sup>	4.61 10 <sup>-5</sup>
PM <sub>10</sub>	Particulate	0.0347	0.01
PM <sub>2.5</sub>	Particulate	0.0347	0.01
Hg	Vaporous	1.49 10 <sup>-3</sup>	2.0 10 <sup>-5</sup>

1. EEA guidebook 2023

2. Emissions of particulates and particle bound substances are estimated to be 71% less after implementation of NeR

3. Emissions of Hg are estimated to be 98 – 99.5 % less after implementation of NeR

### **Open burning of waste (5C2)**

Traditionally, a number of festive days are brightened by bonfires. These celebrations have a strong cultural and regional background, mostly taking place in specific parts/regions of the Netherlands. Scrap pallets, orchard, hedgerow and wooded bank pruning; and forest residues are used for these bonfires, which are exempted from the general ban on burning of waste and are regulated and controlled by local enforcing authorities. Emissions from bonfires are reported under Open burning of waste (5C2).

The number of bonfires in the Netherlands fluctuates per year, mainly depending on how strongly tradition is respected and on the local weather at the time. Table 7.14 provides an overview of the known bonfires reported in this category, with the date/period of occurrence and the geographical location. Spontaneous (small) bonfires and non-registered/regulated fires have not been included.

The activity data used is largely derived from specific websites, regional newspapers, news articles and sometimes permits. Estimates of the annual amounts of pallet and pruning wood burned are based on this information and supplemented by expert judgement.

Table 7.14 Overview of known bonfires

Name	Date/period	Location(s)
New Year's Eve	1 January	Scheveningen/Duindorp
Christmas tree burning	1 January	Nationwide
Easter fires	Easter (March/April)	Northern and eastern areas
Meierblis	30 April	Texel (the largest island of the Dutch Wadden Islands)
Luilak	Saturday before Whitsunday (May/June)	Northwest
St.-Martin's day	11 November	The northernmost and southernmost provinces

### Easter fires

Table 7.15 provides an overview of the total amount (m<sup>3</sup>) of pruning burned in the four large Easter fires.

Table 7.15 Estimated amounts (m<sup>3</sup>) of pruning wood burned in the four largest Easter fires in the Netherlands

Year	Dijkershoek	Espelo <sup>1</sup>	Beuseberg	Holterbroek
2015	5,308	5,783	2,289	1,634
2020	0	0	0	0
2021	0	0	0	0
2022	4,293	3,644	1,852	1,468
2023	1,000	1,000	1,000	1,000
2024	1,000	1,000	1,000	1,000

1. The Easter fire at Espelo is on the UNESCO list of immaterial heritage

For earlier years, the activity data has been based on the trend in inhabitants (a 10% increase in inhabitants results in a 10% increase in the amount of pruning burned).

All other Easter fires in the Netherlands are much smaller and the occurrence of these bonfires depends on local initiatives and organisation. In most Dutch municipalities, no permits are needed if the volume of the bonfire is below 1,000 m<sup>3</sup>. The average volume of the smaller Easter bonfires is estimated at 250 m<sup>3</sup>. The number of Easter fires is estimated at roughly 400. In 2019, the Easter bonfires were smaller as a result of drought. Most municipalities banned Easter fires and the remainder only allowed small fires.

In 2020 and 2021 there were no Easter bonfires as result of the COVID-19 restrictions.

### New Year's Eve fires

Both the Scheveningen and Duindorp fires were regarded as the biggest bonfires in the Netherlands (each 12,000 m<sup>3</sup> of pallets in 2019) due to fierce competition between both neighbourhoods. The volume of pallets

burned can be measured accurately because of the competition to have the biggest bonfire. There were no fires in Scheveningen and Duindorp in 2019–2021, due to safety restrictions (2019) and COVID-19 (2020 and 2021). From 2022 onwards, the size of the piles has been limited to 1,000 m<sup>3</sup> due to nitrogen restrictions applied.

*Picture 7.1 The piles of pallets at Scheveningen and Duindorp for the 2019 New Year's Eve bonfires*



All other bonfires on New Year's Eve in the Netherlands are much smaller, and the occurrence of these bonfires depends on local initiatives and organisation. In most Dutch municipalities, no permits are needed if the volume of the bonfire is below 1,000 m<sup>3</sup>. As a result, the number of (small) New Year's Eve fires and the volumes of these fires are not registered and can only be estimated on the basis of articles in local newspapers.

As a result of the nitrogen restrictions applied from 2022 onwards, the total volume of wood burned on New Year's Eve is estimated to be 4,000 m<sup>3</sup> (around 2,000 m<sup>3</sup> for Scheveningen and Duindorp + 2,000 m<sup>3</sup> for the other smaller non-registered bonfires). This volume is used for the complete time series.

The bonfires Meierblis, Luilak and St Maarten are not spread wider. And the total amounts of wood burned is estimated at 16,250 m<sup>3</sup>, 500 m<sup>3</sup> and 5,000 m<sup>3</sup> respectively.

#### **Wood density and heating value of pallets**

The density of pruning wood is based on a Belgian report from the Flemish government on waste from 2014 ([www.Lne.be](http://www.Lne.be)) and equals 0.15 Mg/m<sup>3</sup>.

The density of pallets is based on a standard pallet size of 0.8 x 1.2 x 0.144 m and a standard pallet weight of 25 kg, resulting in a density of 0.18 Mg/m<sup>3</sup>.

The heating value of pallets has been derived from Jansen's (2010) 'kachemodel'. This equals 15.6 MJ/kg.

In terms of EF, a distinction is made between the burning of pallets and the burning of pruning wood. The EFs for the burning of pallets have been derived from EMEP/EEA (2016; NFR Category 1A4 – Table 3.39 Open fireplaces burning wood); the EFs for the burning of pruning wood from EMEP/EEA (2016; NFR Category 5C2 – Table 3.2 Open burning of agricultural wastes/forest residue).

## 7.6 Wastewater handling (5D)

### 7.6.1 *Source category description*

In the Netherlands, almost all wastewater is treated in domestic (5D1) or industrial (5D2) wastewater treatment plants (WWTPs). WWTPs produce small amounts of NMVOC emissions.

Normally, industrial wastewater is also treated at domestic WWTPs. However, this wastewater stream is charged on the basis of the average amount of pollutants and volume. Thus, for some industries it is cheaper to treat their own wastewater on-site before discharging directly to surface water or to the sewage system (depending on the level of remaining pollutants and volume). Thus, the incoming wastewater at domestic WWTPs comprises household wastewater, industrial wastewater and urban run-off (mainly off rooftops and streets).

The on-site treated industrial wastewater comprises water from the industrial process, and in some cases, water used for cooling processes and run-off from the paved industrial site.

Part of the WWTPs process their sewage sludge in an anaerobic digester to produce methane. The methane is captured and used in energy production or flared. Therefore, NO<sub>x</sub>, SO<sub>x</sub>, particulate matter and CO emissions from WWTPs are reported under the source category Commercial/Institutional: Stationary (1A4ai) and for these pollutants the notation key 'IE' (Included Elsewhere) is used in source categories 5D1 and 5D2.

### 7.6.2 *Overview of shares and trends in emissions*

Emission levels in this source category are relatively low. Therefore, the shares and trends in these emissions are not elaborated here.

### 7.6.3 *Emissions, activity data and (implied) emission factors*

#### **Domestic WWTPs**

Activity data from domestic WWTPs come from a separate inventory performed by Statistics Netherlands (CBS) in partnership with Netherlands Enterprise Agency (RVO), the Dutch Water Authorities and consultancy firm Arcadis (Honig et al., 2026). Table 7.15 provides an overview of the activity data used over time. In 2023 and 2024, the

volume of domestic wastewater treated increased substantially as a result of abnormally higher rainfall collected in the sewage system.

NMVOC is calculated using the default Tier 1 emission factor of 15 mg NMVOC/m<sup>3</sup> wastewater treated (EEA, 2023).

### **Industrial WWPTs**

Information on the industrial biological wastewater treatment plants and related volumes of wastewater treatment is compiled from a Statistics Netherlands database for the years 1993–2016. From 2016 onwards data from the AERs (annual environmental reports from individual companies) on volumes of wastewater is used. For a short description of the method to determine the volumes of industrial wastewater treated in industrial biological wastewater treatment plants, see Geertjes & Baas (2022). In previous submissions, data for 2017–2021 was a copy of the 2016 values but corrected for new plants and plants taken out of service. In the 2024 and 2025 submissions the timeseries 2017–2023 were gradually updated on basis of an extra survey module in the AER register. This is continued each year. So, data on 2024 were compiled on basis of this now yearly survey (see Table 7.16).

NMVOC is calculated using the Tier 1 emission factor of 15 mg NMVOC/m<sup>3</sup> wastewater handled (EEA, 2023).

*Table 7.16 Wastewater volume data (key years) of biological wastewater treatment plants*

Year	Total volume of wastewater treated (Mio m <sup>3</sup> )	
	Domestic WWTP	Industrial WWTP
1990	1,643	338
1995	1,854	316
2000	1,997	316
2005	1,841	239
2010	1,934	369
2015	1,957	248
2020	1,938	245
2021	1,964	244
2022	1,808	244
2023	2,245	244
2024	2,229	232

## **7.7 Other waste (5E)**

### *7.7.1 Source category description*

The source category Other waste (5E) comprises the following emission sources:

- Sludge spreading;
- Waste preparation for recycling;
- Scrapped refrigerators/freezers;
- Accidental building and car fires.

**Sludge spreading**

WWTPs produce sewage sludge. In the Netherlands, sewage sludge can be used as a fertiliser in agriculture if it meets the legal environmental quality criteria. In line with the EMEP/EEA Guidebook, emissions from this source are reported under Sewage sludge applied to soils (3Da2b).

**Waste preparation for recycling**

Waste preparation for recycling is carried out mainly by companies that process waste to turn it into new base materials. These processes entail small emissions of NO<sub>x</sub>, NMVOC, SO<sub>x</sub>, CO, particulate matter, several metals, PAHs and dioxins.

**Scrapped refrigerators /freezers**

Since 1995, the production and sale of refrigerators and freezers (R/F) using chlorofluorocarbons as refrigerant has been prohibited in the European Union. However, given an average lifetime of at least 15 years, R/F units using CFCs are still in use, and significant numbers are discarded each year. In the Netherlands, discarded R/F units are collected and processed by specialised companies that remove and destroy the CFCs still present in the units. Still, in some cases the CFCs have leaked into the environment before the R/Fs were discarded and processed. This emission source represents the leakage emissions of CFCs and possible processing inefficiencies that lead to the emission of CFCs into the environment.

**Accidental building and car fires**

Mainly by accident (but sometimes on purpose), cars and houses are damaged or destroyed by fire. The smoke caused by such fires is the source of emissions. The amount of material burned is determined by the response time of (professional) fire-fighters. Accidental building and car fires produce, among others, emissions of particulate matter and dioxins.

7.7.2 *Overview of shares and trends in emissions*

Emission levels in this source category are relatively low. Therefore, the shares and trends in these emissions are not elaborated here.

7.7.3 *Emissions, activity data and (implied) emission factors***Waste preparation for recycling**

Data on emissions from the process of waste preparation for recycling was based on environmental reports (AERs) by large industrial companies. Where necessary, extrapolations were made to produce emission totals per industry group, using either IEFs and production data, or production data based on environmental reports in combination with specific EFs (Honig et al., 2026).

**Scrapped refrigerators/freezers**

When recycling scrapped refrigerators/freezers, a small amount of NMVOC (as dichlorodifluoromethane (CFC12), used as refrigerant) is emitted. In the calculations, an EF of 105 g CFC12 per recycled refrigerator/freezer (after correction for recovered CFC12) was used.

To estimate the number of CFC R/F equipment discarded annually from 1990 to 2030, a combination of multiple data is needed. First, the

number of R/F units put on the market between 1960 and 1994 in the Netherlands was extracted from CBS data. These R/Fs are all assumed to use CFC-12 as a refrigerant.

The Weibull distribution is used to estimate the number of CFC R/F units discarded annually. On the basis of data from CBS, the average lifetime of a refrigerator is estimated at 16.4 years, and that of a freezer at 18.6 years. Furthermore, the shape of the Weibull function is 2.2 for refrigerators and 1.3 for freezers (Magalini et al., 2014).

As a last step, corrections are applied for exported scrap refrigerators and freezers (Visschedijk et al., 2026).

### ***Accidental building and car fires***

Further details regarding the methodology are provided in Visschedijk et al. (2026).

The number of buildings and cars exposed to fire was collected by the joint fire brigades in the Netherlands and reported annually via Statistics Netherlands, until the year 2013. Those numbers are used for the time series 1990–2013.

Since 2013, data by the Dutch Association of Insurers has been used for car fires. On 28-2-2025 a newspaper (Van der Heijden & Klerks, 2025) published data on annual number of car fires (from the Netherlands Institute for Public Safety (NIPV)) and annual number of damage claims filed at insurance companies from the Association of Insurers (AoI). These numbers are made available for 2020 until 2024. The ratio between the total car fires (NIPV) and the total number of damage claims filed at insurance companies (AoI) gives the ratio of claims and actual number of fires (gives an indication of uninsured vehicles). Previously a ratio of 33% was used for 2014 - 2019, on basis of the new data a ratio of 19% seems more applicable. This new ratio resulted in new (reduced) numbers of car fires from 2014 - 2019. The annual amount of car fires before 2014, have not been changed.

For the number of indoor fires from 2014 onwards, no accurate data are available from Statistics Netherlands. Before 2014, the reported number of indoor fires seemed roughly proportional to the total number of buildings. On an annual basis, a relatively constant fraction of all buildings was affected by a fire incident. On the basis of this percentage, the number of indoor fires occurring from 2014 onwards was estimated, indicating about 15,000–16,000 indoor fires annually.

According to multi-year statistics on the number of fatal house fires in the Netherlands ([Nederlands Instituut Publieke Veiligheid](#)), in about 55% of the cases, studied, the destruction is confined to a single room; in 17%, it is confined to a single floor; and in 28%, the entire house burns down. Table 7.17 provides an overview of the estimated amounts of combustible material burned, based on an average Dutch situation of a one-family home consisting of 3 floors and 4 rooms per floor. The amount of combustible material is based on a Dutch study on average material use in Dutch houses. On average, a Dutch house consists of 10.3 tonne combustible material (8.6 tonne wood/triplex and 1.7 tonne

plastics). The interior is estimated to add another 4.5 tonne of combustible material, which consist for 50% of wood.

Table 7.17 Amounts of burned combustible materials average housefire in the Netherlands

<b>Average Dutch situation of a one-family home made up of 3 floors and 4 rooms per floor</b>		
<b>Destruction by fire (limited to)</b>	<b>Combustible materials burned (%)</b>	<b>Combustible materials burned (Mg)</b>
Same room	10	1.48
Same floor	33	4.9
Complete house	100	14.8

When this data on fire destruction and occurrence is combined, it results in the following amount of combustible materials burned:

$$1.48 \times 55\% + 4.9 \times 17\% + 14.8 \times 28\% = 5.8 \text{ Mg}$$

For house fires, country-specific EFs have been derived from the amount of combustible materials in an average Dutch house combined with a percentage burned in each fire as explained in this section. The emissions of all pollutants (except dioxin) from the combustible materials of the construction and the combustible materials of the interior materials are calculated using the EFs in Table 3.39 in Chapter 1A4 of the Guidebook (for wood) and EFs in Table 3.2 in Chapter 5C1a of the Guidebook (for plastics and other non-wood materials). The emissions of dioxin are calculated using the EF from Aasestad (2007) of 170 µg I-TEQ per Mg burned material.

For car fires, the default EFs from the EMEP/EEA Guidebook (2023) are used. Table 7.18 provides an overview of the number of house and car fires.

Table 7.18 number of house and car fires

<b>Year</b>	<b>Number of housefires</b>	<b>Number of car fires</b>
1990	12,592	4,827
1995	13,634	5,766
2000	13,910	6,064
2005	13,147	4,411
2010	15,563	4,280
2015	15,176	4,045
2020	15,784	5,998
2021	15,933	5,417
2022	16,091	5,851
2023	16,250	5,868
2024	16,408	6,465



## 8 Other

### 8.1 Overview of the sector

The Other sources sector (NRF 6) includes emissions from sources that cannot be placed under any specific NFR.

### 8.2 Other sources (6A)

#### 8.2.1 *Source category description*

This source category includes only NH<sub>3</sub> emissions from the following sources:

- Human transpiration and respiration;
- Domestic animals (pets).

#### ***Human transpiration and respiration***

Through the consumption of food, nitrogen (N) is introduced into the human system. Most nitrogen is released into the sewage system through faeces and urine. Part of the nitrogen is released as ammonia through sweating and breathing and is reported in this emission source.

#### ***Domestic animals (pets)***

Emissions from domestic animals consist mainly of NH<sub>3</sub> coming from dung and urine. This source comprises the combined emissions from:

- Dogs;
- Cats;
- Birds (undefined);
- Pigeons;
- Rabbits.

#### 8.2.2 *Key sources*

Source category 6A Other is a level 2024 key source of NH<sub>3</sub>.

#### 8.2.3 *Overview of shares and trends in emissions*

An overview of emissions and the trends for this sector is provided in Table 8.1.

Table 8.1 Overview of NH<sub>3</sub> emission totals in Other sources (NFR 6)

Year	NH <sub>3</sub>
	Gg
<b>1990</b>	<b>2.7</b>
1995	2.8
2000	2.9
2005	3.0
2010	3.1
2015	3.2
2020	3.3
2021	3.3
2022	3.4
2023	3.4
<b>2024</b>	<b>3.4</b>
1990-2024 <sup>1)</sup>	0.8
1990-2024 <sup>2)</sup>	29%
2024 % <sup>3)</sup>	3%

1. Absolute difference
2. Relative difference from 1990 in %
3. % of national total 2024

#### 8.2.4 Emissions, activity data and (implied) emission factors

##### **Human transpiration and respiration**

NH<sub>3</sub> emissions from this source gradually increased in the course of the time series, in line with the increase in the human population, from 1.5 Gg in 1990 to 1.8 Gg in 2024.

Population numbers in the Netherlands are derived from CBS Statline (<http://statline.cbs.nl/>). They increased from 14,892,574 in 1990 to 17,942,942 in 2024.

To avoid underestimation, the high-end EF of 0.1004 kg NH<sub>3</sub> per person per year (Sutton et al., 2000) was used to calculate emissions from this source.

##### **Domestic animals (pets)**

NH<sub>3</sub> emissions from this source increased slightly in the course of the time series from 1.2 Gg in 1990 to 1.6 Gg in 2024.

Emissions are calculated using an EF per household. The number of households is derived from Statistics Netherlands. The EF used is based on Booij (1995), who calculated a total emission of 1.220 Gg NH<sub>3</sub> from all domestic animals (cats, dogs, rabbits and birds) for the year 1990. On the basis of the total emission in 1990 and the number of households in 1990, an EF of 0.2 kg NH<sub>3</sub> per household was calculated (Visschedijk et al., 2026).

8.2.5 *Methodological issues*

The methodology used for calculating emissions from the sources Human transpiration and respiration and Domestic animals is described in Visschedijk et al. (2026).

There are no specific methodological issues.

8.2.6 *Uncertainties and time series consistency*

No accurate information was available for assessing uncertainties about emissions from sources in this sector.

8.2.7 *Source-specific QA/QC and verification*

Verification for the source Domestic animals (pets) is carried out using a survey conducted by order of the branch organisation DIBEVO (entrepreneurs in the pet supplies branch). The numbers of cats and dogs derived from this survey combined with the EFs for cats and dogs from Sutton et al. (2000) represent 70% of the total emissions from pets (Booij, 1995).

There are no further source-specific QA/QC procedures in place in this sector. The remainder of sources in this sector are covered by the general QA/QC procedures, as discussed in Chapter 1.

8.2.8 *Source-specific recalculations*

There were no source-specific recalculations for the sector Other sources.

8.2.9 *Source-specific planned improvements*

There are currently no planned improvements.



## 9 Large Point Sources

LPS were submitted in 2025 for emissions data of 2023.

### **Industrial LPS**

All industrial point sources in the Netherlands that meet the criteria have the legal obligation to report their emissions electronically as part of an Annual Environmental Report (AER)(see Section 1.3.2). Following validation and data checking, the data is stored in the Pollutant Release Transfer Register (PRTR). The European Pollutant Release Transfer Register (EPRTR) and the Large Point Sources (LPS) are extracts from this PRTR.

The 2025 LPS submission comprises all industrial facilities that reported emissions for one or more pollutants above the thresholds specified in Table 1 of the reporting guidelines (Executive body for the Convention on Long-range Transboundary Air Pollution; decision ECE/EB.AIR/125). For NH<sub>3</sub>, this threshold is the same as for EU Directive 2010/75/EU.

### **Agricultural LPS**

In the emission inventory of the Netherlands (PRTR) only industrial sites are included as point sources. The Dutch inventory contains emissions from agriculture at the level of national totals, but agricultural facilities are not included in the inventory as point sources.

For its EPRTR reporting, however, the Netherlands makes an inventory of all agricultural facilities that meet the EPRTR criteria for animal numbers and have emissions of NH<sub>3</sub> above the EPRTR threshold. The criteria for animal numbers are:

- more than 40,000 places for poultry;
- or more than 2,000 places for production pigs (over 30 kg);
- or more than 750 places for sows.

These agricultural facilities from the EPRTR have been included in the 2025 LPS Annex submission. These emissions are therefore consistent with EPRTR reporting. It should be noted, however, that these emissions differ from agricultural emissions in the Dutch emission inventory, because under the EPRTR other emissions factors are applied.



## 10 Response to the Reviews

### 10.1 CLRTAP review 2024 and 2025

At its 25th session in 2007, the Executive Body for the Convention on Long-Range Transboundary Air Pollution approved methods and procedures for the review of national emission inventories. On the basis of this decision, the national inventories (CLRTAP and NECD) have been subject to five-year cycles of in-depth technical reviews since 2008. The technical review of national inventories checks and assesses parties' data submissions with a view to improving the quality of emission data and associated information reported to the Convention. The review process is aimed at making inventory improvements by checking the transparency, consistency, comparability, completeness and accuracy (TCCCA criteria) of the submitted data (see <http://www.ceip.at/>).

The review also seeks to achieve a common approach to prioritising and monitoring inventory improvements under the Convention together with other organisations that have similar interests, such as the United Nations Framework Convention on Climate Change (UNFCCC), the European Union National Emission Ceilings ([NEC Directive](#)) and the [European Pollutant Release and Transfer Register](#) (E-PRTR).

In 2024, the focus of the CLRTAP in-depth review was on:

- emissions from the sector IPPU solvents with a particular focus on NMVOC emissions;
- gridded data for the sector IPPU solvents with a particular focus on NMVOC emissions.

Table A3.1 represents the status of the implementation of the recommendations from this CLRTAP review.

In 2025, the focus of the CLRTAP review was on the Projections. The status of the implementation of the recommendations from this CLRTAP review on the 2025 Projections submission will be reported in the IIR 2027, along with the next submission of the Projections in 2027.

### 10.2 NECD review 2021 and 2025

Article 10(3) of the revised NECD introduces a regular annual review of EU Member States' national emission inventory data in order to:

- verify, amongst others, the transparency, accuracy, consistency, comparability and completeness of the information submitted;
- check the consistency of prepared data with LRTAP requirements;
- calculate technical corrections where needed.

The 2025 NFR and IIR submission by the Netherlands was reviewed. Several recommendations were made to improve the inventory and the inventory report. Within the limitations of resources, the actions that were based on these recommendations were given a high priority and were added to the work plan in order to ensure a follow-up to the majority of recommendations before the next NFR submission. Appendix

3, Table A3.2 presents the status of the implementation of the recommendations from this NECD review.

As part of the 2021 review, the 2021 submissions of the Large Production Sites (LPS) and the so-called 'Gridded data' were reviewed. The status of following up on the recommendation from these parts of the review can be found in Appendix 3, Tables A3.3 and A3.4.

In 2025, the Netherlands Projections submission of 2025 was reviewed. The status of the implementation of the recommendations from this NECD review on the 2025 Projections submission will be reported in the IIR 2027, along with the next submission of the Projections in 2027.

## 11 Recalculations and Other Changes

### 11.1 Recalculations and improvements of certain elements of the IIR

Compared to the IIR 2025 (Staats et al., 2025), several improvements in source allocation and emission factors used were implemented in the Pollutant Release and Transfer (PRTR) system. These recalculations were initiated by the internal QA/QC cycle and recommendations from external reviews, improving the comparability with the methodologies as elaborated in the EMEP/EEA guidebook. The main changes in the inventory are:

#### *Overall*

- Whenever updated/improved activity data became available these are used to improve the emission calculation (all sectors).
- Due to changes in the energy statistics and fuel use, the emissions in various categories changed (2015–2023).
- Changes in the emissions by individual companies for the 1990–2023 period, as reported under Sectors 1 and 2, result from improvements or error corrections in the emission estimates as reported in their Annual Environmental Reports (AERs).
- More specifically, a completeness check for the years 1990-2010 was carried out, resulting in a correction of missing emissions in these years.

#### *Energy*

- EC<sub>2.5</sub> emissions from individual companies have been recalculated for the full time series. In previous submissions, EC<sub>2.5</sub> emissions were calculated based on the EC<sub>k</sub>/PM<sub>10</sub> ratio. Now, EC<sub>2.5</sub> emissions are calculated based on EC<sub>2.5</sub>/PM<sub>2.5</sub> fractions, based on the EMEP/EEA 2023 Guidebook. This leads to recalculations for sectors where PM<sub>2.5</sub>/PM<sub>10</sub> fractions do not follow standard ratios, often because of the use of company reported data under e-AERs. This affects emissions under 1A1, 1A2, 1A4ai, 1A4bi.
- Under 1A1a, 1A2gviii, 1A3ai and 1A4ci, emissions of Cd, Hg, and Pb have increased due to the addition of these emissions from combustion of biogas and solid biomass, from 2009 onwards.
- The activity data of wood combustion has been corrected for the complete time series, leading to recalculations of emissions under 1A2gviii, 1A4ai, and 1Aci.
- Under 1A2gviii, the NO<sub>x</sub> emission factor for wood combustion in the wood industries has been updated to match the EMEP/EEA Guidebook.
- For 1A2b, dioxin emissions from 2006 and 2009 have been corrected.
- NMVOC emissions from gasoline service stations (under 1B2av) have been recalculated for 2015-2023, as the amount of fuel used for road transport was updated in the energy statistics.

#### *Specifically for transport:*

- Aviation:
  - o Minor corrections in aircraft – engine pairings and updated emission factors, leading to small recalculations.

- o Increase of NMVOC emissions as now also HC emissions from engine starts for turbofan engines are calculated.
- Road transport:
  - o PAH emissions increased from 2011 onwards for all vehicle types except mopeds and motorcycles. This is due to an error correction in the calculation.
  - o Recalculation of kilometres driven results in minor changes in all emissions from 2022-2023.
  - o An error correction in the allocation of emissions of POPs from cold starts and cooling units of heavy-duty vehicles, leading to an increase of emissions of POPs in 1A3bi-iii.
  - o Recalculation of diesel fuel for non-road mobile machinery has decreased the diesel fuel usage and related emissions for heavy-duty vehicles (1A3biii), for the full time series.
  - o NO<sub>x</sub> emissions of heavy duty vehicles (1A3biii) have increased for 2018-2023, due to a recalculation of ageing of SCR systems.
- Railways
  - o Recalculation of energy use by CBS has led to a small decrease in electricity use of railways in 2023. This has led to a slight decrease in (wear) emissions from electric trains in 2023.
- Non-road mobile machinery (NRMM)
  - o For most machine types, previous estimates of historical machine sales have been re-assessed. Furthermore, lifetimes and machinery-specific scrappage functions have been adjusted. This has led to significant changes to the modelled fuel consumption and emissions.
  - o The modelled inflow of electric machinery has been changes substantially, leading to changes of emissions.
  - o The distribution of machinery types over economic sectors has been updated, leading to an update of emissions for different machine types. Especially the public services sector has received a larger share, while the allocation to industry has decreased.
  - o For 2022 and 2023, an updated diesel fuel use was provided for the agricultural sector, resulting in a decrease of emissions.
  - o The NO<sub>x</sub> emission factor for diesel engines of STAVE IV and V have been lowered based on new measurements.
  - o Emissions from petrol evaporation are now also estimated, using a Tier 2 method.

### *IPPU*

- As also listed under 'Energy' - EC<sub>2.5</sub> emissions from individual companies have been recalculated for the full time series. In previous submissions, EC<sub>2.5</sub> emissions were calculated based on the EC<sub>2.5</sub>/PM<sub>10</sub> ratio. Now, EC<sub>2.5</sub> emissions are calculated based on EC<sub>2.5</sub>/PM<sub>2.5</sub> fractions, based on the EMEP/EEA 2023 Guidebook. This leads to recalculations for sectors where PM<sub>2.5</sub>/PM<sub>10</sub> fractions do not follow standard ratios, often because of the use of company reported data under e-AERs. This affects emissions under 2A, 2B, 2C, 2H.

- For 2A5b Construction and demolition, particulate matter emissions were recalculated for the full time series, resulting from the reversion of an error correction in the previous submission (of a supposed double counting).
- PM emissions under 2A5c Storage, handling and transport of mineral products were recalculated for 2023, due to new data becoming available.
- Emissions of NMVOC, PM<sub>10</sub>, PM<sub>2.5</sub>, benzene, PAH, and cadmium under 2A6 Asphalt production were recalculated due to newly available activity data.
- Emission estimates for HCB emissions under 2C1 Iron and steel production have been added, leading to emissions for the full time series.
- NMVOC emissions from chemical laundries (2D3a and 2D3f) were updated due to the introduction of new machines, leading to an update of the EF, and an update of the activity data.
- Under 2G Other product use, there are two recalculations:
  - Increase of emissions from smoking of cigarettes for the full time series, as activity data increased due to the addition of cigarettes bought abroad and illegally produced.
  - Recalculation of NMVOC emissions from stationary refrigeration for 2021-2023. This is due to a delay in activity data availability and an error correction for 2021.

### *Agriculture*

- The amount of treated manure has been harmonised for the calculations regarding storage and treatment. This leads to recalculations (increases) of NO<sub>x</sub> emissions under 3B. For dairy cattle (3B1a), emissions are recalculated from 2006 onwards. For non-dairy cattle (3B1b), this led to an increase in NO<sub>x</sub> emissions for the full time series. For swine (3B3), emissions are recalculated for all years since 2006, which was the first year with swine manure treatment. It also leads to minor recalculations in NH<sub>3</sub> emissions for cattle (3B1a and 3B1b).
- NH<sub>3</sub> emissions for 3B1a Manure management – Dairy cattle increased for 2022 and 2023, due to an error correction.
- For 3B4d Manure management – Goats, PM and NH<sub>3</sub> emissions increased, due to updated emission factors.
  - For PM, emissions increased for all years since 1991. The new EF has been applied for all years since 2018. The old one is used for 1990. For the years 1991-2017, constant linear interpolations has been applied to create a consistent time series.
  - For NH<sub>3</sub>, the new EF has been applied from 2018 onwards. The old EF is applied to 1990-1998. For 1999-2017, constant linear interpolation has been applied.
- NMVOC emissions from manure management have been recalculated for all sectors and years for which NH<sub>3</sub> were recalculated. This leads to minor increases in NMVOC emissions from dairy cattle (3B1a Manure management – Dairy cattle), and to decreases of NMVOC emissions from goats (3B3), from 1999 to 2023.
- NH<sub>3</sub> and NO<sub>x</sub> emissions from Inorganic N-fertilisers (3Da1) increased for 2019-2023, resulting from the updated emission

factor for NH<sub>3</sub> from goat housing. This updated EF results in higher N concentrations of rinsing liquid from air scrubbers on goat houses, leading to higher NH<sub>3</sub> and NO<sub>x</sub> emissions when applied to soils.

