



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

National Inventory Document 2026

Greenhouse gas emissions in the Netherlands
1990–2024

RIVM report 2026-0022



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Synopsis

National Inventory Document 2026

Greenhouse gas emissions in the Netherlands 1990–2024

Total greenhouse gas (GHG) emissions in the Netherlands decreased by 1.2 per cent in 2024, compared to the 2023 emissions. This is a smaller reduction than in 2023, when emissions decreased by around 7 per cent. The industry sector (IPPU) emitted more greenhouse gases, while fewer greenhouse gases were emitted in the energy and transport sectors as a result of an increased use of renewables. These are mainly biofuels, wind energy and solar energy. In total, the share of renewable energy accounted for 20 per cent of the total energy consumption in the Netherlands. In 2023, this share amounted to 17 per cent.

The total amount of GHG emissions is expressed in CO₂ equivalents and compared to emissions in the base year 1990. Emissions are converted into CO₂ equivalents to enable adding up the impacts of the various greenhouse gases. The total amount was 144.4 Mt CO₂ eq in 2024. This is 36.3 per cent less than in the base year, when the emissions amounted to 226.6 Mt CO₂ eq. The Dutch Climate Law, in line with the European Climate Law, sets a target of 55 per cent reduction in net greenhouse gas (GHG) emissions by 2030, compared to 1990 levels. It also states a long-term target for the Netherlands to be climate neutral in 2050, which means net zero greenhouse gas emissions.

The CO₂ emissions were 28.9 per cent below the level in the base year. The emissions of the other greenhouse gases (methane, nitrous oxide, and fluorinated gases) have been reduced by 56.9 per cent since 1990.

These figures are derived from the definitive inventory of greenhouse gas emissions from 1990 through 2024. At the request of the Ministry of Climate Policy and Green Growth (KGG), RIVM updates this inventory every year. Thus, the Netherlands complies with the national reporting obligations for 2026 set out by the United Nations Framework Convention on Climate Change (UNFCCC), the Paris Agreement, and the Governance Regulation of the Energy Union (EU 2018/1999) and implementing regulations. In the autumn of 2025, the preliminary emission figures for 2024 were published.

This report contains an analysis on GHG emissions trends between 1990 and 2024. It also includes an assessment of the main sources of GHGs (key sources), a description of the uncertainty in the emissions estimates, and descriptions of the calculation methods and data sources used. Last, this report contains a general description of the quality assurance system and of how the Dutch Emission Inventory checks its data (QA/QC plan).

Keywords: greenhouse gases, emissions, trends, methodology, climate, renewable energy sources, international

Publiekssamenvatting

National Inventory Document 2026

Emissies van broeikasgassen tussen 1990 en 2024

In 2024 is in Nederland in totaal 1,2 procent minder broeikasgassen naar de lucht uitgestoten dan in 2023. Dit is een kleinere daling dan in 2023, toen de uitstoot met ongeveer 7 procent afnam. De industrie stootte in 2024 meer broeikasgassen uit, maar de energie- en transportsector minder door het gebruik van meer hernieuwbare energiebronnen. Dat zijn vooral biobrandstoffen, windenergie en zonne-energie. In totaal vormen de hernieuwbare energiebronnen 20 procent van het energieverbruik in Nederland. In 2023 was dit 17 procent.

De totale hoeveelheid uitgestoten broeikasgassen wordt uitgedrukt in CO₂-equivalenten en vergeleken met het basisjaar 1990. De uitstoot wordt omgerekend naar CO₂-equivalenten om de invloed van de verschillende broeikasgassen te kunnen optellen. De totale hoeveelheid was in 2024 144,4 megaton CO₂-equivalenten. Dat is 36,3 procent lager dan in het basisjaar, toen de totale hoeveelheid 226,6 megaton CO₂-equivalenten was. In de Nederlandse klimaatwet staat, in lijn met de Europese klimaatwet, dat de netto uitstoot van broeikasgassen in 2030 minstens 55 procent lager moet zijn dan in het basisjaar 1990. En dat Nederland in 2050 klimaatneutraal moet zijn, oftewel netto geen broeikasgassen meer uitstoot.

De uitstoot van het broeikasgas CO₂ is 28,9 procent lager dan die in het basisjaar. De uitstoot van de andere broeikasgassen (methaan, distikstofoxide en gefluoreerde gassen) is sinds 1990 met 56,9 procent gedaald.

Deze gegevens komen uit de definitieve inventarisatie van broeikasgasemissies in de jaren 1990 tot en met 2024 die het RIVM elk jaar op verzoek van het ministerie van Klimaat en Groene Groei (KGG) maakt. Hiermee voldoet Nederland aan de nationale rapportageverplichtingen voor 2026 van het Klimaatverdrag van de Verenigde Naties (UNFCCC), van het Akkoord van Parijs en van de Europese verordening (2018/1999) over de governance van de energie-unie en de klimaatactie. In het najaar van 2025 zijn de voorlopige emissiecijfers over 2024 gepubliceerd.

De inventarisatie geeft ook inzicht in ontwikkelingen in de uitstoot van broeikasgassen tussen 1990 en 2024. Verder is er een analyse van de belangrijkste bronnen die broeikasgassen uitstoten. Ook is de onzekerheid in de berekening van deze uitstoot beschreven, net als de gebruikte berekeningsmethoden en databronnen. Tot slot wordt het kwaliteitssysteem beschreven en hoe de Nederlandse Emissieregistratie de berekeningen controleert (QA/QC plan).

Kernwoorden: broeikasgassen, emissies, trends, methodiek, klimaat, hernieuwbare energiebronnen, internationaal

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Executive summary

ES.1. Background information on greenhouse gas (GHG) inventories and climate change

This report documents the Netherlands' annual submission of its greenhouse gas (GHG) emissions inventory for 2026, in line with the annual reporting requirements under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement (PA). It contributes to fulfilling the reporting requirements under the Governance Regulation of the Energy Union (EU 2018/1999) and implementing regulations. The report has been prepared in line with the reporting guidelines provided in Decisions by the UNFCCC Conference of the Parties (COP) and the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA).

Note that this report provides no specific information on government policies for reducing GHG emissions. Such information can be found, for example, in the Netherlands State of the Environment Report 2025 (PBL, 2025) (biennial edition; in Dutch: *Balans van de Leefomgeving*) prepared by the Netherlands Environmental Assessment Agency (PBL), in the first Biennial Transparency Report of the Netherlands under the Paris Agreement (RVO, 2024), in the Climate and Energy Outlook 2025 (PBL, TNO, Statistics Netherlands and RIVM, 2025), and in the updated National Energy and Climate Plan 2021–2030 (EZK, 2024).

The Enhanced Transparency Framework (ETF) tooling and corresponding Common Reporting Tables (CRT), containing data on emissions, activity data, and implied emission factors (IEFs), accompany this report. The complete set of CRT tables, as well as the NID 2026 in PDF format, are also available on <http://english.rvo.nl/nie>.

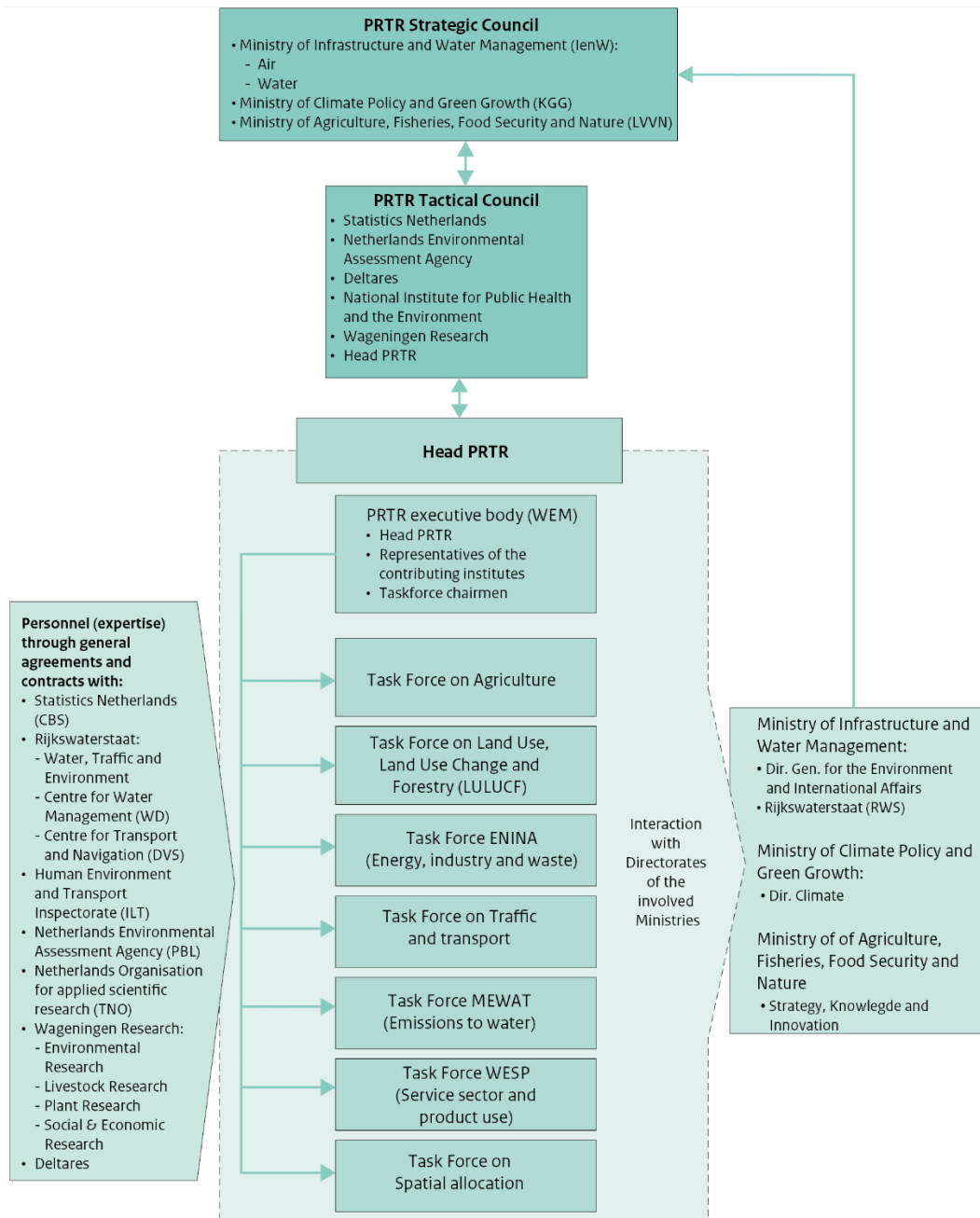
Please note that a detailed description of the calculation methods for the various CRT sectors can be found in the corresponding methodology reports, which form an integral part of the inventory. The calculation methods are adjusted and updated every year according to the most recent scientific insights.

Institutional arrangements for inventory preparation

The GHG emissions inventory process of the Netherlands is an integral part of the national Pollutant Release and Transfer Register (NL-PRTR). Figure ES.1 shows the structure of the inventory process and the bodies responsible for each stage.

The Ministry of Infrastructure and Water Management and the Ministry of Climate Policy and Green Growth (KGG) have contracted the National Institute for Public Health and the Environment (RIVM) to compile and maintain the PRTR and to coordinate the annual preparation of the NID and the completion of the CRT tables.

Figure ES.1 Organisational arrangements for the Dutch PRTR project



Methodology reports

Emissions data are reported in accordance with the 2006 IPCC Guidelines (IPCC, 2006) and for a significant part (where indicated), the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Methodologies have been incorporated. The methodologies are described in methodology reports. The present CRT/NID is based on these methodology reports, which are part of the submission. Table ES.1 provides an overview of the methodology reports. More detailed references are included in Annex 7 and are also available at <http://english.rvo.nl/nie>. The methodology reports, and any

changes in them, have been prepared and approved under the lead of the Chair of the respective PRTR Task Force. Moreover, the methodology reports are reviewed and approved by the National Inventory Entity (NIE).

Table ES.1 Overview of the methodology reports and their references as used in the NID

Title	Report number	Reference in text	CRT categories
Methodology for the calculation of emissions to air from the sectors Energy, Industry and Waste	RIVM report 2026-0019	Honig et al.	1 (excluding 1.A.3), 2 and 5
Methodology for the calculation of emissions from the transport sector	RIVM report 2026-0023	Witt et al.	1.A.3
Methodology for the calculation of emissions from product usage by consumers, construction, and services	RIVM report 2026-0021	Visschedijk et al.	Parts of CRT 1.A.4.b, 2.D.2, 2.G.3, 2.G.4, and 5.C.2
Methodology for the calculation of emissions from agriculture	RIVM report 2026-0020	Van der Zee et al.	3
Greenhouse gas reporting of the LULUCF sector in the Netherlands	Methodological background, update 2026, WOt-technical report 298	Van Baren et al.	4

Base year

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

ES.2. Summary of trends related to national emissions and removals

In 2024, total GHG emissions (including indirect CO₂ emissions and emissions from LULUCF) in the Netherlands were estimated at 144.4 Mt (Megaton) CO₂ equivalents (CO₂ eq). This is approximately 36.3% below total emissions in the base year 1990 (226.6 Mt CO₂ eq).

CO₂ emissions (including indirect CO₂ emissions and emissions from LULUCF) in 2024 were 28.9% lower than in 1990. CH₄ emissions in 2024 were 50.0% below 1990 levels, mainly due to decreased emissions from the Waste sector and the Agriculture sector. N₂O emissions decreased by 59.1% in 2024 compared to 1990, mainly due to decreases in emissions from Agriculture and from Industrial processes and product use (IPPU).

Compared to the base year, the emissions of F-gases (HFCs, PFCs and SF₆) decreased by 81.9%, 99.0% and 37.8%, respectively (see Table ES.2). Total emissions of all F-gases were 86.2% lower than in 1990, partly as a result of the Netherlands' programme for reducing emissions of non-CO₂ greenhouse gases. Figure ES.2 shows a graphical representation of these trends.

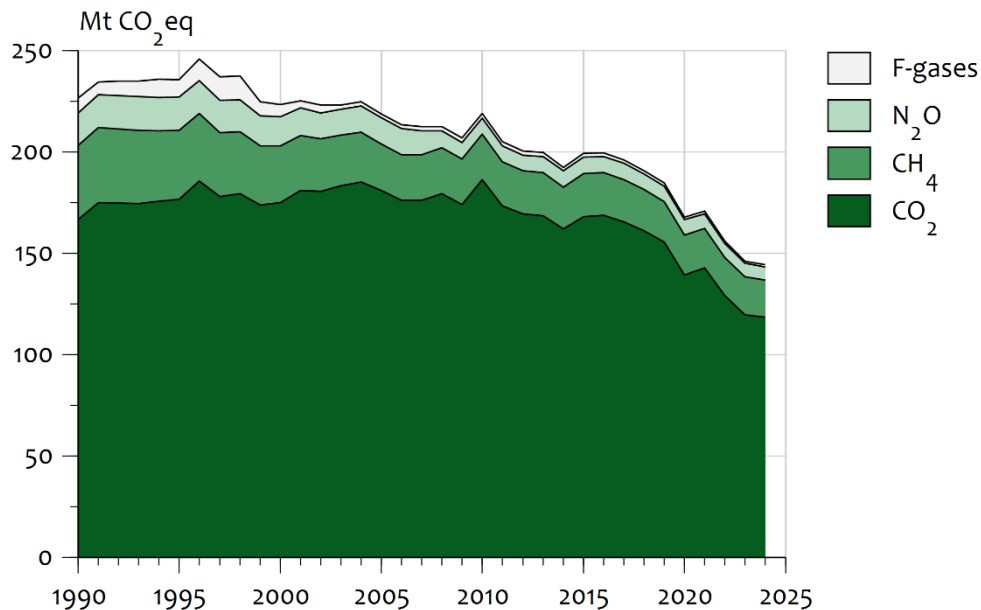
Table ES.2 Summary of emissions trends per gas (Mt CO₂ equivalents, including LULUCF and indirect CO₂ emissions), 1990–2024 (differences due to rounding)

	CO₂ incl. LULUCF and indirect	CH₄ incl. LULUCF	N₂O incl. LULUCF	HFCs	PFCs	SF₆	Total (incl. LULUCF and indirect)
1990	166.7	36.5	16.1	4.7	2.4	0.21	226.6
1995	176.7	34.0	16.2	6.3	2.1	0.26	235.6
2000	175.1	27.9	14.3	4.0	1.7	0.24	223.3
2005	181.1	23.0	12.9	1.3	0.33	0.16	218.7
2010	186.3	22.4	7.9	2.0	0.29	0.11	219.0
2015	168.2	21.1	8.1	1.7	0.10	0.12	199.3
2020	139.4	19.7	7.5	1.0	0.06	0.13	167.8
2023	119.8	18.6	6.6	0.90	0.04	0.11	146.1
2024	118.5	18.3	6.6	0.85	0.03	0.13	144.4

Compared to 2023, GHG emissions in 2024 decreased by 1.2%. The changes for the specific gases were as follows (please note that differences compared to table ES.2 are due to rounding):

- CO₂ emissions (including LULUCF) decreased by 1.0% (-1.2 Mt CO₂) – mainly in the categories 1.A.1 Energy industries (-1.1 Mt CO₂) – due to reduced gaseous and liquid fuel consumption, and 1.A.3 Transport (-1.1 Mt CO₂) due to reduced diesel consumption. The CO₂ emissions in category 1.A.2 Manufacturing industries increased by 0.6 Mt in 2024. The amount of energy from renewables and waste in the Netherlands accounted for 19.8% of final energy consumption in the Netherlands in 2024, a year-on-year increase by 17.4% compared to 2023.
- CH₄ emissions decreased by 2.1% (-0.4 Mt CO₂ eq), mainly due to a small decrease in emissions in 3A (Enteric fermentation) and 5.A (Solid waste disposal on land).
- N₂O emissions decreased slightly by 0.48% (-0.03 Mt CO₂ eq) due to small decreases in some categories, such as category 3.D (Agricultural soils), and slightly increased emissions in other categories.
- F-gas emissions decreased by 3.8% (-0.04 Mt CO₂ eq). Emissions of all F-gases decreased (HFC emissions decreased by 5.5% or 0.05 Mt CO₂ eq, PFC emissions by 40.1% or 0.02 Mt CO₂ eq and SF₆ emissions by 25.7% or 0.03 Mt CO₂ eq). Fluctuations in F-gas emissions over the past few years are mainly due to market circumstances. The main decrease for both HFCs in 2024 stemmed from category 2.B.9 (Fluorochemical production) and 2.F (Product uses as substitutes for ODS). The main decrease for PFCs was in category 2.E.1 (Integrated circuit or semiconductor).

Figure ES.2 Overview of trends in GHG emissions per gas (including LULUCF), 1990–2024



ES.3. Overview of source and sink category emission estimates and trends

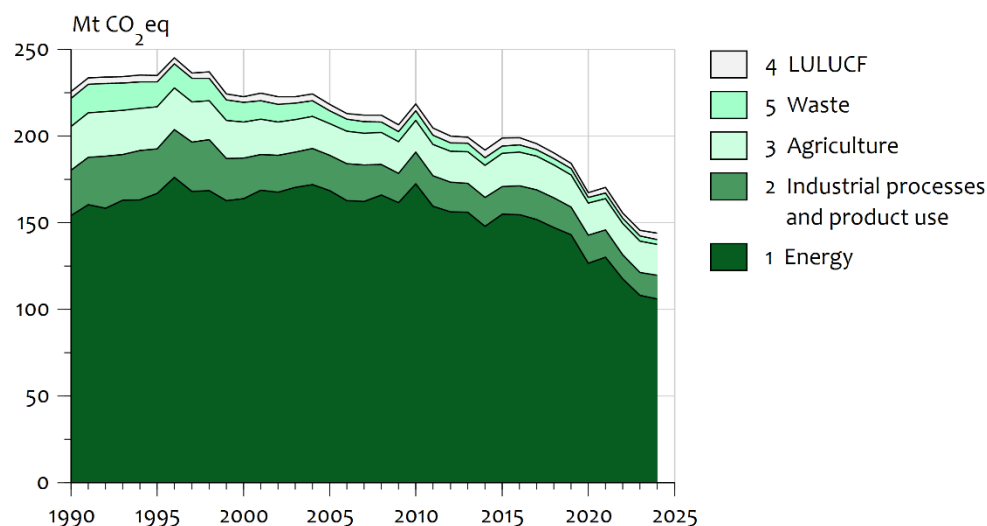
Together, Table ES.3 and Figure ES.3 provide an overview of the emissions trends (in CO₂ eq) per IPCC sector. The Energy sector is by far the largest contributor to national total GHG emissions. In 2024, emissions from this sector were about 31.1% lower than in 1990. Emissions from all sectors were lower than in the base year, the largest relative decreases being in Waste and IPPU.

In this inventory, all major source categories show a decrease in CO₂ equivalent emissions compared to 1990. Only a few source categories show an increase in emissions since 1990, e.g. category 1.A.1.a Other fuels (+1.8 Mt CO₂), 1.A.1.b Petroleum refining: gases (+0.8 Mt CO₂), 1.A.3.b Road transportation: gasoline (+1.6 Mt CO₂), 1.A.3.d Domestic navigation (+0.4 Mt CO₂), 3.A.1 Cattle: mature dairy cattle (+0.4 Mt CO₂ eq), 3.A.4 Other livestock (+0.2 Mt CO₂ eq), 4.A.2 Land converted to forest land (+0.3 Mt CO₂), 4.C grassland (+0.1 Mt CO₂), 4.E Settlements (0.5 Mt CO₂), 4.F Other land +0.05 Mt CO₂) and 4.G Harvested wood products (+0.2 Mt CO₂).

Table ES.3 Summary of emissions trends per sector (Mt CO₂ equivalents, with all indirect emissions included in the IPPU sector), 1990–2024

	1. Energy	2. IPPU	3. Agriculture	4. LULUCF	5. Waste	Total (incl.) LULUCF
1990	154.1	27.0	25.4	3.8	16.3	226.6
1995	166.9	26.3	24.4	3.7	14.4	235.6
2000	163.8	24.0	20.8	3.4	11.3	223.3
2005	168.4	20.8	18.4	3.6	7.5	218.7
2010	172.4	18.8	18.4	4.0	5.5	219.0
2015	154.9	16.4	19.2	4.5	4.2	199.3
2020	126.6	16.5	18.5	2.8	3.4	167.8
2023	108.1	13.7	18.1	3.3	3.0	146.1
2024	106.1	14.0	17.7	3.7	2.9	144.4

Figure ES.3 Overview of trends in GHG emissions per sector (incl. LULUCF), 1990–2024



ES.4. Other information

Emissions trends for indirect GHGs and precursor gases

Compared to 1990, CO and NMVOC emissions were reduced in 2024 by 66.6% and 61.0%, respectively. For SO₂, the reduction amounted to 92.0%; for NO_x, the 2024 emissions were 73.2% below the 1990 level. Table ES.4 provides trend data. Further documentation on these gases can be found in the annual Informative Inventory Report (IIR, Staats et al., 2026).

Table ES.4 Emissions trends for indirect GHGs and SO₂ (in kt)

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Total NO_x	675.3	572.5	483.6	426.9	344.9	270.8	212.2	185.8	180.7
Total CO	1187.8	948.7	761.1	728.3	658.8	526.5	439.2	400.9	396.9
Total NMVOC	600.0	432.0	334.3	268.3	272.8	257.1	253.2	238.0	234.1
Total SO₂	197.6	136.4	78.1	67.6	36.1	31.0	19.7	17.5	15.8

ES.5. Key category analysis

The IPCC Approach 1 method consists of ranking the list of source category/gas combinations according to their contribution to annual national total emissions and to the national total trend (for details of the Approach 1 analysis, see the corresponding methodology reports). The key categories are those whose emissions add up to 95% of the national total (including LULUCF): 43 categories for annual level assessment (emissions in 2024) and 49 categories for the trend assessment. In total, the Netherlands reports 139 source categories.

The IPCC Approach 2 method for the identification of key categories requires the incorporation of the uncertainty in each of these source categories before ordering the list of shares. This has been carried out using the uncertainty estimates presented in Annex 2. Here, a total contribution of up to 90% to the overall uncertainty has been used to avoid the inclusion of too many small sources. The results of the Approach 1 and Approach 2 level and trend assessments are summarised in Annex 1. A combination of Approach 1 and 2 and level and trend assessments yield a total of 67 key categories, including LULUCF.

On the basis of the Approach 1 level assessment, the five major key sources in the Netherlands are shown in Table ES.5. Together, these five key sources account for 40% of total emissions in 2024 (CO₂ eq).

Table ES.5 The five largest key sources in the Netherlands

CRT category	Name	Gas
1.A.3.b	Road transportation: gasoline	CO ₂
1.A.1.a	Public electricity and heat production: gaseous	CO ₂
1.A.2	Manufacturing industries and construction: gaseous	CO ₂
1.A.1.a	Public electricity and heat production: solids	CO ₂
1.A.4.b	Residential: gaseous	CO ₂

For further details about the key category analysis, see section 1.4 and Annex 1.

ES.6. Improvements introduced

Since the NIR 2025 (Van der Net et al., 2025), some improvements to the inventory (including recalculations) have been implemented, which are documented in this NIR 2026. The rationale behind the recalculations is documented in Chapters 3–9 and their impacts on the inventory are summarised in Chapter 10. Table ES.5 presents the results of these recalculations in the NIR 2026 compared to the figures reported in the NIR 2025.

Table ES.5 Differences between the NIR 2025 and NIR 2026 for the 1990–2024 period resulting from recalculations (units: Mt CO₂ eq; for F-gases: kt CO₂ eq)

Gas	Source	1990	2000	2010	2020	2023
CO ₂ [Mt]	NIR 2026	165.8	174.5	185.9	139.0	119.3
	NIR 2025	166.8	175.9	186.3	139.6	120.1
	<i>Difference</i>	-0.6%	-0.8%	-0.3%	-0.5%	-0.7%
CH ₄ [Mt CO ₂ eq]	NIR 2026	36.5	27.9	22.4	19.7	18.6
	NIR 2025	36.5	27.9	22.3	19.5	18.4
	<i>Difference</i>	0.2%	0.2%	0.3%	0.9%	1.1%
N ₂ O [Mt CO ₂ eq]	NIR 2026	16.1	14.3	7.9	7.5	6.6
	NIR 2025	16.1	14.4	7.9	7.5	6.6
	<i>Difference</i>	0.1%	-0.1%	0.0%	0.1%	0.3%
PFCs [kt CO ₂ eq]	NIR 2026	2396.6	1715.2	290.5	61.8	41.9
	NIR 2025	2396.6	1715.2	290.5	61.8	41.9
	<i>Difference</i>	0.0%	0.0%	0.0%	0.0%	0.0%
HFCs [kt CO ₂ eq]	NIR 2026	4697.2	4029.3	1978.0	1011.4	901.9
	NIR 2025	4697.2	4029.3	1978.0	1026.9	688.4
	<i>Difference</i>	0.0%	0.0%	0.0%	-1.5%	31.0%
SF ₆ [kt CO ₂ eq]	NIR 2026	213.1	235.6	108.1	128.4	105.3
	NIR 2025	213.1	235.6	108.1	128.4	105.3
	<i>Difference</i>	0.0%	0.0%	0.0%	0.0%	0.0%
Total [Mt CO ₂ eq]	NIR 2026	226.6	223.3	219.0	167.8	146.1
	NIR 2025	227.5	224.6	219.4	168.3	146.4
	<i>Difference</i>	-0.4%	-0.6%	-0.2%	-0.3%	-0.2%

1 National circumstances, institutional arrangements and cross-cutting information

1.1 Background information on greenhouse gas inventories and climate change

This report documents the Netherlands' annual submission of its greenhouse gas (GHG) emissions inventory for 2026, in line with the United Nations Framework Convention on Climate Change (UNFCCC) and the annual reporting requirements under the Paris Agreement. The report is also in line with reporting requirements under the Governance Regulation of the Energy Union (EU 2018/1999) and implementing regulations.

The report has been prepared in line with the reporting guidelines provided in Decisions by the UNFCCC Conference of the Parties (COP) and the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA).

This report is structured as follows:

- Chapter 1 documents the National System as approved by the UNFCCC review in 2007 (and reconfirmed in 2017).
- 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:
 - o Energy (sector 1);
 - o Industrial processes and product use (IPPU, sector 2);
 - o Agriculture (sector 3);
 - o Land use, land-use change and forestry (LULUCF, sector 4);
 - o Waste (sector 5);
 - o Other (sector 6).
- Chapter 9 describes indirect CO₂ emissions.
- Chapter 10 documents recalculations and improvements since the previous report (NIR 2025).
- The annexes provide information on key categories, uncertainty analysis, inverse modelling results, and other detailed information.

This chapter provides accompanying information to the national greenhouse gas inventory, including a description of the National System, QA/QC procedures, key categories, uncertainties, and a general description of data sources.

1.1.1 Background information on climate change reporting

Climate Convention, Kyoto Protocol and Paris Agreement

The United Nations Framework Convention on Climate Change (UNFCCC) was ratified for the European part of the Netherlands in 1994 and took effect in March 1994. In 2005, the convention's Kyoto Protocol (KP) came into force. Rules for Monitoring, Reporting, and Verification (MRV), initially agreed under the Convention itself, were further

extended in the KP under Articles 5, 7, and 8, and implemented successively. The National System for the Netherlands under Article 5.1 of the KP was reviewed (Article 8 of the KP) and accepted in 2007. The greenhouse gas (GHG) inventory is prepared annually under this National System. The UNFCCC (in-country) review of the BTR/NIR 2024, which took place in March/April 2025, confirmed that the Netherlands' inventory and inventory process continues to be in line with the requirements for National Systems.

Following the transition from the Kyoto Protocol to the Paris Agreement, the national arrangements for the preparation of the inventory (including quality assurance and control procedures) must still be implemented and maintained, similar to the previous requirements.

The annual National Inventory Report (NIR) submitted under the UNFCCC and Paris Agreement consists of the National Inventory Document (NID) and accompanying Common Reporting Tables (CRTs). The Netherlands' NIR is prepared in accordance with the Modalities, procedures and guidelines (MPGs) for the transparency framework for action and support referred to in Article 13 of the Paris Agreement (Decision 18/CMA.1)¹; and the structure of this report follows the suggested outline of the national inventory document (Decision 5/CMA.3, Annex V)². In line with the MPGs, the methodologies applied to calculating the emissions are in accordance with the 2006 IPCC Guidelines, as well as with the 2019 Refinement to the 2006 IPCC Guidelines where relevant, and can be found in this report and the methodology reports.

Geographical coverage

The reported emissions are those that derive from the legal territory of the Netherlands. This includes inland water bodies and coastal waters in a zone stretching 12 nautical miles from the coastline. It excludes the constituent countries of the Kingdom of the Netherlands: Aruba, Curaçao and Sint Maarten. It also excludes Bonaire, Saba and Sint Eustatius, which have been public bodies (*openbare lichamen*) since 10 October 2010 with their own legislation, which is not applicable to the European part of the Netherlands. Emissions from offshore oil and gas production on the Dutch part of the continental shelf are included.

1.1.2

Background information on the GHG emissions inventory

The NID and CRT cover the seven direct GHGs: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃) (the last four are termed the 'F-gases'). For reasons of data confidentiality, NF₃ emissions cannot be reported separately; therefore, they are included in the PFC emissions. Note that chlorofluorocarbons (CFCs) are not reported, as they are covered by the Montreal Protocol.

The Netherlands reports total GHG emissions including indirect CO₂ emissions (originating from the use and/or evaporation of NMVOC). The following *indirect* GHG emissions are also reported: nitrogen oxides

¹ <https://unfccc.int/sites/default/files/resource/10a1.pdf>

² [CMA2021_L10a2E.pdf](#)

(NO_x); carbon monoxide (CO); non-methane volatile organic compounds (NMVOC); and sulphur oxides (SO_x).

This report provides explanations for the trends in GHG emissions per gas and per sector for the 1990–2024 period. Moreover, it summarises the methods and data sources used for the assessments of the uncertainty in annual emissions and in emissions trends, as well as for the Key Category Assessment following Approaches 1 and 2 from the 2006 IPCC Guidelines.

This inventory report does not include detailed assessments of the extent to which changes in emissions are due to the implementation of policy measures. This information can be found in, among others, the 1st Biennial Transparency Report of the Netherlands under the Paris Agreement (RVO, 2024) and the Climate and Energy Outlook 2025 (PBL, TNO, Statistics Netherlands, RIVM 2025).

The Netherlands also reports emissions under other international agreements. All emissions estimates are adopted from the Netherlands' Pollutant Release and Transfer Register (PRTR), which is compiled by various cooperating organisations, described in Box 1.

They form one unique database, which is used to ensure consistency regarding all internationally reported data.

In line with the requirements of the national arrangements for the preparation of the inventory, the methodologies for calculating GHG emissions in the Netherlands are updated on an annual basis. Since 2015, emissions data has been calculated according to the 2006 IPCC Guidelines (IPCC, 2006) and, for a significant part (where indicated), according to the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

The methodologies applied in the NIR 2026 are documented in five methodology reports. These reports are an integral part of this submission (see Annex 7) and are available on the website: <http://english.rvo.nl/nie>. The methodology reports are prepared and approved under the lead of the PRTR Task Force Chair. Any changes in methodologies are also reviewed by the National Inventory Entity (NIE). Changes in methodologies are described in the relevant chapters. Chapter 10 documents the recalculations and improvements made following the recommendations in the latest reviews.

The CRT spreadsheet files accompany this document as electronic annexes. The CRT contains detailed information on GHG emissions, activity data, and (implied) emission factors (EFs) by sector, source category, and GHG. The National Inventory Report (NIR) comprises the complete CRT and this National Inventory Document (NID), which is available on <http://english.rvo.nl/nie>.

1.2 A description of national circumstances and institutional arrangements

1.2.1 *National entity or national focal point*

The Ministry of Climate Policy and Green Growth (KGG) has overall responsibility for climate change policy issues, including the preparation of the National GHG Emissions Inventory.

The National System was finalised and established by the end of 2005 and is described in greater detail in the first Biennial Transparency Report of the Netherlands under the Paris Agreement (RVO, 2024).

As part of this system, the Act on the Monitoring of Greenhouse Gases also took effect in December 2005. This Act required the establishment of the National System for the monitoring of GHGs and empowered the Climate Policy and Green Growth Minister of Economic Affairs and Climate Policy (EZK, now Climate Policy and Green Growth (KGG)) to appoint an authority responsible for the National System and the National GHG Emissions Inventory. In a subsequent regulation, the Minister appointed the Rijksdienst voor Ondernemend Nederland (RVO) as the NIE, the single national entity required under the Kyoto Protocol. Following the end of the second commitment period under the Kyoto Protocol and the transition to reporting under the Paris Agreement, national arrangements for the preparation of the inventory still have to be maintained, similar to the previous requirements. Additionally, under EU regulation Member States have to operate, and seek to continuously improve, a national inventory system in accordance with UNFCCC requirements on national systems. This obligation is included in the EU's Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action ('Governance Regulation') and elaborated in implementing acts.

In addition to coordinating the establishment and maintenance of a National System, RVO was tasked with the coordination of improved QA/QC activities as part of the National System, as well as with the coordination of support/response to the UNFCCC review process. EZK (now KGG) assigned the National Institute for Public Health and the Environment (RIVM) as the institute responsible for coordinating the compilation and maintenance of the pollutants emission register/inventory (PRTR system), which includes GHGs. The main purpose of the PRTR project is the production of an annual set of emissions data that is up to date, complete, transparent, comparable, consistent, and accurate. The PRTR project system is used as the basis for the GHG emissions documented in this NID and for the completion of the CRT. RIVM coordinates the annual compilation of the NIR.

1.2.2 *Inventory preparation process*

1.2.2.1 The Dutch PRTR

The Dutch PRTR system has been in operation since 1974. This system encompasses data collection, data processing, and registering and reporting emissions data for approximately 375 policy-relevant compounds and compound groups present in air and water. The emissions data are produced in an annual cycle (RIVM, 2025).

In addition to RIVM, various external agencies contribute to the PRTR by performing calculations or submitting activity data (see Box 1).

Box 1: Pollutant Release and Transfer Register (PRTR)

Responsibilities regarding the coordination of the PRTR

Major decisions on tasks and priorities are taken by the Steering Committee ER (SCER) by approving the Annual Work Plan. This committee consists of representatives of the commissioning ministries, regional governments, RIVM, Statistics Netherlands (CBS) and the Netherlands Environmental Assessment Agency (PBL).

As per September 2020, the SCER was split into a Strategic Board, consisting of representatives of the commissioning ministries (Ministries of Infrastructure and Water Management; Climate Policy and Green Growth; and Agriculture, Fisheries, Food Security and Nature), and a Tactical Board, consisting of representatives of the various external agencies and RIVM (see Figure 1.1). The Strategic Board formally approves the Annual Work Plan.

The Head of PRTR at RIVM is responsible for the PRTR process; the outcomes of that process are the responsibility of the bodies involved. The collaboration of the various bodies is ensured by means of contracts, covenants, or other agreements.

Task Forces

Emissions experts from the participating organisations take part in the Task Forces that calculate national emissions from ~500 relevant emission sources. After intensive checking, national emissions figures are accepted by the Head of PRTR and the dataset is stored in the Central Database.

The ~500 relevant emissions sources are logically divided into 48 work packages. An emissions expert is responsible for one or more work packages, for data collection, and for emissions calculation. The experts are also closely involved in developing the methodologies for calculating the emissions. Work packages are assigned to the seven Task Forces described below.

Task Force on Energy, Industry and Waste Management (ENINA)

Covers emissions to air from the industry, energy production, refinery, and waste management sectors. ENINA includes emissions experts from the following organisations: RIVM, TNO, Statistics Netherlands, and Rijkswaterstaat Environment (Waste Management Department).

Task Force on Transportation

Covers emissions to soil and air from the transport sector (aviation, shipping, rail, and road transport). PBL, Rijkswaterstaat, Statistics Netherlands, RIVM, and TNO participate in this task force.

Task Force on Agriculture

Covers the calculation of emissions to soil and air from agriculture. Participating organisations include RIVM, PBL, Wageningen Research

(WR, including Wageningen Environmental Research, Wageningen Livestock Research, Wageningen Plant Research, and Wageningen Social and Economic Research), and Statistics Netherlands.

Task Force on Water (MEWAT)

Covers the calculation of emissions from all sectors to water. MEWAT includes experts from Rijkswaterstaat, Deltares, RIVM, Statistics Netherlands, Wageningen Environmental Research, and TNO.

Task Force on Consumers and Other Sources of Emissions (WESP)

Covers emissions caused by consumers, trade, and services. The members are emissions experts from RIVM and TNO.

Task Force on Land Use, Land-Use Change and Forestry (LULUCF)

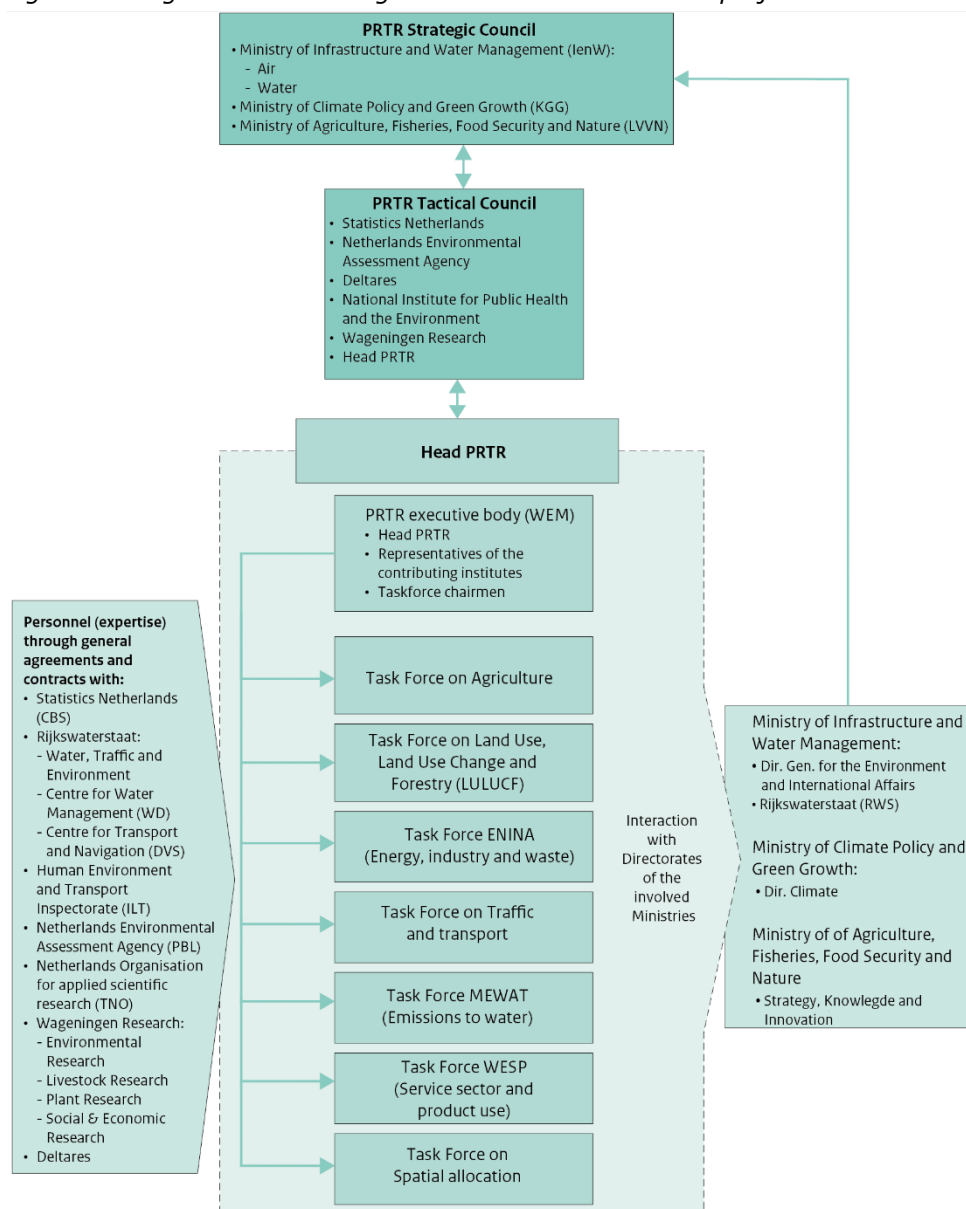
Covers the calculation of sources and sinks from Land use, land-use change and forestry. The LULUCF task force includes emission experts from the following organisations: Wageningen Research (WR, including Wageningen Environmental Research), PBL, Deltares, and RIVM.

Task Force on spatial allocation

This task force does not calculate emissions but geographically distributes the emissions throughout the Netherlands instead. The task force includes emission experts from Wageningen Research (WR, including Wageningen Environmental Research), TNO, Statistics Netherlands, Deltares, RIVM, and PBL.

These Task Forces are responsible for assessing the emissions estimates. RIVM commissioned TNO to assist in the compilation of the CRT. A complete overview of the organisational arrangements of the PRTR project are shown in Figure 1.1.

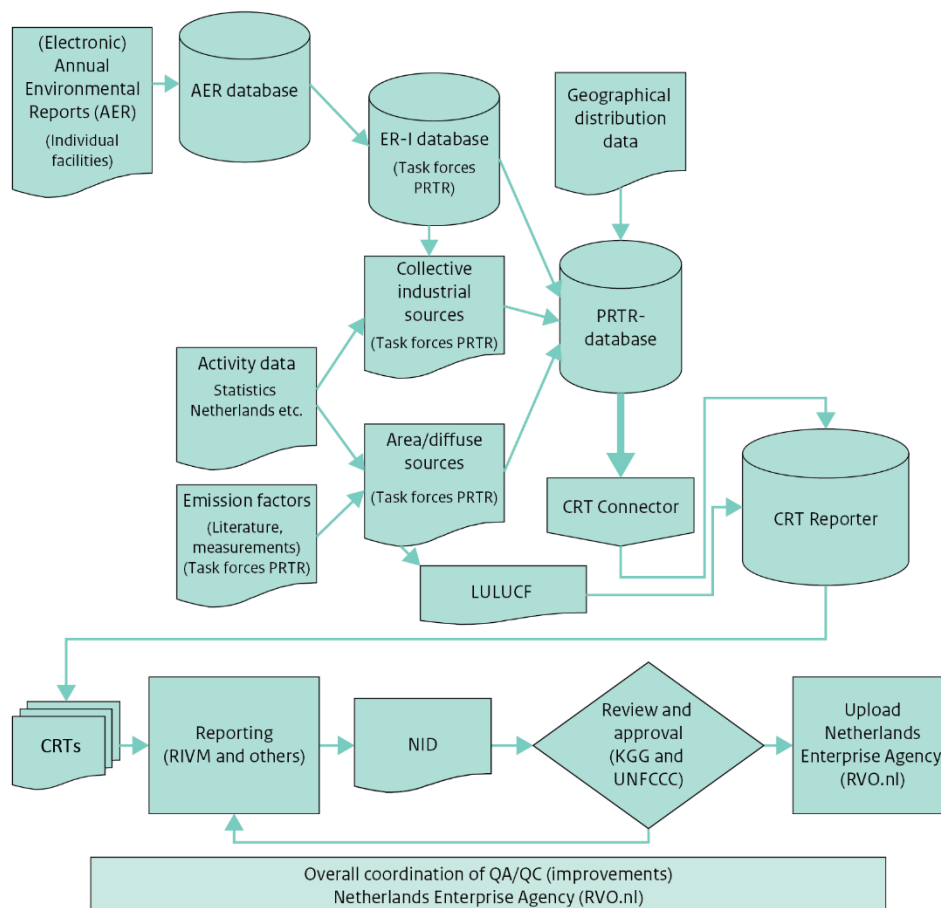
Figure 1.1 Organisational arrangements for the Dutch PRTR project



1.2.2.2 GHG inventory data collection process

The primary process for preparing the GHG emissions inventory in the Netherlands is summarised in Figure 1.2.

Figure 1.2 Main elements in the GHG emissions inventory process



Various data suppliers provide the basic input data for emissions estimates. The principal data sources for GHG emissions are:

Statistical data

Statistical data are provided under various (not specifically GHG-related) obligations and legal arrangements. These include national statistics from Statistics Netherlands and various other sources of data on sinks, water, and waste. The provision of relevant data for GHGs is guaranteed through covenants and an Order in Decree prepared by KGG. For GHGs, agreements with Statistics Netherlands and Rijkswaterstaat Environment with respect to waste management are in place.

Data from individual companies

Legal obligation

Data from individual companies is provided in the form of electronic annual environmental reports (e-AERs). A large number of companies have a legal obligation to submit an e-AER that includes – in addition to other environment-related information – emissions data validated by the competent authorities (usually regional implementing agencies and occasionally local authorities) that also issue environmental permits to these companies.

Any industrial activity in the Netherlands requires an environmental permit. As part of the permit application, the operator has to submit a documented account of the plant's emissions and production capacity. On the basis of these data, the competent authority will set (emissions) limits in the environmental permit. The determination of the applicable (emissions) limits is based on national policies and the specific expertise of the competent authorities. This expertise is also used in the annual verification of the emissions in the environmental reports. The national inventory relies on this verification and only performs sample checks on the data. This procedure is only possible due to the country-specific situation in the Netherlands, where industry is fully aware of the need for the emissions reductions that are required by legislation. This results in open and constructive communications between plant operators and competent authorities on activity levels and emissions. For this reason, the inventory team minimise their verification of the emissions data from individual companies.

Some companies provide data voluntarily within the framework of environmental covenants. Large companies are also obliged to participate in the European Emission Trading System (EU-ETS). They have to report their CO₂ emissions in specific annual ETS emissions reports.

Use of company-specific data for emissions calculations

For the calculation of combustion emissions, standard emission factors (based on the Dutch fuel list, see Annex 5) are used. In specific cases, company-specific emission factors are used. This refinement is mainly applied to companies using fuels with potentially non-standard emission factors and companies with significant emissions. For further information, see the ENINA methodology report in section 2.1.3.3 (Honig et al., 2026).

Occasionally, data from individual companies is also used to calculate process emissions; for example, for the production of methanol, silicon carbide, carbon black, and titanium oxide. Further information on the calculation method of process emissions can be found in Honig et al. (2026), paragraph 2.2.3.

For the emissions figures for precursor gases (CO, NO_x, NMVOC, and SO₂) from industrial sources, the e-AERs from individual companies are used directly, providing information that is essential for calculating emissions for companies that do not submit e-AERs.

Confidentiality of company information

Many Dutch industrial (sub)sectors consist of a single company. This is the reason why, for some sectors, the Netherlands cannot report activity data (confidential business information) in the NID or CRT at the most detailed level. Although this may hamper the review process, all confidential data can and will be made available to the EU and UNFCCC review teams on request.

Additional GHG-related data

Additional GHG-related data are provided by other institutes and consultants specifically contracted to provide information on sectors not sufficiently covered by the above-mentioned data sources. For example, RIVM has contracts and financial arrangements with various agricultural institutes and TNO.

In 2004, the Ministry of Agriculture, Nature and Food Quality (LNV (now LNVN)) contracted a number of agricultural institutes to develop a monitoring system and methodology description for the LULUCF dataset. In accordance with a written agreement between the Ministry of Climate Policy and Green Growth (KGG) and RIVM, these activities also form part of the PRTR.

1.2.3 *Archiving of information*

The preparation of the NIR includes the documentation and archiving of statistical data for the estimates and QA/QC activities. RVO is responsible for coordinating QA/QC and responses to the EU, as well as for providing additional information requested by the UNFCCC once the NID and the CRT have been submitted. RVO is also responsible for coordinating the submission of supporting data for the UNFCCC review process. KGG formally approves the NIR prior to submission; in some cases, approval follows consultation with other ministries. See section 1.5 for further information on the QA/QC plan.

Data processing and storage are coordinated by RIVM. These processes notably consist of the elaboration of emissions estimates and data preparation in the PRTR database. The emissions data are stored in a central database, thus efficiently and effectively satisfying national and international criteria for emissions reporting. Using the Enhanced Transparency Framework (ETF) tooling and corresponding Common Reporting Tables (CRT), all relevant emissions and activity data are extracted from the PRTR database, thus ensuring the highest level of consistency. The data from the CRT is used in the compilation of the NIR.

1.2.4 *Processes for official consideration and approval of inventory*

RIVM is responsible for the preparation of the NIR, using input from the relevant PRTR Task Forces and from RVO in its role as the NIE. RVO is responsible for submission to the UNFCCC in its role as the NIE, following approval by KGG.

1.3 Brief general description of methodologies (including tiers used) and data sources used

1.3.1 *Methodologies*

Table 1.1 provides an overview of the methods used to estimate GHG emissions. Methodology reports documenting the methodologies, data sources, and QA/QC procedures used in the GHG emissions inventory of the Netherlands, as well as other key documents, are listed in Annex 3.

The sector-specific chapters of this report provide a brief description of the methodologies applied to estimating the emissions from each key category.

Table 1.1 CRT Summary Table 3 with methods and EFs applied

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂		CH ₄		N ₂ O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
1. Energy	T1,T2,T3,CS,NA	D,CS,PS,NA	T1,T1b,T2,T3,OTH,NA	D,CS,PS,OTH,NA	D,T1,T2,NA	D,CS,NA
1.A. Fuel combustion	T1,T2,CS,NA	D,CS,NA	T1,T2,T3,NA	D,CS,NA	D,T1,T2,NA	D,CS,NA
1.A.1. Energy industries	T2,CS,NA	D,CS,NA	T1,T2,NA	D,CS,NA	D,T1,NA	D,NA
1.A.2. Manufacturing industries and construction	T1,T2,NA	D,CS,NA	T1,T2,T3,NA	D,CS,NA	D,T1,T2,NA	D,CS,NA
1.A.3. Transport	T1,T2,NA	D,CS,NA	T1,T2,T3,NA	D,CS,NA	T1,T2,NA	D,CS,NA
1.A.4. Other sectors	T1,T2,NA	D,CS,NA	T1,T2,NA	D,CS,NA	T1,T2,NA	D,CS,NA
1.A.5. Other	T2,NA	CS,NA	T2,NA	CS,NA	T2,NA	CS,NA
1.B. Fugitive emissions from fuels	T1,T2,T3,CS,NA	D,CS,PS,NA	T1,T1b,T2,T3,OTH,NA	D,CS,PS,OTH,NA	NA	NA
1.B.1. Solid fuels	T2,NA	CS,NA	OTH,NA	OTH,NA	NA	NA
1.B.2. Oil and natural gas and other emissions from energy production	T1,T2,T3,CS,NA	D,CS,PS,NA	T1,T1b,T2,T3,NA	D,CS,PS,NA	NA	NA
1.C. CO ₂ transport and storage	NA	NA				
2. Industrial processes	T1,T1a,T2,T3,CS,NA	D,CS,PS,NA	T1,CS,NA	D,CS,NA	T1,T2,T3,CS,NA	CS,PS,OTH,NA
2.A. Mineral industry	T1,T3,CS,NA	D,PS,NA	NA	NA	NA	NA
2.B. Chemical industry	T1,T3,CS,NA	D,CS,NA	T1,CS,NA	CS,NA	T1,T2,T3,NA	CS,PS,OTH,NA
2.C. Metal industry	T1a,T2,NA	D,PS,NA	NA	NA	NA	NA
2.D. Non-energy products from fuels and solvent use	T1,T3	D,CS	T1,NA	D,NA	NA	NA
2.E. Electronic Industry					NA	NA
2.F. Product uses as ODS substitutes						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂		CH ₄		N ₂ O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
2.G. Other product manufacture and use	CS,NA	CS,NA	T1,CS	CS	T1,CS,NA	CS,NA
2.H. Other	T1	CS	NA	NA	NA	NA
3. Agriculture	T1,NA	D,NA	T1,T2,T3,NA	D,CS,NA	T1,T1b,T2,NA	D,CS,NA
3.A. Enteric fermentation			T1,T2,T3,NA	D,CS,NA		
3.B. Manure management			T1,T2,NA	D,CS,NA	T1,NA	CS,NA
3.C. Rice cultivation			NA	NA		
3.D. Agricultural soils			NA	NA	T1,T1b,T2,NA	D,CS,NA
3.E. Prescribed burning of savannahs			NA	NA	NA	NA
3.F. Field burning of agricultural residues			NA	NA	NA	NA
3.G. Liming	T1	D				
3.H. Urea application	T1	D				
3.I. Other carbon-containing fertilisers	NA	NA				
3.J. Other	NA	NA	NA	NA	NA	NA
4. Land use, land-use change and forestry	T1,T2,T3,CS,NA	D,CS,NA	T1,T2,CS,NA	D,CS,NA	T1,T2,CS,NA	D,CS,NA
4.A. Forest land	T1,T2,NA	D,CS,NA	T1,T2,NA	D,CS,NA	T1,NA	D,CS,NA
4.B. Cropland	T1,T3,CS,NA	D,CS,NA	T2,NA	CS,NA	T2,NA	D,CS,NA
4.C. Grassland	T1,T2,T3,CS,NA	D,CS,NA	T2,CS,NA	D,CS,NA	T2,CS,NA	D,CS,NA
4.D. Wetlands	T1,T2,NA	D,CS,NA	T2,NA	D,NA	T1,NA	D,NA
4.E. Settlements	T1,T2,CS,NA	D,CS,NA	NA	NA	T2,NA	D,CS,NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂		CH ₄		N ₂ O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
4.F. Other land	T1,T2,CS,NA	D,CS,NA	NA	NA	T2,NA	D,CS,NA
4.G. Harvested wood products	T2,NA	D,NA				
4.H. Other	NA	NA	NA	NA	NA	NA
5. Waste	CS,NA	CS,NA	T1,T2,CS,NA	D,CS,NA	T1,T2,CS,NA	D,CS,NA
5.A. Solid waste disposal			NA	NA		
5.B. Biological treatment of solid waste			T1,T2,NA	CS,NA	T1,NA	CS,NA
5.C. Incineration and open burning of waste	CS,NA	CS,NA	CS,NA	CS,NA	CS,NA	CS,NA
5.D. Waste water treatment and discharge			T1,T2	D,CS	T2,NA	D,NA
5.E. Other	NA	NA	NA	NA	NA	NA
6. Other (as specified in summary 1)	NA	NA	NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs		PFCs		Unspecifi ed mix of HFCs and PFCs		SF ₆		NF ₃	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
2. Industrial processes	T2,CS,NA	CS,NA	T2,CS,NA	CS,NA	NA,NO	NA,NO	CS,NA	CS,NA	NA	NA
2.A. Mineral industry										
2.B. Chemical industry	T2,NA	CS,NA	T2,NA	CS,NA	NA,NO	NA,NO	NA	NA	NA	NA
2.C. Metal industry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.D. Non-energy products from fuels and solvent use										
2.E. Electronic Industry	NA	NA	CS,NA	CS,NA	NA	NA	NA	NA	NA	NA
2.F. Product uses as ODS substitutes	T2,CS,NA	CS,NA	NA	NA	NA	NA	NA	NA	NA	NA
2.G. Other product manufacture and use	NA	NA	NA	NA	NA,NO	NA,NO	CS,NA	CS,NA	NA	NA
2.H. Other	NA	NA	NA	NA						

Abbreviations: CS = country-specific, D=default, T1 = Tier 1, T2 = Tier 2 and T3 = Tier 3

1.3.2 *Data sources*

The methodology reports provide detailed information on the activity data used for the inventory. In general, the following primary data sources supply the annual activity data used in the emissions calculations:

- Fossil fuel data: (1) Statistics Netherlands national energy statistics (Energy Balance); (2) natural gas and diesel consumption in the agricultural sector (Wageningen Social and Economic Research (WSER); (3) (residential) biofuel data: Statistics Netherlands national renewable energy statistics (Renewable Energy).
- Transport statistics: (1) monthly statistics for traffic and transport; (2) Statistics Netherlands national renewable energy statistics (Renewable Energy).
- Industrial production statistics: (1) individual company AERs; (2) national statistics; (3) occasional confidential personal data from companies; (4) ETS reports as a data source and for QA/QC reasons.
- Consumption/emissions of PFCs and SF₆: reported by individual firms.
- Refrigerant use data from inspection authorities: data on filling, reusing, dismantling, and retrofitting stationary cooling installations, for calculating HFC emissions from stationary cooling.
- Data from EU F-gas portal, summarised by EEA.
- Data from individual companies about use of metered-dose inhalators.
- Anaesthetic gas: data provided by the three suppliers in the Netherlands for the period up to 2019. Should not all suppliers provide their data, gap filling is performed on the basis of market shares. For 2022, data are provided by the Dutch organisation for anaesthesiology (Nederlandse Vereniging voor Anesthesiologie, NVA).
- Spray cans containing N₂O: the Dutch Association of Aerosol Producers (Nederlandse Aerosol Vereniging, NAV).
- Animal numbers and Manure production and handling: Statistics Netherlands /WSER agricultural database, data from the annual agricultural census and the I&R system of RVO.
- Fertiliser statistics and distribution: WSER agricultural statistics and the INITIATOR model from WEnR.
- Forest and wood statistics:
 - stem volume, annual growth, carbon balance: data from five National Forest Inventories: HOSP (1988–1992), 5th National Forest Inventory (NFI-5, 2001–2005), 6th National Forest Inventory (NFI-6 2012–2013), 7th National Forest Inventory (NFI-7 2017–2021), and the first three years of the 8th National Forest Inventory (NFI-8 2022–2026);
 - harvest data: wood balance data from the National Forest Inventories NFI-5, NFI-6, NFI-7, and NFI-8, in combination with FAO harvest statistics;
 - FAO and Probos data on imports, exports, and production of sawn wood, wood panels, and paper and paperboard from 1961 onwards.
- Land use and land-use change: based on digitised and digital topographical maps from 1990 (Kramer and Van Dorland, 2009),

2004 (Kramer et al., 2007), 2009 (Kramer and Clement, 2016), 2013 (Kramer and Clement, 2015), 2017 (Kramer, 2019), 2021 (Kramer and Los, 2022), and 2025 (Hazeu et al. 2023).

- Soil maps: De Vries et al. (2003) and 2014 update (De Vries et al., 2014) and projected map 2040 (Erkens et al., 2021).
- Soil information system: information on soil profiles, soil organic matter, and bulk density (Finke et al., 2001; Kuikman et al., 2003; De Groot et al., 2005; Lesschen et al., 2012; Knotters et al., 2022).
- RothC and Miterra models for calculating carbon stock changes in managed mineral soils under agricultural use.
- SOMERS model for calculating emissions from coastal organic soils (Erkens et al., 2022).
- Waste treatment in incineration plants, composting and digestion of organic waste, amount landfilled, and CH₄ recovery from landfills: Working Group on Waste Registration (WAR), Rijkswaterstaat Environment, and Statistics Netherlands.
- Wastewater data: national statistics from Statistics Netherlands, individual company AERs.

Many recent statistics are available on the Statistics Netherlands' statistical website StatLine (CBS, 2026) and from the Statistics Netherlands /PBL/RIVM Environmental Data Compendium (CLO, 2026). It should be noted, however, that the units and definitions used for domestic purposes on these websites may differ from those used in this report (for instance: temperature-corrected CO₂ emissions versus actual emissions in this report; in other cases, emissions are presented with or without the inclusion of organic CO₂ and with or without LULUCF sinks and sources).

1.4 Brief description of key categories

The analysis of key categories is performed in accordance with the 2006 IPCC Guidelines. To facilitate identification of key categories, the contribution made by categories to total emissions is classified per gas, according to the IPCC potential key category list, as presented in volume 1, chapter 4, table 4.1 of the 2006 IPCC Guidelines. An extensive overview of the results of the key category analysis (KCA) is provided in Annex 1 of this report. The key categories are also listed per sector in Chapters 3 to 9. Please note that the Netherlands uses a country-specific aggregation. This is because of the differences in uncertainty estimates of emissions within categories, for example for fuels (disaggregation by main fuel type). The KCA is used for the prioritisation of possible inventory improvement actions.

Two approaches to performing the KCA have been used. In Approach 1, key categories are identified using a pre-determined cumulative emission threshold. Key categories are those categories that, when listed in descending order of magnitude, add up to 95% of the total national inventory level. In Approach 2, uncertainties are included for activity data, emission factors, and total emissions. Here, key categories are those categories that, together, are responsible for 90% of the uncertainty at the total national inventory level. The method of

error propagation is used to calculate the total uncertainty per category resulting from the uncertainties in activity data and emission factors. Apart from the level assessment, a trend assessment is performed. The level assessment looks at the contribution made by each source or sink category to the total national inventory level. The trend assessment identifies those categories that may not be large enough to be identified by means of the level assessment, but should still receive particular attention since their trends differ significantly from the trend of the overall inventory. As with the level assessment, the trend assessment is performed with and without the incorporation of uncertainty data, the latter being based on error propagation.

The IPCC Approach 1 method (without uncertainties) has 43 categories for the annual level assessment (emissions in 2024) and 49 categories for the trend assessment out of a total of 140 source categories. A combination of Approaches 1 and 2 (the last one including uncertainties), level and trend assessments, amounts to a total of 67 key categories including LULUCF.

1.5 Brief general description of QA/QC plan and implementation

1.5.1.1 Information on the QA/QC plan

As part of its National System, the Netherlands has developed and implemented a QA/QC programme. This programme is assessed annually and updated as necessary. The key elements of the current programme (RVO, 2023) are summarised in this chapter, notably those relating to the NIR. For more detailed information on the QA/QC programme, please see [Quality assurance and quality control \(rvo.nl\)](https://rvo.nl/en/quality-assurance-and-quality-control).

1.5.1.2 QA/QC procedures for the CRT/NID 2026

The system of methodology reports was developed and implemented in order to increase the inventory's transparency, including methodologies, procedures, tasks, roles, and responsibilities. Transparent descriptions of all these elements are included in the methodology reports for each gas and sector as well as in process descriptions for other relevant tasks in the National System. The methodology reports are assessed annually and updated as necessary.