- NH<sub>3</sub>, NO<sub>x</sub> and therefore also NMVOC emissions from 3Da2a 'Animal manure applied to soils' decrease for the full time series, resulting from the recalculations under 3B. These recalculations in 3B affect the amount of Total Applied Nitrogen available for application.
- The NO<sub>x</sub> emissions related to agricultural use of organic soils have been recalculated based on new insights on the area of peat and peaty soils in the Netherlands. This leads to NO<sub>x</sub> increases under 3Da4 for 1990-2020 and decreases in 2021-2023.
- The preliminary figures for the application of inorganic fertilisers compost, pesticides and the grassland renewal rate in 2023 have been updated to final figures, leading to small changes in NO<sub>x</sub> and NH<sub>3</sub> emissions under 3Da2c and HCB emissions from 3Df.
- Emissions from grassland renewal have been reallocated from 3Da2a (animal manure applied to soils) to 3Da4 (crop residues applied to soils).

#### Waste

- All emissions under 5A Solid waste disposal on land have been recalculated for 2021, 2022 and 2023 due to newly available activity data. This leads to a decrease of emissions.
- NH<sub>3</sub> emissions of 5B2 Anaerobic digestion at biogas facilities has increased for 2005 up until 2023, increasing from 8 tons in 2005 to around 370 tons in 2023. This is due to the addition of emissions from waste processed in co-digesters.
- For 5E Other waste, emissions of PCDD/PCDF (dioxins/furans) and particulate matter species have been recalculated for 2014-2023. The ratio between car fires and the number of incidents reported to insurers has been adjusted for this period, leading to a decrease of emissions from car fires.

Further details on the above changes can be found in the respective sectoral chapters.

#### 11.1.1 *Effects of recalculations and improvements*

Tables 11.1 to 11.3 show the changes in total national emission levels for the various pollutants, compared to the inventory report of 2024.

In general, the national emissions of the various pollutants only show limited changes compared to the previous submission (on average less than 5%) except for black carbon (BC) emissions in 2020 and 2023, Cd emissions in 2023, PCDD/PCDF (dioxins/furans) emissions in 2023, and HCB emissions for 2010, 2020, and 2023.

The change in BC emissions in 2020 and 2023 results mainly from the different updates in offroad mobile machinery. The recalculation of Cd emissions in 2023 is only 0.07 ton, but as total emissions have decreased to 0.5 ton, this is a relative change of 15%. It results mainly from updates in 1A4, 2G, and 1A2gviii. The decrease in PCDD/PCDF (dioxins/furans) emissions in 2023 is a result of updates/corrections in company reporting in AERs, under 1A1a. The increase of HCB emissions

is a result from the newly estimates HCB emissions for 2C1 Iron and steel production.

Table 11.1 Differences in total national emission levels between current and previous inventory reports, for the years 1990, 2000, 2010, 2020 and 2023 (NO<sub>x</sub>, NMVOC, SO<sub>x</sub>, NH<sub>3</sub> and particulate matter)

<b>National total</b>		<b>NO<sub>x</sub></b> (as NO <sub>2</sub> ) <b>Gg</b>	<b>NMVOC</b> <b>Gg</b>	<b>SO<sub>x</sub></b> (as SO <sub>2</sub> ) <b>Gg</b>	<b>NH<sub>3</sub></b> <b>Gg</b>	<b>PM<sub>2.5</sub></b> <b>Gg</b>	<b>PM<sub>10</sub></b> <b>Gg</b>	<b>TSP</b> <b>Gg</b>	<b>BC</b> <b>Gg</b>	<b>CO</b> <b>Gg</b>
1990	IIR 2025	682.2	600.8	198.1	346.6	57.2	80.5	102.2	14.2	1177.1
	IIR 2026	675.3	600.0	197.6	346.6	56.9	80.3	101.9	14.0	1187.8
Difference:	absolute	-7.0	-0.8	-0.5	0.0	-0.3	-0.2	-0.2	-0.2	10.7
	%	-1.0%	-0.1%	-0.3%	0.0%	-0.6%	-0.3%	-0.2%	-1.6%	0.9%
2000	IIR 2025	491.3	334.6	78.5	174.9	34.7	50.0	57.0	10.6	757.5
	IIR 2026	483.6	334.3	78.1	175.0	34.6	50.1	57.1	10.4	761.1
Difference:	absolute	-7.7	-0.4	-0.4	0.0	0.0	0.1	0.1	-0.2	3.5
	%	-1.6%	-0.1%	-0.5%	0.0%	-0.1%	0.2%	0.2%	-1.5%	0.5%
2010	IIR 2025	345.9	271.9	36.1	134.4	22.0	35.6	43.0	4.9	655.2
	IIR 2026	344.9	272.8	36.1	134.7	22.4	36.2	43.6	5.1	658.8
Difference:	absolute	-1.0	0.8	0.0	0.3	0.4	0.6	0.6	0.1	3.6
	%	-0.3%	0.3%	0.0%	0.2%	1.8%	1.6%	1.3%	2.3%	0.6%
2020	IIR 2025	209.0	252.9	19.6	124.6	14.2	26.6	31.1	2.4	426.8
	IIR 2026	212.2	253.2	19.7	125.4	14.9	27.4	31.9	2.6	439.2
Difference:	absolute	3.2	0.3	0.0	0.9	0.6	0.9	0.9	0.2	12.4
	%	1.5%	0.1%	0.1%	0.7%	4.5%	3.3%	2.8%	9.7%	2.9%
2023	IIR 2025	183.8	238.4	17.5	116.4	13.8	26.2	30.7	2.1	386.0
	IIR 2026	185.8	238.0	17.5	117.2	14.4	27.0	31.1	2.3	400.9
Difference:	absolute	2.0	-0.5	0.0	0.9	0.6	0.8	0.4	0.2	15.0
	%	1.1%	-0.2%	-0.2%	0.7%	4.3%	2.9%	1.4%	9.4%	3.9%

Table 11.2 Differences in total national emission levels between current and previous inventory reports, for the years 1990, 2000, 2010, 2020 and 2023 (metals)

<b>National total</b>		<b>Pb</b>	<b>Cd</b>	<b>Hg</b>	<b>As</b>	<b>Cr</b>	<b>Cu</b>	<b>Ni</b>	<b>Se</b>	<b>Zn</b>
		<b>Mg</b>	<b>Mg</b>	<b>Mg</b>	<b>Mg</b>	<b>Mg</b>	<b>Mg</b>	<b>Mg</b>	<b>Mg</b>	<b>Mg</b>
1990	IIR 2025	335.6	4.1	3.7	1.5	12.0	92.5	75.7	0.4	225.7
	IIR 2026	335.6	4.1	3.7	1.5	12.0	92.5	75.7	0.4	225.8
	Difference:									
	absolute	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2000	IIR 2025	29.1	3.1	1.2	1.7	5.3	109.9	20.8	0.8	99.8
	IIR 2026	29.1	3.1	1.2	1.7	5.3	109.9	20.9	0.8	99.9
	Difference:									
	absolute	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	%	-0.2%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2010	IIR 2025	37.7	4.7	0.8	0.8	3.9	116.2	2.5	1.6	103.0
	IIR 2026	37.7	4.8	0.8	0.8	3.9	116.2	2.5	1.6	103.0
	Difference:									
	absolute	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	%	0.1%	0.7%	0.2%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
2020	IIR 2025	5.8	2.0	0.5	0.3	3.2	103.9	1.8	0.2	178.1
	IIR 2026	6.0	2.1	0.5	0.3	3.2	103.9	1.8	0.2	178.2
	Difference:									
	absolute	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	%	2.4%	3.8%	1.5%	0.1%	0.1%	0.0%	0.3%	0.0%	0.0%
2023	IIR 2025	4.0	0.5	0.4	0.2	3.5	111.0	1.9	0.1	70.1
	IIR 2026	4.1	0.5	0.4	0.2	3.5	110.8	1.9	0.1	70.1
	Difference:									
	absolute	0.1	0.1	0.0	0.0	0.0	-0.2	0.0	0.0	0.0
	%	3.0%	15.1%	-2.6%	0.1%	-0.1%	-0.2%	0.2%	0.0%	-0.1%

Table 11.3 Differences in total national emission levels between current and previous inventory reports, for the years 1990, 2000, 2010, 2020 and 2023 (PCDD/F, PAHs, HCB and PCB)

National total		PCDD/ PCDF	benzo(a) pyrene	benzo(b) fluor- anthene	benzo(k) fluor- anthene	indeno (1.2.3 -cd) pyrene	Total 1-4	HCB	PCB
		g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	kg
1990	IIR 2025	744.9	5.5	8.1	4.2	3.0	21.4	66.4	38.4
	IIR 2026	745.0	5.5	8.1	4.2	2.9	21.1	66.7	38.4
Difference	absolute	0.0	0.0	0.0	0.0	0.0	-0.3	0.2	0.0
	%	0.0%	-0.1%	-0.1%	0.1%	-0.6%	-1.4%	0.4%	0.0%
2000	IIR 2025	37.5	2.0	2.0	1.1	1.0	6.6	17.1	0.3
	IIR 2026	37.6	2.0	2.0	1.1	0.9	6.3	17.4	0.3
Difference	absolute	0.1	0.0	0.0	0.0	0.0	-0.3	0.2	0.0
	%	0.3%	0.0%	0.0%	1.2%	-1.7%	-4.4%	1.4%	0.0%
2010	IIR 2025	40.1	2.2	2.2	1.2	1.1	7.5	3.5	0.3
	IIR 2026	40.2	2.2	2.2	1.2	1.1	7.2	3.7	0.3
Difference	absolute	0.1	0.0	0.0	0.0	0.0	-0.3	0.2	0.0
	%	0.3%	0.6%	0.7%	2.2%	-0.3%	-3.8%	6.4%	0.0%
2020	IIR 2025	30.0	1.5	1.3	0.7	0.7	4.9	3.4	0.1
	IIR 2026	30.1	1.5	1.4	0.7	0.7	4.7	3.7	0.1
Difference	absolute	0.1	0.0	0.0	0.0	0.0	-0.2	0.2	0.0
	%	0.3%	1.4%	1.6%	2.2%	1.1%	-3.9%	7.0%	0.0%
2023	IIR 2025	42.9	1.5	1.5	0.8	0.7	5.1	3.2	0.1
	IIR 2026	32.1	1.6	1.5	0.8	0.8	4.9	3.4	0.1
Difference	absolute	-10.9	0.0	0.0	0.0	0.0	-0.1	0.2	0.0
	%	-25.3%	1.5%	1.5%	2.6%	1.4%	-2.9%	5.9%	0.0%

## **11.2 Planned improvements**

The remaining actions with respect to content will be prioritised and are planned for implementation in future inventories. Appendix 3 includes relevant plans that result from review recommendations but may not yet have been implemented in this submission.

## **11.3 Status of implementation of review recommendations**

Appendix 3 describes the status of implementation of review recommendations. This includes tables showing an overview of the implementation of actions from the NECD-2024 inventory review, EMEP-2024 inventory review, NECD-2021 LPS review, NECD-2021 gridded data review, and the NECD-2023 projections review.



## 12 Projections

### 12.1 Projected trends in emissions of air pollutants for the Netherlands

Air pollutant emissions, especially NO<sub>x</sub>, PM<sub>2.5</sub> and SO<sub>x</sub>, have been declining steadily over the last two decades. Restriction of emission limit values has played a major role and resulted in abatement technologies, such as the application of DeNO<sub>x</sub>, and application and/or switching to cleaner fuels. The emission of NH<sub>3</sub> declined since 2000 up until 2013, resulting in stagnation. This stagnation is mainly due to the abolition of milk quota, which ultimately led to growth for dairy cattle farms up until 2017. Emissions of NMVOC declined steadily, due to policies focused on NMVOC up until 2004. From that moment onwards, this decline has decreased.

This trend of declining air pollutant emissions in the past will continue in future according to these projections under the *WaM scenario*, for all relevant NEC pollutants. It is remarkable that according to current projections for NO<sub>x</sub> and NH<sub>3</sub> for the 2022–2030 period, the relative pace of this reduction will increase. For NO<sub>x</sub>, this is the result of an intensifying reduction for vans and seaborne shipping and remains strong due to electrification in (cargo) road transport. For NH<sub>3</sub>, current projections are the result of a decrease of cattle stock, due to diminution and expiration of the (manure) derogation for the Nitrates Directive, as well as various buyout schemes to terminate cattle and livestock farming. In the long run, NH<sub>3</sub> reduction is not very strong, since most relevant policies are applicable for the 2022–2030 period.

This trend of declining air pollutants contributes to cleaner air and a reduction of nitrogen deposition on nature. Moreover, the NEC targets in place for 2030 and beyond are extremely likely to be met according to both the *WM scenario* and the *WaM scenario* (see Table 12.1). The reason for meeting these targets is, among others, that by the time of agreement in 2016, only limited co-benefits could be taken into account as a result of (the restriction of) climate and energy policies, as well as national nitrogen policies. Despite the contribution of this declining trend to cleaner air and nature and meeting the NEC targets, the nitrogen deposition targets according to the Environmental and Planning Act of the Netherlands will not be met.

### 12.2 Projections have been prepared in the framework of the Netherlands Climate and Energy Outlook 2024

The emission projections of air pollutants for the IIR 2025 have been prepared within the framework of the Netherlands Climate and Energy Outlook 2024 (PBL, TNO, CBS & RIVM, 2024). This Outlook is called *Klimaat- en Energieverkenning 2024* in Dutch, abbreviated as 'KEV2024'. The projections in this report are consistent with the projections of energy and greenhouse gas emissions for the Netherlands. Projections of air pollutants in the Netherlands have been prepared for target year 2030 as well as for 2035. For 2040, a qualitative perspective on future trends has been drafted.

The preparation of the Outlook is the responsibility of the Netherlands Environmental Assessment Agency (PBL) in cooperation with the National Institute for Public Health and the Environment (RIVM) and the Netherlands Organisation for Applied Scientific Research (TNO).

The corresponding KEV 2024 report can be found on the website of the PBL (<https://www.pbl.nl/kev> (in Dutch), an [English summary](#) is available). Underlying reports and datasets for the KEV can also be found on this website (via the links <https://www.pbl.nl/kev/publicaties> and <https://www.pbl.nl/kev/rekenmodellen-klimaat-en-energieverkenning-kev> (in Dutch)), including:

- a [description of the model system](#) used for calculating projections of greenhouse gases and air pollutants;
- a complete [overview of all policies and measures](#) that have been taken into account, with detailed descriptions of the assumed effects.

For international reporting to the European Commission, an English report has been written for the National Energy and Climate Plans, which is available [here](#). A substantial part of this report is based on the KEV2023, thus providing insights into relevant aspects of the Dutch climate and energy outlooks.

### 12.3 National report with projections for air pollutants

The projections for the emissions of air pollutants are described in the report '[Emissieramingen luchtverontreinigende stoffen 2025](#)' (PBL, 2025a; in Dutch). This report describes the emission trends starting from the base year 2022 up to the year 2030 and 2035 for the five air pollutants under the new National Emission reduction Commitments Directive (NEC Directive, 2016/2284/EU), i.e. NO<sub>x</sub>, NH<sub>3</sub>, PM<sub>2.5</sub>, SO<sub>x</sub> and NMVOC. In addition projections have been prepared for PM<sub>10</sub>. A qualitative perspective on trends up to 2040 has been included as well.

This outlook report complies with the requirement within the NEC Directive (Directive 2016/2284/EU) to report emission projections every two years. Moreover, these projections are required to calculate the future developments with respect to air quality and nitrogen deposition in the Netherlands.

Projected activity data can be found in the Annex IV reporting template.

### 12.4 Measures and policies

The submitted projections take into account all relevant information about measures up to 1 May 2024. Three projections have been prepared:

- *Adopted policy* includes all climate and relevant environmental policies implemented on 1 May 2024. This projection has been used to report according to the *With Measures (WM)* scenario, according to the guidelines for international reporting.
- *Planned policy* includes all climate and relevant environmental policies that, by 1 May 2024, had been made public, officially announced in Letters to Parliament and worked out in sufficient detail. This projection has been used to report according to the

*With Additional Measures (WAM)* scenario, according to the guidelines for international reporting.

- *Proposed policy* includes policy plans and intentions that, by 1 May 2024, had been made public, but had not yet been worked out in sufficient detail. This projection, including proposed policies, has been prepared for the first time. This has been executed to provide additional information to Dutch policy makers concerning the possible impacts of (so-called 'non-specific') measures that still have to be worked out properly. This is mainly relevant for the governmental plans of the current Cabinet-Schoof, which were published around 1 May 2024. This projection has not been used for international reporting.

Most of the content of the Dutch reports serving the Netherlands Climate and Energy Outlook 2024, is based on the *adopted policies* (i.e. *WM scenario*) and *planned policies* (i.e. *WAM scenario*), including detailed calculations for the outlook report.

Part of the proposed policy measures have only been assessed with respect to a conceivable emission reduction impact by 2030. For several other measures, no assessments have been made for the *proposed policy* projection due to insufficient information. Proposed measures are clearly different from planned measures; therefore, they have not been incorporated into the reported WAM scenario.

The projections made for the *adopted policies* (i.e. *WM scenario*) and *planned policies* (i.e. *WAM scenario*) have been used for the published outlook report and for this IIR. The projections reported in this IIR are the adopted (WM) and the planned (WAM) projections, and these are fully consistent (concerning policy definitions) with Dutch projections in previous IIR-reports. Several climate and energy policies and measures are incorporated into the calculated emission trends for the relevant air pollutants. Also, relevant national (adopted and planned) environmental policies have been incorporated into the emission projections, such as measures stemming from the Dutch air quality agreement and the Dutch action plan to tackle nitrogen pollution in Natura 2000 conservation areas. A full overview of relevant climate and energy policies and environmental policies has been published in the side publication for the KEV '*Beleidsverzicht en factsheets beleidsinstrumenten*' (PBL, TNO & RIVM, 2024; in Dutch). In this publication, substantial background information has been provided for individual policy measures in factsheets.

The complete list of (environmental) policies included in the KEV2024 projections is presented in Tables 1.1 and 1.2 of the referenced report (PBL, TNO, CBS & RIVM, 2024; in Dutch).

Relevant climate and energy policies, which have been incorporated into the *WM scenario* and the *WAM scenario* include:

- SDE++ subsidy scheme to stimulate renewable energy and CO<sub>2</sub> reduction techniques; this is the major subsidy scheme for renewable energy in the Netherlands;
- Various other financial instruments, such as the European Emission trading scheme (ETS), deployment of ETS2 scheme, a

national CO<sub>2</sub> tax for industry and greenhouse horticulture, energy taxes, subsidy schemes, tax reduction schemes for energy-saving technologies. These schemes include various, recent modifications;

- Ban on coal-fired power plants by 2030 and recent developments with respect to the development (and delays) of large projects for renewable energy, e.g. large wind farms;
- Various regulations and subsidy schemes for the built environment, including Ecodesign requirements, policies to stimulate insulation and district heating and policies to abandon the use of natural gas for new buildings;
- Various regulations and subsidy schemes for mobility, including policies with respect to biofuels, RED III, electric vehicles, restriction of the number of flights at Amsterdam Airport Schiphol, zero-emission zones in cities for delivery vans and trucks and levies on heavy duty trucks, policies to make inland and seaborne shipping more sustainable;
- Various regulations and subsidy schemes for the industry, greenhouse horticulture and agriculture, including stimulation to implement CCS, sustainable hydrogen production, stimulation of a circular economy and LULUCF-related policies.

Several environmental policies and measures are included in the *WM scenario*. The most relevant include:

#### Sector Industry:

- Amendment of generic emission requirements following the Environmental Activities Decree (in Dutch: Besluit Activiteiten Leefomgeving).

#### Sector Mobility:

- Roadmap and covenant clean and zero-emission construction (targeting non-road mobile machinery for construction)
- Temporary subsidy scheme for shore power for sea-borne vessels 2024–2026;
- Euro7 requirements for road transport;
- Restriction of EU CO<sub>2</sub> emission limit values for heavy-duty road transport beyond 2030;
- Subsidy Scheme for Limitation of energy use in the fishery sector (ENERGIEVIS);
- Sustainability scheme diesel traction for railways Zutphen-Oldenzaal and Almelo-Mariënberg.

#### Sector Agriculture:

- Regulation and buy-out schemes to terminate cattle farming (in Dutch: Lbv);
- Regulation and buy-out schemes to terminate cattle farming targeted at locations with emission peaks (relating to Natura2000 protected areas; in Dutch: Lbv-plus);
- Subsidy and switch-over schemes to implement sustainable agricultural practices;
- Regulation for provincial measures for permit holders, whose permits turn out to be non-viable due to nitrogen policies (in Dutch: Regeling provinciale maatregelen PAS-melders);

- Provincial acceleration measures for the National Programme Rural Areas (in Dutch: Versnelling NPLG);
- Diminution and expiration of the (manure) derogation for the Nitrates Directive (in Dutch: vervallen derogatie onder Nitraatrichtlijn).

Several environmental policies and measures are included in the *WAM scenario*. The most relevant include:

#### Sector Mobility:

- Expansion of subsidy scheme for sustainable inland shipping (in Dutch: SRVB);
- Temporary subsidy scheme for shore power for sea-borne vessels 2024–2026;
- CO<sub>2</sub> differentiation truck levies and backflow of these revenues to support sustainable freight traffic.

#### Sector Agriculture:

- Decrease of the amount of pig rights and poultry rights (this targets the maximum amount of animals that may be kept in livestock farming);
- Faster decrease of the amount of phosphate rights of dairy cattle upon trading these rights (this targets the maximum amount of cattle that may be kept in dairy cattle farming);
- Restriction of the emission limit values for particulate matter at poultry stables;
- Blending obligation of renewable (green) gas.

As mentioned before, a third scenario called proposed policies, includes policy plans and intentions that, by 1 May 2024, had been made public, but had not yet been worked out in sufficient detail. This is mainly relevant for the governmental plans at that time of the current Schoof Cabinet, but not restricted to these. This scenario includes some plans under the Clean Air Agreement (in Dutch: Schone Lucht Akkoord) and the revision of the Industrial Emissions Directive. But it also includes some intentions of the current cabinet, e.g. increasing the maximum speed on highways, the reintroduction of duty-free diesel for agriculture and the reintroduction of the original derogation under the Nitrates Directive. This projection has not been used for international reporting in this report. If policies will be worked out in more detail, these intentions will be included under the *WM* and *WAM scenarios* for the IIR publication in 2027.

*Table 12.1 Results of NEC emissions (in Gg) for the WAM (With Additional Measures) scenario according to European definitions (i.e. NEC Directive) for 2030 and 2035*

<b>Pollutant</b>	<b>2005</b>	<b>2022</b>	<b>Projection 2030</b>	<b>EU NEC target 2030</b>	<b>Projection 2035</b>
NO <sub>x</sub>	395	162	118 [109-129]	154	94.9
NH <sub>3</sub>	155	121	101 [95.8-107]	122	97.6
PM <sub>2.5</sub>	28.5	14.3	12.6 [11.1-14.0]	15.7	11.8
SO <sub>x</sub>	67.9	19.6	16.7 [12.3-18.5]	31.9	15.2
NMVOC	204	154	153 [148-160]	173	148

The numbers within brackets represent the calculated uncertainty of this projection, which has only been determined for 2030. The NEC emissions for 2005 and 2022 are based on emissions inventories that have been used for the projections (statistics from the Dutch emission inventory as reported in February 2024). The target for 2030 has been calculated according to the NEC Directive and represents the maximum allowed emissions for the Netherlands

## 12.5 Projection totals for compliance checking NEC-targets 2030

In Table 12.1 the projection results for the *WAM scenario* are summarised according to European definitions. European definitions mean that calculations have been performed according to definitions as prescribed in the NEC Directive (Directive 2016/2284/EU) and not according to the definition for Dutch territory. This means, for example, that international maritime traffic is not taken into account (aircraft emissions beyond the landing and take-off cycle are not taken into account for either definition). Also, the emissions of NO<sub>x</sub> and NMVOC from manure management and agricultural soils (NFR 3B and 3D; Sector Agriculture) are exempted from the compliance totals. Lastly, emissions from road transport are calculated on the basis of fuel sold; hence, not on the amount of driven kilometres. The EU NEC targets in Table 12.1 have been calculated using reduction percentages according to the NEC Directive (Directive 2016/2284/EU) and represent the maximum allowable emissions for the Netherlands.

The maximum emissions allowed ('emission ceilings') provided in Table 12.1 have been calculated on the basis of the statistics from the Dutch emission inventory as reported in February 2024. This has been done since projections are based on this inventory. It should be noted that projections given here for 2030 may not be compared to maximum allowed emissions in 2030 that are calculated on the basis of statistics from the Dutch emission inventory as reported in February 2025.

As can be seen in Table 12.1, the targets in place for 2030 and beyond are extremely likely to be met according to the *WAM scenario*.

## 12.6 Emissions uncertainty range for 2030

The projections are based on future expectations with respect to the development of various factors that determine the economy, energy system and emissions. These factors encompass developments of external factors, such as macro-economic developments, population growth and energy and CO<sub>2</sub> prices. The likely effectiveness of policy measures has also been estimated.

Uncertainties in relevant factors have been translated into consequences for emissions in 2030. For every factor and every pollutant, it has been estimated how much the emission could deviate (upwards and downwards) from the central projection, expressed as a point value. It has also been determined whether, how and to what extent one factor is interlinked with another factor. All this information has been brought together in a Monte Carlo uncertainty analysis. Separate analyses have been performed for the national NEC total and for the totals per KEV sector. The result is an uncertainty range with respect to the projected point values. The possibility of new policies coming in and/or the possibility that policies will stop have not been taken into account in the uncertainty analysis. The uncertainty range is calculated given the policies taken into account in the reported scenarios (WM and WAM). The uncertainty range only provides the uncertainty determined by external factors such as prices and economic developments and the uncertainty in the effectiveness for those measures that are included in

the central projection. The uncertainty in the historical emissions of the emission inventory has been excluded from the uncertainty analysis.

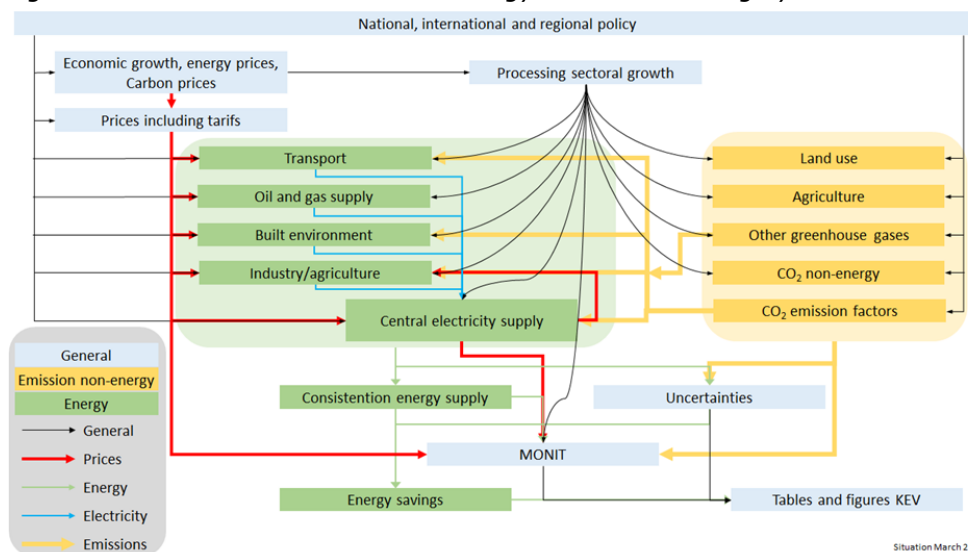
## 12.7 Model descriptions

This section briefly describes the modelling system for projections of energy, greenhouse gas emissions and NEC emissions. In the Netherlands, a combination of modelling tools is used. The National Energy Outlook Modelling System (NEOMS) is the primary modelling suite, which has been developed for over twenty years by the Energy Research Centre of the Netherlands (ECN) and PBL Netherlands Environmental Assessment Agency for projections and policy evaluations. In 2018, the NEOMS was transferred to PBL.

### National Energy Outlook Modelling System

NEOMS is a suite of models to simulate the various parts and sectors of the Dutch Energy System (PBL, 2025b). Some constituent models have been developed in spreadsheets (Excel) and Python, some are optimisation models developed in AIMMS or GAMS. While each model is unique, the general starting point is a detailed inventory of the existing portfolio of (economic) activities in all sectors, such as industrial production, transportation volumes, etcetera. The models translate the activity levels in an (projected) energy demand and supply, using assumptions on energy prices, policies and technologies. The models are calibrated using recent national statistics on energy demand and supply, investments, added value and data available from other sources (e.g. world market prices for oil, gas and coal from IEA and futures markets, monitoring of government programmes). Building on the drivers for developments in the energy system, such as economic growth, population growth, behavioural change and technological development – some as endogenous efforts, some defined exogenously – the models simulate the development of the system, activity levels and the uptake of alternative technologies therein, taking into account consumer preferences and market behaviours and the impact of policies thereupon. Combining expected technology deployment and the demand for various products and energy services results in projections of final and primary energy consumption, greenhouse gas emissions and air pollutants. Most energy demand and supply models provide data on investment costs and costs for operation and maintenance.

Figure 12.1 Overview of the National Energy Outlook Modelling System



NEOMS enables the exchange of data between twelve energy models, producing consistent and detailed results. Detailed results include energy demand, supply, emissions, technology uptake, investments, costs, prices, policy impacts. The total system includes about twenty-two sub-sectors including all relevant technologies and fuels per sub-sector. Their CO<sub>2</sub> emissions are also calculated.

The NEOMS models currently cover the following sectors and their corresponding models:

- Energy demand
- Industry and agriculture (E2-Mission)
- Service sector (SAVE-Services)
- Households (Hestia and EVA)
- Transport (various models)
- Energy supply
- Combined heat and power (E2-Mission)
- Electricity supply (Competes)
- Refineries (SERUM)
- Renewables (RESolve-E and E2-Mission)
- Gas and oil supply

The outputs of the separate models are combined in a model of the total energy sector (SELPE) in which the validity and consistency of the energy system as a whole is verified. Ultimately, all the results feed into MONIT-Conversion, a tool that calculates the energy savings per sector and produces aggregated results for all kinds of analyses, for example for the presentation tool MONIT.

### Energy demand

#### ***E2-Mision (industry, agriculture and CHP)***

E2-Mission is a simulation model that calculates the energy demand of industry and agricultural sectors and the sectoral

implementation of combined heat and power generation. The future energy demand is calculated on the basis of the economic growth per subsector and the measures taken.

### ***SAVE-Services (services sector)***

SAVE-Services is a simulation model for the services sector. On the basis of the economic growth per subsector and the measures taken, the model calculates future gas and electricity demands.

### ***Hestia (households)***

Hestia models the energy efficiency of the housing stock and simulates the investment behaviour of home owners at the level of individual houses. The model calculates the development of the gas, electricity and heat consumption until 2050. Hestia is open source and open access.

### ***EVA (households)***

EVA uses a detailed stock database to calculate the national electricity use of household appliances. EVA offers a detailed view on the impact of changes in the penetration of appliances and autonomous or policy driven (mostly 'Ecodesign') changes in energy consumption.