The generic annual data and QC process is as follows. The responsible experts (in Dutch: 'werkvelddrekkers') within the respective PRTR Task Forces fill in a standard-format database with emissions data for the time series – this year, the data relates to 1990–2024 (with the exception of the LULUCF data, which is delivered via a separate submission). This standard-format database is uploaded to and stored in the national emissions database. Following a first check of the data by RIVM for completeness, the (corrected) data are made available to the relevant Task Forces for consistency checks and trend analyses (comparability, accuracy).

Several weeks before the current dataset was fixed, a trend verification workshop was organised by RIVM (on 4 December 2025). The verification process is described in more detail in section 1.5.1.3. The workshop's conclusions, including those with respect to how the experts should resolve issues for improvement identified during the workshop,

are documented and collected by RIVM. After collecting these various issues from the workshop, the Task Forces add other inventory improvement actions (e.g. from review actions). These improvement actions are then prioritised within the Task Forces and, in consultation with the PRTR head, it is decided which improvements points the task forces will execute and implement in the year to come..

QA for the current NIR 2026 also includes the following activities:

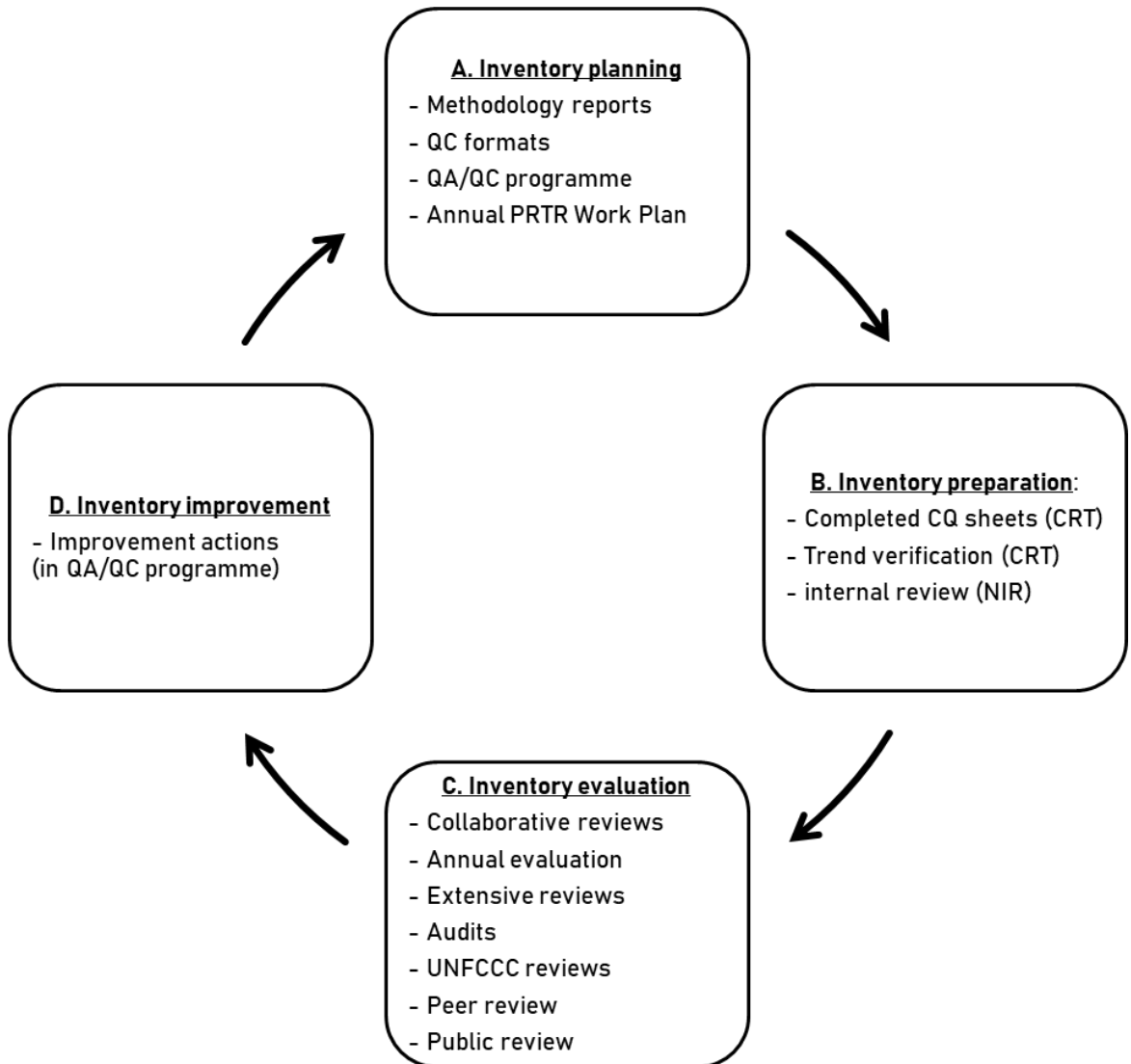
- Taking remaining issues from former UNFCCC reviews and ESR/LULUCF reviews into account and making the requested improvements (summarised and updated in Annex 10).
- A peer and public review on the basis of the definitive submission of the previous NIR in Q2 2025. Results of these reviews are summarised in Chapter 10. Identified issues will be addressed in upcoming NIDs.
- On the Emission Registration website, the NID and its corresponding methodology reports can be easily accessed: <https://www.emissieregistratie.nl/documentatie>. Public feedback is accepted via the e-mail address emissieregistratie@rivm.nl.
- In order to identify and detect possible errors, the following tools are also used:
 - A list that links NL PRTR database entries to CRT entries is shared with the responsible experts. The aim is to give the experts insights into the link between the NL PRTR database and the CRT;
 - An Excel tool used to prepare tables and figures for the NIR is also made available to experts. This tool permits checking trends at a sub-category level;
 - An Excel overview including IEFs per (sub)category is extracted from the CRT. This overview permits checking dips and jumps across the time series.

The QA/QC system must operate within the available resources (both capacity and finance). Within these limitations, QA/QC activities focus on:

- *The QA/QC programme* (RVO, 2023), which has been developed and implemented as part of the national arrangements. This programme includes quality objectives, the QA/QC plan, and a general schedule for the implementation of the activities. The programme is reviewed annually and updated as necessary (the full description of the QA/QC programme can also be found here: [Quality assurance and quality control \(rvo.nl\)](https://www.rvo.nl/en/quality-assurance-and-quality-control)).

Figure 1.1 summarises the main elements of the annual QA/QC cycle. To ensure high quality and continuous improvement, the annual inventory process is implemented as a cyclical project, on the basis of the iterative Deming cycle of Plan–Do–Check–Act. QA/QC procedures for basic LULUCF data are different from QA/QC procedures for other sectors and have been elaborated and documented in the description of QA/QC of the external agencies (Van der Net et al., 2026).

Figure 1.3 QA/QC management cycle (RVO, 2023)



- *The annual RIVM Work Plan* (RIVM, 2025). The Work Plan describes the tasks and responsibilities of the parties involved in the PRTR process – such as products to be delivered, scheduling (planning), and emissions estimation (including the methodology reports on GHGs) – as well as those assigned to the members of the Task Forces. The annual Work Plan also describes the general QC activities that need to be performed by the Task Forces before the annual PRTR database is fixed (see section 1.5.1.3).
- *European Emission Trading Scheme (EU-ETS)*. Selected companies (large emitters) are part of the EU-ETS. They are obliged to report their CO₂ emissions in accordance with monitoring procedures, which include strict QA/QC. The reported emissions are checked and approved by the Dutch Emissions Authority (NEa) and used in the inventory for QC and used to calculate specific EFs.
- *Agreements/covenants* between RIVM and other institutes involved in the annual PRTR process. The general agreement is that, by accepting the annual Work Plan, the institutes involved

commit to delivering capacity for the work/products specified in that Work Plan. The role and responsibilities of each institute have been described (and agreed on) within the framework of the PRTR Work Plan.

- *Specific procedures* established to fulfil the QA/QC requirements. General agreements on these procedures are described in the QA/QC programme as part of the National System. The following specific procedures and agreements have been described in the QA/QC plan and the annual PRTR Work Plan:
 - o QC on data input and data processing as part of the annual trend analysis and consolidation of the database following approval of the institutions involved.
 - o Documentation of the consistency, completeness, and correctness of the CRT data. According to the 2006 IPCC Guidelines (volume 1, chapter 6), the emissions estimates for all source categories or sub-source categories that a change in the last year that exceeds the previous year by 10% have to be checked. The Netherlands has chosen for a lower limiting value: 5% changes at target group level, and 0.5% at levels concerning the national total. In these cases, the work package leaders provide explanations for the identified changes. The work package leaders send these explanations to the secretary of the PRTR project, who centrally archives them.
 - o A peer and public review based on the definitive submission of the previous NIR. Results of this review are summarised in Chapter 10 and in the QA/QC sections of the specific chapters. Identified issues will be addressed in upcoming NIRs.
 - o Audits: In the context of the annual Work Plan, it has been agreed that the institutions involved in the PRTR will inform RIVM about forthcoming internal audits. Furthermore, RVO is assigned the task of organising audits, as needed, of relevant processes or organisational issues within the National System.
 - o Archiving and documentation: Internal procedures have been agreed (in the PRTR annual Work Plan) for general data collection and the storage of fixed datasets in the RIVM database, including the documentation/archiving of QC checks. To improve transparency, the implemented QC checklists have also been documented and archived, as part of the QA/QC plan. A shared online workspace (Teams) used during the preparation of the NIR has also facilitated checks and systematic documentation during the drafting stage, improving the traceability of comments/recommendations and implementation thereof (as well as other changes), which can also be carried forward in subsequent inventory cycles more easily.
 - o Methodology reports: These have been updated and documented and are an integral part of this submission (see Annex 7).
 - o RVO (as the NIE) maintains a website (www.rvo.nl/nie) and a central archive of relevant documents.
- *Annual inventory improvement*: Within the inventory project, resources are made available to keep the total inventory up to

the latest standards. In an annual cycle, Task Forces are invited to draft proposals for improving their emissions estimates. The proposals are prioritised in a consensus process and budgets are made available for the selected improvements. Proposals for improvements that contribute to a reduction in the uncertainty of emissions estimates are given priority over others. All planned improvements are documented in the annual Work Plan.

- *Evaluation*: Once a year, all parties involved in the annual inventory tasks are invited to participate in an evaluation of the process. The results are inputted into the annual review of the QA/QC programme and the annual Work Plan.
- *General QC checks*: A checklist was developed and implemented to facilitate general QC checks. A number of general QC checks have been added to the annual PRTR Work Plan and are mentioned in the methodology reports. The general QC for the present inventory was largely performed at the institutes involved as an integral part of their PRTR work (Van der Net et al., 2026).
- *Category-specific QC*: The comparison of emissions data to data from independent sources was one of the actions proposed in the inventory improvement programme. In Annex 8 of the current submission, the reported Dutch emissions are compared to emissions estimates derived from atmospheric observations. The data for this comparison is provided by the PARIS project (<https://horizoneurope-paris.eu/>) and the German project ITMS (<https://www.itms-germany.de/en>).

1.5.1.3 Verification activities for the CRT/NID 2026

Two weeks prior to the trend analysis meeting, RIVM made available a snapshot of the database in a web-based application (Emission Explorer, EmEx), allowing checks by the institutes and experts involved (PRTR Task Forces). This enabled the Task Forces to check for level errors and inconsistencies in the algorithms/methods used for calculations throughout the time series. The Task Forces performed checks for all gases and sectors. The sector totals were compared to the previous year's dataset. Where significant differences were found, the Task Forces evaluated the emissions data in greater detail. The results of these checks were used as inputs for discussions at the trend analysis workshop and were subsequently documented.

During the trend analysis, the GHG emissions for all years between 1990 and 2024 were checked in two ways:

1. The datasets from previous years' submissions were compared to the current submission; emissions from 1990 to 2023 should be identical to those reported last year, unless methodological changes have been announced for them..
2. The data for 2024 was compared to the trend development for each gas since 1990. Checks of outliers were carried out at a more detailed level for the sub-sources of all sector background tables. Experts specifically checked:
 - annual changes in the emissions of all GHGs;
 - annual changes in activity data;
 - annual changes in IEFs;
 - level values of IEFs.

Data checks were performed by sector experts and others involved in preparing the emissions database and the inventory, resulting in a checklist of actions to be taken. This checklist was used as input for the trend analysis meeting and supplemented with the actions agreed at this meeting. This action list is shared with all work package leaders and Task Force Chairs. Table 1.2 presents the key verification actions for the CRT tables/NID 2026.

The completion of any actions was reported on the checklist. On the basis of the completed checklist and the documentation of trends, the chairpersons of the task forces approved the dataset of their respective task force. The dataset was then fixed by the Head of the PRTR and formally agreed on by the principal institutes: RIVM, PBL, Statistics Netherlands, Deltares, and WR.

The internal versions of the CRT and NID and all documentation (emails, data sheets and checklists) used in the preparation of the NIR are stored electronically on a server at RIVM.

Last, as part of the overall QA/QC and verification system, the IPCC guidelines also highlight the value of verification activities that include comparisons to emissions estimates derived from independent assessments. For example, comparisons to atmospheric observations through inverse modelling can be particularly useful, since they are fully independent of standard estimation drivers such as sector activity data. Significant differences between inventory and model results can point to areas deserving further investigation by the inventory compilers. As from the NIR 2025, a dedicated annex (Annex 8) has been included on comparing inventory emissions estimates to estimates based on atmospheric observations, which will form an additional component of annual verification activities.

Table 1.2 Key actions for the NIR 2026

Item	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	01-07-2025	Task Forces	List of methodological issues and recalculations for the upcoming NIR	Definitief OVERZICHT Methodewijzigingen reeks 1990–2024.xlsx on Microsoft teams ER Consortium channel
Input of outstanding issues for this inventory	1-12-2025	RIVM	Input for trend analysis	Actiepunten Definitieve cijfers 1990–2024 on Microsoft teams ER Consortium channel
Trend analysis	4-12-2025	Task Forces	Updated action list	Actiepunten Definitieve cijfers 1990–2024 on Microsoft teams ER Consortium channel
Resolving the issues on the action list	11-12-2025	Task Forces RIVM/ TNO National Inventory Compiler (NIC)	Final dataset	Actiepunten Definitieve cijfers 1990–2024 on Microsoft teams ER Consortium channel
Comparison of data in CRT and E-PRTR database	Until 15-03-2026	NIC/TNO	Draft CRT sent to EU Final CRT to EU	15-01-2025 15-03-2025
Writing and checks of NIR	Until 15-3-2026	Task Forces/ NIC/TNO/NIE	Final texts	R:\.\NI National Inventory Report\NIR 2026\NIR redactie and shared Teams pages
Generation of tables for NIR from CRT tables	Until 15-3-2026	NIC/TNO	Final CRT and corresponding sector/category tables NID	R:\....\NIR 2026\CRT....\Tables and Figures.xlsx

1.5.1.4 Treatment of confidentiality issues

Some of the data used in the compilation of the inventory is confidential and cannot be published in print or electronic format. The Netherlands uses the code 'C' in the CRT for these data items. All confidential data can be made available to the official UNFCCC review process upon request.

1.6 General uncertainty assessment, including data pertaining to the overall uncertainty of inventory totals

Two approaches for performing an uncertainty analysis have been used. In Approach 1, the uncertainty of the national GHG emissions in the Netherlands is assessed via error propagation calculations. Within this method, it is assumed that the individual uncertainty estimates for activity data and emission factors are uncorrelated and that all have a normal distribution. In Approach 2, a Monte Carlo simulation is performed in which correlations and other distributions have been taken into account, as far as possible.

Approach 1 uncertainty – propagation of error

The following information sources were used for estimating the uncertainty in activity data and EFs:

- default uncertainty estimates reported in accordance with the 2006 IPCC Guidelines (IPCC, 2006) and the 2019 Refinement to the 2006 IPCC Guidelines;
- sections on uncertainties included in the methodology reports (see Annex 7 for references).

These data sources were supplemented with expert judgements by RIVM, PBL, WR, and Statistics Netherlands emissions experts. Uncertainty estimates were prepared independently, and the experts' views were discussed to reach consensus. On the basis of 1990 and 2024 data, uncertainties were estimated for both annual emissions and the emissions trend for the Netherlands. Uncertainties are presented here as half the 95% confidence interval. The reason for halving the 95% confidence interval is that the value then corresponds to the familiar plus or minus value when uncertainties are loosely quoted as 'plus or minus x%'. In cases where asymmetric uncertainty ranges were assumed, the larger percentage was used in the calculation.

The results of the uncertainty calculation are summarised in Annex 2 of this report. The calculation of annual uncertainty in CO₂ equivalent emissions results in an overall uncertainty of approximately 3% in 2024, based on calculated uncertainties of 3%, 8%, 28%, and 23% for CO₂ (including LULUCF), CH₄, N₂O, and F-gases, respectively (see Table 1.6).

Table 1.3 presents the 1990–2023 trend uncertainties per greenhouse gas and Table 1.4 presents the 1990–2024 trend uncertainties per CRT category. Both are based on error propagation.

Table 1.3 Trend uncertainties (95% confidence ranges) of individual gases based on standard error propagation

Greenhouse gas	Trend compared to base year (%)	Uncertainty in trend (%)
CO ₂	-29.1	1.2
CH ₄	-50.6	4.6
N ₂ O	-59.1	4.9
F gases	-75.2	6.8
All	-36.2	1.4

Table 1.4 Trend uncertainties (95% confidence ranges) per CRT category based on standard error propagation

Category	Trend compared to base year (%)	Uncertainty in trend (%)
Sector 1	-31.1	1
Sector 2	-47.3	6.9
Sector 3	-30.1	4.4
Sector 4	-5.8	10.6
Sector 5	-82.4	2.1

However, these figures do not include the correlation between source categories (e.g. cattle numbers for enteric fermentation and animal manure production), nor do they include a correction for non-reported sources. The correlation between source categories is included in a Monte Carlo uncertainty assessment.

Approach 2 uncertainty – Monte Carlo analysis

A Monte Carlo analysis has been implemented into the Dutch emissions inventory of the 2024 emissions level data and its results are used for comparison to the error propagation results.

Where possible, correlations between activity data and emission factors have been included in the Monte Carlo analysis.

Activity data:

- The energy statistics are more accurate on an aggregated level (e.g. for Industry) than on a detailed level (e.g. for each individual industrial sector). This type of correlation also occurs in several transport subsectors, such as road transport, shipping, and aviation.
- The same data source is used to calculate different emissions. This type of correlation occurs where the identifier of the activity (e.g. animal numbers or inhabitants) must be equal in different source/pollutant combinations.

Emission factors:

- The uncertainty of an EF for a specific fuel from stationary combustion is assumed to be equal for all the sources using this fuel in the stationary combustion sector. This type of correlation

is also used in several transport subsectors such as shipping and aviation.

- The EFs for the various types of cattle (cattle for meat production or dairy cattle) are assumed to be correlated. The same goes for the EFs for poultry, and for horses, mules and asses.

The results of the Approach 2 uncertainty analysis based on Monte Carlo are presented in Table 1.5, and the uncertainties based on standard error propagation are presented in Table 1.6.

Table 1.5 Level uncertainties for 2024 (95% confidence ranges) based on Monte Carlo analysis, including LULUCF

CRT category	CO₂	CH₄	N₂O	F-gases	Total (CO₂ eq)
1	2%	35%	32%		3%
2	20%	61%	43%	24%	20%
3	19%	9%	41%		12%
4	34%	79%	100%		32%
5	27%	20%	22%		17%
Total	4%	9%	28%	21%	4%

Table 1.6 Level uncertainties for 2024 (95% confidence ranges) based on standard error propagation, including LULUCF

CRT category	CO₂	CH₄	N₂O	F-gases	Total (CO₂ eq)
1	2%	27%	33%		2%
2	23%	62%	43%	23%	19%
3	18%	9%	38%		12%
4	64%	58%	2348%		570%
5		20%	27%		17%
Total	3%	8%	28%	23%	3%

For LULUCF, the total uncertainty calculated using Monte Carlo analysis is significantly lower than the uncertainty based on error propagation. For CO₂, N₂O, and CH₄, there are skew distributions for uncertainty (e.g. -80% and +200%). In the Monte Carlo analysis, both values are used, while in the error propagation calculation, only the + value (or 200%) is used. As a result, the total uncertainty according to the error propagation method is higher than the uncertainty according to the Monte Carlo analysis.

Further details on the level and trend uncertainty assessments can be found in Annex 2. In the analyses described above (and detailed in Annex 2), only random errors were estimated, on the assumption that the methodology used for the calculations did not include any systematic errors that can occur in practice.

Base year (1990) uncertainties

Table 1.7 presents the uncertainties in the base year according to the 2000 methodology (Van Amstel et al., 2000), compared to the results in

this submission. Both are based on expert judgement combined with error propagation, but in the current methodology, categories are subdivided and uncertainties are more detailed.

Table 1.7 Assessment of uncertainties in 1990 emissions (without LULUCF for the 2000 methodology)

Greenhouse gas	2000 methodology	2026 methodology
CO ₂	3%	3%
CH ₄	17%	4%
N ₂ O	34%	12%
F-gases	100%	15%
Total	4%	3%

1.7 General assessment of completeness

DNV GL (2020) was commissioned by the NIE to investigate the completeness of the Netherlands Greenhouse Gas Inventory. As a result, the conclusions from the former assessment of completeness still stand. The Netherlands' GHG inventory includes most sources that, according to the 2006 IPCC Guidelines, should be included in the inventory. The following minor sources are not included:

- CO₂ from Asphalt roofing (2.A.4.d) due to negligible amounts (below threshold);
- CO₂ from Road paving (2.A.4.d) due to negligible amounts (below threshold);
- CH₄ emissions from Other livestock (alpacas) (3.A.1) due to negligible amounts (below threshold);
- CH₄ and N₂O emissions from the decomposition of manure from Other livestock (alpacas) (3.A.2) due to negligible amounts (below threshold);
- CH₄ from Enteric fermentation: poultry (3.A.4) due to negligible amount of CH₄ production in this animal category. The 2019 refinement of the IPCC Guidelines does not provide a default EF for enteric CH₄ emissions from poultry;
- Part of CH₄ from Industrial wastewater (5.D.2 sludge) due to negligible amounts;
- Direct N₂O emissions from Septic tanks (5.D.3), as they are unlikely to occur given the anaerobic circumstances in these tanks;
- Precursor emissions (carbon monoxide (CO), nitrogen oxide (NO_x), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO₂)) from memo item 'International bunkers' (international transport), as these emissions are not included in national total emissions;
- Indirect CO₂ emissions from CO process emissions due to negligible amounts.

A number of recommendations by DNV GL relating to the 2019 refinement of the IPCC Guidelines have been implemented, and other recommendations will be further explored. During the COP26, it was decided that the implementation of these guidelines will be voluntary as of the NIR 2023.

Annex 6 presents the assessment of completeness and sources, potential sources, and sinks for this submission of the NID 2026 and the CRT tables.

1.8 Metrics

In this report, GHG emissions are given in megaton (Mt) and kiloton (kt); 1 megaton (Mt) is equal to 1 teragram (Tg) and 1 kiloton (kt) is equal to 1 gigagram (Gg). Global warming potential (GWP)-weighted emissions of the GHGs are also provided (in CO₂ equivalents), using GWP values that are based on the effects of GHGs over a 100-year horizon, in accordance with decision 18/CMA.1 '*Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement*' (UNFCCC, 2018) and the 5th IPCC Assessment Report (AR5). The GWP of each individual GHG is provided in Annex 9.

2 Trends in greenhouse gas emissions and removals

2.1 Description of emission and removal trends for aggregated GHG emissions and removals

This chapter summarises the trends in GHG emissions for the 1990–2024 period by GHG and by sector. More sectoral details are provided in Chapters 3–8.

Table 2.1 presents all GHG emissions by gas and by sector in 2024. Also, the relative shares of the sectors are provided. CO₂ is the main GHG emission in the Netherlands, followed by CH₄, N₂O and F-gases.

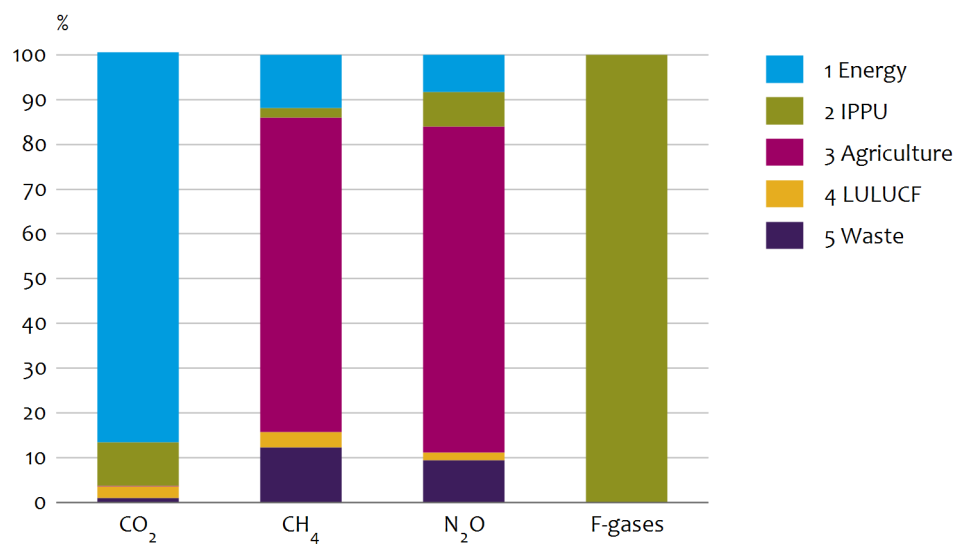
Table 2.1 The Netherlands' GHG emissions in CO₂ equivalents (kt) by gas and by sector in 2024

Sector	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total	Share
1. Energy	103,401.7	2166.5	548.4						106,116.6	73%
2. Industrial processes and product use	11,641.2	388.6	509.8	852.2	25.1	132.4	NO	IE,NA,NO	13,549.4	9%
3. Agriculture	81.9	12,845.8	4799.3						17,727.1	12%
4. Land use, land-use change and forestry ⁽¹⁾	2978.3	608.7	114.4						3701.4	3%
5. Waste	IE,NA,NO	2243.7	618.8						2862.5	2%
6. Other (as specified in summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO		
Indirect CO ₂ ⁽³⁾	439.4								439.4	0%
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF									144396.4	100%
International bunkers	46,176.5	378.8	337.2						46,892.6	
Aviation	10,430.9	2.1	80.0						10,513.0	
Navigation	35,745.6	376.7	257.2						36,379.6	

The Energy sector is by far the largest contributor to the inventory, followed by Agriculture, IPPU, LULUCF, and Waste.

Figure 2.1 presents the contributions made by the individual sectors (including LULUCF) to the total emissions of the various GHGs.

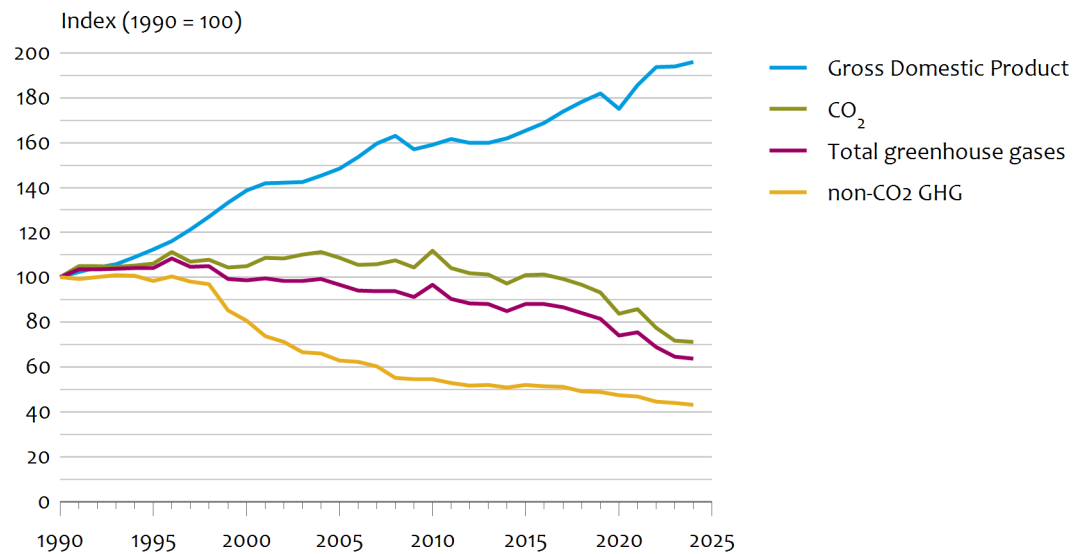
Figure 2.1 Relative contributions by the individual sectors (including LULUCF) to GHG emissions in 2024



The dominance of the Energy sector regarding CO₂ emissions is clearly visible. The agricultural sector is the main contributor of CH₄ and N₂O emissions. All F-gases originate from the IPPU sector.

Figure 2.2 shows the index of economic development (GDP) of the Netherlands since 1990, compared to the development in GHG emissions for the 1990–2024 period.

Figure 2.2 Development of greenhouse gas emissions compared to GDP (Gross Domestic Product), for the 1990–2024 period



In 2024, total GHG emissions (including indirect CO₂ emissions and including emissions from LULUCF) in the Netherlands were estimated at 144.4 Mt CO₂ eq. This is 36.3% lower than the 226.6 Mt CO₂ eq reported for the base year (1990), while the economy increased by more than 90% in the same period. The trend in total GHG emissions was largely determined by the emission reductions achieved in non-CO₂ gases (56.9% reduction in 2024 compared to 1990; over the same period, CO₂ emissions declined by 28.9%).

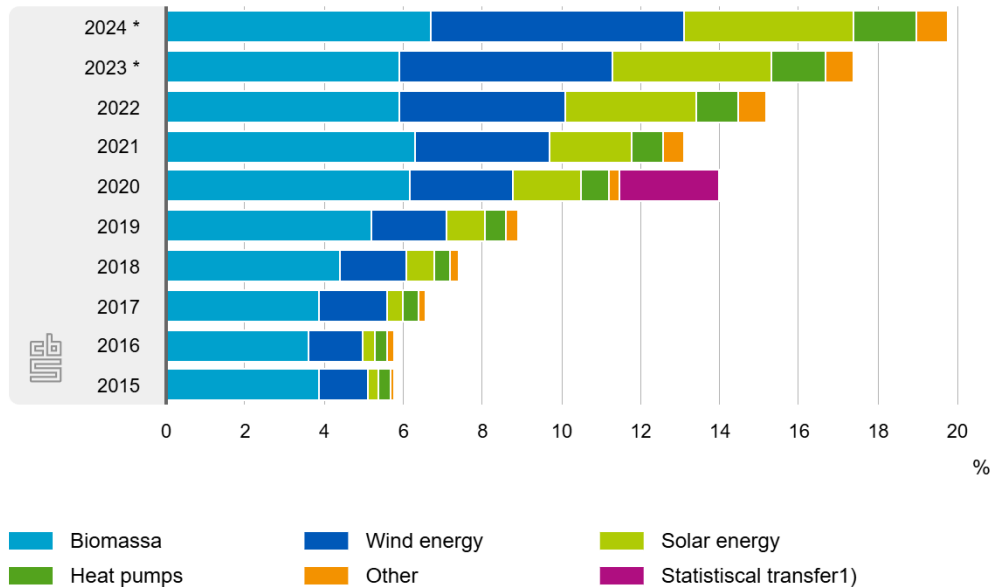
Renewable energy

Figure 2.3 shows the mix of renewable energy sources in the Netherlands and the trend. In 2024, renewables accounted for 358 PJ (19.8% of total energy use in the Netherlands), a year-on-year increase by 17.4% compared to 2023³.

³ [Consumption of energy from renewable sources rises to 20 percent | CBS \(consulted 12 January 2026\)](#)

Figure 2.3 Development of renewable energy sources as a percentage of total energy demand in the Netherlands, 1990–2024 (Statistics Netherlands, 2026)

Renewable energy as a share of total energy consumption



* provisional figures

1) Renewable energy purchased from another EU member state, in accordance with EU's Renewable Energy Directive (RED). A statistical transfer means that no physical transfer took place.

Energy efficiency

The efficiency of total energy consumption can be expressed by the so-called technical ODEX as defined by the Odyssee-Mure project⁴. The technical ODEX measures the energy efficiency progress by sector (industry, transport, households, services) and for the economy as a whole (total of all energy consumers). The dimension of the ODEX is total energy used divided by a measure of energy-consuming activities, which means that a lower value of the ODEX represents an increase in energy efficiency. For each sector, the index is calculated as a weighted average of sub-sectoral indices of energy efficiency progress; sub-sectors are industrial branches, services sector branches, end-uses for households and transport modes.

⁴ <https://www.indicators.odyssee-mure.eu/odex-indicators-database-definition.pdf>

Figure 2.4 Technical ODEX for the Netherlands, 2000–2023⁵



Efficiency for total final energy consumption, as measured by the so-called technical ODEX, has improved by around 1.67% per year since 2000⁶. This can be derived from the value of 67.9 of the total ODEX in 2023 shown in Figure 2.4. Below-average annual gains have been achieved in services (1.27%/year) and especially in transport (0.35%/year). Larger gains were achieved in the residential sector (2.61%/year) and in industry (2.16%/year). The highest efficiency improvement since 2019 occurred in the households sector resulting from the high energy prices towards the end of 2021 and in 2022.

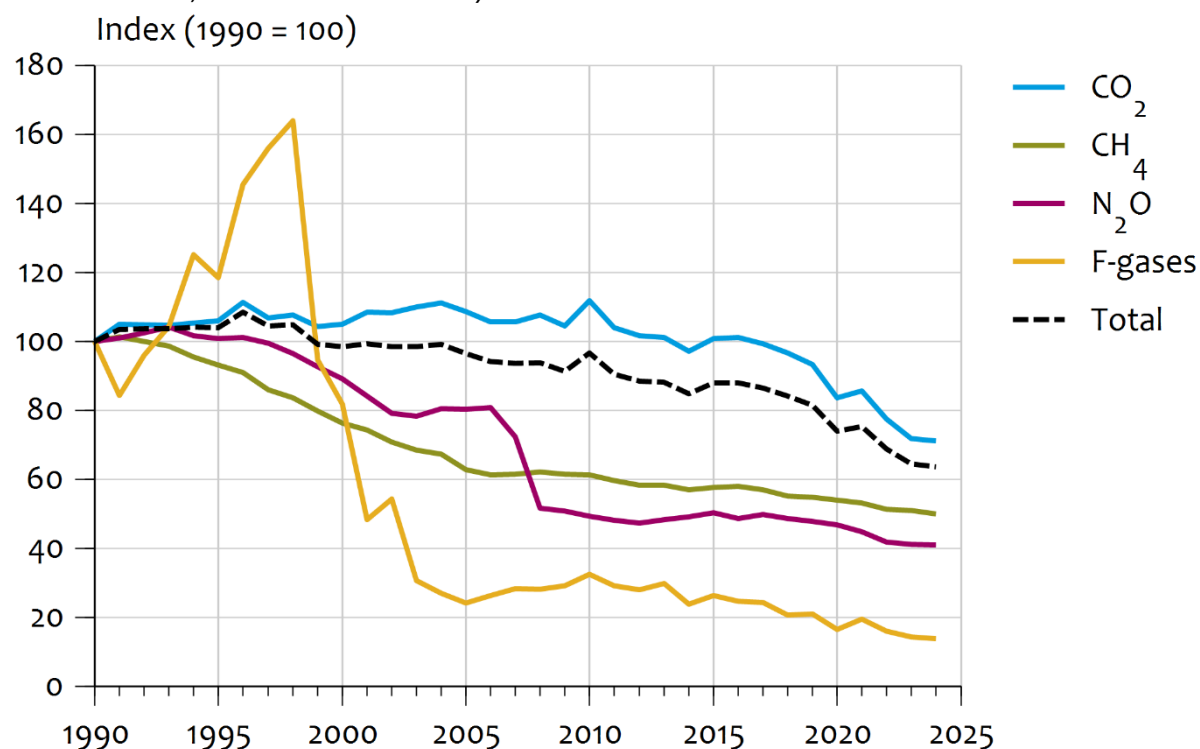
2.2 Description of emission and removal trends by gas

Figure 2.5 shows the emissions trends for the various gases and aggregated national total GHGs.

⁵ One negative point in this figure (-1) represents a 1% increase in efficiency for final energy consumption compared to reference year 2000.

⁶ <https://www.odyssee-mure.eu/publications/efficiency-trends-policies-profiles/netherlands.html>

Figure 2.5 Relative emissions trends of the individual GHGs (including LULUCF) in the Netherlands, 1990–2024. The base year 1990 is set at 100



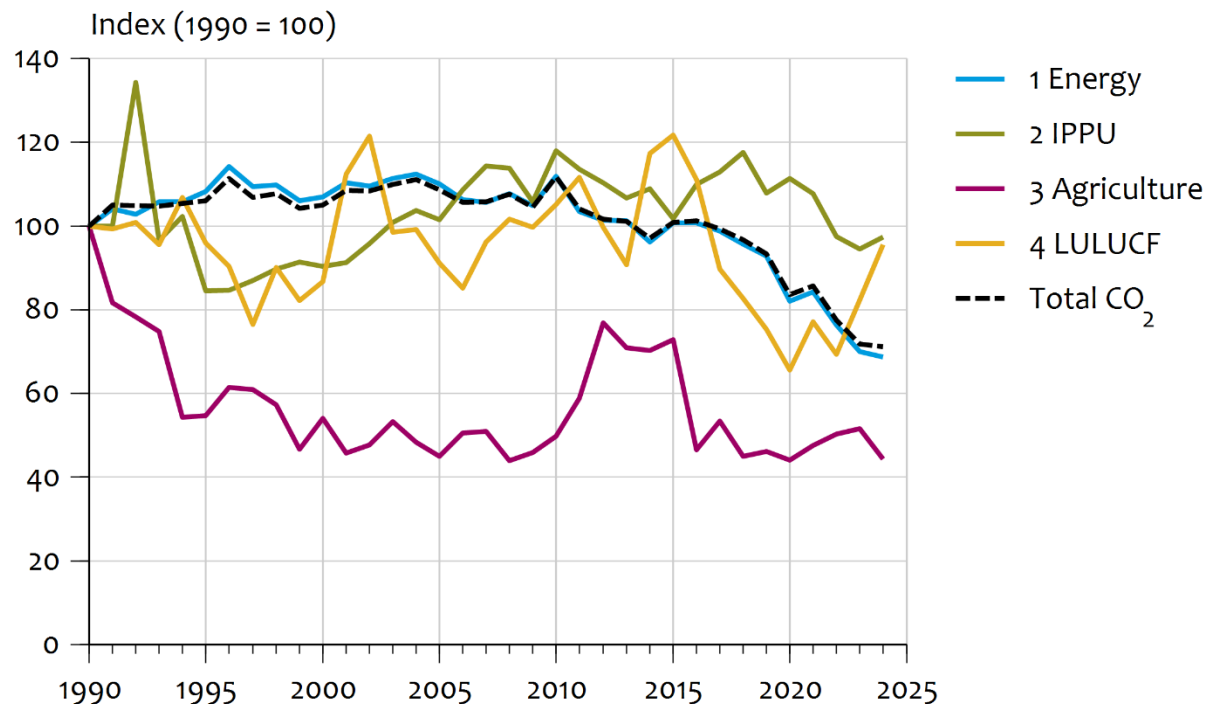
In the 1990–2024 period, emissions of total GHG decreased by 36.3%. Emissions of carbon dioxide (CO₂) decreased by 28.9%. Emissions of the non-CO₂ GHGs methane (CH₄), nitrous oxide (N₂O), and F-gases decreased by 50.0%, 59.1%, and 86.2%, respectively.

2.2.1

Carbon dioxide

Figure 2.6 shows the CO₂ emissions trends for the individual sectors.

Figure 2.6 Relative emissions trends of CO₂ in the Netherlands per sector, 1990–2024. The base year 1990 is set at 100



In the 1990–2024 period, national CO₂ emissions (including indirect emissions) decreased by 28.9% (from 166.7 Mt CO₂ eq to 118.5 Mt CO₂ eq).

With regard to CO₂ emissions, the Energy sector is the primary sector in the Dutch GHG emissions inventory and is responsible for 87.2% of total CO₂ emissions in the country (Figure 2.1). In the 1990–2024 period, CO₂ emissions from the Energy sector decreased by 31.1%. Note that in Figure 2.6, the CO₂ emissions trend for the Energy sector almost completely overlaps with that of total CO₂ emissions.

Within the Energy sector, an increasing trend in electric power production until 2005 corresponds to a substantial increase in CO₂ emissions from fossil fuel combustion by power plants. Also, the diesel fuel consumption from road transport increased by 60% between 1990 and 2008, resulting in increased emissions in this sector. The decreasing trend of CO₂ from 2016 onwards is the result of a decline in coal combustion resulting from the closure of coal-fired power plants (2016–2020), and an increase in renewable energy (with the main increase from 2020 onwards). Apart from these overall trends, some substantial interannual fluctuations are visible. These peaks and dips are mostly due to weather conditions. More natural gas is used during cold winters (1996 and 2010) while less is used in warm winters (2014 and 2020). The dip in the graph in 2020 is amplified by a decrease in liquid fuel combustion for vehicle use during the COVID-19 pandemic. In 2021, CO₂ emissions show a peak as a result of a cold winter. The combustion of solid fuels rose again in 2021 and 2022, as a result of the increasing prices of natural gas at the end of 2021, in 2022, and at the beginning of 2023. In 2023, the solid fuel consumption decreased again,

as a result of increased renewable electricity production and lower natural gas prices. For further details about the emissions in the Energy subsectors, see section 2.3.

Compared to the Energy sector, other sectors contribute much less to CO₂ emissions (Figure 2.1). The IPPU sector is responsible for 9.8% of the total CO₂ emissions in the Netherlands). CO₂ emissions from the Agriculture and LULUCF sectors amount to 0.07% and 2.5% of the total CO₂ emissions in 2024.

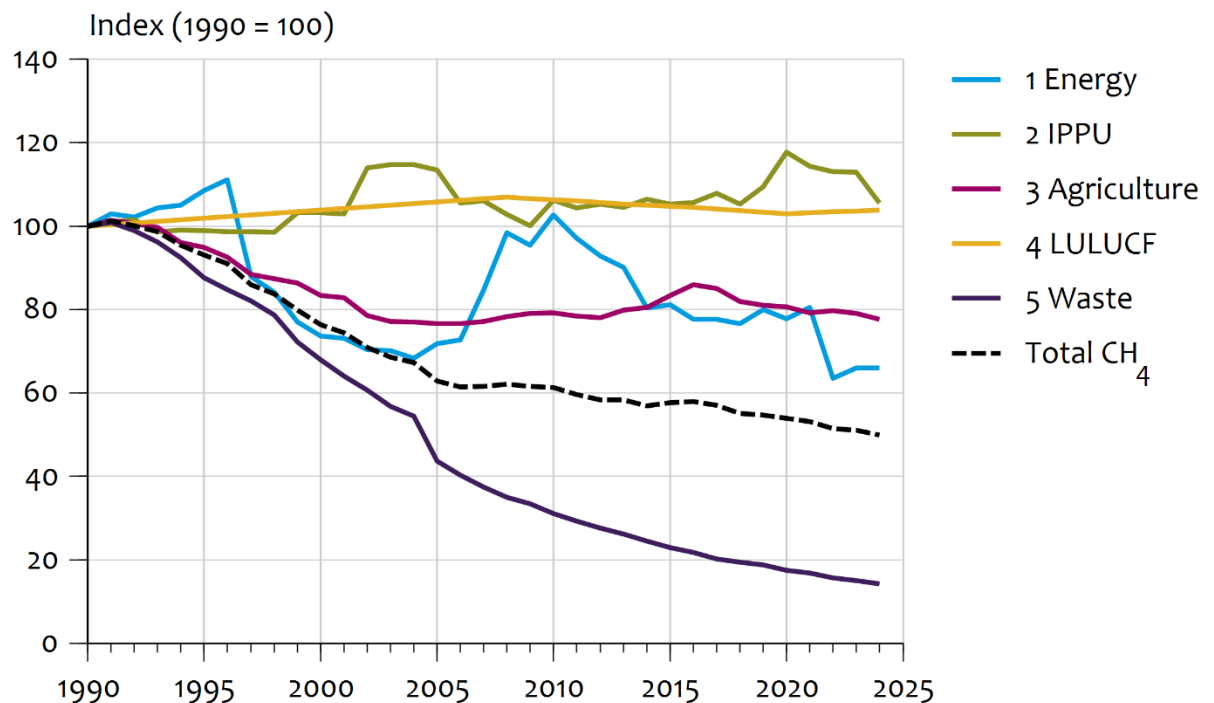
The trend of CO₂ emissions from Agriculture is mainly explained by fluctuations in the application of liming products and urea application (see Chapter 5).

2.2.2

Methane

Figure 2.7 shows the relative CH₄ emissions trends of the individual sectors over time.

Figure 2.7 Relative emissions trends for CH₄ in the Netherlands per sector, 1990–2024. The base year 1990 is set at 100



Between 1990 and 2024, national CH₄ emissions decreased by 50.0%, from 36.5 Mt to 18.3 Mt CO₂ eq.

The trend of total CH₄ emissions shows a relatively strong reduction between 1990 and 2005. After 2005, emissions declined further, but at a slower pace.

The Agriculture sector was the largest contributor to total methane emissions in 2024 (70.4%) (Figure 2.1). Between 1990 and 2024, CH₄ emissions from Agriculture declined by 22.4%.

The trend in methane emission from the Agriculture sector is mainly explained by changes in the number of mature dairy cattle and pigs (further explained in Chapter 5). The number of dairy cattle has decreased since the 1990s due to higher production rates per animal and production quotas. Between 2012 and 2016, the number of cattle increased again as dairy farmers anticipated the abolition of milk production quotas. However, this resulted in exceeding the European phosphate production ceiling. The Dutch government implemented new policies in accordance with this ceiling: the phosphate reduction scheme was followed by the phosphate quota that were introduced in 2018 (MLNV, 2017). These policies resulted in a decrease in cattle (all categories) that can be kept in the Netherlands and resulted in a decrease in cattle numbers from 2017 to 2024.

CH₄ emission from the Waste sector was 12.3% of total CH₄ emissions in 2024 (Figure 2.1). In the 1990–2024 period, methane emissions from the Waste sector decreased by 82.4%, mainly due to an 88.4% reduction in CH₄ from Managed waste disposal on land (5.A).

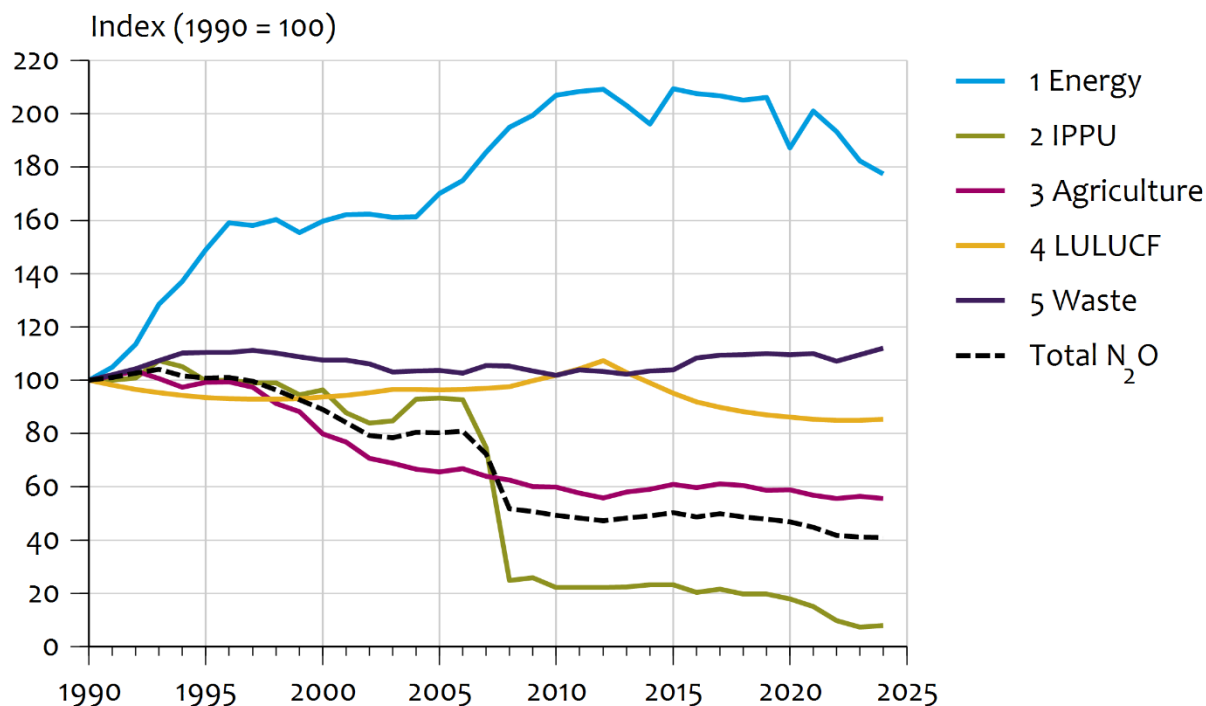
The Energy sector contributed 11.9% to total CH₄ emissions in the Netherlands in 2024 (Figure 2.1). In the 1990–2024 period, CH₄ emissions from Energy declined by 34.0%, mainly in the category Fugitive emissions (1.B). The strong increase between 2005 and 2010 can be explained by more natural gas combustion as a result of the increased installation of gas engines (with a relatively high emission factor compared to other engines) in the agricultural sector in that period.

2.2.3

Nitrous oxide

Figure 2.8 shows the N₂O emissions trends of the individual sectors over time.

Figure 2.8 Relative emissions trends for N₂O in the Netherlands per sector, 1990–2024. The base year 1990 is set at 100



The national total inventory of N₂O emissions decreased by 59.1%, from 16.1 Mt CO₂ eq in 1990 to 6.6 Mt CO₂ eq in 2024.

The Agriculture sector was the largest contributor to the total nitrous oxide emissions in 2024 (72.8%) (Figure 2.1). N₂O emissions from Agriculture declined by 44.3% between 1990 and 2024.

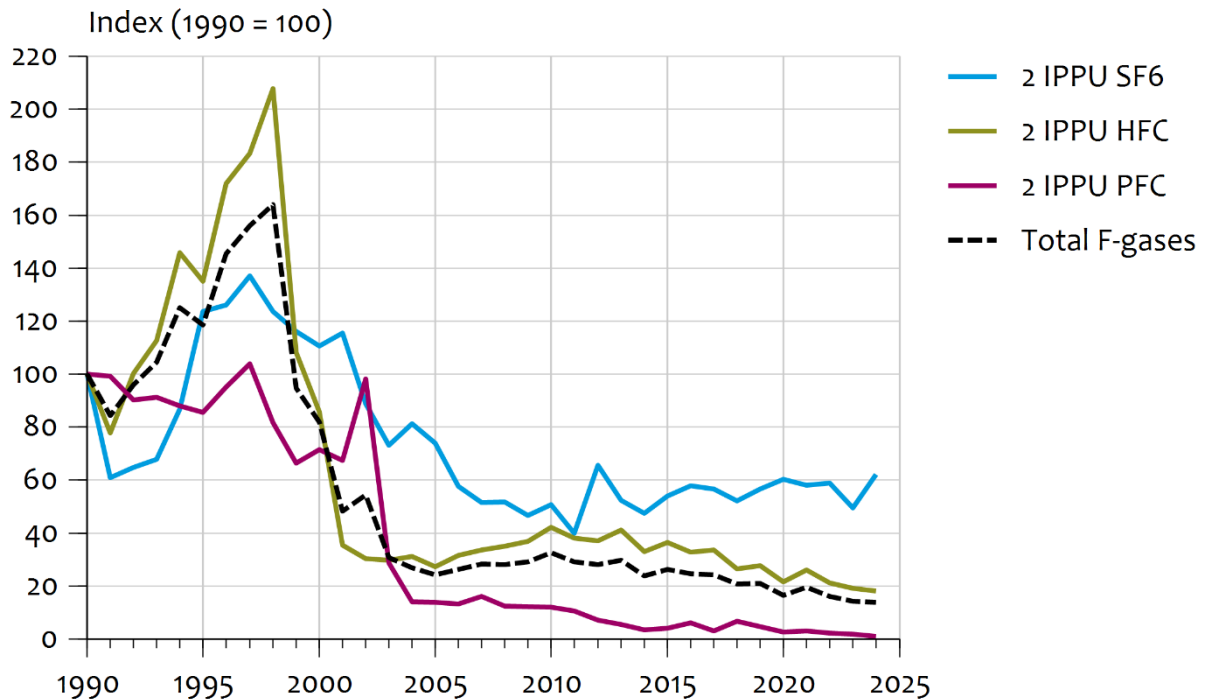
The decreasing trend of N₂O emissions in the agricultural sector is a result of a decrease in organic and inorganic N fertiliser application, a decrease in animal numbers, and a decrease in grazing in the agricultural sector from 1990 to 2012. Emissions increased slightly in 2013–2017, while 2018 and 2019 show a decrease. After a decrease in 2021 and 2022, emissions increased again in 2023, mainly due to higher emissions from manure application, pasture manure, and losses of soil organic matter.

In 2024, the IPPU, Waste, and Energy sectors contributed 7.7%, 9.4%, and 8.3%, respectively, to total N₂O emissions in the Netherlands (Figure 2.1). In the 1990–2024 period, N₂O emissions from the IPPU sector decreased by 92.1%. N₂O emissions within the IPPU show a sharp decline in 2008. This is a result of applying catalytic reduction technologies in the production process of nitric acid (2B2). The installation of these technologies was a result of bringing this sector under EU-ETS regulation. In the 1990–2024 period, emissions from Waste and Energy increased by 12.1% and 77.5%, respectively. In the Energy sector, the increase in N₂O emissions mostly took place in the category Fuel combustion (1.A). This is mainly the result of the introduction of catalysts in vehicles.

2.2.4 Fluorinated gases

Fluorinated gases are only emitted in the IPPU sector (Figure 2.1). Within the IPPU sector, there are several F-gas emissions. Figure 2.9 shows the F-gas emissions trends over the 1990–2024 period.

Figure 2.9 Relative emissions trends of fluorinated gases in the Netherlands, 1990–2024. The base year 1990 is set at 100



Total emissions of F-gases have decreased by 86.2%, from 7.3 Mt CO₂ eq in 1990 to 1.0 Mt CO₂ eq in 2024, partly as a result of the Netherlands' programme for reducing emissions of non-CO₂ greenhouse gases (ROB).

Within the fluorinated gases, emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆) decreased by 81.9%, 99.0%, and 37.8%, respectively, over the 1990–2024 period.

It should be noted that, because emissions of NF₃ only take place in one company, the NF₃ emissions are included in PFC emissions for confidentiality reasons.

The increase in emissions between 1995 and 1998 is mainly due to a 35% increase in the HFC-23 emission as a result of increased production of HCFC-22. The sharp decrease in emissions in the 1998–2000 period is the result of a 69% decrease in HFC-23 emissions following the installation of a thermal converter (TC) at the plant.

Since 1990, there has been a substantial increase in HFC use as a substitute for (H)CFC use (category 2.F). In 2024, this category accounts for 93.7% of national total HFC emissions (0.80 Mt CO₂ eq).

2.3 Description of emission and removal trends by sector

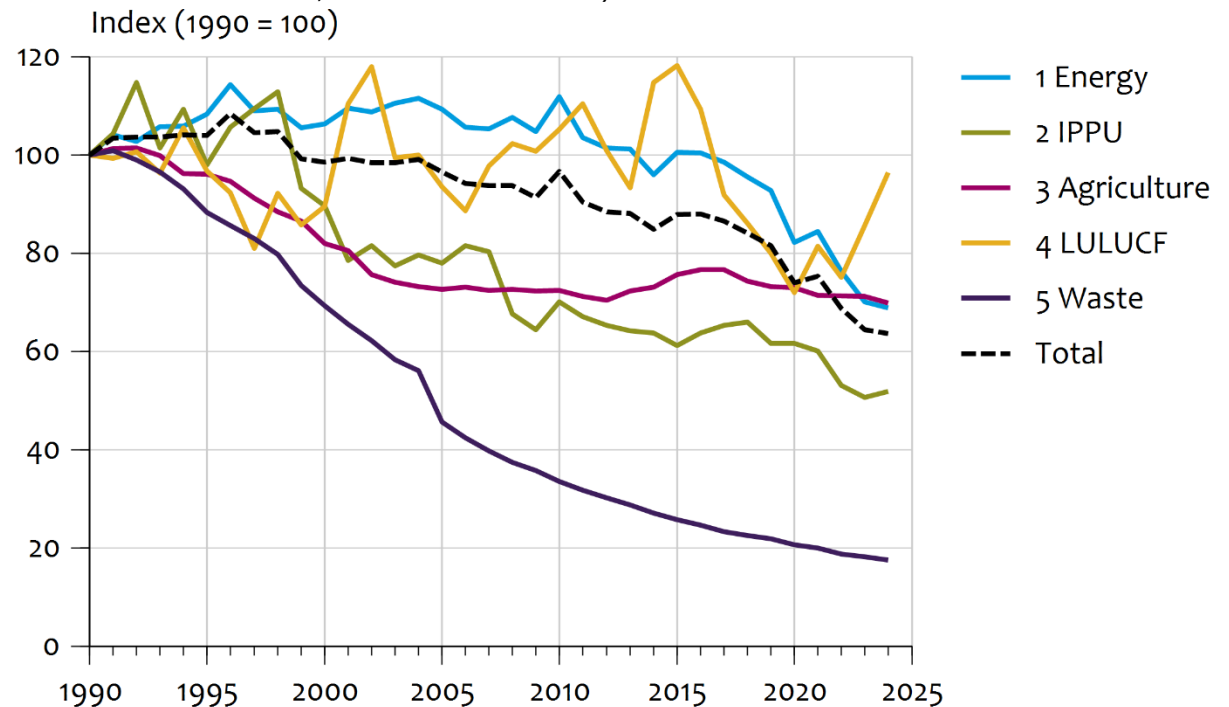
Table 2.2 and Figure 2.10 provide an overview of emissions trends for each CRT category in Mt CO₂ equivalents. Please note that all indirect CO₂ emissions are assigned to IPPU in these overviews.

Table 2.2 Summary of emissions trends per sector (Mt CO₂ equivalents, including indirect CO₂ emissions), 1990–2024

	1. Energy	2. IPPU	3. Agriculture	4. LULUCF	5. Waste	Total (incl.) LULUCF
1990	154.1	27.0	25.4	3.8	16.3	226.6
1995	166.9	26.3	24.4	3.7	14.4	235.6
2000	163.8	24.0	20.8	3.4	11.3	223.3
2005	168.4	20.8	18.4	3.6	7.5	218.7
2010	172.4	18.8	18.4	4.0	5.5	219.0
2015	154.9	16.4	19.2	4.5	4.2	199.3
2020	126.6	16.5	18.5	2.8	3.4	167.8
2023	108.1	13.7	18.1	3.3	3.0	146.1
2024	106.1	14.0	17.7	3.7	2.9	144.4

The Energy sector is by far the largest contributor to national total GHG emissions (contributing 68.0% in the base year and 73.5% in 2024).

Figure 2.10 Relative GHG emissions trends (including LULUCF) from the individual sectors in the Netherlands, 1990–2024. The base year 1990 is set at 100



The emissions from the Energy sector decreased by 31.1% in the 1990–2024 period.

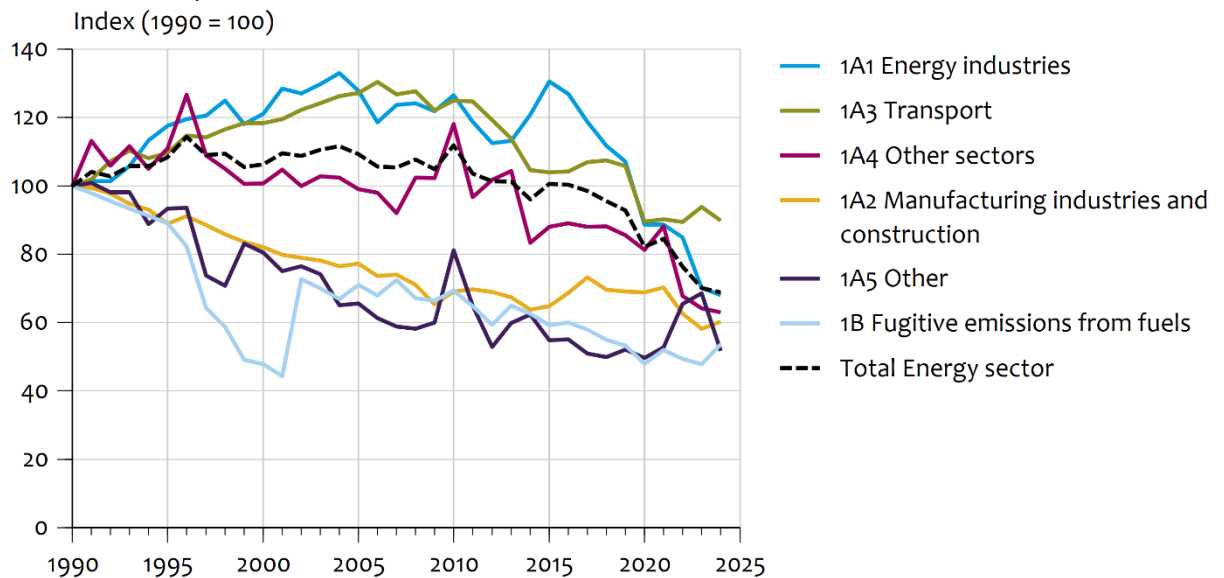
In 2024, total GHG emissions from all other sectors (IPPU, Agriculture, LULUCF, and Waste) decreased by 48.3%, 30.1%, 3.6%, and 82.4%, respectively, compared to the base year.

2.3.1

Energy

Figure 2.11 shows the relative trend in total GHG emissions from the Energy sector and individual subsectors.

Figure 2.11 Relative emissions trends for the Energy sector and subsectors, 1990–2024. The base year 1990 is set at 100



Between 1990 and 2024, total fossil fuel combustion decreased by 19.2% due to a 50.3% decrease in solid fuel consumption, a 26.8% decrease in gaseous fuel consumption, and a 1.5% decrease in liquid fuel consumption (see Chapter 3).

The main fluctuations in GHG emissions from this sector can be explained as follows:

- Weather conditions: Natural gas is the main source of energy used in the Netherlands for space heating. The peaks in Figure 2.11 are cold winters in 1996 and 2010, while the dip in 2014 is the result of a relatively mild winter.
- COVID-19: In 2020, there was a dip in total GHG emissions, mainly due to a decrease in liquid fuel combustion for vehicle use during the COVID-19 pandemic;
- The decreasing trend from 2016 onwards in total GHG emissions in the Energy sector is the result of a decline in coal combustion resulting from the closure of coal-fired power plants, and an increase in renewable energy.
- The decrease in CO₂ emissions between 2022 and 2024 is mainly due to a decrease in gaseous fuel consumption due to high prices of natural gas between the end of 2021 and the beginning of 2023, and to an increased renewable electricity production. In 2024, natural gas consumption increased slightly compared to 2023, but is not back at the level of 2021 and earlier, because of the relatively warm winter in 2023–2024.

As the Energy sector is the largest contributor to national total GHG emissions, further details about the emissions trends for the individual categories in the Energy sector are provided in the paragraphs below.