### ***Transport***

The transport model is a tool to incorporate the results of the calculations of all kinds of models specific to the transport sector used at PBL into the databases of NEOMS. This enables the other models to use this data for their calculations.

## **Energy Supply**

### ***COMPETES (electricity supply)***

COMPETES is used to calculate decisions in investments and operations for centralised electricity production in the EU. On the basis of the Dutch sectoral electricity demand, hourly electricity production from intermittent renewables and sectoral implementation of combined heat and power, the remaining demand is covered by COMPETES, taking into account the merit order of the supply curve of centralised electricity generators and electricity trade with neighbouring countries. COMPETES also provides the commodity prices for electricity.

### ***SERUM (refineries and oil supply)***

SERUM is an optimisation model for the Dutch oil refining sector. On the basis of expectations about the demand for oil products, environmental measures and crude properties, SERUM calculates the required crude intake, the required refining configuration and the energy use for the entire process. On the basis of energy use and energy carriers, emission developments are calculated.

### ***RESolve-E (renewables)***

The aim of the RESolve-E model is to provide data about renewable energy production, including biomass combustion in

various types of (medium-sized) combustion installations. It is noted here that, due to closure of coal-fired power plants in 2030 in the Netherlands, by 2030 biomass co-firing will no longer be eligible either.

For the renewable energy production that is eligible to receive a subsidy via the SDE subsidy scheme, the SDE budget constitutes a ceiling for the total production. Because renewable energy can contribute to realising the energy performance coefficient standards for new buildings, the renewable energy production of Hestia and SAVE-Services serve as input for RESolve-E. Many renewable energy technologies have been transferred from RESolve-E to E2-Mission, so RESolve-E does not cover heat production technologies anymore. Ultimately, RESolve-E will be fully incorporated into other models (e.g. E2-Mission, COMPETES).

### ***Gas/oil production (gas and oil supply)***

In this model, the supply of natural gas and crude oil is calculated on the basis of the availability of natural gas in the 'Groningen' gas field, and other onshore as well as offshore fields for gas and oil. Exogenous assumptions are made about the volume for gas storage, gas export and oil export. If demand exceeds this production, natural gas and oil will be imported. The model calculates the amount of energy needed for production, storage and transport as well as losses in the grid.

### **Other models and tools in NEOMS**

#### ***Energy prices***

The energy prices tool provides electricity and gas prices for the various sectors as defined in NEOMS. This data can be used by the NEOMS models.

#### ***SELPE (validity and consistency check)***

SELPE is an optimisation model that is used to model the entire Dutch energy sector. Most of the constraints are set by the above-mentioned models. The aim of this model is to check the feasibility and consistency of the outcomes of the other models, for example verifying that the total electricity demand does not exceed the electricity supply.

#### ***MONIT***

The output of the SELPE model is very detailed. MONIT-Conversion can aggregate its results into any format needed by the user. The output is made available to MONIT and can also be made available to external parties. Another function of this tool is to calculate the energy efficiency indicators. The tool is used to present the combined results of the models in such a way that they can be used in all kinds of reports, together with historical data.

**NEC-emissions calculations relating to energy use**

The NEC emissions, i.e. NO<sub>x</sub>, NH<sub>3</sub>, PM<sub>2.5</sub> (and PM<sub>10</sub>), SO<sub>x</sub> and NMVOC, relating to energy use, are calculated in line with the results of all afore-mentioned models. Statistics of point sources, as well as inventories of installations and its characteristics, are combined with projected energy use, emission factors and the potential effect of policies, if deemed relevant. To that purpose, spreadsheet tools have been developed and are kept updated.

**Non-energy models**

The results from NEOMS are used and/or complemented with the modelling of non-CO<sub>2</sub> emissions and non-energy-related CO<sub>2</sub> emissions (LULUCF). This is achieved using sectoral models (agriculture and LULUCF) and spreadsheet tools (industry and other sectors).

**Agriculture**

For the calculation of the agricultural emission projections, the National Emission Model for Agriculture (NEMA) is used (Van der Zee et al., 2026). NEMA models CH<sub>4</sub>, NH<sub>3</sub>, N<sub>2</sub>O, NO<sub>x</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> and CO<sub>2</sub> emissions from agriculture using a methodology in compliance with the IPCC and EMEP Guidelines. Usually, the model runs with historical input data calculating the emissions for the National inventory report and the Informative inventory report. Input data for projections is based on the estimated effects of existing policies and expert judgement using other models, research and historical trends. Institutes involved in estimating input data are Wageningen Economic Research, Wageningen Environmental research, Wageningen Livestock Research and PBL.

**12.8 Role of biomass in the projection**

As mentioned before, biomass combustion in various types of (medium-sized) combustion installations is determined using the RESolve-E model. This is relevant because this type of renewable energy is mainly determined by the subsidy scheme SDE++. Since various categories, in particular the ones for solid biomass combustion in medium-sized combustion installations, have been closed in this subsidy scheme, biomass combustion does not have a significant role in the projections.

It is noted here that due to closure of coal-fired power plants in 2030 in the Netherlands, by 2030, biomass co-firing will no longer be eligible either.

Wood combustion in domestic dwellings is calculated and projected using a separate model. This model calculates the total amount of wood use on the basis of wood consumption per hour of each type of stove and the operating hours per year per stove. The input is updated on the basis of regular surveys made by Statistics Netherlands (CBS) (Jansen, 2016; Visschedijk & Dröge, 2020; Visschedijk & Dröge, 2026).

## 12.9 Role of waste in the projection

Waste processing has not been mentioned specifically in former model descriptions. In general, a large part of Dutch household waste, such as glass, paper, compostable waste and plastic waste, is collected separately to facilitate substantial recycling. Household residual waste is incinerated in dedicated waste incinerators, which need to meet strict emission requirements. These waste incinerators often produce power as well as heat for district heating. Waste incinerators, and their respective emissions, are incorporated into the afore-mentioned spreadsheet tools to calculate NEC emissions relating to energy use.

For historical reasons, the Netherlands had excess capacity of waste incinerators, which it used to incinerate foreign waste. The Dutch government regards this as detrimental and discourages this by putting a tax on imported waste. Due to this policy, the amount of imported waste has been declining since 2018. The outlook for inland supply of household waste will depend on developments and policies with respect to recycling and circularity, but its effects remain uncertain. Therefore, it is assumed for this outlook that waste supply will remain at its current level, which means that future waste incineration will remain stable. Since a decline of waste supply may also be anticipated, a future decrease in waste incineration has been adopted as part of the uncertainty analysis. As mentioned before, due to regulations, waste incineration in the Netherlands is a relatively small source of environmental emissions.



## 13 Adjustments and Compliance

### 13.1 Compliance with the emission reduction targets

In 2001, being an EU Member State, the Netherlands adopted the NECD (National Emission reductions Commitments Directive) 2001 (EU, 2001), which was replaced by the revised NECD 2016 (EU, 2016). In 2017, the Netherlands signed and ratified the amended text on the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (UNECE Gothenburg Protocol). Both the NECD and the Gothenburg Protocol commit the Netherlands to reducing its NO<sub>x</sub>, SO<sub>x</sub>, NMVOC, NH<sub>3</sub> and PM<sub>2.5</sub> emissions to the agreed national reduction targets for the years 2020–2029 and for 2030 and beyond, compared to the 2005 emissions.

Both for the Gothenburg Protocol and the NECD, the Netherlands has opted to calculate the compliance totals on the basis of fuel sold.

The emission reduction targets for both the NECD and the Gothenburg Protocol amount to the same percentage for each pollutant. However, for NO<sub>x</sub> and NMVOC, there is a difference between the NECD and the Gothenburg Protocol regarding the calculation of the emission totals for compliance checking. Under the NECD, the emissions of NO<sub>x</sub> and NMVOC from manure management and agricultural soils (NFR 3B and 3D; Agriculture Sector) are exempted from the compliance total, whereas these sources are included in the Gothenburg Protocol.

Table 13.1 shows total emissions for compliance under the NECD, and the reductions achieved.

*Table 13.1 NECD compliance totals, emissions reduction targets and achieved reductions*

Pollutant	Compliance total (Gg)				Target 2020-2029	Achieved reduction			Target 2030
	2005	2020	2023	2024		2020	2023	2024	
<b>NO<sub>x</sub></b>	391.3	178.1	153.6	148.7	<b>45%</b>	54%	61%	62%	61%
<b>NMVOC</b>	202.4	165.7	152.5	149.3	<b>8%</b>	18%	25%	26%	15%
<b>SO<sub>2</sub></b>	67.6	19.7	17.5	15.8	<b>28%</b>	71%	74%	77%	53%
<b>NH<sub>3</sub></b>	155.3	125.4	117.2	112.6	<b>13%</b>	19%	24%	27%	21%
<b>PM<sub>2.5</sub></b>	28.5	14.9	14.4	13.9	<b>37%</b>	48%	50%	51%	45%

Under the NECD, the emissions of NO<sub>x</sub>, NMVOC, NH<sub>3</sub>, SO<sub>x</sub>, and PM<sub>2.5</sub> comply with the 2020–2029 reduction targets (2021 and 2022 not shown in the table). In 2024, the targets for 2030 are also being met for all five pollutants.

Table 13.2 shows total emissions for compliance under the Gothenburg Protocol, and the reductions achieved.

Table 13.2 Gothenburg Protocol compliance totals, emissions reduction targets and achieved reductions

Pollutant	Compliance total (Gg)				Target 2020-2029	Achieved reduction			Target 2030
	2005	2020	2023	2024		2020	2023	2024	
<b>NO<sub>x</sub></b>	426.9	212.2	185.8	180.7	<b>45%</b>	50%	56%	58%	61%
<b>NMVOC</b>	268.3	253.2	238.0	234.1	<b>8%</b>	6%	11%	13%	15%
<b>SO<sub>2</sub></b>	67.6	19.7	17.5	15.8	<b>28%</b>	71%	74%	77%	53%
<b>NH<sub>3</sub></b>	155.3	125.4	117.2	112.6	<b>13%</b>	19%	24%	27%	21%
<b>PM<sub>2.5</sub></b>	28.5	14.9	14.4	13.9	<b>37%</b>	48%	50%	51%	45%

Under the Gothenburg Protocol, the Netherlands is not in compliance with the NMVOC reduction target for the year 2020 (highlighted in orange) without adjustment.

With regard to the reduction targets that have been set for 2030, in 2024 these are being met for SO<sub>2</sub>, NH<sub>3</sub> and PM<sub>2.5</sub> but not yet for NO<sub>x</sub> and NMVOC (Table 13.2).

### 13.2 Adjustment under the Gothenburg Protocol

Decision 2012/3 (UNECE, 2012) of the Executive Body stated that as a flexibility mechanism adjustments can be made to the emissions inventory for demonstrating compliance with the emission reduction targets. Under specific circumstances, such adjustments allow a Party to report national emission estimates, which differ from their best science national emission estimates, for compliance purposes.

The 2013 EMEP/EEA Guidebook implemented a default methodology and default EFs for NMVOC from animal husbandry and manure management. In 2017, this resulted in the inclusion of the NMVOC emissions from agriculture into the emission inventory as best science estimate, as described in Chapter 6. Thus, the NMVOC emissions from these sources were not accounted for at the time when emission reduction commitments were set. For this reason, this new NMVOC source is eligible to be applied as an adjustment to the inventory for the purpose of demonstrating compliance to the reduction targets.

In the 2022 submission, the Netherlands applied for an adjustment for NMVOC emissions from source category 3B1a (Manure management – Dairy cattle) for the years 2005 and 2020. The adjustment was approved following review. For source explanation and methodology, we refer to Chapter 6 (Agriculture).

In this 2026 submission, an adjustment is again needed for 2020. The same adjustment is applied that was approved in 2022. The NMVOC emission from 3B1a differs slightly from the emission reported in the 2022 submission. This is due to recalculations that were introduced and explained in the 2023 and 2024 submissions. In the 2025 and 2026 submissions, no new recalculations for sector 3B1a have been introduced. Appendix 6 gives an overview of the data used for the adjustment.

Table 13.3 presents the adjusted total emissions of NMVOC for compliance under the Gothenburg Protocol, and the reductions achieved based on the adjusted emissions.

*Table 13.3 Compliance under the Gothenburg Protocol with the approved inventory adjustment for NMVOC in the year 2020*

<b>Year</b>	<b>Inventory total (Gg)</b>	<b>Reduction target</b>	<b>Unadjusted reduction</b>	<b>Adjustment NFR-3B1a (Gg)</b>	<b>Adjusted compliance total (Gg)</b>	<b>Reduction with adjustment</b>
<b>2005</b>	<b>268.3</b>	-	-	24.2	244.0	-
<b>2020</b>	253.2	8%	6%	43.6	209.6	14%
<b>2021</b>	240.0	8%	11%	-	-	-
<b>2022</b>	240.7	8%	10%	-	-	-
<b>2023</b>	238.0	8%	11%	-	-	-
<b>2024</b>	234.1	8%	13%	-	-	-

When the approved adjustment is applied to the inventory, compliance is achieved for NMVOC emissions in the year 2020, as Table 13.3 shows.



## 14 Spatial Distributions

### 14.1 Background for reporting

In 2025, the Netherlands reported geographically distributed emissions to the UNECE LRTAP Convention for the year 2022. The data delivered consists of two separate sets, one for Large Point Sources (LPS) and one dataset aggregated at NFR level and spatially distributed at the EMEP 0.1°x0.1° longitude-latitude grid. The NFR data also includes the LPS data. Substances reported are NO<sub>x</sub> (as NO<sub>2</sub>), NMVOC, SO<sub>x</sub> (as SO<sub>2</sub>), NH<sub>3</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>, Black Carbon (BC), CO, Pb, Cd, Hg, PCDD/PCDF (dioxins/furans), PAHs, HCB and PCBs. Guidelines for reporting air emissions at grid level are provided in Spatial Mapping of emissions in the EMEP/EEA air pollutant emission inventory guidebook 2023 (EEA, 2023). Gridded emission data is used in integrated European air pollution models, e.g. GAINS and EMEP's chemical transport models. The aggregated sectors, 'gridded NFR' (GNFR), for reporting are defined in Table I of annex IV to the Guidelines for reporting emission data under the Convention on Long-Range Transboundary Air Pollution (EEA, 2023).

The supplied LPS and NFR data originate from one and the same dataset, the [dataset '1990-2022 definitive'](#) of the Netherlands Emission Inventory. This means that the data is mutually consistent with each other; there are no differences between the emissions from the deliveries and the emissions as recorded for the relevant dataset in the emission inventory.

### 14.2 Methodology for disaggregation of emission data

#### *Energy, Industrial Processes and Product Use*

For energy and industrial processes, the vast majority of emissions (80-90%) can be directly linked to large companies with a reporting obligation. The remaining part of the emissions is distributed across the locations of smaller companies on the basis of the number of jobs. The company locations are well known, but the data on the number of employees is sometimes outdated. In addition, the number of jobs is only partly representative of the company emissions. Therefore, this method is classified as Tier 1. See [this link](#) for the factsheet.

#### *Transport*

For inland shipping, recreational shipping and fishing, AIS (Automatic Identification System) data is used for the spatial distribution, which provides a direct picture of the position and speed of a ship.

By linking this data to data on ship types and derived emission factors, an accurate picture of the emission totals and the spatial distribution is created. Given their accuracy, these distributions can be considered Tier 3. More information can be found [here](#).

For [road traffic](#) an advanced traffic model is used for spatial distribution, which is largely fed with navigation and mobile phone data. That is why this distribution method is also considered Tier 3.

For [aviation](#), the data for Schiphol (which has by far the largest share in aviation emissions) is accurately recorded and is classified as Tier 3.

For [railways](#), data on the number of trains per railway section is used. This data provides a good picture of the distribution, but is a few years old, hence Tier 2.

The distribution of emissions by mobile equipment is linked to agricultural land use for agriculture, and to business locations and jobs for industry. Since both distributions are less accurate, they are classified as Tier 1. For [mobile equipment in construction](#), TNO has developed a specific method to be able to localise and quantify the use of this equipment. This distribution is estimated as Tier 2.

#### *Agriculture*

Within the agriculture category, the distribution of emissions from stables and storage uses animal numbers and emission factors per stable type from the [Geographic Information System for Agricultural Businesses \(GIAB\)](#). For emissions from the application of (artificial) fertiliser on the land, the results of the [Initiator model](#) are used. Both methods have been specifically developed to provide the most accurate possible picture of the spatial distribution and are classified as Tier 3. Emissions from tillage and harvesting are linked to [agricultural land use](#) files. Since this distribution is somewhat less specific, it is classified as Tier 2.

#### *Waste Management*

Waste incineration plants in the Netherlands have a reporting obligation, which means that both location and emissions are known. The same applies to sewage treatment plants. Emissions from [landfills](#) are distributed on the basis of data on released and flared landfill gas. This method is estimated as Tier 2, which also applies to the emissions from the [processing of GFT](#), which is related to the amount of processed waste per location.

### **14.3 Method changes in spatial distribution**

Since the last delivery in 2021 with spatially distributed data for 2018, there have been a number of method changes regarding the spatially distributed emission data. For road traffic, a new model has been used to map the distribution of traffic intensity on the roads in the Netherlands. A clear difference with the previous model is the use of 'real-time data' based on navigation and mobile phones to visualise the distribution. This means that the distribution is even more in line with the actual traffic intensity, especially on non-motorways. For inland shipping, the distribution of emissions was based on model calculations with the Inland Shipping Analysis System (BIVAS) of Rijkswaterstaat. However, for 2022, just like for sea shipping, AIS (Automatic Identification System) data is available, which means that the distribution can be based on the actual number of ships and the actual sailing speed and ship type. For the distribution of emissions at Amsterdam Airport Schiphol, new data from the Netherlands Aerospace Centre (NLR) was used for 2022. In addition to flying (emissions during flight, braking and taxiing), this also includes emissions from platform traffic and the use of generators. The emission distribution for fisheries and agriculture (stables and storage, use of artificial and animal

manure) was recalculated on the basis of new data in combination with the most recent versions of the models used for this purpose.

#### **14.4 Maps with geographically distributed emission data**

The maps below are examples of the disaggregated emission data based on the latest reporting data (2022) from the [Netherlands Pollutants Release and Transfer Register](#). They all result from allocating emissions to the grid using the methods described above. The selected air pollutants are ammonia (NH<sub>3</sub>), sulphur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>) and fine particulates (PM<sub>2.5</sub>). Figures 14.1–14.4 represent the geographically distributed emissions for these air pollutants.

On a national scale, the agricultural sector is the main contributor to NH<sub>3</sub> emissions (Figure 14.1). Emissions of NH<sub>3</sub> are mainly caused by livestock farming and particularly by the handling of manure. Therefore, they are related to the storage and spreading of manure, as well as to animal housing. The burning of fossil fuels also emits NH<sub>3</sub>. Therefore, some inland shipping routes and fishing grounds are visible in the map. There are no other large surface water sources that contribute to the national ammonia emission. Compared to other sectors, however, the emission quantities from inland shipping and fisheries are small.

Both SO<sub>x</sub> and NO<sub>x</sub> are predominantly emitted by transport; therefore, cities, main roads, airports and shipping routes are clearly visible in the maps (Figures 14.2-14.3). On the SO<sub>x</sub> map, inland shipping routes stand out from the rest because more reduction measures were taken in other sectors than in inland shipping.

On the map of fine particulate matter (Figure 14.4), cities, airports, agriculture, main roads and shipping routes can all be recognised due to the fact that residential heating, agricultural animal housing, traffic and shipping are main sources of PM emissions.

Figure 14.1 Geographical distribution of NH<sub>3</sub> emissions in the Netherlands in 2022

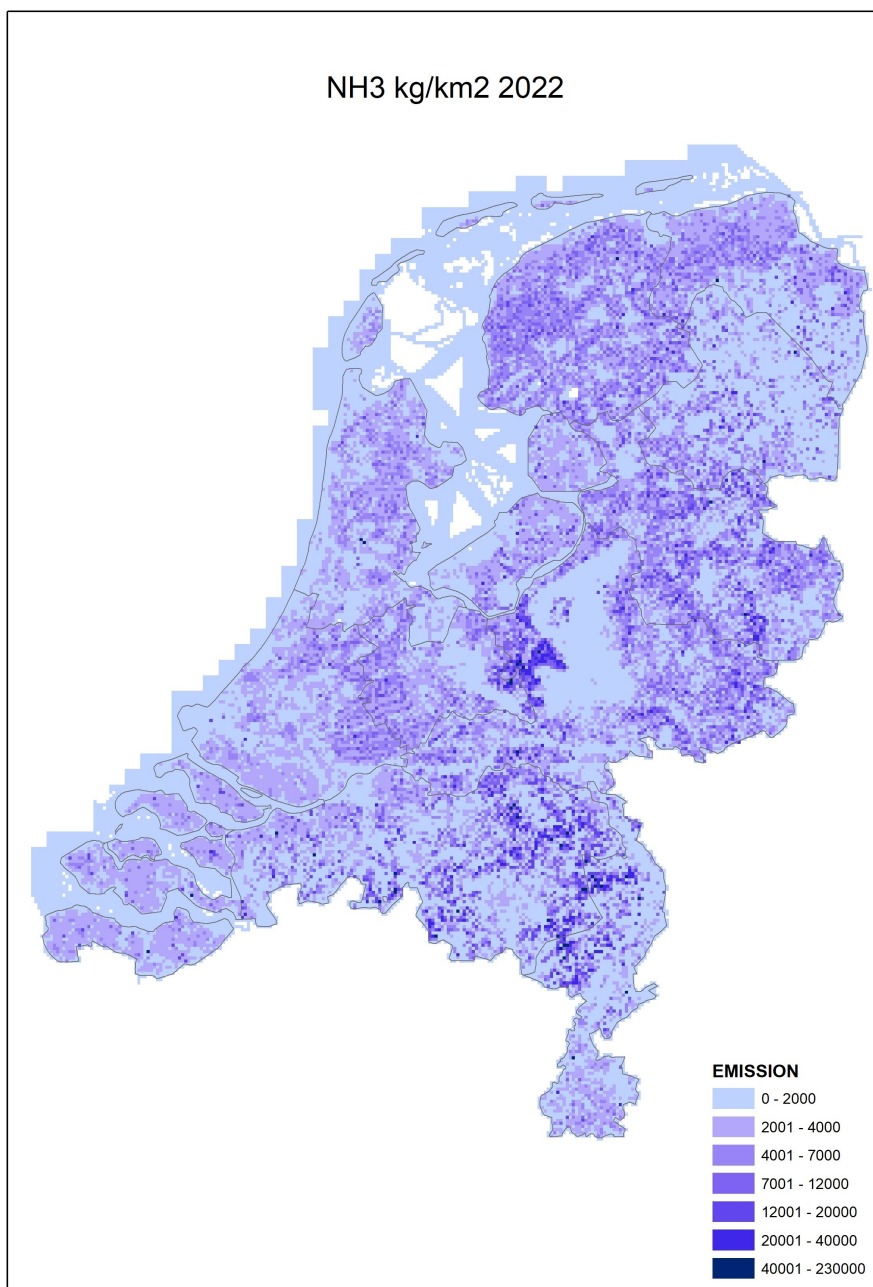


Figure 14.2 Geographical distribution of SO<sub>x</sub> emissions in the Netherlands in 2022

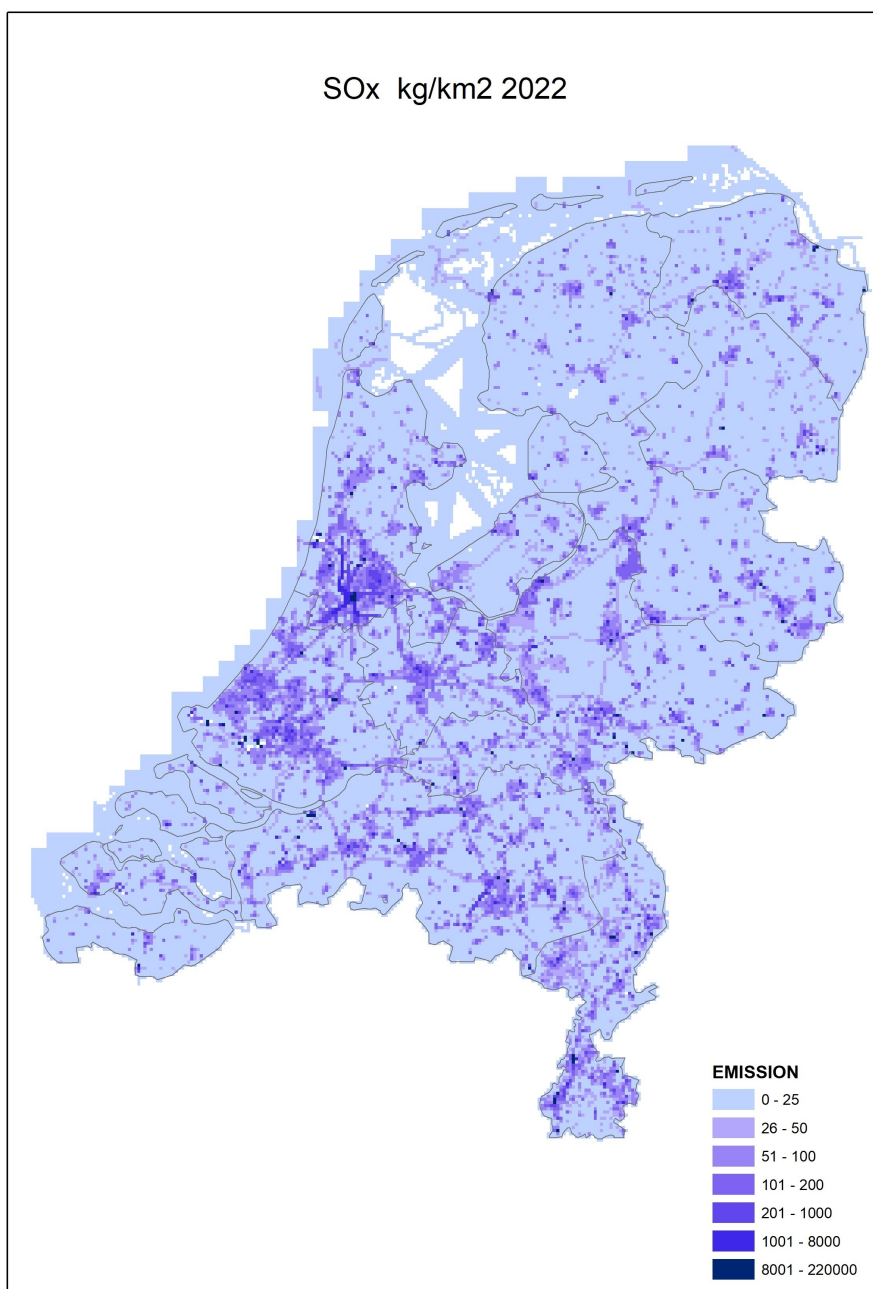


Figure 14.3 Geographical distribution of NO<sub>x</sub> emissions in the Netherlands in 2022

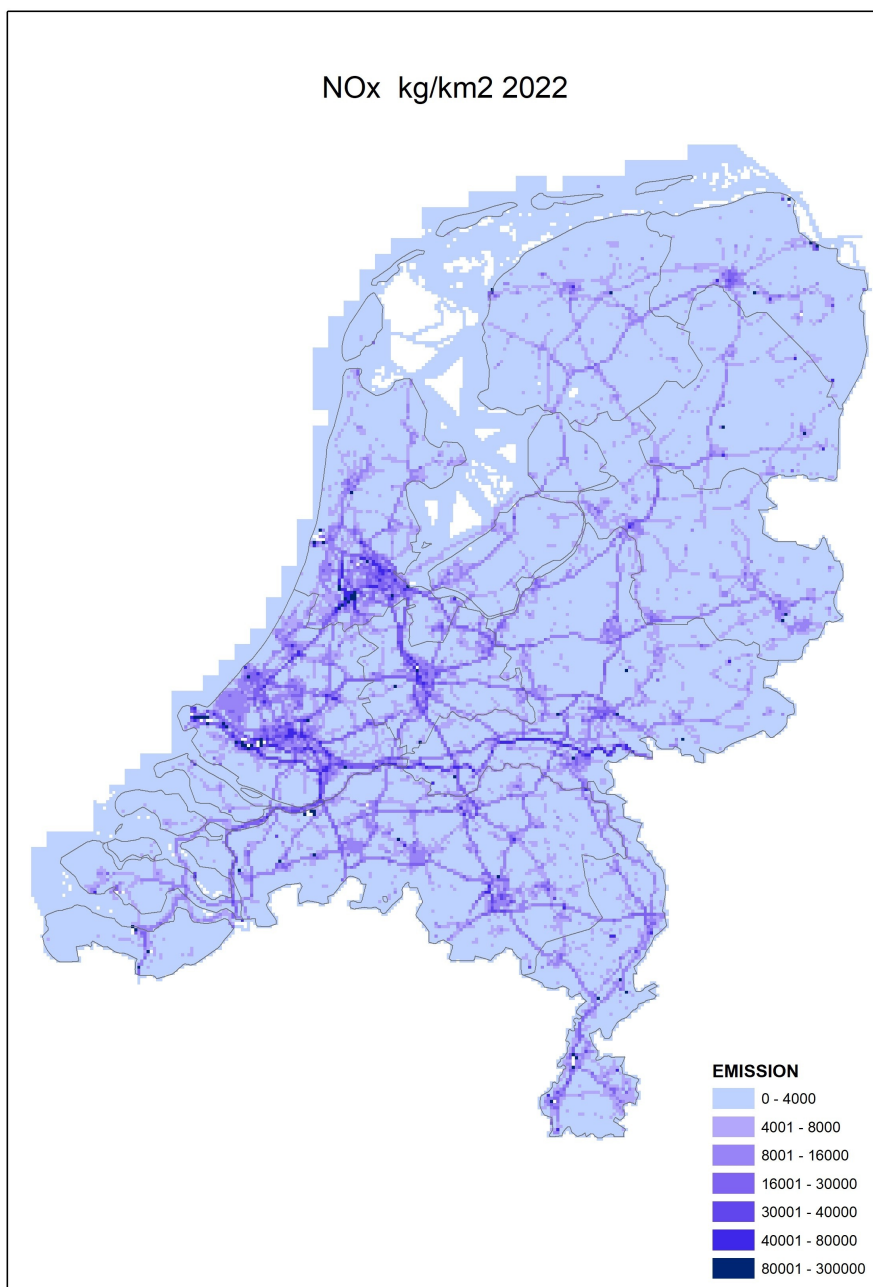
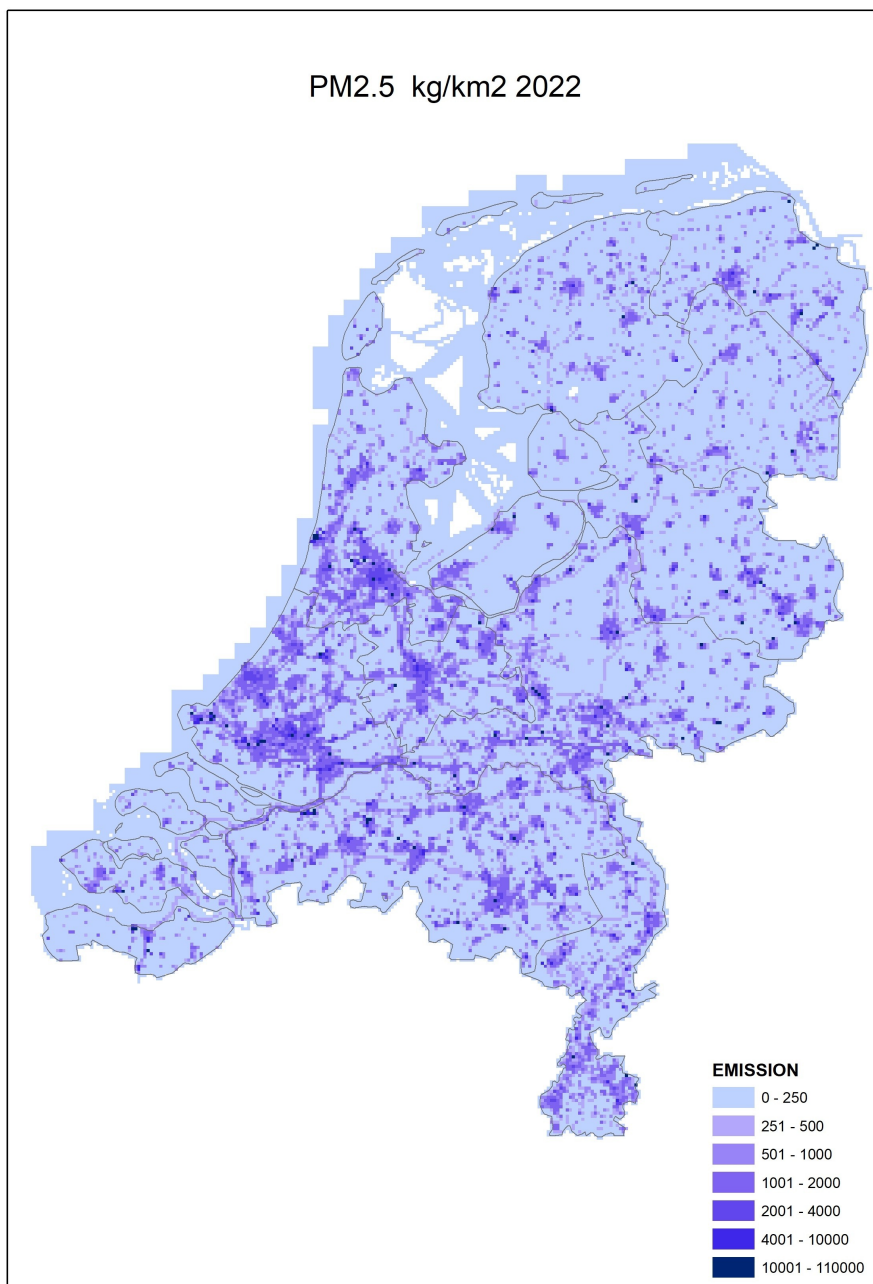


Figure 14.4 Geographical distribution of PM<sub>2.5</sub> emissions in the Netherlands in 2022





## Acknowledgements

Many colleagues from a number of organisations – Statistics Netherlands (CBS), Wageningen University and Research (WUR), the Netherlands Enterprise Agency (RVO.nl), the Netherlands Environmental Assessment Agency (PBL), the National Institute for Public Health and the Environment (RIVM) and the Netherlands Organisation for applied scientific research (TNO) – have been involved in the annual update of the Netherlands Pollutant Release & Transfer Register (NL-PRTR), also called the Emission Registration (ER) system, which contains emissions data on about 375 pollutants. The emissions calculations, including those for greenhouse gas emissions, are performed by members of the ER Task Forces. This is a major task, since the Netherlands' inventory contains details of many emission sources.

The emission and activity data of the Netherlands' inventory were converted into the NFR source categories contained in the Nomenclature for Reporting (NFR) tables, which form a supplement to this report. Also, the methodology reports are an integral part of the IIR report.

In addition to the authors, several people contributed to this report. Kees Baas (CBS), Bas Guis (CBS), Olaf van Hunnik (RWS), Olaf Janmaat (RWS), Joris Meesters (RIVM), Johanna Montfoort (RIVM) and Antoon Visschedijk (TNO) provided information regarding emission sources and/or suggested text.

Guido Hollman, Jolien van Huijstee, Martin Kosterman, Loes van der Net, Eveline Rijkssen and Jacqueline Wanders (all at RIVM) contributed to data processing, chart production and data quality control.

We greatly appreciate the contributions by each of these groups and individuals to this Informative Inventory Report and supplemental NFR tables, as well as those of the external reviewers who provided comments on the report.



## References

- A., R van der, J. Ding and H. Eskes (2024). Monitoring European anthropogenic NO<sub>x</sub> emissions from space. *Atmospheric Chemistry and Physics*, 24(13), pp.7523-7534.
- Aasestad K. (eds.) (2007). Norwegian Emission Inventory 2007. Documentation of methodologies for estimating emissions of greenhouse gases and long range transboundary air pollutants. *Report 2007/38, Statistics Norway*.
- Amstel, A.R. van, R.J. Swart, M.S. Krol, J.P. Beck, A.F. Bouwman & K.W. van der Hoek (1993). Methane the other greenhouse gas; research and policy in the Netherlands. *RIVM report 481507 001. RIVM, Bilthoven*.
- Baren, S.A. van, E.J.M.M. Arets, Y. Berger Barnett, G. Erkens, N. Kelly, H. Kramer, J.P. Lesschen (2026). Greenhouse Gas Reporting of the LULUCF sector in the Netherlands; Methodological background, update 2026. Statutory Research Tasks Unit for Nature & the Environment (WOT Natuur & Milieu), Wageningen. WOT-technical report 298.
- Bikker, P., L.B. Šebek, C. van Bruggen & O. Oenema (2019). Stikstof- en fosfaatexcretie van gangbaar en biologisch gehouden landbouwhuisdieren. Herziening excretieforfaits Meststoffenwet 2019. WOT-technical report 152. Wettelijke Onderzoekstaken Natuur & Milieu, Wageningen UR, Wageningen (in Dutch).
- Bolt, E. (2003). Schatting energieverbruik van binnenvaartschepen (Energy consumption of inland vessels) Version 3, 22 October (in Dutch). Available: <http://bivas.chartasoftware.com/Documents/328>
- Booij, H. (1995). Gezelschapsdieren, RIVM report 772414003, RIZA nota 93.46/C6. DGM (in Dutch).
- Bremmer, H.J., L.M. Troost, G. Kuipers, J. de Koning & A.A. Sein (1993). Emissies van dioxinen in Nederland. RIVM/TNO report 770501003. RIVM/TNO, Bilthoven/Apeldoorn (in Dutch).
- Broeke, H.M. ten, J.H.J. Hulskotte & H. Denier van der Gon (2008). Emissies door bandenslijtage afkomstig van het wegverkeer. TNO, Utrecht (in Dutch).
- Bruggen, C. van and Geertjes, K. (2019). Stikstofverlies uit opgeslagen mest - Stikstofverlies berekend uit het verschil in verhouding tussen stikstof en fosfaat bij excretie en bij mestafvoer. CBS, the Hague, the Netherlands.
- Cavalli, F., Putaud, J.-P. (2008). Toward a Standardized Thermal-optical Protocol for Measuring Atmospheric Organic and Elemental Carbon: The EUSAAR Protocol. JRC. <https://doi.org/10.2788/87062>
- CBS (2012). Standardised calculation methods for animal manure and nutrients. Standard data 1990-2008. Statistics Netherlands, The Hague/Heerlen, the Netherlands.
- CBS (2019). Dierlijke mest en mineralen 1990–2018. Statistics Netherlands, The Hague/Heerlen, the Netherlands.
- CBS (2020). Dierlijke mest en mineralen 2019. Statistics Netherlands, The Hague/Heerlen, the Netherlands.

- CBS (2021). Dierlijke mest en mineralen 2020. Statistics Netherlands, The Hague/Heerlen, the Netherlands.
- CBS (2022). Dierlijke mest en mineralen 2021 (in Dutch). Statistics Netherlands, The Hague/Heerlen, the Netherlands.
- CBS (2023). Dierlijke mest en mineralen 2022 (in Dutch). Statistics Netherlands, The Hague/Heerlen, the Netherlands.
- CBS (2024). Dierlijke mest en mineralen 2023. Statistics Netherlands, The Hague/Heerlen, the Netherlands.
- CBS (2025). Dierlijke mest en mineralen 2024. Statistics Netherlands, The Hague/Heerlen, the Netherlands.
- Coops, O., L. Luning, H. Oonk & J. Boom (1995). Emissies van stortplaatsen (Emissions from landfill sites). VROM Hoofdinspectie Milieuhygiëne, Publicatie Emissieregistratie 28. VROM, The Hague (in Dutch).
- Cuhls, C., Mähl, B., Clemens, J. (2015). Ermittlung der Emissionssituation bei der Verwertung von Bioabfällen (Determining the emission situation during treatment of biowaste). Umweltbundesamt, ISSN 1862-4804, Dessau-Roßlau, 2015. In German.
- Dellaert, S.N.C. & R. Dröge (2017). Uncertainty of the NO<sub>x</sub>, SO<sub>x</sub>, NH<sub>3</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, EC<sub>2.5</sub> and NMVOC emissions from transport. TNO, Utrecht.
- Dellaert, S.N.C. & J.H.J. Hulskotte (2017). Emissions of air pollutants from civil aviation in the Netherlands. TNO 2017 R10055, TNO, Utrecht.
- Dellaert, S.N.C.; Ligterink, N.E.; Hulskotte, J.H.J.; Van Eijk, E. (2023) EMMA - MEPHISTO model: Calculating emissions for Dutch NRMM fleet. TNO 2023 R12643, Utrecht. Available: <https://publications.tno.nl/publication/34641969/9yvJcp/TNO-2023-R12643.pdf>
- Denier van der Gon, H., H.M. ten Broeke & J.H.J. Hulskotte (2008). Emissies door wegdekslijtage ten gevolge van het wegverkeer. TNO, Utrecht (in Dutch).
- Denier van der Gon, H. & J.H.J. Hulskotte (2010). Methodologies for estimating shipping emissions in the Netherlands. A documentation of currently used emission factors and related activity data. BOP Report 500099012. PBL Netherlands Environmental Assessment Agency, Bilthoven.
- Ding, J., R. van der A, H. Eskes, H., E. Dammers, M. Shephard, R. Wichink Kruit, M. Guevara and L. Tarrason (2024). Ammonia emission estimates using CrIS satellite observations over Europe. Atmospheric Chemistry and Physics, 24(18), pp.10583-10599.
- DHV (1999). Eindevaluatierapport meetprogramma GFT-verwerkingsinstallaties SMB, SOW/CAW en Arcadis. Final report by order of ministry VROM, registration number ML-TE981217. DHV, Amersfoort (in Dutch).
- EC (2012). Study on the potential for reducing mercury pollution from dental amalgam and batteries. Final Report, European Commission -DMG 11 July 2012 Annex L.

- EEA (2016). EMEP/EEA Air pollutant emission inventory guidebook 2016. EEA Technical report 21/2016. European Environment Agency (EEA), Copenhagen. Available: <https://www.eea.europa.eu/publications/emep-eea-guidebook-2016>
- EEA (2019). EMEP/EEA Air pollutant emission inventory guidebook 2019. EEA Technical report 21/2016. European Environment Agency (EEA), Copenhagen. Available: <https://www.eea.europa.eu/publications/emep-eea-guidebook-2019>
- EEA (2023). EMEP/EEA Air pollutant emission inventory guidebook 2023. EEA report 06/2023. European Environment Agency (EEA), Copenhagen. Available: EMEP/EEA air pollutant emission inventory guidebook 2023. Available: <https://www.eea.europa.eu/publications/emep-eea-guidebook-2023>
- Ehrlich, C., Noll, G., Kalkoff, W.-D., Baumbach, G., Dreiseidler, A. (2007). PM<sub>10</sub>, PM<sub>2.5</sub> and PM<sub>1.0</sub> – emissions from industrial plants – Results from measurement programmes in Germany. Atmospheric Environment 41, 6236-6254.
- EU (2016), Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC. Available: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L2284&from=EN>
- Eurocontrol (2022). European Aviation Fuel Burn and Emissions Inventory System for the European Environment Agency (for data from 2005 to 2021). EUROCONTROL.
- Geertjes, K. & K. Baas (2022). Berekening NMVOS luchtmissies uit industriële biologische afvalwaterzuivering. Internal note (in Dutch) CBS, Den Haag.
- Guis, B., (2006). Meta informatie Emissieregistratie: Vuurhaarden bijschatting luchtmissies (In Dutch). CBS.
- Van der Heijden, M. and Klerks, M. (2025, February 28). Record aantal autobranden: brandweer moet elk anderhalf uur ergens blussen. Algemeen Dagblad (in Dutch). [https://www.ad.nl/binnenland/recordaantal-autobranden-brandweer-moet-elke-anderhalf-uur-ergens-blussen~a68f4d71/?slug\\_rd=1](https://www.ad.nl/binnenland/recordaantal-autobranden-brandweer-moet-elke-anderhalf-uur-ergens-blussen~a68f4d71/?slug_rd=1)
- Helms, H., U. Lambrecht, & W. Knörr (2010). Aktualisierung des Modells TREMOD – Mobile Machinery (TREMOM-MM). UBA TEXTE 28/2010. Dessau-Rosslau, Germany (in German).
- Honig, E., J.A. Montfoort, R. Dröge, S.E.H. van Mil, B. Guis, K. Baas, B. van Huet and O.R. van Hunnik (2026). Methodology for the calculation of emissions to air from the sectors Energy, Industry and Waste. RIVM report 2026-0019, RIVM, Bilthoven.
- Hulskotte, J., Ligterink, N.E, Gé, X., Bolech, M. Dröge, R. (2024). Vernieuwd emissiemodel voor het berekenen van motoremissies uit de recreatievaart. TNO report 2024 R11268.
- Hulskotte, J.H.J, Ter Brake, M.C. (2017). Revised calculation of emissions of fisheries on the Netherlands territory, TNO report TNO 2017 R10784, Utrecht.

- Hulskotte, J.H.J., Bolt, E. (2013). EMS-protocol emissies door binnenvaart: verbrandingsmotoren. TNO report. TNO, Utrecht (in Dutch).
- Hulskotte, J.H.J., Verbeek, R.P. (2009). Emissiemodel Mobiele Machines gebaseerd op machineverkoop in combinatie met brandstof Afzet (EMMA). TNO-report TNO-034-UT-2009-01782\_RPT-ML. TNO, Utrecht (in Dutch).
- Hulskotte, J.H.J., Bolt, E., Broekhuizen, D. (2003a). EMS-protocol emissies door binnenvaart: verbrandingsmotoren. RWS-AVV, Rotterdam (in Dutch).
- Hulskotte, J.H.J., Bolt, E., Broekhuizen, D. (2003b). EMS-protocol Verbrandingsemissies door stilliggende zeeschepen in havens, RWS-AVV, Rotterdam (in Dutch).
- Hulskotte, J., Bolt, E., Broekhuizen, D. (2003c). EMS-protocol emissies door verbrandingsmotoren van zeeschepen op het Nederlands Continentaal Plat, Adviesdienst Verkeer en Vervoer. Rotterdam (in Dutch).
- ICAO (2020). Doc 9889: Airport air quality manual (2nd ed.) (p. 200). International Civil Aviation Organization (ICAO).
- IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.
- Jager, D. de & K. Blok (1993). Onderzoek naar het gehalte aan organische stof in de verschillende afvalcomponenten (Research into volatile solids content in the various waste components). Utrecht (in Dutch).
- Jansen, B.I. (2010). Emissiemodel houtkachels, TNO, Utrecht (in Dutch).
- Jansen, B. (2016). Vernieuwd emissiemodel houtkachels. TNO 2016 R10318. <https://resolver.tno.nl/uuid:14ddee1e-d4cc-461d-a122-bec0863c9e2a>
- Kadijk, G., N. Ligterink, P. van Mensch, J. Spreen, R. Vermeulen & W. Vonk (2015). Emissions of nitrogen oxides and particulates of diesel vehicles. TNO report 2015 R10838. TNO, Delft.
- Kauffman, K.F., Hulskotte, J., Koch, R. (2025). Sea Shipping Emissions 2023: Netherlands Continental Shelf, 12-Mile Zone and Port Areas. MARIN
- Klein Goldewijk, K, J.G.J. Olivier, J.A.H.W. Peters, P.W.H.G. Coenen & H.H.J. Vreuls (2004). Greenhouse gas emissions in the Netherlands 1990–2002. National Inventory Report 2004. RIVM report 773201008/2004. RIVM, Bilthoven.
- KNMI/TEMIS  
[https://www.temis.nl/airpollution/no2col/tropomi\\_no2\\_data\\_versions.php#v260](https://www.temis.nl/airpollution/no2col/tropomi_no2_data_versions.php#v260) (accessed on 16.02.2026)
- Koppejan, J. & de Bree, F., (2018). Kennisdocument Houtstook in Nederland (in Dutch). Procede Biomass BV. Enschede, September 2018.
- Kraan, T.C., N.E. Ligterink & A. Hensema (2014). Uncertainties in emissions of road traffic: Euro-4 diesel NO<sub>x</sub> emissions as case study. TNO report TNO R11316. TNO, Delft.

- Kruijne, R., A. Denneman, F. Naus, J. Lahr (2025). Bestrijdingsmiddelengebruik bij landbouwkundige toepassingen. [https://legacy.emissieregistratie.nl/erpubliek/documenten/06%20Water/01%20Factsheets/74%20-%20Factsheet%20Bestrijdingsmiddelengebruik%20bij%20landbouwkundige%20toepassingen\\_september\\_2025\\_definitief.pdf](https://legacy.emissieregistratie.nl/erpubliek/documenten/06%20Water/01%20Factsheets/74%20-%20Factsheet%20Bestrijdingsmiddelengebruik%20bij%20landbouwkundige%20toepassingen_september_2025_definitief.pdf)
- Lambrecht, U., H. Helms, K. Kullmer & W. Knörr (2004). Entwicklung eines Modells zur Berechnung der Luftschadstoffemissionen und des Kraftstoffverbrauchs von Verbrennungsmotoren in mobilen Geräten und Maschinen. IFEU, Heidelberg, Germany (in German).
- Lampert, C., Tesar, M., Thaler, P. (2011). Klimarelevanz und Energieeffizienz der Verwertung biogener Abfälle. Umweltbundesamt report 0353, Umweltbundesamt, ISBN 978-3-99004-156-7, Vienna (in German).
- Ligterink, N.E. & R. de Lange (2009). Refined vehicle and driving behaviour dependencies in the VERSIT+ emission model. TNO Science & Industry, Delft.
- Ligterink, N.E., P. van Mensch and M. Elsgeest (2023). Emissiemetingen Stadler passagierstrein met diesel en HVO. TNO-2023-R12287, TNO Science & Industry, Delft.
- Ligterink, N.E., T. Smit and J.S. Spreen (2017). Insight into the energy consumption, CO<sub>2</sub> emissions and NO<sub>x</sub> emissions of rail freight transport. TNO-2017-R11679, TNO Science & Industry, Delft.
- Ligterink, N.E., S.N.C. Dellaert and P. van Mensch (2021). AUB (AdBlue verbruik, Uren, en Brandstofverbruik): een robuuste schatting van NO<sub>x</sub> en NH<sub>3</sub> uitstoot van mobiele werktuigen. TNO-2021-R12305 and TNO-2021-R12305-tab, TNO Science & Industry, Delft.
- Ligterink, N. E.Eijk, E. van. (2024). Rail emissions—Update of national Dutch emission factors. TNO.
- LVC (2024). Numbers deceased and cremated persons. Available: <https://lvc-online.nl/cremeren-in-nl/aantallen/>
- Magalini, F., Wang, F., Huisman, J., Ruediger, K., Baldé, K., van Straalen, V., Hestin, M., Lecerf, L., Sayman, U., Akpulat, O., (2014). Study on collection rates of waste electrical and electronic equipment (WEEE): possible measures to be initiated by the commission as required by article 7(4), 7(5), 7(6) and 7(7) of Directive 2012/19/EU on waste electrical and electronic equipment (WEEE).
- MARIN (2011). MARIN's emission inventory for North Sea shipping 2009: validation against ENTEC's inventory and extension with port emissions. MARIN, Wageningen.
- Melse, R.W. & C.M. Groenestein (2016). Emissiefactoren mestbewerking. Inschatting van emissiefactoren voor ammoniak en lachgas uit mestbewerking. Livestock Research Rapport 962. Wageningen UR Livestock Research, Wageningen, (in Dutch).
- Mensch, P. van, S.A. van Merrienboer, D. Tol, A. Rondaij, J. Harmsen and R.W. Fransen (2022). Inventarisatie en categorisatie huidige en toekomstige aanbod duurzame mobiele werktuigen, bouwlogistieke voertuigen, spoorwerktuigen en vaartuigen die worden ingezet voor de waterbouw. TNO-2017-R11048, TNO Science & Industry, Delft.
- Mijling, B. and R.J. van der A (2012). Using daily satellite observations to estimate emissions of short-lived air pollutants on a mesoscopic scale. Journal of Geophysical Research: Atmospheres, 117(D17).

- Mosquera, J., Y. Goselink, P.H.R. van Valkengoed, J.M.G Hol (2025). Stalemissie van ammoniak, methaan, lachgas, geur en PM<sub>10</sub>: Resultaten van praktijkmetingen in stallen voor jongvee, blankvleeskalveren, roséveeskalveren, geiten, biggen, vleesvarkens en dragende zeugen. Wageningen Livestock research Rapport 1512 (in Dutch).
- Most M. van der, A. Bannink, A. Bleeker, D.W. Bussink, H.J.C van Dooren, J.F.M. Huijsmans, J. Kros, K. Oltmer, M.B.H. Ros, L. Schulte-Uebbing, G.L. Velthof, S. Weijers, and T.C. van der Zee (2026). Emissies naar lucht uit de landbouw, 1990-2024: Emissies naar lucht uit de landbouw berekend met NEMA voor 1990-2024 (in Dutch). Wettelijke Onderzoekstaken Natuur & Milieu, WUR, Wageningen, the Netherlands, in prep.
- Net, L. van der, P.W.H.G. Coenen, S.E.H. van Mil, J.D. Rienstra, P.J. Zijlema, K. Baas, S.A. van Baren, Y. Berger Barnett, R. Dröge, K. Geertjes, E. Honig, B. van Huet, R.A.B. te Molder, J.A. Montfoort, T.C. van der Zee, H.C.H. Witt and M.C. van Zanten (2026). Greenhouse gas emissions in the Netherlands 1990-2024 - National Inventory Document 2026. RIVM report 2026-0022, RIVM, Bilthoven.
- NOGEPa (2012). Covenant Environmental Reporting Oil and Gas Industry (In Dutch). <https://www.nogepa.nl/download-file/3>
- NOGEPa (2018). Industry guideline no 23 (In Dutch) <https://www.nogepa.nl/download-file/75>
- NS-CTO (1992). Project koperemissies spoorwegverkeer. NS-CTO, Utrecht (in Dutch).
- NVWA (2025). Afzetgegevens van gewasbeschermingsmiddelen in Nederland in 2023 per werkzame stof in kg (In Dutch). Available: [Afzetgegevens+van+gewasbeschermingsmiddelen+in+Nederland+2023.pdf](https://www.nvwa.nl/afzetgegevens+van+gewasbeschermingsmiddelen+in+Nederland+2023.pdf)
- Oenema, O., G.L. Velthof, N. Verdoes, P.W.G. Groot Koerkamp, G.J. Monteny, A. Bannink, H.G. van der Meer & K.W. van der Hoek (2000). Forfaitaire waarden voor gasvormige stikstofverliezen uit stallen en mestopslagen (in Dutch). Alterra-rapport 107 (revised edition). Alterra Wageningen UR, Wageningen.
- Oonk, H. (2016). Correction factor F for adsorption of CO<sub>2</sub> in leachate. Oonkay, Apeldoorn.
- Oonk, H., A. Weenk, O. Coops & L. Luning (1994). Validation of landfill gas formation models. TNO report 94-315. TNO, Apeldoorn.
- OsPar (2011). Oslo and Paris conventions. Overview assessment of implementation reports on OSPAR Recommendation 2003/4 on controlling the dispersal of mercury from crematoria. <https://www.ospar.org/documents?v=7262 , consulted January 2023>
- PBL, TNO, CBS and RIVM (2024). Klimaat- en Energieverkenning 2024. Den Haag: Planbureau voor de Leefomgeving. <https://www.pbl.nl/publicaties/klimaat-en-energieverkenning-2024>, <https://www.pbl.nl/en/publications/climate-and-energy-outlook-of-the-netherlands-2024>
- PBL, TNO, RIVM (2024). Beleidsoverzicht en factsheets beleidsinstrumenten - achtergronddocument bij de Klimaat- en Energieverkenning 2024. PBL, Den Haag.

- PBL (2025a). Emissieramingen luchtverontreinigende stoffen 2025. PBL, Den Haag, in cooperation with RIVM, TNO and WUR.  
[Emissieramingen luchtverontreinigende stoffen 2025. Rapportage bij de Klimaat- en Energieverkenning 2024](#)
- PBL (2025b). Rekenmodellen Klimaat- en Energieverkenning (february 2025). <https://www.pbl.nl/kev/rekenmodellen-klimaat-en-energieverkenning-kev>
- Ruysenaars, P.G., A. Couvreur, J. Hoekstra, J. Jacobs, M. Lammerts-Huitema, W.J.R. Swart and W. de Vries (2024). Monitoring report Target scope for the Clean Air Agreement, second progress assessment. RIVM Report 2023-0383. RIVM, Bilthoven. (in Dutch).
- RWS (2008). Remslijtage. Waterdienst, Centre for Water Management, Lelystad (in Dutch).
- Soest-Vercammen, E.L.J., Hulskotte, J.H.J., Heslinga, D.C. (2002). Monitoringsprotocol Bijschatting: Stationaire NO<sub>x</sub> bronnen kleiner dan 20 MWth. TNO report R2002/042.
- Spakman, J., M.M.J Van Loon, R.J.K Van der Auweraert, D.J. Gielen, J.G.J. Olivier & E.A. Zonneveld (1997). Methode voor de berekening van broeikasgasemissies (Method of calculating greenhouse gas emissions). VROM Emissions Registration 37. VROM, The Hague (in Dutch).
- Spreen, J.S., G. Kadijk, R.J. Vermeulen, V.A.M. Heijne, N.E. Ligterink, U. Stelwagen, R.T.M. Smokers, P.J. van der Mark & G. Geilenkirchen (2016). Assessment of road vehicle emissions: methodology of the Dutch in-service testing programmes. TNO, Delft.
- Staats, N., Bolech, M., Dellaert, S.N.C., Dröge, R., Van Eijk, E., Honig, E., Van Huet, B., Van Huijstee, J., Van Mil, S.E.H., Te Molder, R.A.B., Plomp, A.J., Wever, D., Witt, H., Van Zanten, M.C., Van der Zee T. (2025). Informative Inventory Report 2025. Emissions of transboundary air pollutants in the Netherlands 1990–2023. RIVM report 2025-0007, RIVM, Bilthoven.
- Stelwagen, U. & N.E. Ligterink (2015). HD Euro-V Truck PM<sub>10</sub> and EC emission factors. TNO, Delft.
- Sutton, M.A., U. Dragosits, Y.S. Tang & D. Fowler (2000). Ammonia emissions from non-agricultural sources in the UK. Atmospheric Environment 34 (2000), 855–869.
- UNECE (2012). Decision 2012/3: Adjustments under the Gothenburg Protocol to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them. Available: [United Nations \(unece.org\)](https://unece.org)
- UNECE (2015). Technical Guidance for Emissions Inventory Adjustments under the Amended Gothenburg Protocol, Available: [United Nations \(unece.org\)](https://unece.org)
- UNECE (2023). Guidelines for reporting emissions and projections data under the Convention, Available: [United Nations \(unece.org\)](https://unece.org)
- Visschedijk, A.J.H., Pacyna, J., Pulles, T., Zandveld, P., Denier van der Gon, H. (2004). Coordinated European Particulate Matter Emission Inventory Program (CEPMEIP), In: P. Dilara et al. (eds), Proceedings of the PM emission inventories scientific workshop, Lago Maggiore, Italy, 18 October 2004, EUR 21302 EN, JRC 2004, pp 163-174.
- Visschedijk, A.J.H., W. Appelman, J.H.J. Hulskotte & P. Coenen (2007). Onderhoud van methodieken Emissieregistratie 2006-2007. TNO report A-R0865/B. TNO, Apeldoorn (in Dutch).

- Visschedijk, A.J.H. & R. Dröge (2019). Ratio between PM<sub>2.5</sub> and PM<sub>10</sub> for emissions from the energy and industry sector. TNO report 2019 R10320. TNO, Utrecht.
- Visschedijk, A.J.H. & Dröge, R., (2020). Aanpassing van het TNO houtkachelmodel aan de WoON 2018 houtverbranding enquêteresultaten en prognoses van emissies van huishoudelijke houtkachels tot 2030 (in Dutch). TNO report 2020 R10652. <https://resolver.tno.nl/uuid:91ff3654-a9dd-4c0e-8a28-05b0024e8729>
- Visschedijk, A.J.H., R. Dröge, J.H.J. Hulskotte (2026). Emissiefactoren van NO<sub>x</sub>, KWS, CO, PM<sub>10</sub> en SO<sub>x</sub> door aardgasverbranding kleine bronnen. TNO report in preparation.
- Visschedijk, A., J.A.J. Meesters, M.M. Nijkamp, W.W.R Koch, B.I. Jansen, and R. Dröge (2026). Methodology for the calculation of emissions from product usage by consumers, construction and services. RIVM report 2026-0021.
- VROM (2002). Landelijk afvalbeheersplan 2002-2012, IenW, the Hague, the Netherlands. (in Dutch).
- Witt, H., van der A, R. J., Ding, J., Kuenen, J., and van Zanten, M. C.: A detailed comparison of the Dutch emission inventory with satellite-derived NO<sub>x</sub> emissions, EGUsphere [preprint], <https://doi.org/10.5194/egusphere-2025-6036>, 2025.
- Witt, H., Geilenkirchen, G., Bolech, M., Dellaert, S., Eijk, E. van, Geertjes, K. (2026a). Methodology for the calculation of emissions from the transport sector, RIVM report 2026-0023, Bilthoven.
- Witt, H., Geilenkirchen, G., Bolech, M., Dellaert, S., Eijk, E. van, Geertjes, K. (2026b). Methodology for the calculation of emissions from the transport sector: tables. Supplement to RIVM report 2026-0023.
- Van der Zee, T.C., A. Bleeker, W. Bussink, H.J.C. van Dooren, J.F.M. Huijsmans, H. Kros, J. Mosquera, M. van der Most, K. Oltmer, M. Ros, L. Schulte-Uebbing, G.L. Velthof and S. Weijers (2026). Methodology for estimating emissions from agriculture in the Netherlands - calculations for methane, ammonia, nitrous oxides, non-methane volatile organic compounds, fine particles and carbon dioxide emissions using the National Emission Model for Agriculture (NEMA). RIVM report 2026-0020, Bilthoven.