2.3.1.1 Energy industries (1.A.1)

The main fluctuations in GHG emissions in this category (1.A.1) can be explained as follows:

- an increase in natural gas combustion due to a change in ownership structures of CHP (Combined Heat and Power) plants which resulted in a shift of natural gas combustion from 1.A.2 to 1.A.1.a in 1990–1998;
- new, large coal-fired power plants commencing operations in 2015 and 2016, resulting in a shift from natural gas to coal;
- closure of old coal-fired power plants in 2015–2019, resulting in a decrease in coal consumption from 2017 onwards;
- in some years (e.g. in 1999–2008 and in 2012–2014), the import of electricity was higher than in other years;
- total CO₂ emissions from the five large refineries in the Netherlands fluctuated between 10 and 13 Mt CO₂;
- combustion of natural gas by the oil and gas production industry for heating purposes increased from 2008 to 2013. Between 2013 and 2024, the production of natural gas was reduced by 88%, which also resulted in a decrease in the amount of natural gas combusted in this category;
- The combustion of solid fuels has increased again in 2021 and 2022, as a result of the high prices of natural gas at the end of 2021, in 2022 and at the beginning of 2023;
- In 2023, the solid fuel consumption decreased again, as a result of increased renewable electricity production and lower natural gas prices;
- In 2024, the solid fuel consumption increased slightly compared to 2023, mainly in the category Iron and steel.

2.3.1.2 Manufacturing industries and construction (1.A.2)

The main fluctuations in GHG emission in this sector (1.A.2) can be explained as follows:

- decreasing emissions since 1990 were mainly due to a decrease in cogeneration facilities in the industrial sector (category 1.A.2.c Chemicals);
- emissions in the category 1.A.2 generally follow production in the Manufacturing industries. The effect of the economic crisis in 2008 is clearly visible. In 2016 and 2017, emissions increased because of growing economic activities;
- the decrease in GHG emissions in 2018 and 2019 was a result of less natural and residual gas combustion (category 1.A.2.c Chemicals);
- In 2024, the solid fuel consumption increased slightly compared to 2023, mainly in the category Iron and steel (1.A.2.a). The dip in 2023 in this subsector resulted from maintenance activities at the main iron and steel plant in the Netherlands.

The chemical industry chiefly contributed to the 39.9% decrease in CO₂ emissions from combustion in 1.A.2 over the 1990–2024 period.

2.3.1.3 Transport (1.A.3)

The main fluctuations in GHG emissions in this category (1.A.3) can be explained as follows:

- an increase in diesel fuel consumption between 1990 and 2006 resulted in increased emissions in category 1.A.3.b (Road vehicles);
- since 2006, GHG emissions from transport have decreased, while from 2014 till 2020, they have slightly increased again; this is explained by a growing economy with more transport in the 2014–2019 period;
- in 2020, a dip in GHG emissions in the category Transport is clearly visible. This is due to measures taken during the COVID-19 pandemic, resulting in much less road traffic;
- Following the resumption of road traffic, GHG emissions increased to 25.0 Mt CO₂ eq in 2023 and decreased by 5% in 2024 to 23.8 Mt CO₂ eq.

2.3.1.4 Other sectors (1.A.4)

The main fluctuations in GHG emissions in this category (1.A.4) can be explained as follows:

- Substantial interannual fluctuations in emissions are a result of fluctuations in temperature. More natural gas is used during cold winters (e.g. 1996 and 2010) and less in mild winters (e.g. 2014).
- In the category Residential (1.A.4.b), CO₂ emissions have decreased since 1990, while the number of households has increased. This is mainly due to improved insulation and increased use of high-efficiency boilers for central heating.
- In 2022 and 2023, a large decrease of CO₂ emissions can be seen as a result of the high natural gas prices (resulting in less heating by households). In 2024, the natural gas prices decreased again, but the natural gas consumption did not increase because of the relatively warm winter in 2023–2024.

2.3.2 *Industrial processes and product use*

In 2024, IPPU contributed 8.1% to the national total GHG emissions compared to 11.5% in 1990. The sector is also a source of N₂O emissions, accounting for 7.7% of national total N₂O emissions in 2024.

The main fluctuations in GHG emissions as shown in Figure 2.10 can be explained as follows:

- category 2.B: an increase in emissions of fluorinated gases until 1998, mainly due to increased production of HCFC-22;
- category 2.B: a major decrease in emissions of fluorinated gases from 1999 onwards due to a reduction in HFC-23 emissions from HCFC-22 production;
- category 2.B: a decrease in N₂O emissions as a result of applying catalytic reduction technologies in the production of nitric acid under EU-ETS regulations from 2008 onwards.

2.3.3 *Agriculture*

In 2024, Agriculture contributed 12.3% to the national total GHG emissions compared to 11.2% in 1990. This sector is a major

contributor to national total CH₄ and N₂O emissions; in 2024, Agriculture accounted for 70.4% of the total CH₄ emissions and for 72.8% of the total N₂O emissions.

The main fluctuations in GHG emissions in the Agriculture sector as shown in Figure 2.10 can be explained as follows:

- category 3.A: emissions decreased slightly, mainly due to a decrease in CH₄ emissions from cattle;
- category 3.D: N₂O emissions have decreased from 1990 onwards, resulting from a relatively large decrease in N inputs into soil.

2.3.4 *LULUCF*

The total net emissions in the LULUCF sector decreased from 3.8 Mt CO₂ eq in 1990 to 3.7 Mt CO₂ eq in 2024. The sector accounts for 2.6% of national total CO₂ equivalent emissions in 2024.

The main fluctuations in GHG emissions from 1990 to 2024 can be explained as follows:

- CO₂ emissions from the drainage of peat soils and peaty soils were the major source of the net emission from Cropland (4.B), Grassland (4.C) and Settlements (4.E) and decreased from 5.36 Mt CO₂ in 1990 to 4.40 Mt CO₂ in 2024.
- CO₂ emissions from management of mineral soils on Cropland remaining (4.B.1) and Grassland remaining (4.C.1) are also big drivers of fluctuations in emissions throughout the time period.

Compared to 2023, emissions in the LULUCF sector increased from 3.3 to 3.7 Mt CO₂ eq, because of decreased uptake and increased decomposition of carbon in mineral soils of remaining grasslands and cropland. This might be due to the fact that 2024 was a wet and warm year, hindering uptake and increasing decomposition of carbon in mineral soils.

2.3.5 *Waste*

Between 1990 and 2024, emissions from the Waste sector decreased by 82.4% (from 16.3 Mt CO₂ eq in 1990 to 2.9 Mt CO₂ eq in 2024). This decrease is mainly due to an 88.4% reduction in CH₄ from landfills. The landfilling of waste with large amounts of biodegradables (such as household waste) was first discouraged and then banned in the Netherlands.

2.3.6 *Precursor gases*

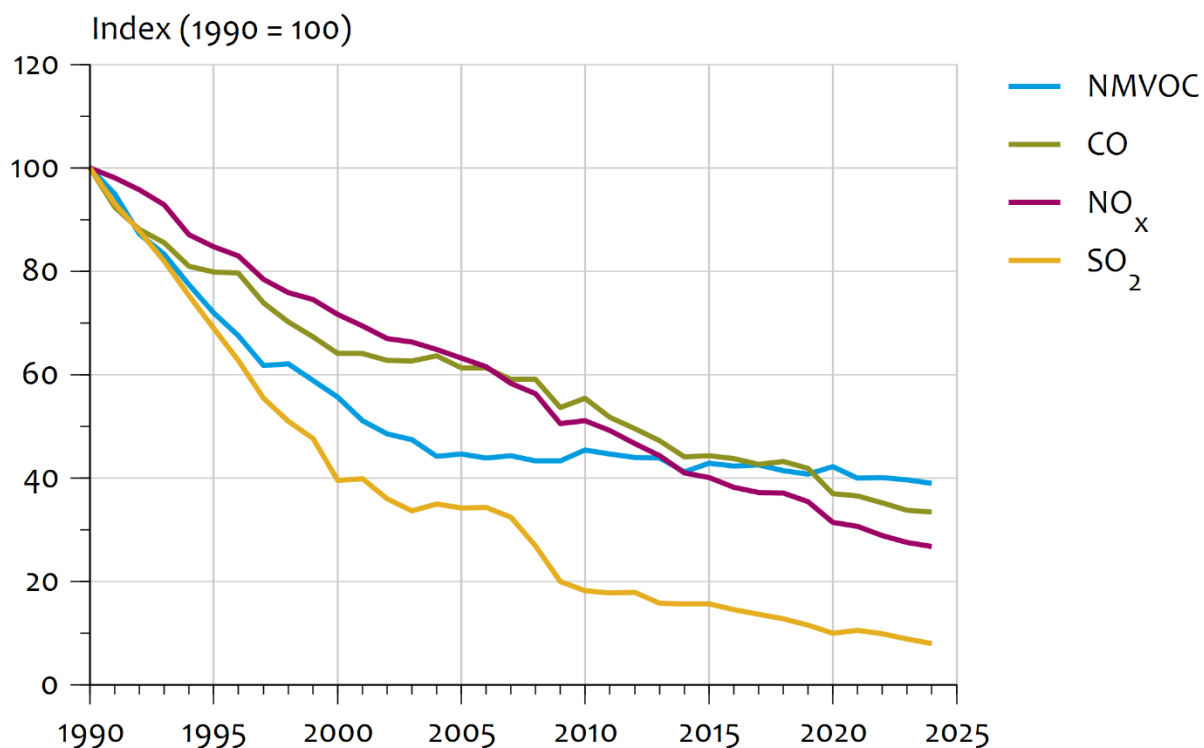
The emissions of carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), and sulphur dioxide (SO₂) are also reported in the greenhouse gas inventory, as requested by the UNFCCC guidelines. Although these gases are not included in the GWP-weighted GHG emission totals, they affect the overall radiative balance of the atmosphere and thus contribute to climate change. Nitrogen oxides, carbon monoxide, and NMVOCs can result in an increase in tropospheric ozone concentration, increasing radiative forcing. Sulphur oxides are included because they contribute to sulphate aerosol formation, which has a cooling effect.

The calculation methodologies regarding these emissions are explained in detail in the Netherlands' Informative Inventory Report (Staats et al., 2026), in line with the EMEP guidebook. Table 2.3 provides the emissions trends for carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), and sulphur dioxide (SO₂). Figure 2.12 shows the relative emissions trends of these gases.

Table 2.3 Emissions trends for NO_x, CO, NMVOC, and SO₂ (in kt)

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Total NO_x	675.3	572.5	483.6	426.9	344.9	270.8	212.2	185.8	180.7
Total CO	1187.8	948.7	761.1	728.3	658.8	526.5	439.2	400.9	396.9
Total NMVOC	600.0	432.0	334.3	268.3	272.8	257.1	253.2	238.0	234.1
Total SO₂	197.6	136.4	78.1	67.6	36.1	31.0	19.7	17.5	15.8

Figure 2.12 Relative emissions trends for NO_x, CO, NMVOC, and SO₂ in the Netherlands, 1990–2024. The base year 1990 is set at 100



In the 1990–2024 period, emissions of CO, NO_x, NMVOC, and SO₂ were reduced by 67%, 73%, 61%, and 92%, respectively. With the exception of NMVOC, most of the emissions stem from fuel combustion.

3 Energy (CRT sector 1)

Major changes in the Energy sector compared to the National Inventory Report 2025

Emissions:	In 2024, GHG emissions relating to the Energy sector decreased by 1.8% compared to 2023. The decrease mainly occurred due to reduced gaseous and liquid fuel consumption in the Energy industries (1.A.1), and to reduced diesel consumption in Transport (1.A.3).
No longer a key category:	1.A.1 Energy Industries: all fuels N ₂ O
Methodologies and recalculations:	Energy statistics have been updated/improved for the years 1990–2023. Activity data for solid and liquid biomass has been corrected for stationary combustion (excluding 1.A.4.b.i) for the complete time series. The model for Non-Road Mobile Machinery (1.A.2.g.v.ii, 1.A.4.a.ii, 1.A.4.b.ii, 1.a.4.c.ii) has been updated/improved for the years 1990–2023. Diesel for Recreational craft, which had been classified under Road transportation in the energy statistics from 2013 onwards, has been shifted from 1.A.3.b Road Transportation to 1.A.3.d Domestic navigation. Diesel for military land equipment is no longer allocated to 1.A.4.a.ii NRMM, but to 1.A.5.b Mobile military use for the entire time series.

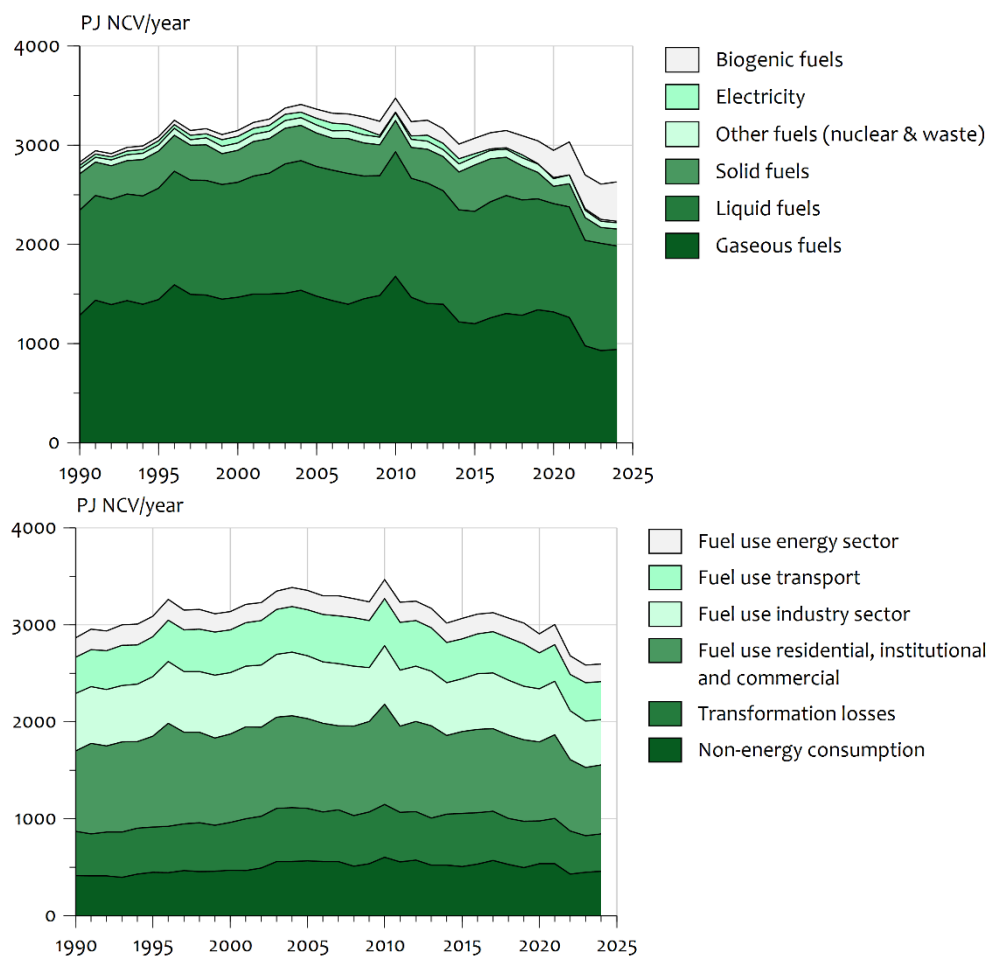
3.1 Overview of the sector and background information

3.1.1 Energy supply and energy demand

The energy system in the Netherlands is largely driven by the combustion of fossil fuels (Figure 3.1). Natural gas is used most, except in 2022–2024 when high prices of natural gas between the end of 2021 and the beginning of 2023 resulted in a reduction of the natural gas consumption in these years. In 2024, natural gas consumption increased slightly compared to 2023, but is not back to the level of 2021 and earlier, because of the relatively warm winter in 2024. The share of biogenic fuels has increased from 1% in 1990 to 16% in 2024, and has been used for a large part in electricity production. The contribution made by other fuels (fossil waste & nuclear) is relatively small (2–3%).

Part of the supply of fossil fuels is not used for energy purposes but for feed stocks in the (petro-)chemical or fertiliser industries. Emissions from fuel combustion (as reported for the Sectoral Approach in CRT 1.A) are consistent with national energy statistics (available via: <https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dl=CD128>).

Figure 3.1 Overview of energy supply and energy demand in the Netherlands, 1990–2024 in PJ Net Calorific Value (NCV), as published by Statistics Netherlands



'Electricity' refers to imported electricity only.

3.1.2 Trends in fossil fuel use and fuel mix

Natural gas represents a majority share (>50%) of national energy consumption in all non-transport categories: Energy industries, Manufacturing industries and construction, and Other sectors (mainly for space heating). Oil products are primarily combusted in transport, refineries, and the petrochemical industry, while the use of coal is limited to power generation and steel production.

Between 1990 and 2024, total fossil fuel combustion decreased by 19.2% due to a 53.0% decrease in solid fuel consumption, a 26.8% decrease in gaseous fuel consumption, and a 1.5% decrease in liquid fuel consumption.

Total fossil fuel consumption for combustion decreased by about 0.8% between 2023 and 2024 due to a 3.8% decrease in liquid fuel combustion, a 4.3% decrease in other fuel combustion, a 1.4% increase in gaseous fuel combustion, and a 9.4% increase in solid fuel combustion.

Note that solid fuel consumption showed an increase in 2015 and 2016, which was caused by three new coal-fired power plants. The decrease in solid fuel consumption between 2016 and 2020 was due to the closure of old coal-fired power plants. The combustion of solid fuels increased again in 2021 and 2022, as a result of the rising prices of natural gas at the end of 2021, in 2022 and at the beginning of 2023. In 2023, the solid fuel consumption decreased again, as a result of increased renewable electricity production and lower natural gas prices. In 2024, the solid fuel consumption increased slightly compared to 2023, mainly in the category Iron and steel.

Winter temperatures have a large influence on gas consumption, as natural gas is used for space heating in most buildings in the Netherlands. 1996 and 2010 both had a cold winter compared to other years, causing an increase in the use of gaseous fuel for space heating. 2014 had a mild winter compared to other years resulting in a decline in the use of gaseous fuel for space heating.

3.1.3 *GHG emissions from the Energy sector*

Table 3.1 shows the emissions in the main categories in the Energy sector. The Energy sector is the largest sector in the Dutch GHG emissions inventory and is responsible for 73.5% of total CO₂ emissions in the country, resulting primarily from combustion and to a relatively small extent from fugitive emissions.

Table 3.1 Overview of emissions in the Energy sector in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Emissions in Mt CO ₂ eq			2024 vs 1990 %	Contribution by the category in 2024 (%) to the		
		1990	2023	2024		sector	total gas	total CO ₂ eq
1 Energy	CO ₂	150.5	105.4	103.4	-31.3%	97.4%	87.2%	71.6%
	CH ₄	3.3	2.2	2.2	-34.0%	2.0%	11.9%	1.5%
	N ₂ O	0.31	0.56	0.55	77.5%	0.52%	8.3%	0.38%
	all	154.1	108.1	106.1	-31.1%	100.0%		73.5%
1.A Fuel combustion	CO ₂	149.6	104.3	102.1	-31.7%	96.2%	86.1%	70.7%
	CH ₄	1.0	1.7	1.7	77.3%	1.6%	9.5%	1.2%
	N ₂ O	0.31	0.56	0.55	77.5%	0.52%	8.3%	0.38%
	all	150.9	106.6	104.4	-30.8%	98.4%		72.3%
1.B Fugitive emissions	CO ₂	0.89	1.0	1.3	44.7%	1.2%	1.1%	0.89%
	CH ₄	2.3	0.49	0.43	-81.4%	0.40%	2.3%	0.30%
	all	3.2	1.5	1.7	-46.4%	1.6%		1.2%
Total national emissions (incl. LULUCF)	CO ₂	166.7	119.8	118.5	-28.9%			
	CH ₄	36.5	18.6	18.3	-50.0%			
	N ₂ O	16.1	6.6	6.6	-59.1%			
	Total*	226.6	146.1	144.4	-36.3%			

* including f-gases

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

The Energy sector includes:

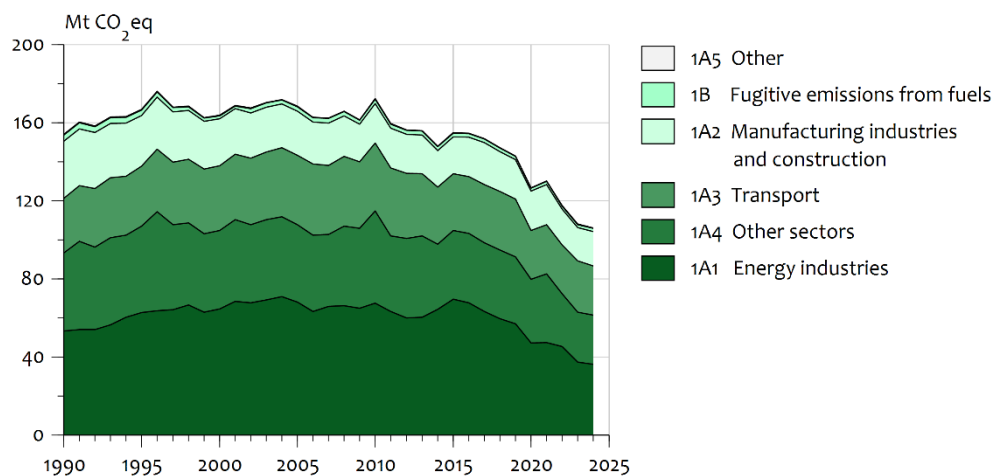
- use of fuels in stationary and mobile applications;
- conversion of primary energy sources into more usable energy forms in refineries and power plants;
- exploration and exploitation of primary energy sources;
- distribution of fuels.

Key categories are indicated throughout the chapter on (sub)category level.

3.1.4 Overview of shares and trends in emissions

Figure 3.2 show the contributions by the subcategories and emissions trends in the Energy sector. Most of the emissions from the Energy sector stem from the category Energy industries (1.A.1), followed by Transport (1.A.3) and Other sectors (1.A.4).

Figure 3.2 Sector 1 Energy – trends and emissions levels of total greenhouse gas emissions per source category, 1990–2024



3.2 Fuel combustion (1.A)

Table 3.2 presents the source categories and trends in emissions under category 1.A in the Energy sector.

Table 3.2 Overview of emissions in the category Fuel combustion (1.A) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
		Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
1.A Fuel combustion	CO ₂	149.6	104.3	102.1	-31.7%	96.2%	86.1%	70.7%
	CH ₄	1.0	1.7	1.7	77.3%	1.6%	9.5%	1.2%
	N ₂ O	0.31	0.56	0.55	77.5%	0.52%	8.3%	0.38%
	All	150.9	106.6	104.4	-30.8%	98.4%		72.3%
1.A.1 Energy Industries	CO ₂	53.1	37.1	36.0	-32.3%	33.9%	30.4%	24.9%
	CH ₄	0.08	0.11	0.12	55.6%	0.11%	0.66%	0.08%
	N ₂ O	0.13	0.19	0.18	37.1%	0.17%	2.7%	0.12%
	All	53.4	37.4	36.3	-32.0%	34.2%		25.1%
1.A.2 Manufacturing industries and construction	CO ₂	29.1	16.9	17.5	-39.9%	16.5%	14.8%	12.1%
	CH ₄	0.07	0.06	0.06	-7.9%	0.06%	0.33%	0.04%
	N ₂ O	0.03	0.03	0.03	12.7%	0.03%	0.52%	0.02%
	All	29.2	17.0	17.6	-39.8%	16.6%		12.2%
1.A.3. Transport	CO ₂	27.7	25.9	24.8	-10.4%	23.3%	20.9%	17.2%
	CH ₄	0.20	0.07	0.07	-65.5%	0.06%	0.38%	0.05%
	N ₂ O	0.10	0.29	0.28	194.7%	0.27%	4.3%	0.20%
	All	28.0	26.3	25.1	-10.1%	23.7%		17.4%
1.A.4. Other sectors	CO ₂	39.3	24.2	23.6	-39.9%	22.3%	19.9%	16.4%
	CH ₄	0.64	1.4	1.5	133.5%	1.4%	8.2%	1.0%
	N ₂ O	0.05	0.05	0.05	4.5%	0.04%	0.72%	0.03%
	All	40.0	25.7	25.2	-37.0%	23.7%		17.4%
1.A.5. Other	CO ₂	0.39	0.26	0.20	-48.3%	0.19%	0.17%	0.14%
	CH ₄	0.00	0.00	0.00	-53.2%	0.00%	0.00%	0.00%
	N ₂ O	0.01	0.00	0.00	-53.2%	0.00%	0.04%	0.00%
	All	0.39	0.27	0.20	-48.4%	0.19%		0.14%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

3.2.1

Comparison of the sectoral approach with the reference approach

Emissions from fuel combustion are estimated by multiplying fuel quantities combusted through specific energy processes by fuel-specific emission factors (EFs) and, in the case of non-CO₂ GHGs, source category-dependent EFs. This Sectoral Approach (SA) is based on actual fuel demand statistics. The IPCC Guidelines also require – as a quality control activity – the estimation of CO₂ emissions from fuel combustion on the basis of a national carbon balance derived from fuel supply statistics. This is the Reference Approach (RA). This section makes a detailed comparison of the SA the RA.

Energy supply balance

Table 3.3 presents the energy supply balance of fossil fuels for the Netherlands in 1990 and 2024 at a relatively high aggregation level. The Netherlands used to produce large amounts of natural gas, both onshore (Groningen gas) and offshore. A large share of the gas produced was exported. Due to earthquakes in Groningen caused by natural gas extraction, the production has been reduced since 2014. More natural gas has been imported. Natural gas represents a large share of the national energy supply.

Table 3.3 Energy supply balance for the Netherlands (PJ NCV/year) as reported in CRT table 1.A(b)

Year	Role	Indicator name	Solid fuels	Liquid fuels	Gaseous fuels
1990	Supply	Primary production	0	170	2283
		Total imports	390	3811	85
		Stock change	2	13	0
		Total exports	-25	-2422	-1081
		Bunkers	0	-530	0
	Consumption	Gross inland consumption	-367	-1043	-1286
		<i>whereof: Final non-energy consumption</i>	-11	-324	-95
2024	Supply	Primary production	0	18	300
		Total imports	172	5889	1035
		Stock change	5	-14	117
		Total exports	-4	-4292	-494
		Bunkers	0	-600	-16
	Consumption	Gross inland consumption	-172	-1002	-941
		<i>whereof: Final non-energy consumption</i>	-1	-414	-95

Comparison of CO₂ emissions

The IPCC Reference Approach (RA) uses apparent consumption data (gross inland consumption) per fuel type to estimate CO₂ emissions from fossil fuel use. This approach is used as a means of verifying the sectoral total CO₂ emissions from fuel combustion (IPCC, 2006). The RA uses Eurostat energy statistics (production, imports, exports, stock changes, and bunkers) to determine apparent fuel consumption, which is then combined with carbon EFs to calculate carbon content of the fuels. Non-combusted carbon used as feedstock, as a reductant, or for other non-energy purposes is subsequently deducted.

The Eurostat energy statistics for the Netherlands are based on national energy statistics as provided by Statistics Netherlands, but the level of aggregation may differ at times. The fuels from the Eurostat energy statistics are allocated to the fuels in the RA, as presented in Table 3.4. National default, partly country-specific, CO₂ EFs are adopted from Zijlema (2026) (see Annex 5).

Table 3.4 Relation between fuel types in RA and in Eurostat energy statistics

Fuel types in the Reference Approach			Fuel types in the Eurostat energy statistics
Liquid fossil	Primary fuels	Crude oil	Crude oil
	Secondary fuels	Natural gas liquids	Natural gas liquids
		Gasoline	Additives and oxygenates (excluding biofuel portion) Gasoline-type jet fuel Motor gasoline (excluding biofuel portion) Aviation gasoline
		Jet kerosene	Kerosine-type jet fuel (excluding biofuel portion)
		Other kerosene	Other kerosene
		Gas/diesel oil	Gas oil and diesel oil (excluding biofuel portion)
		Residual fuel oil	Fuel oil
		Liquefied petroleum gases (LPG)	Liquified petroleum gases
		Naphtha	Naphtha
		Bitumen	Bitumen
		Lubricants	Lubricants
		Petroleum coke	Petroleum coke
		Other oil	Paraffin waxes Other oil products n.e.c Refinery gas White spirit and special boiling point industrial spirit
Solid fossil	Primary fuels	Anthracite	Anthracite
		Coking coal	Coking coal
		Other bituminous coal	Other bituminous coal
		Lignite	Lignite
	Secondary fuels	BKB and patent fuel	Brown coal briquettes Patent fuel
		Coke oven/gas coke	Coke oven coke Gas coke

Fuel types in the Reference Approach			Fuel types in the Eurostat energy statistics
		Coal tar	Coal tar
Gaseous fossil		Natural gas (dry)	Natural gas
Waste (non-biomass fraction)		Other	Non-renewable municipal waste Industrial waste (non-renewable)
Peat			NO ¹⁾
<i>Biomass total</i>		Solid biomass	Primary solid biofuels Charcoal
		Liquid biomass	Pure biogasoline Blended biogasoline Pure biodiesels Blended biodiesels Pure bio jet kerosene Blended bio jet kerosene Other liquid biofuels
		Gas biomass	Biogases
		Other non-fossil fuels (biogenic waste)	Renewable municipal waste

Notes:

1. NO = Not occurring; Peat is not used in the Netherlands.

Table 3.5 presents the results of the RA calculations for the 1990–2024 period, compared to the official national total emissions reported as Fuel combustion (SA, source category 1.A). The annual difference calculated from the direct comparison ranges between -0.5% and 7.8%.

Table 3.5 Comparison of CO₂ emissions: RA versus SA (in Mt)

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Reference Approach									
Liquid fuels	49.2	52.4	52.7	54.9	53.1	47.5	42.5	46.8	41.6
Solid fuels	33.4	34.2	30.1	31.4	29.4	43.6	15.9	14.5	16.1
Gaseous fuels	67.7	76.3	77.5	78.6	87.5	62.1	68.4	48.5	47.6
Other fuels	0.6	0.9	1.5	2.2	2.5	2.8	2.7	2.7	2.4
Total RA	150.9	163.8	161.8	167.1	172.6	156.0	129.5	112.5	107.6
	1990	1995	2000	2005	2010	2015	2020	2023	2024
Sectoral Approach									
Liquid fuels	45.5	50.0	51.8	51.7	46.8	41.4	36.0	38.3	35.7
Solid fuels	33.6	34.2	29.9	31.4	29.8	42.9	16.2	14.6	16.1
Gaseous fuels	69.9	77.4	77.3	79.2	88.2	63.4	67.7	48.9	47.9
Other fuels	0.6	0.8	1.6	2.1	2.5	2.9	2.8	2.6	2.5
Total SA	149.6	162.3	160.6	164.4	167.3	150.6	122.6	104.3	102.1
	1990	1995	2000	2005	2010	2015	2020	2023	2024
Difference (%)									
Liquid fuels	8.1%	5.0%	1.9%	6.3%	13.4%	14.8%	18.1%	22.1%	16.5%
Solid fuels	-0.4%	-0.1%	0.7%	-0.3%	-1.3%	1.6%	-1.5%	-0.4%	-0.2%
Gaseous fuels	-3.2%	-1.4%	0.2%	-0.7%	-0.7%	-2.0%	1.1%	-0.7%	-0.6%
Other fuels	1.3%	5.6%	-5.7%	4.5%	0.6%	-2.7%	-2.6%	4.6%	-3.2%
Total	0.9%	0.9%	0.8%	1.6%	3.2%	3.6%	5.6%	7.8%	5.4%

Differences between the RA and the SA are due to four factors:

- In response to review recommendations (E.2 2022) and in line with the IPCC 2006 Guidelines (volume 3, chapter 1, box 1.1 and volume 3, chapter 3.9.4.2), the emissions from combustion of chemical waste gas in the category Chemical industry have been allocated to 2B10. However, these emissions actually result from the combustion of liquid fuels, and are also included in the energy statistics as fuel combustion. The chemical waste gas is produced during the production process by fuels that are included as 'transformation input' in the energy statistics. Therefore, the CO₂ emissions from chemical waste gas should be included in the comparison between the Reference Approach and the Sectoral

Approach (for liquid fuels). Chemical waste gas combustion is responsible for 3.5–9.7 Mt CO₂, which is now included in CRT 2B.

- The energy statistics contain production data for additives. These data cannot be included in the RA tables and is therefore excluded from the RA (while combustion of these fuels is included in the SA). As a result, the CO₂ emissions from liquid fuels in the RA are slightly underestimated. Production of additives is responsible for 0.3–1.2 Mt CO₂.
- There is a 'statistical difference' in the energy statistics, responsible for approximately 0–2% of the RA total per year.
- In the SA, company-specific EFs are used, while country-specific EFs are used in the RA.

If the CO₂ emissions in the Reference Approach and Sectoral Approach are corrected for the production of additives and the combustion of waste gases reported in CRT category 2, the total difference between the Reference Approach and Sectoral Approach ranges between -5.4% and +2.3%. For the years 2000–2023, the difference ranges between -1.3% and +2.3%. See table 3.6.

Table 3.6 Comparison of CO₂ emissions: RA versus SA after correction for production of additives in the Reference Approach and correction for combustion of chemical waste gas in CRT category 2 in the Sectoral Approach (in Mt).

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Reference Approach, corrected for production of additives									
Total RA	150.9	163.8	161.8	167.1	172.6	156.0	129.5	112.5	107.6
Correction RA – production of additives	0.3	0.6	0.7	0.7	0.6	0.7	0.6	0.8	0.5
Corrected RA	151.2	164.3	162.5	167.7	173.1	156.7	130.1	113.3	108.1
	1990	1995	2000	2005	2010	2015	2020	2023	2024
Sectoral Approach, corrected for combustion of chemical waste gas reported in CRT category 2									
Total SA	149.6	162.3	160.6	164.4	167.3	150.6	122.6	104.3	102.1
Correction SA – combusted waste gas reported in CRT2	5.7	3.5	3.9	5.3	7.7	6.5	7.6	6.8	6.5
Corrected SA	155.3	165.8	164.4	169.7	175.0	157.0	130.2	111.2	108.6

	1990	1995	2000	2005	2010	2015	2020	2023	2024
	Difference between corrected Reference Approach and corrected Sectoral Approach (%)								
Difference corrected RA/SA	-2.6%	-0.9%	-1.2%	-1.2%	-1.1%	-0.2%	0.0%	1.9%	-0.4%

3.2.2 *International bunker fuels (1.D)*

3.2.2.1 Category description

Figure 3.3. shows that jet kerosene consumption (used in international aviation) more than doubled between 1990 and 1999 and continued to increase slowly between 2000 and 2019 (except for the 2009–2012 period, when the economic crisis resulted in a decrease in fuel deliveries). In 2020 and 2021, the jet kerosene consumption decreased as a result of measures taken during the COVID-19 pandemic. Subsequently, consumption increased again to 146 PJ in 2024. From 1990 to 2007, sales of aviation gasoline were reported in the Energy Balance (0.5 PJ in 1990), but not after that. Sales of biokerosene have been reported as of 2022 and amounted to 5 PJ in 2024.

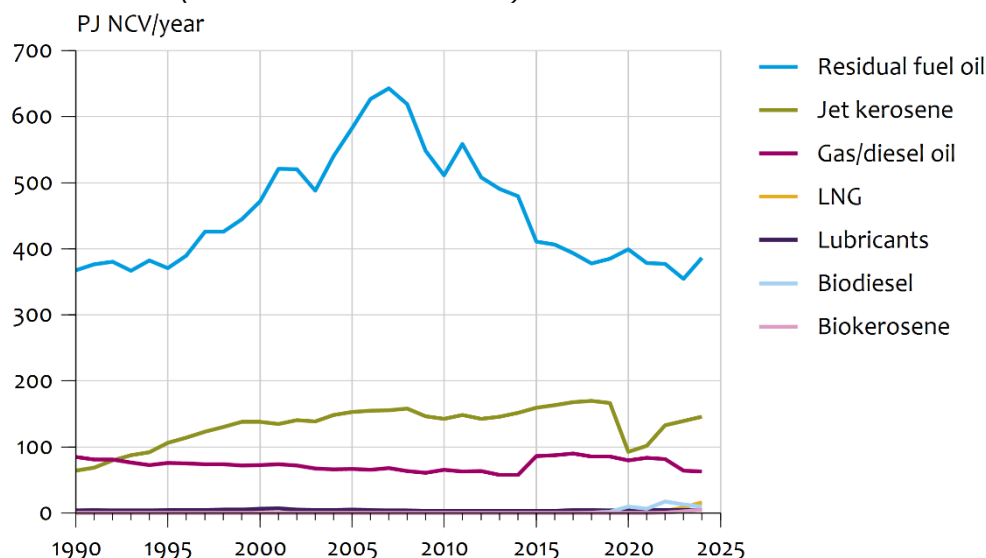
Fuel deliveries for international navigation (residual fuel oil, gas/diesel oil, LNG, biodiesel, and lubricants) increased by 57% between 1990 and 2007, but have since decreased by 33% to 480 PJ in 2024. In the 2008–2012 period, this decrease can mainly be attributed to the economic crisis. Fuel deliveries have, however, continued to decrease through 2023, even though the economy and transport volumes have grown. The continued decrease can be partly attributed to more fuel-efficient shipping (resulting from lower sailing speed, for instance, as shown by Marin, 2019), and partly to the decreased share of Dutch ports in the Northwest European bunker market. In 2024, sales increased by 8% compared to 2023.

Deliveries of diesel oil for international maritime navigation increased by 49% between 2014 and 2015. Ships switched from fuel oil to using diesel oil. This can be attributed to more stringent regulations, in 2015, on sulphur oxide emissions from ships in the Emission Control Areas (ECAs) of the North Sea. Diesel oil contains less sulphur dioxide than the cheaper fuel oil.

In 2024, diesel deliveries continued to decrease slightly, from 63 PJ in 2023 to 61 PJ (-1%). The supply of LNG almost doubled from 8.6 to 16.4 PJ. This development is due to international agreements (EU, International Maritime Organization) to emit less CO₂. Ships are becoming more energy-efficient and are increasingly using cleaner fuels. Despite this, sales of cheaper residual fuel oil increased by 9% in 2024, from 354 PJ in 2023 to 386 PJ. This can be entirely attributed to an increase in high-sulphur fuel oil (HFO). Low-sulphur fuel oil accounted for three-quarters of sales in 2024 (over 85% in previous years). Many ships use scrubbers (exhaust gas cleaning systems) to continue using HFO, but from July 2027, ships in and around ports in Western Europe will no longer be allowed to discharge wash water into the sea (OSPAR convention).

Deliveries of lubricants for international navigation increased from 3.8 PJ in 1990 to 7.1 PJ in 2001, followed by a decrease to 3.2 PJ in 2009 (economic crisis), after which they increased again to 4.8 PJ in 2024.

Figure 3.3 Marine and aviation bunker fuels, 1990–2024, as reported in CRT table 1.D (from Statistics Netherlands)



3.2.2.2 Methodological issues

Fuel deliveries are derived from the Energy Balance. As described in Witt et al. (2026), CO₂ emissions from bunker fuels are calculated using a Tier 1 and Tier 2 approach. Default IPCC heating values and CO₂ EFs are used for heavy fuel oil, jet kerosene, and lubricants, whereas country-specific heating values and CO₂ EFs are used for diesel oil derived from the Netherlands' list of fuels (Zijlema, 2026). CH₄ and N₂O emissions resulting from the use of bunker fuels are calculated by means of a Tier 1 approach, using default IPCC EFs for both substances (IPCC Guidelines, volume 2, chapter 3, tables 3.5.3 and 3.6.5).

3.2.2.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

Uncertainty estimates for the activity data and EFs used for calculating international bunker fuel emissions are presented in table 2.5 of the tables annex to Witt et al. (2026), which also shows the sources used to estimate uncertainties.

Time-series consistency

Emissions from international bunker fuels are calculated from the energy statistics combined with default and country-specific EFs as mentioned in 3.2.2.2. Energy statistics are prepared by Statistics Netherlands, using the same methodology for the complete time series. In 2015 and 2016, the energy statistics from 1990 onwards were revised, using the same methodology for all years. These revised energy statistics have been used from the 2017 submission onwards. The activity data are consistent throughout the time series.

3.2.2.4 Category-specific QA/QC and verification

The quantity of bunker fuels sold will depend on developments in aviation and shipping with foreign destinations and on fuel prices. From 1990 onwards, the number of flights to and from Dutch airports, most of them international, gradually increased to 566,000 flights in 2019. Due to international travel restrictions as a result of the COVID-19 pandemic, the number of flights were halved in 2020. From 2021 onwards, the number of commercial flights have increased again to 537,000 flights in 2024 (Statistics Netherlands). This development corresponds to the amount of fuel sold (jet kerosine).

In international navigation, a comparison to the volume of goods and people transported is less clear, which is due to the different types of fuel, to international fuel prices, and to the fact that ships have become more energy-efficient. In 2024, the transported cargo weight of cross-border freight transport was virtually the same as in 2023 (Statistics Netherlands).

3.2.2.5 Category-specific recalculations

The energy statistics have been updated for a few fuels/years:

- Residual fuel oil (international navigation): The fuel sales of residual fuel oil has been updated for 2015–2023, resulting in a small increase or decrease, particularly in 2023 by -0.9% (-3.2 PJ).
- Gas/diesel oil (international navigation): The fuel sales of gas/diesel oil have been adjusted for 1991 by -4.9% (-4.2 PJ).
- Aviation gasoline (international aviation): a small forgotten item in the years 1990–2015: <0.1 PJ during all these years.

This updated activity data are used to calculate the emissions of CO₂, CH₄, and N₂O and this resulted in the following changes in emissions (in kt CO₂ eq):

1.D.1.a. International aviation (aviation bunkers)

	1990	2000	2005	2010	2015	2020	2023
CO ₂	3.46	3.88	0.72	0.00	-0.51	-0.13	-1.32
CH ₄	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N ₂ O	0.03	0.03	0.01	0.00	0.00	0.00	-0.01

1.D.1.b. International navigation (marine bunkers)

	1990	2000	2005	2010	2015	2020	2023
CO ₂	0.00	0.00	0.00	0.00	7.71	-10.54	248.34
CH ₄	0.00	0.00	0.00	0.00	0.02	-0.03	-0.63
N ₂ O	0.00	0.00	0.00	0.00	0.05	-0.07	-1.70

3.2.2.6 Category-specific planned improvements

There are no planned improvements.

3.2.3 Feed stocks and non-energy use of fuels

Table 3.3 shows that a large share of the gross national consumption of petroleum products was used for non-energy applications. These fuels were mainly used as feedstock in the petrochemical industry (naphtha), and the carbon is stored in many products (bitumen, lubricants,

et cetera). A fraction of the gross national consumption of natural gas (mainly in ammonia production) and coal (Electronics industry, Food processing) was also used in non-energy applications, and hence, this gas/coal was not directly oxidised. In many cases, these products are finally oxidised in waste incinerators or during use (e.g. lubricants in two-stroke engines). In the RA, these product flows are excluded from the calculation of CO₂ emissions.

3.2.4 Energy industries (1.A.1)

3.2.4.1 Category description

Table 3.7 provides an overview of the emissions from the category Energy industries (1.A.1) as well as from the key categories. Figure 3.4 presents the development of total GHG emissions by sub-category of the Energy industries in the years 1990–2024.

Table 3.7 Overview of emissions in the category Energy industries (1.A.1) in the base year and the last two years of the inventory (in Mt CO₂ eq)

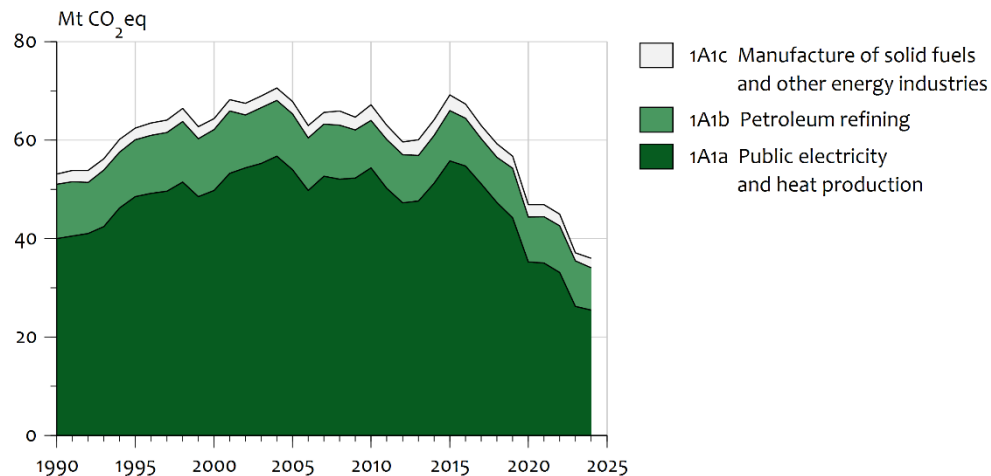
Sector/category	Gas	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
Emissions in Mt CO ₂ eq					%	sector	total gas	total CO ₂ eq
1.A.1 Energy Industries	CO ₂	53.1	37.1	36.0	-32.3%	33.9%	30.4%	24.9%
	CH ₄	0.08	0.11	0.12	55.6%	0.11%	0.66%	0.08%
	N ₂ O	0.13	0.19	0.18	37.1%	0.17%	2.7%	0.12%
	All	53.4	37.4	36.3	-32.0%	34.2%		25.1%
1.A.1.a Public electricity and heat production, total	CO ₂	40.0	26.2	25.5	-36.4%	24.0%	21.5%	17.6%
1.A.1.a liquids	CO ₂	0.23	0.29	0.21	-9.5%	0.20%	0.18%	0.15%
1.A.1.a solids	CO ₂	25.9	10.6	10.9	-57.7%	10.3%	9.2%	7.6%
1.A.1.a gas	CO ₂	13.3	12.7	11.9	-10.8%	11.2%	10.0%	8.2%
1.A.1.a other fuels	CO ₂	0.60	2.5	2.4	301.6%	2.3%	2.0%	1.7%
1.A.1.b. Petroleum refining, total	CO ₂	11.0	9.3	8.6	-21.6%	8.1%	7.3%	6.0%
1.A.1.b liquids	CO ₂	10.0	7.9	6.8	-31.7%	6.4%	5.7%	4.7%
1.a.1.b gases	CO ₂	1.0	1.4	1.8	75.6%	1.7%	1.5%	1.3%
1.A.1.c Manufacture of solid fuels and other energy industries, total	CO ₂	2.1	1.6	1.9	-9.3%	1.8%	1.6%	1.3%
1.A.1.c solids & liquid	CO ₂	0.93	0.66	1.0	3.3%	0.90%	0.81%	0.66%
liquids	CO ₂	0.01	NO	NO		0.00%	0.00%	0.00%
solids	CO ₂	0.92	0.66	0.96	4.4%	0.90%	0.81%	0.66%
1.A.1.c gases	CO ₂	1.2	0.94	0.96	-19.2%	0.90%	0.81%	0.66%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas and to the total national emissions (in CO₂ eq) are provided.

In line with the IPCC Guidelines (see volume 1, Table 4.1 in IPCC, 2006), aggregated emissions by fuel type and by category are used for the categorisation of key categories in 1.A.1 (the same approach is used for 1.A.2, 1.A.3, and 1.A.4). On that basis, category 1.A.1 comprises the following key categories:

- 1.A.1.a Public electricity and heat production: solids CO₂ (L,T)
- 1.A.1.a Public electricity and heat production: gaseous CO₂ (L1,T1)
- 1.A.1.a Public electricity and heat production: other fuels: waste incineration CO₂ (L,T)
- 1.A.1.b Petroleum refining: liquids CO₂ (L,T)
- 1.A.1.b Petroleum refining: gaseous CO₂ (L1,T1)
- 1.A.1.c Manufacture of solid fuels: solids CO₂ (L,T)
- 1.A.1.c Manufacture of solid fuels: gaseous CO₂ (L1,T1)

Figure 3.4 1.A.1 Energy industries – trend in total GHG emissions by sub-category, 1990–2024



Public electricity and heat production (1.A.1.a)

The Dutch electricity sector mainly consists of gas and coal-fired power stations and gas-fired cogeneration plants (combined heat and power, CHP). Many of the gas-fired cogeneration plants are operated as joint ventures with industries. The increasing trend in electric power production until 2005 corresponds to a substantial increase in CO₂ emissions from fossil fuel combustion by power plants (see Figure 3.4). The decreasing trend of CO₂ from 2016 onwards is the result of a decline in coal combustion due to the closure of coal-fired power plants (2016–2020), and of an increase in renewable energy (with the main increase from 2020 onwards).

In 1990, renewable energy was responsible for only a small share of the electricity production in the Netherlands, but this increased to 50% of the total electricity production in 2024 (as reported by Statistics Netherlands in:

<https://opendata.cbs.nl/#/CBS/en/dataset/80030eng/table?dl=CD269>).

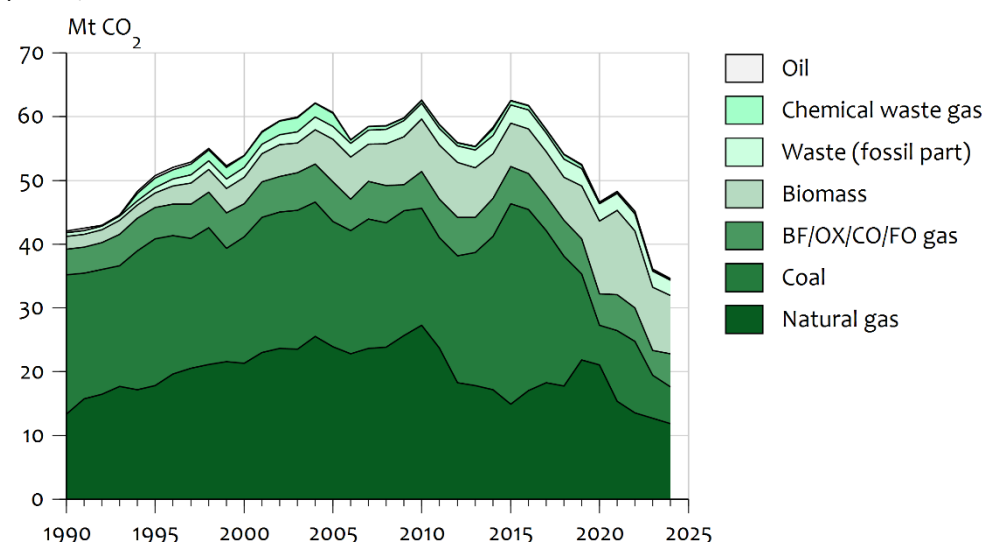
The main renewable energy sources for electricity production are wind, solar and biomass.

The sub-category Public electricity and heat production source also includes all emissions from large-scale waste incineration facilities. Since

all these incineration facilities produce heat and/or electricity, the emissions from waste incineration are allocated in 1.A.1.a and the waste incinerated in these installations is allocated under other fuels (fossil part of waste) and biomass (biogenic part of waste).

In addition, a large proportion of blast furnace gas and a significant part of coke oven gas produced by the single iron and steel plant in the Netherlands is combusted in the public electricity sector (see Figure 3.5; BF/OX/CO/FO refers to blast furnace gas, oxygen furnace gas, coke oven gas, and phosphor oven gas).

Figure 3.5 Trend in CO₂ emissions from fossil and biogenic fuel use in power plants, 1990–2024.



BF/OX/CO/FO gas refers to blast furnace gas, oxygen furnace gas, coke oven gas, and phosphor oven gas

Waste oils (waste oil, waste lubricant, waste solvent, et cetera) are collected by certified waste management companies. Until 2002, waste oils were used in the preparation of bunker fuels. Since then, this use has been prohibited for environmental reasons, and waste oils are now either exported to Germany or recycled. The recycling part of waste oils (feedstock for chemical plants, clean-up, and/or distillation) results in small fractions of non-useable wastes. In the past, these were incinerated in a special combustion facility in the Netherlands (reported under 1.A.1.a as plant-recovered waste heat). Since the closure of this plant, the residues have been exported for ecological processing, and the resulting foreign emissions are no longer included in the Dutch inventory.

Most of the biogas combustion recovered at landfill sites occurs in combined heat and power (CHP) plants operated by utilities; therefore, these emissions are also allocated to 1.A.1.a.

CO₂ emissions from the waste incineration of fossil carbon increased from 1990 until 2017. Since then, these emissions have declined. From 1990 onwards, an increasing amount of waste has been combusted rather than deposited in landfills, the result of environmental policy aimed at reducing waste disposal in landfills as well as at the import of waste (see

Chapter 7). The increase in the CO₂ EF for other fuels between 2004 and 2010 was due to the increase in the share of plastics (with a high carbon content) in combustible waste.

The decrease in the implied emission factor (IEF) for CO₂ from biomass in the 1990–2000 period is due to the increase in the share of pure biomass co-combusted with coal-firing, which has a lower EF than the organic carbon in waste combustion with energy recovery.

Between 1990 and 1998, a change in the ownership structures of plants (joint ventures) caused a shift of cogeneration plants from category 1.A.2 (Manufacturing industries and construction) to 1.A.1.a (Public electricity and heat production). This shift largely explains the increase in natural gas combustion in 1.A.1.a between 1990 and 1998. A similar shift occurred for a few large steam boilers fired by chemical waste gas. The corresponding CO₂ emissions allocated to the Energy sector increased from virtually zero in 1990 to 8.5 Mt in 1998 and to 9.1 Mt in 2005. The strong increase in liquid fuel use in 1994 and 1995 was due to the use of chemical waste gas (which is included in liquid fuels) in joint venture electricity and heat production facilities. This also explains the somewhat lower IEF for CO₂ from liquids since 1995, because the EF for chemical waste gas is lower than the EF for other liquid fuels.

Figure 3.5 shows a fluctuation in CO₂ emissions in 1.A.1.a due to market circumstances. Other influencing factors have been:

- an increase in natural gas combustion due to a change in ownership structures of plants, which resulted in a shift of natural gas combustion from 1.A.2 to 1.A.1.a in 1990–1998;
- new, large coal-fired power plants commencing operations in 2015 and 2016 resulted in a shift from natural gas to coal;
- closure of old coal-fired power plants in 2015–2019 has resulted in a decrease in coal consumption from 2017 onwards;
- high natural gas prices in 2022 (see Statistics Netherlands: https://opendata.cbs.nl/#/CBS/en/dataset/85666ENG/table?dl=C_D295) resulted in a decrease in natural gas consumption and an increase in coal consumption;
- In some years, the import of electricity was higher (e.g. 1999–2008 and 2012–2018) than in others (see https://opendata.cbs.nl/#/CBS/en/dataset/84575ENG/table?dl=C_D290).

CH₄ and N₂O emissions have increased since 1990, and this is mainly due to the increased amount of waste incinerated (for N₂O) and the increased amount of biomass combusted (for CH₄).

Petroleum refining (1.A.1.b)

There are five large refineries in the Netherlands; they export a large part of their products to the European market. Consequently, the Dutch petrochemical industry is relatively large.

1.A.1.b is the second largest emission source sub-category in category 1.A.1. The combustion emissions from this sub-category should be viewed in relation to the fugitive emissions reported under category 1.B.2. From 1990 to 2024, total CO₂ emissions from the refineries (as reported in 1.A.1.b and 1.B.2.a-iv) fluctuated interannually between 9.8 and 12.7 Mt CO₂.

Since 1998, one refinery has operated a Shell Gasification and Hydrogen Production (SGHP) unit, supplying all the hydrogen for a large-scale hydrocracker. The chemical processes involved in the production of hydrogen also generate CO₂ (CO₂ removal and a two-stage CO shift reaction). Refinery data specifying these fugitive CO₂ emissions is available and has been used since 2002. It is reported in category 1.B.2. Combustion emissions reported in this category are calculated by subtracting the carbon for this non-combustion process from the total fuel use in this category.

The use of plant-specific EFs for refinery gas from 2002 onwards has also caused a change in the IEF for CO₂ emissions from total liquid fuel compared to the years prior to 2002. The EF for refinery gas is adjusted to ensure exact correspondence between the total CO₂ emissions calculated and the total CO₂ emissions officially reported by the refineries.

The interannual variation in the IEFs for CO₂, CH₄, and N₂O emissions from liquid fuels is explained by the high and variable proportion (ranging between 40% and 90%) of refinery gas in total liquid fuel. Refinery gas has a low default EF compared to most other oil products and has shown variable EFs for the years from 2002 onwards.

Manufacture of solid fuels and other energy industries (1.A.1.c)

Source sub-category 1.A.1.c comprises:

- 1.A.1.ci: Fuel combustion (of solid fuels) for on-site coke production by iron and steel plant Tata Steel and fuel combustion from an independent coke production facility (Sluiskil, which ceased operations in 1999).
- 1.A.1.cii: Combustion of 'own' fuel (natural gas) by the oil and gas production industry for heating purposes: the difference between the amounts of fuel produced and sold, minus the amounts of associated gas that are flared, vented, or lost by leakage.

Fuel combustion emissions from coke production (1.A.1.ci) by the iron and steel plant are based on a mass balance. See section 3.2.5.1 for further information on emissions from the iron and steel sector, including emissions from coke production.

CO₂ emissions from 1.A.1.c.ii increased from 2008 to 2013. The increase is mainly due to the operation of less productive sites for oil and gas production compared to those operated in the past. This explains the steady increase over time in this category with respect to gas consumption. Between 2013 and 2024, the production of natural gas declined by 88% (see Statistics Netherlands:

<https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dl=CD2B3>), which also resulted in a decrease in the amount of natural gas combusted in this sector. The interannual variability in the EFs for CO₂ and CH₄ emissions from gas combustion (non-standard natural gas) is mainly due to differences in gas composition and the variable losses in the compressor stations of the gas transmission network, reported in the Annual Environmental Reports (AERs) of the gas transport company.

Liquid fuels are generally not used in 1.A.1.c; only a small amount of liquid fuels was used until 2013. From 2014 onwards, no liquid fuel use has been registered in the energy statistics for this sub-sector.

3.2.4.2 Methodological issues

This section provides a description of the methodology to calculate emissions from stationary combustion in the energy industries. The section is split into two parts: First, a description of the stationary combustion of all sectors except waste incineration, followed by a description of the methodology for waste incineration.

Details of methodologies, data sources, and country-specific source allocation issues are provided in section 2.1 (stationary combustion excluding waste incineration) and section 2.3.2.1 (waste incineration) of the ENINA methodology report (Honig et al., 2026).

Methodology for all sectors except waste incineration

The emissions from this source category are calculated in two steps: First, emissions are calculated by multiplying fuel consumption by country-specific EFs. Second, emissions reported by a select number of companies are used to refine the emissions calculation. The following section provides a description of these two steps as well as a comparison of the country-specific EFs and the IEFs (including an explanation of the differences).

Emissions calculation step 1

The first step of the emissions calculation consists of a multiplication of fuel consumption by country-specific EFs.

Activity data are derived from the aggregated statistical data from national energy statistics published annually by Statistics Netherlands (see <https://opendata.cbs.nl/#/CBS/en/dataset/83140ENG/table?dl=CD128>). The aggregated statistical data are based on confidential data from individual companies.

Emission factors are either IPCC default or country-specific EFs (Tier 1 and Tier 2 methods for CO₂, Tier 2 method for CH₄, and Tier 1 method for N₂O). For CO₂, IPCC default EFs are used (see Annex 5) with the exception of CO₂ from natural gas, coal, cokes, waste, waste gases, gas/diesel oil, gasoline, LPG, liquid biomass, and gaseous biomass, for which country-specific EFs are used. The CH₄ EFs are adopted from Scheffer (1997), except for the use of natural gas in gas engines and for waste. See section 2.1 of the ENINA methodology report (Honig et al., 2026) for further details on the CH₄ EF for gas engines. For N₂O, IPCC default EFs are used, except for waste and for solid fuels from the combined iron and steel plant.

A complete overview of the EFs is presented in section 2.1.3.3 of the ENINA methodology report (Honig et al., 2026).

Emissions calculation step 2

In the second step, the emissions reported by selected companies are used to refine the emissions calculation. Emissions data from individual companies (as reported in the AER and/or ETS reports) is used if companies report a different CO₂ EF for derived gases or other bituminous coal. The reported emissions data are validated by the competent authority. If these data are not accepted by the competent authority, the CO₂ emissions data are not used for the emissions inventory; country-specific EFs are used instead. This has occurred only

occasionally, and the emissions are recalculated when the validated data from these companies becomes available.

For each relevant company, data from the AERs and the ETS is compared (QC check) and the data that provides greater detail for the relevant fuels and installations is used. The CO₂ emissions reported by a company are combined with energy use as recorded in energy statistics for that specific company, to derive a company-specific EF. For each selected company, a company-specific EF is derived and used to calculate its emissions.

The following company-specific EFs have been calculated:

- Natural gas: Since 2003, company-specific EFs have been derived for the combustion of 'raw' natural gas (i.e. unprocessed natural gas). For the years prior to 2003, EFs from the Netherlands' list of fuels (Zijlema, 2026) are used.
- Refinery gas: Since 2002, company-specific EFs have been derived for all companies, which are used in the emissions inventory. For the years prior to 2002, EFs from the Netherlands' list of fuels (Zijlema, 2026) are used.
- Chemical waste gas: Since 1995, company-specific EFs have been derived for a selection of the (largest) companies. For the remaining companies, the default EF is used. If data from any of the selected companies was missing, a company-specific EF for that particular company was used (derived in 1995). For the 1990–1994 period, a country-specific EF based on an average EF for four (large) companies has been used.
- Coke oven gas: Since 2007, company-specific EFs have been derived for most companies. As coke oven gas is produced only at the one iron and steel company in the Netherlands, it is assumed that all coke oven gas has the same content, and the derived EF is used for all companies that use coke oven gas. For the years prior to 2007, EFs from the Netherlands' list of fuels (Zijlema, 2026) are used.
- Phosphorus gas: Since 2006, company-specific EFs have been derived for one company, which are used in the emissions inventory. For the years prior to 2006, EFs from the Netherlands' list of fuels (Zijlema, 2026) are used. This fuel was only used until 2012, when the only company using this fuel ceased operation.
- Coal: Since 2006, company-specific EFs have been derived for most companies (for the power plants that report a reliable company-specific EF), and the default EFs are used for the remaining companies. For the years prior to 2006, EFs from the Netherlands list of fuels (Zijlema, 2026) are used.
- Coke oven/gas coke (cokes): Since 2006, a company-specific EF has been derived for one company. For the other companies, a country-specific EF is used. For the years prior to 2006, a country-specific EF is used for all companies.

Methodology for waste incineration

Detailed information on activity data and EFs (waste incineration in WIPs) can be found in section 2.3.2.1 of Honig et al. (2026).

The activity data for the amount of waste incinerated derives mainly from the annual survey performed by the Working Group on Waste Registration (WAR) at all fourteen waste incineration plants (WIP) in the Netherlands. Data can be found in a background document

(Rijkswaterstaat, 2026). The waste incineration plants process a small portion of hazardous waste (100–150 kiloton). Examples are certain organic liquids from the chemical industry, cleaning cloths contaminated with oil and/or solvents, and oil filters. Other hazardous waste is incinerated in rotary kilns abroad (mainly in North-Western Europe). Hospital waste is nearly always incinerated in a special facility, see Appendix C-5 of the aforementioned report. This installation processes approximately 10 kiloton of hospital waste.

Fossil-based and biogenic CO₂, CH₄, and N₂O emissions from waste incineration are country-specific (Tier 2) and are calculated from the total amount of waste incinerated by waste stream. For some waste streams, the composition is updated annually, on the basis of analyses of household residual waste. The composition of other waste streams is described in section 2.3.2.1.1 of Honig et al. (2026).