## Appendix 1 The use of notation keys 'IE' and 'NE'

Table A1.1 The Included Elsewhere (IE) notation key explained

<b>NFR code</b>	<b>Substance(s)</b>	<b>Included in NFR code</b>	<b>Explanation</b>
1A1c	All, except NO <sub>x</sub> , SO <sub>x</sub> , CO, Hg and PCBs	1A2a (all pollutant) and 1B2b (NMVOC)	The emissions from coke production are reported by the combined coke production and iron/steel production plant in the Netherlands. It is not possible to split the emissions into coke production and iron/steel production, and therefore the emissions of this source are reported in 1A2a. The emissions from the oil and gas industry are allocated to 1A1c (combustion emissions reported by gas companies using natural gas) and 1B2b (NMVOC fugitive emissions)
1A2a	NH <sub>3</sub> , dioxin, PAH	2C1	Emissions are reported by the one iron and steel plant in the Netherlands. Distinction between combustion and process emissions is not always possible. When this is not possible, emissions of NH <sub>3</sub> are reported in 2C1.
1A2b	PAH	2C3, 2C5, 2C6, 2C7a	Emissions are reported by several non-ferrous plants in the Netherlands. Distinction between combustion and process emissions is not always possible.
1A2f	All	1A2gviii	Whether splitting these emission sources is possible is under evaluation by the specific task force.
1A3ei	All	1A2gviii, 1A4cii, 1B2b	Combustion and process emissions from pipeline transport cannot be split due to lack of detailed activity data.
1A5a	All	1A4ai	The emissions from military stationary combustion are included in 1A4ai.
1B1a	TSP, PM <sub>10</sub> , PM <sub>2.5</sub>	2H3	Only emissions from coal storage and handling occur. These cannot be separated from emissions of other storage and handling of dry bulk products, so are included in 2H3.
1B1b	All	1A2a	Emissions from coke production are reported by the combined coke production and iron/steel production plant in the Netherlands. It is not possible to split the emissions between coke production and iron/steel production, and therefore all emissions are reported in 1A2a.
1B2aiv	NO <sub>x</sub> , SO <sub>x</sub> , CO, BC and PAH	1A1b	Emissions are reported by the refineries in the Netherlands. Distinction between combustion and fugitive emissions is not always possible.

<b>NFR code</b>	<b>Substance(s)</b>	<b>Included in NFR code</b>	<b>Explanation</b>
1B2c	NO <sub>x</sub> , NMVOC, SO <sub>x</sub> , TSP, PM <sub>10</sub> , PM <sub>2.5</sub> , BC, CO	NMVOC included in 1B2b; NO <sub>x</sub> , SO <sub>x</sub> , TSP, PM <sub>10</sub> , PM <sub>2.5</sub> , BC and CO included in 1A1c	Combustion and process emissions cannot be split due to lack of detailed activity data.
2A2	All	2A6	Because of allocation problems, emissions from 2A2 are reported in the category Other mineral products (2A6).
TSP, PM <sub>10</sub> , PM <sub>2.5</sub>	All	2A6	Because of allocation problems, emissions from 2A5a are reported in the categories 1A2gvii, 2A1, and 2H3.
2B1	All	2B10a	Because of allocation problems and for confidentiality reasons, emissions from 2B1 are included in Chemical industry: Other (2B10a).
2B2	All	2B10a	Because of allocation problems and for confidentiality reasons, emissions from 2B2 are included in Chemical industry: Other (2B10a).
2B5	All	2B10a	Because of allocation problems and for confidentiality reasons, emissions from Silicon carbide (2B5) are included in Chemical industry: Other (2B10a).
2B6	All	2B10a	Because of allocation problems and for confidentiality reasons, emissions from 2B6 are included in Chemical industry: Other (2B10a).
2B7	All	2B10a	Because of allocation problems and for confidentiality reasons, emissions from 2B7 are included in Chemical industry: Other (2B10a).
2B10a	NO <sub>x</sub> , and SO <sub>x</sub>	1A2c	Because it is not possible to split the SO <sub>x</sub> and NO <sub>x</sub> from chemical industry, all SO <sub>x</sub> and NO <sub>x</sub> emissions are reported in 1A2c.
2B10b	All	2D3i	Emissions from storage, handling and transport of chemical products are reported in 2D3i (other)
2C4	All	2H3	For confidentiality reasons, emissions from 2C4 are included in 2H3.
2C7a	NO <sub>x</sub> , SO <sub>x</sub> , CO, Hg, As and dioxins	1A2b	Combustion emissions are reported in 1A2b.
2C7d	All	2H3	Because only emissions from the storage and handling of bulk products companies are available, emissions from 2C7d are reported in 2H3. The 2H3 subcategory in the Dutch PRTR includes, among others, emissions from the storage and handling of bulk products. Only companies that have the storage and handling of bulk products as their main activity are included in the 2H3 subcategory.

<b>NFR code</b>	<b>Substance(s)</b>	<b>Included in NFR code</b>	<b>Explanation</b>
2D3g	NMVOC	2B10a	See IIR, Section 5.3.1.
2L	All	2H3	Because the 2016 Guidebook is not clear about which sources belong to 2L, 2L is included in 2H3 (Other industrial processes).
3B4a	NO <sub>x</sub> , NMVOC, NH <sub>3</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> and TSP	3B1a and 3B1b	Little information is available for the years 1990-2015 on animal numbers and to create the most consistent time series emissions are included with cattle.
5A	BC	1A1a and 1A5a	Emissions from heat and power production from landfill gas recovery are included in the sector Energy.
5C1a	All	1A1a	All waste incinerators in the Netherlands produce heat and/or electricity. Emissions from heat and power production are included in the sector Energy.
5C1bi	All	1A1a	All waste incinerators in the Netherlands produce heat and/or electricity. Emissions from heat and power production are included in the sector Energy.
5C1bii	All	1A1a	All waste incinerators in the Netherlands produce heat and/or electricity. Emissions from heat and power production are included in the sector Energy.
5C1biii	All	1A1a	All waste incinerators in the Netherlands produce heat and/or electricity. Emissions from heat and power Production are included in the sector Energy.
5C1biv	All	1A1a	All waste incinerators in the Netherlands produce heat and/or electricity. Emissions from heat and power production are included in the sector Energy.
5C1bv	NH <sub>3</sub> , BC	1A1ai	The natural gas used for cremation cannot be split from the natural gas used for heating the crematoria buildings. Therefore, all emissions from natural gas combustion in this sector are allocated to 1A4ai.
5D1	NO <sub>x</sub> , SO <sub>x</sub> , TSP, PM <sub>10</sub> , PM <sub>2.5</sub> , BC and CO	1A4ai	Emissions from heat and power production are included in the sector Energy.
5D2	NO <sub>x</sub> , SO <sub>x</sub> , TSP, PM <sub>10</sub> , PM <sub>2.5</sub> , BC and CO	1A4ai	Emissions from heat and power production are included in the sector Energy.

Table A1.2 The Not Estimated (NE) notation key explained

<b>NFR code</b>	<b>Substance(s)</b>	<b>Reason for non-estimation</b>
1A1b, 1A2a, 1A3bi-iv, 1A3bi(fu)-iv(fu) 1A3	HCB	assumed negligible; no method available
1A2d, 2C5	PCBs	assumed negligible
1A2c, 1A2gvii, 1A3c, 1A3di(ii), 1A3dii, 1A4aii, 1A4bii, 1A4cii, 1A5b, 1B2aiv	HCB and PCBs	assumed negligible
1A2d, 1A2e	dioxins	assumed negligible
1A3ai(i)	NH <sub>3</sub> and Hg	assumed negligible
1A3aii(i)	NH <sub>3</sub> , Cd, Hg, As, Cr, Cu, Ni, Se, Zn,	assumed negligible
1A3bv, 1A3bv(fu)	dioxins, PAHs and HCB	assumed negligible
1A3bvi, 1A3bvi(fu)	Hg, dioxins and HCB	assumed negligible
1A3bvii, 1A3bvii(fu)	Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, dioxins, PAHs and HCB	assumed negligible
1B1a	NMVOC, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn	assumed negligible. For BC and metals no method available
1B2ai, 1B2av and 1B2b	SO <sub>x</sub> , dioxins	assumed negligible. No method available in the Guidebook
1B2c	Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, dioxins	assumed negligible. For PAH and dioxins, no method is available in the Guidebook
2C5	PM <sub>2.5</sub> , PM <sub>10</sub>	assumed negligible
2C7a	PM <sub>2.5</sub> , PM <sub>10</sub> , BC, Pb, Cd, Cr, PCBs	assumed negligible
2D3b	NO <sub>x</sub> , SO <sub>x</sub> , CO, dioxins, PAHs, HCB	assumed negligible
2D3c	All	assumed negligible
3Da2a, 3Da2b, 3Da2c, 3Da3 and 3Da4	TSP, PM <sub>10</sub> and PM <sub>2.5</sub>	assumed negligible
3Db	NH <sub>3</sub> , TSP, PM <sub>10</sub> and PM <sub>2.5</sub>	assumed negligible
3Dd	NMVOC	Assumed negligible
3De	NO <sub>x</sub> , SO <sub>x</sub> , BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni and Se	assumed negligible
3Df	NO <sub>x</sub> , SO <sub>x</sub> , NH <sub>3</sub> , CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn and Se	assumed negligible

<b>NFR code</b>	<b>Substance(s)</b>	<b>Reason for non-estimation</b>
3I	NO <sub>x</sub> , NMVOC, SO <sub>x</sub> , NH <sub>3</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> , TSP, BC, Pb, Cd, Hg, As, Cr, Cu, Ni and Se	assumed negligible
6A	NO <sub>x</sub> , NMVOC, SO <sub>x</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> , TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, dioxins, PAHs, PCB and HCB	assumed negligible

## Appendix 2 Key category analysis results

The Approach 1 methodology presented in the EMEP/EEA emission inventory guidebook 2023 was used. Results from the key (source) category analysis have been calculated and sorted for every component. In addition to a 2024 and 1990 level assessment, a trend assessment was performed. In both approaches, key source categories are identified using a cumulative threshold of 80%.

For the key source analysis, the emissions were taken from the fuel-sold calculations.

### *SO<sub>x</sub> key sources*

*Table A2.1.a SO<sub>x</sub> key source categories identified by 2024 level assessment (emissions in Gg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A1b	Petroleum refining	6.4	40.6%	40.6%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	3.0	18.8%	59.4%
1A1a	Public electricity and heat production	1.9	12.3%	71.7%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	1.0	5.6%	84.4%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	1.0	5.9%	78.8%

*Table A2.1.b SO<sub>x</sub> key source categories identified by 1990 level assessment (emissions in Gg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A1b	Petroleum refining	67.1	33.9%	33.9%
1A1a	Public electricity and heat production	48.5	24.5%	58.5%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	20.0	10.1%	68.6%
1A3biii	Road transport: Heavy duty vehicles and buses	9.3	4.7%	73.3%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	9.1	4.6%	77.9%
2A6	Other mineral products	5.5	2.8%	80.8%

Table A2.1.c SO<sub>x</sub> key source categories identified by 1990–2024 trend assessment

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1A1b	Petroleum refining	0.334	33.3%	33.3%
1A1a	Public electricity and heat production	0.256	25.5%	58.8%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.105	10.5%	69.3%
1A3biii	Road transport: Heavy duty vehicles and buses	0.051	5.1%	74.4%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.034	3.4%	77.8%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.027	2.7%	80.4%

*NO<sub>x</sub> key sources*Table A2.2.a NO<sub>x</sub> key source categories identified by 2024 level assessment (emissions in Gg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A3biii	Road transport: Heavy duty vehicles and buses	22.1	12.3%	12.3%
1A3bi	Road transport: Passenger cars	17.3	9.6%	21.8%
3Da2a	Animal manure applied to soils	14.4	8.0%	29.8%
1A3di(ii)	International inland waterways	10.6	5.9%	35.7%
1A1a	Public electricity and heat production	9.91	5.5%	41.2%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	9.63	5.3%	46.5%
1A2gvii	Mobile Combustion in manufacturing industries and construction	9.56	5.3%	51.8%
3Da1	Inorganic N-fertilizers (includes also urea application)	8.80	4.9%	56.7%
1A3bii	Road transport: Light duty vehicles	8.78	4.9%	61.5%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	7.4	4.1%	65.6%
1A3dii	National navigation (shipping)	7.2	4.0%	69.6%

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	5.1	2.8%	72.4%
1A4a <sup>ii</sup>	Commercial/institutional: Mobile	4.88	2.70%	75.10%
1A4c <sup>iii</sup>	Agriculture/Forestry/Fishing: National fishing	4.8	2.7%	77.8%
1A4b <sup>i</sup>	Residential: Stationary	4.7	2.6%	80.3%

*Table A2.2.b NO<sub>x</sub> key source categories identified by 1990 level assessment (emissions in Gg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A3b <sup>i</sup>	Road transport: Passenger cars	141.6	21.0%	21.0%
1A3b <sup>iii</sup>	Road transport: Heavy duty vehicles and buses	129.3	19.2%	40.1%
1A1a	Public electricity and heat production	82.9	12.3%	52.4%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	35.9	5.3%	57.7%
1A2g <sup>vii</sup>	Mobile Combustion in manufacturing industries and construction	25.8	3.8%	61.5%
1A3d <sup>i(ii)</sup>	International inland waterways	22.3	3.3%	64.9%
1A3b <sup>ii</sup>	Road transport: Light duty vehicles	21.0	3.1%	68.0%
1A4c <sup>iii</sup>	Agriculture/Forestry/Fishing: National fishing	20.7	3.1%	71.0%
1A4b <sup>i</sup>	Residential: Stationary	20.6	3.0%	74.1%
1A2g <sup>viii</sup>	Stationary combustion in manufacturing industries and construction: Other	19.6	2.9%	77.0%
3Da2a	Animal manure applied to soils	19.6	2.9%	79.9%
1A1b	Petroleum refining	18.8	2.8%	82.7%

Table A2.2.c NO<sub>x</sub> key source categories identified by 1990–2024 trend assessment

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1A3bi	Road transport: Passenger cars	0.251	24.7%	24.7%
1A3biii	Road transport: Heavy duty vehicles and buses	0.217	21.3%	46.0%
1A1a	Public electricity and heat production	0.148	14.5%	60.5%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.058	5.7%	66.2%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.0334	3.3%	69.5%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0329	3.2%	72.7%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.032	3.17%	75.86%
1A4bi	Residential: Stationary	0.032	3.16%	79.02%
1A1b	Petroleum refining	0.029	2.84%	81.85%

*NH<sub>3</sub> key sources*Table A2.3.a NH<sub>3</sub> key source categories identified by 2024 level assessment (emissions in Gg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
3Da2a	Animal manure applied to soils	30.6	27.1%	27.1%
3B1a	Manure management - Dairy cattle	20.7	18.4%	45.5%
3B3	Manure management - Swine	10.9	9.6%	55.1%
3Da1	Inorganic N-fertilizers (includes also urea application)	8.9	7.9%	63.0%
3B1b	Manure management - Non-dairy cattle	8.8	7.9%	70.8%
3B4gi	Manure management - Laying hens	7.5	6.6%	77.5%
6A	Other (included in national total for entire territory)	3.4	3.0%	80.5%

Table A2.3.b NH<sub>3</sub> key source categories identified by 1990 level assessment (emissions in Gg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
3Da2a	Animal manure applied to soils	199.8	57.6%	57.6%
3B3	Manure management - Swine	49.2	14.2%	71.8%
3B1a	Manure management - Dairy cattle	22.3	6.4%	78.3%
3Da3	Urine and dung deposited by grazing animals	15.7	4.5%	82.8%

Table A2.3.c NH<sub>3</sub> key source categories identified by 1990–2024 trend assessment

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
3Da2a	Animal manure applied to soils	0.723	67.3%	67.3%
3B3	Manure management - Swine	0.164	15.3%	82.5%

#### NMVOC key sources

Table A2.4.a NMVOC key source categories identified by 2024 level assessment (emissions in Gg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
2D3a	Domestic solvent use including fungicides	46.1	19.7%	19.7%
3B1a	Manure management - Dairy cattle	43.7	18.7%	38.4%
2D3i	Other solvent use	13.9	6.0%	44.3%
2D3d	Coating applications	13.9	5.9%	50.3%
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	11.4	4.9%	55.2%
3B1b	Manure management - Non-dairy cattle	10.7	4.6%	59.7%
2H3	Other industrial processes	10.1	4.3%	64.0%
1A3bi	Road transport: Passenger cars	9.1	3.9%	67.9%
3Da2a	Animal manure applied to soils	8.5	3.6%	71.6%
1A4bi	Residential: Stationary	7.9	3.4%	75.0%
2H2	Food and beverages industry	6.0	2.6%	77.5%
1A3biii	Road transport: Heavy duty vehicles and buses	4.46	1.9%	79.44%
1B2av	Distribution of oil products	3.88	1.66%	81.10%

Table A2.4.b NMVOC key source categories identified by 1990 level assessment  
(emissions in Gg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A3bi	Road transport: Passenger cars	99.4	16.6%	16.6%
2D3d	Coating applications	93.1	15.5%	32.1%
3Da2a	Animal manure applied to soils	48.2	8.0%	40.1%
1A3bv	Road transport: Gasoline evaporation	35.4	5.9%	46.0%
2B10a	Chemical industry: Other	33.4	5.6%	51.6%
2H3	Other industrial processes	25.3	4.2%	55.8%
2D3a	Domestic solvent use including fungicides	24.3	4.1%	59.9%
2D3i	Other solvent use	18.4	3.1%	62.9%
1A3biii	Road transport: Heavy duty vehicles and buses	17.2	2.9%	65.8%
1B2av	Distribution of oil products	16.9	2.8%	68.6%
3B1a	Manure management - Dairy cattle	15.3	2.6%	71.2%
1B2aiv	Fugitive emissions oil: Refining / storage	14.8	2.5%	73.6%
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	14.6	2.4%	76.1%
2D3h	Printing	14.4	2.4%	78.5%
3B1b	Manure management - Non-dairy cattle	14.1	2%	81%

Table A2.4.c NMVOC key source categories identified by 1990–2024 trend assessment

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1A3bi	Road transport: Passenger cars	0.247	18.7%	18.7%
2D3d	Coating applications	0.217	16.4%	35.1%
3Da2a	Animal manure applied to soils	0.108	8.2%	43.3%
1A3bv	Road transport: Gasoline evaporation	0.093	7.0%	50.4%
2B10a	Chemical industry: Other	0.083	6.3%	56.6%
3B1a	Manure management - Dairy cattle	0.078	5.9%	62.5%
2D3a	Domestic solvent use including fungicides	0.060	4.5%	67.0%
2H3	Other industrial processes	0.042	3.2%	70.2%

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1B2aiv	Fugitive emissions oil: Refining / storage	0.036	2.8%	72.9%
1B2av	Distribution of oil products	0.036	2.69%	75.61%
1A3biii	Road transport: Heavy duty vehicles and buses	0.035	2.6%	78.3%
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	0.034	2.61%	80.86%

### CO key sources

Table A2.5.a CO key source categories identified by 2024 level assessment (emissions in Gg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A3bi	Road transport: Passenger cars	122.5	30.9%	30.9%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	59.7	15.0%	45.9%
1A4bi	Residential: Stationary	56.9	14.3%	60.2%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	24.68	6.22%	66.46%
1A4bii	Residential: Household and gardening (mobile)	20.7	5.2%	71.7%
1A3biv	Road transport: Mopeds & motorcycles	17.9	4.5%	76.2%
1A4aai	Commercial/institutional: Mobile	15.3	3.9%	80.05%

Table A2.5.b CO key source categories identified by 1990 level assessment (emissions in Gg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A3bi	Road transport: Passenger cars	582.7	49.1%	49.1%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	187.7	15.8%	64.9%
1A4bi	Residential: Stationary	73.6	6.2%	71.1%
1A3bii	Road transport: Light duty vehicles	46.3	3.9%	75.0%
1A4bii	Residential: Household and gardening (mobile)	38.5	3.2%	78.2%

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	37.41	3%	81.35%

Table A2.5.c CO key source categories identified by 1990–2024 trend assessment

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1A3bi	Road transport: Passenger cars	0.582	55.9%	55.9%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.162	15.5%	71.4%
1A3bii	Road transport: Light duty vehicles	0.053	5.1%	76.5%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.046	4.5%	81.0%

*PM<sub>10</sub> key sources*Table A2.6.a PM<sub>10</sub> key source categories identified by 2024 level assessment (emissions in Gg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A4bi	Residential: Stationary	4.3	16.3%	16.3%
3B4gi	Manure management - Laying hens	1.9	7.3%	23.6%
2G	Other product use	1.8	6.7%	30.3%
2A5b	Construction and demolition	1.66	6.3%	36.6%
1A3bvi	Road transport: Automobile tyre and brake wear	1.6	6.1%	42.7%
1A3bvii	Road transport: Automobile road abrasion	1.3	5.1%	47.8%
2H2	Food and beverages industry	1.3	5.0%	52.7%
2A6	Other mineral products	1.2	4.4%	57.2%
2C1	Iron and steel production	0.9	3.5%	60.7%
3B4gii	Manure management - Broilers	0.77	2.9%	63.6%
2A5c	Storage, handling and transport of mineral products	0.72	2.74%	66.35%
3B3	Manure management - Swine	0.67	2.5%	68.9%
3De	Cultivated crops	0.65	2.5%	71.4%
2B10a	Chemical industry: Other	0.62	2.4%	73.7%
2H3	Other industrial processes	0.54	2.0%	75.8%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.50	1.88%	77.67%

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
5E	Other waste	0.48	1.8%	79.5%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.42	1.6%	81.1%

Table A2.6.b  $PM_{10}$  key source categories identified by 1990 level assessment (emissions in Gg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
2C1	Iron and steel production	9.1	11.4%	11.4%
1A3biii	Road transport: Heavy duty vehicles and buses	7.7	9.5%	20.9%
1A4bi	Residential: Stationary	7.2	9.0%	29.9%
1A1b	Petroleum refining	6.4	7.9%	37.8%
1A3bi	Road transport: Passenger cars	5.6	6.9%	44.8%
2H2	Food and beverages industry	4.5	5.5%	50.3%
2B10a	Chemical industry: Other	4.1	5.1%	55.4%
1A3bii	Road transport: Light duty vehicles	3.8	4.7%	60.1%
2H3	Other industrial processes	3.0	3.8%	63.9%
1A2gvii	Mobile Combustion in manufacturing industries and construction	2.8	3.4%	67.4%
1A1a	Public electricity and heat production	2.2	2.8%	70.1%
2A6	Other mineral products	2.1	2.6%	72.7%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	1.7	2.1%	74.81%
3B3	Manure management - Swine	1.6	2.0%	76.8%
2G	Other product use	1.5	1.8%	78.6%
2A5c	Storage, handling and transport of mineral products	1.4	1.8%	80.4%

Table A2.6.c  $PM_{10}$  key source categories identified by 1990–2024 trend assessment

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
2C1	Iron and steel production	0.152	13.8%	13.8%
1A3biii	Road transport: Heavy duty vehicles and buses	0.137	12.5%	26.3%
1A1b	Petroleum refining	0.115	10.4%	36.8%
1A3bi	Road transport: Passenger cars	0.099	9.0%	45.8%
1A3bii	Road transport: Light duty vehicles	0.068	6.1%	51.9%

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
2B10a	Chemical industry: Other	0.064	5.9%	57.8%
2H2	Food and beverages industry	0.058	5%	63%
1A4bi	Residential: Stationary	0.054	4.9%	68.0%
2H3	Other industrial processes	0.046	4.2%	72.2%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.043	3.9%	76.2%
1A1a	Public electricity and heat production	0.038	3.5%	79.6%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.023	2.05%	81.70%

### *PM<sub>2.5</sub> key sources*

*Table A2.7.a PM<sub>2.5</sub> key source categories identified by 2024 level assessment (emissions in Gg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A4bi	Residential: Stationary	4.1	29.1%	29.1%
2G	Other product use	1.11	8.0%	37.1%
2A6	Other mineral products	1.0	7.5%	44.5%
2A5b	Construction and demolition	0.55	4.0%	48.5%
2C1	Iron and steel production	0.52	3.8%	52.3%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.47	3.4%	55.7%
5E	Other waste	0.44	3.2%	58.8%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.40	2.8%	61.7%
2B10a	Chemical industry: Other	0.39	2.8%	64.4%
1A3di(ii)	International inland waterways	0.34	2.5%	66.9%
1A4ai	Commercial/institutional: Stationary	0.31	2.26%	69.17%
1A3dii	National navigation (shipping)	0.30	2.2%	71.3%
1A3bvi	Road transport: Automobile tyre and brake wear	0.29	2.1%	73%
2H2	Food and beverages industry	0.27	2.0%	75.4%
1A3biii	Road transport: Heavy duty vehicles and buses	0.26	1.9%	77.2%
1A4aai	Commercial/institutional: Mobile	0.23	1.62%	78.85%
1A5b	Other, Mobile (including military, land based and recreational boats)	0.22	1.6%	80.5%

Table A2.7.b  $PM_{2.5}$  key source categories identified by 1990 level assessment  
(emissions in Gg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A3biii	Road transport: Heavy duty vehicles and buses	7.7	13.5%	13.5%
1A4bi	Residential: Stationary	6.8	12.0%	25.5%
2C1	Iron and steel production	5.9	10.4%	35.9%
1A3bi	Road transport: Passenger cars	5.6	9.8%	45.7%
1A1b	Petroleum refining	4.9	8.5%	54.2%
1A3bii	Road transport: Light duty vehicles	3.8	6.7%	60.9%
1A2gvii	Mobile Combustion in manufacturing industries and construction	2.6	4.6%	65.5%
2B10a	Chemical industry: Other	2.6	4.5%	70.0%
1A1a	Public electricity and heat production	1.8	3.2%	73.1%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	1.6	3%	76.0%
2A6	Other mineral products	1.6	3%	78.8%
2G	Other product use	1.3	2.2%	81.0%

Table A2.7.c  $PM_{2.5}$  key source categories identified by 1990–2024 trend assessment

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1A3biii	Road transport: Heavy duty vehicles and buses	0.172	17.1%	17.1%
2C1	Iron and steel production	0.126	12.4%	29.5%
1A3bi	Road transport: Passenger cars	0.124	12.3%	41.8%
1A1b	Petroleum refining	0.110	10.9%	52.6%
1A3bii	Road transport: Light duty vehicles	0.085	8.4%	61.0%
1A4bi	Residential: Stationary	0.065	6.4%	67.4%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.052	5.1%	72.5%
2B10a	Chemical industry: Other	0.050	5.0%	77.53%
1A1a	Public electricity and heat production	0.040	3.9%	81.4%

*Black Carbon key sources**Table A2.8.a Black carbon key source categories identified by 2024 level assessment (emissions in Gg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A4bi	Residential: Stationary	0.49	22.4%	22.4%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.24	10.7%	33.1%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.20	9.0%	42.1%
1A3di(ii)	International inland waterways	0.16	7.1%	49.2%
1A3dii	National navigation (shipping)	0.14	6.2%	55.5%
1A3biii	Road transport: Heavy duty vehicles and buses	0.14	6.1%	61.6%
5E	Other waste	0.11	4.9%	66.5%
1A4aaii	Commercial/institutional: Mobile	0.11	4.88%	71.42%
1A3bii	Road transport: Light duty vehicles	0.11	4.9%	76.3%
1A5b	Other, Mobile (including military, land based and recreational boats)	0.09	4.13%	80.41%

*Table A2.8.b Black carbon key source categories identified by 1990 level assessment (emissions in Gg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Gg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A3biii	Road transport: Heavy duty vehicles and buses	3.9	27.6%	27.6%
1A3bi	Road transport: Passenger cars	2.5	18.1%	45.7%
1A3bii	Road transport: Light duty vehicles	2.1	14.7%	60.4%
1A2gvii	Mobile Combustion in manufacturing industries and construction	1.3	9.6%	70.0%
1A4bi	Residential: Stationary	0.9	6.3%	76.3%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.8	5.9%	82.2%

*Table A2.8.c Black carbon key source categories identified by 1990–2024 trend assessment*

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1A3biii	Road transport: Heavy duty vehicles and buses	0.316	31.1%	31.1%

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1A3bi	Road transport: Passenger cars	0.208	20.4%	51.5%
1A3bii	Road transport: Light duty vehicles	0.166	16.3%	67.8%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.097	9.50%	77.29%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.050	4.90%	82.19%

### *Pb key sources*

*Table A2.9.a Pb key source categories identified by 2024 level assessment (emissions in Mg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
2C1	Iron and steel production	1.07	23.3%	23.3%
1A3aii(i)	Domestic aviation LTO (civil)	0.75	16.3%	39.6%
1A3bi	Road transport: Passenger cars	0.51	11.1%	50.8%
2A3	Glass production	0.40	8.7%	59.4%
1A3c	Railways	0.34	7.4%	67%
1A3bvi	Road transport: Automobile tyre and brake wear	0.34	7.4%	74.3%
2B10a	Chemical industry: Other	0.17	3.7%	78.0%
1A1a	Public electricity and heat production	0.17	3.70%	81.74%

*Table A2.9.b Pb key source categories identified by 1990 level assessment (emissions in Mg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A3bi	Road transport: Passenger cars	230.1	68.6%	68.6%
2C1	Iron and steel production	55.7	16.6%	85.2%

*Table A2.9.c Pb key source categories identified by 1990–2024 trend assessment*

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1A3bi	Road transport: Passenger cars	0.694	69.3%	69.3%
2C1	Iron and steel production	0.165	16.5%	85.8%

*Hg key sources**Table A2.10.a Hg key source categories identified by 2024 level assessment (emissions in Mg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A1a	Public electricity and heat production	0.08	22.2%	22.2%
2A6	Other mineral products	0.07	18.0%	40.3%
1A3bi	Road transport: Passenger cars	0.06	16.7%	56.9%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.04	11.3%	68.2%
1A4bi	Residential: Stationary	0.04	9.3%	77.5%
2C1	Iron and steel production	0.03	7.5%	85.0%

*Table A2.10.b Hg key source categories identified by 1990 level assessment (emissions in Mg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A1a	Public electricity and heat production	1.9	52.7%	52.7%
2B10a	Chemical industry: Other	0.7	19.1%	71.8%
2C1	Iron and steel production	0.4	10.6%	82.4%

*Table A2.10.c Hg key source categories identified by 1990–2024 trend assessment*

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1A1a	Public electricity and heat production	0.562	68.2%	68.2%
2C1	Iron and steel production	0.109	13.3%	81.5%

*Cd key sources**Table A2.11.a Cd key source categories identified by 2024 level assessment (emissions in Mg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A3bi	Road transport: Passenger cars	0.11	18.3%	18.3%
2C1	Iron and steel production	0.08	14%	32%
2G	Other product use	0.08	13.8%	46.2%
2B10a	Chemical industry: Other	0.08	13.3%	59.5%
1A4bi	Residential: Stationary	0.06	9.6%	69.1%
2C6	Zinc production	0.03	4.9%	74.0%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.02	4.13%	78.15%
1A1a	Public electricity and heat production	0.024	4.06%	82.20%

Table A2.11.b Cd key source categories identified by 1990 level assessment (emissions in Mg)

NFR14 Code	Long name	1990 Mg	Contribution	Cumulative contribution
2C6	Zinc production	1.8	43.5%	43.5%
1A1a	Public electricity and heat production	0.9	23.2%	66.7%
2C1	Iron and steel production	0.7	16.8%	83.5%

Table A2.11.c Cd key source categories identified by 1990–2024 trend assessment

NFR14 Code	Long name	Trend	Trend contribution	Cumulative trend contribution
2C6	Zinc production	0.499	47.3%	47.3%
1A1a	Public electricity and heat production	0.264	25.1%	72.4%
2C1	Iron and steel production	0.172	16.4%	88.8%

#### Dioxin key sources

Table A2.12.a Dioxin key source categories identified by 2024 level assessment (emissions in g I-Teq)

NFR14 Code	Long name	2024 g I-Teq	Contribution	Cumulative contribution
5E	Other waste	16.6	55.8%	55.8%
1A4bi	Residential: Stationary	6.0	20.2%	76.1%
2D3i	Other solvent use	4.6	15.6%	91.6%

Table A2.12.b Dioxin key source categories identified by 1990 level assessment (emissions in g I-Teq)

NFR14 Code	Long name	1990 g I-Teq	Contribution	Cumulative contribution
1A1a	Public electricity and heat production	582.6	78.2%	78.2%
1A4ai	Commercial/institutional: Stationary	100.0	13.4%	91.6%