Table 3.8 presents the total amounts of waste incinerated in terms of mass, energy, the fraction of biomass in energy, and the corresponding amounts of fossil and biogenic carbon in the total waste incinerated. The variations in annual emissions arise from the variations in the composition of the various waste streams. The decrease in the amount of incinerated waste in 2023 and 2024 is due to the fact that one waste incinerator was shut down for a longer period of time as a result of an incident.

Table 3.8 Composition of incinerated waste in WIPs

	1990	2000	2005	2010	2015	2020	2023	2024
Total waste incinerated (kt)	2780	4896	5503	6459	7564	7572	6841	6422
Total waste incinerated (TJ)	22,746	51,904	55,058	63,818	75,299	71,742	65,665	61,715
Energy content (MJ/kg)	8.2	10.6	10.0	9.9	10.0	9.5	9.6	9.6
Fraction biomass (energy %)	58.2	50.4	47.8	53.1	54.2	53.5	53.1	52.5
Amount of fossil carbon (kt)	164	433	561	675	780	739	695	659
Amount of biogenic carbon (kt)	544	938	909	1172	1381	1343	1220	1145

Fossil-based CO₂ is calculated on the basis of the fossil-based carbon content of the incinerated waste. In turn, the fossil-based carbon content is calculated on the basis of the carbon content of the various components in the various waste streams. As stated above, for some waste streams, the composition is updated annually.

Table 3.9 presents the emissions from the waste incineration plants. The emissions trend is directly related to the trend for the amount of waste processed.

Table 3.9 Emissions due to incinerated waste in WIPs

(in kt)	1990	2000	2005	2010	2015	2020	2023	2024
Total CO ₂ emission	2596	5025	5392	6770	7924	7634	7022	6612
CO ₂ captured and stored in a product	-	-	-	-	-	1	-	-
Fossil CO ₂ emissions	601	1586	2058	2473	2861	2709	2548	2416
Biogenic CO ₂ emissions	1995	3439	3334	4296	5063	4925	4474	4197
N ₂ O emissions	0	0.1	0.1	0.1	0.2	0.4	0.38	0.36
Total fossil GHG emissions (kt CO ₂ eq)	620	1647	2129	2562	2975	2821	2649	2511

The capture of carbon in a product is taken into account in the WIPs' CO₂ emissions. The amount of carbon capture is insignificant (except for 2020); less than 1 kt of CO₂ (fossil and biogenic) was captured and used in the production of bicarbonate.

Several Dutch WIPs capture CO₂. There is no clear guidance from IPCC on how to account for the usage of captured CO₂ from this specific category in the inventory. The Netherlands deals with this in two lines of potential application of the carbon captured:

- *usage as growth medium in agriculture.* As most of the CO₂ will ultimately be emitted to the atmosphere, this amount is not subtracted from the produced CO₂;
- *usage as raw material in the production of bicarbonate.* The captured amount is subtracted from the produced CO₂.

The data on the amount and type of usage comes from the annual survey of WIPs (Rijkswaterstaat, 2026). Detailed information can be found in section 2.3.2.1 of Honig et al. (2026).

On the basis of measurement data (Spoelstra, 1993), an EF of 20 g/ton waste is applied to N₂O from incineration with selective catalytic reduction (SCR). For incineration with selective non-catalytic reduction (SNCR), an EF of 100 g/ton is applied. The percentage of SCR has increased significantly since 1990.

A survey of EFs for CH₄ used in other countries and an analysis of emissions from waste incinerators in the Netherlands made it clear that the CH₄ concentration in the flue gases from waste incinerators is below the background CH₄ concentration in ambient air. Therefore, the Netherlands uses an EF of 0 g/GJ and reports no methane. The 2006

IPCC Guidelines state that an EF of 0 g/GJ is possible (volume 5, sections 5.2.2.3 and 5.4.2. Emissions are reported in the CRT file with the code 'NO' (as the CRT cannot handle zero values)).

A more detailed description of the method and the EFs used can be found in section 2.3.2.1.2 of Honig et al. (2026). A comparison between the country-specific EFs and the IPCC defaults can also be found in this report.

Comparison of emission factors

For 2024, approximately 97% of fossil CO₂ emissions were calculated using either country-specific or company-specific EFs. The remaining 3% of CO₂ emissions (from petroleum coke, other oil, lignite, and bitumen) were calculated using default IPCC EFs.

Table 3.10 provides an overview of the implied emission factors (IEFs) used for the most important fuels (up to 95% of fuel use) in the category Energy industries (1.A.1). Since part of the emissions data in this category originates from individual companies, some of the values (in Table 3.10) deviate from the standard emission factors. For reasons of confidentiality, detailed data on fuel consumption and EFs per CRT category and fuel is not presented in the NIR, but is available to reviewers on request.

Table 3.10 Overview of IEFs used for the most important fuels (up to 95% of fuel use) for the year 2024 in the category Energy industries (1.A.1)

Fuel	Amount of fuel used in 2024 (TJ NCV)	IEFs (g/GJ)		
		CO ₂ (x1000)	N ₂ O	CH ₄
Natural gas	258,823	56.7	0.29	9.88
Other bituminous coal	130,804	93.9	0.79	0.44
Waste gas	87,481	67.1	0.10	3.60
Solid biomass	43,189	109.6	3.00	30.00
Waste, biomass	32,406	129.5	6.39	0.00
Waste, fossil	29,309	82.4	5.23	0.00
Blast furnace gas	22,331	241.1	0.11	0.35

Explanation of the implied EFs

Natural gas

The CO₂, CH₄, and N₂O EFs for natural gas deviate from the standard EFs (56.2 kg CO₂/GJ, 5.7 g CH₄/GJ, and 0.1 g N₂O/GJ) because this category includes emissions from the combustion of crude natural gas. Furthermore, a higher CH₄ emission factor is used for natural gas combustion in gas engines.

Other bituminous coal

CO₂ emissions from coal are based on emissions data from the ETS, and the IEF is different from the country-specific EF. The N₂O emissions are calculated on the basis of default IPCC emission factors (for 1.A.1.a) and a company-specific emission factor for the combined iron/steel plant (for 1.A.1.c). The IEF for N₂O in Table 3.10 is a weighted average.

Waste gas (refinery gas)

CO₂ emissions from refinery gas occur in refineries and in the Energy sector. The CO₂ emissions are partly based on emissions data from the ETS; therefore, the IEF is different from the country-specific EF.

Waste

The EF for N₂O emissions from waste incineration (both the fossil and biomass fraction) either involves selective non-catalytic reduction (SNCR) or with selective catalytic reduction (SCR) (100 g/ton and 20 g/ton, respectively). The EF thus depends on how the incinerator is operated. The EF for CH₄ from waste incineration is 0 g/GJ, the result of a study on emissions from waste incineration (section 2.3.2.1.2 of Honig et al. (2026); DHV, (2010); and NL Agency, (2010)). This is in accordance with the 2006 IPCC Guidelines volume 5, sections 5.2.2.3 and 5.4.2. Therefore, the emissions are reported in the CRT file with the notation key NO as the CRT cannot handle zero values. The EF for CO₂ is dependent on the carbon content of the waste, which is determined annually (section 7.4 below; Honig et al., 2026).

Blast furnace gas

CO₂ emissions from blast furnace gas are based on emissions data from the ETS, and the IEF is different from the country-specific EF. The CH₄ and N₂O emissions are calculated on the basis of default IPCC emission factors (for 1.A.1.a) and a company-specific emission factor for the combined iron/steel plant (for 1.A.1.c). The IEFs for CH₄ and N₂O in Table 3.10 are a weighted average.

Trends in the IEF

Trends in the IEF for most sectors can be explained by the composition of fuels used in that sector. The largest fluctuations can be explained as follows:

- 1.A.1.a solid CO₂: The CO₂ IEF for solid fuels in 1.A.1.a ranges between 103.1 and 131.6 kg/GJ. The main fuels used are other bituminous coal (with an EF of 92.7 kg/GJ) and blast furnace gas (with a default EF of 247.4 kg/GJ). A larger share of blast furnace gas results in a higher IEF. The IEFs are higher in the 2019–2024 period due to a smaller amount of other bituminous coal, while blast furnace gas remained fairly stable.
- 1.A.1.c gaseous CO₂: The CO₂ IEF for gaseous fuels in 1.A.1.c ranges between 42.6 and 70.4 kg/GJ. The main fuels used in the production of oil and natural gas are crude 'wet' natural gas (directly extracted from the wells) and regular natural gas. The EF for wet natural gas is variable and tends to be slightly higher than the EF for regular natural gas. The variation in the EF for wet natural gas causes the variation in the IEF for gaseous fuels in 1.A.1.c.
- 1.A.1.c solid CO₂: The CO₂ IEF for solid fuels in 1.A.1.a ranges between 51.4 and 115.3 kg/GJ. Emissions are based on a mass balance of Tata Steel. The fuels in the mass balance are other bituminous coal (with an EF of 92.7 kg/GJ), coke oven / gas coke (with a default EF of 106.8 kg/GJ), coal tar (with an EF of 80.7 kg/GJ), blast furnace gas (with a default EF of 247.4 kg/GJ) and coke oven gas (with a default EF of 42.8 kg/GJ).

3.2.4.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The uncertainty in total emissions from this category is estimated at 6% for CO₂, 30% for CH₄, and 54% for N₂O.

The accuracy of data on fuel consumption in this category is generally considered to be high: 1–2% for natural gas, 1–2% for coal, 2% for blast furnace gas and coke oven gas, 4% for other fuels (waste incineration), 10% for lignite, and 5–10% for liquid fuels. The high accuracy in most of this activity data are due to the limited number of utilities and refineries, their large fuel consumption, and the fact that the data recorded in national energy statistics is verified as part of the European ETS.

For natural gas, the uncertainty in the CO₂ EF is estimated at 0.25% on the basis of the fuel quality analysis reported by Heslinga and Van Harmelen (2006) and in the methodology reports. For natural gas in oil and gas production (1.A.1.c), an uncertainty of 5% is assumed, which relates to the variable composition of offshore gas.

For hard coal (bituminous coal), an analysis was made of coal used in power generation (Van Harmelen and Koch, 2002), which is accurate to within approximately 0.5% for the year 2000 (based on 1270 samples taken in 2000). In 1990 and 1998, however, the EF varied by ± 0.9 kg CO₂/GJ (see table 4.1 in Van Harmelen and Koch, 2002); consequently, if the default EF is applied to other years, the uncertainty is greater. An uncertainty of 5% is assumed for the CO₂ EF of coal.

Analysis of the default CO₂ EFs for coke oven gas and blast furnace gas reveals uncertainties of approximately 15% (data reported by the steel plant). The composition of chemical waste gas is much more variable, and therefore an uncertainty of 30% is applied. To diesel, LPG, other oil products, and petroleum coke, CO₂ EF uncertainties of 2%, 2%, 5%, and 18%, respectively, have been assigned.

The uncertainty in the EFs for emissions of CH₄ and N₂O from stationary combustion is estimated at 50% for both gases for all fuels except waste.

For waste incineration, the uncertainty in the fossil CO₂ and N₂O emission factors for 2024 is estimated at 6% and 99%, respectively. The main factors influencing the uncertainties are the total amount being incinerated and the fractions of various waste components used for calculating the amounts of fossil and biogenic carbon in the waste (from their fossil and biogenic carbon fraction), and the corresponding amounts of fossil and biogenic carbon in the total waste incinerated. For a more detailed analysis of these uncertainties, see Rijkswaterstaat (2014).

Time-series consistency

Emissions from stationary energy combustion are calculated from the energy statistics combined with country-specific EFs (at the beginning of the time series), or from a combination of company-specific and country-specific EFs (at the end of the time series).

Time-series consistency is ensured for EFs and activity data for most sectors as follows:

- Company-specific emission factors have been used from the moment the data were available in MJV or ETS (depending on the fuel, starting between 1995 and 2007). For earlier years, country-specific emission factors have been applied. The country-specific EFs are based on company-specific data. Multi-year company-specific data from the most relevant companies has been used to calculate an average country-specific EF. As the same information is used to calculate both the country-specific EFs and the company-specific EFs, the EFs are consistent throughout the time series.
- Energy statistics are prepared by Statistics Netherlands using the same methodology for the complete time series. In 2015 and 2016, the energy statistics from 1990 onwards were revised using the same methodology for all years. These revised energy statistics have been used from the 2017 submission onwards. The activity data are consistent throughout the time series.

Time-series consistency in other sectors

For 1.A.1.c.ii, the emissions data for 1990–2001 is obtained from the annual reports by the oil and gas extraction companies as drawn up by Fugro-Ecodata; data from 2002 onwards has been reported by individual companies in their AERs. Both datasets are based on data from individual companies and, therefore, they are consistent throughout the time series.

3.2.4.4 Category-specific QA/QC and verification

The trends in fuel combustion in public electricity and heat production (1.A.1.a) are compared to trends in domestic electricity consumption (production plus net imports). Large interannual changes were identified and explained (e.g. changes in fuel consumption by joint ventures). For oil refineries (1.A.1.b), a carbon balance calculation was made to check completeness. The trend in total CO₂ reported as fuel combustion by refineries was also compared to trends in activity indicators, such as total crude throughput. The IEF trend tables were then checked for changes, and interannual variations were explained in this NIR. Changes in the IEF were mainly due to changes in the type of fuel used. Furthermore, the IEFs of individual fuels were compared to the default emission factors, and deviations from the standard EFs are explained in the NIR.

CO₂ emissions reported by companies (both in their AERs and within the ETS) were validated by the competent authority and compared. Further details on the validation of energy data can be found in section 2.1 of the ENINA methodology report (Honig et al., 2026).

3.2.4.5 Category-specific recalculations

Correction liquid and solid biomass

The solid and liquid biomass consumption data has been corrected for the complete time series for all stationary combustion sub-categories except 1.A.4.b.i. The data flow of the solid and liquid biomass statistics has been updated to match the data flow of the fossil fuel statistics. This resulted in two changes of the activity data:

- Activity data of biomass in earlier years was originally rounded to 1 TJ, but now activity data with more digits is used.

- Error correction: With the update, several errors were found in the biomass statistics. These have been corrected.

This resulted in the following differences for all years (in kt CO₂ eq for biogenic emissions). For the years 2015–2023, this table also includes the results of the regular update of the energy statistics:

CRT	Gas	1990	1995	2000	2005	2010	2015	2020	2023
1.A.1.a.i.	CO ₂	-48.2	-55.9	-66.8	-79.3	-36.4	0.0	0.0	-37.4
	CH ₄	-0.4	-0.4	-0.5	-0.9	-0.2	0.0	0.0	-0.3
	N ₂ O	-0.5	-0.5	-1.8	-9.9	-9.1	-3.7	-15.1	-12.9
1.A.2.g.iv.	CO ₂	-91.6	-98.1	-98.2	-101.2	-98.7	-104.7	-54.9	-39.6
	CH ₄	-0.7	-0.8	-0.8	-0.8	-0.8	-0.8	-0.4	-0.3
	N ₂ O	-0.9	-0.9	-0.9	-1.0	-1.0	-1.0	-0.5	-0.4
1.A.2.g.v.	CO ₂	-0.0					0.0		
	CH ₄	-0.0					0.0		
	N ₂ O	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1
1.A.2.g.viii.	CO ₂	139.8	239.6	235.8	236.2	111.1	28.5	-80.5	-81.3
	CH ₄	1.1	1.8	1.8	1.9	0.7	0.2	-0.3	-0.5
	N ₂ O	0.9	1.6	1.5	1.1	-1.9	-3.0	-4.3	-4.2
1.A.4.a.i.	CO ₂	-0.0	-10.9	-13.2	-15.6	21.3	39.6	47.2	67.4
	CH ₄	-0.0	-0.8	-1.0	-1.2	1.6	3.0	3.6	5.2
	N ₂ O	-0.1	-0.2	-0.2	-0.2	0.0	0.1	0.0	-0.3
1.A.4.c.i.	CO ₂	-0.0	3.7	2.6	-17.6	-66.0	36.6	47.5	74.0
	CH ₄	-0.0	0.3	0.2	-1.3	-5.1	2.8	3.6	5.7
	N ₂ O	-0.0	0.0	-0.0	-0.2	-0.9	-0.4	-1.2	-0.2
Total	CO ₂	-0.1	78.4	60.2	22.6	-68.8	0.0	-40.7	-16.9
	CH ₄	-0.0	0.1	-0.3	-2.3	-3.6	5.3	6.5	9.8
	N ₂ O	-0.6	-0.1	-1.5	-10.1	-12.9	-8.0	-21.1	-18.2

Update energy statistics 2015–2023

The energy statistics have been improved for 2015–2023. This is an annual update, and the main changes are described on the Table

Information of the Energy Balance Sheet (available via:

<https://opendata.cbs.nl/#/CBS/en/dataset/83989ENG/table?ts=1765534146208>).

The main recalculations in 1.A.1.a due to the update of the energy statistics include a change in the biogenic share of natural gas in 2015–2023 (resulting in a reallocation from natural gas to biogenic natural gas of 0.67 kt CO₂ in 2015 and 1.63 kt CO₂ in 2023). Furthermore, the natural gas activity data has been updated in 2015–2023 (+1.58 kt CO₂ in 2015 and + 158.81 kt CO₂ in 2023). Other main recalculations include an update of gas/diesel oil in 2015–2023 (-1.19 kt CO₂ in 2015 and - 1.60 kt CO₂ in 2023), an update of LPG in 2015–2021 (+1.10 kt CO₂ in 2015 and +1.40 kt CO₂ in 2021), an update of residual fuel oil in 2015 (-0.98 kt CO₂ in 2015), an update of biogas in 2023 (-2.22 kt CO₂ in

2023) and an update of other oil in 2021–2023 (-10.29 kt CO₂ in 2021 and -12.48 kt CO₂ in 2023). Also, emissions of CH₄ and N₂O have been recalculated from the updated energy statistics.

All updates of the energy statistics (including the smaller updates in the energy statistics that are not mentioned here) resulted in the following changes in emissions in 1.A.1.a (in kt CO₂ eq):

1.A.1.a (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	-0.17	2.62	0.20	-0.37	0.21	0.79	-9.84	-13.75	-15.55
CO ₂ biogenic	0.67	0.71	0.70	0.93	1.24	1.84	0.66	3.63	-0.59
CH ₄	11.77	7.22	5.45	5.89	5.26	5.15	3.23	2.89	4.76
N ₂ O	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.02	-0.02	-0.03

The main recalculations in 1.A.1.b due to the update of the energy statistics include a change in the biogenic share of natural gas (resulting in a reallocation from natural gas to biogenic natural gas of 0.14 kt CO₂ in 2015 and 0.66 kt CO₂ in 2023). Furthermore, the natural gas activity data for 2023 has been updated (+46.73 kt CO₂). Since total reported CO₂ emissions from the Dutch refineries are used for this sector, the increase in CO₂ emissions from natural gas results in a decrease of CO₂ emissions from refinery gas in 2023 (-46.73 kt CO₂). This is a reallocation between gaseous and liquid fuels, which is not visible in the table below. Also, emissions of CH₄ and N₂O have been recalculated from the updated energy statistics.

All updates of the energy statistics (including the smaller updates in the energy statistics that are not mentioned here) resulted in the following changes in emissions in 1.A.1.b (in kt CO₂ eq):

1.A.1.b (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	-0.17	-0.16	-0.09	2.37	1.28	5.14	2.34	-0.59	-0.66
CO ₂ biogenic	0.14	0.11	0.09	0.15	0.16	0.25	0.11	0.31	0.66
CH ₄	-0.00	-0.00	0.00	0.00	0.00	0.01	0.00	-0.00	0.13
N ₂ O	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	-0.00	0.02

The recalculations in 1.A.1.c ensuing from the update of the energy statistics are all rather small. The biogenic share of natural gas was updated, resulting in a reallocation from natural gas to biogenic natural gas of 0.07 tonnes CO₂ in 2015 and 0.16 tonnes CO₂ in 2023. The other recalculations were rather small. The largest change was other bituminous coal in 2015–2023 (with the largest change at -0.056 tonnes in 2017).

Update activity data before 2015

Apart from the annual updates in the energy statistics between 2015 and 2023, some small corrections in earlier years have also been made:

- 1.A.1.a, Residual fuel oil in 2008 (-0.003 kt CO₂)
- 1.A.1.b, Lubricants in 1990 (-0.007 kt CO₂) and 1997 (-0.003 kt CO₂)
- 1.A.1.b, Other kerosene in 1995 (-0.002 kt CO₂) and 1996 (-0.002 kt CO₂)

3.2.4.6 Category-specific planned improvements
There are no planned improvements.

3.2.5 *Manufacturing industries and construction (1.A.2)*

3.2.5.1 Category description

Table 3.11 provides an overview of sub-source categories and emissions in the category Manufacturing industries and construction (1.A.2).

Key categories

- 1.A.2 Manufacturing industries and construction: liquids CO₂ (L1,T1)
- 1.A.2 Manufacturing industries and construction: solids CO₂ (L)
- 1.A.2 Manufacturing industries and construction: gaseous CO₂ (L,T1)

Table 3.11 Overview of emissions in the category Manufacturing industries and construction (1.A.2) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
		Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
1.A.2 Manufacturing industries and construction	CO ₂	29.1	16.9	17.5	-39.9%	16.5%	14.8%	12.1%
	CH ₄	0.07	0.06	0.06	-7.9%	0.06%	0.33%	0.04%
	N ₂ O	0.03	0.03	0.03	12.7%	0.03%	0.52%	0.02%
	All	29.2	17.0	17.6	-39.8%	16.6%		12.2%
1.A.2 liquids	CO ₂	3.5	1.7	1.6	-54.7%	1.5%	1.3%	1.1%
1.A.2 solids	CO ₂	6.6	3.3	4.2	-36.4%	4.0%	3.6%	2.9%
1.A.2 gases	CO ₂	19.0	11.9	11.7	-38.4%	11.1%	9.9%	8.1%
1.A.2.a. Iron and steel	CO ₂	5.6	3.6	4.6	-17.9%	4.3%	3.9%	3.2%
1.A.2.b. Non-ferrous metals	CO ₂	0.21	0.10	0.10	-53.7%	0.09%	0.08%	0.07%
1.A.2.c. Chemicals	CO ₂	11.6	5.8	5.8	-50.0%	5.5%	4.9%	4.0%
1.A.2.d. Pulp, paper, and print	CO ₂	1.7	0.66	0.69	-58.4%	0.65%	0.59%	0.48%
1.A.2.e. Food processing, beverages, and tobacco	CO ₂	4.0	3.2	3.1	-22.1%	2.9%	2.6%	2.2%
1.A.2.f. Non-metallic minerals	CO ₂	2.3	1.0	0.91	-60.3%	0.86%	0.77%	0.63%
1.A.2.g. Other	CO ₂	3.8	2.6	2.3	-39.0%	2.2%	1.9%	1.6%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

Natural gas is mostly used in the Chemicals, Food processing, beverages, and tobacco, and related industries (1.A.2.c and 1.A.2.e); solid fuels (i.e. coal and coke-derived fuels, such as blast furnace/oxygen furnace gas) are mostly used in the Iron and steel industry (1.A.2.a); and liquid fuels are mostly used in the Chemicals industry (1.A.2.c) and in Other industries (1.A.2.g) (see Table 3.12). Within category 1.A.2 (Manufacturing industries and construction), sub-category 1.A.2.c (Chemicals) is the largest fuel user (see Table 3.12). Other large fuel-using industries are included in 1.A.2.a (Iron and steel), 1.A.2.e (Food processing, beverages, and tobacco), and 1.A.2.g (Other). In response to review recommendation (E.2, 2022) and in line with the IPCC 2006 Guidelines (volume 3, chapter 1, box 1.1 and volume 3, chapter 3.9.4.2), the combustion emissions of waste gases have been allocated to CRT2 (in cases where the waste gases are combusted at the plant where they are produced) in the NIR 2024. Therefore, part of the

combustion emissions has been allocated from 1.A.2.c to 2.B from the NIR 2024 onwards.

The shares of CH₄ and N₂O emissions from industrial combustion are relatively small, and are not a key source.

In the 1990–2024 period, CO₂ emissions from combustion in 1.A.2 decreased by 39.9% (see Table 3.11 and Figure 3.6); the chemical industry contributed to this decrease.

Table 3.12 Fuel use in 1.A.2 Manufacturing industries and construction in selected years (PJ NCV/year)

Gaseous fuels

Fuel type/ Sub-category	Amount of fuel used (PJ NCV/year)								
	1990	1995	2000	2005	2010	2015	2020	2023	2024
1.A.2.a. Iron and steel	11.7	13.0	13.7	12.5	12.0	11.1	11.0	8.0	9.1
1.A.2.b. Non-ferrous metals	3.8	4.3	4.2	4.0	3.6	2.3	2.7	1.8	1.8
1.A.2.c. Chemicals	170.7	138.9	115.8	103.6	96.4	93.9	124.8	101.7	100.9
1.A.2.d. Pulp, paper, and print	29.2	24.4	27.4	29.7	21.0	18.6	15.6	11.8	12.4
1.A.2.e. Food processing, beverages, and tobacco	63.7	68.4	73.7	67.1	57.0	58.2	60.2	55.8	54.9
1.A.2.f. Non-metallic minerals	26.1	23.8	26.5	23.5	22.6	20.4	19.1	16.4	14.6
1.A.2g. Other	30.1	34.8	36.2	32.6	31.4	24.2	20.4	16.7	15.1

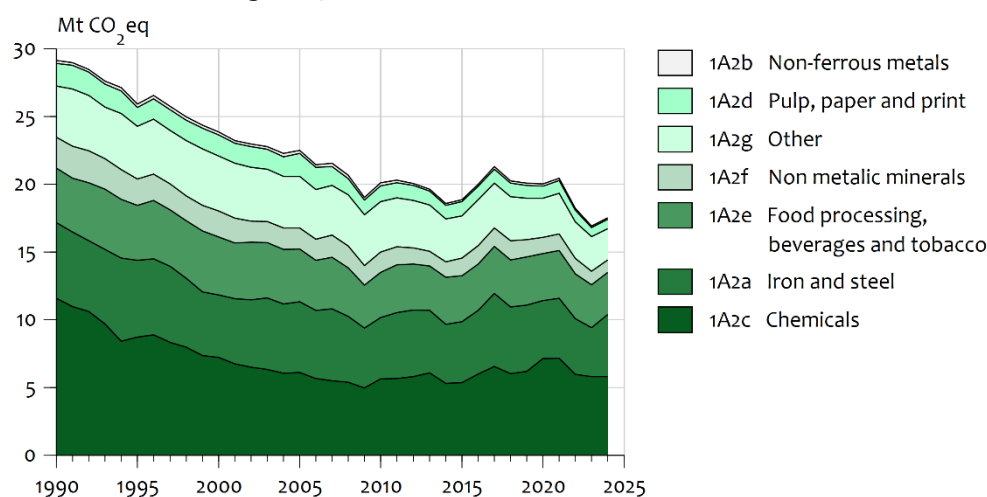
Liquid fuels

Fuel type/ Sub-category	Amount of fuel used (PJ NCV/year)								
	1990	1995	2000	2005	2010	2015	2020	2023	2024
1.A.2.a. Iron and steel	0.3	0.3	0.1	0.1	0.1	0.0	0.2	NO	NO
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	0.0	0.0	0.0	0.0
1.A.2.c. Chemicals	10.7	10.3	7.7	2.9	2.6	0.7	1.4	1.1	1.6
1.A.2.d. Pulp, paper, and print	0.0	0.0	NO	NO	NO	0.0	0.0	0.0	0.0
1.A.2.e. Food processing, beverages, and tobacco	2.2	0.6	0.2	0.2	NO	0.0	0.0	0.0	0.0
1.A.2.f. Non-metallic minerals	5.6	4.2	1.9	0.8	0.7	0.2	0.0	0.0	0.0
1.A.2g. Other	27.5	26.0	26.7	26.0	24.4	23.3	23.7	22.4	20.0

Solid fuels

Fuel type/ Sub-category	Amount of fuel used (PJ NCV/year)								
	1990	1995	2000	2005	2010	2015	2020	2023	2024
1.A.2.a. Iron and steel	73.4	80.6	68.5	81.0	70.5	80.7	71.1	57.4	76.1
1.A.2.b. Non-ferrous metals	0.0	NO	NO	NO	NO	0.0	0.0	NO	0.0
1.A.2.c. Chemicals	12.8	0.2	0.1	NO	NO	NO	0.1	0.1	0.0
1.A.2.d. Pulp, paper, and print	0.1	NO	NO	NO	NO	NO	NO	NO	0.0
1.A.2.e. Food processing, beverages, and tobacco	2.4	1.2	1.1	0.6	1.0	0.9	0.7	0.3	0.4
1.A.2.f. Non-metallic minerals	3.3	2.1	2.3	1.5	1.5	1.4	1.0	0.7	0.8
1.A.2.g. Other	0.4	0.2	0.3	0.5	1.6	0.5	0.3	0.0	0.0

Figure 3.6 1.A.2 Manufacturing industries and construction – trend and emissions levels of source categories, 1990–2024.

**Iron and steel (1.A.2.a)**

This sub-category refers mainly to the integrated steel plant (Tata Steel, previously known as Corus and/or Hoogovens), which produces 5000–7000 kt of crude steel per annum. Figure 3.7 shows Tata Steel's production process. The reduction in steel production and CO₂ emission in 2023 resulted from maintenance at the Tata steel plant in that year. In addition to the integrated crude steel plant, the sector comprises a (small) secondary steel-making plant, which mostly uses scrap metal in an electric arc furnace to produce wire, and a number of iron foundries. The method used for calculating CO₂ emissions from Tata Steel is based on a carbon mass balance, so CO₂ emissions are not measured directly. The method allocates a quantity of C to relevant incoming and outgoing process streams (Table 3.13). As a result, CO₂ emissions can be determined at plant level only; allocation of emissions to the various sub-processes is not possible. The ultimate difference between input and output, net C, is converted into a net CO₂ emission at plant level. For reasons of confidentiality, Table 3.13 does not include the quantities of

the inputs and outputs. The figures can, however, be made available for review purposes.

Table 3.13 Input/output table for the Tata Steel integrated steel plant

Inputs	Outputs
Excipients	Produced steel
Steel scrap and raw iron	Carbonaceous products
Oil	Coke
Pellets	BTX
Additives (limestone/dolomite)	TPA (tar, pitch, and asphalt)
Iron ore	Mixed process gases: power plants
Injection coal	
Natural gas	
Coking coal	

Figure 3.7 shows the relation between the input streams from Table 3.13 (highlighted yellow) and the production process, together with the resulting emissions and the CRT categories in which the emissions were reported. Please note that the sub-flows of the gases (emissions) cannot be disaggregated in this approach; only the final flows are relevant and reported.

During the production of iron and steel, coke and coal are used as reducing agents in the blast and oxygen furnaces, resulting in blast furnace gas and oxygen furnace gas as by-products, which are used as fuel for energy purposes (see also Figure 3.7).

The Energy Balance of Statistics Netherlands distinguishes between energy figures from the coke plant and the summed fuel use of the rest of the production process in the integrated steel plant. Therefore, only combustion emissions from the coke plant and the rest of the integrated crude steel plant can be estimated. These combustion emissions (including flaring emissions) are included in 1.A.1.c.i (Manufacture of solid fuels) and 1.A.2.a (Energy: iron and steel). Tata Steel also exports a large part of its carbon to the Energy sector in the form of mixed production gas. The related emissions are included in 1.A.1.a (Public electricity and heat production).

The relevant net process emissions are reported under sub-categories 1.B.1.b (Solid fuel transformation), 2.C.1 (Iron and steel production), and 2.A.4.d (Other process uses of carbonates).

Interannual variations in CO₂ combustion emissions from the crude steel plant can be mainly explained by the varying amounts of solid fuels used in this sector.

Combining all CO₂ emissions from the sector, total emissions closely follow the interannual variation in crude steel production (see Figure 3.8). Even though production of crude steel has increased over time, total CO₂ emissions from crude steel production have not increased. This indicates a substantial energy efficiency improvement in the sector.

Figure 3.7 Production process of the Tata Steel integrated steel plant

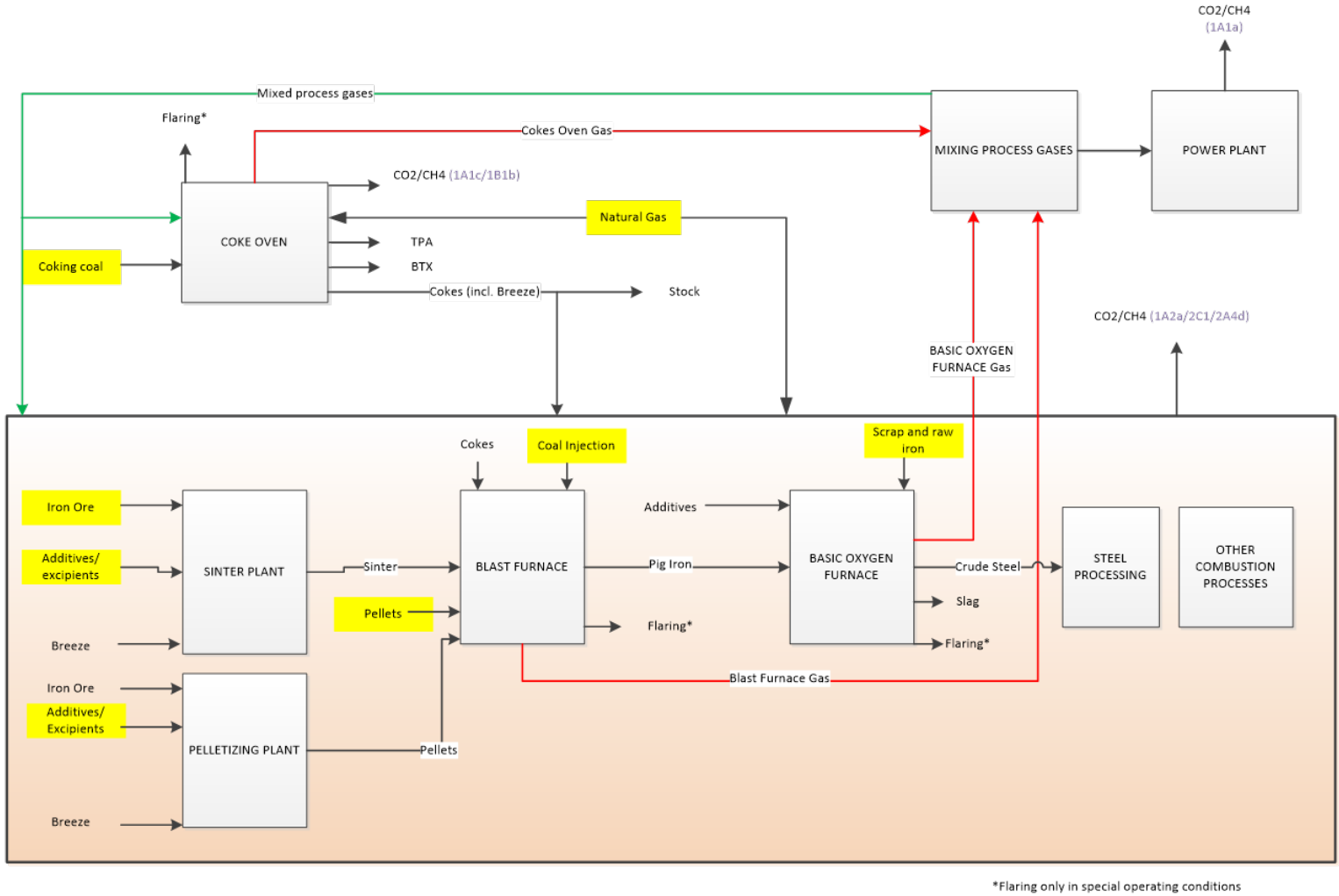
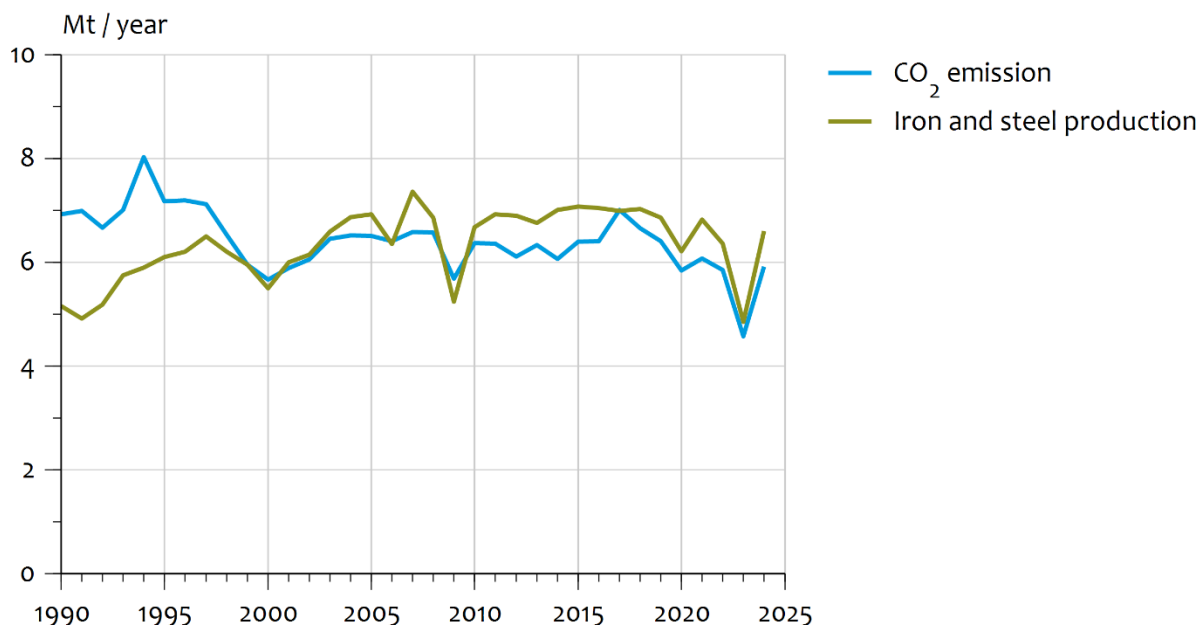


Figure 3.8 CO₂ emissions (kt) and crude steel production (kt) in category 1.A.2.a, 1990–2024



Non-ferrous metals (1.A.2.b)

This sub-category consists mainly of two aluminium smelters (the last of which ceased production in 2022) and several smaller non-ferro companies. CO₂ emissions from anode consumption in the aluminium industry are included in 2.C (Metal production). This small source category contributes only about 0.1–0.2 Mt CO₂ eq to the national total GHG Emissions Inventory, predominantly from the combustion of natural gas. Energy consumption in the aluminium industry is largely based on electricity, the emissions of which are included in sub-category 1.A.1.a (Public electricity and heat production).

The amounts of liquid and solid fuels vary considerably across years, but both the amounts and the related emissions are almost negligible. The interannual variation of the IEFs for liquid fuels is largely a result of changes in the mix of underlying fuels (e.g. the share of LPG, which has a relatively low EF) and is also partly due to the small amounts used.

Chemicals (1.A.2.c)

CO₂ emissions from this sub-category have decreased from 1990 to 2024, mainly due to a large decrease in the consumption of natural gas over the same period. This is largely due to a decrease in cogeneration facilities in this industrial sector.

In response to review recommendation (E.2, 2022) and in line with the IPCC 2006 Guidelines (volume 3, chapter 1, box 1.1 and volume 3, chapter 3.9.4.2), the emissions from the combustion of chemical waste gas (in liquids) and phosphor oven gas (in solids) have been allocated to 2B10 from the 2024 NIR onwards (for waste gases that are combusted within the same source category). The IPCC 2006 Guidelines (volume 3, chapter 1, box 1.1) state that *'Combustion emissions from fuels obtained directly or indirectly from the feedstock for an IPPU process will normally be allocated to the part of the source category in which the*

process occurs (these source categories are normally 2.B and 2.C). However, if the derived fuels are transferred for combustion in another source category, the emissions should be reported in the appropriate part of Energy Sector source categories (normally 1.A.1 or 1.A.2).' Therefore, all combustion emissions from chemical waste gas, which is produced and combusted within the chemical sector, have been allocated to 2.B.10 from the 2024 NIR onwards.

Pulp, paper, and print (1.A.2.d)

In line with the decreased consumption of natural gas, CO₂ emissions have reduced since 1990. A substantial fraction of natural gas has been used for cogeneration. The relatively low CO₂ emissions since 1995 can be explained by the reallocation of emissions to the Energy sector due to the formation of joint ventures.

The amounts of liquid and solid fuel combustion vary considerably across years, but the amounts and related emissions are almost negligible. The interannual variation in the IEFs for liquid fuels is due to variable shares of derived gases (chemical waste gas) and LPG in total liquid fuel combustion.

Food processing, beverages, and tobacco (1.A.2.e)

CO₂ emissions from this sub-category increased in the 1990–1998 period, decreased in the 1998–2010 period, and has been rather stable from 2010 onwards. The decrease between 1998 and 2010 was due to the reallocation (since 2003) of joint ventures at cogeneration plants whose emissions were formerly allocated to 1.A.2.e but are now reported under Public electricity and heat production (1.A.1.a).

The amounts of liquid and solid fuels vary considerably across years, but the amounts and related emissions are relatively small. The interannual variation in the IEFs for liquid fuels is due to variable shares of LPG in total liquid fuel combustion.

Non-metallic minerals (1.A.2.f)

CO₂ emissions from this sub-category decreased in the 1990–2024 period as a result of the decreasing consumption of natural gas.

The amounts of liquid and solid fuels vary considerably across years, but the amounts and related emissions are relatively small. The interannual variation in the IEFs for liquid fuels is due to variable shares of LPG, which has a lower CO₂ EF, in total liquid fuel combustion.

Other (1.A.2.g)

CO₂ emissions from this subcategory reduced over the 2010–2024 period, mainly as a result of decreased natural gas consumption. This sub-category comprises all other industry branches, including production of textiles, wood and wood products, and electronic equipment. It also includes GHG emissions from non-road mobile machinery (NRMM) used in industry and construction, which are described in section 3.2.7. Most of the CO₂ emissions from this sub-category stem from gas, liquid fuels, and biomass combustion.

3.2.5.2 Methodological issues

Details of methodologies, data sources, and country-specific source allocation issues are provided in section 2.1 of the ENINA methodology report (Honig et al., 2026) and in chapter 9 of the transport methodology report (Witt et al., 2026). The emissions calculation for stationary combustion in category 1.A.2 follows the same steps as the calculation for Energy industries (1.A.1), see section 3.2.4.2. The only difference is that for the iron and steel plant Tata Steel (reported in 1.A.2.a), an EF of 0.27 g N₂O/GJ (based on reported emissions from Tata Steel) and an EF of 0.44 g CH₄/GJ (standard EF for other bituminous coal) are used to calculate emissions from Tata Steel in 1.A.2.a.

The methodology for the calculation of NRMM emissions is described in section 3.2.7.2.

For 2024, approximately 99% of the fossil CO₂ emissions were calculated using country-specific or company-specific EFs. The remaining 1% of CO₂ emissions was calculated by means of default IPCC EFs. These remaining emissions are mainly the result of the combustion of other oil, other kerosene, lignite, and petroleum coke.

An overview of the IEFs used for the principal fuels (up to 95% of the fuel use) in the Manufacturing industries and construction category (1.A.2) is provided in Table 3.14. As some emissions data in this sector originates from individual companies, the IEFs sometimes deviate from the standard emission factors. For reasons of confidentiality, detailed data on fuel consumption and EFs per CRT category and fuel is not presented in the NIR, but it is available to reviewers on request.

Table 3.14 Overview of IEFs used for the most important fuels (up to 95% of fuel use) for the year 2024 in the Manufacturing industries and construction category (1.A.2)

Fuel	Amount of fuel used in 2024 (TJ NCV)	Implied emission factors (g/GJ)		
		CO ₂ (x1000)	N ₂ O	CH ₄
Natural gas	208,738	56.2	0.10	6.98
Coke oven / Gas coke	51,856	106.8	0.29	1.11
Other bituminous coal	39,890	93.1	0.28	0.44
Gas / Diesel oil	19,687	72.5	1.89	1.08
Solid biomass	14,085	108.9	3.00	38.34

Explanations for the IEFs

Natural gas

The standard CH₄ EF for natural gas is 5.7 g/GJ. Only for gas-powered CHP plants, a higher EF is used (see section 2.1 of Honig et al. (2026)), which explains the higher IEF for CRT 1.A.2.

Coke oven / Gas coke and other bituminous coal

For solid fuels, an EF of 0.27 g N₂O/GJ (based on reported emissions from Tata Steel) and an EF of 0.44 g CH₄/GJ (standard EF for other bituminous coal) are used to calculate emissions from the iron and steel plant. The standard EFs are used for solid fuel combustion in other sectors. Reported CO₂ emissions from other bituminous coal and coke oven/gas coke are

based on emissions data from the ETS. Therefore, the CO₂ IEFs are different from the standard country-specific EF.

Gas / Diesel oil

Gas/Diesel oil is used in stationary and mobile combustion, for which various EFs for CH₄ and N₂O are used.

Solid biomass

The CH₄ emission factor differs per sector, ranging between 30 and 300 g/GJ.

In the iron and steel industry, a substantial proportion of total CO₂ emissions is reported as process emissions in CRT 2.C.1, based on net losses calculated from the carbon balance of the process (coke and coal inputs in the blast furnaces and the blast furnace gas produced). Since the fraction of BF/OX gas captured and used for energy varies over time, the trend in the emissions of CO₂ accounted for by this source category should be viewed in association with the reported process emissions (see Figure 3.7). The emissions calculations for the iron and steel industry are based on a mass balance.

The fuel consumption data in 1.A.2.g (Other) is not based on large surveys and therefore, it is the least accurate in this part of sub-category 1.A.2.

The methodology for the calculation of NRMM emissions is described in section 3.2.7.2.

3.2.5.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The uncertainty in total emissions of this category is estimated to be about 7% for CO₂, 37% for CH₄, and 47% for N₂O.

The uncertainty of fuel consumption data in the manufacturing industries is 2% for solid fuels, 3% for natural gas, 5% for liquid fuels in mobile combustion, 10% for liquid fuels in stationary combustion, and 10% for biogenic fuels.

For natural gas, the uncertainty in the CO₂ EF is estimated to be 0.25% on the basis of the fuel quality analysis reported by Heslinga and Van Harmelen (2006), which is further discussed in Olivier et al. (2009). For liquid fuels, CO₂ EF uncertainties have been derived of 2% (diesel, LPG, gasoline), 3% (petroleum) and 5% (other oil products). For solid fuels, an uncertainty has been assigned of 5% to coal and coke, and an uncertainty of 15% has been assigned to blast furnace gas and coke oven gas. The CH₄ and N₂O EF uncertainty is 50% for both gases in stationary combustion, and 250% and 300% for CH₄ and N₂O EF, respectively, in mobile combustion.

Time-series consistency

Emissions from stationary energy combustion are calculated from the energy statistics, combined with country-specific EFs (at the beginning of the time series) or from a combination of company-specific and country-

specific EFs (at the end of the time series). Time-series consistency is ensured for EFs and activity data for most sectors is as follows:

- Company-specific emission factors have been used from the moment the data were available in MJV or ETS (starting between 1995 and 2007, depending on the fuel). For earlier years, country-specific emission factors have been applied. The country-specific EFs are based on company-specific data. Multi-year company-specific data from the most relevant companies has been used to calculate an average country-specific EF. As the same information is used to calculate both the country-specific EF and the company-specific EFs, the EFs are consistent throughout the time series.
- Energy statistics are prepared by Statistics Netherlands, using the same methodology for the complete time series. In 2015 and 2016, the energy statistics from 1990 onwards were revised, using the same methodology for all years. These revised energy statistics have been used from the 2017 submission onwards. The activity data are consistent throughout the time series.

3.2.5.4 Category-specific QA/QC and verification

The trends in CO₂ emissions from fuel combustion in the iron and steel industry, non-ferrous industry, food processing, pulp and paper, and other industries are compared to trends in the associated activity data: crude steel and aluminium production, indices of food production, pulp and paper production, and cement and brick production. Large interannual changes are identified and explained (e.g. changed allocation of fuel consumption due to joint ventures). Moreover, for the iron and steel industry, the trend in total CO₂ emissions reported as fuel combustion-related emissions (included in 1.A.2.a) and industrial process emissions (included in 2.C.1) is compared to the trend in the activity data (crude steel production). A similar comparison is made for the total trend in CO₂ emissions from the chemical industry (sum of 1.A.2.c and 2.B) and trends split per main fuel type or specific process (chemical waste gas combustion and process emissions from ammonia production). IEF trend tables are checked for large changes and large interannual variations at different levels, which are explained in the NIR. Changes in the IEF are mainly due to changes in the type of fuel used. Furthermore, the IEFs of individual fuels are also compared to the default emission factors, and deviations from the standard EFs are explained in the NIR.

CO₂ emissions reported by companies (both in AERs and as part of the ETS) are validated by the competent authority and then compared (see also section 3.2.4.4). Further details on the validation of the energy data can be found in Honig et al. (2026), section 2.1.

QA/QC and verification of NRMM data and emissions are described in section 3.2.7.4.

3.2.5.5 Category-specific recalculations *Stationary combustion*

Correction liquid and solid biomass

The solid and liquid biomass consumption data has been corrected for the complete time series for all stationary combustion categories except 1.A.4.b.i. The data flow of the solid and liquid biomass statistics has

been updated to match the data flow of the fossil fuel statistics. This resulted in two changes in the activity data:

- Activity data of biomass in earlier years was originally rounded to 1 TJ, but now, activity data with more digits is used.
- Error correction: In the process of the update, several errors were found in the biomass statistics. These have been corrected.

See section 3.2.4.5 for the recalculations resulting from the corrections in liquid and solid biomass.

Update energy statistics 2015–2023

The energy statistics for 2015–2023 have been improved. This is an annual update, and the main changes are described on the Table Information of the Energy Balance Sheet (available via:

<https://opendata.cbs.nl/#/CBS/en/dataset/83989ENG/table?ts=1765534146208>).

The main recalculations in CRT 1.A.2 include an update of LPG emissions (+18.1 kt CO₂ in 2015 and +3.7 kt CO₂ in 2023) and a change in the biogenic share of natural gas (resulting in a reallocation from natural gas to biogenic natural gas). Emissions of CH₄ and N₂O have also been updated for all fuels.

These improvements resulted in the following changes in emissions (in kt CO₂ eq):

1.A.2.a. Iron and steel. The main recalculations in 1.A.2.a are for LPG in 2015–2021 (+1.85 kt CO₂ in 2015 and +3.08 kt CO₂ in 2021), for other bituminous coal in 2022–2023 (-4.08 kt CO₂ in 2022 and -3.11 kt CO₂ in 2023), for natural gas in 2021–2023 (-1.23 kt CO₂ in 2021 and -0.52 kt CO₂ in 2023), and for petroleum coke in 2022–2023 (-7.37 kt CO₂ in 2022 and -7.84 kt CO₂ in 2023). Furthermore, the change in the biogenic share of natural gas resulted in a reallocation of CO₂ emissions from gaseous fuels to biomass in 2015–2023 (0.03 kt in 2015 and 0.05 kt in 2023).

1.A.2.a (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	1.82	1.57	2.78	2.14	2.38	3.95	1.83	-12.05	-11.52
CO ₂ biogenic	0.03	0.03	0.02	0.03	0.04	0.05	0.02	0.14	0.05
CH ₄	-0.32	-0.33	-0.15	-0.06	-0.05	-0.05	-0.07	-0.08	-0.06
N ₂ O	-0.11	-0.11	-0.06	-0.03	-0.03	-0.03	-0.02	-0.06	-0.06

1.A.2.b. Non-ferrous metals. The main recalculations in 1.A.2.b are for LPG in 2015–2023 (+0.06 kt CO₂ in 2015 and +0.41 kt CO₂ in 2023) and for natural gas in 2021–2023 (+0.37 kt CO₂ in 2021 and -0.21 kt CO₂ in 2023). Furthermore, the change in the biogenic share of natural gas resulted in a reallocation of CO₂ emissions from gaseous fuels to biomass in 2015–2023 (0.01 kt in 2015 and 0.02 kt in 2023).

1.A.2.b (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	0.06	0.10	0.09	0.58	0.78	0.75	1.02	0.49	0.60
CO ₂ biogenic	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.02
CH ₄	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N ₂ O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1.A.2.c. Chemicals. The main recalculations in 1.A.2.c are for LPG in 2015–2023 (+3.12 kt CO₂ in 2015 and +0.02 kt CO₂ in 2023), for coke oven / gas coke in 2018–2023 (+6.42 kt CO₂ in 2018 and +5.18 kt CO₂ in 2023), for natural gas in 2015–2023 (+0.22 kt CO₂ in 2015 and +5.22 kt CO₂ in 2023), and for other oil in 2015–2023 (+0.0002 kt CO₂ in 2015 and -1.82 kt CO₂ in 2023). Furthermore, the change in the biogenic share of natural gas resulted in a reallocation of CO₂ emissions from gaseous fuels to biomass in 2015–2023 (0.42 kt in 2015 and 1.23 kt in 2023).

1.A.2.c (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	2.89	1.26	1.49	8.12	6.61	6.50	9.68	-1.41	7.37
CO ₂ biogenic	0.46	0.42	0.45	0.57	0.36	0.48	-0.02	1.82	0.67
CH ₄	0.20	0.16	0.15	0.15	0.13	0.13	0.13	0.16	-0.05
N ₂ O	0.00	0.00	0.00	0.03	0.02	0.02	0.03	0.01	0.02

1.A.2.d. Pulp, paper, and print. The main recalculations in 1.A.2.d are for LPG in 2015–2023 (+1.55 kt CO₂ in 2015 and +0.34 kt CO₂ in 2023) and for natural gas in 2019–2023 (-0.04 kt CO₂ in 2019 and +17.00 kt CO₂ in 2023). Furthermore, the change in the biogenic share of natural gas resulted in a reallocation of CO₂ emissions from gaseous fuels to biomass in 2015–2023 (0.04 kt in 2015 and 0.26 kt in 2023).

1.A.2.d (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	1.23	1.51	1.53	1.14	1.25	0.78	1.43	-9.62	17.09
CO ₂ biogenic	0.05	0.04	0.04	0.05	0.05	0.08	0.04	0.15	0.26
CH ₄	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.03	0.05
N ₂ O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	0.01

1.A.2.e. Food processing, beverages, and tobacco. The main recalculations in 1.A.2.e are for LPG in 2015–2023 (+2.05 kt CO₂ in 2015 and +0.01 kt CO₂ in 2023), for other bituminous coal in 2021–2023 (+0.47 kt CO₂ in 2021 and -4.26 kt CO₂ in 2023), and for natural gas in 2021–2023 (+0.03 kt CO₂ in 2021 and +4.81 kt CO₂ in 2023). Furthermore, the change in the biogenic share of natural gas resulted in a reallocation of CO₂ emissions from gaseous fuels to biomass in 2015–2023 (0.14 kt in 2015 and 0.45 kt in 2023).

1.A.2.e (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	1.38	1.91	2.54	1.41	1.11	0.96	1.45	-0.64	0.02
CO ₂ biogenic	0.15	0.14	0.13	0.22	0.25	0.35	0.18	0.91	0.48
CH ₄	0.88	1.19	0.76	0.59	0.33	0.33	0.39	-0.14	1.44
N ₂ O	0.05	0.06	0.06	0.07	0.06	0.05	0.07	0.02	0.01

1.A.2.f. Non-metallic minerals. The main recalculations in 1.A.2.f are for LPG in 2015–2023 (+1.67 kt CO₂ in 2015 and +2.86 kt CO₂ in 2023), for other bituminous coal in 2022–2023 (-0.38 kt CO₂ in 2022 and -0.19 kt CO₂ in 2023), and for natural gas in 2016 and 2021–2023 (-0.11 kt CO₂ in 2016 and +0.57 kt CO₂ in 2023). Furthermore, the change in the biogenic share of natural gas resulted in a reallocation of CO₂ emissions from gaseous to biomass in 2015–2023 (0.05 kt in 2015 and 0.12 kt in 2023).

1.A.2.f (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	0.93	1.63	1.38	1.31	1.13	1.07	2.15	-1.17	3.12
CO ₂ biogenic	0.05	0.05	0.04	0.06	0.06	0.09	0.05	0.27	0.12
CH ₄	0.14	0.08	0.05	0.04	0.04	0.03	0.02	0.03	0.04
N ₂ O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	0.00

1.A.2.g. Other (excluding 1.A.2.g.vii). The main recalculations in 1.A.2.g (excluding 1.A.2.g.vii) are for LPG in 2015–2023 (+9.31 kt CO₂ in 2015 and +0.10 kt CO₂ in 2023), for lignite in 2020–2022 (-0.01 kt CO₂ in 2020 and -3.10 kt CO₂ in 2022), and for natural gas in 2017–2023 (+0.03 kt CO₂ in 2017 and -17.16 kt CO₂ in 2023). Furthermore, the change in the biogenic share of natural gas resulted in a reallocation of CO₂ emissions from gaseous to biomass in 2015–2023 (0.06 kt in 2015 and -0.06 kt in 2023).

1.A.2.g (excl. 1.A.2.g.v ii) (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	9.25	10.44	8.10	11.09	8.78	9.15	35.62	-2.12	-17.00
CO ₂ biogenic	0.06	0.06	0.06	0.07	0.08	0.10	0.06	0.28	-0.06
CH ₄	0.02	0.02	0.02	0.04	0.02	0.02	0.03	0.01	-0.03
N ₂ O	0.00	0.00	0.00	0.00	0.00	0.00	0.01	-0.01	-0.01

Update activity data before 2015

Apart from the annual updates in the energy statistics between 2015 and 2023, some small corrections were made in earlier years:

- 1.A.2.a, Lubricants in 1994–2004, other kerosene in 1998;
- 1.A.2.c, gasoline in 1995 and lubricants in 2002;
- 1.A.2.e, other kerosene in 2002 and 2004;
- 1.A.2.f, lubricants in 1990–2002;
- 1.A.2.g, other kerosene in 1996–2014, and gasoline in 1997.

Mobile combustion

Recalculations relating to NRMM are described in section 3.2.7.5.

3.2.5.6 Category-specific planned improvements

No category-specific improvements for stationary combustion have been planned.

3.2.6 *Transport (1.A.3)*

3.2.6.1 Category description

Table 3.15 provides an overview of sources and emissions in this category in the Netherlands. CO₂ is by far the most important GHG within the category Transport.

Table 3.15 Overview of emissions in the category Transport (1.A.3) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the			
		Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq	
1.A.3. Transport	CO ₂	27.7	25.9	24.8	-10.4%	23.3%	20.9%	17.2%	
	CH ₄	0.20	0.07	0.07	-65.5%	0.06%	0.38%	0.05%	
	N ₂ O	0.10	0.29	0.28	194.7%	0.27%	4.3%	0.20%	
	All	28.0	26.3	25.1	-10.1%	23.7%		17.4%	
1.A.3.a. Civil aviation	CO ₂	0.08	0.03	0.03	-68.0%	0.03%	0.02%	0.02%	
1.A.3.b. Road vehicles	CO ₂	26.4	24.7	23.5	-11.2%	22.1%	19.8%	16.3%	
	CH ₄	0.20	0.06	0.06	-71.7%	0.05%	0.31%	0.04%	
	N ₂ O	0.09	0.28	0.28	204.9%	0.26%	4.2%	0.19%	
	1.a.3.b gasoline	CO ₂	10.7	12.2	12.3	15.2%	11.6%	10.4%	8.5%
	1.a.3.b diesel oil	CO ₂	13.0	12.0	10.6	-18.2%	10.0%	9.0%	7.4%
	1.a.3.b LPG	CO ₂	2.7	0.33	0.36	-87.0%	0.34%	0.30%	0.25%
	1.a.3.b Natural gas	CO ₂	NA,NO	0.13	0.14		0.13%	0.12%	0.09%
	1.A.3.c. Railways	CO ₂	0.09	0.07	0.06	-34.9%	0.06%	0.05%	0.04%
1.A.3.d. Domestic navigation	CO ₂	0.73	1.0	1.1	56.9%	1.07%	0.96%	0.79%	
1.A.3.e Other transportation	CO ₂	0.34	0.07	0.08	-75.3%	0.08%	0.07%	0.06%	

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

This sector comprises the following key categories:

1.A.3.b	Road transportation: gasoline	CO ₂ (L,T)
1.A.3.b	Road transportation: diesel oil	CO ₂ (L,T)
1.A.3.b	Road transportation: LPG	CO ₂ (T)
1.A.3.b	Road transportation	N ₂ O(L2,T)
1.A.3.d	Domestic navigation	CO ₂ (L1,T1)

Emissions from mobile sources that are described elsewhere in the report:

- Emissions from fuels delivered to international aviation and navigation (aviation and marine bunkers) are reported separately in the inventory (see section 3.2.2).
- Emissions from military use are included in 1.A.5 (see section 3.2.8).
- Energy consumption for pipeline transport is not recorded separately in national energy statistics, but CO₂ and N₂O combustion emissions from gas transport are included in 1.A.3.e. CO₂ process emissions and the CH₄ emissions from gas

transport are reported in 1.B.2.b (Gas transmission and storage), while CO₂ and CH₄ emissions from oil pipelines are included in 1.B.2.a (Oil transport) as described in section 3.3.2.

- CO₂ emissions from lubricant use in two-stroke engines in mopeds and motorcycles have been included into 1.A.3.b.iv, in accordance with the 2006 IPCC Guidelines.
- Emissions from NRMM (non-road mobile machineries; see section 3.2.7) are reported under various sub-categories, in line with the agreed CRT format:
 - o Industrial and construction machinery: 1.A.2.g;
 - o Commercial and institutional machinery: 1.A.4.a;
 - o Residential machinery: 1.A.4.b;
 - o Agricultural machinery: 1.A.4.c.
- Emissions from Fisheries (1.A.4.c.iii) are reported in section 3.2.7.

Overview of shares and trends in energy use and emissions

In 2024, Transport was responsible for 17.4% of GHG emissions in the Netherlands. GHG emissions from transport increased by 30% between 1990 and 2006, from 28.0 to 36.5 Mt CO₂ eq. This increase was mainly due to an increase in diesel fuel consumption and resulting CO₂ emissions from road transport. From 2006 to 2022, GHG emissions from transport decreased by 31% to 25.0 Mt CO₂ eq. In 2023, the GHG emissions increased by 5%, after which they decreased again by 4% in 2024 to 25.1 Mt CO₂ eq.

Total energy use and resulting GHG emissions from transport are summarised in Figures 3.9 and 3.10, respectively. As these figures show, road transport accounts for the majority of energy use and GHG emissions in this category throughout the time series.