Table A2.12.c Dioxin key source categories identified by 1990–2024 trend assessment

NFR14 Code	Long name	Trend	Trend contribution	Cumulative trend contribution
1A1a	Public electricity and heat production	0.810	80.4%	80.4%

*PAH key sources**Table A2.13.a PAH key source categories identified by 2024 level assessment (emissions in Mg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A4bi	Residential: Stationary	2.9	60.9%	60.9%
5E	Other waste	0.61	13.0%	73.9%
2A6	Other mineral products	0.28	5.95%	79.8%
5C2	Open burning of waste	0.24	5%	85%

*Table A2.13.b PAH key source categories identified by 1990 level assessment (emissions in Mg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
2C3	Aluminium production	6.9	32.7%	32.7%
1A4bi	Residential: Stationary	3.5	16.6%	49.3%
2D3d	Coating applications	2.4	11.4%	60.7%
2C1	Iron and steel production	1.6	7.8%	68.5%
2H3	Other industrial processes	1.4	6.5%	75.0%
1A3bi	Road transport: Passenger cars	0.8	3.9%	78.8%
1A1c	Manufacture of solid fuels and other energy industries	0.7	3.3%	82.1%

*Table A2.13.c PAH key source categories identified by 1990–2024 trend assessment*

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
2C1	Iron and steel production	0.094	30.0%	30.04%
1A3bi	Road transport: Passenger cars	0.042	13.31%	43.35%
2B10a	Chemical industry: Other	0.039	12.5%	55.87%
1A4bi	Residential: Stationary	0.038	12.2%	68.1%
1A3biii	Road transport: Heavy duty vehicles and buses	0.030	9.5%	77.59%
1A1a	Public electricity and heat production	0.010	3.0%	80.63%

*HCb key sources**Table A2.13.a HCB key source categories identified by 2024 level assessment (emissions in Mg)*

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A1a	Public electricity and heat production	2.9	87.9%	87.9%

Table A2.13.b HCB key source categories identified by 1990 level assessment  
(emissions in Mg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A1a	Public electricity and heat production	45.2	67.8%	67.8%
3Df	Use of pesticides	21.1	31.7%	99.5%

Table A2.13.c HCB key source categories identified by 1990–2024 trend assessment

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
1A1a	Public electricity and heat production	0.668	66.6%	66.6%
3Df	Use of pesticides	0.333	33.2%	99.8%

#### PCB key sources

Table A2.13.a PCB key source categories identified by 2024 level assessment  
(emissions in Mg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>2024 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.06	44.8%	44.8%
1A1a	Public electricity and heat production	0.04	32%	76.6%
1A1c	Manufacture of solid fuels and other energy industries	0.01	10.7%	87.3%

Table A2.13.b PCB key source categories identified by 1990 level assessment  
(emissions in Mg)

<b>NFR14 Code</b>	<b>Long name</b>	<b>1990 Mg</b>	<b>Contribution</b>	<b>Cumulative contribution</b>
2C1	Iron and steel production	19.2	49.9%	49.9%
1A1a	Public electricity and heat production	12.1	31.5%	81.4%

Table A2.13.c PCB key source categories identified by 1990–2024 trend assessment

<b>NFR14 Code</b>	<b>Long name</b>	<b>Trend</b>	<b>Trend contribution</b>	<b>Cumulative trend contribution</b>
2C1	Iron and steel production	0.501	50.8%	50.8%
1A1a	Public electricity and heat production	0.315	32.0%	82.8%

## Appendix 3 NECD and EMEP review 2024; Status on implementation of recommendations

This appendix contains the following tables:

- Table A3.1 provides an overview of the status of implementation of recommendations from the EMEP-2024 inventory review;
- Table A3.2 provides an overview of the status of implementation of recommendations from the NECD-2025 inventory review
- Table A3.3 provides an overview of the status of implementation of recommendations from the NECD-2021 LPS review;
- Table A3.4 provides an overview of the status of implementation of recommendations from the NECD-2021 Gridded data review;

### **Overall assessment by the NECD review team of the quality of the 2025 inventory submission**

- The TERT considered the 2025 inventory submission for NO<sub>x</sub>, NMVOC, SO<sub>2</sub>, NH<sub>3</sub>, PM<sub>2.5</sub>, and PM<sub>10</sub> to be of very good quality in terms of completeness and accuracy. The IIR submitted in 2025 described the methods used for the NO<sub>x</sub>, NMVOC, SO<sub>2</sub>, NH<sub>3</sub>, PM<sub>2.5</sub>, and PM<sub>10</sub> transparently.
- The TERT considered the 2025 inventory submission for HMs and POPs to be of adequate quality in terms of completeness and accuracy. The IIR submitted in 2025 described the methods used for the HMs and POPs transparently.
- To improve the quality of these submissions, the TERT suggests that the Netherlands:
  - o Calculate missing emissions for sources, even if the emissions are expected to be small, e.g. recommendations NL-2A3-2019-0002, NL-2C5-2025-0001, NL-2C7a-2023-0001 and NL-3Da2c-2025-0001;
  - o Further improve the transparency of the IIR by providing detailed information on assumptions and methodologies e.g. recommendations NL-5C-2025-0001, NL-2A5a-2022-0002, NL-1A3bi-2025-0002;
  - o Include revised estimates (e.g., NL-1A1a-2025-0002, NL-1A4ci-2018-0001) and corrections agreed during the review (e.g., NL-1A2b-2019-0001, NL-1A2d-2025-0001).
- The TERT considers that it received sufficient responses from Netherlands to undertake the 2025 NECD inventory review.

Table A3.1 Overview of the implementation of actions from the **2024 EMEP inventory review**

EMEP Observation	Recommendation	Reference to IIR or improvement status
NL-2024-2D3a-1	<p>ERT noted in relation to IIR 2024, 2D3 for industrial processes, that total category and subcategory emissions consist of the sum of data from individual facilities, supplemented by estimated emissions from non-published (small and medium-sized) facilities (p. 122, chapter 5.1.2 IIR 2024. In IIR 2024, page 123, it is explained that since 2000, due to the lack of data on production and emissions at individual facilities, total emissions by category and subcategories are calculated differently and details are given in the IIR. Use of this method in category 2D3d coating applications (with a focus on industrial activities), 2D3e degreasing, 2D3f dry cleaning, 2D3g chemical products, 2D3h printing and 2D3i other solvent uses not described in more detail in the 2024 IIR.</p> <p>During the review process, the Netherlands explained that as an exception, the methodology for calculating emissions from industrial coatings is described in another methodological report. On page 172, 'Group 5: NMVOC emissions from industrial coating applications'. Information on secondary techniques was obtained from the 2010 Paint Industry NMVOC Reduction Plan, which does not contain specific information on oxidizers or absorbers. For subsequent submissions, investigations will be conducted on this topic. The ERT recommends that the Netherlands include a more precise explanation of the origin of NMVOC emissions for category 2D3a in the Solvent sector in the next submission to increase transparency of the inventory.</p> <p>The ERT encourages the Netherlands, although the explanation was given during the review process, to make the IIR as transparent as possible, so include information in the next submission on whether the ESIG data for hand sanitizers were used for calculation or just to check the results, include information on how the use of the agents was assessed for disinfection for 2022 as well.</p>	A detailed description was added to the 2024 submission.

EMEP Observation	Recommendation	Reference to IIR or improvement status
NL-2024-2D-1	<p>ERT noted in relation to IIR 2024, 2D3 for industrial processes, that total category and subcategory emissions consist of the sum of data from individual facilities, supplemented by estimated emissions from non-published (small and medium-sized) facilities (p. 122, chapter 5.1.2 IIR 2024. In IIR 2024, page 123, it is explained that since 2000, due to the lack of data on production and emissions at individual facilities, total emissions by category and subcategories are calculated differently and details are given in the IIR. Use of this method in category 2D3d coating applications (with a focus on industrial activities), 2D3e degreasing, 2D3f dry cleaning, 2D3g chemical products, 2D3h printing and 2D3i other solvent uses not described in more detail in the 2024 IIR.</p> <p>During the review process, the Netherlands explained that as an exception, the methodology for calculating emissions from industrial coatings is described in another methodological report. On page 172, 'Group 5: NMVOC emissions from industrial coating applications'. Information on secondary techniques was obtained from the 2010 Paint Industry NMVOC Reduction Plan, which does not contain specific information on oxidizers or absorbers. For subsequent submissions, investigations will be conducted on this topic. The ERT recommends the Netherlands, for the sake of better transparency of the IIR, to include in the next submission an explanation of the methodology for calculating emissions from industrial coatings, which is described in the second methodological report.</p> <p>The ERT also recommends the Netherlands to include information on planned investigations into secondary techniques in the next submission.</p>	<p>The description can be found here in the <a href="#">ENINA methodology report 2024</a>. Please refer to page 172, 'Group 5: NMVOC emissions from industrial coating application'. Methodology reports should be considered as a part of the IIR. Information about secondary techniques was obtained from a paint industry NMVOC reduction plan dating from 2010, not containing specific information about oxidators or adsorbers. For next submissions, investigations will be made on this subject.</p>

EMEP Observation	Recommendation	Reference to IIR or improvement status
NL-2024-2D3a-2	<p>The ERT noted with reference to the IIR 2024, category 2D3a uses of domestic products including fungicides, page 136, that a report is cited in reference for explanations of methods used for VOC emissions: For a detailed description of the methodology of the emission sources, see Visschedijk et al. (2024) (Visschedijk, A.J.H., J.A.J. Meesters, M.M. Nijkamp, W.W.R. Koch, B.I. Jansen &amp; R. Dröge, (2024). RIVM Report 2024-0016. This report was not found on the Web by the ERT.</p> <p>During the review process, the Netherlands explained that the Visschedijk et al (2024) report should have been submitted together with the IIR, as it contains a complete description of the emission assessment for product use. Chapter 3 shows a list of NFR codes and emission sources in that NFR category. This table also shows a chapter that describes the emission source in more detail.</p> <p>The ERT recommends the Netherlands to include in the next submission an explanation of the complete description of the emission assessment as well as the methodology described in a separate report by Visschedijk et al (2024), because for the sake of better transparency it is necessary to explain all the necessary information about the method of emission calculation in the IIR.</p>	Methodology reports should be considered as a part of the IIR.
NL-2024-2D-2	<p>The ERT noted with reference to IIR 2024, categories 2D3e degreasing, 2D3f dry cleaning, 2D3g chemical products, 2D3h printing, pollutant NMVOC, all the years that the Netherlands reports NMVOC emissions from these categories in the NFR 2024 tables, but does not describe them in the IIR 2024, chapter 5.5.</p> <p>During the review process, the Netherlands briefly listed other sectors, but it would be good to describe other sectors as well. They are 2D3e: degreasing in the metallurgical industry - the production index of this sector is used, 2D3f: NACE 96.012: washing and (dry) cleaning and painting, described in chapter 3, 32 and 33 Visschedijk at al, 2D3g is included in 2B10a, 2D3h: emissions from printing are calculated from annual ink sales statistics, provided by the Dutch Paint and Ink Manufacturers Association (VWVF).</p> <p>The ERT recommends the Netherlands to include information on non-key categories in the next submission to make the IIR as transparent as possible and to avoid confusion that certain activities do not take place if they are not described.</p>	Description is added the IIR.

<b>EMEP Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or improvement status</b>
Gridding	<p>With reference to IIR 2024, the ERT noted that the information on the grid parameters and LPS data used is only sparsely described, but a link to further information has been included.</p> <p>The ETR encourages the Netherlands to provide information in more detail. e.g. NFR Aggregation for Gridding and LPS (GNFR) NFR Code Long name NFR Description (e.g. Distribution up to district level) and Tier-Level 3 / 2 / 1. As an overview and for completeness to the reader.</p>	<p>A more elaborate description of the disaggregation methodology per sector has now been included in Chapter 14, including information on the tier level of the methods for each sector.</p>

Table A3.2 Overview of the implementation of actions from the **2025 NECD inventory review**

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or improvement status</b>
NL-2A5b-2025-0001	<p>For category 2A5b Construction and Demolition in all years, the TERT notes that there was a recalculation between the 2024 and 2025 submissions which the Netherlands explained was due to the removal of a perceived double count of particulate matter (PM) emissions between 2A5b Construction and Demolition and Waste, where PM from Mineral Waste handling is reported. The TERT noted following review of the 2023 EMEP/EEA Guidebook that some key construction processes may now not be included within the Netherlands estimate. Specifically, road construction, which from review of the methodology report appear to have been removed from the calculated Netherlands IEF. The TERT considers it unlikely that emissions from road construction are included in mineral waste processes. In response to a question raised during the review, the Netherlands explained that on further review it was concluded that this 'double count' should not have been removed from the estimate and provided a revised estimate for the years 2005, 2020-2023. The TERT agreed with the revised estimate provided by the Netherlands. The TERT recommends that the Netherlands include the revised estimate in the next submission. Furthermore, the TERT notes that the methodology used by the Netherlands is to use economic index to estimate emissions from construction based on</p>	<p>The PM emissions in 2A5b have been recalculated, similar to the revised estimate that was submitted during the 2025 NECD review. The emissions factors are on the list of improvements.</p>

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or improvement status</b>
	<p>a study in 2000. The use of economic data by the Netherlands for 2A5b Construction and Demolition means that the time series variability expected in this sector is not observed for the Netherlands as it is for other Member States. For example, no trend features exist for events which may impact on construction and demolition activities such as economic downturn or major events.</p> <p>The TERT recommends that the Netherlands include the revised estimate in the next submission. The TERT further recommends that the Netherlands review the applicability of the use of economic data to estimate emissions from construction and consider if the emission factors from 1997 remain relevant to activity in the Netherlands.</p>	
NL-0A-2020-0001	<p>The TERT noted that no information on uncertainty was provided for other pollutants beyond the main pollutants. This was raised during the 2020 and 2021 NECD inventory reviews. In response to the question raised during the review, the Netherlands responded that they are giving higher priority to the estimate of uncertainties for the gridded data. In addition, that due to time constraints the assessment of uncertainties for heavy metals and POPs is still on the list of improvement.</p> <p>The TERT reiterates the previous recommendation that the Netherlands include uncertainty estimates for all NECD pollutants in the inventory in line with the guidance given in "Part A 5 Uncertainties 2023" of the EMEP/EEA Guidebook 2023, which is used to assess the uncertainty by pollutant and sector. The TERT further recommends that the methods used for the assessment of the uncertainty are described in the IIR transparently along with a summary of uncertainties by pollutant and sector as requested in the "Recommended Structure for Informative Inventory Report" (Annex II_v2021). In case of any delays in the implementation the TERT recommends the Member State to provide in the IIR progress of the implementation of this improvement with clear steps and schedule.</p>	Due to resource constraints this remains on the longlist of improvements.
NL-0A-2025-0002	<p>The TERT noted that the value 'zero' was reported across 12 pollutants and 17 categories. In response to a question raised during the review, the Netherlands acknowledged the error, provided the corrected values (notation keys) and confirmed that this will be corrected in the 2026 submission.</p> <p>The TERT recommends that the Netherlands include the corrected values (notation keys) instead of 'zero' in the next submission.</p>	The reporting of 'zero' values was caused by a technical problem, this issue has been solved for the 2026 submission.

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or improvement status</b>
NL-11B-2025-0001	<p>For category 11B Forest Fires, all years, pollutants PM2.5, PM10, the TERT noted that the notation key 'NR' (not reported) was used whilst a Tier 1 method is available in the 2023 EMEP/EEA Guidebook. In response to a question raised during the review, the Netherlands explained that they have not yet been able to implement the Tier 1 method due to limited resources but intend to do so for the 2026 submission.</p> <p>The TERT recommends that the Netherlands include an emissions estimate for category 11B Forest Fires in the next submission.</p>	Delayed and now planned for 2027.
NL-1A2d-2025-0001	<p>For 1A2d Stationary Combustion in Manufacturing Industries and Construction: Pulp, Paper and Print, PM2.5, PM10 and all years, the TERT notes that there may be an under-estimate of emissions which is due to the low calculated implied emission factors. The TERT notes that the issue is below the threshold of significance. In response to a question raised during the review, the Netherlands provided additional data which confirmed that the issue does not relate to changes in emissions above the threshold of significance and informed the TERT that it was not necessary to process the new data as a revised estimate.</p> <p>The TERT recommends that The Netherlands revise the PM2.5 and PM10 estimates in the next submission according to the data provided during the review.</p>	The potentially missing PM2.5 emissions in 1A2d are very small (less than the reporting threshold), and therefore we have used the emissions from the environmental reports as it is
NL-1A3bii-2023-0002	<p>For category 1A3bii Road Transport: Light Duty Vehicles, NOX, years 2021 and 2022, the TERT notes that the IEF for NOX are lower than those for other Member States. This was raised during the 2023 and 2024 NECD review, and the TERT recommended that the reference for the source of the NOX emission factor be added in the 2024 and 2025 IIR, or in the Appendix 5. The TERT noted in the 2024 review that neither the 2024 IIR, or Appendix 5, include such reference. In response to a question raised during the 2024 review, the Netherlands stated that the reference was overlooked as the text does not mention the study used. In the 2025 review, the TERT notes that the reference is added to Appendix 5, but paragraph 3.4.1 of the 2025 IIR does not contain the mentioned explanation. In response to a question raised during the 2025 review, the Netherlands explained the methodology of calculating the emissions for category 1A3bii, but indicated not knowing why the IEF are low when compared to other Member States. The TERT reiterates the recommendation that Netherlands include the reference along</p>	Excuses for the misunderstanding. We were referring to section 3.4.1 of Witt et al. (2025, part of Annex 5) and not section 3.4.1 of the IIR. Section 3.4.1 of Witt et al. (2025) contains a detailed explanation of the methodology to calculate emissions and a reference to the

EMRT-NECD Observation	Recommendation	Reference to IIR or improvement status
	with the explanation to paragraph 3.4.1 of the IIR in the next year's submission to improve transparency.	measurement report (TNO, 2022).
NL-1A3bvi-2023-0001	<p>For 1A3bvi Road Transport: Automobile Tyre and Brake Wear, PM2.5, PM10, all years, the TERT notes that the ratio PM10/PM2.5 is significantly higher than for most other Member States and the EU27 average (5.5 vs. 1.9). A similar issue exists for 1A3bvii Road Transport: Automobile Road Abrasion, i.e., the ratio of the Netherlands is 6.7 vs. 1.9 in other countries. This was raised in the 2023 NECD review. The 2024 IIR states 'Due to limited resources the issue was not solved in the 2024 submission but is added to the list of improvements for the IIR 2025 submission.' The 2025 IIR states 'In response to the recommendation from the IIR 2023 review (NL-1A3bvi-2023-0001) regarding the ratio PM10/PM2.5, we have planned improvements on these ratios for the IIR 2025.' (p. 91), 'The ratio of PM10 and PM2.5 from brake and tyre wear will be updated in due course as soon as specific measurement results are available.' (p.97) and 'As there is an ongoing project within the Dutch PRTR Task Force for Transportation to measure country-specific PM10/PM2.5 ratios, the decision was made to wait for these results to update the ratios, instead of having a recalculation in subsequent years. This information was included in the source description in paragraph 4.3.3 and as a source-specific planned improvement in paragraph 4.3.9.' (Appendix 4, p.266).</p> <p>The TERT reiterates the recommendation that the ratio PM10/PM2.5 for 1A3bvi, Road Transport: Automobile Tyre and Brake Wear, for all years be addressed within the Dutch PRTR-Task Force for Transportation and provide information in the next submission.</p>	Delayed and now planned for 2026. It has been added to the list of planned improvements.
NL-1B1a-2022-0001	<p>For category 1B1a Fugitive Emissions from Solid Fuels: Coal Mining and Handling, pollutants PM2.5 and PM10 and all years, the TERT noted that there is a lack of transparency regarding reporting of PM emissions from storage and handling of coal. This was raised during the 2022 and 2024 NECD inventory reviews. The TERT notes that the issue is below the threshold of significance for a technical correction. The TERT notes that the IIR (Table A4.1 ) states that the issue has been included in the list of improvements and that the recommendation will be addressed in the 2026 submission. The TERT reiterates the recommendation that the Netherlands investigate further if emissions from storage and handling of coal are included in the AERs for the relevant</p>	This issue is still on the list of planned improvements.

EMRT-NECD Observation	Recommendation	Reference to IIR or improvement status
	companies, and include estimates for companies that do not include the emissions in their AERs, and include a description in the IIR in the 2026 submission.	
NL-2A5a-2022-0002	<p>For category 2A5a Quarrying and Mining of Minerals Other Than Coal, pollutants PM10, PM2.5 and all years, the TERT notes that the previous recommendation (NL-2A5a-2022-0002) which recommends that the Netherlands further clarify the use of the notation key 'IE', has not been implemented. This was raised during the 2022, 2023, and 2024 NECD inventory reviews. The IIR states in relation to emissions from 2A5a that 'emissions from companies responsible for these PM emissions are now reported under 1A2gvii, 2A1, and 2H3. It is currently unclear what contribution of these PM emissions belongs to 2A5a. Also, it needs to be investigated to what extent emissions from 2A5a are reported at all. This will be examined for future submissions. The TERT notes that the issue is below the threshold of significance for a technical correction as it is mainly an issue of comparability and transparency and therefore relates to a potential allocation issue as opposed to completeness. However, the Netherlands have stated some minor completeness issues as the Netherlands in previous reviews acknowledged that a small-scale operation was not included. The TERT considers that the effect will likely be below the threshold of significance. In response to a question raised during the review, the Netherlands explained that the issue is on the list of improvements, however, due to resource limitations it was not possible to resolve the issue for the latest submission, but it is intended to address the recommendation for the next submission. The TERT understands from further consultation that, given the national circumstances of the Netherlands, emissions during the extraction of sand and gravel are unlikely—despite the availability of aggregate production data (<a href="https://www.aggregates-europe.eu/facts-figures/figures/">https://www.aggregates-europe.eu/facts-figures/figures/</a>) typically considered under 2A5a. This is primarily because the Netherlands' flat, water-rich geography means that most extraction occurs via wet methods (from rivers, lakes, and offshore sites), which are not expected to generate significant particulate matter emissions. As such, any minimal emissions from this activity are likely captured under other sectors where aggregates are processed or disposed of.</p> <p>The TERT reiterates the recommendation that the Netherlands provide further clarification on whether the identified small missing source has been addressed, clarify</p>	The issue is on the long list of improvements, and because still limited by resources we still weren't able to resolve this issue.

EMRT-NECD Observation	Recommendation	Reference to IIR or improvement status
	what contribution of these PM emissions actually belongs to 2A5a, Quarrying and Mining of Minerals Other Than Coal, and also to what extent emissions from 2A5a are reported at all, and report on the findings in the next IIR.	
NL-2A6-2025-0001	For category 2A6 Other Mineral Products, pollutants PM10 and PM2.5, and the entire time series, the TERT notes that recalculations were applied for PM10 but not PM2.5. The TERT notes that the issue is below the threshold of significance for a technical correction. In response to a question raised during the review, the Netherlands explained that these 'recalculations' are due to a new sub-category being estimated in the 2025 submission for the first time - asphalt production plants. Estimates were made using emission factors from the US-EPA who also publish emission factors for PM2.5 for this source. The TERT recommends that the Netherlands include estimates of PM2.5 for asphalt production plants using these emission factors identified by the Netherlands in the next submission.	Implemented, see paragraph 5.2.1, 5.2.4 and 5.2.5.
NL-2B-2022-0001	For 2B Chemical industry for SO <sub>2</sub> , NO <sub>x</sub> , NH <sub>3</sub> , NMVOC, PM <sub>2.5</sub> , PM <sub>10</sub> and for all years, the TERT notes that there is a lack of transparency as all emissions are assigned to NFR 2B10a Other chemical industry, which is a key category for PM <sub>2.5</sub> and PM <sub>10</sub> . This does not relate to an over- or under-estimate of emissions. This was raised during the 2022, 2023 and 2024 NECD inventory review. In response to a question raised during the review, the Netherlands explained that due to unforeseen circumstances (limited capacity due to prolonged illness) the correct allocation of emissions has not been possible. The TERT reiterates the recommendation that the Netherlands disaggregate emissions into the different NFR categories that are currently reported in 2B10a, Chemical industry: Other, in its next submission and provide sufficient explanation in the IIR.	Again we apologize that performing this task did not happen. The intention is now to perform this task for the 2027 submission.
NL-2C5-2023-0001	For category 2C5 Lead Production, pollutants PM <sub>2.5</sub> and PM <sub>10</sub> , emissions are currently reported for part of the time series. This was raised during the 2023 and 2024 NECD inventory reviews. The TERT notes that the issue is below the threshold of significance for a technical correction. Furthermore, the IIR states in section 5.4.1 that there is only one lead producer in the Netherlands, whereas in section 5.4.3 and 5.4.6 two lead producers are referred to. The TERT understands from previous clarification, and the	The PM <sub>10</sub> /2.5 issue is on the long list of improvements, the text about the two producers is corrected.

EMRT-NECD Observation	Recommendation	Reference to IIR or improvement status
	<p>improvement item listed in section 5.4.6 that the estimation of emissions from PM2.5 and PM2.5 from 2C5 are planned as an improvement item. The TERT notes that emissions should be estimated by mathematical methods (2023 EMEP/EEA Guidebook chapter 4 Time series consistency) in case data is not available for all years. In response to a question raised during the review, the Netherlands clarified that there is one main lead producer that reports emissions to air with the other being a more general producers of various products, amongst which are lead products. This will be clarified and corrected in the next submission. The TERT notes that the IIR states that the issue has been included in the list of improvements and that the recommendation will be addressed in future submission.</p> <p>The TERT reiterates the recommendation that the Netherlands include the missing emission estimates in its next submission.</p>	
NL-2C7a-2023-0001	<p>For category 2C7a Copper Production, pollutants SO<sub>2</sub> (1990-2023); PM<sub>2.5</sub> (2009-2023); PM<sub>10</sub> (2009-2023), the TERT notes that no emissions are reported. This was raised during the 2023 and 2024 NECD inventory review. The TERT notes that the issue is below the threshold of significance for a technical correction. In the 2025 IIR it is explained that since 2009, the single copper production company has not reported PM<sub>10</sub> emissions because the emissions are below the reporting threshold of 5,000 kg. For this reason, PM<sub>10</sub> emissions are reported as 'NE' in 2C7a, as well as PM<sub>2.5</sub> as normally, the reported PM<sub>10</sub> emissions are used to calculate PM<sub>2.5</sub> emissions. In response to a question raised during the review, the Netherlands explained that for the next submission it is intended to derive PM<sub>10</sub> and PM<sub>2.5</sub> from the TSP emission data that is reported. Furthermore, for SO<sub>2</sub>, it was explained that the copper production facility does report SO<sub>2</sub> emissions that should have been reported under 2C7a. For 2023, this was 23 kg (reporting threshold is 20.000 kg).</p> <p>The TERT reiterates the recommendation that the Netherlands include the missing emission estimates in its next submission.</p>	The PM <sub>10</sub> /2.5 issue is on the long list of improvements.
NL-2D3c-2022-0001	<p>For 2D3c Asphalt Roofing, NMVOC, PM<sub>10</sub>, PM<sub>2.5</sub>, for all years, the TERT notes that the notation key 'NE' (not estimated) is used whilst a Tier 1 method is available in the 2023 EMEP/EEA Guidebook. This was raised during the 2022, 2023 and 2024 NECD inventory reviews. The TERT notes that the issue is below the threshold of significance for a</p>	The PM <sub>10</sub> /2.5 issue is on the long list of improvements.