Figure 3.9 1.A.3 Transport – energy use of source categories in PJ, 1990–2024

Fuel consumption

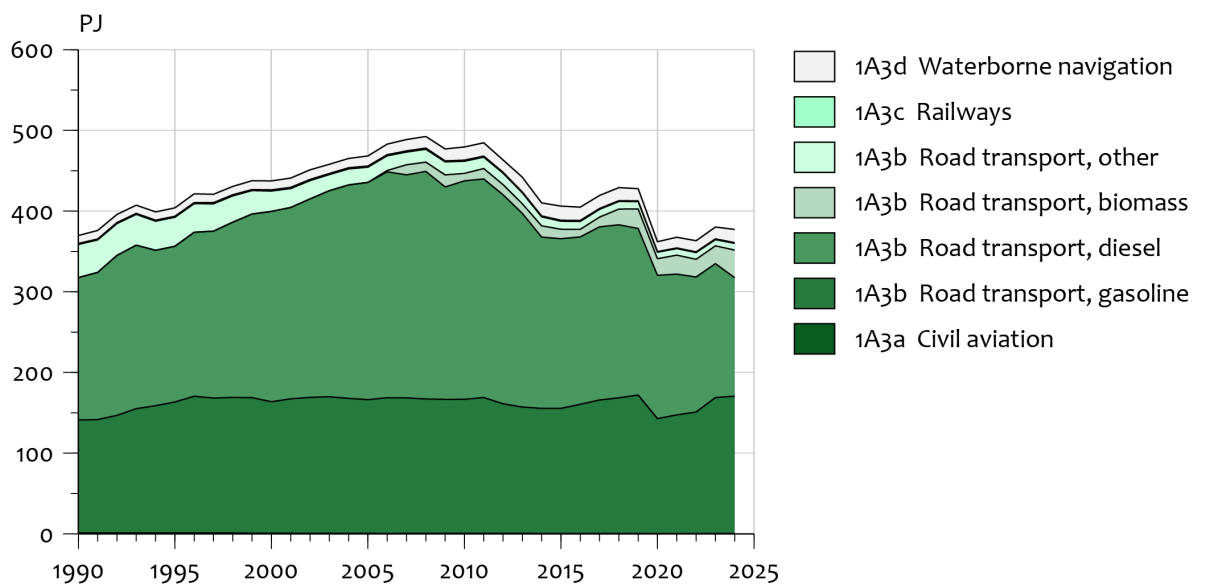


Figure 3.10 1.A.3 Transport – emissions levels of source categories, 1990–2024

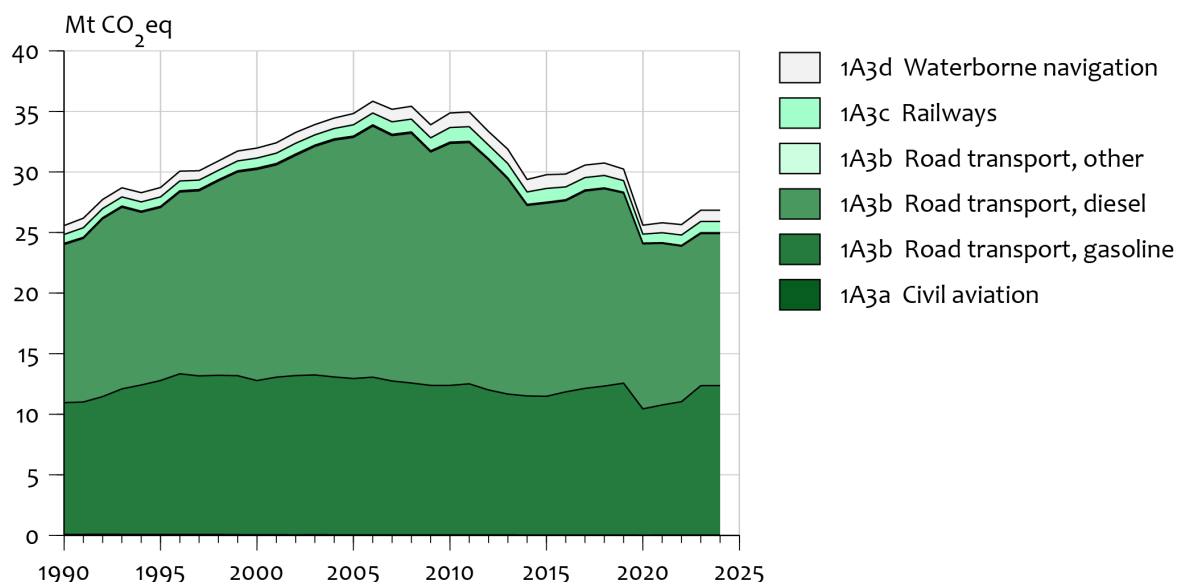
Emissions

Figure 3.10 shows that GHG emissions from transport steadily increased between 1990 and 2006. The increase is more or less in line with the increase in road transport volumes, although energy efficiency has increased (see Road transport 1.A.3.b). Between 2006 and 2008, emissions stabilised due to an increase in the use of biofuels in road transport. CO₂ emissions from biofuels are reported separately in the inventory; they are not part of the national emissions totals (and are therefore not included in Figure 3.10). In 2009, GHG emissions from transport decreased slightly, primarily due to the economic crisis and the resulting decrease in freight transport volumes. In 2010 and 2011, emissions increased slightly due to a decrease in the use of biofuels in 2010, and an increase in road transport volumes in 2011. Between 2011 and 2014, CO₂ emissions decreased by 16%. This can largely be attributed to an increase in cross-border refuelling resulting from a difference in fuel prices between the Netherlands and Belgium/Germany. Since emissions are based on the amount of fuel sold, they decrease as more fuel is purchased abroad (Geilenkirchen et al., 2017). Due to an improving economy with more transport in the 2014–2019 period, CO₂ emissions increased by 3%. In 2020 and 2021, there was much less road traffic due to the COVID-19 pandemic and the guidelines regarding social distancing. As a result, the emissions decreased significantly compared to 2019.

After the resumption of road traffic, GHG emissions increased by 4% in 2023 compared to 2022 but they are still lower than before the pandemic. In 2024, GHG emissions decreased by 5% due to reduced diesel sales.

Civil aviation (1.A.3.a)

Given the small size of the Netherlands, there is hardly any domestic aviation. The share of domestic civil aviation (i.e. aviation with departure and arrival in the Netherlands, including emissions from

overland flights which depart from and arrive at the same airport) in GHG emissions in the Netherlands was less than 0.1% throughout the time series. The use of jet kerosene for domestic aviation decreased from 1.0 PJ in 1990 to 0.3 PJ in 2024, and the use of aviation gasoline decreased from 0.2 PJ in 1990 to 0.06 PJ in 2024. GHG emissions from civil aviation decreased accordingly.

Road transport (1.A.3.b)

The share of Road transport (1.A.3.b) in national GHG emissions increased from 12.3% in 1990 to 17.4% in 2024. Between 1990 and 2006, total GHG emissions from road transport increased from 26.7 to 35.0 Mt CO₂ eq, mainly due to an increase in transport volume. From 2006 to 2015 GHG emissions decreased to 27.6 Mt CO₂ eq, after which they increased slightly. Due to COVID-19 restrictions, in the 2020–2022 period, emissions fell to 23.8 million tonnes of CO₂ equivalent in 2022. Additionally, a daytime speed reduction to 100 km/h was imposed on motorways from March 2020, resulting in a reduction of fuel consumption by road transport on motorways. After the resumption of road transport GHG emissions increased to 25.0 Mt CO₂ eq in 2023 and decreased by 5% in 2024 to 23.8 Mt CO₂ eq.

Between 1990 and 2008, diesel fuel consumption increased by 60% (+105 PJ). This increase was caused by both a large rise in freight transport volumes and a growing number of diesel passenger cars and light-duty trucks in the Dutch car fleet.

Between 2008 and 2019, diesel fuel consumption decreased by 27% to 206 PJ. This decrease can be attributed to three factors: the improved fuel efficiency of the diesel passenger car fleet; a very modest growth of diesel road transport volumes; and an increase in cross-border fuelling. The fuel efficiency of the passenger car fleet in the Netherlands has improved in recent years as a result of increasingly stringent EU CO₂ emissions standards for new passenger cars and fiscal incentives for the purchase of fuel-efficient cars. In recent years, as more fuel-efficient cars entered the car fleet, average fuel efficiency improved (although it should be noted that improvements in fuel efficiency in the real world were much smaller than those indicated by type approval values). Moreover, road transport volumes were more or less stable between 2008 and 2014, mainly due to the economic crisis. In recent years until 2022, however, the economic upturn has resulted in an increase in transport volumes. In 2023, Dutch trucks transported significantly fewer million tons of goods than in 2022 (-7%), while in 2024, they transported approximately the same amount of weight as in 2023. Finally, an increase in excise duties for diesel fuel in the Netherlands in 2014 resulted in an increase in cross-border refuelling, especially for freight transport (Geilenkirchen et al., 2017). This may cause diesel sales to deviate from the trend in road transport.

Gasoline consumption increased from 140 to 169 PJ between 1990 and 1996 and subsequently fluctuated between 163 and 169 PJ until 2011. Subsequently, gasoline sales for road transport decreased to 155 PJ in 2014 but increased again to 171 PJ in 2019. The decrease between 2011 and 2014 can be attributed to a combination of improved fuel efficiency of the passenger car fleet, stabilisation of road transport volumes, and

an increase in cross-border refuelling. The subsequent increase can be chiefly attributed to economic growth resulting in increased traffic volumes. Restrictions for social interaction during the COVID-19 pandemic (such as the work-from-home policy) caused sales of both gasoline and diesel to decrease by 14% in 2021 compared to 2019.

Road transport started to increase again in 2022 and surpassed the 2019 level in 2024. In 2024, gasoline sales increased by 1% to 170 PJ, but diesel sales to all vehicle types, particularly passenger cars and heavy-duty vehicles, continued to decrease, resulting in declining sales to road transport by 12% to 147 PJ. An increasingly cleaner fleet reduces emissions per traffic kilometre. Due to the high fuel prices in recent years as a result of the war in Ukraine, cross-border refuelling has played a greater role than in previous years. Because emissions are calculated on the basis of the amount of fuel sold, increased cross-border refuelling results in apparently lower emissions. LPG consumption for road transport decreased steadily throughout the time series: from 41 PJ in 1990 to 5 PJ in 2024, mainly due to the decreasing number of LPG-powered passenger cars in the car fleet. As a result, the share of LPG in energy use by road transport decreased significantly between 1990 and 2024, from 11% to 1%. The use of natural gas in road transport has increased in recent years and amounted to 2.4 PJ in 2024. Within the category Transport, natural gas is mainly used for public transport buses, although the number of CNG/LNG-powered passenger cars and light and heavy-duty trucks has also increased in recent years.

Biofuels have been used in road transport since 2003. The use of biofuels increased from 0.1 PJ in 2003 to 24 PJ in 2021. In 2022 and 2023, this was slightly lower at 22 PJ. In 2024, sales of biofuels increased by 56% (PJ), representing 9.5% of the total amount of energy sold to road transport. This is a result of a legal obligation to use renewable energy for transport. For the most part, this obligation is met by the increasing use of biofuels, and also through electrification of road vehicles.

The share of CO₂ emissions is 98.57% of total GHG emissions from road transport. The share of N₂O in total GHG emissions from road transport (in CO₂ eq) is small (1.19% in 2024). N₂O emissions from road transport increased from 0.3 kt in 1990 to 0.9 kt in 1996, then stabilised for a few years, then increased to 1.3 kt in 2011. Since then, they have fluctuated between 1.0 and 1.2 kt. The development of N₂O emissions in addition to the development in transport volumes can be explained by a combination of two factors:

- N₂O emissions per vehicle-kilometre of subsequent generations of three-way catalyst (TWC)-equipped gasoline cars have decreased (Kuiper and Hensema, 2012). Nitrous oxide (N₂O) is mainly released by an incomplete reduction of nitrogen oxides to nitrogen in TWC. The emission has remained almost constant in recent years. On the one hand, the number of cars with a catalytic converter is increasing, on the other hand, cars with the latest generation of catalytic converters produce considerably less N₂O. (A TWC or non-selective catalytic reduction (NSCR) oxidises CO and hydrocarbons to CO₂ and water and reduces NO_x

to nitrogen gas. The flue gases are passed over the catalyst without the addition of reagents).

- Recent generations of heavy-duty diesel trucks equipped with selective catalytic reduction (SCR) catalysts to reduce NO_x emissions emit more N₂O per vehicle-kilometre than older trucks (Kuiper and Hensema, 2012). (SCR is a chemical process used to remove nitrogen oxides (NO_x) from the flue gases produced by a combustion process by injecting ammonia or a mixture of urea and demineralised water, known as Diesel Exhaust Fluid (DEF), into the exhaust gases.) In recent years, this has resulted in an increase in N₂O emissions from heavy-duty vehicles, which offsets the decrease in N₂O emissions from gasoline-powered passenger cars.

The share of CH₄ in GHG emissions from road transport (in CO₂ eq) is also small (0.24% in 2024). CH₄ emissions from road transport decreased by 72% between 1990 and 2024. This was due to a reduction in VOC emissions, resulting from the implementation and subsequent tightening of EU emissions legislation for new vehicles. CH₄ emissions are estimated as a fraction of total VOC emissions. As almost the entire gasoline car fleet is currently equipped with catalysts and carbon canisters, the decrease in VOC emissions, and therefore CH₄ emissions, has stagnated since 2009.

Railways (1.A.3.c)

Railways (1.A.3.c) are a minor source of GHG emissions, accounting for 0.2% of total GHG emissions from Transport in the Netherlands in 2024. Diesel fuel consumption by railways has fluctuated between 0.7 and 1.5 PJ throughout the time series, even though transport volumes have grown. This decoupling between transport volumes and diesel fuel consumption has resulted from the increasing electrification of rail (freight) transport. In 2024, diesel fuel consumption by railways amounted to 0.8 PJ and biofuel consumption increased to 0.1 PJ. Most rail transport in the Netherlands is electric, with total electricity use for rail transport amounting to over 6 PJ annually in recent years. GHG emissions resulting from electricity generation for railways are not reported under 1.A.3.c but are included in 1.A.1.a.

Waterborne navigation (1.A.3.d)

(Domestic) waterborne navigation is a small source of GHG emissions in the Netherlands. Waterborne navigation in the Netherlands is mostly internationally orientated, i.e. ships either depart or arrive abroad. As emissions from international navigation are reported under Bunkers (1.D, section 3.2.2), the share of (domestic) waterborne navigation in total GHG emissions from the category Transport is small, ranging between 2.4% and 4.6% throughout the time series (the largest share is found in 2024: 4.6%).

Domestic waterborne navigation comprises emissions from passenger and freight transport within the Netherlands, including offshore operations and recreational craft. Fuel consumption for Domestic waterborne navigation increased from 10 PJ in 1990 to 18 PJ in 2013, but then decreased to 12 PJ in 2020 before increasing again to 16 PJ in 2024. These fluctuations can partially be explained by changes in offshore operations.

In line with the fuel consumption trend, GHG emissions from Domestic waterborne navigation increased from 0.7 Mt CO₂ eq in 1990 to 1.3 Mt in 2013 and then decreased to 0.9 Mt in 2020. In 2024, they amounted to 1.2 Mt.

Other transportation (1.A.3.e)

Other transportation consists of pipeline transport with CO₂ and N₂O emissions occurring at natural gas compressor stations. This is a minor source, which accounted for 1.2% of GHG emissions in the total category Transport in 1990 and only 0.3% in 2024.

3.2.6.2 Methodological issues

This section describes the methodologies and data sources used to calculate GHG emissions from transport in the Netherlands. Table 3.16 summarises the methods and types of EFs used for transport. More details on methodological issues can be found in Witt et al. (2026).

Table 3.16 Overview of methodologies for the category Transport (1.A.3)

CRT code	Source category description	Method	EF
1.A.3.a	Civil aviation	T1	CS, D
1.A.3.b	Road transport	T2, T3	CS, D
1.A.3.c	Railways	T1, T2	CS, D
1.A.3.d	Waterborne navigation	T1, T2	CS, D
1.A.3.e	Pipeline transport	T2	CS, D

CS: Country-specific, D: Default

Civil aviation (1.A.3.a)

GHG emissions from domestic civil aviation in the Netherlands are estimated using a Tier 1 methodology. Fuel deliveries for domestic and international aviation are derived from the Energy Balance. This includes deliveries of jet kerosene and aviation gasoline. The heating values and CO₂ EFs for aviation gasoline and kerosene are derived from Zijlema (2026). Country-specific values are used for aviation gasoline, whereas for jet kerosene, default values from the 2006 IPCC Guidelines are used. Default EFs are also used for N₂O and CH₄. In the previous two reporting years, the CH₄ IEFs for Landing and Take-Off (LTO) from the CLEO model were used, but these were not applicable to the cruise duration of flights. Therefore, the default EF for CH₄ has now been reverted. Since domestic civil aviation is not a key source in the inventory, the use of a Tier 1 methodology is deemed sufficient.

Emissions of precursor gases (NO_x, CO, NMVOC and SO₂), reported in the CRT under Domestic aviation, are calculated as the sum of domestic LTO emissions, which are calculated by means of the CLEO model (Dellaert & Hulskotte, 2017), and domestic cruise emissions as provided by Eurocontrol to member countries. As the data provided by Eurocontrol does not include flights that failed to submit a flight plan, scaling factors have been used to estimate the missing emissions.

Road transport (1.A.3.b)

The activity data for calculating GHG emissions from road transport is derived from the Energy Balance. This includes fuel sales of gasoline, diesel, liquefied petroleum gas (LPG), natural gas (CNG and LNG), and

biofuels. Table 2.1 in the (separate Excel) annex to Witt et al. (2026) provides an overview of the methodology used to distribute the Energy Balance data across the various CRT categories.

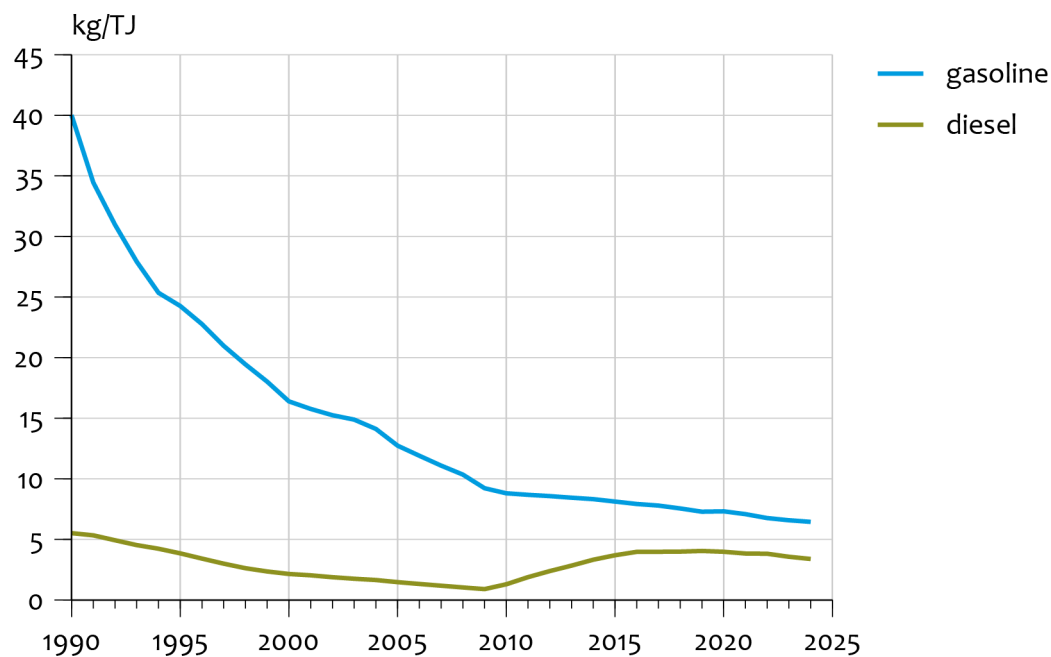
Since 2013, diesel for road transport in energy statistics has included diesel for recreational craft, because a higher excise duty rate (equal to the one for road transport) was applied to diesel for recreational craft. In previous reporting years, this diesel for recreational craft was not deducted from the diesel for road transport.

CO₂ emissions from road transport are calculated using a Tier 2 methodology. Country-specific heating values and CO₂ EFs are used. These were derived from measurement programmes, the most recent having been performed in 2016 and 2017 with a follow-up for gasoline in 2017–2019, and have been brought up to date by Statistics Netherlands. A detailed description of the methodology currently used for calculating GHG emissions for road transport is provided in chapter 2 of Witt et al. (2026). The EFs used are provided in the tables annex to Witt et al. (2026) in Table 2.2B (for CH₄ and N₂O EFs) and Tables 2.2A and 2.7 (CO₂ EFs).

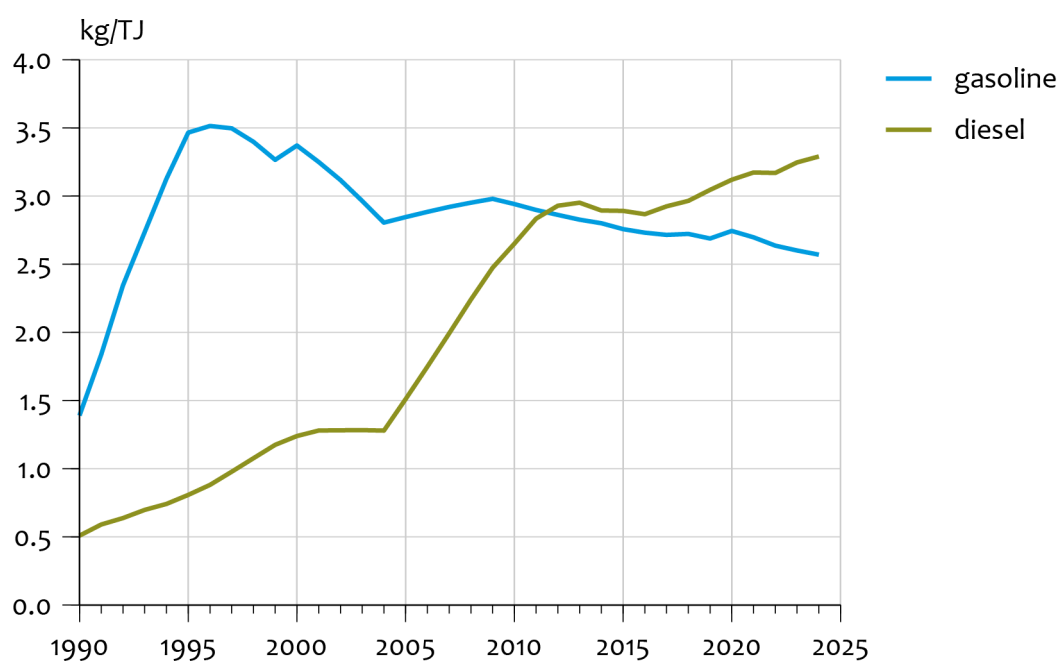
The implied N₂O and CH₄ emission factors for road transport have been changed due to several developments. For one thing, measurements ensuing from the European New Car Assessment Programme (NCAP) resulted in new EFs for Euro 5 and Euro 6 petrol passenger cars. The changes were also due to CH₄ EFs for Euro 5 mopeds (through new insights for EFs VOC) and to changes in the vehicle fleet. (TNO, 2024). Figure 3.11 shows the implied N₂O and CH₄ EFs for road transport. The CH₄ EFs have decreased steadily for all fuel types throughout the time series due to EU emissions legislation for hydrocarbon (HC). Since 2009, diesel vehicles have been equipped with a selective catalytic reduction (SCR), which can lead to incomplete combustion and increased methane emissions. That is why Euro 5 and 6 diesel vehicles have a higher CH₄ emission factor. The N₂O EFs for gasoline increased between 1990 and 1995 due to the increasing number of catalyst-equipped passenger cars in the car fleet, but have since decreased steadily, as described in section 3.2.6.1. The N₂O IEF for diesel has increased in recent years, mainly due to the increasing number of heavy-duty trucks and buses equipped with an SCR catalyst. Tables 3.11, 3.16, and 3.17 in the (separate Excel) annex to Witt et al. (2026) provide an overview of the implied emission factors for road traffic.

Figure 3.11 IEFs per fuel type for CH₄ (upper graph) and N₂O (lower graph) emissions by road transport, 1990–2024

CH₄ IEFs



N₂O IEFs



Railways (1.A.3.c)

Fuel deliveries to railways are derived from the Energy Balance. Since 2025, Statistics Netherlands has obtained diesel data directly from Arriva, Rijmar, and Strukton, the refuelling facility operators. From 2020

to 2024, Statistics Netherlands obtained the diesel data from ProRail, which, in turn, received the data from these operators. ProRail is responsible for the railway network of the Netherlands and is a member of Vivens, a cooperative of rail carriers that purchase diesel for the entire rail sector in the Netherlands. Before 2020, Statistics Netherlands obtained these data from Vivens.

CO₂ emissions from railways are calculated by means of a Tier 2 methodology, using the same country-specific CO₂ EFs as the ones used for road transport (Swertz et al., 2018). Due to a lack of country-specific EFs, CH₄ and N₂O emissions for railways are estimated by means of a Tier 1 methodology, using EFs that have been derived from the 2023 EEA Emission Inventory Guidebook.

Waterborne navigation (1.A.3.d)

Diesel fuel consumption for domestic inland navigation is derived from the Energy Balance. In order to calculate GHG emissions from fuel consumption by recreational craft, this fuel consumption (gasoline as well as diesel) is estimated annually using an updated bottom-up approach derived from Hulskotte (2024). The spatial distribution of recreational craft emissions is determined on the basis of AIS signals produced by those craft that have a transponder on board (approximately 4% of the fleet). The AIS signals further provide detailed insight into sailing speeds these vessels make (valuable input to enhance the accuracy of modelling). The estimated gasoline sales to recreational craft have been reported separately in the energy statistics from 1990 onwards. Rather than being reported separately in the energy statistics, the estimated diesel sales to recreational craft have been included under Road transport from 2013 onwards because a higher excise duty rate (the same as for road transport) was applied. In previous reporting years, this diesel for recreational craft was not deducted from the amount of diesel for Road transport. For the years 1990–2012, diesel for recreational craft is included in the energy statistics under Inland navigation.

The fuel consumption from the Energy Balance is allocated to international bunkers and inland navigation. Apart from reporting its total fuel sales to Statistics Netherlands, each fuel supplier fills in a survey, specifying to which type(s) of shipping (inland navigation, fisheries, international shipping, et cetera) its fuels have been delivered. Within inland navigation, the distinction between domestic inland navigation (included in 1.A.3.d) and international inland navigation (included in 1D International bunker fuels) is uncertain. On the basis of the survey and expert judgement by Statistics Netherlands, the fuel sales of each fuel supplier for Inland navigation are attributed to either national or international navigation. This methodology is used consistently throughout the time series.

A Tier 2 methodology is used to calculate CO₂ emissions from domestic waterborne navigation using country-specific CO₂ EFs, while a Tier 1 method is used for CH₄ and N₂O emissions. A description of the country-specific EFs for CO₂ and the EFs used for CH₄ and N₂O, including the underlying methodology, is provided in Witt et al. (2026); the EFs are included in Table 2.2 of the tables annex.

Other transportation (1.A.3.e)

The methodology used for calculating emissions from Other transportation (Pipeline transport – gaseous fuels) is described in section 3.3.

Fossil carbon in biofuels

Part of the carbon in certain types of biofuels has a fossil origin, and as such should be reported as fossil fuel. The following methodology is used:

- Derive the total amount of biogasoline and biodiesel used for transport in the Netherlands from the Energy Balance, as reported annually by Statistics Netherlands.
- Determine the share of various types of biogasoline and biodiesel used in the Dutch market, as reported annually by the Dutch Emissions Authority (NEa, 2025) and reported in table 2.8 in the (separate Excel) annex to Witt et al. (2026).
- Apply the fossil fraction of the carbon content for biodiesel (Sempos, 2018) and biogasoline (annex III of the EU Renewable Energy Directive, 2018/2001/EC). For biogasoline, no adjustments were made to the activity data from the Energy Balance as Statistics Netherlands already takes into account that part of bio-ETBE and bio-MTBE has a fossil origin and adjusts its data accordingly.

Table 3.17 presents the input for steps 2 and 3, i.e. the shares of various types of biofuels in total biogasoline and biodiesel use for transport in the 2011–2024 period, as reported by NEa (2025), and the fossil part of the carbon content per fuel type.

Table 3.17 Share (in %, rounded) of the various types of biofuels in total biofuel consumption for transport¹ in the Netherlands (NEa, 2025)

	fossil part of CC	2011	2015	2020	2021	2022	2023	2024
		<i>% TJ (biogenic part)</i>						
Biogasoline								
bio-ethanol	0%	92	100	90	92	92	100	98
bio-ETBE	63%	0	0	2	0	0	0	2
bio-MTBE	78%	7	0	0	0	0	0	0
bio-methanol	0%	1	0	0	0	0	0	0
bionaphtha	0%	0	0	8	8	8	0	0
		100	100	100	100	100	100	100
		<i>% TJ (biogenic and fossil part)</i>						
Biodiesel								
FAME	5.4%	100	98	87	78	72	65	36
HVO	0%	0	2	13	21	28	35	64
FAEE	0%	0	1	0	0	0	0	0
		100	100	100	100	100	100	100

¹ Transport by road, rail and non-road mobile machinery

Source: Statistics Netherlands, based on NEa data.

For further information on the separate CO₂ emission factors used for biofuels, see table 2.7 in the (separate Excel) annex to Witt et al. (2026). There is no distinction in emission factors for CH₄ and N₂O between biofuels and fossil fuels.

3.2.6.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

Uncertainty estimates for the activity data and IEFs used for calculating transport emissions are presented in table 2.5 of the tables annex to Witt et al. (2026), which also shows the sources used to estimate uncertainties. Table 3.18 summarises the uncertainties of total fuel consumption and for activity data and EFs per source category, fuel type, and gas.

The uncertainties of total fuel consumption in the Netherlands by mobile sources are derived from Statistics Netherlands. The uncertainties of activity data per source category are derived from Statistics Netherlands or have been estimated by expert judgment. The uncertainty estimates for N₂O and CH₄ for civil aviation, railways, and waterborne navigation are IPCC defaults. The uncertainties in EFs for road transport and CO₂ EFs for other source categories are based on expert judgement. Information on uncertainties is updated annually in accordance with methodological improvements and recalculations, following consultation with experts.

Table 3.18 Uncertainties for activity data and emission factors, category 1.A.3

CRT	Source category	Fuel type	Gas	Activity data	EFs
	Total fuel consumption	Gasoline		+ - 2%	
		Diesel (land vehicles)		+ - 3%	
		Diesel (water vessels)		+ - 5%	
		LPG		+ - 5%	
		Biogasoline		+ - 5%	
		Biodiesel		+ - 5%	
1.A.3.a	Civil aviation	Avgas	CO ₂	+ - 10%	+ - 4%
		Avgas	N ₂ O	+ - 10%	+ - 98%
		Avgas	CH ₄	+ - 10%	+ - 101%
		Kerosene	CO ₂	+ - 10%	+ - 4%
		Kerosene	N ₂ O	+ - 10%	-70% - +150%
		Kerosene	CH ₄	+ - 10%	+ - 53%
1.A.3.b	Road transportation	Gasoline	CO ₂	+ - 5%	+ - 2%
		Gasoline	N ₂ O	+ - 5%	+ - 50%
		Gasoline	CH ₄	+ - 5%	+ - 50%
		Diesel	CO ₂	+ - 5%	+ - 2%
		Diesel	N ₂ O	+ - 5%	+ - 50%
		Diesel	CH ₄	+ - 5%	+ - 50%
		LPG	CO ₂	+ - 5%	+ - 2%
		LPG	N ₂ O	+ - 5%	+ - 50%
		LPG	CH ₄	+ - 5%	+ - 50%
		CNG_LNG	CO ₂	+ - 5%	+ - 0%
		CNG_LNG	N ₂ O	+ - 5%	+ - 50%
		CNG_LNG	CH ₄	+ - 5%	+ - 50%
1.A.3.c	Railways	Diesel	CO ₂	+ - 25%	+ - 2%
		Diesel	N ₂ O	+ - 25%	+ - 100%
		Diesel	CH ₄	+ - 25%	+ - 100%
1.A.3.d	Water-borne navigation	all	CO ₂	+ - 5%	+ - 2%
		all	N ₂ O	+ - 5%	-40% - +140%
		all	CH ₄	+ - 5%	+ - 50%

Time-series consistency

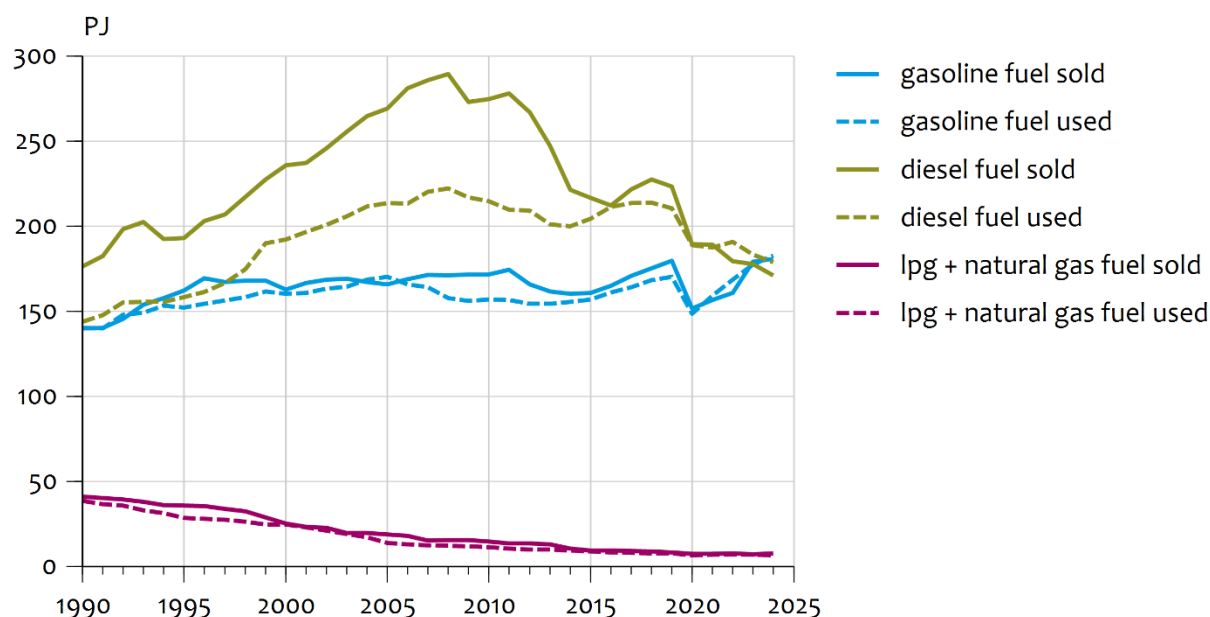
Emissions from transport sectors are calculated from the energy statistics combined with country-specific EFs. Time-series consistency is ensured for EFs and activity data for most sectors as follows:

- A description of the country-specific EFs for CO₂ and the EFs used for CH₄ and N₂O, including the underlying methodology, is provided in Witt et al. (2026); the EFs are included in table 2.2 of the tables annex.
- Energy statistics are prepared by Statistics Netherlands, using the same methodology for the complete time series. In 2015 and 2016, the energy statistics from 1990 onwards were revised, using the same methodology for all years. These revised energy

statistics have been used from the 2017 submission onwards.
The activity data are consistent throughout the time series.

- 3.2.6.4 Category-specific QA/QC and verification
GHG emissions from Transport are based on fuel sold. To check the quality of the emissions totals, activity data for road transport (i.e. energy use per fuel type) is also calculated using a bottom-up approach based on vehicle-kilometres travelled and specific fuel consumption per vehicle-kilometre for various vehicle types. A comparison between the fuel sales data and the bottom-up calculation of fuel consumption gives an indication of the validity of the (trends in the) fuel sales data.
Figure 3.12 shows the time series for both fuel sold and fuel used for gasoline (including bioethanol), diesel (including biodiesel), and LPG + natural gas in road transport.

Figure 3.12 Fuel sold and fuel used for road transport in the Netherlands, 1990–2024



Between 1990 and 2024, the time series for fuel sold and fuel consumed show a strong correspondence for the combined fuels LPG and natural gas and somewhat less so for gasoline (Figure 3.12). The distinction between LPG and natural gas is unknown for fuel used in the years 1990–2007; therefore, it has been combined in Figure 3.12. However, the time series for diesel deviate: even though the trend is mostly comparable, diesel sales on Dutch territory were substantially higher than diesel consumption. The differences ranged between 11% and 33%. In recent years, any substantial difference between fuel used and fuel sold has disappeared.

The difference between diesel used and diesel sold in the 1990–2020 period can be partly explained by the use of diesel in long-haul distribution trucks, which can travel several thousand kilometres on a full tank. Diesel fuel sold to long-haul trucks in the Netherlands is mostly consumed abroad and is therefore not included in the diesel consumption on Dutch territory. Although this omission is partially offset

by the consumption by trucks that travel in the Netherlands but do not refuel here, it is expected that the impact of Dutch long-haul trucks refuelling in the Netherlands is dominant, given the small size of the country.

In order to validate the activity data for railways and waterborne navigation, as derived from the Energy Balance, the trends in fuel sales data for both source categories are compared to trends in transport volumes. Trends in energy use for waterborne navigation closely correspond with trends in transport volumes, although this does not necessarily hold for trends in domestic inland navigation. This would suggest that the growth in transport volumes mostly relates to international transport.

For railways, the correspondence between diesel deliveries and freight transport volumes is weak. This can be explained by the electrification of rail freight transport, with the exception of shunting activity, which largely continues to use diesel. Figures compiled by Rail Cargo (2007, 2013) make clear that in 2007, only 10% of all locomotives used in the Netherlands were electric, whereas by 2012, the proportion of electric locomotives had exceeded 40% due to the electrification of most freight rail lines. For this reason, recent years in the time series have seen a decoupling of transport volumes and diesel deliveries. Consequently, the decline in diesel consumption for railways, as derived from the Energy Balance, is deemed plausible.

3.2.6.5 Category-specific recalculations

New data were derived from the Energy Balance, and the GHG emissions were adjusted accordingly. This applies to all types of fuels. In addition to this regular update, other changes are described in the paragraphs below.

Diesel for Recreational craft, which has been classified under Road transportation in the energy statistics from 2013 onwards, has been shifted from 1.A.3.b Road Transportation to 1.A.3.d Domestic Navigation (2.0 PJ in 2013, 1.7 PJ in 2023).

Changes to the Non-road mobile machinery (NRMM) model and its transfer to the energy statistics (see section 3.2.7.5), as well as the transfer of bottom-up data on Recreational craft fuel consumption to the energy statistics for the entire time series (now also for the years 1990–2014), have led to a revised allocation of gasoline and diesel with an exchange of gasoline and diesel with Road transport (gasoline: +0.2 PJ in 1990 and -0.2 PJ in 2023; diesel: +0.0 PJ in 1990 and -2.7 PJ in 2023). This exchange does not apply to diesel in the 1990–2013 period, as a lower excise duty rate on diesel for NRMM and Recreational craft applied at that time, and therefore, diesel for both activities was not included in the observation/recording of diesel sales for road transport.

As mentioned before, the data for Road transportation has been updated. This resulted in the following changes in emissions (in kt CO₂ eq):

1.A.3.b. Road transport, gasoline

	1990	2000	2005	2010	2015	2020	2023
CO ₂	16.94	26.62	21.89	22.36	22.10	0.76	-11.20
CH ₄	0.25	0.16	0.10	0.08	0.07	0.00	-0.50
N ₂ O	0.85	0.31	0.21	0.24	0.22	0.01	-1.37

1.A.3.b. Road transport, diesel oil

	1990	2000	2005	2010	2015	2020	2023
CO ₂	0.00	0.00	0.00	0.00	-	-	-
CH ₄	-0.22	-0.44	-0.64	-0.68	-0.49	-0.46	-0.58
N ₂ O	-0.04	-0.75	-1.01	-2.58	-10.46	-12.24	-11.89

1.A.3.d. Domestic Navigation, gas/diesel oil

	1990	2000	2005	2010	2015	2020	2023
CO ₂	-0.59	0.00	0.00	0.00	147.82	130.44	126.56
CH ₄	0.00	0.00	0.00	0.00	0.40	0.35	0.34
N ₂ O	0.00	0.00	0.00	0.00	1.08	0.95	0.93

- 3.2.6.6 Category-specific planned improvements
No category-specific improvements have been planned.

3.2.7 *Other sectors (1.A.4)*

- 3.2.7.1 Category description
Table 3.19 and Figure 3.13 present the subcategories and emissions trends in sector 1.A.4.

Table 3.19 Overview of emissions in the category Other sectors (1.A.4) in the base year and the last two years of the inventory

Sector/category	Gas	Emissions in Mt CO ₂ eq			2024 vs 1990 %	Contribution by the category in 2024 (%) to the		
		1990	2023	2024		sector	total gas	total CO ₂ eq
1.A.4. Other sectors	CO ₂	39.3	24.2	23.6	-39.9%	22.3%	19.9%	16.4%
	CH ₄	0.64	1.4	1.5	133.5%	1.4%	8.2%	1.0%
	N ₂ O	0.05	0.05	0.05	4.5%	0.04%	0.72%	0.03%
	All	40.0	25.7	25.2	-37.0%	23.7%		17.4%
1.A.4.a. Commercial/Institutional	CO ₂	8.6	5.7	5.2	-39.8%	4.9%	4.4%	3.6%
	CH ₄	0.05	0.07	0.06	19.1%	0.06%	0.35%	0.04%
	CO ₂	7.8	4.9	4.5	-42.6%	4.2%	3.8%	3.1%
1.A.4.a Natural gas	CO ₂	7.8	4.9	4.5	-42.6%	4.2%	3.8%	3.1%
1.A.4.b. Residential	CO ₂	20.8	11.3	11.1	-46.8%	10.4%	9.3%	7.7%
	CH ₄	0.50	0.30	0.29	-42.3%	0.27%	1.6%	0.20%
	CO ₂	19.9	11.2	10.9	-45.2%	10.3%	9.2%	7.6%
1.A.4.b Natural gas	CO ₂	19.9	11.2	10.9	-45.2%	10.3%	9.2%	7.6%
1.A.4.c. Agriculture/forestry/fishing	CO ₂	9.9	7.2	7.4	-25.3%	7.0%	6.2%	5.1%
	CH ₄	0.08	1.1	1.1	1299.8%	1.1%	6.2%	0.8%
	CO ₂	2.6	1.6	1.5	-40.0%	1.4%	1.3%	1.1%
1.A.4.c liquids	CO ₂	2.6	1.6	1.5	-40.0%	1.4%	1.3%	1.1%
1.A.4.c Natural gas	CO ₂	7.3	5.5	5.8	-20.2%	5.5%	4.9%	4.0%

Sector 1.A.4 comprises the following key categories:

1.A.4	Liquids excl. 1.A.4.c:	CO ₂ (L1)
1.A.4.a	Commercial/Institutional:	CO ₂ (L,T1)
	gaseous	
1.A.4.b	Residential gaseous	CO ₂ (L,T)
1.A.4.b	Residential: all fuels	CH ₄ (L2)
1.A.4.c	Agriculture/forestry/fisheries:	CO ₂ (L1)
	liquids	
1.A.4.c	Agriculture/forestry/fisheries:	CO ₂ (L,T)
	gaseous	

1.A.4.c Agriculture/forestry/fisheries: CH₄ (L,T)
all fuels

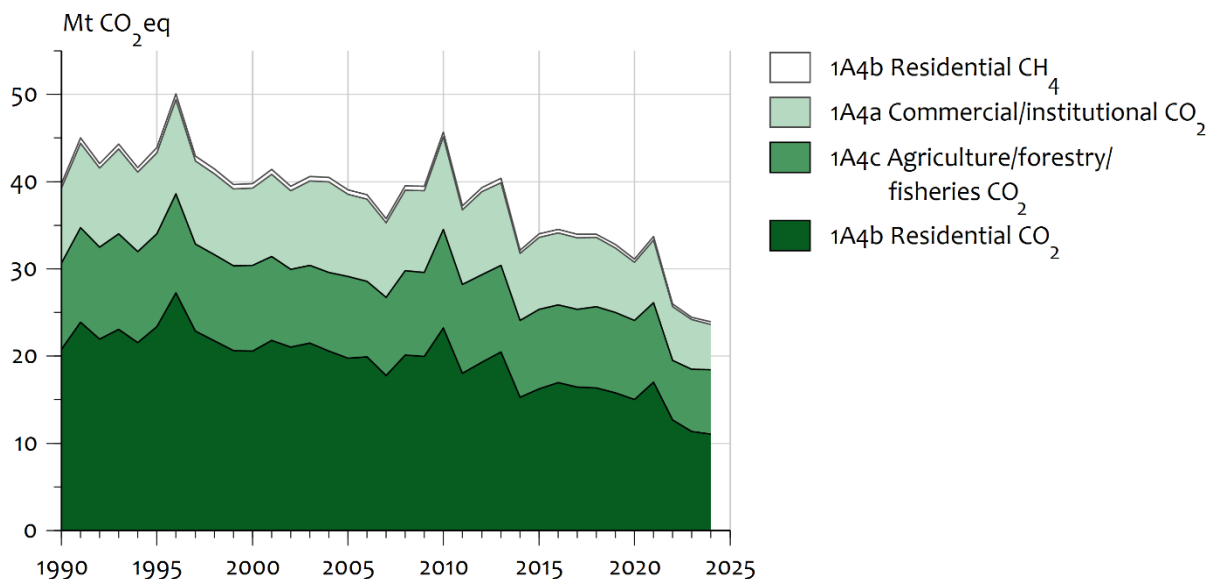
Sub-category 1.A.4.a (Commercial and institutional services) comprises commercial and public services, such as banks, schools and hospitals, and services relating to trade (including retail) and communications; it also includes emissions from the production of drinking water and miscellaneous combustion emissions from waste handling activities and from wastewater treatment plants (WWTPs), as well as emissions from non-road mobile machinery (NRMM) used in the trade and services sectors.

Sub-category 1.A.4.b (Residential) relates to fuel consumption by households for space heating, water heating, and cooking. Space heating uses about three-quarters of the Netherlands' total consumption of natural gas in the residential sector. The residential sub-category also includes emissions from NRMM used by households.

Sub-category 1.A.4.c (Agriculture, forestry and fisheries) comprises stationary combustion emissions from agriculture, horticulture, greenhouse horticulture, cattle breeding, and forestry. It also includes emissions from agricultural NRMM (1.A.4.c.ii) and from Fishing (1.a.4.c.iii).

The emissions of sub-categorie 1.A.2.g.vii (Manufacturing industries and construction, off-road vehicles, and other machinery) are described in this chapter, as it is part of the same NRMM model for 1.A.4.

Figure 3.13 1.A.4 Other sectors – emissions levels of source categories, 1990–2024



Commercial and institutional services (1.A.4.a)

CO₂ emissions in the Commercial and institutional services (1.A.4.a) sub-category have decreased since 1990. The interannual variations in emissions are mainly due to temperature: more natural gas is used during cold winters (e.g. 1996 and 2010), less in warm winters (e.g. 2014).

Energy use by NRMM used in trade increased from 8.9 PJ in 1990 to 12.0 PJ in 2011 and then decreased to 9.9 PJ in 2024, with CO₂ emissions decreasing accordingly. Energy use mostly consists of diesel fuel, although some gasoline is used, and in last decade, the use of biofuels has increased, amounting to 1.0 PJ in 2024.

Residential (1.A.4.b)

Also for this category, the interannual variations in emissions are mainly due to temperature: more natural gas is used during cold winters (e.g. 1996 and 2010), less in warm winters (e.g. 2014). Only for the years 2022 and 2023, a larger decrease can be seen due to the high natural gas prices (resulting in less heating by households). In 2024, the natural gas prices decreased again, but thanks to the relatively warm winter, the natural gas consumption did not increase.

The annual variations are much larger for liquid and solid fuels because of the smaller figures. Emissions from biomass consumption predominantly relate to wood combustion.

In the category Residential, CO₂ emissions have decreased since 1990, even though the number of households has increased. This is mainly due to the improved insulation of dwellings and the increased use of high-efficiency boilers for central heating.

Energy consumption by NRMM used in the category Residential decreased from 1.3 PJ in 1990 to 0.7 PJ in 2024, with CO₂ emissions decreasing accordingly. Energy use consists of gasoline only, and from 2006, biofuels have also been applied.

Agriculture, forestry, and fisheries (1.A.4.c)

Most of the energy in this source sub-category is used for space heating, water heating, and cogeneration of electricity. The major fuel used is natural gas; hardly any solid fuels are used. NRMM used in agriculture mostly uses diesel oil, although some biofuel and gasoline is used. Biofuel use has increased. Fishing uses diesel oil and combined this with some residual fuel oil until 2016.

Total CO₂ emissions in the sub-category Agriculture, forestry, and fisheries have decreased since 1990, mainly due to a decrease in gas consumption for stationary combustion as a result of various energy conservation measures. For example, in greenhouse horticulture, the surface area of heated greenhouses has increased but their energy consumption has been reduced.

Part of the CO₂ emissions from the agricultural sector consists of emissions from cogeneration facilities, which can also provide electricity to the national grid.

In addition, since the autumn of 2005, CO₂ emissions from two plants have been used for crop fertilisation in greenhouse horticulture. Total annual amounts are approximately 0.4 Mt CO₂. Because the sector can use the CO₂ delivered by the two plants for crop fertilisation, it needs to combust less natural gas to produce CO₂ itself.

The CH₄ emissions in the Agriculture, forestry and fisheries sub-category have increased since 1990 due to the shift from natural gas combustion in boilers to the natural gas combustion in gas engines. The increase in CH₄ emissions is the result of the higher CH₄ emission factor for gas engines.

GHG emissions from agricultural NRMM (1.A.4.c.ii) have been relatively constant throughout the time series, ranging between 1.0 and 1.4 Mt CO₂ eq.

CO₂ emissions from fisheries have decreased significantly, from 1.3 Mt in 2000 to 0.3 Mt in 2024. This is due to the decline in the number of fishing vessels in the Netherlands since 1990, along with a decrease in their engine power.

NRMM of Manufacturing industries and construction (1.A.2.g.vii)

NRMM energy consumption in manufacturing and construction is 22.5 PJ in 2024 and has a fairly stable energy use at 24–28 PJ over the 1990–2023 period, with corresponding CO₂ emissions. Energy use mostly consists of diesel fuel, although some gasoline and LPG is used, while the use of biofuels has increased over the last decade, particularly in 2024, amounting to 2.5 PJ in that year..

3.2.7.2 Methodological issues

Details of methodologies, data sources and country-specific source allocation issues are provided in:

- Honig et al. (2026), section 2.1: Stationary combustion;
- Visschedijk et al. (2026), chapters 21 and 25: Residential wood combustion and charcoal use;
- Witt et al. (2026), chapter 9: Non-road mobile machinery.

This section provides a brief description of the methodology applied to Stationary combustion (1.A.4.a.i, 1.A.4.b.i, and 1.A.4.c.i) and Mobile combustion (1.A.2.g.vii, 1.A.4.a.ii, 1.A.4.b.ii, 1.A.4.c.ii, and 1.A.4.c.iii).

Stationary combustion

The emissions from this source category are estimated by multiplying fuel use statistics by IPCC default and country-specific EFs (Tier 1 and Tier 2 method for CO₂ and CH₄ and Tier 1 method for N₂O).

Activity data

The activity data used in this sector is mainly derived from energy statistics supplied by Statistics Netherlands. For the following emission sources, other activity data are used:

- The activity data for charcoal consumption in barbecues is based on energy statistics from Statistics Netherlands for one year. To create a complete time series, the activity data are following the trend for annual meat consumption.

- The activity data for residential wood combustion is based on (six-yearly) surveys by Statistics Netherlands; the results of these surveys are used to prepare a complete time series. See Visschedijk et al. (2026) for further details on these wood combustion statistics.
- The activity data for landfill gas is available from landfill site operators (in m³). This activity data are not included in the CRT as it is available in m³ rather than in GJ. data are data are The amount of landfill gas for energy purposes is available in NID Table 7.6.

Emission factors

The following EFs are used for stationary combustion: for CO₂, IPCC default EFs are used (see Annex 5) for all fuels except for natural gas, gas/diesel oil, LPG, and gaseous biofuels for which country-specific EFs are used. The Netherlands' list of fuels (Zijlema, 2026) specifies whether the EFs are country-specific or IPCC default values. For CH₄, country-specific EFs are used for all fuels except solid biomass and charcoal. For natural gas in gas engines, a higher EF is used than for boilers (see Honig et al., 2026). The country-specific CH₄ EF for residential gas combustion includes start-up losses, a factor mostly neglected by other countries. For N₂O, IPCC default EFs are used.

The IEF for CH₄ emissions from natural gas combustion in the category Residential (1.A.4.b.i) is the aggregate of the standard EF for gas combustion of 5.7 g/GJ plus the 35 g/GJ of total residential gas combustion that represents start-up losses. These occur mostly in cooking devices, but also in central heating and hot-water production devices. This results in an EF of 40.7 g/GJ. CH₄ emissions from start-up losses are six times higher than the CH₄ combustion emissions.

The IEF for CH₄ emissions from natural gas combustion in the agricultural sector (1.A.4.c.i) is an average of the EF for gas engines and other stationary combustion. The increased use of internal combustion engines in CHP plants operating on natural gas has increased the IEF for methane in this category, as these engines are characterised by high methane emissions.

Mobile combustion

- Emissions from Fisheries (1.A.4.c.iii) are calculated on the basis of IPCC Tier 2 methodologies. Fuel use data are combined with country-specific EFs for CO₂. CH₄ and N₂O emissions from Fisheries are derived using a Tier 1 methodology. The EFs are presented in Table 2.2B of the tables annex to Witt et al. (2026).
- Fuel consumption by NRMM is derived from the Energy Balance, which, in turn, uses the output of the EMMA model (Dellaert et al., 2023). CO₂ emissions from NRMM are estimated using a Tier 2 methodology (for the EF). Country-specific heating values and CO₂ EFs are used, as for road transport.
- CH₄ and N₂O emissions from NRMM are estimated using a Tier 3 methodology, using country-specific EFs. CH₄ EFs are presented in table 9.6 of the tables annex to Witt et al. (2026).

Table 3.20 Overview of methods used for the calculation of emissions for NRMM and fisheries

CRT code	Source category description	Method	EF
1.A.2.g.vii	Industry and construction	T2, T3	CS
1.A.4.a.ii	Commercial/institutional	T2, T3	CS
1.A.4.b.ii	Residential	T2, T3	CS
1.A.4.c.ii	Agriculture/forestry	T2, T3	CS
1.A.4.c.iii	National Fishing	T1, T2	CS, D

CS: Country-specific, D: Default

General

For 2024, more than 99% of the CO₂ emissions in 1.A.4 were calculated using country-specific EFs (mainly natural gas). The remaining (less than) 1% of CO₂ emissions were calculated by means of default IPCC EFs. These mainly consist of emissions from other kerosene.

An overview of the IEFs used for the most important fuels (up to 95% of the fuel use) in *Other sectors (1.A.4)* is provided in Table 3.21.

Table 3.21 Overview of IEFs used for the most important fuels (up to 95% of fuel use) for the year 2024 in *Other sectors (1.A.4)*

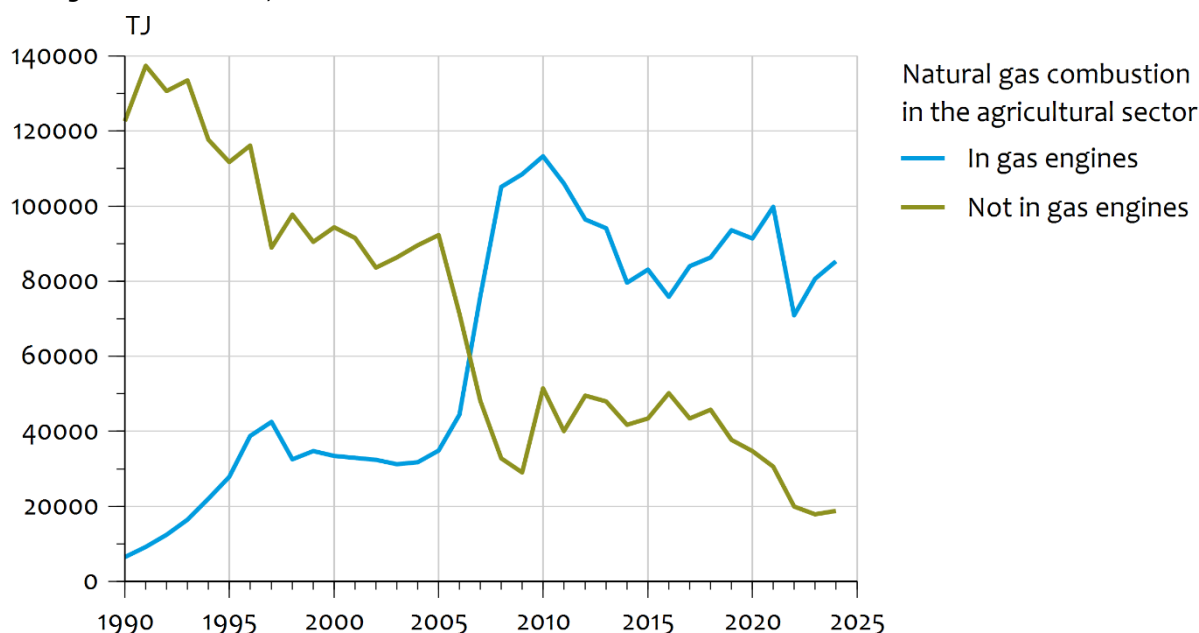
Fuel	Amount of fuel used in 2023 (TJ NCV)	IEFs (g/GJ)		
		CO ₂ (x 1000)	N ₂ O	CH ₄
Natural gas	377,273	56.2	0.1	127.1
Gas / Diesel oil	27,926	72.5	1.6	2.1
Solid biomass	23,939	113.6	3.8	183.5

Explanations of the IEFs

- Natural gas: The standard CH₄ EF for natural gas is 40.7 g/GJ (5.7 g/GJ for combustion and 35.0 g/GJ for start-up losses). A higher EF is only used for gas engines (due to gas slip), which explains the higher EF for this sector.
- Gas/diesel oil: Gas/Diesel oil is used in stationary and mobile combustion for which different EFs for CH₄ and N₂O are used.
- Solid biomass: The implied CO₂ EF for Solid biomass consists of a combination of wood combustion with an EF of 112 kg/GJ and solid biomass combustion with an EF of 109.6 kg/GJ. The implied CH₄ EF for solid biomass consists of a combination of residential wood combustion (with an EF of 140 g/GJ) and wood combustion in the services and agricultural sectors (with an EF of 300 g/GJ).

Trends in the IEFs for most sectors can be explained by the composition of fuels used in that sector. The largest fluctuations are visible in the CH₄ EF for gaseous fuels. This results from the difference in CH₄ EF used for natural gas combusted in gas engines (ranging between 250 and 450 g/GJ) and the CH₄ EF used for natural gas combusted in other plants (5.7 g/GJ). Figure 3.14 shows the trend in natural gas combusted in gas engines and in other plants. The increase between 2005 and 2010 can be explained by the increased installation of gas engines in the agricultural sector over that period.

Figure 3.14 Trend in natural gas consumption in gas engines (with a relatively high emission factor) and other engines (with a relatively low emission factor) in the agricultural sector, 1990–2024



3.2.7.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The uncertainty in total emissions from this source category is approximately 5% for CO₂, 47% for CH₄, and 88% for N₂O.

The uncertainty in the gas consumption data are similarly estimated at 3% for the Services category, 5% for the Residential category, and 5% for Agriculture. For liquid fuels, an uncertainty of 30% for the Services category, 20% for the Residential category, and 15% for Agriculture is estimated. Since the uncertainty in small values in national statistics is generally greater than in larger values, as indicated by the high interannual variability of the data, the uncertainty in solid fuel consumption is estimated to be even higher, i.e. 50%.

For natural gas, the uncertainty in the CO₂ EF is estimated at 0.25% on the basis of the fuel quality analysis reported by Heslinga and Van Harmelen (2006) and discussed in Olivier et al. (2009). For the CO₂ EFs for liquids and solids, uncertainties of 2% (diesel and LPG), 3% (petroleum), and 5% (coal) have been assigned. The uncertainty in the CH₄ and N₂O EFs is estimated to be much higher. For residential wood combustion, the CH₄ and N₂O EF uncertainty is estimated at 200% and 250% respectively. For all other fuels, the uncertainty in CH₄ and N₂O EF is 50%.

As most of the fuel consumption in this source category is used for space heating, consumption has varied considerably per year due to variations in winter temperatures. For trend analysis, a method is used to correct the CO₂ emissions from gas combustion (the main fuel for heating purposes) for the varying winter temperatures. This involves the use of the number of 'heating degree days' under normal climate

conditions, which is determined by the long-term trend, as explained by Visser (2005).

The uncertainty in activity data for NRMM is estimated to be 10–30% for all fuels as reported in Table 2.5 of the tables annex to Witt et al. (2026). The uncertainty of total diesel consumption for mobile sources is 3%, the uncertainty of total benzine consumption is 2%, and the uncertainty of total LPG consumption is 5% (see also 3.2.6.3). The uncertainty in the EFs is estimated to be 2% for CO₂ (all fuels), -50%/+300% for N₂O and -40%/+250% for CH₄. The CO₂ estimate was assumed to be equal to the estimate for road transport fuels, which, in turn, was based on expert judgement. The estimates for CH₄ and N₂O were derived from the 2006 IPCC Guidelines.

Time-series consistency

Emissions from stationary energy combustion are calculated from the energy statistics combined with country-specific EFs (at the beginning of the time series) or from a combination of company-specific and country-specific EFs (at the end of the time series). Time-series consistency is ensured for EFs and activity data: The country-specific EFs are based on company-specific data. Company-specific data from the most relevant companies in a number of years has been used to calculate an average country-specific EF. As the same information is used to calculate both the country-specific EF and the company-specific EFs, the EFs are consistent throughout the time series.

Energy statistics are consistent throughout the time series, as these are derived from the same data source (Statistics Netherlands).

3.2.7.4 Category-specific QA/QC and verification

Trends in CO₂ emissions from the three sub-categories were compared to trends in related activity data: number of households, number of people employed in the services sector, and the total surface area of heated greenhouses. Large interannual changes were identified, and explanations were sought (e.g. interannual changes in CO₂ emissions, by calculating temperature-corrected trends to identify the anthropogenic emissions trends). Subsequently, the trend tables for the IEFs were used to identify large changes and large interannual variations at the category level, for which explanations were sought and included in the NIR. Changes in the IEFs are mainly due to changes in the type of fuel used. Furthermore, the IEFs of individual fuels are also compared to the default emission factors, and deviations from the standard EFs are explained in the NIR. More details on the validation of the energy data can be found in section 2.1 of Honig et al. (2026).

NRMM data and model

Significant effort was invested in recent years into checking and verification of NRMM modelling and outcomes.

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 (the Netherlands vehicle authority), can be queried and makes available a relatively complete

overview of the Dutch NRMM fleet, which was notably lacking before. As the registry contains information on machine type, fuel type, and date of entry, this allows for a further comparison to and validation of the modelled machine fleet, resulting in continuous updates to the model, especially to the estimated machine sales for some machinery types (see section 3.2.7.5.).

3.2.7.5 Category-specific recalculations *Stationary combustion*

Correction liquid and solid biomass

The solid and liquid biomass consumption data has been corrected for the complete time series for all stationary combustion sectors except 1.A.4.b.i. The data flow of the solid and liquid biomass statistics has been updated to match the data flow of the fossil fuel statistics. This resulted in two changes of the activity data:

- In earlier years, activity data of biomass was rounded to 1 TJ, but now, activity data with more digits is used.
- Error correction: With the update, several errors were found in the biomass statistics. These have been corrected.

See section 3.2.4.5 for the recalculations resulting from the correction in liquid and solid biomass.

Update energy statistics 2015–2023

The energy statistics have been improved for the 2015–2023 period. This is an annual update, and the main changes are described on the Table Information of the Energy Balance Sheet (available via: <https://opendata.cbs.nl/#/CBS/en/dataset/83989ENG/table?ts=1765534146208>). The main changes are an update of the LPG statistics and a change in the share of biogenic natural gas (resulting in a reallocation from natural gas to biogenic natural gas).

The main recalculations in 1.A.4.a.i due to the update of the energy statistics include a change in the biogenic share of natural gas in 2015–2023 (resulting in a reallocation from natural gas to biogenic natural gas of 0.33 kt CO₂ in 2015 and -0.61 kt CO₂ in 2023). Furthermore, the natural gas activity data has been updated in 2023 (-63.19 kt CO₂ in 2023). Other main recalculations include an update of LPG in 2015–2023 (-22.33 kt CO₂ in 2015 and -29.65 kt CO₂ in 2023). Also, emissions of CH₄ and N₂O have been recalculated from the updated energy statistics.

The changes in energy statistics (including the other small changes) resulted in the following changes in emissions (in kt CO₂ eq):

1.A.4.a.i (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	-22.89	-26.05	-24.49	-26.09	-24.45	-25.72	-51.91	-39.67	-92.32
CO ₂ biogenic	0.32	0.29	0.27	0.36	0.31	0.34	-0.11	0.98	-0.61
CH ₄	8.76	5.61	5.24	7.33	5.88	3.37	3.27	3.58	2.87
N ₂ O	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.04

The main recalculations in 1.A.4.b.i due to the update of the energy statistics include a change in the biogenic share of natural gas in 2015–2023 (resulting in a reallocation from natural gas to biogenic natural gas of 0.72 kt CO₂ in 2015 and 1.15 kt CO₂ in 2023). Furthermore, the natural gas activity data has been updated in 2022–2023 (-762.20 kt CO₂ in 2022 and -28.63 kt CO₂ in 2023). Also, emissions of CH₄ and N₂O have been recalculated from the updated energy statistics.

The changes in energy statistics (including the other small changes) resulted in the following changes in emissions (in kt CO₂ eq):

1.A.4.b.i (kt CO ₂ eq)	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	-1.09	-0.69	-0.77	-0.83	-0.85	-1.28	-0.75	-762.20	-28.63
CO ₂ biogenic	0.72	0.69	0.62	0.84	0.88	1.30	0.71	-2.79	1.15
CH ₄	-0.00	-0.00	-0.00	0.00	-0.00	0.00	-0.00	-15.43	-2.14
N ₂ O	-0.00	-0.00	-0.00	0.00	0.00	0.00	-0.00	-0.36	-0.01

The main recalculations in 1.A.4.c.i due to the update of the energy statistics include a change in the biogenic share of natural gas in 2015–2023 (resulting in a reallocation from natural gas to biogenic natural gas of 0.32 kt CO₂ in 2015 and 0.09 kt CO₂ in 2023). Furthermore, the natural gas activity data has been updated in 2023 (-59.76 kt CO₂ in 2023). Other main recalculations include an update of LPG in 2015–2023 (-0.001 kt CO₂ in 2015 and +13.34 kt CO₂ in 2023) and an update of biogas in 2023 (+7.04 kt CO₂ in 2023). Also, emissions of CH₄ and N₂O have been recalculated from the updated energy statistics.

The changes in energy statistics (including the other small changes) resulted in the following changes in emissions (in tonnes):

1.A.4.c.i	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO ₂ fossil	-0.32	-0.29	-0.28	-0.39	-0.42	-0.62	-0.31	-1.38	-46.51
CO ₂ biogenic	0.32	0.29	0.28	0.39	0.42	0.62	0.31	1.38	7.13
CH ₄	11.17	0.00	-0.00	0.00	0.00	0.00	-0.00	-0.00	15.62
N ₂ O	-0.00	0.00	-0.00	0.00	0.00	0.00	-0.00	0.00	-0.02

Non-road Mobile Machinery

Several updates have been implemented into the model and the input data:

1. Substantial updates to the emission model input data and parameters were implemented as a result of further analysis of the RDW registry for NRMM. For most machinery types, new survival curves have been derived by comparing several snapshots of the RDW database on registered NRMM in the Netherlands (see section 3.2.7.4.). Additionally, median lifetimes were reassessed, leading to changes in the machinery fleet, most notably in the earlier years (1990–2000). Additional machinery types were identified and added to the model, most notably tool carriers, ATVs, transporters, road trains, forwarders, and agricultural front mowers. Last, the introduction of electric machinery has been revised, using data from the RDW registry when available, and using averages for these machinery types as proxies for machinery types that are not included in the registry. These updates are part of a continuous effort, with some refinements expected in future years.
2. A new diesel consumption total for agriculture has been provided by Wageningen Social and Economic Research for the year 2023, resulting in a substantial decrease by 1.7 PJ of diesel in sector 1.A.4.c..ii as well as in a reallocation of diesel in the energy statistics.
3. Using a link between the RDW registry and the sector codes of businesses that registered these machines, the sector allocation of NRMM types has been revised, with a substantial re-allocation of machinery from the Industry sector to Commercial/institutional, and some re-allocations between Construction and Agriculture.
4. Diesel sales for land equipment to Defence in the energy statistics are no longer allocated to NRMM (1.A.4.a.ii), but are now allocated to Defence (1.A.5.b).

The above changes result in substantial changes in fuel consumption and related emissions over the full time series. Gasoline consumption has decreased by 6–8% in the 1990–2018 period. Diesel consumption has increased by more than 10% since 2001 and by 20–30% in the 2008–2018 period. LPG consumption has increased by 13–35% between 1990 and 2023.

Due to changes in the NRMM model as a result of a newly available resource, the fuel consumption of non-road mobile machinery (NRMM) and its allocation to the various types of NRMM has changed significantly. The data has been taken over from the NRMM model and have been largely incorporated into the energy statistics, but not yet for 1.A.2.g.vii. NRMM of Manufacturing industries and construction (which is planned for next year). This has resulted in a revised allocation of gasoline. There is an exchange for gasoline between NRMM and Road transport. See also section 3.2.6.5.

As mentioned before, the activity data on NRMM has been updated. This resulted in the following changes in emissions (in kt CO₂ eq):

Total NRMM, total fuel

	1990	2000	2005	2010	2015	2020	2023
1.A.2.g.vii.	-	-	-	-	-	-	-
1.A.4.a.ii.	526.12	598.54	500.54	313.19	147.96	-59.68	-74.59
1.A.4.b.ii.	42.60	186.21	332.85	507.48	402.73	384.57	375.28
1.A.4.c.ii.	-16.83	-16.04	-15.40	-14.22	-15.00	-12.37	-9.40
1.A.4.c.ii.	14.95	13.73	12.89	8.83	6.21	34.47	104.02

1.A.2.g.vii. Manufacturing industries and construction, off-road vehicles and other machinery, gasoline

	1990	2000	2005	2010	2015	2020	2023
CO ₂	-2.37	-8.24	-7.16	-7.52	-4.82	-2.20	-1.07
CH ₄	-0.11	-0.40	-0.28	-0.21	-0.09	-0.01	0.02
N ₂ O	0.00	-0.02	-0.01	-0.02	-0.01	0.00	0.00

1.A.2.g.vii. Manufacturing industries and construction, off-road vehicles and other machinery, diesel oil

	1990	2000	2005	2010	2015	2020	2023
CO ₂	-	-	-	-	-	-	-
CO ₂	479.39	550.18	459.78	272.16	122.04	-43.80	-59.90
CH ₄	-0.18	-0.18	-0.18	-0.14	-0.07	-0.03	-0.03
N ₂ O	-1.03	-1.19	-0.99	-0.59	-0.24	0.03	-0.43

1.A.2.g.vii. Manufacturing industries and construction, off-road vehicles and other machinery, LPG

	1990	2000	2005	2010	2015	2020	2023
CO ₂	-41.76	-37.14	-31.09	-31.46	-19.73	-12.89	-12.38
CH ₄	-0.69	-0.68	-0.60	-0.63	-0.41	-0.29	-0.26
N ₂ O	-0.59	-0.53	-0.44	-0.45	-0.28	-0.18	-0.18

1.A.4.a.ii. Commercial/institutional, off-road vehicles and other machinery, liquid fuels

	1990	2000	2005	2010	2015	2020	2023
CO ₂	41.16	184.69	331.30	505.78	400.54	381.07	371.93
CH ₄	1.33	0.96	0.63	0.44	0.49	0.50	0.46
N ₂ O	0.12	0.56	0.92	1.25	1.19	1.94	2.01

1.A.4.b.ii. Residential, off-road vehicles and other machinery, liquid fuels

	1990	2000	2005	2010	2015	2020	2023
CO ₂	-16.10	-15.47	-14.86	-13.73	-14.54	-12.03	-9.15
CH ₄	-0.70	-0.54	-0.51	-0.45	-0.41	-0.29	-0.21
N ₂ O	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.02

1.A.4.c.ii. Agriculture/forestry/fishing, off-road vehicles and other machinery, gasoline

	1990	2000	2005	2010	2015	2020	2023
CO ₂	-11.70	-12.30	-9.12	-9.67	-8.20	-0.60	2.71
CH ₄	-0.58	-0.53	-0.11	-0.01	0.04	0.29	0.40
N ₂ O	-0.02	-0.03	-0.02	-0.02	-0.02	0.00	0.01

1.A.4.c.ii. Agriculture/forestry/fishing, off-road vehicles and other machinery, diesel oil

	1990	2000	2005	2010	2015	2020	2023
CO ₂	0.00	0.00	0.00	0.00	1.14	26.95	-110.59
CH ₄	0.01	0.03	-0.01	-0.06	-0.07	0.01	0.02
N ₂ O	0.00	0.00	0.00	0.00	-0.20	-1.68	-3.38

1.A.4.c.ii. Agriculture/forestry/fishing, off-road vehicles and other machinery, LPG

	1990	2000	2005	2010	2015	2020	2023
CO ₂	26.47	25.78	21.49	18.02	13.17	9.35	7.13
CH ₄	0.40	0.42	0.36	0.32	0.24	0.18	0.14
N ₂ O	0.37	0.36	0.30	0.26	0.19	0.13	0.10

3.2.7.6 Category-specific planned improvements

No category-specific improvements for stationary combustion have been planned.

3.2.8 *Other (1.A.5)*

3.2.8.1 Category description

Source category 1.A.5 (Other) consists of emissions from military land forces, aviation and navigation (in 1.A.5.b); see Table 3.22. This sector has no key categories. Emissions have decreased since 1990.

Table 3.22 Overview of emissions in the category Other (1.A.5) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
		Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
1.A.5 Other	CO ₂	0.39	0.26	0.20	-48.3%	0.19%	0.17%	0.14%
	CH ₄	0.00	0.00	0.00	-53.2%	0.00%	0.00%	0.00%
	N ₂ O	0.01	0.00	0.00	-53.2%	0.00%	0.04%	0.00%
	All	0.39	0.27	0.20	-48.4%	0.19%		0.14%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

3.2.8.2 Methodological issues

Diesel sales for land equipment to Defence in the energy statistics are now allocated to Defence and no longer to NRMM (1.A.4.a.ii).

A country-specific top-down (Tier 2) method is used for calculating the emissions from fuel combustion from military land forces, aviation and navigation. Activity data for both land forces, aviation and navigation is derived from national energy statistics and comprises all fuel delivered for military purposes within the Netherlands, including fuel deliveries to militaries of other countries; the EFs for military aviation and navigation are presented in Table 3.23. The CO₂ EFs were derived from the Ministry of Defence, whereas the EFs for N₂O and CH₄ were derived from Hulskotte (2004). For diesel for military land equipment, the year-dependent CO₂, N₂O and CH₄ EFs of NRMM Commercial/institutional are used (Witt et al., 2026).

Table 3.23 Emission factors used for military marine and aviation activities.

Category		CO ₂	CH ₄	N ₂ O
Military ships	EF (g/GJ)	75.250	2.64	1.87
Military aviation	EF (g/GJ)	72.900	10.00	5.80
Total	Emissions in 2024 (kt)	200	0.01	0.01

Source: Hulskotte (2004)

3.2.8.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The uncertainty in total CO₂ emissions from this source category is approximately 5%. Uncertainties for CH₄ and N₂O emissions from this category are substantially higher: 78% for CH₄ and 115% for N₂O.

Time-series consistency

Emissions from energy combustion are calculated from the energy statistics combined with country-specific EFs. This method and the source of activity data and emission factor is the same for the complete time series.

3.2.8.4 Category-specific QA/QC and verification
The source category is covered by the general QA/QC procedures discussed in Chapter 1.

3.2.8.5 Category-specific recalculations
Diesel sales for land equipment to Defence in the energy statistics are now allocated to Defence (1.A.5.b) and were previously allocated to NRMM (1.A.4.a.ii) as mentioned in section 3.2.7.5.
This resulted in the following changes in emissions (in kt CO₂ eq):

1.A.5.b. Military use, liquid fuels

	1990	2000	2005	2010	2015	2020	2023
CO ₂	72.64	57.02	58.06	56.36	50.76	31.26	40.65
CH ₄	0.02	0.02	0.02	0.02	0.01	0.01	0.02
N ₂ O	0.32	0.26	0.29	0.32	0.29	0.16	0.20

3.2.8.6 Category-specific planned improvements
No category-specific improvements have been planned.

3.3 Fugitive emissions from fuels; oil and natural gas and other emissions from energy production (1.B)

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

- 1.B.1 Solid fuels (coke manufacture);
- 1.B.2 Oil and gas (production, gas processing, hydrogen plant, refineries, transmission, distribution).

The following categories are key categories:

1.B.2 Fugitive emissions from oil and gas operations CO₂ (L1,T1)
1.B.2.c Venting and flaring CH₄ (T)

Table 3.24 shows that total GHG emissions in 1.B decreased from 3.2 Mt CO₂ eq to 1.7 Mt CO₂ eq between 1990 and 2024.

Table 3.24 Overview of emissions in the Fugitive emissions from fuels sector (1.B) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
		Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
1.B Fugitive emissions from fuels	CO ₂	0.89	1.0	1.3	44.7%	1.2%	1.1%	0.89%
	CH ₄	2.3	0.49	0.43	-81.4%	0.40%	2.3%	0.30%
	All	3.2	1.5	1.7	-46.4%	1.6%		1.2%
1.B.1. Solid fuels transformation	CO ₂	0.11	0.07	0.07	-40.7%	0.06%	0.06%	0.05%
	CH ₄	0.01	0.00	0.00	-60.9%	0.00%	0.03%	0.00%
1.B.2. Oil and Natural Gas and Other Emissions from Energy Productions	CO ₂	0.77	0.97	1.2	56.8%	1.1%	1.0%	0.84%
	CH ₄	2.3	0.48	0.42	-81.5%	0.40%	2.3%	0.29%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

3.3.1 Solid fuels (1.B.1)

3.3.1.1 Category description

Both CO₂ and CH₄ emissions in this source category are only a small part of the national totals. Fugitive emissions from this category relate to coke manufacture and charcoal production.

- Coke manufacture: The Netherlands currently has only one coke production facility at the Tata Steel iron and steel plant. A second independent coke producer in Sluiskil discontinued its activities in 1999.
- Charcoal production: In the past, another emission source in this category was the production of charcoal. The decrease in CH₄ emissions throughout the time series is explained by changes in charcoal production. Until 2009, the Netherlands had one large charcoal production location that served most of the Netherlands, and also had a large market share in neighbouring countries. Production at this location stopped in 2010.

3.3.1.2 Methodological issues

Charcoal production

The following EFs have been used: 1990–1997: 0.03 kg CH₄/kg charcoal (IPCC 2006 Guidelines) and 1998–2010: 0.0000111 kg CH₄/kg charcoal (Reumermann and Frederiks, 2002). This sharp decrease in EF was applied because the operator changed from a traditional production system to the Twin Retort system (with reduced emissions). Further background information can be found in section 2.2.3.1 of the annex

'Methodology for the Calculation of Emissions to Air from the Sectors Energy, Industry and Waste' by Honig et al. (2026).

Coke production

To calculate emissions of CH₄ from coke production, the standard IPCC value of 0.1 g CH₄ /ton of coke produced is used.

CO₂ emissions relating to transformation losses from coke ovens form only a relatively small part of the total emissions from the iron and steel industry in the Netherlands. Emission totals for the iron and steel industry can be found in section 3.2.5. The figures for emissions from transformation losses were originally based on national energy statistics of coal inputs and of coke and coke oven gas produced, from which a carbon balance of the losses was calculated. Any non-captured gas was by definition included in the net carbon loss calculation used for the process emissions. Because of uncertainty in the large input and output volumes of the coke oven, the amount of fugitive emissions calculated by means of the mass balance method was unrealistically high.

Therefore, the method has been changed and the CO₂ EF for fugitives was based on company information, assuming 1% of coke oven input to be lost in the form of fugitive emissions for the entire time series. On the basis of detailed discussions during the 2017 annual inventory review cycle and taking into account the high level of uncertainty relating to the use of the mass balance approach, the assumption applied could be considered conservative and the remainder of the non-captured gas from the coke plant is assumed to be combusted in the coke ovens. The corresponding emissions were reported under subcategory 1.A.1.c.i.

For category 1.B.1, the production of coke oven coke registered by Statistics Netherlands is reported in the CRT. Detailed information on activity data and EFs can be found in the annex titled 'Methodology for the Calculation of Emissions to Air from the Sectors Energy, Industry and Waste' by Honig et al. (2026).

3.3.1.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The uncertainty in annual CO₂ emissions from coke production (included in 1.B.1.b) is estimated to be about 15%. This uncertainty relates to the conservative assumption of the carbon losses in the conversion from coking coal to coke and coke oven gas. The uncertainty in annual CH₄ emissions from coke production and charcoal production is estimated to be about 10%.

Time-series consistency

The methodology used to estimate emissions from solid fuel transformation is consistent throughout the time series.

3.3.1.4 Category-specific QA/QC and verification

These source categories are covered by the general QA/QC procedures discussed in Chapter 1.

3.3.1.5 Category-specific recalculations

No recalculations have been performed.

- 3.3.1.6 Category-specific planned improvements
No improvements have been planned.

3.3.2 *Oil and natural gas (1.B.2)*

3.3.2.1 Category description

Emissions from oil and natural gas comprise:

- emissions from oil and gas exploration, production, processing, flaring and venting (CO₂, CH₄, N₂O);
- emissions from oil and gas transmission (CO₂, CH₄, N₂O);
- emissions from gas distribution networks (pipelines for local transport) (CO₂, CH₄);
- emissions from oil refining (CH₄);
- emissions from hydrogen plants (CO₂).

Note that:

- Combustion emissions from oil and gas exploration and production are reported under 1.A.1.c.
- Fugitive emissions from gas and oil exploration and production are included in fugitive emissions from combined Venting and flaring (1.B.2.c).
- CO₂ and N₂O combustion emissions from gas transmission are included in 1.A.3.e.i (Pipeline transport – gaseous fuels). CO₂ process emissions and CH₄ emissions from gas transmission can be found in 1.B.2.b.iv (Gas transmission and storage).
- CO₂ and CH₄ emissions from oil pipelines are included in 1.B.2.a.iii (Oil transport). This is consistent with the 2006 IPCC Guidelines.
- Fugitive CO₂ emissions from refineries are included in the combustion emissions reported in category 1.A.1.b, as the fugitive emissions cannot be separated from the total of emissions reported under 1.A.1.b. Fugitive CH₄ emissions from refining can be found in 1.B.2.a.iv.
- Process emissions of CO₂ from a hydrogen plant of a refinery (about 0.9 Mt CO₂ per year) were reported in 1.B.2.a.iv. As refinery data specifying these fugitive CO₂ emissions has been available from 2002 onwards (environmental reports (AER) from the plant), these emissions have been re-allocated from 1.A.1.b to 1.B.2.a.iv.
- Due to the Dutch emission regulation for VOCs all possible sources included in 1.B.2.a.v Distribution of oil products are equipped with abatement measures to capture fugitive emissions. There are no emission factors of CH₄ and CO₂ for this category in the IPCC guidelines; therefore, these emissions are considered 'not applicable' (NA) and activity data are considered 'not estimated' (NE).
- No relevant emissions are expected in the Netherlands in categories 1.B.2.a.vi Other, 1.B.2.b.vi Other, and 1.B.2.d Other, which all have the notation key 'not occurring' (NO).

Gas production and gas transmission vary according to demand: in cold winters, more gas is produced. The gas distribution main lines network was gradually expanding as new housing estates were being built, but is now stabilised at around 125*10³ km. PVC and PE are mostly used as

materials for this expansion, replacing cast iron pipelines (see Honig et al., 2026, chapter 2.4).

The IEF for gas distribution has gradually decreased as the proportion of cast iron pipelines decreased due to their gradual replacement and the expansion of the network. Their present share of the total is less than 2%; in 1990, it was 10%. See the Methodological issues of Gas distribution in section 3.3.2.2.

Since the 1990s, CO₂ and CH₄ emissions from oil and gas production, particularly from flaring and venting, have been significantly reduced. This is due to the implementation of environmental measures to reduce venting and flaring, such as using formerly 'wasted' gas for energy production purposes.

3.3.2.2 Methodological issues

Oil and gas exploration, production, processing, flaring, and venting
Country-specific methods comparable to the IPCC Tier 3 method are used to estimate emissions of fugitive CH₄ and CO₂ from Oil and gas exploration, production and processing, and from venting and flaring (1.B.2). Each operator uses its own detailed installation data to calculate emissions and reports those emissions and fuel uses in aggregated form in its electronic AER (e-AER). Activity data are obtained from national energy statistics as a proxy and reported in the CRT tables. The data in the statistics can be adjusted retrospectively (changes in definitions/ allocation) and these changes will show up in the CRT tables.

Gas distribution

Since 2004, the gas distribution sector has annually recorded the number of leaks found per material of the pipelines, with detailed information on pipeline length per material. A roughly five-yearly survey of leakages per length, material, and pressure range is conducted, covering the entire length of the grid. Total CH₄ emissions in m³ are obtained from the Methane Emission from Gas Distribution (*Methaanemissie door Gasdistributie*) annual reports, commissioned by Netbeheer Nederland (Association of Energy Network Operators in the Netherlands) and compiled by KIWA (KIWA, 2023). In the KIWA annual reports, the CH₄ emissions in m³ are calculated using a bottom-up method that complies with the Tier 3 methodology described in the IPCC Guidelines, chapter 4. The IPCC Tier 3 method for calculating CH₄ emissions from gas distribution due to leakages (1.B.2.b.v) is based on country-specific EFs calculated from leakage measurements for the main lines emissions. On the basis of a total of 65 leakage measurements, the pipeline material mix in 2013, and the results of the leakage survey, three EFs were calculated: 323 m³ CH₄ per km of pipeline for grey cast iron, 51 m³ CH₄ per km of pipeline for other materials with a pressure of ≤200 mbar, and 75 m³ CH₄ per km of pipeline for other materials with a pressure of >200 mbar. From the NIR 2025 submission onwards, the emissions from 1.B.2.b.v. Gas distribution have been improved as a result of monitoring and improvement actions from the six Dutch gas distribution companies in the Oil and Gas Methane Partnership (OGMP). The method of estimating the methane emissions of the main lines is used by the individual companies, and ongoing investigations resulted in additional estimates of emissions from methane (e.g. systematic review of leaks of service

pipelines, third-party damage of main pipelines and third-party damage of service pipelines). To create new time series, the overlap splicing technique from the IPCC Guidelines was used. This technique can be found in Guidebook chapter 5, Times series consistency, section 5.3.3.1. Overlap data was made available for the 2018–2023 period and recalculation took place for the years 1990–2017. Details of methodologies, data sources and country-specific source allocation issues are provided in section 2.4 of the ENINA methodology report (Honig et al., 2026).

Oil and gas transmission

Emissions of CO₂ and CH₄ due to the transmission of natural gas (1.B.2.b.iv) are obtained from information of NV Nederlandse Gasunie. The emissions of CO₂ presented are considered to be combustion emissions; therefore, they are reported under IPCC category 1.A.3.e.i (gaseous). Additionally, to give a complete overview of emissions, the amount of fugitive CO₂ emissions from gas transmission is calculated using the Tier 1 method with the default IPCC EF of 8.8 E-7 kt10⁶ m³ of marketable Gas, adopted from the 2006 IPCC Guidelines, chapter 4, table 4.2.4. This figure has been applied to CRT category 1.B.2.b.iv for the entire time series.

For the NIR 2016, emissions of methane from gas transmission were evaluated and improved. As a result of the implementation of Gasunie's LDAR (Leak Detection and Repair) programme, new emissions data for CH₄ became available. Leakages at larger locations, such as the thirteen compressor stations, were all fully measured. In addition, fugitive emissions of methane from each of those locations were added to the emissions in the year after the facilities came into operation. The adjustments of the CH₄ emissions for the smaller locations were based on measurements of a sample from those locations and added to the complete time series. These improvements have been implemented in submissions for the entire time series from the NIR 2016 onwards.

The emissions of CO₂ and CH₄ from the transport of crude oil are calculated on the basis of the default TIER 1 IPCC emission factors (IPCC 2006, Table 4.2.4), which are converted from kg/m³ to kg/kt for the situation in the Netherlands. For the activity data, the volume of crude oil transported through the Netherlands to Germany and Belgium, as reported annually by Statistics Netherlands, is used.

Oil refining and hydrogen plant

Fugitive emissions of CH₄ from refineries in category 1.B.2.a.iv are based on a 4% share in total VOC emissions reported in the refinery AERs (Spakman et al., 2003); in recent years, they have been directly reported in these AERs. They show significant interannual fluctuations in CH₄ emissions, as the allocation of the emissions to either combustion or process has not been uniform over time. For further information, see Honig et al. (2026). Also, process emissions of CO₂ from the only hydrogen factory of a refinery in the Netherlands are reported in category 1.B.2.a.iv. As Dutch companies are not obliged to report activity data, the AERs only include emissions.

The energy input of refineries from national energy statistics is taken as a proxy for activity data for this category and is reported in the CRT tables. The data in the statistics can be adjusted retrospectively (changes in definitions/allocation), and these adjustments will show up in the latest version of the CRT tables.

Detailed information on activity data and EFs of Oil and natural gas (1.B.2) can be found in chapter 2.4 of the annex titled 'Methodology for the Calculation of Emissions to Air from the Sectors Energy, Industry and Waste'; Honig et al. (2026).

3.3.2.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The uncertainty for flaring is based on expert judgement, estimated to be 50% for the activity data, 5% for the CO₂ emission factor and 50% for the CH₄ emission factor. The uncertainty for venting is estimated to be 50% for the activity data and 20% for the CO₂ and CH₄ emission factors.

For flaring, this uncertainty takes into account the variability in the gas composition of the smaller gas fields. For venting, it accounts for the high CO₂ content of the natural gas produced at some locations.

For CH₄ from gas transport and gas distribution, the uncertainty in the emissions is estimated to be 40% and 50%, respectively. This uncertainty refers to the limited number of actual leakage measurements for various types of materials and pressures, on which the Tier 3 methodology for methane emissions from gas distribution is based.

For CH₄ from oil refining and oil transport, the uncertainty is estimated to be 100% for both sources.

Time-series consistency

A consistent methodology is used to calculate emissions throughout the time series, relying on, among others, national energy statistics.

3.3.2.4 Category-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

3.3.2.5 Category-specific recalculations

No recalculations have been performed.

3.3.2.6 Category-specific planned improvements

No improvements have been planned.

3.4 CO₂ transport and storage (1.C)

Emissions from CO₂ transport and storage are included in 1.A.1.a and 1.A.1.b. The notation key IE is used for this sector.

Transport of combustion off-gases (containing CO₂) occurs from energy production facilities to nearby greenhouses to increase the CO₂ content of the greenhouse atmosphere (as a growth enhancer). The emissions from this activity are accounted for in the combustion emissions from the energy producers (1.A.1.a and 1.A.1.b).

The capture of carbon in a product is taken into account in the CO₂ emissions from waste incineration plants (see section 3.2.4.2). In 2019, a methodology was developed to account for the carbon capture and usage of CO₂ (CCU) from waste incineration facilities. The methodology includes the various types of usage. In earlier years, the amount of carbon capture was insignificant and this amount is still low in 2024: less than 1 kt of CO₂ (fossil and biogenic) was captured and used in the production of bicarbonate. Further information is included in section 3.2.4.2. This is taken into account in the emission calculation of waste incineration plants (in 1.A.1.a).

4 Industrial processes and product use (CRT sector 2)

Major changes in the Industrial processes and product use (IPPU) sector compared to the National Inventory Report 2025

Emissions:	Total GHG emissions in the IPPU sector increased (from 13.2 Mt CO ₂ eq in 2023 to 13.5 Mt CO ₂ eq in 2024). This was the result of an increase, mostly in CO ₂ emissions (+0.3 Mt), within category 2.B (chemical industry).
Key categories:	2.A.2 Lime production CO ₂ is no longer a key category in the NIR 2026

4.1 Overview of the sector and background information

Emissions of GHGs in this sector include the following:

- all non-energy-related emissions from industrial activities (including construction);
- all emissions from the use of F-gases (HFCs, PFCs (incl. NF₃) and SF₆), including their use in other sectors;
- N₂O emissions originating from the use of N₂O in anaesthesia and as a propelling agent in aerosol cans (e.g. cans of cream).

Fugitive emissions of GHGs in the Energy sector (not relating to fuel combustion) are included in IPCC category 1.B (Fugitive emissions). Table 4.1 and Figure 4.1 present the trends in total GHG emissions from the IPPU sector.

In 2024, IPPU contributed 9.4% to total national GHG emissions (including LULUCF) compared to 11.5% in 1990. The sector is a major source of N₂O emissions, accounting for 7.7% of total national N₂O emissions in 2024, of which the major share (0.45 Mt CO₂ eq, or 6.8% of total N₂O emissions) came from category 2.B (Chemical industry).

Table 4.1 Overview of emissions in the Industrial production and product use sector, in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key				2024 vs 1990	Contribution by the category in 2024 (%) to the		
			1990	2023	2024				
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
2. Total Industrial Processes	CO ₂		12.0	11.3	11.6	-2.7%	85.9%	9.8%	8.1%
	CH ₄		0.37	0.42	0.39	5.5%	2.9%	2.1%	0.27%
	N ₂ O		6.5	0.47	0.51	-92.1%	3.8%	7.7%	0.35%
	HFC		4.7	0.90	0.85	-81.9%	6.3%	100.0%	0.59%
	PFC		2.4	0.04	0.03	-99.0%	0.19%	100.0%	0.02%
	SF ₆		0.21	0.11	0.13	-37.8%	0.98%	100.0%	0.09%
	All		26.1	13.2	13.5	-48.1%	100.0%		9.4%
2.A. Mineral industry	CO ₂		1.4	0.96	0.96	-32.1%	7.1%	0.81%	0.66%
2.B. Chemical industry	CO ₂		9.8	9.9	10.3	4.3%	75.7%	8.7%	7.1%
	CH ₄		0.31	0.36	0.34	8.8%	2.5%	1.9%	0.23%
	N ₂ O		6.3	0.42	0.45	-92.8%	3.3%	6.8%	0.31%
	HFC	T	4.7	0.08	0.05	-98.9%	0.40%	6.3%	0.04%
	PFC		NO	0.01	0.00		0.01%	3.2%	0.00%
	All		21.1	10.8	11.1	-47.5%	81.9%		7.7%
2.C. Metal Production	CO ₂		0.45	0.01	0.01	-98.8%	0.04%	0.00%	0.00%
	PFC		2.4	NO	NA,NO		0.00%	0.00%	0.00%
	All		2.8	0.01	0.01	-99.8%	0.04%		0.00%
2.D. Non-energy products from fuels and solvent use	CO ₂		0.19	0.38	0.39	104.4%	2.9%	0.33%	0.27%
	CH ₄		0.00	0.00	0.00	148.0%	0.00%	0.00%	0.00%
	All		0.19	0.38	0.39	104.4%	2.9%		0.27%
2.E. Integrated circuit or semiconductor	PFC	Non- key	0.02	0.04	0.02	6.8%	0.18%	96.8%	0.02%

Sector/category	Gas	Key				2024 vs 1990	Contribution by the category in 2024 (%) to the		
			1990	2023	2024				
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
2.F. Product uses as substitutes for ODS	HFC		IE,NO	0.82	0.80		5.9%	93.7%	0.55%
2.G. Other	CO ₂	Non- key	0.00	0.00	0.00	218.6%	0.00%	0.00%	0.00%
	CH ₄	Non- key	0.06	0.05	0.05	-12.8%	0.37%	0.28%	0.03%
	N ₂ O	Non- key	0.20	0.06	0.06	-70.3%	0.44%	0.90%	0.04%
	SF ₆	Non- key	0.21	0.11	0.13	-37.8%	0.98%	100.0%	0.09%
	All		0.47	0.21	0.24	-48.5%	1.8%		0.17%
2.H. Other process emissions	CO ₂	Non- key	0.07	0.03	0.03	-57.5%	0.23%	0.03%	0.02%
Indirect CO ₂ emissions	CO ₂	T	0.92	0.43	0.44	-52.1%	3.2%	0.37%	0.30%
National Total GHG emissions (incl. LULUCF)	CO ₂		166.7	119.8	118.5				
	CH ₄		36.5	18.6	18.3				
	N ₂ O		16.1	6.6	6.6				
	HFCs		4.7	0.90	0.85				
	PFCs		2.4	0.04	0.03				
	SF ₆		0.21	0.11	0.13				
	All		226.6	146.1	144.4				

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

Figure 4.1 Sector 2 Industrial processes and product use – trends and emissions levels of source categories, 1990–2024

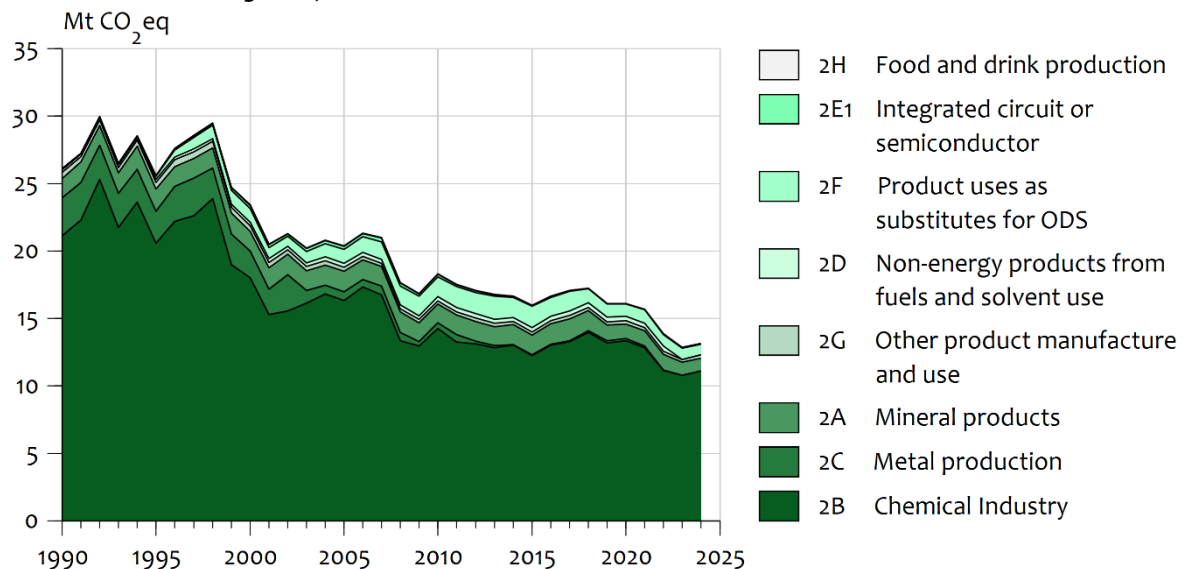


Figure 4.1 shows two major decreases in emissions in the Chemical industry (2.B):

- In 1999 a reduction in HFC-23 emissions from HCFC-22 production took place as a result of the installation of a thermal converter;
- In 2008 a sharp reduction in N₂O emissions took place as a result of applying catalytic reduction technologies in the production process of nitric acid. The installation of these technologies was one result of bringing this sector under EU-ETS regulation.

In the Netherlands, many industrial processes take place in one or two companies. In view of the sensitivity of data from these companies, only total emissions are reported, in accordance with the Aarhus Convention. Emissions at installation level and production data are treated as confidential unless a company has no objection to publication. All confidential information is, however, available for the inventory compilation, and the ENINA Task Force has direct access to it. ENINA can also provide this information to official review teams once they have signed a confidentiality agreement. In response to review recommendation (E.2, 2022) and in line with the IPCC 2006 Guidelines (volume 3, chapter 1, box 1.1 and volume 3, section 3.9.4.2), the emissions from combustion of waste gases occurring within the same source category are allocated to CRT 2. This includes chemical waste gas and phosphor oven gas emissions from the chemical industry (reported in CRT 2.B.10). The main categories (2.A–H) in the IPPU sector are discussed in the following sections.

4.2 Mineral products (2.A)

4.2.1 Category description

Table 4.2 presents the CO₂ emissions relating to the sub-sectors in category 2.A.

Table 4.2 Overview of the category Mineral Industry (2.A), in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
2.A. Mineral industry	CO ₂		1.4	0.96	0.96	-32.1%	6.8%	0.81%	0.66%
2.A.1. Cement production	CO ₂	T	0.42	NO	NO		0.00%	0.00%	0.00%
2.A.2. Lime production	CO ₂	Non-key	0.16	0.19	0.17	2.3%	1.2%	0.14%	0.12%
2.A.3. Glass production	CO ₂	Non-key	0.14	0.07	0.06	-59.8%	0.41%	0.05%	0.04%
2.A.4.a Ceramics	CO ₂	Non-key	0.14	0.10	0.08	-40.5%	0.60%	0.07%	0.06%
2.A.4.b Other uses of Soda Ash	CO ₂	Non-key	0.07	0.10	0.10	52.1%	0.75%	0.09%	0.07%
2.A.4.d Other	CO ₂	L,T	0.48	0.49	0.55	13.5%	3.9%	0.46%	0.38%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

Category 2.A comprises the following key categories:

2.A.1	Cement production	CO ₂ (T1)
2.A.4.d	Other	CO ₂ (L,T)

The following processes are included in 2.A.4.a: production of bricks, roof tiles, floor tiles, wall tiles, vitrified clay pipes and refractory products, and other ceramic products. Process-related CO₂ emissions from ceramics originate from the calcination of carbonates in the clay.

CO₂ emissions from other process uses of carbonates (2.A.4.d) originate from:

- limestone use for flue gas desulphurisation (FGD);
- limestone and dolomite use in iron and steel production;
- dolomite consumption (mostly used for road construction).

4.2.2 Methodological issues

For all source categories, the methodologies used to estimate emissions of CO₂ comply with the 2006 IPCC Guidelines, volume 3. More detailed descriptions of the methods and EFs used can be found in section 2.2.3.2 'Non-fossil process emissions' of the methodology report Honig et al. (2026).

2.A.1 (Cement clinker production)

Because of changes in raw material composition over time, it is not possible to reliably estimate CO₂ process emissions on the basis of clinker production activity data and a default EF. For that reason, the only cement producer in the Netherlands chose to base the calculation of CO₂ emissions on the carbonate content of the process input (Honig et al., 2025). Thus, process emissions data were obtained from the

company's AER until June 2020, when the company closed down. As no cement production has taken place since, NO has been reported from the emission year 2021 onwards.

2.A.2 (Lime production)

CO₂ emissions occur in two plants in the sugar industry, where limestone is used to produce lime for sugar juice purification. The third plant was closed in 2008. Limestone use depends on the level of beet sugar production. Until 2016, this activity data were obtained from the sugar company's annual reports. From 2017 onwards, one of the plants has not reported these data anymore; therefore, from that year onwards, the total beet sugar production was adopted from the sugar branch organisation's annual report. Approximately 375 kg of limestone is required for each ton of beet sugar produced (SPIN, 1992). The emissions are calculated using the IPCC default EF of 440 kg CO₂ per ton of limestone.

Lime production does not occur in the paper industry in the Netherlands.

2.A.3 (Glass production)

Until the 2015 submission, CO₂ emissions were based on plant-specific EFs and gross glass production; for the method, see Honig et al. (2026). From the 2015 submission onwards, the CO₂ figures have been based on the verified EU-ETS Emission Reports of the glass production companies.

2.A.4.a (Ceramics)

The calculation of CO₂ emissions from the manufacturing process of ceramic products in the Netherlands complies with the Tier 1 method as described in the 2006 IPCC Guidelines, volume 3, chapter 2, section 2.34.:

$$CO_2 \text{ emissions} = Mc \times (0.85EF_l + 0.15EF_d)$$

Where:

Mc = mass of carbonate consumed (tonnes);

0.85 = fraction of limestone;

0.15 = fraction of dolomite;

EF_l = EF limestone (0.440 ton CO₂/ton limestone);

EF_d = EF dolomite (0.477 ton CO₂/ton dolomite).

The mass of carbonate consumed (Mc) is determined as follows:

$$Mc = M_{clay} \times cc$$

Where:

M_{clay} = amount of clay consumed, calculated by multiplying the national production data for bricks and roof tiles, vitrified clay pipes, and refractory products by the default loss factor of 1.1 from the 2006 Guidelines. National production data are obtained from the ceramics trade organisation.

cc = default carbonate content of clay (0.1), adopted from the 2006 Guidelines.

2.A.4.b (Other uses of soda ash)

For 2001 and 2002, net domestic consumption of soda ash was estimated by taking the production capacity of 400 kt as a basis, then adding the import figures and deducting the export figures for the relevant year. For 1990–2000 and from 2003 onwards, these figures have been estimated by extrapolating from the 2001 and 2002 values. This extrapolation incorporates the trend in chemicals production as this is an important user of soda ash. Emissions are calculated using the standard IPCC EF of 415 kg CO₂ per ton of soda ash (Na₂CO₃) (2006 IPCC Guidelines, volume 3, chapter 2, table 2.1).

2.A.4.d (Other)

This category consists of three components. CO₂ emissions are based on:

- *consumption of limestone for flue gas desulphurisation (FGD) in the coal-fired power plants:* emissions data are obtained from ETS reports;
- *limestone and dolomite use in crude steel production:* The only Dutch crude steel producer (Tata Steel) annually reports these data, from which CO₂ emissions are calculated by using the IPCC emission factor (as described in Honig et al. (2026), section 2.2.3.2);
- *apparent dolomite consumption (mostly in road construction):* these emissions are calculated by means of the following formula: CO₂ emissions from dolomite use = (Total net dolomite use – Dolomite use in agriculture) * EF dolomite. Total net dolomite use is available until 2003 from Statistics Netherlands. It is assumed that the emissions by this category have remained constant since 2004.

4.2.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The uncertainty analysis outlined in Annex 2 and presented in Table A2.3 provides the estimates of uncertainties per IPCC source category. Uncertainty estimates used in the Tier 1 analysis are based on expert judgement as no detailed information is available on the emissions reported by the facilities (cement clinker production, limestone and dolomite use, and soda ash production).

For the emission categories under 2.A, uncertainties are in the range of 50–75%. This is mainly determined by the relatively high uncertainty in the emission factors, although for ceramics (2.A.4.a) and lime production (2.A.2), the activity data are also relatively uncertain: 50% and 75%, respectively.

The uncertainties of the IPCC default EFs used for some processes are not assessed. However, as these are minor sources of CO₂, this absence of data has not been given further consideration.

Time-series consistency

Consistent methodologies have been applied to all source categories. The time series involves a certain amount of extrapolation with respect to the activity data for soda ash use and emissions data for glass

production, thereby introducing further uncertainties in the earliest part of the time series for these sources.

4.2.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedure discussed in Chapter 1.

4.2.5 *Category-specific recalculations*

No category-specific recalculations have been performed.

4.2.6 *Category-specific planned improvements*

As asked by the TERT (I.5 in NIR 2024), for 2.A.4.d, the process emissions associated with mineral wool production will be included as per the 2006 IPCC Guidelines (volume 3, chapter 2, p. 2.27), as we did not succeed in implementing this recommendation in this submission. We plan to request the ETS report of this company this year.

4.3 **Chemical industry (2.B)**

4.3.1 *Category description*

The national inventory of the Netherlands includes emissions of GHGs from the following source categories reported in category 2.B (Chemical industry):

- *Ammonia production (2.B.1): CO₂ emissions:* natural gas is used as feedstock for ammonia production. CO₂ is a by-product of the chemical separation of hydrogen from natural gas. During the ammonia (NH₃) production process, hydrogen and nitrogen are combined and react together to form ammonia. N₂O emissions from ammonia production in the Netherlands are covered by the EU-ETS.
- *Nitric acid production (2.B.2): N₂O emissions:* The production of nitric acid (HNO₃) generates N₂O, a by-product of the high-temperature catalytic oxidation of ammonia. Two companies are responsible for the N₂O emissions from nitric acid production in the Netherlands.
- *Caprolactam production (2.B.4.a): N₂O emissions:* Caprolactam is produced in the Netherlands as part of the production cycle for nylon materials, and has been manufactured by one company since 1952. As a result, this emission source is responsible for all (100%) N₂O emissions by the caprolactam industry in the Netherlands. N₂O emissions from caprolactam production in the Netherlands are not covered by the EU-ETS.
- *Silicon carbide production (2.B.5.a): CH₄ emissions:* petrol cokes are used during the production of silicon carbide. The volatile compounds in the petrol coke form CH₄.
- *Titanium dioxide production (2.B.6): CO₂ emissions:* these arise from the oxidation of coke used as a reductant.
- *Soda ash production (2.B.7): CO₂ emissions:* these are related to the non-energy use of coke.
- *Petrochemical and carbon black production (2.B.8): emissions:* For each sub-category below, one plant is present in the Netherlands:
 - o methanol: CH₄ (2.B.8.a);
 - o ethylene: CH₄ (2.B.8.b);

- o ethylene oxide: CO₂ (2.B.8.d);
- o acrylonitrile: CO₂/CH₄/N₂O (Included in 2.B.10);
- o carbon black: CH₄ (2.B.8.f).
- *Fluorochemical production (2.B.9):*
- o *by-product emissions – production of HCFC-22 (2.B.9.a1): HFC-23 emissions:* Chlorodifluoromethane (HCFC-22) is produced at one plant in the Netherlands. Tri-fluoromethane (HFC-23) is generated as a by-product during the production of chlorodifluoromethane and emitted through the plant condenser vent;
- o *by-product emissions – other – handling activities (2.B.9.b3): emissions of HFCs:* one company repackages HFCs from large units (e.g. containers) into smaller units (e.g. cylinders) and trades in HFCs. Many companies import small units with HFCs and sell them in the trading areas.
- *Other (2.B.10): CO₂ emissions:*
 - o *Industrial gas production:* Hydrogen and carbon monoxide are mainly produced from the use of natural gas as a chemical feedstock. During the gas production process, CO₂ is emitted.
 - o *Carbon electrode production:* For the production of carbon electrodes, (petroleum) coke is used as a feedstock. During this process, CO₂ is emitted.
 - o *Activated carbon production:* the Netherlands is home to one of world's largest manufacturers of activated carbon, for which peat is used as a carbon source, and CO₂ is a by-product.
- *Other (2.B.10): CO₂, CH₄ and N₂O emissions:*
 - o Combustion emissions of waste gases (chemical waste gas and phosphor oven gas) occurring within the same category where the waste gases are produced (i.e. the category Chemical industry) have been reallocated from 1.A.2.c to 2.B.10 in response to review recommendation (E.2, 2022) and in line with the IPCC 2006 Guidelines (volume 3, chapter 1, box 1.1 and volume 3, section 3.9.4.2). The IPCC 2006 Guidelines state that '*Combustion emissions from fuels obtained directly or indirectly from the feedstock for an IPPU process will normally be allocated to the part of the source category in which the process occurs. These source categories are normally 2.B and 2.C.*'. Therefore, all combustion emissions from chemical waste gases that are produced and combusted within the category Chemical industry have been reallocated from 1.A.2.c to 2.B.10.
 - o acrylonitrile: CO₂/CH₄/N₂O

Remarks:

- Adipic acid (2.B.3), glyoxal (2.B.4.b), glyoxylic acid (2.B.4.c), and calcium carbide (2.B.5.b) are not produced in the Netherlands. As a result, the Netherlands does not report these emissions in the CRT under 2.B.
- Many processes relating to this source category take place in only one or two companies. Because of the company data confidentiality requirements, emissions from 2.B.5 and 2.B.6 are included in 2.B.8.g.

Overview of shares and trends in emissions

Table 4.3 provides an overview of the proportions of emissions from the main category Chemical industry (2.B). Emissions from this category contributed 9.3% of the total national GHG emissions (including LULUCF) in 1990 and 7.7% in 2024.

Table 4.3 Overview of the category Chemical industry (2.B), in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key				2024 vs 1990	Contribution by the category in 2024 (%) to the		
			1990	2023	2024		sector	total gas	total CO ₂ eq
			Emissions in Mt CO ₂ eq			%			
2.B. Chemical industry	CO ₂		9.8	9.9	10.3	4.3%	73.3%	8.7%	7.1%
	CH ₄		0.31	0.36	0.34	8.8%	2.4%	1.9%	0.23%
	N ₂ O		6.3	0.42	0.45	-	3.2%	6.8%	0.31%
	HFC	T	4.7	0.08	0.05	92.8%	0.39%	6.3%	0.04%
	PFC		NO	0.01	0.00	98.9%	0.01%	3.2%	0.00%
	All		21.1	10.8	11.1	-	79.4%		7.7%
2.B.1. Ammonia production	CO ₂	L,T	2.7	2.0	2.5	-8.7%	17.6%	2.1%	1.7%
2.B.2. Nitric acid production	N ₂ O	T	5.4	0.07	0.07	-	0.52%	1.1%	0.05%
2.B.4. Caprolactam production	N ₂ O	T	0.66	0.07	0.07	-	0.49%	1.0%	0.05%
2.B.7. Soda ash production	CO ₂	Non-key	0.06	NO	NO	89.6%	0.00%	0.00%	0.00%
2.B.8. Petrochemical and carbon black production	CO ₂	L,T	0.34	0.48	0.54	62.3%	3.9%	0.46%	0.38%
	CH ₄	L2,T2	0.30	0.35	0.33	8.5%	2.3%	1.8%	0.23%
2.B.9. Fluorochemical production	HFC	T	4.7	0.08	0.05	-	0.39%	6.3%	0.04%
	PFC		NO	0.01	0.00	98.9%	0.01%	3.2%	0.00%
2.B.10. Other chemical industry	CO ₂	L,T	6.7	7.5	7.3	7.6%	51.9%	6.1%	5.0%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

This category comprises the following key categories:

2.B Fluorochemical production

2.B.1 Ammonia production

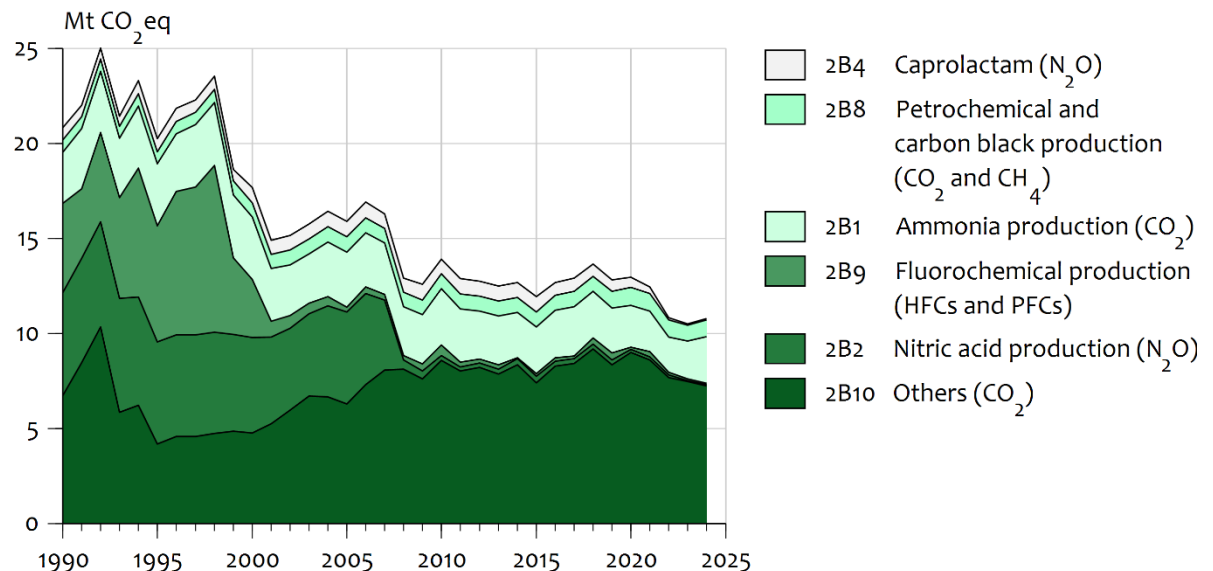
HFC (T)

CO₂ (L,T)

2.B.4 Caprolactam production	N ₂ O (T)
2.B.2 Nitric acid production	N ₂ O (T)
2.B.8 Petrochemical and carbon black production	CO ₂ (L,T)
2.B.8 Chemical industry: Petrochemical and carbon black production	CH ₄ (L2,T2)
2.B.10 Other	CO ₂ (L,T)
2.B.10 Other	N ₂ O (L2,T)

Figure 4.2 shows the trend in CO₂ equivalent emissions for category 2.B (Chemical industry) in the 1990–2024 period.

Figure 4.2 2.B Chemical industry – trend and emissions levels of source categories, 1990–2024



Mainly due to a reduction in HFC-23 emissions from HCFC-22 production (by implementation of a thermal convertor in 1998), total GHG emissions from 2.B (Chemical industry) decreased between 1990 and 2001. Between 2001 and 2007, total GHG emissions from 2.B remained stable. As Figure 4.2 (above) and Table 4.4 (below) show, the main decrease in N₂O emissions took place in 2008 as a result of a reduction measure relating to the production of nitric acid. From 2008 onwards, this process has been brought under EU-ETS. A major reduction was achieved by a change in the nitric acid production process. Since 2008, total GHG emissions from 2.B have remained relatively stable.

Table 4.4 Trend in N₂O emissions from Chemical industry (2.B) (kt CO₂ eq)

Year	2.B.2 Nitric acid production	2.B.4.a Caprolactam production	2.B.10.b Acrylonitrile production	Total
1990	5411	658	217	6286
1995	5367	691	239	6296
2000	5042	803	275	6120
2005	4837	816	311	5964
2010	257	752	347	1357
2015	329	802	299	1431
2020	178	534	376	1088
2021	180	367	356	902
2022	134	124	309	567
2023	68	66	278	414
2024	73	68	307	445

Nitric acid production (2.B.2)

Technical measures (optimising the platinum-based catalytic converter alloys), which were implemented at one of the nitric acid plants in 2001, resulted in an emissions reduction of 9% compared to 2000. Over the 2002–2006 period, the emissions fluctuations resulted from variations in production levels.

As mentioned above, technical measures (implemented at all nitric acid plants in the third quarter of 2007) resulted in an emission reduction of 23% compared to 2006. In 2008, the full effect of the measures was reflected in lower emissions; a reduction of 90% compared to 2006. The further reduction in 2009 was primarily caused by the economic crisis. Because of the closure of one of the plants and an improved catalytic effect in another, emissions decreased again in 2010. The reduction in 2011 resulted from an improved catalytic effect in two of the plants. After 2011, the fluctuations in N₂O emissions from the nitric acid plants were mainly due to operating conditions (such as unplanned stops) and to a lesser extent to variations in production levels.

In former NIRs (such as the 2020 NIR), all significant reduction measures for N₂O emissions from nitric acid production in 2007 and 2008 have been described, with details per plant.

Caprolactam production (2.B.4.a) and Acrylonitrile production (2.B.8.e)

As a result of government funding, a reduction measure was implemented in the caprolactam production plant in 2021, resulting in lower 2.B.4.a emissions. Furthermore, the fluctuations in emissions from these sources are mainly due to variations in production levels.

Fluorochemical production (2.B.9)

Table 4.5 presents the trends in HFC emissions from the categories HCFC-22 production and HFCs/PFCs from handling activities over the

1990–2024 period. Emissions of HFC-23 increased by approximately 35% in the 1995–1998 period due to increased production of HCFC-22. However, in the 1998–2000 period, emissions of HFC-23 decreased by 69% following the installation of a thermal converter (TC) at the plant. The removal efficiency of the TC (kg HFC-23 processed in TC/kg HFC-23 in untreated flow/year) is the primary factor, and the production level is the secondary factor influencing the variation in emissions levels between 2000 and 2008.

Due to the economic crisis, HCFC-22 production levels were much lower in the last quarter of 2008 and 2009, resulting in lower HFC-23 emissions. Following the economic recovery, the HCFC-22 production was much higher again in 2010, resulting in higher HFC-23 emissions. Since 2010, emission fluctuations have been mainly due to the fluctuations in the removal efficiency of the TC and to a lesser extent by the production levels. The significant emission fluctuations in sub-category 2.B.9.b.3 (Handling activities) over the 1992–2024 period can be explained by the large fluctuations in handling activities, which depend on customer demand.

Table 4.5 Trends in HFC-23 by-product emissions from the production of HCFC-22 and HFC emissions from handling activities (2.B.9.a and 2.B.9.b) (kt CO₂ eq)

Year	2.B.9.a: HFC-23	2.B.9.b: HFCs	Total
1990	4697.2	NO	4697.2
1995	6103.5	12.4	6115.8
2000	2565.6	469.5	3035.2
2005	207.8	44.4	252.2
2010	414.1	102.0	516.0
2015	98.7	28.7	127.4
2020	81.5	19.9	101.4
2021	215.7	28.8	244.6
2022	128.9	15.1	144.0
2023	58.5	23.2	81.8
2024	15.6	38.3	54.0

4.3.2 *Methodological issues*

For all chemical industry source categories, these are the methodologies used to estimate GHG emissions:

- 2.B.1 (Ammonia production): A method equivalent to IPCC Tier 3 is used to calculate CO₂ emissions from ammonia production in the Netherlands. The calculation is based on the consumption of natural gas and a country-specific EF. Data on the use of natural gas is obtained from Statistics Netherlands. Because there are only two ammonia producers in the Netherlands, the consumption of natural gas and the country-specific EF are confidential. Furthermore, according to the IPCC guidelines, CO₂ stored in urea is subtracted from the production emissions. Emissions occurring in the sectors or

categories where urea is applied (agriculture, car-SCR, melamine production), are allocated to those sectors or categories. The CO₂ stored in urea is calculated by using production figures. As the Netherlands is a net exporter of fertilisers, by far the largest amount of the stored CO₂ is exported and emitted elsewhere through application. (CO₂ emission from melamine production is allocated to CRF category 2.B.8.g.) The 2.B.1 emissions in the Netherlands are covered by the EU-ETS. For ETS, the CO₂-storage should *not* be subtracted from the production emissions.

- 2.B.2 (Nitric acid production): The emissions figures are based on data reported by the nitric acid manufacturing industry, that are included in the national Pollutant Release and Transfer Register (PRTR). In the years before these were available, an IPCC Tier 2 method was used to estimate N₂O emissions.
- 2.B.4.a (Caprolactam production): From 2015 onwards, N₂O emissions have been obtained from the company's AER.
- 2.B.5 (Carbide production): CH₄ emissions are obtained from the company's AER.
- 2.B.6 (Titanium dioxide production): CO₂ emissions are obtained from the company's AER.
- 2.B.7 (Soda ash production): the notation code 'NO' has been included in the CRT tables from 2010 onwards, as soda ash production has stopped. See Honig et al. (2026) for earlier years.
- 2.B.8 (Petrochemicals and carbon black production):
 - o 2.B.8.a: methanol production, CH₄;
 - o 2.B.8.b: ethylene production, CH₄;
 - o 2.B.8.f: carbon black, CH₄;
 - o 2.B.8.g: melamine production, CO₂;
 - o 2.B.8.d: (Ethylene oxide production): CO₂;The CO₂ and CH₄ process emissions from these minor sources are calculated by multiplying the IPCC default EFs by the annual production figures from the AERs or ETS reports (Tier 1). Exceptions are ethylene (oxide) production: CH₄ and CO₂ emissions are estimated on the basis of capacity data by using a default capacity utilisation rate of 86% (based on Neelis et al., 2005) and applying the default EF of 0.86 t/t ethylene oxide. From 2020 onwards, EU petrochemistry data has been used as a new source. As it is not possible to find current activity data for ethylene production in the Prodcom database from EUROSTAT, the Netherlands cannot supply activity data to verify this assumption.
From 2017 onwards, N₂O emissions from acrylonitrile production have been obtained from the company's AER.
For reasons of confidentiality all above-mentioned sources of 2.B.8, 2.B.5 and 2.B.6 are included in 2.B.8.g.
- 2.B.9.a.1 (production of HCFC-22): This source category is identified as a trend key source of HFC-23 emissions. Emission figures are obtained from the company's AER. This company determines the HFC-23 load in the untreated flow by a continuous flow meter in combination with an in-line analysis of the composition of the stream. The amount of HFC-23 destroyed in the Thermal Converter is registered.
- 2.B.9.b.3 (Handling activities: HFCs): Emission figures are obtained from the company's AER.

- 2.B.10 (Other), process emissions: Because no IPCC methodologies exist for these processes (and the 2019 Refinement-methodology for H₂ has not been implemented yet), country-specific methods and EFs are used. These refer to:
 - o 2.B.10.b: acrylonitrile production, CH₄, N₂O and CO₂;
 - o The production of industrial gases: With natural gas as input (chemical feedstock), industrial gases, such as H₂ and CO, are produced. Emissions data are available from the verified ETS emission reports.
 - o Production of carbon electrodes: CO₂ emissions are estimated on the basis of fuel use (mainly pet coke and coke). A small oxidation fraction (5%) is assumed, on the basis of data reported in the AERs.
- Production of activated carbon: From 2013 onwards, CO₂ emissions from activated carbon production in the Netherlands have been included in the EU-ETS. Therefore, as from the 2015 submission, the figures have been based on the verified EU-ETS Emission Reports of the activated carbon producer.
- 2.B.10 (Other), waste gas combustion: The combustion of waste gas is calculated according to the methods described in section 3.2.4.2. For chemical waste gas, company-specific EFs have been derived for a selection of (the largest) companies from 1995 onwards. For the remaining companies, the default EF is used. If data from any of the selected companies was missing, a company-specific EF for the missing company was used (derived in 1995). For the 1990–1994 period, a country-specific EF that is based on an average EF for four (large) companies was used. For phosphorus gas, company-specific EFs have been derived for the single company and have been used in the emissions inventory (since 2006). For the years prior to 2006, EFs from the Netherlands' list of fuels (Zijlema, 2026) are used. This fuel was only used until 2012, when the single company using this fuel ceased operation.

Activity data for estimating CO₂ emissions is based on data for the feedstock use of fuels provided by Statistics Netherlands.

4.3.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The uncertainty analysis outlined in Annex 2 (presented in Tables A2.1 and A2.2) provides estimates of uncertainties according to IPCC source categories.

The uncertainty in annual CO₂ emissions from ammonia production is estimated to be in the range of 30%. Uncertainties for other categories are much higher. For 2.B.8 Petrochemical and carbon black production (both for CO₂ and CH₄) and for category 2.B.10 Other, uncertainties are in the range of 70%; this is determined by uncertainties in both the activity data and emission factors (both in the range of 50%, estimated by expert judgement).

As N₂O emissions from HNO₃ production in the Netherlands are included in the EU-ETS, all companies continuously measure their N₂O emissions. This has resulted in a lower annual emissions uncertainty of approximately 5%.

The uncertainty in HFC-23 emissions from HCFC-22 production is estimated to be approximately 15%. For HFC emissions from handling activities, the uncertainty is estimated to be about 20%. These figures are all based on expert judgement.

Time-series consistency

Consistent methodologies are used throughout the time series for the sources in this category. A certain amount of extrapolation is involved with respect to emissions data for acrylonitrile production, thereby introducing further uncertainties for the 1995–2009 period.

4.3.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

From 2008 onwards, N₂O emissions from HNO₃ production in the Netherlands have been included in the EU-ETS. For this purpose, the companies developed monitoring plans approved by the NEa (Dutch Emissions Authority). In 2018, the companies' emissions reports (2017 emissions) were independently verified and submitted to the NEa, where they were compared to those reported in the CRT tables for the year 2017. No differences were found between the emissions figures in the CRT tables and those in the emissions reports under EU-ETS. As described in section 4.3.2, the availability of ETS reports improved the quality of the calculations. For emission year 2020, the ETS report and AER of the largest of the two HNO₃ producers in the Netherlands were compared. The reported emissions are exactly the same. However, emission figures for the other HNO₃ producer could not be compared because it is situated in the Chemelot industrial zone, and Chemelot only reported emissions from the total estate to the ETS, not from individual companies. Recently, this AER contained more detailed information, however, which may allow for the comparison to be made in a subsequent submission.