EMRT-NECD Observation	Recommendation	Reference to IIR or improvement status
	<p>technical correction. The TERT notes that the IIR states that the issue has been included in the list of improvements (IIR p.271) as 'no activity data were available'. The Netherlands explain in the IIR that efforts have been made to search for activity data and that there are no producers where the production of asphalt roofing is the main economic activity. The item remains as part of the improvement plan.</p> <p>The TERT reiterates the recommendation that the Netherlands include these estimates in the next NFR and IIR submission.</p>	
NL-3B4a-2025-0001	<p>The TERT notes that the notation key provided for category 3B4a Manure Management - Buffalo for pollutants SO<sub>2</sub>, CO, Heavy metals and POPs is 'IE' (included elsewhere). The TERT understands that emissions from this category are included in 3B1a, Manure management - Dairy cattle, and 3B1b, Manure management - Non-dairy cattle, where appropriate notation key was used.</p> <p>The TERT recommends that the Netherlands change the notation key to 'NA' (not applicable) in category 3B4a, Manure Management – Buffalo, where appropriate, for the 2026 submission.</p>	The notation keys have been updated to NA where applicable for buffalo.
NL-3Da1-2025-0001	<p>The TERT notes that activity data for category 3Da1 Inorganic N-fertilizers (includes also urea application) is expressed in the wrong unit (kg of N reported instead of tons of N). Using corrected unit for activity data, the TERT also notes that the implied emission factor for the 3Da1 NFR category ranges from 0.033 kgNH<sub>3</sub> / kN in 1990 to 0.045 kgNH<sub>3</sub> / kgN in 2023, which are not in line with the values reported in Table 6.10 (p 155) of the IIR (0.03 to 0.02). In response to a question raised during the review, the Netherlands confirmed that both observations were true due to an error in the IEF calculation sheet for the period 2000-2023 and that the mistake will be fixed in the next submission.</p> <p>The TERT recommends that the Netherlands use the correct unit for activity data reporting in its CRT tables for category 3Da1, Inorganic N-fertilizers, and that provide a correction of the IEF table in the 2026 submission, to improve transparency.</p>	The activity data has been added in kg, the table (6.10) has been updated.
NL-3Da2c-2025-0001	<p>For category 3Da2c Other Organic Fertilisers Applied to Soils (including compost), NH<sub>3</sub>, years 2005-2023, the TERT notes that there is a lack of transparency regarding the mineralization factor used for anaerobic digestion of manure in biogas plants. This does not relate to an over- or under-estimate of emissions. In response to a question raised</p>	Due to the way NEMA handles N in manure treatment this issue proved to be more

EMRT-NECD Observation	Recommendation	Reference to IIR or improvement status
	<p>during the review, Netherlands explained it wasn't aware of this mineralization factor and that it would improve calculation in the next submissions. The Netherlands also provided a calculation sheet for digested manure showing that the increase of emissions from accounting for the mineralization factor is below the threshold of significance. The calculation provided doesn't include co-digestates but considering that most digestion plants are using only manure. The TERT agrees that the impact is below the threshold of significance.</p> <p>The TERT recommends that the Netherlands include the additional mineralization of digested manure as well as an estimate of co-digestates in the next submission.</p>	<p>difficult than anticipated. All efforts will be made to include the mineralisation in the next submission. The issue has been added to the planned improvements in section 6.2.8.</p>
NL-5C-2025-0001	<p>For 5C1 Waste Incineration the TERT noted that in the IIR there is a lack of transparency regarding the notation key. Indeed, the TERT noted in the NFR tables that the notation key 'IE' is applied for the complete time series and that it is indicated in the IIR 2025: "The heat generated by waste incineration is used to produce electricity and heat buildings. These categories, therefore, are reported under the Energy sector (source category Public Electricity and Heat Production (1A1a))" (waste chapter) and "All waste incineration plants recover energy and are included in source category 1A1a." (Energy chapter, page 45). With such a justification the TERT would have expected the use of the notation key 'NO'. On the other hand, the TERT noted that in the Eurostat database that waste incineration without energy recovery occurs in the Netherlands (about 1000 kt of waste, including 77 kt of municipal waste in 2023). Moreover, the TERT noted that the total of "other fuels" is lower than what would be expected based on Eurostat data (using a NCV of 10 TF/kt). In response to a question raised during the review, the Netherlands explained that the figures between Eurostat and the data provided in the National Inventory Report (NIR) cannot simply be compared with each other. The quantities from file 1710299 originate from the biennial delivery for the reporting obligation for regulation EU 2150/2002. The data show the quantity of processed waste in the Netherlands and abroad of Dutch waste. Data in the National Inventory Report only show the processed quantities of waste that have been processed in Dutch waste incineration plants. When checking the Eurostat reporting rules (<a href="https://ec.europa.eu/eurostat/cache/metadata/en/env_wasgt_esms.htm">https://ec.europa.eu/eurostat/cache/metadata/en/env_wasgt_esms.htm</a>), the TERT noted that it is indicated: "In the table on waste treatment: all waste treated within the</p>	<p>In paragraph 7.5.3 of the IIR, a table on the amount of waste incinerated is added. It is also explained that all waste incineration plants (WIPs) report the emission of pollutants in their AER and are included in the category 1A1a.</p>

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or improvement status</b>
	<p>borders of a country (consequently excluding exports and including imports of waste).” Which is not consistent with the justification provided by the Netherlands. The Netherlands also provided detailed information on the type of waste incinerated (household and comparable commercial waste, wood for energy generation, sewage sludge from communal waste water treatment plants, manure and industrial waste streams (industrial liquid waste streams and chemical waste like solvents), the associated NCV and emissions allocation (1A1a) and AD allocation (under biomass (sewage sludge and manure) and under liquid fuels (industrial liquid waste and chemical waste). The TERT agreed that the comparison with Eurostat data may be difficult for these waste with specific NCV. Finally, the Netherlands highlighted that they consider that 'IE' is the proper notation key because the process of waste incineration does occur, but emissions are reported elsewhere. The TERT disagree and consider that if there is no waste incineration without energy recovery, emissions should be reported as 'NO' in the NFR 5C tables.</p> <p>The TERT recommends that the Netherlands report information provided in the answer regarding all waste incineration with and without energy recovery in its 2026 submission by providing the methodology used to estimate emissions from waste incineration with energy recovery (type of waste incinerated, in which kind of plants, amount of waste and in energy, EFs applied, NCV, references), the NFR categories where emissions are reported and investigate further the apparent discrepancy between national data and Eurostat data. Moreover, if investigations regarding Eurostat data confirm that incineration without energy recovery doesn't occur, the TERT recommends that the Netherlands report 'NO' instead of 'IE' in their next submission.</p>	
NL-5E-2025-0001	<p>For 5E Other Waste (accidental building fires), for all pollutants and all years, the TERT notes that there is a lack of transparency regarding the definition of combustible materials in the 2025 IIR. This does not relate to an over- or under-estimate of emissions. Indeed, The TERT notes, pages 181-182, that a country specific methodology is applied based on the estimation of the combustible material burned annually and the application of emission factors. All EFs (except for dioxins) relate to 'wood burning in open fireplaces' (table 3-39 of the chapter 1A4 of the 2023 EMEP/EEA Guidebook). However, the TERT does not expect 'combustible materials' to be exclusively wood, but</p>	<p>In paragraph 7.7.3 extra explanation is given that the emission factor of plastic is derived from the EEA guidebook, chapter 5C1a table 3.2.</p>

EMRT-NECD Observation	Recommendation	Reference to IIR or improvement status
	<p>also some plastic like materials. In response to a question raised during the review, the Netherlands explained that emission factors for house fires were derived from EFs for the combustion of wood from the EMEP/EEA Guidebook (under `1A4 energy small combustion) and for the combustion of the plastic part from the EMEP/EEA Guidebook category 5C1a (Municipal Waste Incineration without abatement).</p> <p>The TERT recommends that the Netherlands improve the transparency of the IIR by including the details regarding accounting for the plastic part in the estimate of emissions from the accidental house fires in the 2026 submission.</p>	
NL-2C1-2025-0001	<p>For 2C1 Iron and Steel Production and HCB emissions across the entire time series, the notation key 'NE' (not estimated) is used whilst a Tier 1 method is available in the 2023 EMEP/EEA Guidebook. This results in an under-estimate that is above the threshold of significance. In response to a question raised during the review the Netherlands explained that the single steel producer Tata Steel reports emissions via their AER (annual emissions report) and that given HCB emissions are not reported, this means emissions of HCB are below the reporting threshold of 10 kg/year. However, the threshold for significance for HCB emissions in 2023 is 0.063 kg and therefore the TERT decided to calculate a technical correction for the years 1990-2023 using a Tier 1 methodology, which was not accepted by the Netherlands. The estimates demonstrate that the issue is above the threshold of significance.</p> <p>The TERT recommends that the Netherlands include HCB emissions from 2C1 Iron and Steel Production in its next submission and further investigate whether abatement technologies are in place at the steel production facility, as indicated in the response to a review question, to determine the applicability of the Tier 1 estimate.</p>	HCB emission is estimated for the steel plant, and communicated with them.
NL-2C7a-2019-0001	<p>For 2C7a Copper Production for Cd emissions and years 1990-2023, the notation key 'NE' (not estimated) is used whilst a Tier 1 method is available in the 2023 EMEP/EEA Guidebook. This results in an under-estimate that is above the threshold of significance. In response to a question raised during the review, the Netherlands explained that the use of a Tier 1 methodology is not appropriate, as the estimated emissions would exceed the facility's Cd reporting threshold under the AER. This is due to the abatement measures that have been installed. However, calculating Cd emissions using the ratio of cadmium to copper in the Tier 1 emission factors indicates that Cd emissions exceed the</p>	Cd emissions measurement reports were requested at this company. This resulted in a Cd emission of 0.68 kg for one year, which is below the EPRTTR reporting threshold and

EMRT-NECD Observation	Recommendation	Reference to IIR or improvement status
	<p>threshold of significance, even if they remain below the AER reporting threshold. As a result, the TERT calculated a technical correction based on the Tier 1 emission factor ratio between Cu and Cd emissions; however, this correction was not accepted by the Netherlands.</p> <p>The TERT recommends that the Netherlands include Cd emissions from 2C7a Copper Production in its next submission and further investigate the presence of abatement technologies at the facility, as referenced in the response to a review question, to assess the applicability of the technical correction.</p>	<p>the threshold of significance. Therefore, NE is reported. Also, the company promised to undertake further measurement actions.</p>
NL-1A1a-2025-0002	<p>For 1A1a Public Electricity and Heat Production, PCDD/F and year 2023, the TERT notes that from 2022 to 2023 emissions increased by 1015%. In response to a question raised during the review, the Netherlands explained that there was a unit error in the reporting of a waste incineration plant for 2023 and provided a revised estimate for year 2023 and stated that it will be included in the next submission. The TERT agreed with the revised estimate provided by the Netherlands.</p> <p>The TERT recommends that the Netherlands include the revised estimate in the next submission.</p>	<p>The dioxin emission for 1 plant in 2023 has been corrected, similar to the revised estimate that was submitted during the 2025 NECD review.</p>
NL-1A4ci-2018-0001	<p>For category 1A4ci Agriculture/Forestry/Fishing: Stationary, pollutants Cd, Pb and Hg, all years, the TERT noted that the Netherlands report emissions and that the observation raised during the 2018, 2019 and 2020 NECD review ('NE' reported for Cd and Pb) is resolved. However, the TERT notes that the previous observation was based on the assumption that only natural gas is used as a fuel and that in the 2025 submission also biomass consumption is reported. In response to a question raised during the review, the Netherlands explained that Cd, Pb and Hg emissions from fuelwood and biogas are not estimated for stationary sources. The Netherlands provided revised estimates for categories 1A4ci Agriculture/Forestry/Fishing: Stationary and 1A4ai Commercial/institutional: Stationary and years 2005, 2020-2023 and stated that it will be included in the next submission. The TERT agreed with the revised estimate provided by the Netherlands.</p> <p>The TERT recommends that the Netherlands include the revised estimate in the next submission.</p>	<p>The emissions of Cd, Pb and Hg from combustion of solid biomass and biogas have been calculated and added to inventory, similar to the revised estimate that was submitted during the 2025 NECD review</p>

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or improvement status</b>
NL-1A2a-2019-0001	<p>For category 1A2a Stationary Combustion in Manufacturing Industries and Construction: Iron and Steel, pollutants Cd, Hg and Pb and for all years, the TERT noted that there is a lack of transparency regarding allocation of emissions between the categories 1A2a and 2C1 Iron and Steel Production. This does not relate to an over- or under-estimate of emissions. This was raised during the 2019, 2020 and 2021 NECD reviews. In response to a question raised during the review, the Netherlands explained that they are aware of the issue regarding time series consistency for allocation of emissions to 1A2a and 2C1, respectively. The Netherlands explained that data from the Iron and Steel plant is based on stack measurements at several emissions points with combined flue gases from incineration of fuels and process emissions. For this reason, emissions cannot be split based on a reasonable method (it concerns different combinations of different fuels in different processes) and that any split would be artificial. The Netherlands stated that this issue will be added on the longlist of improvements. The TERT recommends that the Netherlands keep the allocation issue between categories 1A2a, Stationary Combustion in Manufacturing Industries and Construction: Iron and Steel, and 2C1, Iron and Steel Production, on their list of improvements and that the Netherlands explains the allocation problems between categories 1A2a and 2C1 in their IIR in the next submission.</p>	Chapter 3.3.4 explains the allocation problems between 1A2a and 2C1
NL-1A2b-2019-0001	<p>For 1A2b Stationary Combustion in Manufacturing Industries and Construction: Non-Ferrous Metals, pollutants PCDD/F, years 2006 and 2009, the TERT notes that emissions (2006: 0.42 g, 2009: 1.65 g) are high outliers in time series. This was raised during the 2019 and 2020 NECD review. In response to a question raised during the review, the Netherlands explained that the PCDD/F emissions in 2006 and 2009 in 1A2b are not correct, and this should have been corrected in the 2022 submission. The error is caused by unit errors in the company reporting of 2 companies. In 2006, one company reported 0.000403 kg PCDD/F, and this should be 0.000000403 kg. In 2009, another company reported 0.001647 kg PCDD/F and this should be 0.000001647 kg. The TERT recommends that the Netherlands revise PCDD/F emissions of 1A2b Stationary Combustion in Manufacturing Industries and Construction: Non-Ferrous Metals, pollutants PCDD/F and years 2006 and 2009 in their next submission.</p>	The dioxin emissions in 1A2b in 2006 and 2009 have been corrected

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or improvement status</b>
NL-1A3bi-2025-0002	<p>For the category 1A3bi Road Transport: Passenger Cars, pollutants PCDD/PCDF (dioxins/furans), year 2005, the TERT notes that the implied emission factor (IEF) is outside of the 95% confidence interval when compared to the other member states. Studying the 2025 IIR, the TERT could not find clear documentation of the PCDD/PCDF emission factors for 1A3b explaining the rather low IEF. In response to a question raised during the review, the Netherlands sent a description of the methodology. The Netherlands also stated having planned a revision of the PCDD/PCDF profiles in the coming years. The TERT notes that the issue is below the threshold of significance for a technical correction.</p> <p>The TERT recommends that the Netherlands include a clear description of the methodology used to estimate PCDD/PCDF in the next year's IIR. Furthermore, the TERT recommends that the Netherlands add updating the PCDD/PCDF profiles to the list of planned improvements in their next submission.</p>	<p>The description in section 3.2.3 and table 3.10E of Witt et al. (2026) have been updated for clarity. Updating of PCDD/PCDF profiles has been added to the list of planned improvements.</p>
NL-1A3dii-2018-0001	<p>For category 1A3dii National Navigation (shipping), for HCB and PCB, for all years the TERT notes that there is a lack of transparency regarding the use of the notation key 'NE' in the NFR tables and the status of the implementation of the improvement. In response to a question raised during the review, the Netherlands explained that they do not find the default emission factors in the EMEP/EEA Guidebook to be applicable to inland shipping, particularly given the use of sulphur free, pure distillate diesel fuel for inland shipping since 2010, and therefore do not consider using the default values for HCB and PCB for inland shipping to be an improvement. The Netherlands also indicated that they would consider an update if new literature source or measurements were to become available. Furthermore, the Netherlands assume the HCB and PCB emissions for this category to be negligible. This was raised during the 2018, 2019 and 2021 NECD inventory reviews. The TERT notes that the issue is below the threshold of significance for a technical correction. The TERT notes that the IIR states that the issue is not included in the list of improvements.</p> <p>The TERT reiterates the recommendation that Netherlands implement a new methodology for the next submission and include relevant documentation in the next IIR submission.</p>	<p>We will implement a new methodology when suitable emission factors become available. As it is not clear when this will be we do not yet include this in the list of planned improvements.</p>

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or improvement status</b>
NL-1A4ciii-2018-0001	<p>For the category 1A4ciii Agriculture/Forestry/Fishing: National Fishing, the pollutants heavy metals, PCDD/F, POPs, HCB and PCBs, all years the TERT notes there was a lack of transparency regarding the use of notation key 'NE' and the status of the implementation of the improvement to include these emissions for this category. This was raised during the 2018, 2019 and 2021 NECD inventory review. The TERT notes that in the 2025 submission the Netherlands have included the calculation of heavy metals, PCDD/F, POPs, HCB and PCBs. Though, on page 117 of the 2025 IIR the Netherlands state that 'The emission calculations for heavy metals, PCBs/HCBs and Dioxins and for PAHs are based on activity data that is not in line with the scope of other emissions in the inventory. Instead of fuel-sold, emissions are based on the AIS (Automatic Identification System) data for fishing ships on Dutch national territory. Due to technical implementation difficulties, translation to fuel-sold emissions has not yet been performed. The AIS data-based emissions are estimated to be twice as high as fuel-sold emissions. Therefore, we expect an overestimation of these emissions in the current inventory. This issue is on the list of inventory improvements.' The TERT notes that the issue is below the threshold of significance for a technical correction. The TERT notes that the IIR states that the issue has been included in the list of improvements and that the recommendation will be addressed in the next year's submission. The TERT reiterates the recommendation that the Netherlands study this subject further and report the findings in next year's inventory report.</p>	Delayed and now planned for future inventory reports.
NL-2A3-2019-0002	<p>For category 2A3 Glass Production, for Cd emissions in 2008-2011 and 2023, the TERT noted that the Netherlands has replaced the previously reported notation key "NA" as zero, while there are methods and EFs provided in the 2023 EMEP/EEA Guidebook. It was also noted that there is a lack of transparency on the time series inconsistency as there are significant increases in emissions reported in 2017 and 2020, which are no longer explained in the IIR. Related issues were raised during the 2019, 2020 and 2021 NECD review. The TERT noted that the issue is below the threshold of significance for a technical correction. The TERT notes that the increase in Cd emissions in 2017 was previously justified in section 5.2.3 of the IIR submitted in 2021. In response to a question raised during the review, the Netherlands explained that the single company reporting Cd emissions did not report any emissions for 2023 and zeros in the NFR were</p>	A very small emission of 2 kg is reported for 2024 by this company, so no notation key.

EMRT-NECD Observation	Recommendation	Reference to IIR or improvement status
	<p>supposed to be reported using 'NA' as a notation key. The TERT notes that emissions should be estimated by mathematical methods (2023 EMEP/EEA Guidebook chapter 4 Time series consistency) in case data is not available for all years, and in cases where emissions are not estimated due to facility reporting, the notation key 'NE' should be used as emissions are likely still arising, but may be negligible.</p> <p>The TERT recommends that the Netherlands add back in previous explanations for time series inconsistency from Cd emissions in 2A3, Glass Production, and consider alternative estimation methodologies to ensure completeness of reporting across years that facility data does not reach reporting thresholds for the next submission.</p>	
NL-2C5-2025-0001	<p>For category 2C5 Lead Production no emissions are reported for PCBs across the time series. The TERT would expect emissions to be reported for these pollutants because emissions of other pollutants have been reported for this category. The TERT notes that the issue is below the threshold of significance for a technical correction. It is noted by the TERT that the Netherlands have stated on page 231 of the IIR that these emissions are 'assumed negligible', however Tier 1 emission factors are available within the 2023 EMEP/EEA Guidebook. In response to a question raised during the review, the Netherlands explained that PCB emissions are not reported, which means that these are at least below the reporting threshold of 100g/year.</p> <p>The TERT acknowledges that this means emissions are below the threshold for significance, however for comparability with other Member States, the TERT recommends that the Netherlands estimate emissions of PCBs or otherwise justify why emissions are negligible in the next IIR submission.</p>	<p>We might consider to find out the AD, for applying the Tier1 calculation. At a glance, the company states on their website that annually 16.000 Mg lead is produced. However, this seems to be the production of this company in 10 countries. This has to be found out further, but even if this is the AD for the Netherlands, than Tier1 would give an emission of 32 mg PCB/year. Also given the reporting threshold of 100 g/year we consider this as negligible.</p>

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or improvement status</b>
NL-2C6-2019-0001	<p>For category 2C6 Zinc Production, for Hg emissions, for the whole time series, the TERT noted that the notation key 'NA' is still reported while Tier 1 and Tier 2 methods and emission factors are available in the 2023 EMEP/EEA Guidebook. This was raised during the 2019, 2020 and 2021 NECD reviews. The TERT notes that in response to the recommendation from the 2021 NECD review the Netherlands added justification in section 5.4.3 of the IIR (2025) to explain that the zinc production company does not report any Hg emissions as annual measurements at the chimney reveal that no, or very little mercury is emitted. This is explained to be as 'mercury present in the ore is removed by forming a mercury-selenium compound before the ore gets in contact with sulphuric acid in the process'. However, in this case, the TERT would consider it more appropriate to use the notation key 'NE' as emissions are occurring but in negligible amounts. However, in response to a question during the review the Netherlands reasserted that 'NA' is most appropriate as annual measurements at the chimney reveal that no, or very little mercury is emitted.</p> <p>The TERT recommends that the Netherlands provide further justification of the efficiency of the outlined abatement measure (%) and that, assuming emissions are not possible to estimate if below the Netherlands own reporting threshold, that 'NE' remains the most appropriate notation key as 'NA' should be used for instances where pollutant and category combinations are not expected in any case. The TERT recommends that these changes be implemented for the next submission.</p>	NA is supposed to be appropriate.
NL-2C7a-2019-0002	<p>For category 2C7a Copper Production, pollutant Hg and for the entire time series, the TERT notes that the notation key 'IE' was reported without justification on how these emissions are estimated or how they are expected to be included in another category. The 2025 IIR explains that emissions of multiple compounds are reported as 'IE' for 2C7a, as they are included in NFR category 1A2b. Related issues concerning estimation of Hg emissions from 2C7a were raised during the 2019 and the 2021 NECD reviews. The Netherlands previously explained that the only operator of copper production in the Netherlands is below the AER's reporting threshold (1 kg a year) and as such Hg emissions are not reported by the operator. The Netherlands also previously outlined that attempts were being made to contact the operator to obtain copper production data and information on the implementation of abatement technology over time. In response</p>	Check with the company still has to be performed.

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or improvement status</b>
	<p>to a question raised during the 2025 review, the Netherlands further explained that there was still no direct contact with this company and that the facility has recently been taken over by another company. The Netherlands did not clarify how emissions from this category are reportedly included within 1A2b given that is stated that emission data is based on reported emissions in AERs and therefore the use of 'IE' seems inappropriate. The Netherlands provided evidence that Hg emissions from the facility would be below the threshold of significance through calculation of expected emissions of Hg based on the ratio provided in the Tier 1 emission factors (2023 EMEP/EEA Guidebook) between Hg and Cu emissions.</p> <p>The TERT recommends that the assumptions made on abatement technologies installed at the plant are verified with the facility, and emission estimates included within the next submission using the ratio approach if considered appropriate. Otherwise, the TERT recommends that emissions are reported as 'NE' with justification provided in the IIR.</p>	

Table A3.3 Overview of the implementation of actions from the **2021 NECD LPS review**

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference into IIR or status</b>
NL-LPS-GEN-2021-0001	<p>The TERT noted that in 2019, the coordinates provided for the following LPSs are more than 10 km away from those reported in the Industrial Reporting database (v4) for the corresponding E-PRTR facility (matching facility ID and distance given in parentheses): Dow Benelux BV .Hoek. .4592. (51104; 13 km), Afvalstoffendienst gemeente Hertogenbosch (203707; 34 km). In response to a question raised during the review, the Netherlands explained that LPS-coordinates have their origin in the operators Annual Environmental Reports (AERs), and that there may have been an error in these coordinates.</p> <p>The TERT agrees with the approach suggested by the Netherlands of asking operators to correct their reporting in the AER and recommends that the Netherlands upload a corrected version of the 2019 LPS data (Annex VI file) to the CDR as corrected coordinates for these plants are available, as well as ensuring that this issue does not reoccur in the 2023 LPS data submission in 2025.</p>	The errors are corrected and the correct data will be in the 2025 LPS-submission.

Table A3.4 Overview of the implementation of actions from the **2021 NECD Gridded data review**

<b>EMRT-NECD Observation</b>	<b>Recommendation</b>	<b>Reference to IIR or status</b>
NL-GRID-GEN-2020-0003	<p>The TERT notes with reference to gridded emissions submitted in the GNFR tables for NO<sub>x</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>, NMVOC and CO that there may be an under-estimate (for NO<sub>x</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>) or over-estimate (for CO and NMVOC) of emissions. The gridded emissions reported for these pollutants are not consistent with the emissions reported in the national totals (NFR tables). In the cases of NO<sub>x</sub>, PM<sub>2.5</sub>, CO the differences are significant in the national totals reported. In the cases of NMVOC, PM<sub>10</sub> the differences are related to the emissions for F_RoadTransport. The issue will be flagged as a priority recommendation. In response to a question raised in the review the Netherlands acknowledges that there is an error in the data and informed the TERT that it will be corrected and resubmitted.</p> <p>The TERT recommends that Netherlands resubmits the corrected data and ensures that gridded emissions are consistent with national totals in the next submission.</p>	The error was corrected.

## Appendix 4 Additional information to be considered as part of the IIR submission

List A5.1 contains the list of methodology reports that have been submitted to the EU and UNECE as part of the submission of 15 March 2026. These reports are to be considered an integral part of this IIR 2026.

### A5.1 List of methodology reports

#### ENINA (Energy, IP, Waste):

Methodology for the calculation of emissions to air from the sectors Energy, Industry and Waste  
RIVM report 2026-0019

E. Honig, J.A. Montfoort, R. Dröge, S.E.H. van Mil, B. Guis, K. Baas, B. van Huet and O.R. van Hunnik

#### Transport:

Methodology for the calculation of emissions from the transport sector  
RIVM report 2026-0023

H. Witt, G. Geilenkirchen, M. Bolech, S. Dellaert, E. van Eijk and K. Geertjes

This report includes a separate Excel document with activity data and emission factors: Methodology report transport ER 1990–2024.xlsx

#### Product Use and Service sectors:

Methodology for the calculation of emissions from product usage by consumers, construction and services  
RIVM report 2026-0021

A. Visschedijk, J.A.J. Meesters, M.M. Nijkamp, W.W.R Koch, B.I. Jansen and R. Dröge

#### Agriculture:

Methodology for the calculation of emissions from agriculture - calculations for methane, ammonia, nitrous oxide, nitrogen oxides, non-methane volatile organic compounds, fine particles and carbon dioxide emissions using the National Emission Model for Agriculture (NEMA)  
RIVM report 2026-0020

T.C. van der Zee, A. Bleeker, W. Bussink, H.J.C van Dooren, J.F.M. Huijsmans, H. Kros, J. Mosquera, M. van der Most, K. Oltmer, M. Ros, L. Schulte-Uebbing, G.L. Velthof and S. Weijers

These reports are also available at the website <http://rivm.nl>

## Appendix 5 Combined NFR source category KCA uncertainty analysis

The Approach 2 (Monte Carlo) uncertainty analysis, as described in Section 1.5, makes use of uncertainty information at the level of emission source and also produces results at that level. The level of detail is comparable to the SNAP reporting codes and is more specific than the NFR and GNFR sectors. By using the uncertainty estimates at the emission source level, the identification of key sources is more specific and precise.

The results of the uncertainty analyses at the emission source level are presented in the graphs below. For each substance, the uncertainty estimates (95% confidence level) of the emission sources are plotted against their share of the national total emission. For clarity, the plotted emission sources are classified by GNFR sector. The graphs visualise the emission sources that have a relatively large contribution to the national total and also have a high uncertainty. The addition of the uncertainty as a weight factor provides extra detail to the ranking of the key sources. This information can be helpful in the process of prioritising inventory improvements.

Details of the key sources are provided in the accompanying tables. The emission sources that have a relatively large contribution to the national total and/or also have a high uncertainty are labelled. The tables give a summary of these labelled key sources.

Figure A5.1 Uncertainty estimates (95% confidence level) of emissions sources for NH<sub>3</sub> plotted against their share of the national total emission

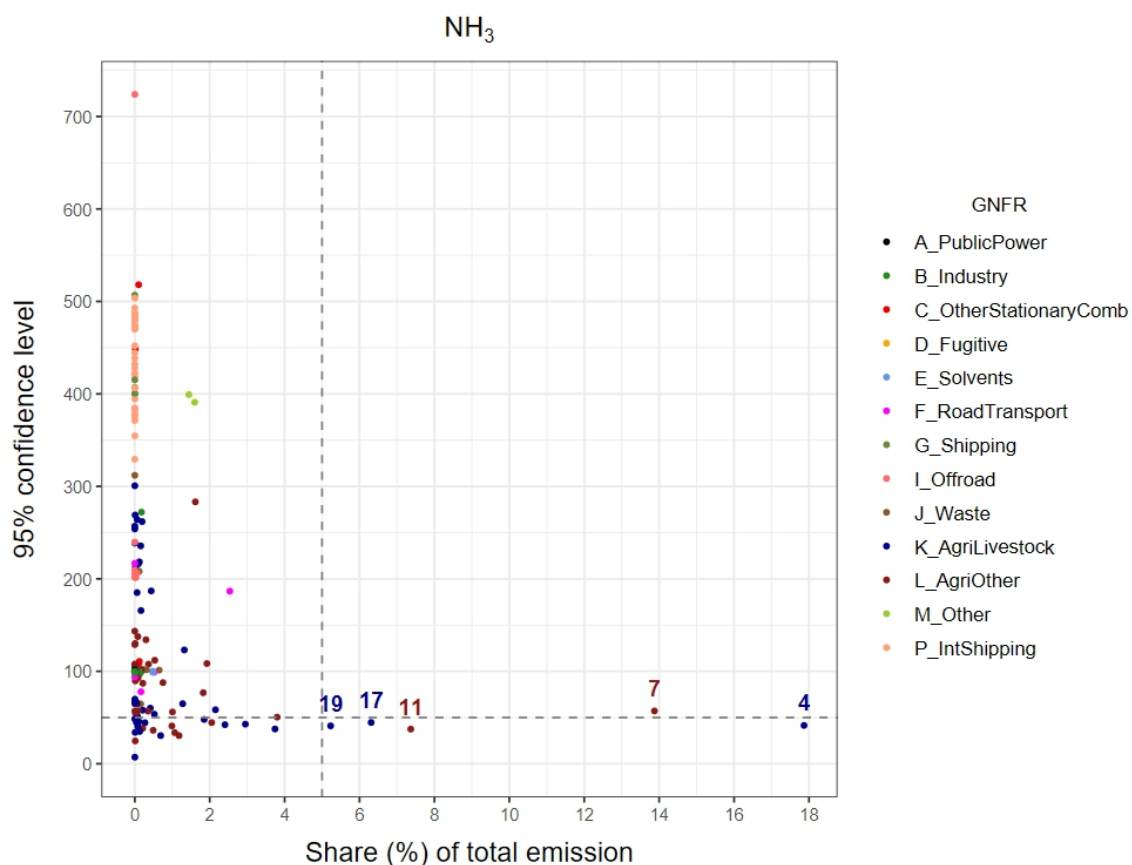


Table A5.1 Emission sources of NH<sub>3</sub> with a relative high uncertainty and contribution to the national total emission (numbers correspond with labels in graph)

#	NFR Code	Long Name	Emission source	Share	Uncertainty estimate
4	3B1a	Manure management - Dairy cattle	Mature dairy cattle, manure in housing	17.9%	41%
7	3Da2a	Animal manure applied to soils	Mature dairy cattle, manure application	13.9%	57%
11	3Da1	Inorganic N fertilisers (includes also urea application)	Fertiliser application	7.4%	37%
17	3B3	Manure management - Swine	Fattening pigs, manure in housing	6.3%	45%
19	3B4gi	Manure management - Laying hens	Laying-hens, manure in housing	5.2%	41%

Figure A5.2 Uncertainty estimates (95% confidence level) of emissions sources for  $\text{NO}_x$  plotted against their share of the national total emission

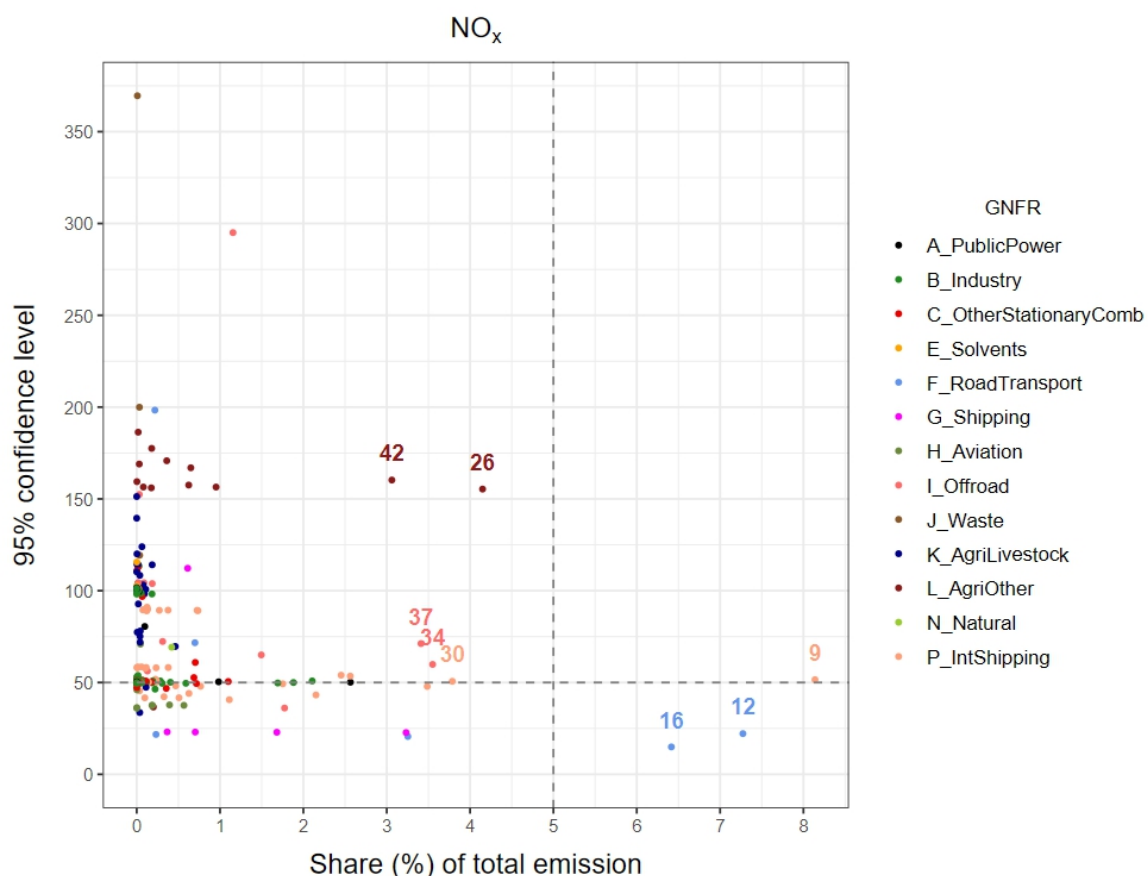


Table A5.2 Emission sources of  $\text{NO}_x$  with a relative high uncertainty and contribution to the national total emission (numbers correspond with labels in graph)