For the production of HCFC-22 (2.B.9.a.1), the operators' data in annual environmental reports (including confidential information) is verified on an annual basis by the competent authority.

4.3.5 *Category-specific recalculations*

Minor recalculations have been performed for 2.B.1 as a result of changed share of biogas, and for 2.B.10 as a result of an error in the emission calculation.

4.3.6 *Category-specific planned improvements*

- Applying the 2019 Refinement for hydrogen production is intended for the 2027 submission.
- A better method for calculation emissions from ethylene (oxide) production will be examined.

4.4 Metal production (2.C)

4.4.1 *Category description*

The national inventory of the Netherlands includes GHG emissions relating to two source categories belonging to 2.C (Metal production):

- *Iron and steel production (2.C.1): CO₂ emissions:* the Netherlands has one integrated iron and steel plant (Tata Steel, previously known as Corus and/or Hoogovens). The process emissions from anode use during steel production in the electric arc furnace are also included in this category.
- *Aluminium production (2.C.3): CO₂ and PFC emissions:* the Netherlands had two primary aluminium smelters, the last of which closed in 2022. Since then, no aluminium production has taken place in the Netherlands; therefore, NO is reported for 2.C.3 emissions. In the years before, emissions fluctuated due to aluminium plants closing down and re-opening.

The following sources of GHG emissions do not exist in the Netherlands:

- Ferroalloys production (2.C.2): the small ferroalloy trading companies in the Netherlands do not produce ferroalloys.;
- Magnesium production (2.C.4);
- Lead production (2.C.5);
- Zinc production via electro-thermic distillation or the pyrometallurgical process (2.C.6);
- Other metal production (2.C.7).

Overview of shares and trends in emissions

Table 4.6 provides an overview of emissions in CRT 2.C.

Table 4.6 Overview of the category Metal production (2.C), in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key	1990 2023 2024			2024 vs 1990	Contribution by the category in 2024 (%) to the		
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
2.C. Metal Production	CO ₂		0.45	0.01	0.01	-98.8%	0.04%	0.00%	0.00%
	PFC		2.4	NO	NA,NO		0.00%	0.00%	0.00%
	All		2.8	0.01	0.01	-99.8%	0.04%		0.00%
2.C.1. Iron and steel production 2.C.3. Aluminium production	CO ₂	Non- key	0.04	0.01	0.01	-87.2%	0.04%	0.00%	0.00%
	CO ₂	T1	0.41	0.00	0.00	-	0.00%	0.00%	0.00%
	PFC	T1	2.4	NO	NA,NO	100.0%	0.00%	0.00%	0.00%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

This category comprises the following key categories:

- 2.C.3 Aluminium production CO₂ (T1);
- 2.C.3 Aluminium production PFC (T1).

From 2003 onwards, the level of the PFC emissions from aluminium production (2.C.3) has decreased sharply because reduction measures (side feed to point feed) were taken (see Table 4.7). From then on, emissions have depended mainly on the number of anode effects and little on production level. PFC emissions have decreased further since 2011, and stopped in 2022 as a result of the closures of Zalco and Aldel.

4.4.2 *Methodological issues*

The methodologies used to estimate GHG emissions in all source categories of metal production comply with the 2006 IPCC Guidelines. More detailed descriptions of the methods and EFs used can be found in Honig et al. (2026: sections 2.1.3.3 and 2.2.3.2 (iron and steel production) and 2.2.3.7 (aluminium production)).

Iron and steel production (2.C.1)

As mentioned in section 3.2.5 (for sub-category 1.A.2.a), the calculation for this category is based on a carbon mass balance, which is not included in the NIR for reasons of confidentiality but can be made available for review purposes. Process emissions, for example from the conversion of pig iron to steel, are also obtained from the carbon mass balance.

Combustion emissions are reported under 1.A.1.c (Flaring), 1.A.2.a, 1.B.1.b (CH₄ coke production).

Aluminium production (2.C.3)

Up to emission year 2017, IPCC methods were used to estimate CO₂ and PFC emissions from the anodes used in the primary production of aluminium, with aluminium production serving as activity data. From emission year 2018 onwards (2020 submission), the CO₂ and PFC figures have been obtained from the company's ETS reports and AERs.

4.4.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The uncertainty analysis explained in Annex 2 provides estimates of uncertainties per IPCC source category. The uncertainty in annual CO₂ emissions is estimated at 5–6% both for iron and steel production and for aluminium production, whereas the uncertainty in PFC emissions from aluminium production is estimated to be in the range of 40%. The uncertainty in the activity data are estimated at 2% for aluminium production and 3% for iron and steel production. The uncertainty in the EFs for CO₂ (from all sources in this category) is estimated at 5%, and the EF for PFC from aluminium production at slightly over 40%.

Time-series consistency

A consistent methodology has been used throughout the time series.

4.4.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1. For the source category 2.C.1, in 2018 the activity and emissions data in the AERs was compared to the EU-ETS monitoring reports. No differences were found. The confidential production data for pellet and sinter production can be made available to the review team.

4.4.5 *Category-specific recalculations*

No category-specific recalculations have been performed.

4.4.6 *Category-specific planned improvements*

As a result of the 2021 review (question I.24), performing CH₄ process emissions calculations from sinter production is planned for future submissions. This has low priority because it is below the threshold of significance (it will add approximately 0.02 kt CH₄ to the national total).

4.5 **Non-energy products from fuels and solvent use (2.D)**

4.5.1 *Category description*

Table 4.7 presents an overview of the category Non-energy products from fuels and solvent use. The CO₂ emissions reported in categories 2.D.1 and 2.D.2 stem from the direct use of specific fuels for non-energy purposes, which results in partial or full oxidation during use (ODU) of the carbon contained in the products, such as candles. CO₂ emissions reported in category 2.D.3 stem from urea use in SCR in diesel vehicles.

Table 4.7 Overview of the category Non-energy products from fuels and solvent use (2.D), in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
2.D. Non-energy products from fuels and solvent use	CO ₂		0.19	0.38	0.39	104.4%	2.8%	0.33%	0.27%
	CH ₄		0.00	0.00	0.00	148.0%	0.00%	0.00%	0.00%
	All		0.19	0.38	0.39	104.4%	2.8%		0.27%
2.D.1. Lubricant use	CO ₂	Non- key	0.09	0.09	0.10	8.9%	0.68%	0.08%	0.07%
2.D.2. Paraffin wax use	CO ₂	L2,T	0.10	0.25	0.25	148.0%	1.8%	0.21%	0.18%
2.D.3. Other non- specified	CO ₂	Non- key	NO	0.04	0.04		0.28%	0.03%	0.03%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

Overview of shares and trends in emissions

The CO₂ and CH₄ emissions from 2.D.1 and 2.D.2 have increased but have remained a small source between 1990 and 2024. CO₂ emissions from urea use in diesel vehicles (2.D.3) increased from 0 to 39 kt between 2005 and 2024.

4.5.2 *Methodological issues*

The methodologies used to estimate GHG emissions in 2.D.1, 2.D.2, and 2.D.3 comply with the 2006 IPCC Guidelines, volume 3, as described in Honig et al. (2026), section 2.2.3.1.

A Tier 1 method is used to estimate emissions from lubricants and waxes using IPCC default EFs. For the use of lubricants and waxes, oxidised during use (ODU) factors of 20% and 100%, respectively, have been used (adopted from the IPCC 2006 Guidelines). CO₂ emissions from urea-based catalysts are estimated by means of a Tier 3 methodology, using country-specific CO₂ EFs for various vehicle types. More detailed descriptions of the method and EFs used can be found in Geilenkirchen et al. (2024).

The activity data are based on fuel use data from Statistics Netherlands.

4.5.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The uncertainty analysis outlined in Annex 2 and presented in Tables A2.1 and A2.2 provides estimates of the uncertainties per IPCC source category.

The uncertainty in the CO₂ EF is estimated at approximately 50% in the ODU factor for lubricants. The uncertainty in the activity data (such as domestic consumption of these fuel types) is generally large as it is based on production, as well as on import and export figures. It is also estimated at 50%, resulting in an overall uncertainty of approximately 70% for category 2.D.1 Lubricant use.

Uncertainties in categories 2.D.2 (Paraffin wax use) and 2.D.3 (Non-energy products from fuels and solvent use) are high; mostly determined by uncertainties in the activity data (100%). Overall Approach 1 uncertainties for these categories are estimated at over 100%.

Time-series consistency.

Consistent methodologies and activity data have been used to estimate emissions throughout the time series.

4.5.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

4.5.5 *Category-specific recalculations*

- For category 2.D.1 (Lubricant use), emissions have been recalculated for the entire time series. This results from an reallocation: emissions from lubricant use of motorcycles were previously allocated to 1.A.3.b.iv., but are now allocated to 2.D.1. Lubricant use, as is also the case for other vehicle types.

- For category 2.D.3.d (Ureum use in SCR), in the years 2018–2023, recalculations were performed as a result of the addition of new vehicle types.

4.5.6 *Category-specific planned improvements*

No improvements have been planned.

4.6 **Electronics industry (2.E)**

4.6.1 *Category description*

PFCs (incl. NF₃) and SF₆ are both used and emitted in Semiconductor manufacture. PFC emissions are reported in 2.E.1, SF₆ emissions are included in 2G2. PFC and SF₆ emissions from thin-film transistor (TFT) flat panel displays (2.E.2), Photovoltaics (2.E.3), Heat transfer fluid (2.E.4) manufacturing, and Other sources (2.E.5) do not occur in the Netherlands; therefore, they are not identified in the inventory.

Overview of shares and trends in emissions

The contribution made by PFC emissions from category 2.E to the total national PFC emissions was 0.95% in 1990 and 96.8% in 2024. The latter figure corresponds to 0.02 Mt CO₂ eq and accounts for 0.02% of national total GHG emissions in 2024 (Table 4.8).

Table 4.8 Overview of the sub-category Integrated circuit or semiconductor (2.E.1) in the base year and the last two years of the inventory (in kt CO₂ eq)

Sector/category	Gas	Key				2024 vs 1990	Contribution by the category in 2024 (%) to the		
			1990	2023	2024		sector	total gas	total CO ₂ eq
			Emissions in kt CO ₂ eq			%			
2.E.1. Integrated circuit or semiconductor	PFC	Non- key	22.7	36.6	24.3	6.8%	0.17%	96.8%	0.02%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

This category comprises no key categories.

4.6.2 *Methodological issues*

The methodology used to estimate PFC emissions from semiconductor manufacture complies with the 2006 IPCC Guidelines, as described in Honig et al. (2026), section 2.2.3.8.

Activity data on the use of PFCs in semiconductor manufacture was obtained from the only manufacturing company (confidential information); EFs are also confidential. Detailed information on the activity data and EFs can be found in the methodology report (Honig et al., 2026).

4.6.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The uncertainty analysis outlined in Annex 2 provides estimates of the uncertainties per IPCC source category. The uncertainty of PFC (incl. NF₃) emissions is estimated at about 25%. The uncertainty in the activity data for the PFC (incl. NF₃) sources is estimated at 5%; for the EFs, the uncertainty is estimated at 25%. All these figures are based on expert judgement.

Time-series consistency

Consistent methodologies have been used to estimate emissions from these sources throughout the time series.

4.6.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

4.6.5 *Category-specific recalculations*

No category-specific recalculations have been performed.

4.6.6 *Category-specific planned improvements*

No improvements have been planned.

4.7 **Product use as substitutes for ODS (2.F)**

4.7.1 *Category description*

The national inventory comprises the following sub-categories within this category:

- stationary refrigeration (2.F.1): HFC emissions;
- mobile air-conditioning (2.F.1): HFC emissions;
- foam-blowing agents (2.F.2): HFC emissions (included in 2.F.6);
- fire protection (2.F.3): HFC emissions (included in 2.F.6);
- aerosols (2.F.4): HFC emissions (included in 2.F.6);
- solvents (2.F.5): HFC emissions (included in 2.F.6);
- other applications (2.F.6): HFC emissions from 2.F.2, 2.F.3, 2.F.4 and 2.F.5 are allocated to 2.F.6.

In the Netherlands, many processes relating to the use of HFCs take place in only one or two companies. For data sensitivity reasons, only the sum of the HFC emissions from 2.F.2–2.F.5 is reported (included in 2.F.6).

There are no emissions from 2.F.1.b (Domestic refrigeration) in the Netherlands because no HFCs are used for domestic refrigeration. In the 1990s, CFCs were replaced by propane.

Overview of shares and trends in emissions

Due to increased HFC consumption as a substitute for (H)CFC use, the contribution made by HFC emissions from category 2.F to national total HFC emissions was 0% in 1990 and 93.7% in 2024. This corresponds with 0.80 Mt CO₂ eq and accounts for 0.6% of national total GHG emissions in 2024 (see Table 4.9).

Table 4.9 Overview of the category Product uses as substitutes for ODS (2.F) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
2.F. Product uses as substitutes for ODS	HFC		IE,NO	0.82	0.80		5.7%	93.7%	0.55%
2.F.1. Stationary refrigeration and Mobile air- conditioning	HFC	L,T	NO	0.70	0.69		4.9%	80.6%	0.48%
2.F.6. Other	HFC	T	NO	0.12	0.11		0.8%	13.1%	0.08%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

This category comprises two key categories:

- 2.F.1 Refrigeration and mobile air-conditioning HFC (L,T);
- 2.F.6 Other HFC (T)

From the 2019 submission onwards, the calculation method (via a stock model) for Stationary refrigeration (2.F.1) has been replaced (see Honig et al., 2025). The new method has used the Refrigerants Registration System to estimate emissions from 2013 onwards. This system is the result of a European mandatory requirement, obliging building owners to register refrigerants.

Emissions for 2.F.1 have been calculated up to 2022. This is the most recent year for which emissions data are available due to delayed reporting. Due to the phasing-out of refrigerants with a high GWP, emissions decreased from 1.028 Mt in 2015 to 0.453 Mt in 2022 (see Table 4.10). In 2017, emissions increased slightly, then decreased rapidly in 2018. This is the result of the phasing-out of some more high-GWP refrigerants. In 2021 there was also a slight increase (an error in the previous submission was corrected here). Emissions data for 2023 and 2024 remained equal to 2022.

With the new method, emission figures are available for:

- 4 industrial sectors: Commercial, Industrial, Stationary air cons and Transport refrigeration;
- 4 emission sources: leakage, filling, dismantling and refrigerant management;
- 5 HFCs: HFC-125, HFC-134a, HFC-143a, HFC-23, and HFC-32. Refrigerants are blends of these HFCs. The registration system contains about twenty refrigerants (see Honig et al. (2026), section 2.2.3.9.2, 'Composition of refrigerants'), and each of those refrigerants is a blend of the five HFCs mentioned above. For example: R452A contains 59% HFC-125 and 11% HFC-32. R134A only consists of 100% HFC-134a.

It appears that leakage emissions are the major emissions source from stationary refrigeration. Emissions from refrigerant management, filling, and dismantling are almost negligible.

Table 4.10 Emissions trends per sub-category from the use of HFCs as substitutes for ODS (kt CO₂ eq)

Year	2.F.1 Stationary refrigeration HFCs	2.F.1 Mobile air- conditioning: HFC134a	2.F.6 Other applications: HFCs	HFCs Total
1990	NO	NO	NO	IE, NO
1995	35.8	7.8	183.3	226.9
2000	255.8	111.3	626.7	993.8
2005	602.4	285.6	141.0	1029.0
2010	898.8	371.8	191.3	1461.9
2015	1028.9	386.3	167.4	1582.6
2020	481.3	308.4	120.4	910.1
2022	435.7	282.4	131.6	849.7
2023	435.7	264.3	120.2	820.2
2024	435.7	250.9	111.7	798.3

4.7.2 *Methodological issues*

The methodology used to estimate emissions in category 2.F complies with the 2006 IPCC Guidelines, volume 3, IPCC Tier 2 methods and is described in Honig et al. (2026), sections 2.2.3.9–2.2.3.11.

The activity data used to estimate emissions of F-gases is derived from the following sources:

- Stationary refrigeration (2.F.1): until emission year 2012, HFCs consumption data were obtained from the annual reports by PricewaterhouseCoopers (PWC). From 2013 onwards, the Refrigerants Registration System has been used to estimate emissions.
- For mobile air-conditioning (2.F.1), the number of cars (by year of construction) and the number of scrapped cars (by year of construction) were obtained from Statistics Netherlands. The amounts of recycled and destroyed refrigerants were obtained from ARN, a waste-processing facility (personal communication).
- Other applications (2.F.6): HFC emissions from 2.F.2, 2.F.3, 2.F.4, and 2.F.5: Until the 2016 submission, consumption data on HFCs was obtained from annual reports by PricewaterhouseCoopers. From 2015 onwards, no consumption data on HFCs has been made available. Therefore, until the 2021 submission, emissions from these sources were kept equal to the 2014 emissions. From the 2022 submission onwards, a temporary estimation method has been developed, and from the 2025 submission onwards, a new calculation method has been developed. For foam blowing, data are used from the European F-gas portal on the production, import, export and destruction of

fluorinated greenhouse gases at the EU level, as summarised annually in dedicated reports by the EEA. For aerosols, detailed data about use of metered dose inhalers is available. Those methods are described in Honig et al. (2026).

Stationary air conditioning (2.F.1)

From the 2019 submission onwards, figures have been used from the Refrigerants Registration System, which includes information on leakage and the filling of (new) installations and dismantling.

Data collection within the Refrigerants Registration System takes place as follows:

- o Data at plant level (amounts of leakages, filling of (new) installations and dismantling) is registered continuously by mechanics at the installation companies.
- o The figures are checked by the inspection authorities every other year.
- o Following approval, the figures are aggregated and delivered to the NL-PRTR.
- o The NL-PRTR calculates the emissions.

Due to the complexity of the system, there is a time-lag for making data available. This means that, in this submission, definitive figures are provided up to and including 2022. The 2023 and 2024 figures are kept equal to the last year for which figures are available (2022).

In the 2027 submission, the 2023 figures from the current submission will be replaced by the definitive figures for 2023.

As a result of (EU) review comments, IPCC extrapolation methods (Trend Extrapolation or Surrogate Data) were investigated to prevent over- or underestimation in the last two years. However, Trend Extrapolation is not recommended if the trend is fluctuating. This applies here because the mix of high and lower GWP refrigerants has been random throughout the years and no trend can be detected. Moreover, the Surrogate Data technique is inappropriate as no data can be found that has any correlation with the random-like use of refrigerants with different GWPs. So, to conclude, an extrapolation cannot be performed and therefore, the emissions from the last two years are kept at the same level. However, over the past few years, a decreasing trend seems to appear. If this continues over the next few years, a Trend Extrapolation method will be considered again.

EFs used to estimate emissions of F-gases in this category are based on the following: Stationary refrigeration: Until the 2016 submission, annual leak rates from surveys (Baedts et al., 2001) were used. Since the figures from the Refrigerants Registration System are used, implied emission factors can be derived.

- Mobile air-conditioning: Annual leak rates from surveys (Baedts et al., 2001) and other literature (Minnesota Pollution Control Agency, 2009; YU & CLODIC, 2008).

Other applications (2.F.6)

A new calculation method was developed for foam-blowing agents and aerosols. From this submission onwards, this method will also be applied to fire protection and solvents.

- *Foam-blowing agents, fire protection and solvents*: the European Environment Agency (EEA) publishes annual reports with summaries of the EU F gas portal. The EU-figures for foam blowing agents were scaled to the Netherlands by using the number of inhabitants as a proxy.
- *Aerosols*: emissions were calculated by combining detailed data that was obtained on the number of metered dose inhalers used in the Netherlands with its content.

It appeared that the application of the new method resulted in 2.F.6 emissions levels comparable to the previous method, so it may be concluded that the estimation was adequate. More detailed descriptions of the methods and EFs used can be found in the methodology report (Honig et al., 2026), as indicated in section 4.1.

4.7.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The uncertainty analysis outlined in Annex 2 provides estimates of uncertainties per IPCC source category. On the basis of expert judgement, the uncertainty in HFC emissions from HFC consumption is estimated at approximately 40–50%, mostly determined by uncertainties in activity data.

Time-series consistency

Consistent methodologies have been used to estimate emissions from Mobile air-conditioning (2.F.1) and Other applications (2.F.6).

For Stationary refrigeration (2.F.1), two methods were used to estimate emissions, as described above. The stock model method was used for the 1990–2012 period, and the Refrigerants Registration System method has been used from 2013 onwards.

For the stock model method, activity data were derived from the sales figures of individual HFCs to the total cooling sector in the Netherlands. These were available annually via a trade flow study until the 2016 submission (reporting year 2014) after which this study stopped. Subsequently, a new method was developed, as applied from the 2019 submission onwards (emission years 2013 and later). Figures from the Refrigerants Registration System that contains data from 2013 onwards are used as the input for this method. In this system, data about leakages, filling of new installations, dismantling, et cetera is collected from the commercial, industrial, and transport refrigeration and stationary air-conditioning sectors. Data on leakages, filling of (new) installations, dismantling, et cetera is not calculated but obtained directly from the system. This new method provides more accurate data than the stock model method. All equipment with a content >3 kg is covered by the Refrigerants Registration System. This is the best source available in the Netherlands. In addition, the emissions calculated by means of the new method are lower than those from the old stock model method, probably due to the assumption that usage figures were the same as the sales figures, and to the fact that a fixed leakage percentage of 5.8% was used; in the new method the average leakage rate for 2013–2017 was approximately 4%.

In the 2021 submission, the Overlap splicing technique from the IPCC Guidelines was used to create a consistent time series, thereby recalculating the 1990–2012 series. The formula used is described in the IPCC Guidelines chapter 5 (Time-series consistency), section 5.3.3.1. The overlap period used is 2013–2015.

As described in section 4.7.2, no trend extrapolation for 2023 and 2024 has been applied; emissions have been kept equal to the 2022 emissions.

4.7.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1. From the implementation of the new method, the refrigerant use data has been available at a high level of reliability.

4.7.5 *Category-specific recalculations*

- As described in section 4.7.2, there is a time-lag for making data available. In this submission, the 2022 figure of 2.F.1 (HFCs from stationary refrigeration) was replaced by the new calculated value. The 2023 and 2024 emissions are kept equal to the 2022 emission
- In the 2021 value, a calculation error was corrected as well. This error was due to format mismatches in the extraction from the underlying data excel sheets and to the main calculation sheet. The total effect of the correction and the recalculation mentioned in the previous bullet is an increase by 379 kt CO₂ eq (+194%) for 2.F.1 in 2021.
- The new calculation method for 2.F.6 emissions that was implemented in the 2025 submission, is now also applied for degreasing and fire extinguishers (see section 4.7.2) for the emission years 2015–2024. This results in the following changes in emissions of unspecified HFCs in 2.F.6:

	2015	2020	2021	2022	2023
kt CO ₂ eq	+2	-15	-24	-26	-26

4.7.6 *Category-specific planned improvements*

For the next submission, it will be examined whether it is possible to split up emissions to 2.F.2–2.F.5 instead of including them in 2.F.6.

4.8 **Other product manufacture and use (2.G)**

4.8.1 *Category description*

This source category comprises emissions relating to Other product manufacture and use (2.G) in:

- Electrical equipment (2.G.1): SF₆ emissions (included in 2.G.2).
- Other (2.G.2): SF₆ emissions from sound-proof windows, electron microscopes, and the electronics industry.
- N₂O from product uses (2.G.3): N₂O emissions from the use of anaesthesia and aerosol cans.
- Other industrial processes (2.G.4):
 - o Fireworks: CO₂, CH₄, and N₂O emissions.
 - o Degassing of drinking water: CH₄ emissions.

Table 4.11 presents 2.G emissions in the base year, as well as in the last two years of the inventory.

Table 4.11 Overview of the category Other product manufacture and use (2.G) in the base year and the last two years of the inventory (in kt CO₂ eq)

Sector/category	Gas	Key	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
			Emissions in kt CO ₂ eq			%	sector	total gas	total CO ₂ eq
2.G. Other product manufacture and use	CO ₂	Non- key	0.19	0.61	0.59	218.6%	0.00%	0.00%	0.00%
	CH ₄	Non- key	57.9	50.5	50.4	-12.8%	0.36%	0.28%	0.03%
	N ₂ O	Non- key	200.0	56.1	59.3	-70.3%	0.42%	0.90%	0.04%
	SF ₆		213.1	105.3	132.4	-37.8%	0.95%	100.0%	0.09%
	All		471.1	212.5	242.8	-48.5%	1.7%		0.08%
2.G.2. SF ₆ and PFCs from other product use	SF ₆	Non- key	213.1	105.3	132.4	-37.8%	0.95%	100.0%	0.09%
2.G.3. N ₂ O from product uses	N ₂ O		197.2	48.5	52.0	-73.6%	0.37%	0.79%	0.04%
2.G.4. Other	CO ₂					218.6%	0.00%	0.00%	0.00%
			0.19	0.61	0.59				
	CH ₄		57.9	50.5	50.4	-12.8%	0.36%	0.28%	0.03%
	N ₂ O		2.9	7.6	7.3	153.6%	0.05%	0.11%	0.01%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

This source category comprises no key categories.

In the Netherlands, many processes relating to the use of SF₆ only take place in one or two companies. Because of the sensitivity of data from these companies, only the sum of the SF₆ emissions in 2.G.1 and 2.G.2 is reported (both included in 2.G.2).

Overview of shares and trends in emissions

The decrease in SF₆ emissions, as shown in table 4.11, was mainly due to:

- the closure of the only manufacturer of high-voltage installations at the end of 2002;
- the use of leak detection equipment in Electrical equipment (2.G.1).

N₂O emissions from 2.G.3 decreased by 73.6% in the 1990–2024 period. N₂O emissions from anaesthesia decreased due to better dosing in hospitals and other medical institutions.

Domestic sales of cream in aerosol cans increased sharply between 1990 and 2023. For this reason, emissions of N₂O from food aerosol cans also increased sharply.

CH₄ and N₂O emissions from fireworks peaked in 2000 because of the millennium celebrations.

4.8.2 *Methodological issues*

The source category Electrical equipment (2.G.1) comprises SF₆ emissions by users of high-voltage circuit breakers and by the only international test laboratory for power switches. Figures for emissions from circuit breakers were obtained from the annual inventory by the company DNV. The methodologies used in earlier years are described in Honig et al. (2026), see sections 2.2.3.12 and 2.2.3.13.

The country-specific methods used for the sources of semiconductor manufacture, sound-proof windows, and electron microscopes are in line with IPCC Tier 2 methods.

Figures for the use of SF₆ in semiconductor manufacture, and electron microscopes were obtained from individual companies (confidential information). Emissions from disposed sound-proof windows are modelled.

EFs used to estimate the emissions of SF₆ in this category are based on the following:

- semiconductor manufacture: confidential information from the only company;
- sound-proof windows: the EF used for production is 33% (IPCC default); the EF (leak rate) used during the lifetime of the windows is 2% per year (IPCC default);
- electron microscopes: confidential information from one company.

Country-specific methodologies are used for the N₂O sources in 2.G.3. A full description of the methodology is provided by Visschedijk et al. (2026). The methodologies used to estimate the emissions from 2.G.3 are:

- *anaesthesia*: The major hospital supplier of N₂O for anaesthetic use reports the consumption data for anaesthetic gas in the Netherlands annually. The EF used for N₂O in anaesthesia is 1 kg/kg gas used. It is assumed that the sales of N₂O for anaesthesia is equal to the consumption;

- *aerosol cans*: The national aerosol organisation (NAV) reports data on the annual sales of N₂O-containing spray cans. The EF for N₂O from aerosol cans is estimated to be 7.6 g/can (on the basis of data provided by one producer) and is assumed to be constant over time.

The methodologies used to estimate emissions from 2.G.4 are:

- fireworks: Country-specific methods and EFs are used to estimate emissions of CO₂, CH₄ and N₂O.
- degassing of drinking water: A country-specific methodology and EF are used to estimate CH₄ emissions, this being the main source of CH₄ emissions in this category.

The activity data used in 2.G.4 is derived from the following sources:

- fireworks: data on annual sales from the trade organisation;
- production of drinking water: volume and fuel use from Statistics Netherlands;
- cigarettes and cigars: volume from excise duty statistics and the trade organisation.

The EFs used in 2.G.4 are based on the following:

- Fireworks: CO₂: 43.25 kg/t; CH₄: 0.825 kg/t; N₂O: 1.935 kg/t (Visschedijk et al., 2024).
- Production of drinking water: 2.47 tons CH₄/10⁶ m³ (Visschedijk et al., 2024).
- Smoking cigarettes and cigars: CO₂: 294 kg/t; CH₄: 1.625 kg/t; N₂O: 0.065 kg/t (Visschedijk et al., 2024).

4.8.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The uncertainty analysis outlined in Annex 2 provides estimates of the uncertainties by IPCC source category. The uncertainty in SF₆ emissions from 2.G.2 (SF₆ use) is estimated to be 34% (IPCC Tier 3a method). For the activity data and the EFs, the uncertainty is estimated at approximately 30% and 15%, respectively.

Uncertainties for the other source categories under 2.G range from 15% (N₂O emissions from Other product manufacture and use) to over 50% (CO₂ and CH₄).

Time-series consistency

Consistent methodologies have been applied to all source categories. The quality of the N₂O activity data needed was not uniform for the complete time series, requiring some extrapolation from the data. This is not expected to significantly compromise the accuracy of the estimates, which is still expected to be sufficient.

4.8.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

4.8.5 *Category-specific recalculations*

For 2.G.4, the activity data of cigarettes has been recalculated. Previously, the activity data were based on tax statistics for cigarettes,

but because of relatively high taxes on cigarettes in the Netherlands, lots of cigarettes are bought in Germany or other countries. Estimates of these foreign and/or illegal cigarettes were made on the basis of annual surveys on the origin of the cigarettes for the years 2015-2025. For the years prior to 2015, the amount of foreign or illegal cigarettes was assumed to be equal to the average of 2015-2025.

The recalculation of the activity data resulted in an increase in CH₄ emissions (+3635 kg CH₄ in 1990 and +3721 kg CH₄ in 2023), and N₂O emissions (+146 kg N₂O in 1990 and +149 kg N₂O in 2023).

4.8.6 *Category-specific planned improvements*

The producer of electron microscopes reports zero emission, it will be checked for the next submission whether this is still correct. Also, the emissions from particle accelerators will be investigated.'

4.9 **Other (2.H)**

4.9.1 *Category description*

This category comprises CO₂ emissions from Food and drink production (2.H.2). In the Netherlands, this concerns the calcination process in the sugar industry, as described in section 4.2.2 under Lime production (2.A.2). CO₂ process emissions in this source category do not only occur from lime production, but are also related to the non-energy use of fuels: coke and anthracite. Carbon is oxidised during these processes, resulting in CO₂ emissions. CO₂ process emissions in the Paper industry (2.H.1) do not occur in the Netherlands.

Overview of shares and trends in emissions

Emissions in 2024 decreased by 57.5% compared to the emissions in 1990 (see Table 4.12).

Table 4.12 Overview of the category Other process emissions (2.H) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key				2024 vs 1990	Contribution by the category in 2024 (%) to the		
			1990	2023	2024	%	sector	total gas	total CO ₂ eq
			Emissions in Mt CO ₂ eq						
2.H. Other process emissions	CO ₂	Non- key	0.07	0.03	0.03	- 57.5%	0.22%	0.03%	0.02%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

This category comprises no key categories.

4.9.2 *Methodological issues*

The methodology used to estimate the GHG emissions complies with the 2006 IPCC Guidelines, volume 3, as described in Honig et al. (2026), section 2.2.3.1.

CO₂ emissions are calculated on the basis of the non-energy use of fuels by the food and drink industry recorded by Statistics Netherlands in national energy statistics on coke consumption, multiplied by an EF. The

EF is based on the national default carbon content of the fuels (see Annex 5), assuming that the carbon is fully oxidised to CO₂.

4.9.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The uncertainty analysis outlined in Annex 2 provides estimates of the uncertainties per IPCC source category. The uncertainty in the emissions from this category is estimated to be around 5% (2% and 5% uncertainty in activity data and EF, respectively).

Time-series consistency

Consistent methodologies and activity data are used throughout the time series for this source.

4.9.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

4.9.5 *Category-specific recalculations*

Minor recalculations have been performed for category 2.H.2 as a result of a shift between process emissions and combustion emissions for sugar production.

4.9.6 *Category-specific planned improvements*

No improvements have been planned.

5 Agriculture (CRT sector 3)

Major changes in the Agriculture sector compared to the National Inventory Report 2025

Emissions:	In 2024, total GHG emissions from the agricultural sector decreased by 1.8% compared to 2023 and by 30.1% compared to 1990.
Key categories:	No changes in key categories compared to the NIR 2025
Methodologies and recalculations:	• The Tier 1 emission factor from the 2019 IPCC Guidelines for enteric fermentation of goats (3.A.4.d) and sheep (3.A.2) has been applied. • The amount of treated manure has been harmonised for all emissions ensuing from manure storage and treatment. This affects the N₂O emissions from manure management of cattle and swine (3.B.1.a, 3.B.1.c, and 3.B.3). • The CH₄ emissions from manure management of poultry have been recalculated as the treated manure received both full storage emissions and reduced storage emissions prior to treatment, which was deemed an overestimation (3.B.4). • Small corrections have been made to the amount of digested and separated manure from cattle in 2023 following updated data, affecting the CH₄ emissions (3.B.1.a and 3.B.1.c). • The NH₃ emissions from manure management have been recalculated due to new insights, thus affecting the indirect N₂O emissions (3.B.5).

- The N₂O emissions from the application of inorganic N-fertilisers have been updated for the years 2019–2023 as the amount of N in the rinsing liquid from air scrubbers on goat housing has been recalculated (3.D.1.a).
- The N₂O emissions relating to losses/gains in soil organic matter content have been recalculated on the basis of new insights from the LULUCF sector (3.D.1.e). The emission factor has also been updated to the value from the 2019 IPCC Guidelines.
- The N₂O emissions relating to the Cultivation of organic soils (3.D.1.f) have been recalculated on the basis of new insights from the LULUCF sector.
- 3.D.2 Indirect emissions from managed soils have changed due to recalculations of NH₃ emissions.
- Final usage rates of inorganic fertilisers, compost, liming, and urea and the grassland renewal rate of 2023 differ from the preliminary rates. This affects the CO₂ and/or N₂O emissions from Agricultural soils (3.D), Liming (3.G), Urea application (3.H), and Crop residues (3.D.1.d).

5.1 Overview of the sector and background information

Emissions of GHGs from Agriculture include all anthropogenic GHG emissions from the agricultural sector, except for:

- Emissions from fuel combustion. These emissions are included in 1.A.2.g Manufacturing industries and construction – Other and 1.A.4.c Other sectors – Agriculture/forestry/fishing; and
- CO₂ emissions through land use in agriculture (CRT sector 4 Land Use, Land-Use Change and Forestry; see Chapter 6).

Table 5.1 provides an overview of the contribution made by the Agriculture sector, subdivided into the relevant subcategories, to the total greenhouse gas emissions in the Netherlands. Emissions are given

for 1990, 2023 and 2024. Table 5.1 also provides the change (%) over the most recent year of the inventory compared to the base year. On the right-hand side of the table, the contribution by the emissions from the category in 2024 to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

Emissions of GHGs in this sector include the following:

- 3.A Enteric fermentation (CH₄);
- 3.B Manure management (CH₄ and N₂O);
- 3.D Crop production and agricultural soils (N₂O);
- 3.G Liming (CO₂);
- 3.H Urea application (CO₂).

The IPCC categories Rice cultivation (3.C), Prescribed burning of savannahs (3.E), Field burning of agricultural residues (3.F), Other carbon-containing fertilisers (3.I), and Other (3.J) do not occur in the Netherlands. Throughout the 1990–2024 period, field burning of agricultural residues was prohibited in the Netherlands (article 10.2 of the Environmental Management Act, or '*Wet Milieubeheer*' in Dutch).

This chapter discusses the national emissions from agriculture and their trends. All emissions are calculated using the NEMA model (Netherlands Emission Model Agriculture). A detailed description of the NEMA model and the exact methods used to calculate the emissions can be found in Van der Zee et al. (2026). The activity data used to calculate the emissions is summarised in Van der Most et al. (2026). The activity data that could not be included in the CRT is added to Van der Most et al. (2026). The calculation method of the volatile substances excreted is described in Bannink et al. (2018). The calculation method of the nitrogen excretion is described in CBS (2012).

In 2024, Agriculture contributed 12.3% of the national GHG emissions in comparison to 11.2% in 1990. This sector is a major contributor to national total CH₄ and N₂O emissions. In 2024, Agriculture accounted for 70.4% of total national CH₄ emissions and for 72.8% of total national N₂O emissions (Table 5.1).

Table 5.1 Overview of emissions from the Agriculture sector, in the base year 1990 and the last two years of the inventory (in Mt CO₂ eq)

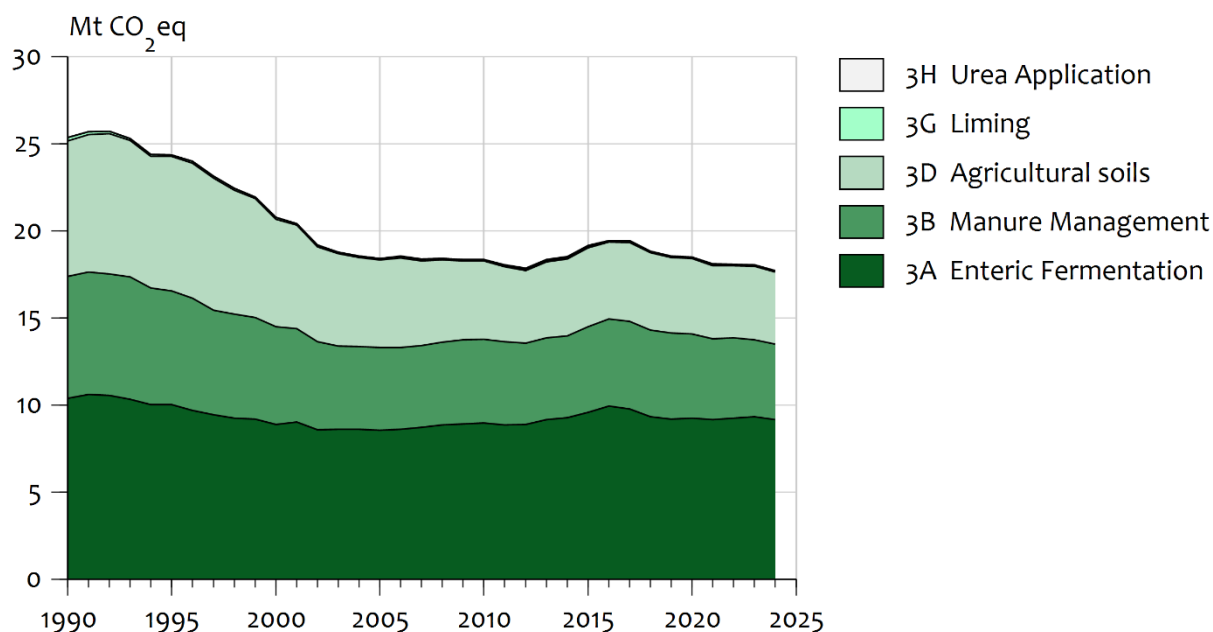
Sector/category	Gas	Key	Emissions in Mt CO ₂ eq			2024 vs 1990	Contribution by the category in 2024 (%) to the		
			1990	2023	2024	%	sector	total gas	total CO ₂ eq
3. Agriculture	CO ₂		0.18	0.10	0.08	-55.6%	0.46%	0.07%	0.06%
	CH ₄		16.5	13.1	12.8	-22.4%	72.5%	70.4%	8.9%
	N ₂ O		8.6	4.9	4.8	-44.3%	27.1%	72.8%	3.3%
	All		25.4	18.1	17.7	-30.1%	100.0%		12.3%
3.A. Enteric fermentation	CH ₄		10.4	9.3	9.2	-11.9%	51.7%	50.2%	6.3%
3.B. Manure management	CH ₄		6.2	3.8	3.7	-40.1%	20.8%	20.2%	2.6%
	N ₂ O		0.84	0.67	0.66	-20.8%	3.7%	10.1%	0.46%
	All		7.0	4.4	4.4	-37.8%	24.6%		3.0%
3.D. Agriculture soils	N ₂ O		7.8	4.2	4.1	-46.8%	23.3%	62.8%	2.9%
3.G. Liming	CO ₂	Non-key	0.18	0.03	0.03	-83.7%	0.17%	0.03%	0.02%
3.H. Urea application	CO ₂	Non-key	0.00	0.07	0.05	3339.7%	0.29%	0.04%	0.04%
National Total GHG emissions (incl. LULUCF)	CO ₂		166.7	119.8	118.5	-28.9%			
	CH ₄		36.5	18.6	18.3	-50.0%			
	N ₂ O		16.1	6.6	6.6	-59.1%			
	Total		226.6	146.1	144.4	-36.3%			

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided. The bottom rows of the table show the national total emissions.

5.1.1 Overview of shares and trends in emissions

Figure 5.1 shows the trend in total GHG emissions from the Agriculture sector.

Figure 5.1 Sector 3 Agriculture – trend and emissions levels of source categories, 1990–2024.

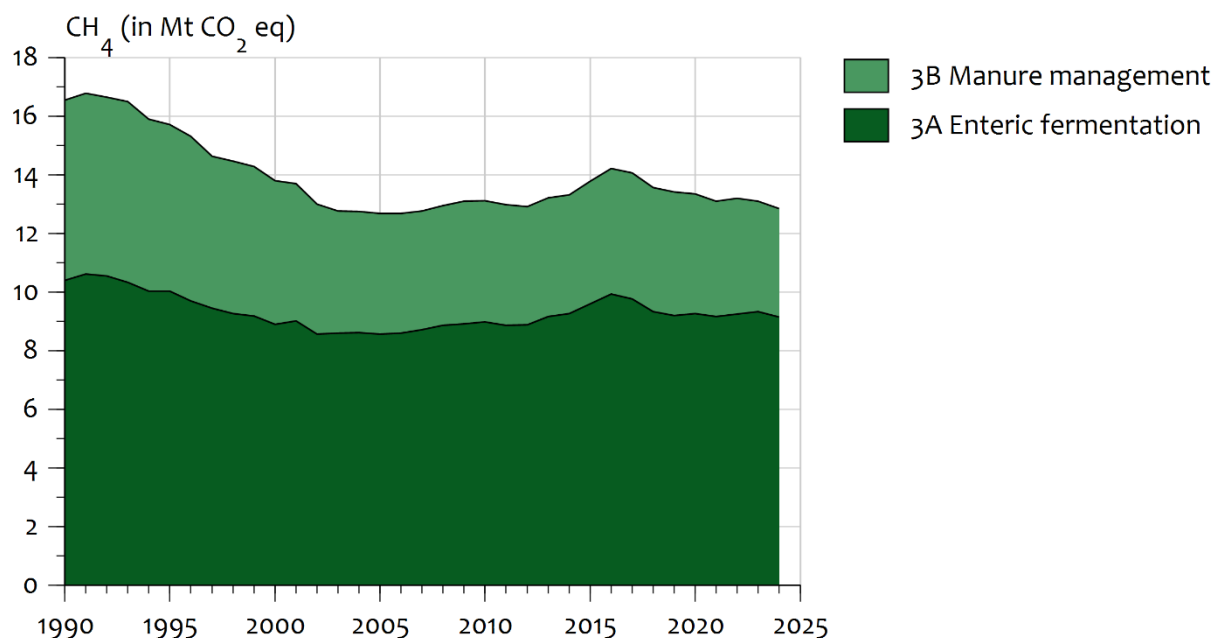


Please note that the contributions by 3.G Liming and 3.H Urea application are so small that they are barely visible in the figure.

Trend in methane emissions

As can be seen in Figure 5.2, the CH₄ emissions from agriculture broadly showed a decline from 1990 to 2005, after which the emissions increased again, peaking in 2016. After 2016, the emissions decreased except for the year 2022. The trends in methane emissions are mainly explained by changes in the number of mature dairy cattle and pigs. The increase in emissions in the years 2012–2016 is mainly due to an increase in the dairy herd, as farmers anticipated the end of the milk quotas. The subsequent decrease results from new legislation limiting the number of cattle.

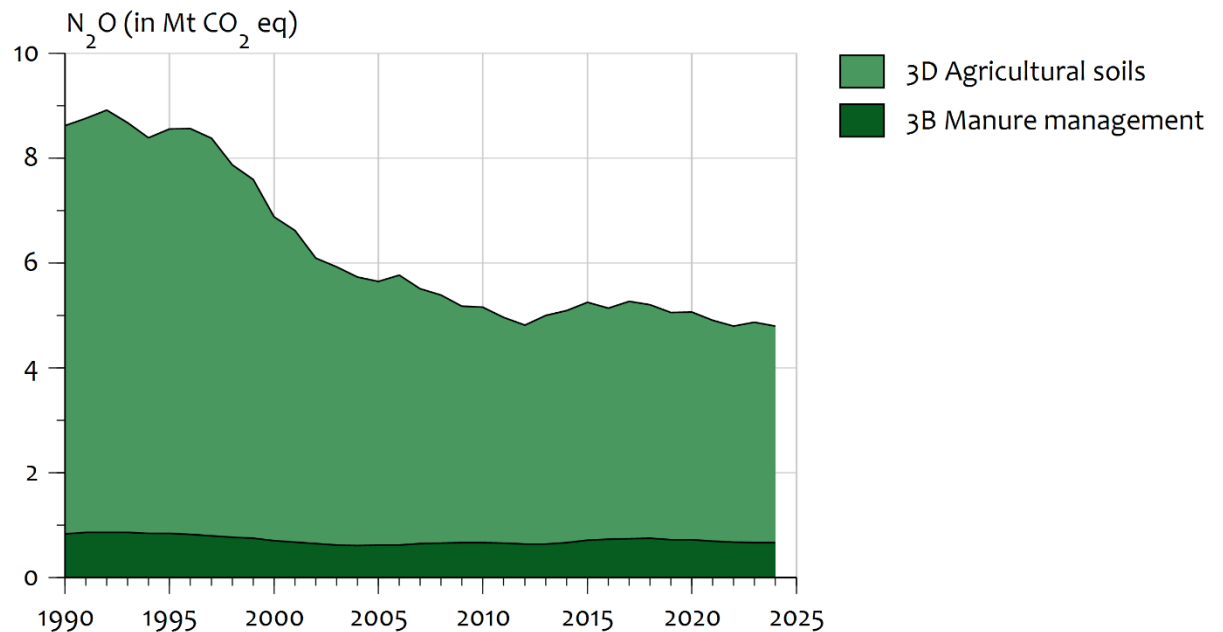
Figure 5.2 Sector 3 Agriculture – trend and emissions levels of source categories for CH₄, 1990–2024



Trend in nitrous oxide emissions

Figure 5.3 shows a large reduction in N₂O emissions from 1990 to 2012. The decrease is mainly effected by category 3.D, as less organic and inorganic N fertiliser and pasture manure was applied. Sector 3.B also declined due to a decrease in animal numbers. Emissions increased in 2013–2017, mainly due to increases in manure application, pasture manure, and inorganic fertiliser application. Emissions decreased in the years 2019–2024 (except for 2020 and 2023), which is mainly due to decreases in manure application, pasture manure, and inorganic fertiliser application.

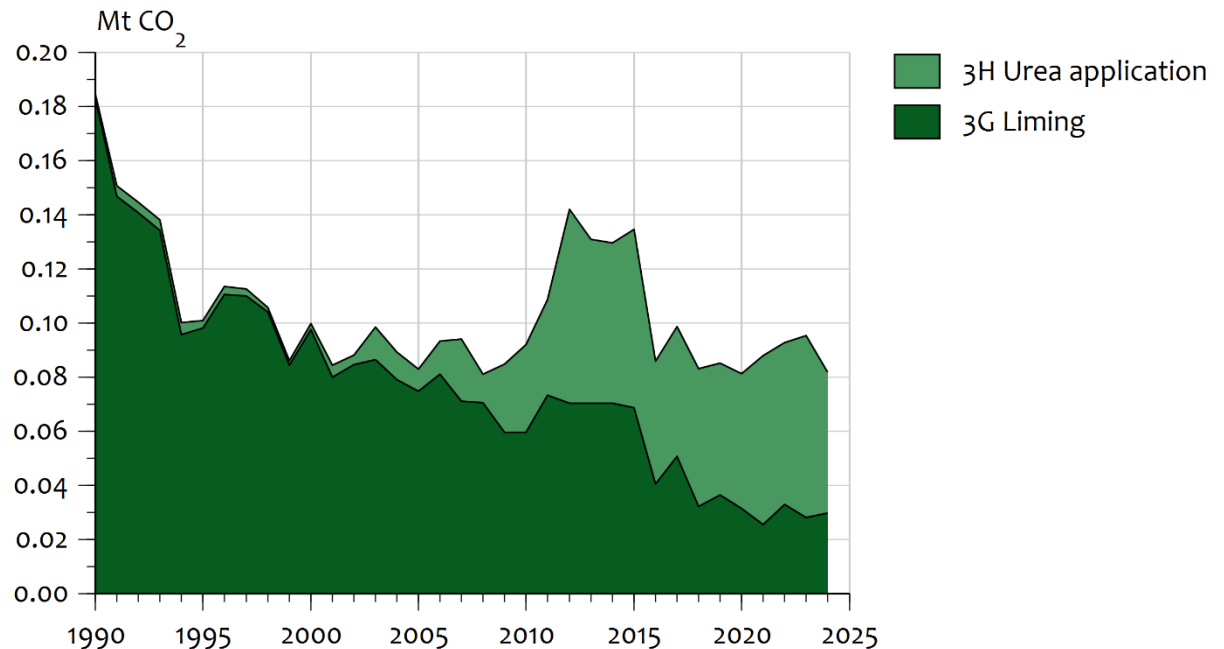
Figure 5.3 Sector 3 Agriculture – trend and emissions levels of source categories for N₂O, 1990–2024



Trend in carbon dioxide emissions

The CO₂ emissions from agriculture reported here are limited to the emissions resulting from Liming (3.G) and Urea application (3.H). Overall, the CO₂ emissions decreased from 1990 until 2008 due to a decrease in the application of liming products in the Netherlands, with interannual fluctuations, as can be seen in Figure 5.3. After 2008, CO₂ emissions increased as more urea was applied as an artificial fertiliser. CO₂ emissions peaked in 2012 after which they plateaued until 2016, when a strong decrease could be observed. In 2017, there was an increase in CO₂ emissions followed by a decrease in 2018. Between 2018 and 2020, CO₂ emissions remained stable with relatively small fluctuations across years. CO₂ emissions increased again in 2021, 2022, and 2023 due to increased liming and urea application. In 2024, emissions decreased due to lower urea application. The time series of CO₂ emissions from agriculture are available in section 9.6 of Van der Most et al. (2026). In 2024, CO₂ emissions comprised 0.5% of the greenhouse gas emissions from agriculture in terms of CO₂ eq.

Figure 5.4 Sector 3 Agriculture – trend and emissions levels of source categories for CO₂, 1990–2024



5.1.2 Overview of trends in activity data

Animal numbers are the primary activity data used in the emissions calculations for Manure management (3.B) and Agricultural soils (3.D). Most animal numbers come from the annual agricultural census performed by Statistics Netherlands. Animal categories that are (no longer) surveyed in the agricultural census, or for which the agricultural census was deemed uncertain, are covered by the Identification and Registration system (I&R) of Netherlands Enterprise Agency (RVO). Table 5.2 presents an overview of the various animal categories. The entire time series of the animal numbers in the Netherlands can be found in annex 2 of Van der Most et al. (2026). Further information on the determination of the animal numbers can be found in section 2 of Van der Zee et al. (2026).

Table 5.2 Animal numbers in 1990–2024 (x 1000)

Animal category	1990	2000	2010	2015	2020	2023	2024
Cattle	4926	4069	3975	4134	3719	3755	3646
Mature dairy cattle	1878	1504	1479	1622	1593	1563	1539
Other mature cattle	120	163	115	80	58	54	52
Growing cattle	2929	2402	2381	2432	2068	2138	2056
Sheep	1702	1305	1130	946	954	888	780
Ewes	790	680	558	523	562	554	501
Young stock and males	913	625	571	423	393	333	279
Swine	13,915	13,118	12,255	12,603	11,860	10,770	10,418
Swine (>25 kg)	8724	8015	7131	7005	6447	5836	5607

Animal category	1990	2000	2010	2015	2020	2023	2024
Young stock (<25 kg)	5191	5102	5124	5598	5414	4934	4811
Goats	61	179	353	470	633	647	636
Mature female goats	37	98	222	292	441	458	451
Young stock and males	23	80	131	178	192	189	185
Horses	370	417	441	417	410	419	424
Mules and asses	1	1	1	1	1	1	1
Poultry	91,680	102,579	99,880	104,760	96,431	87,258	83,957
Other livestock							
Rabbits	786	392	299	381	335	265	263
Does	105	52	39	48	38	30	32
Young stock	681	340	260	333	297	235	231
Fur-bearing animals	554	589	962	1023	435	NO	NO

Between 1990 and 2024, the total number of cattle decreased by 26%. This is due to higher production rates per animal and production quotas. Between 2012 and 2016, the number of cattle increased as dairy farmers anticipated the abolition of milk production quotas. However, this resulted in exceeding the European phosphate production ceiling. The Dutch government implemented new policies in accordance with the phosphate production ceiling: the phosphate reduction scheme, followed by the phosphate quota introduced in 2018 (MLNV, 2017). These policies effected a decrease in cattle (all categories) that can be kept in the Netherlands and resulted in a decrease in cattle numbers from 2017 to 2024. The average milk yield of dairy cows increased from 6003 kg milk cow⁻¹ year⁻¹ to 9115 kg milk cow⁻¹ year⁻¹. Emissions from buffalo are included in the emissions from cattle for two reasons. First, a very small number of buffalo are kept in the Netherlands (less than 5000 in 2023). The small number of buffalo (compared to the number of cattle) does not have a significant effect on the calculated emissions. Second, before 2016, farmers were not asked about keeping buffalo. Farmers thus registered them as cattle in the agricultural census. From 2016 onwards, farmers have had to state how many buffalo they keep, and to state the purpose of the buffalo (beef or dairy). In the calculations, the buffalo are then treated accordingly as dairy cattle, growing cattle or other mature cattle. Therefore, we have included the buffalo with the cattle as this results in the most consistent time series.

The total number of sheep (ewes, rams and lambs) decreased by 54% between 1990 and 2024.

The total number of swine decreased by 25% between 1990 and 2024. Increased production rates per animal resulted in a decrease in swine numbers until 2004, after which animal numbers increased. The increase levelled off after 2011 and was stable until 2015. Between 2016 and 2024, a slow decrease was observed. The number of young stock of swine (piglets up to 25 kg) has been relatively stable between 1990 and 2024, showing that the productivity of the sows has increased.

Between 1990 and 2024, there was an overall decrease in numbers of poultry by 8%. An increase in the number of poultry was observed between 1990 and 2002. As a direct result of the avian flu outbreak in 2003, poultry numbers decreased by almost 30%. In 2004, poultry numbers increased again. In 2010, the number of poultry was equal to the 2002 number. From 2011 onwards, poultry numbers have stabilised, with small interannual fluctuations. The years 2021 and 2022 were marked by large outbreaks of avian influenza. In 2024, the Dutch government provided subsidies to farmers to stop keeping livestock and to demolish animal housing. The goal of the subsidy was to decrease ammonia emissions.

The total number of goats increased by 947% between 1990 and 2024. This increase is due to an increased demand for goat milk and goat cheese. This increase halted in 2010, when goats were culled due to the outbreak of Q fever, but resumed in 2011. In 2024, there was a small decrease in the number of goats.

The total number of horses increased by 15% between 1990 and 2024.

The total number of mules and asses increased by 19% between 1990 and 2024. On the basis of expert judgement, the number of mules and asses between 1990 and 2009 was set at 1000 animals. Since 2010, animal numbers have become available from the agricultural census.

The number of rabbits decreased by 67% between 1990 and 2024 due to a decrease in demand for rabbit meat.

Fur-bearing animals are no longer held in the Netherlands. The production of fur from foxes ceased in 2008 following a ban. The production of fur from minks ceased in 2021. The number of fur-bearing animals increased by 46% between 1990 and 2019. However, due to the 2020 coronavirus pandemic, all mink farms ceased operations as the production of fur from minks was banned. This resulted in a 20% decrease in mink between 1990 and 2020. From 2021 onwards, no mink has been held in the Netherlands.

Emissions from alpacas in the Netherlands have not been included in the inventory as there is no detailed information on their numbers. Alpacas are mostly kept as pets or as a tourist attraction. Animal numbers are expected to be in the same range as mules and asses, i.e. no more than a couple of thousand animals. The threshold for a mandatory inclusion of a new source is 0.05% of national total GHG emissions or 500 kt CO₂ eq, whichever is lower. In the Netherlands, this is the threshold of 0.05%, namely 72 kt CO₂ eq⁷. According to the Tier 1

⁷ Total emission from the Netherlands in 2024 is 144 Mt CO₂ eq. The threshold (0.05%) is thus 72 kt CO₂ eq. The Tier 1 emission factors from the 2006 IPCC guidebook are:

-> CH₄ from enteric fermentation: 8 kg CH₄ per head per year.

-> CH₄ from manure management: 0.955 kg CH₄ per head.

This emission can be calculated by combining the VS excretion, the emission factor of the storage system and body weight. The VS excretion is 11.5 kg VS (1000 kg animal mass)⁻¹ day⁻¹, combined with the high-productivity solid storage emission factor in a cool climate of 3.5 g CH₄ kg VS⁻¹ and a bodyweight of 65 kg:

$11.5/1000 \times 65 \times 3.5/1000 \times 365 = 0.955 \text{ kg CH}_4 \text{ per head.}$

-> N₂O from manure management: 0.282857 kg N₂O.

default values, the combined emission per alpaca is ~ 325.7 kg CO₂ eq (3.A and 3.B). To reach the threshold of 72 kt CO₂ eq, more than 221,000 alpacas would need to be present in the Netherlands. This is highly unlikely as the highest estimate we found for alpacas in the Netherlands amounts to 4000 animals.

The calculations of CH₄ emissions from sheep, goats, and pigs are based on different activity data than the calculations of N₂O emissions (see sections 5.2 and 5.3). CH₄ emissions from sheep, goats, and pigs are based on the average number of animals present, multiplied by the default IPCC emission factors. N₂O emissions are based on the N excretion. The N excretion has been estimated by the Working group on Uniformity of calculations of Manure and mineral data (WUM). The WUM does not provide N excretions for all animal categories individually. The N excretion of rams and lambs is included in the N excretion of the ewes. The N excretion of the male goats and goat kids is included in the N excretion of female goats. The N excretion of piglets is included in the N excretion of the sows. Hence, for the calculation of N₂O emissions, the male and young sheep and goats are omitted, as are the piglets.

The amounts of applied manure and fertilisers are important activity data for the calculation of emissions from Agricultural soils (3.D), Liming (3.G) and Urea application (3.H). For agricultural soils, the application method is also important, as methods developed to reduce the NH₃ emissions have higher N₂O emissions. Between 1990 and 2024, the application of animal manure in kg N decreased by 27%. The reduction is effected by the introduction of more stringent manure application limits. Manure applied to soils during pasturing decreased by 72% due to a reduction of the number of cattle as well as to a decrease in pasturing. The application of inorganic N fertilisers decreased by 46% due to more stringent application limits as well as to a more efficient usage of animal manure, resulting in a reduced demand for inorganic N fertilisers.

Compost application increased by 235% between 1990 and 2024. Sewage sludge application decreased by 96% between 1990 and 2024.

Detailed information on data sources can be found in chapter 2 of Van der Zee et al. (2026).

5.2 Enteric fermentation (3.A)

5.2.1 Category description

Methane emissions are a by-product of enteric fermentation, the digestive process by which organic matter (mainly carbohydrates) is degraded and utilised by micro-organisms under anaerobic conditions. Both ruminant animals (e.g. cattle, sheep, and goats) and non-ruminant animals (e.g. swine, horses, mules, and asses) produce CH₄, but ruminants produce considerably more per unit of feed intake. Enteric fermentation from poultry is not estimated due to the negligible amount

This emission can be calculated by combining the nitrogen excretion rate, animal weight and the emission factor from the guidebook. The default nitrogen excretion rate for western Europe is: 0.38 kg N (1000 kg animal mass per day)⁻¹ Nex = $0.38 * 65/1000 * 365 = 9.0$ kg N, emission factor of 2%
N₂O emission manure management: $9.0 * 0.02 * (44/28) = 0.282857$ kg N₂O per head.
Therefore, the total CO₂ equivalent per alpaca is: $((8 + 0.955) * 28) + (0.282857 * 265) = \sim 325.7$ kg CO₂ equivalent.

of CH₄ production in this animal category. The 2019 refinement of the IPCC Guidelines does not provide a default EF for enteric CH₄ emissions from poultry.

The CH₄ emissions from enteric fermentation have decreased from 10.4 Mt CO₂ eq in 1990 to 9.2 Mt CO₂ eq in 2024 (-11.9% compared to 1990, see Table 5.3). The overall decrease is almost entirely due to the decrease in CH₄ emissions from cattle. Cattle accounted for the majority (90%) of CH₄ emissions from enteric fermentation in 2024. Swine contributed 5% and the animal categories sheep, goats, horses, and mules and asses accounted for the remaining 5%. The reduction of CH₄ emissions from cattle is due to a decrease in animal numbers, partly undone by an increase in EF for Mature dairy cattle (higher production/animal; Table 5.4) (3.A.1.a) and White veal calves (dietary changes to also include roughages in the diet) (3.A.1.c).

The source category enteric fermentation includes emissions from:

- Mature dairy cattle (3.A.1.a);
- Other mature cattle (3.A.1.b);
- Growing cattle (3.A.1.c);
- Sheep (3.A.2);
- Swine (3.A.3);
- Goats (3.A.4);
- Horses (3.A.4);
- Mules and asses (3.A.4).

Table 5.3 Overview of the category Enteric fermentation (3.A) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
3.A. Enteric fermentation	CH ₄		10.4	9.3	9.2	-11.9%	51.7%	50.2%	6.3%
3.A.1. Cattle	CH ₄		9.2	8.3	8.1	-11.2%	46.0%	44.6%	5.6%
Mature dairy cattle	CH ₄	L,T Non-key	5.8	6.1	6.0	3.9%	34.0%	33.0%	4.2%
Other mature cattle	CH ₄		0.24	0.12	0.11	-52.5%	0.63%	0.61%	0.08%
Growing cattle	CH ₄		L	3.1	2.1	2.0	-36.1%	11.3%	11.0%
3.A.2. Sheep	CH ₄		0.43	0.22	0.20	-54.2%	1.1%	1.1%	0.14%
3.A.3. Swine	CH ₄	L2	0.58	0.45	0.44	-25.1%	2.5%	2.4%	0.30%
3.A.2,3.A.4 Other livestock	CH ₄	L	0.20	0.37	0.37	85.4%	2.1%	2.1%	0.26%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

This category comprises the following key categories:

3.A.1	Mature dairy cattle	CH ₄ (L,T)
3.A.1	Young cattle	CH ₄ (L)
3.A.3	Swine	CH ₄ (L2)

3.A.2, 3.A.4 Other CH₄ (L)

5.2.2 Methodological issues

For all the sub-source categories, the methodologies used to estimate emissions follow the 2019 IPCC Guidelines. Detailed information on calculation methods and EFs can be found in chapter 3 of Van der Zee et al. (2026). An overview of the activity data can be found in Statistics Netherlands (2019 through 2025); Van der Most et al. (2026).