#	NFR Code	Long Name	Emission source	Share	Uncertainty estimate
9	1A3di(i)	International maritime navigation	Sailing, NCP, Container ships	8.1%	52%
12	1A3biii	Road transport: Heavy duty vehicles and buses	Exhaust gas, heavy vehicles	7.3%	22%
16	1A3bi	Road transport: Passenger cars	Exhaust gas, passenger cars	6.4%	15%
26	3Da2a	Animal manure applied to soils	Manure application	4.1%	155%
30	1A3di(i)	International maritime navigation	Sailing, NCP, Roro cargo/Car ships	3.8%	51%
34	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Exhaust gas, mobile machinery - agriculture	3.6%	60%
37	1A2gvii	Mobile combustion in manufacturing industries and construction	Exhaust gas, mobile machinery - building & construction	3.4%	71%
42	3Da1	Inorganic N-fertilizers (includes also urea application)	Fertilizer application	3.1%	160%

Figure A5.3 Uncertainty estimates (95% confidence level) of emissions sources for SO<sub>x</sub> plotted against their share of the national total emission

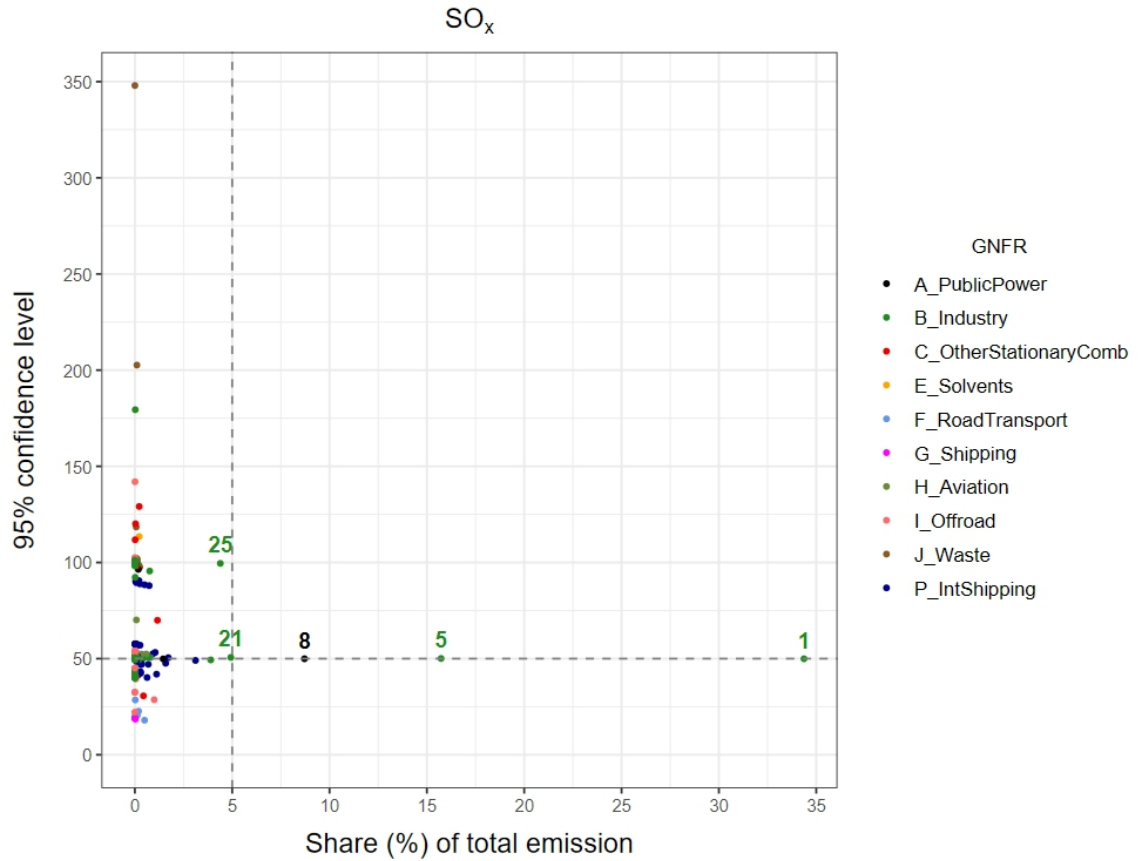


Table A5.3 Emission sources of SO<sub>x</sub> with a relative high uncertainty and contribution to the national total emission (numbers correspond with labels in graph)

#	NFR Code	Long Name	Emission source	Share	Uncertainty estimate
1	1A1b	Petroleum refining	Facilities NACE 19.201: manufacture of refined petroleum products	34.4%	50%
5	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Facilities NACE 24.1-24.3 base metal industry, processing and manufacture of iron and steel	15.7%	50%
8	1A1a	Public electricity and heat production	Facilities NACE 35: production and distribution of electricity and gas	8.7%	50%
21	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	Facilities NACE 23: construction material and glass industry	4.9%	51%
25	2A6	Other mineral products	NACE 23.32: manufacture of bricks and tiles	4.4%	99%

Figure A5.4 Uncertainty estimates (95% confidence level) of emissions sources for NMVOC plotted against their share of the national total emission

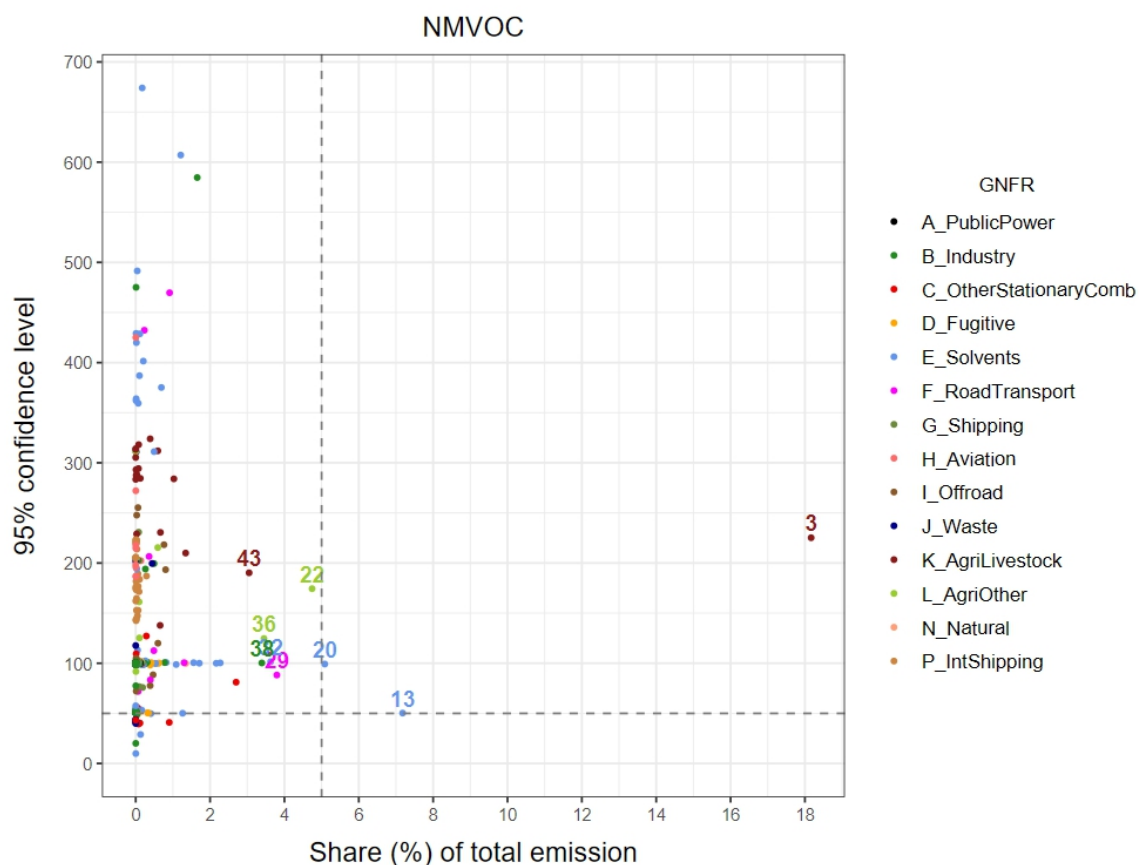


Table A5.4 Emission sources of **NMVOC** with a relative high uncertainty and contribution to the national total emission (numbers correspond with labels in graph)

#	NFR Code	Long Name	Emission source	Share	Uncertainty estimate
3	3B1a	Manure management - Dairy cattle	Mature dairy cattle, manure in housing + storage	18.2%	225%
13	2D3a	Domestic solvent use including fungicides	Solvent and other product use: hand sanitisers	7.2%	50%
20	2D3a	Domestic solvent use including fungicides	Solvent and other product use: cosmetics	5.1%	99%
22	3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	Silage storage	4.7%	174%
29	1A3bi	Road transport: Passenger cars	Exhaust gas, passenger cars	3.8%	88%
32	2D3a	Domestic solvent use including fungicides	Solvent and other product use: car products	3.6%	102%
36	3Da2a	Animal manure applied to soils	Manure application	3.4%	125%

#	NFR Code	Long Name	Emission source	Share	Uncertainty estimate
38	2H3	Other industrial processes	NACE 52.10/52.24: cargo handling and storage	3.4%	100%
43	3B1b	Manure management - Non-dairy cattle	Young cattle breeding, manure in housing + storage	3.0%	190%

Figure A5.5 Uncertainty estimates (95% confidence level) of emissions sources for  $PM_{10}$  plotted against their share of the national total emission

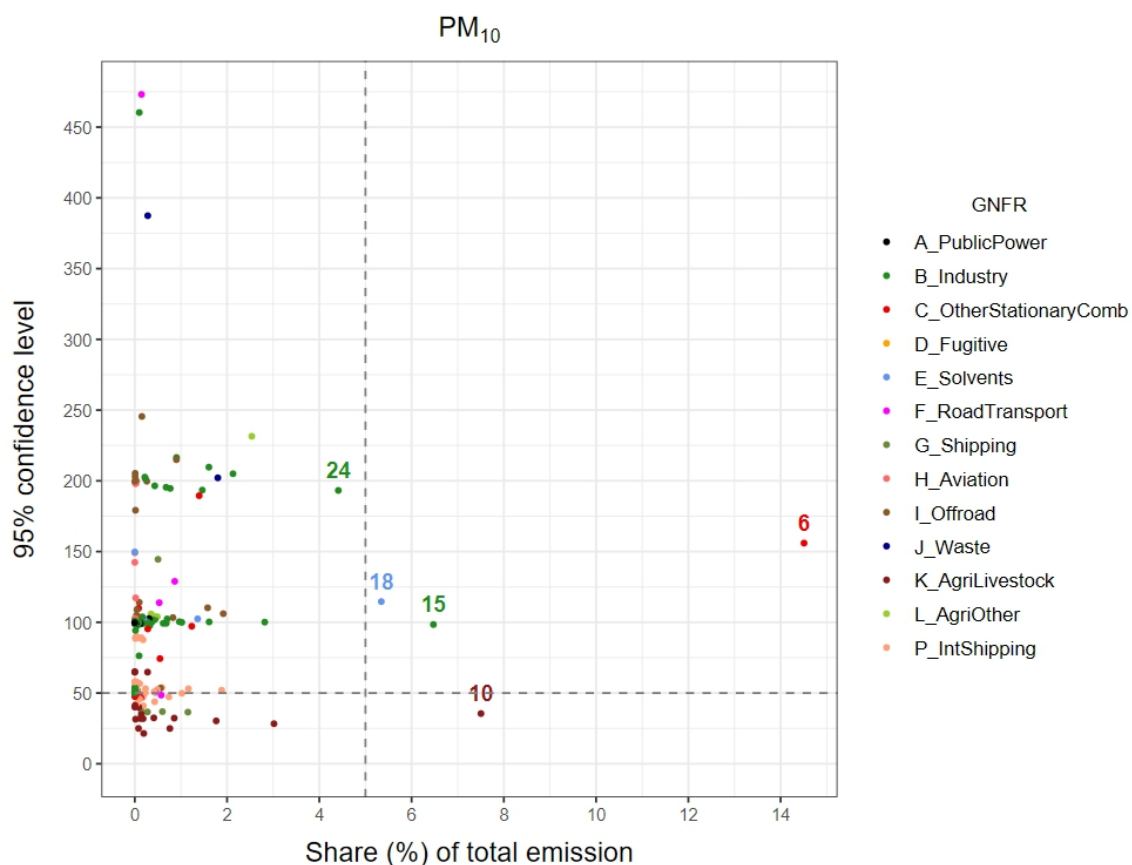


Table A5.5 Emission sources of  $PM_{10}$  with a relative high uncertainty and contribution to the national total emission (numbers correspond with labels in graph)

#	NFR Code	Long Name	Emission source	Share	Uncertainty estimate
6	1A4bi	Residential: Stationary	Residential combustion, wood stoves and fire places	14.5%	156%
10	3B4gi	Manure management - Laying hens	Laying-hens, manure in housing + storage	7.5%	35%
15	2A5b	Construction and demolition	Building and construction sites	6.5%	98%
18	2G	Other product use	Fireworks at new year	5.3%	115%
24	2A6	Other mineral products	NACE 23: construction material and glass industry, diffuse	4.4%	193%

Figure A5.6 Uncertainty estimates (95% confidence level) of emissions sources for PM<sub>2.5</sub> plotted against their share of the national total emission

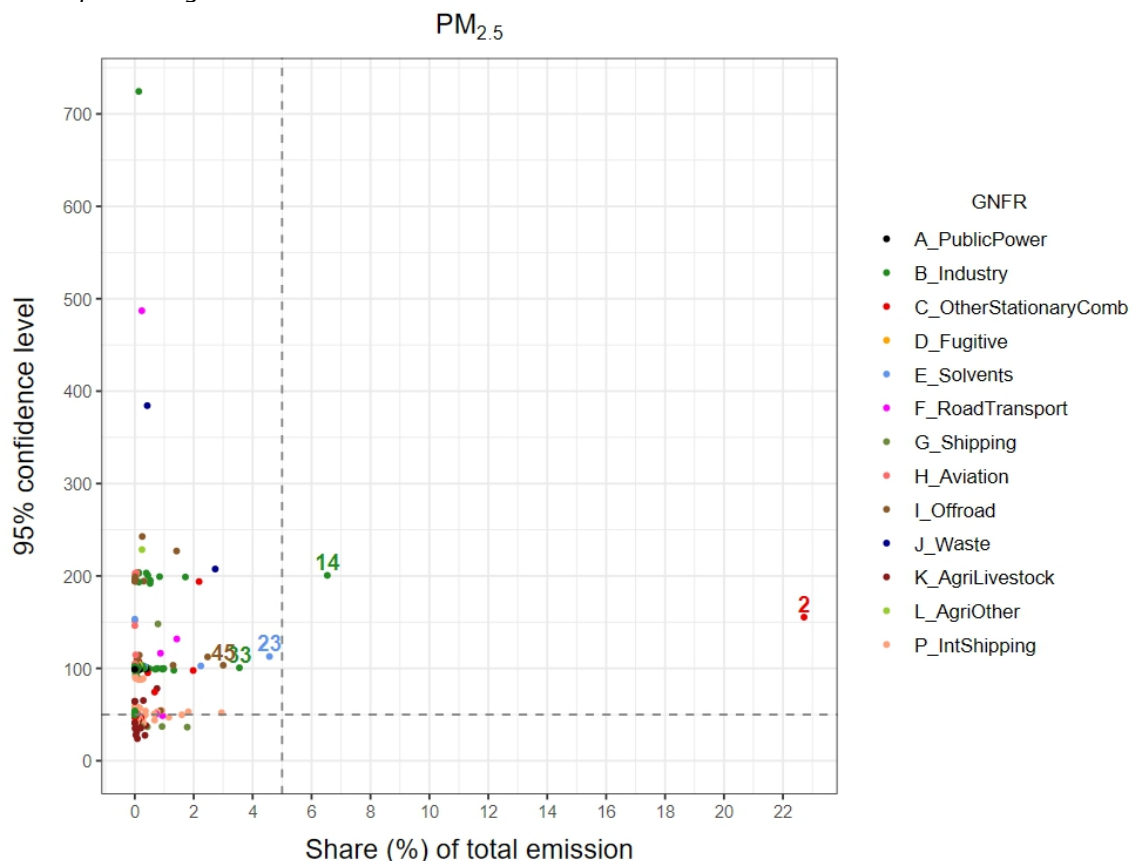


Table A5.6 Emission sources of **PM<sub>2.5</sub>** with a relative high uncertainty and contribution to the national total emission (numbers correspond with labels in graph)

#	NFR Code	Long Name	Emission source	Share	Uncertainty estimate
2	1A4bi	Residential: Stationary	Residential combustion, wood stoves and fire places	22.7%	155%
14	2A6	Other mineral products	NACE 23: construction material and glass industry, diffuse	6.5%	201%
23	2G	Other product use	Fireworks at new year	4.6%	113%
33	1A5b	Construction and demolition	Building and construction sites	3.6%	101%
45	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Exhaust gas, mobile machinery - agriculture	3.0%	103%

## Appendix 6 Data applied for the NMVOC adjustment 3B1a

Table A6.1 Quantification of approved ERC Adjustment Applications

	<b>NMVOC</b>	
	<b>3B1a: Manure management Dairy cattle</b>	
	<b>2005</b>	<b>2020</b>
Activity data (1,000 head)	1,433.202	1,593.071
Adjusted activity data (1,000 head)	1,433.202	1,593.071
AD Revision (%)	0%	0%
EF (Gg/1,000 head)	0.016915827	0.027380637
Adjusted EF	0	0
EF Revision (%)	-/-100%	-/-100%
Emissions (Gg)	24.24	43.62
Adjusted emissions (Gg)	0	0
Adjustment (Gg)	24.24	43.62

## Appendix 7 Verification activities of nitrogen oxides and ammonia emissions with satellite observations

In this annex, reported Dutch emissions of air pollutants are compared with emission estimates derived from satellite observations to verify the reported emissions against an independent data source. Satellite emission estimates were kindly provided by the Royal Netherlands Meteorological Institute (KNMI) and produced with the DECSO algorithm. This annex covers nitrogen oxides (NO<sub>x</sub>) and ammonia (NH<sub>3</sub>) emissions from 2019 until 2024. Compared to the last submission, an updated version of the DECSO algorithm was employed and the resolution of the ammonia data was improved from 0.2 degrees to 0.1 degrees.

### *Summary*

This annex contains a comparison of emission estimates based on satellite observations with reported emissions for nitrogen oxides and ammonia. It should be noted that these are both emission estimates relying on assumptions without one being intrinsically closer to the true emissions in the real world.

For both gases satellite observations largely agreed with the reported emissions. Nitrogen oxide emissions derived from satellite observations were in general slightly lower than the reported emissions, while ammonia emissions were in general slightly larger with large interannual variations. The spatial pattern of the emissions agreed well. The overall decreasing emission trend agreed as well, however, the satellite-based emissions showed much larger inter-annual variability.

### *Data sources and processing*

Emission estimates from atmospheric observations were produced and kindly provided by the Royal Netherlands Meteorological Institute (KNMI). Gratitude is extended to Ronald van der A and Jieying Ding (KNMI) for sharing and discussing the data and for critical reading of this annex. A detailed description of the used data and the algorithm can be found in Van der A et al. (2024), Ding et al. (2024), and Witt et al. (2025). In brief, atmospheric concentrations of NO<sub>x</sub> were derived from the TROPOMI instrument on board of the Sentinel-5P satellite, while NH<sub>3</sub> concentrations were derived from the CrIS instruments on board of the SNPP and NOAA-20 satellites.

To calculate emission estimates from these concentration measurements the DECSO algorithm (Mijling and Van der A, 2012) v6.5 with the CHIMERE chemical transport model was used. DECSO does not require prior emissions as an input, as it uses the emissions of each day as the prior emissions of the subsequent day. The domain for the NO<sub>x</sub> inversion was centered on the Netherlands and reached from 50° N to 54° N and from 2° E to 9° E at a resolution of 0.05°. The domain for the NH<sub>3</sub> inversion reached from 48° N to 54° N and from 1° E to 9° E at a resolution of 0.1°.

Since this domain for which emissions were calculated does not completely include the Dutch part of the North Sea, it was excluded from the analysis based on the spatial distribution of reported emissions. In order to calculate the emissions for the Dutch mainland for 2024, the spatial distribution of 2023 with the emission total of 2024 was used, since the spatial distribution of reported Dutch emissions for 2024 is not yet available.

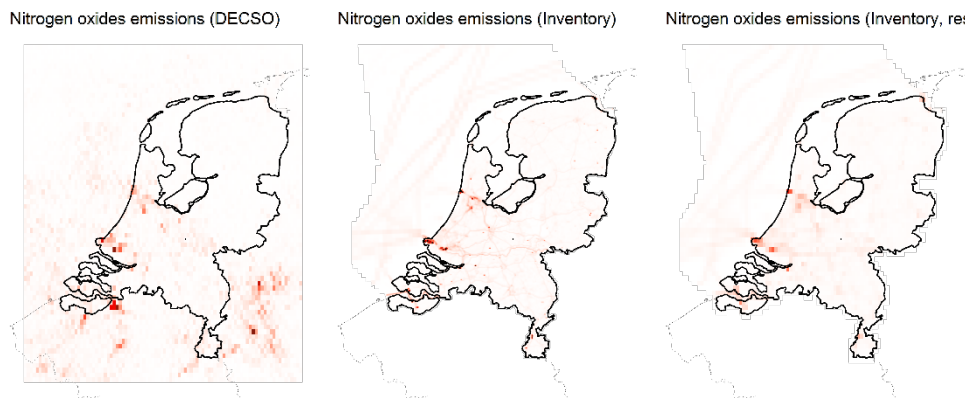
To allow a fair comparison all emissions factually occurring within the Netherlands are taken into account. That means the emissions used here are not calculated strictly following the NEC directive, for example shipping emissions are included and traffic emissions are calculated based on *Fuel Used* and not *Fuel Sold*.

To calculate the national Dutch emissions from the satellite data, pixels within the Netherlands, excluding the Dutch part of the North Sea, were selected. For pixels partially in the Netherlands, the emissions were distributed based on the share of the pixel within the Netherlands. Error bars indicate 95% confidence intervals.

#### *Nitrogen oxides*

A map of NO<sub>x</sub> emissions produced by the DECSO algorithm from satellite observations is shown in Figure A8.1 (left). Due to the high-resolution of 0.05°x0.05°, one can immediately recognize several emission hot spots. In the Netherlands, one can for example clearly identify the Rotterdam area, as well as Amsterdam and different industrial complexes. Outside of the Netherlands, Antwerp, the Ruhr area and German lignite powerplants can be recognized. How well the spatial distribution and location of emission sources is captured in this data set is further emphasized by comparing it to spatially distributed inventory emissions. While the inventory still has a better resolution at 1 km<sup>2</sup>, the two maps show a clear correlation, which becomes even more apparent when the reported emissions are resampled to the resolution of the satellite observations.

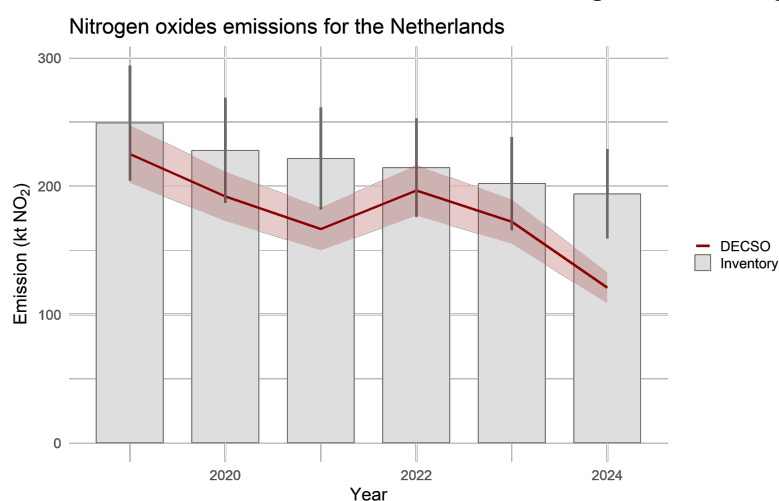
*Figure A8.1 Map of Dutch NO<sub>x</sub> emissions in 2023 according to satellite observations and as reported (in native resolution and resampled to the resolution of the satellite observations)*



In Figure A8.2, total national emissions based on satellite observations were compared to reported emissions. Both datasets agree reasonably

well, with the satellite observations showing slightly lower emissions. On average the satellite-based emissions were 39.2 kt NO<sub>2</sub> lower than the reported emissions (18.5% of reported emissions). Whereas reported emissions continually decreased, DECSO shows stronger inter-annual variations while also showing a general decreasing trend. The smallest deviation was reported for 2022 with 17.6 kt NO<sub>2</sub> (8% of reported emissions) and the largest for 2024 with 73 kt NO<sub>2</sub> (38% of reported emissions).

Figure A8.2 Comparison of the reported Dutch NO<sub>x</sub> emissions with emission estimates derived from satellite observations using the DECSO algorithm

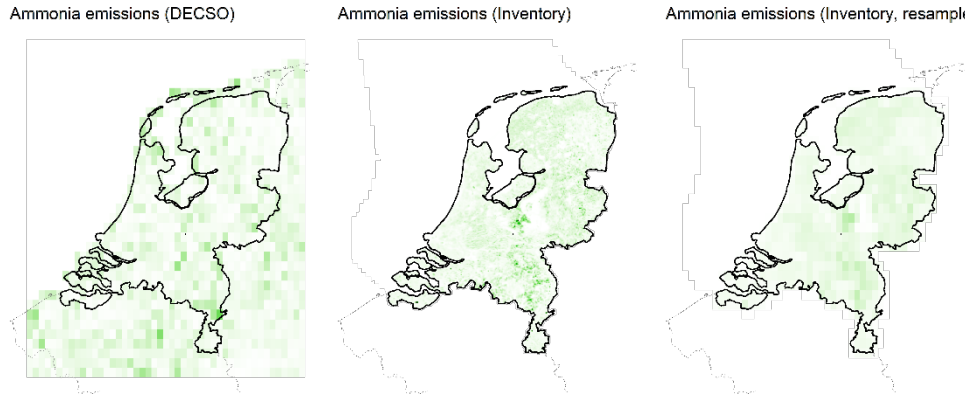


Taken together, both the spatial pattern as well as overall emission levels agreed mostly between satellite observations and reported emissions. A more detailed analysis of these data can be found in Witt et al. (2025). It is so far unclear what causes the differences in inter-annual variability. As large deviations can be observed in 2020 and 2021 an initial suggestion was that this effect was related to the effect of the COVID pandemic. The large deviations observed for 2024 might be related to a version change of the satellite retrieval algorithm (v2.6.0) that impacts all data from 26 Nov. 2023 to 08 Sep. 2024 (KNMI/TEMIS, 2026). This algorithm change was reversed when problems were noticed with its cloud algorithm. This will be further explored in collaboration with KNMI.

### Ammonia

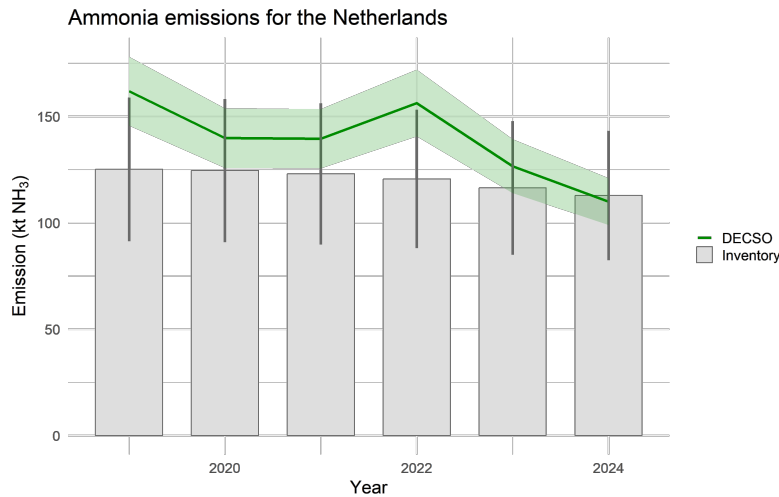
A map of NH<sub>3</sub> emissions produced by the DECSO algorithm from satellite observations is shown in Figure A8.3. One can recognize the area of higher emissions in the central Netherlands (Gelderse vallei), that is also visible in the inventory emission map. Besides that, the emission map shows a rather homogeneous distribution of emissions, which also agrees with the spatial distribution of reported emissions. This becomes especially apparent when the reported emissions are resampled to the resolution of the satellite observations.

Figure A8.3 Map of Dutch NH<sub>3</sub> emissions in 2023 according to satellite observations and as reported (in native resolution and resampled to the resolution of the satellite observations)



A comparison of the total national emissions is shown in Figure A8.4. Both datasets agree reasonably well, with the satellite observations showing in general slightly higher emissions. On average the satellite-based emissions were 18.6 kt higher than the reported emissions (15% of reported emissions). Whereas reported emissions continually decreased, DECSO shows stronger interannual variations while also showing a decreasing trend. The smallest deviation was reported for 2024 where satellite-based emissions were 2.8 kt lower (2.5% of reported emissions) and the largest for 2019 and 2022 with satellite-based emissions that were 36.8 kt and 35.7 kt higher, respectively (29%/30% of reported emissions).

Figure A8.4 Comparison of the reported Dutch ammonia emissions with emission estimates derived from satellite observations using the DECSO algorithm



Taken together, both the spatial pattern as well as overall emission levels agreed mostly between satellite observations and reported emissions. Similarly to nitrogen oxides there is a large inter-annual variability for satellite observations. For ammonia emissions, this could be related to the known temperature dependence of agricultural ammonia emissions. However, it was so far not possible to find a straightforward relation to meteorological parameters as emissions

depend in a complex way on different parameters including temperature, precipitation and agricultural practices.

### *Outlook*

This annex only represents a starting point to more verification activities for emissions of different pollutants. The results presented here illustrate the potential and challenges of these methods. It was found that overall emission levels and spatial emission patterns seemed to fit reasonably well between reported emissions and satellite-based emissions. While the overall decreasing emission trends agreed between the different data, the inter-annual variability of emissions varied strongly. We aim to further investigate these differences in order to improve our understanding; thus paving the way for a further reconciliation of these two independent emission estimates.

Besides attempting to answer the questions raised in these first analyses, it will also be of great interest to further explore the effect of different transport models and inverse modelling algorithms on the resulting emissions. Finally, an aim will be to extend this analysis to more, different pollutants.



N. Staats | M. Bolech | S.N.C. Dellaert | R. Dröge | E. van Eijk |  
E. Honig | B. van Huet | S.E.H. van Mil | R.A.B. te Molder |  
A.J. Plomp | D. Wever | H. Witt | M.C. van Zanten | T. van der Zee

Published by

**National Institute for Public Health  
and the Environment, RIVM**

P.O. Box 1 | 3720 BA Bilthoven  
The Netherlands  
[www.rivm.nl/en](http://www.rivm.nl/en)

April 2026

Committed to health  
and sustainability