Cattle (3.A.1)

A Tier 3 method is used to calculate emissions from mature dairy cattle. For the EF calculation for mature dairy cattle, the Netherlands is split into two regions because of differences in diets: North-West and South-East. Cattle in the North-West (NW) mainly have a grass diet, while those in the South-East (SE) have a larger fraction of maize in their diet. Data used between 1990 and 2012 is published in annex 3 of Van Bruggen et al. (2014). An annual update of cattle diets is published by Statistics Netherlands, (2019 through 2025). Table 5.4 presents the IEFs (implied emission factors) for the various cattle categories reported, including the subdivision into the NW and SE regions for mature dairy cattle. A Tier 2 method is used to calculate emissions from other mature cattle and growing cattle. The IEF for growing cattle is a weighted average calculated from all cattle sub-categories except Dairy cows and suckling cows, and Female fatteners > 2 years (see annex 27 in Van der Most et al., 2026).

Table 5.4 Implied emission factors for methane emissions from enteric fermentation specified according to CRT animal category (kg CH₄/animal/year)

Animal category	1990	2000	2010	2015	2020	2023	2024
Mature dairy cattle	110.4	120.0	127.7	128.7	136.5	139.8	140.0
Of which NW region	111.0	121.7	129.6	130.9	136.6	139.9	140.2
Of which SE region	109.9	118.4	126.3	127.1	136.4	139.7	139.8
Other mature cattle	70.3	72.1	78.1	79.1	77.9	77.1	77.3
Growing cattle	38.3	35.4	35.0	36.4	33.5	34.3	34.8

For both mature dairy cattle and other mature cattle, EFs increased primarily because of an increase in total feed intake per animal in the 1990–2024 period. For mature dairy cattle, a change in the feed nutrient composition partly counteracted this effect. Moreover, the average weight of mature dairy cattle and the average milk production have increased over time, resulting in a higher gross energy intake of mature dairy cattle in 2024 compared to 1990, in spite of a decrease in animal numbers (Statistics Netherlands, 2025). The IEFs of 2024 are higher than 2023 because the feed intake was higher.

For growing cattle, the decrease in EFs between 1990 and 2024 can be explained by a decrease in the average total feed intake due to an increased share of veal calves in the population of growing cattle. This is counteracted, however, by an increase in EF for white veal calves, as

they are fed increasing amounts of roughage to comply with animal welfare considerations. The number of white veal calves and rosé veal calves can be found in annex 2 of Van der Most et al. (2026). The EF for veal calves can be found in annex 27 of Van der Most et al. (2026).

Sub-source categories with a Tier 1 method

According to the IPCC Guidelines, no Tier 2 method is required if the share of a sub-source category is less than 25% of the total emission from a key source category. This is the case for the following sub-source categories:

Sheep (3.A.2)

The animal category Sheep has a 2.2% share in the total CH₄ emissions from enteric fermentation. Therefore, the IPCC 2019 Refinement to the 2006 IPCC Guidelines default (Tier 1) EF of 9 kg CH₄/animal has been used. Changes in emissions from sheep are explained entirely by changes in livestock numbers.

Swine (3.A.3)

The animal category Swine has a 4.8% share in the total CH₄ emissions from enteric fermentation. Therefore, the IPCC 2019 Refinement to the 2006 IPCC Guidelines default (Tier 1) EF of 1.5 kg CH₄/animal has been used. Changes in emissions from swine are explained entirely by changes in livestock numbers.

Other livestock (3.A.4)

The sub-source category Other livestock comprises goats, horses, and mules and asses. These animal categories have a combined share in total CH₄ emissions from enteric fermentation of 4%. Therefore, the IPCC 2019 Refinement to the 2006 IPCC Guidelines default (Tier 1) EFs are used for goats, horses, and mules and asses (9, 18, and 10 kg CH₄/animal, respectively). Changes in emissions from these animal categories are entirely explained by changes in livestock numbers.

Uncertainty assessment

The uncertainty analysis explained in Annex 2 provides estimates of uncertainty according to IPCC source categories. The uncertainty of CH₄ emissions from enteric fermentation ranges between 10% and 42%, mostly determined by the uncertainties in the emission factors (e.g. the uncertainty in the EF for 3.A.3 Swine is estimated at 40%, whereas for 3.A.1.a Mature dairy cattle, the uncertainty is estimated at 15%). Uncertainties for the activity data are estimated between 1% (for 3.A.1, Young cattle) and 17% (3.A.2, 3.A.4 Other).

Time-series consistency

A consistent methodology is used throughout the time series; see section 5.2.2. Emissions are calculated as the product of livestock numbers and EFs. Livestock numbers are collected in an annual census and the I&R, and are published by Statistics Netherlands and RVO, respectively. Consistent methods are used to compile the census to ensure continuity of the collected data. Time series corrections have been implemented to ensure consistency following the switch from the annual census to the I&R. EFs are either constant (default IPCC) or

calculated/modelled from feed intake data collected through an annual survey by Statistics Netherlands, (2019 through 2025).

5.2.3 *Category-specific QA/QC and verification*

This source category is covered by the general QA/QC procedures discussed in Chapter 1.

5.2.4 *Category-specific recalculations*

The CH₄ emission factor for Sheep (3.A.2.a) and Goats (3.A.4.d) has been updated to the Tier 1 value from the 2019 IPCC Guidelines instead of the 2006 IPCC Guidelines. The emission factor for goats increases from 5 to 9 kg CH₄ per goat. The emission factor for sheep increases from 8 to 9 kg CH₄ per sheep. The update has been applied to the entire time series (1990–2024).

5.2.5 *Category-specific planned improvements*

No improvements have been planned.

5.3 **Manure management (3.B)**

5.3.1 *Category description*

Overview of shares and trends in emissions

Both CH₄ and N₂O are emitted during the handling and storage of manure from all animal categories. These emissions relate to the quantity and composition of the manure, and to the various types of manure management systems used.

In the Netherlands, CH₄ emissions from manure management contribute 2.6% to national total GHG emissions and 20.8% to the GHG emissions from the Agriculture sector (Table 5.5). CH₄ emissions from manure management are particularly related to cattle and swine manure (Figure 5.5). Cattle and swine manure management contributed 12.0% and 8.5%, respectively, to the total GHG emissions from the Agriculture sector in 2024. CH₄ emissions from manure management of poultry are a minor key source and have decreased drastically over time (-93.8% from 1990 to 2024).

In 2024, N₂O emissions from manure management contributed 0.46% to national total GHG emissions and 3.7% to the Agriculture sector. Nitrous oxide emissions from manure management from cattle contributed 1.7% to the Agriculture sector total (Table 5.5. and Figure 5.6).

The source category Manure management includes emissions from:

- Mature dairy cattle (3.B.1.a);
- Other mature cattle (3.B.1.b);
- Growing cattle (3.B.1.c);
- Sheep (3.B.2);
- Swine (3.B.3);
- Goats (3.B.4);
- Horses (3.B.4);
- Mules and asses (3.B.4);
- Poultry (3.B.4);
- Rabbits (3.B.4);

- Fur-bearing animals (3.B.4);
- Indirect emissions (3.B.5).

Table 5.5 Overview of the category Manure management (3.B) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key	Emissions in Mt CO ₂ eq			2024 vs 1990	Contribution by the category in 2024 (%) to the		
			1990	2023	2024	%	sector	total gas	total CO ₂ eq
3.B. Manure management	CH ₄		6.2	3.8	3.7	-40.1%	20.8%	20.2%	2.6%
	N ₂ O		0.84	0.67	0.66	-20.8%	3.7%	10.1%	0.46%
	All		7.0	4.4	4.4	-37.8%	24.6%		3.0%
3.B.1. Cattle (total)	CH ₄	Non-key	1.8	2.1	2.1	17.7%	12.0%	11.6%	1.5%
3.B.2. Sheep	CH ₄		0.01	0.00	0.00	-54.2%	0.02%	0.02%	0.00%
3.B.3. Swine	CH ₄	L,T	3.8	1.6	1.5	-60.0%	8.5%	8.3%	1.0%
3.B.4.g. Poultry	CH ₄	T	0.54	0.04	0.03	-93.8%	0.19%	0.18%	0.02%
3.B.4. Other livestock (excluding poultry)	CH ₄	Non-key	0.03	0.02	0.02	-25.3%	0.12%	0.12%	0.01%
3.B.1. Cattle (total)	N ₂ O	Non-key	0.31	0.29	0.29	-3.6%	1.7%	4.5%	0.20%
3.B.2. Sheep	N ₂ O		0.01	0.00	0.00	-80.5%	0.01%	0.02%	0.00%
3.B.3. Swine	N ₂ O	Non-key	0.12	0.09	0.09	-31.3%	0.48%	1.3%	0.06%
3.B.4. Poultry	N ₂ O	Non-key	0.03	0.02	0.02	-22.6%	0.11%	0.31%	0.01%
3.B.4. Other livestock	N ₂ O	Non-key	0.03	0.07	0.07	137.5%	0.37%	1.00%	0.05%
3.B.5. Indirect emissions	N ₂ O	L2,T2	0.35	0.20	0.20	-43.6%	1.1%	3.0%	0.14%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

This category comprises the following key sources

3.B.1	Mature dairy cattle	CH ₄ (L,T)
3.B.1	Growing cattle	CH ₄ (L1)
3.B.3	Swine	CH ₄ (L,T)
3.B.4	Poultry	CH ₄ (T)
3.B.5	Indirect emissions	N ₂ O (L2,T2)

Figure 5.5 Category 3.B Manure management – trend and emissions levels of source categories for CH₄, 1990–2024

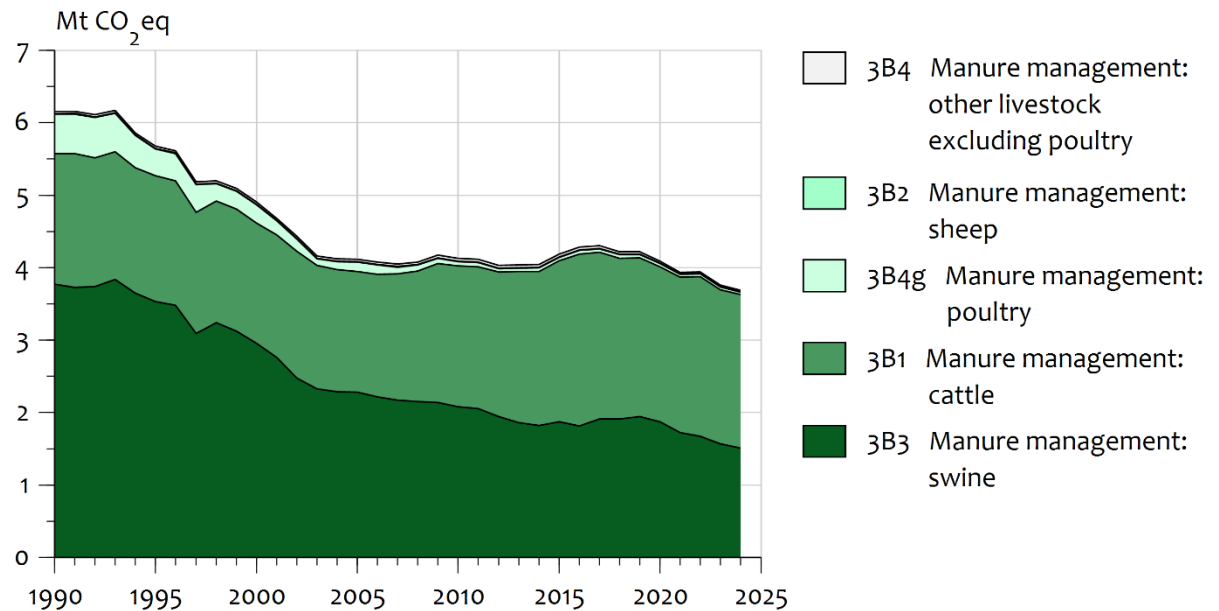
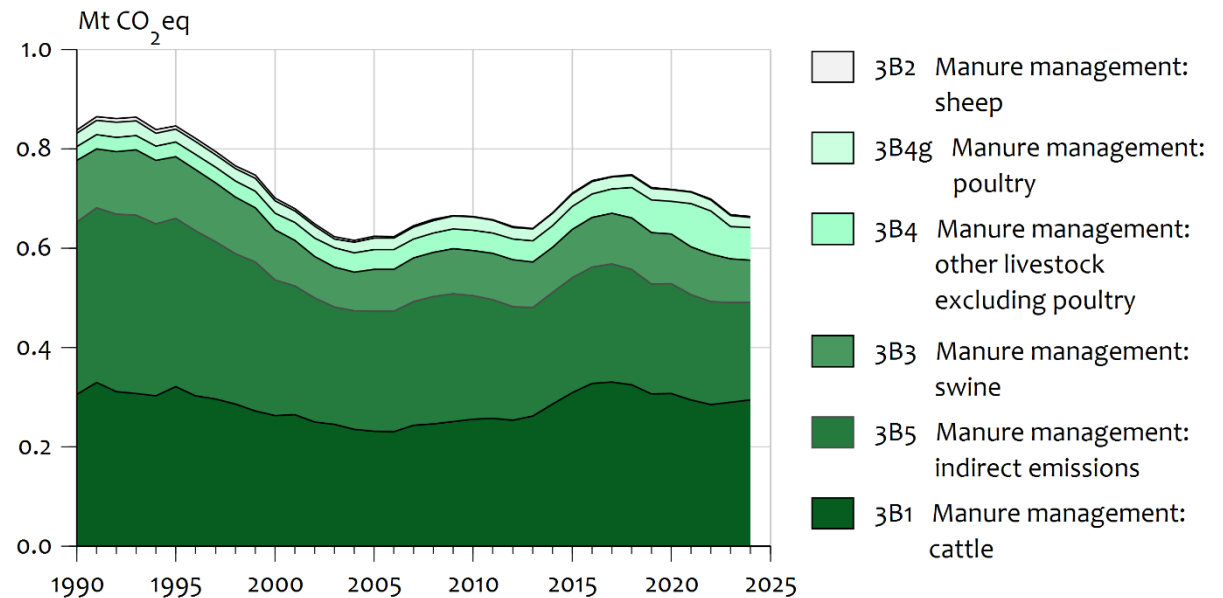


Figure 5.6 Category 3.B Manure management – trend and emissions levels of source categories for N₂O, 1990–2024



Four different manure management systems are used in the Netherlands and included in the calculations:

- Liquid manure management systems;
- Solid manure management systems;
- Manure treatment;
- Manure excreted during grazing on pasture.

Animal numbers were distributed across the various manure management systems using information from the Agricultural census. In accordance with the IPCC 2006 Guidelines, N₂O emissions from manure

excreted during grazing are not considered in source category 3.B Manure management, but in source category 3.D Agricultural soils (see section 5.4). The methods for calculating N excretion for the various livestock categories are described in CBS (2012).

CH₄ from manure management

Between 1990 and 2024, emissions of CH₄ from manure management decreased by 37.8% (Figure 5.2). Emissions from cattle increased by 17.7%, while swine and poultry emissions decreased by 60.0% and 93.8%, respectively (Table 5.5). With an increasing percentage of cattle kept indoors, a larger proportion of the manure is excreted inside animal housing facilities. This results in higher emissions (see annex 4 in Van der Most et al. (2026)). For growing cattle, emissions decreased due to lower livestock numbers; this outweighs the increase in EF (see annex 2 and annex 29 in Van der Most et al. (2026)). An increase in emissions was seen between 2013 and 2017. This was due to an increase in cattle number combined with higher feed intake, resulting in a higher volatile solids (VS) excretion (see annex 2 and annex 28 in Van der Most et al. (2026)). In anticipation of the end of the milk quota (2015), farmers increased their herd size. However, due to new policies, farmers subsequently had to decrease their herd size in order to comply with the phosphate quota (Van der Zee et al. 2026).

For poultry (3.B.4.g), the large decrease in emissions is associated with the change from battery cage systems with liquid manure, to floor housing systems or aviary systems with solid manure (see annex 8 in Van der Most et al., (2026)). This lowered the CH₄ emissions as the solid manure systems have lower EFs. Moreover, the increase of manure treatment had an effect by shortening the manure's storage time (annex 14 in Van der Most et al., (2026)).

The decreasing trend in CH₄ emissions from swine is directly related to the decrease in VS excretion by swine (see annex 28 in Van der Most et al. (2026)). This decreased due to changes in the feed composition (Zom and Groenestein, 2015). The decrease in CH₄ emissions was somewhat counteracted by an increase in livestock numbers in the first part of the time series (up to 1997). For the years 2017–2019, an increase in emissions can be seen as the VS excretion increased. In 2020–2023, VS excretion decreased. In 2024, it increased by 1% (annex 28 of Van der Most et al., (2026)).

N₂O from manure management

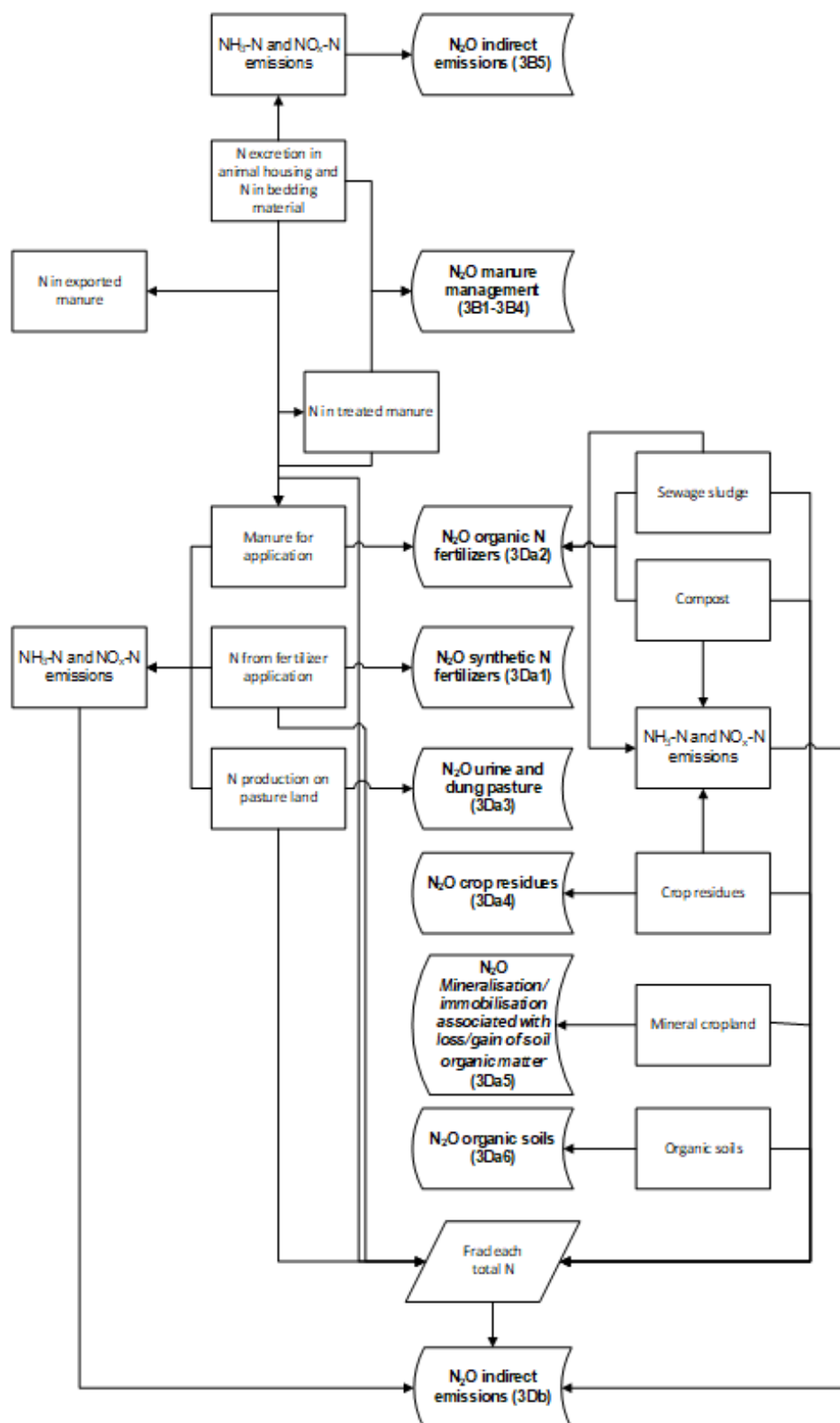
Nitrous oxide emissions are calculated using an N-flow model (Van der Zee et al. 2026). Figure 5.4 is a schematic representation of N flows and the resulting emissions from agriculture. The amount of N in the manure is used throughout the model and corrected for the N emissions that have already taken place. For example, with N excretion in animal housing, losses in the form of NH₃, NO_x, N₂ and N₂O are all relative to the amount of N excreted. Only at the end of the calculation is the combined loss subtracted to yield the remaining N available for application.

The direct N₂O emissions from cattle decreased by 3.6% between 1990 and 2024. Sheep, swine, and poultry emissions decreased by 80.5%, 31.3% and 22.6%, respectively (Table 5.5). Decreasing livestock numbers and N excretions per animal influenced this trend. Between 1990 and 2024, emissions from other livestock increased by 137.5% (Table 5.5); this increase mainly resulted from the increase in the number of goats. Between 1990 and 2013, the N excretion decreased due to an optimisation of animal production, resulting in higher production rates with lower dietary crude protein for all animal categories. From 2014 onwards, the amount of dietary crude protein has stabilised. In 2017, the N excretion of cattle increased again, which can be explained by a decrease in fed maize and an increase of fed grass; grass has a higher N content than maize. Apart from the increased share of grass in the feed, nutrient requirements increased through a higher average milk production and body weight per cow (Statistics Netherlands, 2025). In 2024, the N excretion of cattle decreased as the roughages contained less nitrogen (Statistics Netherlands, 2025).

The Netherlands' manure and fertiliser policy, aimed at reducing N leaching and run-off, regulates the amount of manure production and its application by the introduction of measures such as restrictions on the numbers of swine and poultry per farm (so called 'manure production rights') and maximum application limits for manure and inorganic N fertiliser, all part of the Dutch 'Manure and Fertilisers Act' in accordance with the Nitrates Directive. This has also resulted in a decrease in manure management emissions over the past two decades.

Indirect N₂O emissions following atmospheric deposition of NH₃, and NO_x emitted during the handling of animal manure decreased by 43.6% from 1990 to 2024 (Table 5.5). This decrease is explained by reduction measures for NH₃ and NO_x emissions from animal housing systems and manure storages for the period.

Figure 5.4 Schematic representation of N flows in agriculture and the allocation of emissions to source categories



5.3.2 *Methodological issues*

For all sub-source categories, the methodologies used to estimate emissions follow the 2006 IPCC Guidelines. Detailed information on calculation methods and EFs can be found in chapters 4 and 7 of Van der Zee et al. (2026). An overview of the activity data can be found in Statistics Netherlands (2019 through 2025); Van der Most et al. (2026). Further information on animal housing systems used in the Netherlands can be found at <https://www.infomil.nl/onderwerpen/landbouw/stalsystemen/stalbeschrijvingen/> (in Dutch only).

Emissions from manure treatment are calculated using a Tier 2 method. Five manure treatment systems can be found in the Netherlands: manure separation; the production of mineral concentrates; manure digestion; manure pelleting; and incineration. A description of the EFs for the various types of manure treatment used in the Netherlands can be found in Melse and Groenestein, (2016). Emissions from manure digestion are reported under 5.B.2 Anaerobic digestion at biogas facilities, while emissions from the incineration of manure are reported under 1.A.1.a Other fuels.

CH₄ from manure management

Methane emissions from manure management are calculated using Tier 1 and Tier 2 methods. For horses, goats, mules and asses, sheep, rabbits, and fur-bearing animals, a Tier 1 method is used. For cattle, swine, and poultry, a country-specific Tier 2 approach is used to calculate CH₄ EFs for manure management annually as they constitute key sources. The EFs are calculated for liquid and solid manure management systems within the key animal categories cattle, swine, and poultry and, where applicable, for the manure produced on pasture during grazing. These calculations are based on country-specific data on:

- Manure characteristics: volatile solids excretion (VS, in kg VS/animal/year) and maximum CH₄ producing potential (B₀, in m³ CH₄/kg VS);
- Manure management system conditions (storage temperature and period) for liquid manure systems, which determine the Methane Conversion Factor (MCF).

In the Netherlands, liquid animal manure is stored in pits underneath the slatted floors of animal housing facilities. This manure is regularly pumped into outside storage facilities or applied to the land. Given this practice, country-specific MCF values have been calculated for liquid manure, since the manure management systems are different from the circumstances on which the default is based, as demonstrated in Groenestein et al. (2016). For solid manure management systems and manure produced on pasture while grazing, IPCC default values are used. The amount of time that animals spend on pasture is calculated annually by the Working group on Uniformity of calculations of Manure and mineral data (Statistics Netherlands, 2011–2025). A time series with the emission factors for liquid manure, solid manure, and manure on pasture can be found in annex 29 of Van der Most et al. (2026). If the manure is treated, it is assumed that the storage time is short as it is beneficial for the farmer to treat the manure as soon as possible. In

practice, it is possible that manure is stored for a longer period before treatment. However, to account for this, complex calculations have to be made for all N species, with a high chance of overestimating the emissions. Methane emissions from manure treatment are based on the amount of manure in kg VS treated; emission factors are based on Melse and Groenestein (2016).

Table 5.6 presents the IEFs for manure management per animal category. These are expressed in kg CH₄ per animal per year and are calculated by dividing total emissions by livestock numbers in each category.

Table 5.6 CH₄ implied emission factors (kg/animal/year) for manure management specified by animal category, 1990–2024

Animal category	1990	2000	2010	2015	2020	2023	2024
Cattle							
Mature dairy cattle	23.07	27.97	34.87	36.72	37.59	37.51	38.18
Other mature cattle	7.42	7.50	8.04	8.01	6.80	5.83	5.83
Growing cattle	6.87	6.62	7.05	7.88	7.83	7.89	8.09
Sheep*	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Goats*	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Horses	1.56	1.56	1.56	1.56	1.56	1.56	1.56
Mules and asses	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Swine*	9.68	8.05	6.07	5.31	5.64	5.21	5.18
Swine excl. piglets	15.44	13.18	10.38	9.50	10.31	10.95	10.99
Fattening pigs	12.87	10.76	8.40	7.53	8.31	7.70	7.69
Breeding swine	26.09	23.60	20.18	19.27	20.48	19.32	19.36
Poultry	0.21	0.09	0.02	0.02	0.02	0.02	0.01
Rabbits	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Fur-bearing animals	0.68	0.68	0.68	0.68	0.68	NO	NO

* The IEF is calculated for total animal numbers, including young stock. Manure production by young stock is accounted for in manure production by the mother animal.

Cattle (3.B.1)

The IEF for the manure management of mature dairy cattle increased between 1990 and 2024, as higher feed intake resulted in an increased VS production per cow. The shift in the proportion of the two main manure management systems used in dairy farming (liquid manure in the animal house and manure production on pasture) also contributed to the increased IEF, as cows spend less time grazing: between 1990 and

2024, the share of manure produced in liquid manure management systems increased in comparison to the amount of manure produced on pasture (Statistics Netherlands, 2025).

Swine (3.B.3)

Between 1990 and 2024, the IEF for swine manure management (based on total swine numbers, including piglets) decreased due to a lower VS excretion per animal. The decrease in VS excretion per animal counteracts the increase in animal numbers in earlier years of the time series. The VS excretion decreased because the feed composition changed over the years, increasing the overall digestibility. The IEF also decreased as the productivity of the sows increased between 1990 and 2024, thus distributing the emissions across more animals.

Poultry (3.B.4)

For poultry, the substantial decrease in CH₄ emissions is explained by a shift in the proportion of the two poultry manure management systems (solid and liquid manure) between 1990 and 2013, when the liquid manure system was fully replaced by the solid manure system (Van der Hoek and Van Schijndel, 2006). Decreases after 2013 are explained by an increase in manure treatment with short storage times and thus lower emissions. When poultry manure is not treated before application, it is assumed that poultry manure is stored for only two weeks instead of six months. The emission factor has been set at 10% of the normal storage emissions on the basis of Van Os et al. (2003) and Melse and Groenestein (2016).

Sheep, goats, horses, mules and asses (3.B.2 and 3.B.4)

Sheep, goats, horses, and mules and asses only produce solid manure, which has a low EF. Therefore, the IEFs are also small. These represent the IPCC Tier 1 defaults.

Rabbits and fur-bearing animals

The IPCC Tier 1 default emission factors have been used for rabbits (solid manure) and for fur-bearing animals such as minks and foxes (liquid manure). Keeping fur-bearing animals in the Netherlands was banned in 2021.

Comparison to IPCC default EF for CH₄

The methods applied by the Netherlands for CH₄ calculations are in accordance with the 2006 IPCC Guidelines. Detailed descriptions of the methods are provided in Van der Zee et al. (2026). More detailed data on manure management, based on statistical information on manure management systems, is documented in Van der Hoek and Van Schijndel (2006) for the 1990–2006 period and in Statistics Netherlands (2025) for the period from 2006 onwards.

N₂O from manure management

Direct emissions of N₂O from manure management are calculated using the Tier 1 method. As manure management does not constitute a key category for N₂O emissions, no higher Tier is required. Indirect N₂O emissions from manure management are calculated using a Tier 2 method. Emissions of NH₃ and NO_x are calculated using Tier 2 and Tier 3 methods. The default EF for indirect N₂O emissions from manure

management has been used. An increase in IEF between 2010 and 2024 is the result of increased N excretion combined with a decrease in animal numbers (Table 5.7). This is due to increased feed intake as a result of a higher average weight of mature dairy cattle (Statistics Netherlands, 2019; Van Bruggen et al., 2019) and a higher average milk production. As a result of new insights into the feed intake of horses and ponies, the N excretion increased in 2018 (Bikker et al., 2019).

Table 5.7 N₂O implied emission factors for manure management per animal category, 1990–2024 (mln kg/year and kg N₂O/kg manure-N)

Animal category	1990	2000	2010	2015	2020	2023	2024
Cattle							
Mature dairy cattle	0.34	0.32	0.34	0.35	0.41	0.39	0.39
Other mature cattle	0.19	0.20	0.17	0.18	0.22	0.16	0.16
Growing cattle	0.14	0.13	0.11	0.12	0.12	0.12	0.12
Sheep*	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Goats*	0.19	0.17	0.17	0.18	0.22	0.21	0.22
Horses	0.21	0.21	0.19	0.19	0.26	0.25	0.25
Mules and asses	0.11	0.11	0.10	0.10	0.13	0.13	0.13
Swine*	0.03	0.03	0.03	0.02	0.02	0.01	0.01
Poultry	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rabbits*	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fur-bearing animals	0.01	0.01	0.01	0.01	0.01	NO	NO

* The IEF is calculated from total animal numbers, including young stock. Manure production by young stock is accounted for in the manure production by the mother animal.

For indirect emissions from manure management, the atmospheric N deposition is calculated as described in section 7.4.1 of Van der Zee et al. (2026). The IPCC Guidelines also calculate leaching and run-off from manure storage. In the Netherlands, all slurry manure is stored underneath animal houses or in fully closed external storage tanks (this is an obligation ensuing from the EU Nitrates Directive). Solid manure must be stored on concrete plates with run-off directed into a slurry pit or separate tank.

Comparison to IPCC default EF for N₂O

For the relevant manure management systems and animal categories, the total N content of the manure is calculated by multiplying N excretion (kg/year/head) by livestock numbers. Activity data are collected in compliance with a Tier 2 method. The N₂O EFs used for liquid and solid manure management systems are IPCC defaults. The used method complies with the 2006 IPCC Guidelines.

5.3.3 Uncertainty assessment and time-series consistency Uncertainty assessment

The uncertainty analysis detailed in Annex 2 provides estimates of uncertainty according to IPCC source categories. The uncertainty for CH₄ from manure management ranges between 18% and approximately

40% and is mostly determined by the estimated uncertainties in the EF (18% for 3.B.1 Growing cattle; 38% for 3.A.4 Other). Uncertainties in activity data range between 1% and approximately 39%.

The uncertainty in the annual N₂O emissions from manure management is much higher; it is estimated at 64–100%, and it is attributable to the uncertainties in the EFs. A complete overview of the uncertainties can be found in section 4.4 and annex 10 of Van der Zee et al. (2026).

Time-series consistency

A consistent methodology is used throughout the time series; see section 5.3.2. Emissions are calculated from animal population data and EFs. The animal population data are collected both through the Identification and Registration system and in an annual census published by Statistics Netherlands. Consistent methods are used in compiling the census to ensure continuity in the collected data. EFs are either constant (default IPCC) or calculated/modelled from feed intake data collected through an annual survey by Statistics Netherlands (2019 through 2025).

5.3.4 Category-specific QA/QC

This source category is covered by the general QA/QC procedures discussed in Chapter 1.

5.3.5 Category-specific recalculations

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 P₂O₅ going to treatment was subtracted (P₂O₅ treated / P₂O₅ excreted). The emissions from manure treatment are based on the mandatory transport certificates which state the amount of N going to treatment facilities. The fraction N treated / N excreted differs from the fraction P₂O₅ treated / P₂O₅ excreted as there are N losses in housing, whereas there are no P₂O₅ losses. All calculations relating to storage and treatment are now based on N. The change affects N₂O emissions from manure management regarding Cattle and Swine (3.B.1.a, 3.B.1.c, and 3.B.3). Emissions from swine were recalculated from 2006 onwards (the first year with swine manure treatment). The increase in emissions ranged between 859 kg N₂O (2008) and 61,319 kg N₂O in 2022. Emissions from cattle were recalculated for the entire time series. The increase in emissions ranged between 871 kg N₂O in 1990 (0.1%) and 14,612 kg N₂O in 2022 (1.5%).

The amounts of digested and separated cattle manure in 2023 have been updated to reflect the definitive figures from Statistics Netherlands instead of the preliminary figures, causing CH₄ emissions to decrease by less than 0.01% (3.B.1.a and 3.B.1.c).

The CH₄ emissions from Poultry manure management (3.B.4.g) have been recalculated. Emissions from treated poultry manure in previous NIRs consisted of both the normal storage emissions from poultry manure and the storage emissions prior to treatment. Because treated

poultry manure is stored only very briefly (two weeks instead of six months), this results in an overestimation of the emissions. Therefore, the emissions have been adjusted to reflect only the storage emissions prior to treatment (Van Os et al. 2003 and Melse and Groenestein, 2016). The emissions have been recalculated from 1998 onwards, the first year with poultry manure treatment. The decrease in emissions from poultry manure management ranged between 121,250 kg CH₄ (1.4%) in 1998 and 1,547,610 kg CH₄ in 2017 (50.5%).

The indirect N₂O emissions (3.B.5) have been recalculated for the entire time series as NH₃ and NO_x emissions have been recalculated due to new insights. The biggest change was the updated NH₃ emission factor of goats (Staats et al. 2026). The increase of N from manure management differed per year, ranging from 554.3 kg N in 1990 to 1,240,024 kg N in 2020 (NO_x-N + NH₃-N). The increase in emissions from 3.B.5 ranged between 9 kg N₂O in 1990 (0.001%) and 19,486 kg N₂O in 2020 (2.4%). Further information on the calculation of the indirect emissions can be found in sections 12.9 and 12.10 of Van der Zee et al. (2026).

5.3.6 *Category-specific planned improvements*

The fractions of liquid manure and solid manure that are used for the calculation of CH₄ from manure management of dairy cattle differ from the fractions of liquid and solid manure that are used to calculate all other emissions relating to manure from dairy cattle. The difference results from an additional step in the calculation of CH₄ from manure management of dairy cattle. This step accounts for the solid manure produced indoors by dairy cattle with unlimited grazing during the grazing season. This additional step will be implemented in all calculations relating to manure type in the next NID.

5.4 **Agricultural soils (3.D)**

5.4.1 *Category description*

In 2024, the source category Agricultural soils was responsible for 23.3% of total GHG emissions in the Agriculture sector. Total N₂O emissions from agricultural soils decreased by 46.8% between 1990 and 2024 (Table 5.8). In 2024, N₂O emissions from grazing decreased by 7.9% compared to 2023. Emissions from organic N fertilisers decreased by 1.82% in 2024 due to lower application rates. Emissions from inorganic N fertilisers increased by 1.9% in 2024 compared to 2023. In 2024, emissions from crop residues decreased by 1.2% compared to 2023.

Table 5.8 Overview of the category Agricultural soils (3.D) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key	Emissions in Mt CO ₂ eq			2024 vs 1990	Contribution by the category in 2024 (%) to the		
			1990	2023	2024	%	sector	total gas	total CO ₂ eq
3.D. Agriculture soils	N ₂ O		7.8	4.2	4.1	-46.8%	23.3%	62.8%	2.9%
3.D.1. Direct N ₂ O emissions from agricultural soils	N ₂ O	Key(L,T)	6.3	3.7	3.6	-42.5%	20.6%	55.3%	2.5%
3.D.a.1. Inorganic fertilisers	N ₂ O		1.8	0.95	0.97	-45.0%	5.5%	14.7%	0.67%
3.D.a.2. Organic N fertilisers	N ₂ O		0.69	1.1	1.1	53.9%	6.0%	16.1%	0.74%
3.D.a.3. Urine and dung from grazing animals	N ₂ O		2.7	0.77	0.71	-73.8%	4.0%	10.7%	0.49%
3.D.a.4. Crop residues	N ₂ O		0.42	0.30	0.29	-30.6%	1.6%	4.4%	0.20%
3.D.a.5. Mineralisation/immobilisation associated with loss/gain of soil organic matter	N ₂ O		0.04	0.03	0.04	3.9%	0.22%	0.60%	0.03%
3.D.a.6. Cultivation of organic soils	N ₂ O		0.74	0.58	0.58	-21.8%	3.2%	8.7%	0.40%
3.D.2. Indirect N ₂ O Emissions from managed soils	N ₂ O	Key(L,T)	1.4	0.50	0.49	-65.9%	2.8%	7.4%	0.34%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

This source category comprises the following key categories:

- 3.D.1 Direct emissions from agricultural soils N₂O (L,T)
- 3.D.2 Indirect emissions from managed soils N₂O (L,T)

The decrease in total N₂O emissions from 1990 onwards has been due to a relatively large decrease in N inputs into soil (from inorganic fertiliser and organic N fertiliser applications and from production of animal manure on pasture during grazing; Figure 5.5). This was partly counteracted by a shift from applying manure on top of the soil (surface spreading) towards incorporating it into the soil, initiated by the Dutch ammonia policy. Incorporating manure into the soil reduces emissions of ammonia but increases direct emissions of N₂O, counteracted in part by

lower indirect N_2O emissions following the atmospheric deposition of NH_3 and NO_x .

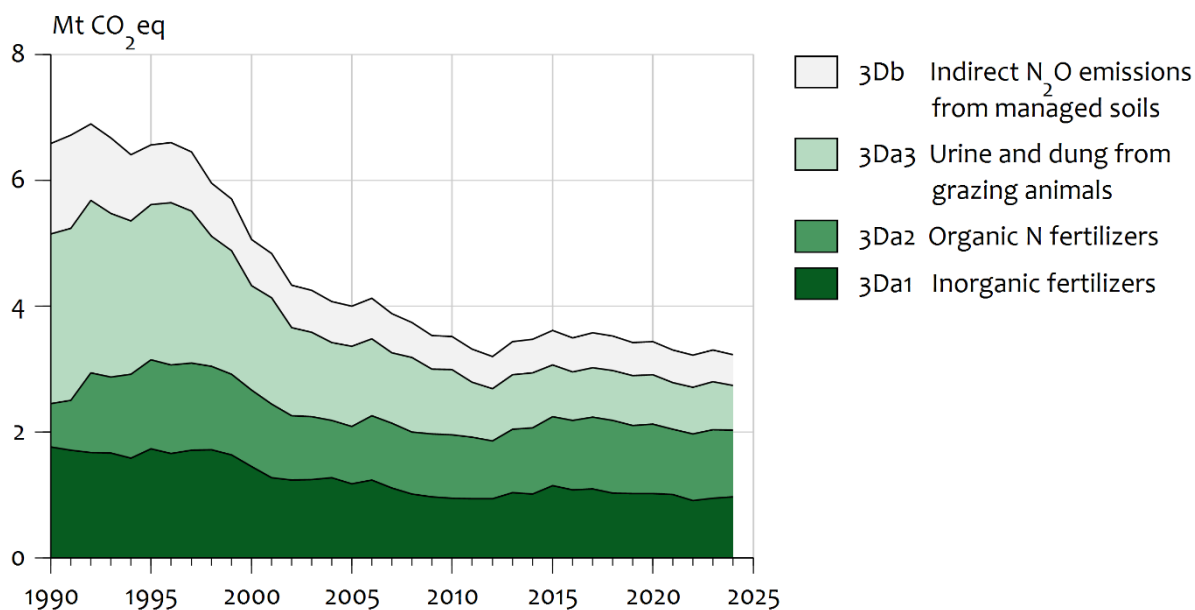
Methane emissions from agricultural soils are regarded as natural, non-anthropogenic emissions and are therefore not estimated.

The source category Agricultural soils includes emissions from:

- Inorganic fertilisers (3.D.a.1);
- Organic N fertilisers (mainly animal manure, 3.D.a.2);
- Urine and dung from grazing animals (3.D.a.3);
- Crop residues (3.D.a.4);
- Mineralisation/immobilisation associated with losses/gains of soil organic matter (3.D.a.5)
- Cultivation of organic soils (3.D.a.6);
- Indirect N_2O emissions from managed soils (3.D.2).

Figure 5.8 shows the trend in total agricultural soils emissions.

Figure 5.8 Category 3.D Agricultural soils – trend and emissions levels of source categories, 1990–2024



Between 70% and 80% of the N excreted in animal housing is available for application to soils. The remainder is lost during storage or exported. The export of manure increased in the last decade, but stagnated in recent years. The method to calculate manure export is explained in section 2.2.5 of Van der Zee et al. (2026), the activity data are provided in Table B16.3 of Van der Most et al. (2026). Approximately 10% to 16% of the N excreted in housing is emitted as NH_3 or NO_x during storage. In addition, part of the N stored in manure is lost as N_2 and N_2O .

The total N supply to the soil was considered to calculate leaching and run-off. This supply consists of N from manure production in animal housing and on pasture (including treated manure, corrected for manure export), as well as the application of inorganic N fertiliser, sewage

sludge and compost. In accordance with the IPCC 2006 Guidelines, the calculation includes atmospheric N deposition because the N deposited to soil is also subject to leaching and run-off. Total N supply to the soil decreased by 39% between 1990 and 2024. This can be explained by the Netherlands' manure and fertiliser policy aimed at reducing N leaching and run-off. This policy regulates the amount of manure production and its application to soils by introducing measures, such as restrictions on the numbers of swine and poultry per farm (so-called 'manure production rights') and maximum application limits for manure and inorganic N fertiliser, all part of the Dutch 'Manure and Fertilisers Act' in accordance with the Nitrates Directive. Because the leaching fraction has also decreased over time, the amount of N leached or run off has been reduced by 48% since 1990. Between 1990 and 2024, the emissions from crop residues decreased by 30.6% (Table 5.8). The same decreasing trend can be seen in the amount of crop residues left on the field. This is mainly due to a decrease in grassland renewal. The rate of grassland renewal decreased as a result of policy changes that encouraged permanent grassland (RVO, 2021). The methodology to calculate N₂O emissions from crop residues is provided in section 12.7 of Van der Zee et al. (2026). Activity data can be found in annex 21 of Van der Most et al. (2026).

5.4.2 *Methodological issues*

Direct and indirect N₂O emissions from agricultural soils are estimated using country-specific activity data on N input to soil and NH₃ volatilisation during grazing, manure management, and manure application. Most of these data are estimated at Tier 2 or Tier 3 level. The present methodologies follow the 2006 IPCC Guidelines. A description of the used methodologies and the data sources is presented in chapter 12 in Van der Zee et al. (2026). Further information can be found in the background document by Van der Hoek et al. (2007). The activity data and characteristics for crops are presented in Van der Most et al. (2026).

Direct N₂O emissions (3.D.a)

An IPCC Tier 2 methodology is used to estimate direct N₂O emissions from agricultural soils.

The EF of inorganic N fertiliser application for direct N₂O emissions between 1990 and 1999 is based on a weighted mean of various inorganic N fertiliser types applied to both mineral and organic soils. The EFs for animal manure applied to or produced on pastureland during grazing between 1990 and 1999 are also based on weighted means of the EF for mineral and organic soils.

For the years from 2000 to 2024, separate EFs have been quantified for organic soils and mineral soils. A distinction has also been made between arable land and grassland. This results in three separate EFs each for inorganic fertiliser application, surface spreading of manure, and manure incorporation into soil. The EFs of grassland and arable land on organic soils are the same, as the carbon content (and thus the potential for N₂O emissions) in these soils is hardly affected by the type of agriculture practiced. For the years 2000–2024, two separate EFs have also been quantified for organic and mineral soils used for grazing.

The emission factors are based on field measurements which also took the effects of lowered groundwater levels into account (Velthof et al. 1996). An overview of the EFs used is presented in Table 5.9, with default IPCC EFs included for comparison.

Table 5.9 Emission factors for direct N₂O emissions from agricultural soils (kg N₂O-N per kg N supplied, except Mineralisation/immobilisation associated with losses/gains of soil organic matter, which is expressed in kg N₂O-N per kg CO₂)

Source	Default IPCC	EF used	Reference
Inorganic N fertiliser	0.01	0.013	1
Mineral soils grassland		0.008	1
Organic soils grassland		0.030	1
Mineral soils arable land		0.007	1
Organic soils arable land		0.030	1
Animal manure application	0.01		
Surface spreading average		0.004	1
Mineral soils grassland		0.001	1
Organic soils grassland		0.005	1
Mineral soils arable land		0.006	1
Organic soils arable land		0.005	1
Incorporation into soil average		0.009	1
Mineral soils grassland		0.003	1
Organic soils grassland		0.010	1
Mineral soils arable land		0.013	1
Organic soils arable land		0.010	1
Sewage sludge	0.01		
Surface spreading		0.004	1
Incorporation into soil		0.009	1
Compost	0.01	0.004	2
Animal manure during grazing (cattle/swine/poultry)	0.02	0.033	1
Mineral soils		0.025	1
Organic soils		0.060	1
Animal manure during grazing (sheep/other animals)	0.01	0.033	1
Mineral soils		0.025	1
Organic soils		0.060	1
Crop residues	0.01	0.01	3
Grassland renewal		5.5*	5
Mineralisation/immobilisation associated with losses/gains of soil organic matter	0.006		
Cultivation of organic soils		0.02	3, 4

*kg N₂O-N per ha grassland renewed

References: 1 = Velthof et al. (2010a), Velthof and Mosquera (2011), Van Schijndel and Van der Sluis (2011); 2 = equal to that of surface-applied manure (Velthof and Mosquera, 2011); 3 = Van der Hoek et al. (2007); 4 = Kuikman et al. (2005); 5 = Velthof et al. 2010b.

Emissions from animal manure application are estimated for two manure application methods: surface spreading (which has a lower EF) and incorporation into soil (which has a higher EF). The higher value for incorporation is explained by two mechanisms. Incorporation of animal manure into the soil produces less NH_3 ; therefore, more reactive N enters the soil available for N_2O emission. Furthermore, the manure is more concentrated (i.e. hot spots/anaerobic) than with surface spreading, generally creating improved conditions for N_2O production during nitrification and denitrification processes.

The different EFs for mineral soils and organic soils and mineral soil – arable land and mineral soil – grassland are due to the difference in organic matter content. The organic matter content of the soil influences the N_2O emission. Organic soils have a higher organic matter content than mineral soils and mineral soils – grassland have a higher organic matter content than mineral soils – arable land. The difference in organic matter content between organic soil – grassland and organic soil – arable is negligible (Velthof and Rietra, 2018).

The IEF of direct N_2O emissions from the application of animal manure on agricultural soils increased by 113% in the 1990–2024 period (Table 5.10). This was caused by an ammonia policy-driven shift from the surface spreading of manure to the incorporation of manure into the soil.

Table 5.10 N_2O implied emission factor (kg N_2O -N per kg N supplied) from animal manure applied (excl. manure on pasture) to agricultural soils, 1990–2024.

	1990	2000	2010	2015	2020	2023	2024
Nitrogen input from manure applied to soils	0.004	0.009	0.008	0.008	0.008	0.008	0.009

The net decrease in Direct N_2O emissions (3.D.1) can be explained by the decrease in the direct N input to the soil by manure and inorganic N fertiliser application, partly countered by an increase in IEF because of the manure incorporation into the soil.

No experimental data on compost emissions is available. On the basis of expert judgement, the emission factor for compost was set equal to that of surface-applied manure, because compost is also applied to the surface. The IPCC guidelines contain one emission factor for all N additions to the soil. The emission factor used is within the uncertainty range provided by the IPCC (0.003–0.03). The EF used for urine and dung deposited by grazing animals is based on Velthof et al. (1996) who conducted a field study on N_2O emissions resulting from grazing in the Netherlands. During their study, the effect of a lowered ground water level was taken into account. Annex 9 in Van der Zee et al. (2026) describes how the results of this paper were used to calculate the emission factors used in the inventory of the Netherlands. As arable farming on organic soils is relatively small compared to arable farming on mineral soils in the Netherlands, the EF for crop residues is based on mineral soils only. The EF of grassland renewal is based on the average of grassland renewal with and without ploughing up the land (Velthof et al. 2010b).

Emissions from mineralisation/immobilisation associated with losses/gains of soil organic matter are calculated using the Tier 1 method from the 2019 refinement to the IPCC guidelines. The losses of soil organic matter are calculated by the LULUCF sector and discussed in Chapter 6. The C/N ratio ranges between 15 and 25.6. The ratio is calculated by the LULUCF sector. Further information can be found in Van Baren et al. (2026).

Indirect N₂O emissions (3.D.b)

An IPCC Tier 2 method is used to estimate indirect N₂O emissions from atmospheric deposition. Country-specific data on NH₃ and NO_x emissions (estimated at Tier 3 level using NEMA) is multiplied by the IPCC default N₂O EF. The emissions can be found in chapter 9 of Van der Most et al. (2026).

Indirect N₂O emissions resulting from leaching and run-off are estimated using country-specific data on total N input to soil and leaching fraction (estimated at Tier 3 level). The leaching fraction can be found in section 4.2 of Van der Most et al. (2026). The leaching fraction applied in the model reflects the specific characteristics of the Dutch agricultural soils, with relatively high water tables. A model (STONE) was adopted to assess this fraction, as described in Velthof and Mosquera (2011), while IPCC default values were used for the N₂O EF.

5.4.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The uncertainty analysis outlined in Annex 2 provides estimates of uncertainty per IPCC source category. The uncertainty in direct N₂O emissions from inorganic N fertiliser, organic N fertiliser, and manure and dung deposited by grazing animals is estimated at 42%, 69%, and 68%, respectively. The uncertainty in indirect N₂O emissions from N used in agriculture is estimated to be more than 200%; primarily relating to the emission factor uncertainties.

Time-series consistency

A consistent methodology is used throughout the time series; see section 5.4.2. Emissions are calculated as the product of livestock numbers and EFs. Livestock numbers are collected through the Identification and Registration system and in an annual census published by Statistics Netherlands (CBS). Consistent methods are used in compiling the census to ensure consistency in the collected data.

5.4.4 *Category-specific QA/QC*

This source category is covered by the general QA/QC procedures discussed in Chapter 1.

5.4.5 *Category-specific recalculations*

Five category-specific recalculations have been performed. The N₂O emissions from the application of inorganic N-fertilisers have been updated for the years 2019–2023 as the amount of N in the rinsing liquid from air scrubbers on goat housing has been recalculated (3.D.1.a). A new, higher estimate of ammonia emissions from goat housing has increased the N content in the rinsing liquid, thereby causing the N₂O emissions from inorganic fertilisers to increase by

119 kg (0.00003%) to 359 kg (0.0001%). Air scrubbers on goat housing are rare, the first air scrubbers were installed in 2019 (section 5.2.3 in Van der Zee et al. 2026).

The N₂O emissions relating to losses/gains in soil organic matter content have been recalculated on the basis of new insights from the LULUCF sector (3.D.1.e). Carbon stock changes for mineral soils under cropland and grassland, have been simulated with RothC using a revised five-year weather-averaging approach that better reflects year-specific management changes while reducing weather-driven variability. The area of peat, peaty and minerals soils used by agriculture have also been updated. Further information can be found in section 6.1.3 of the NID.

The emission factor for N mineralised from mineral soils has also been updated to the value from the 2019 IPCC guidelines (from 0.01 kg N₂O per kg N to 0.006 kg N₂O per kg N). The combined effect of these changes varies per year from -1012 kg N₂O (2022) to -245,218 (2008).

The N₂O emissions relating to the Cultivation of organic soils (3.D.1.f) have been recalculated on the basis of new areas of peat and peaty soils from the LULUCF sector. The change results in higher emissions between 1990 and 2020 and lower emissions in the subsequent years. In 1990 emissions increase by 1214 kg N₂O (0.04%), in 2023 emissions decrease by 9808 kg N₂O (0.45%).

Indirect emissions from managed soils (3.D.2) have changed, which is mainly due to the new mineralisation rates resulting from the aforementioned updates from the LULUCF sector. Other changes have ensued from updated NH₃, NO_x and N₂O emissions from manure management, affecting the amount of manure available for application. Changes to emissions range between -0.7% and +0.2%. Further information on the calculation of the indirect emissions can be found in sections 12.9 and 12.10 of Van der Zee et al. (2026).

Final usage rates of inorganic fertilisers and compost, and the grassland renewal rate of 2023 differ from the preliminary rates. This affects the N₂O emissions from Agricultural soils (+60,280 kg N₂O) (3.D) and Crop residues (-8,209 kg N₂O) (3.D.1.d.).

5.4.6 *Category-specific planned improvements*
There are currently no planned improvements.

5.5 Liming (3.G)

5.5.1 *Category description*

The source category Liming includes emissions of CO₂ from the application of limestone (calcium carbonate) and dolomite (calcium-magnesium carbonate) to agricultural soils. Limestone and dolomite are applied to maintain a suitable pH range for crop and grass production. CO₂ emissions from liming decreased by 83.7% between 1990 and 2024 as a result of a decrease in limestone and dolomite use (Table 5.11).

Table 5.11 Overview of the category Liming (3.G) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key				2024 vs 1990	Contribution by the category in 2024 (%) to the		
			1990	2023	2024		sector	total gas	total CO ₂ eq
			Emissions in Mt CO ₂ eq			%			
3.G. Liming	CO ₂	Non-key	0.18	0.03	0.03	-83.7%	0.17%	0.03%	0.02%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

Category 3.G Liming is not a key category.

Limestone and dolomite make up 40–60% of the calcium-containing fertilisers used in agriculture. The remaining percentage (30%–55% of the total) consists mainly of sugar beet factory lime. CO₂ emissions relating to the latter are balanced by the CO₂ sink in sugar production; therefore, they are not accounted for. Further information can be found in section 2.2.3.1 of Honig et al. (2026).

5.5.2 Methodological issues

Data on liming is derived from annually updated statistics on fertiliser use. The annual amounts of applied limestone and dolomite are converted into CO₂ emissions, in line with the calculations in the 2006 IPCC Guidelines.

Limestone and dolomite amounts reported in CaO (calcium oxide) equivalents are multiplied by the EFs for limestone (440 kg CO₂/ton pure limestone) and for dolomite (477 kg CO₂/ton pure dolomite). This method complies with IPCC Tier 1 methodology. More detailed descriptions of the methodologies and EFs used can be found in chapter 15 of Van der Zee et al. (2026).

5.5.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The analysis outlined in Annex 2 provides estimates of uncertainties by IPCC source category. The uncertainty in CO₂ emissions from liming of soils is calculated at approximately 25%. The uncertainty in the activity data are estimated to be 25% and the uncertainty in the EFs is 1%. When considered over a longer time span, all carbon applied through liming is emitted.

Time-series consistency

The methodology used to calculate CO₂ emissions from limestone and dolomite application for the 1990–2024 period is consistent over time. Statistics on calcium-containing fertiliser use are collected by Wageningen Social and Economic Research and published on the website of agrimatie (2026) (<http://agrimatie.nl/KunstMest.aspx?ID=16927>).

5.5.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

5.5.5 *Category-specific recalculations*

Every year, preliminary numbers of limestone and dolomite application are used for the last year in the inventory. The definitive usage of limestone and dolomite in 2023 differs from the preliminary numbers, resulting in a 12% increase of CO₂ emissions in 2023 (3 kt CO₂).

5.5.6 *Category-specific planned improvements*

The preliminary application rates of the liming products in 2024 will be replaced with the definitive application rates.

5.6 **Urea application (3.H)**

5.6.1 *Category description*

During the production of urea, CO₂ is trapped from the fumes produced by the burning of gas. This CO₂ is subsequently released during the application of urea. The entrapment is attributed to the production. The CO₂ emissions resulting from the application of urea to Dutch farmland are attributed to the Agriculture sector. Between 1990 and 2002, urea usage was low, with small interannual fluctuations. After 2002, urea usage increased, peaking in 2013. After 2013, urea usage shows large interannual fluctuations, but remain at a high level, compared to the 1990s. Carbon dioxide emissions from urea application increased by 3339.7% from 1990 to 2024 (Table 5.12).

Table 5.12 Overview of the category Urea application (3.H) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key	1990 2023 2024			2024 vs 1990	Contribution by the category in 2024 (%) to the		
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
3.H. Urea application	CO ₂	Non-key	0.00	0.07	0.05	3339.7%	0.29%	0.04%	0.04%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

Source category 3.H Urea application is not a key category.

5.6.2 *Methodological issues*

Data on urea application is derived from annually updated statistics on fertiliser use. Urea fertilisers often contain other N compounds. As there is no information on the percentage of urea in urea fertilisers, the calculations assume that urea fertilisers only consist of urea. The amounts of annually applied urea are converted into CO₂ emissions in line with the calculations in the 2006 IPCC Guidelines.

The amount of urea is multiplied by the EF for urea (0.2 kg CO₂/kg urea). This method follows the IPCC Tier 1 methodology. More detailed

descriptions of the methodology and EF used can be found in chapter 16 of Van der Zee et al. (2026).

5.6.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The analysis outlined in Annex 2 provides estimates of uncertainties by IPCC source category. The uncertainty in CO₂ emissions from urea application is calculated at 25%. The uncertainty in the activity data are estimated to be 25% and the uncertainty in the EFs is 1%. When considered over a longer time span, all carbon applied through urea application is emitted.

Time-series consistency

The methodology used to calculate CO₂ emissions from urea application is consistent over time. Statistics on urea application are collected by the agricultural census.

5.6.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

5.6.5 *Category-specific recalculations*

Every year, preliminary numbers of urea application are used for the last year in the inventory. The definitive usage of urea in 2023 differs from the preliminary numbers, resulting in a 1% decrease of CO₂ emissions in 2023.

5.6.6 *Category-specific planned improvements*

The preliminary application rate of urea in 2024 will be replaced by the definitive application rate.

6 Land use, land-use change and forestry (CRT sector 4)

Major changes in the LULUCF sector compared to the National Inventory Report 2025

Emissions: In 2024, total reported LULUCF emissions increased by 12.6% compared to 2023. Compared to the base year, emissions in 2024 were 3.5% lower. As a result of methodological changes described in this NID 2026, emissions in the LULUCF sector for the year 1990 decreased by 13.1% compared to the NID 2025. For 2023, they decreased by 13.5% compared to the NIR 2025.

New Key categories:

4.A.1 Forest land remaining forest land	CO ₂	Key(L,T)
4.A.2 Land converted to forest land	CO ₂	Key(L1,)
4.B.1 Cropland remaining cropland	CO ₂	Key(L,)
4.B.2 Land converted to cropland	CO ₂	Key(L,T)
4.B.2 Land converted to cropland	N ₂ O	Key(L2,)
4.C.1 Grassland remaining grassland	CO ₂	Key(L,T)
4.C.1 Grassland remaining grassland	CH ₄	Key(L2,)
4.C.2 Land converted to grassland	CO ₂	Key(L,T)
4.E.1 Settlements remaining settlements	CO ₂	Key(L2,T)
4.E.2 Land converted to settlements	CO ₂	Key(L,T)
4.E.2 Land converted to settlements	N ₂ O	Key(L2,)
4.F.2 Land converted to other land	CO ₂	Key(L2,T2)

Methodologies: In the NID 2026, eight methodological changes have been implemented. The methodological changes are as follows:

- The emission factor for drained organic soils has been revised for the entire time period, for CRT categories 4.A-C and 4.E, using new measurements and the SOMERS-LUSOS modelling framework to replace a single emission factor with differentiated CO₂ estimates by soil type, land use, nature type, and region.
- New activity data for the 2021–2024 period with the introduction of a new land-use map dated 1-1-2025, thereby shifting to a new land-use map dataset.
- From the 2026 submission onwards, the Dutch LULUCF bookkeeping model uses spatially explicit raster inputs for activity data for all years and land uses. A new spatial interpolation method for making annual land-use and soil maps makes this possible.
- Carbon stock changes for mineral soils under Cropland and Grassland, CRT categories 4.B and 4.C, are simulated with RothC

using a revised five-year weather-averaging approach that better reflects year-specific management changes while reducing weather-driven variability.

- Mineral soil N₂O emissions, for CRT categories 4(III).A-4(III).E, from land-use change disturbances are now calculated using updated C:N ratios derived from 1047 soil samples from the 2018 Dutch Soil Sampling Programme, providing soil- and land-use-specific ratios that replace estimates.
- The emission factor for N₂O from nitrogen mineralisation on mineral soils for CRT categories 4(III).A-4(III).E due to soil carbon loss was updated from 0.01 to 0.006 kg N₂O-N per kg N, which is in line with the 2019 IPCC Refinements and ensures consistency with the Agriculture sector under Dutch wet climate conditions.
- The LULUCF bookkeeping model was updated so that pixels transitioning from organic to mineral soils due to peat oxidation are now assigned the corresponding mineral-soil carbon stocks instead of zero, enabling correct modelling of subsequent carbon stock changes from later land-use transitions.
- The introduction of spatially explicit SOMERS-based emission factors for each land-use/soil combination eliminated the need for a variable fixed drainage fraction.

6.1 Overview of the sector and background information

6.1.1 *General overview of shares and trends in sources and sinks*

This chapter describes the 2026 GHG inventory for the Land Use, Land-Use Change, and Forestry (LULUCF) sector. It covers both the sources and the sinks of CO₂ from LULUCF. Emissions of nitrous oxide (N₂O) from the cultivation of organic soils are included in the Agriculture sector (category 3.D 'Agricultural soils'), except for N₂O emissions from Forest land, which are reported in CRT Table 4(II). Direct N₂O emissions from nitrogen mineralisation associated with loss/gain of soil organic matter in all land categories (CRT table 4(III)) are included here, except those from Cropland remaining cropland, which are included in the Agriculture sector (CRT Table 3.D). Methane (CH₄) emissions from drainage ditches in drained Forest land, Cropland, agricultural grasslands, and Trees outside Forest on organic soils are reported in CRT Table 4(II) as a specific category under organic soils for these land-use categories. Emissions of CH₄ from open water are reported under Wetlands in CRT Table 4(II). CO₂, N₂O, and CH₄ emissions from biomass burning are included in CRT Table 4(IV).

Table 6.14 presents the most recent estimates of the relative composition of land use in the Netherlands in terms of standardised LULUCF classes. To provide additional context on how these aggregated classes translate to the Dutch context, supplementary statistics based on further subdivisions are presented below:

Land use in the Netherlands is dominated by agriculture (24.1% agricultural grasslands and 18.8% cropland for a total of 42.9% agricultural land use), followed by settlements (16.3%) and forestry

(8.8%); 10.1% comprises non-agricultural grasslands, other vegetation, dunes, nature reserves, wildlife areas, heather, and reed swamp. The remaining area (21.9%) is open water (information based on the 2025 land-use map used for LULUCF reporting, see the second method change in section 6.1.3 of this report and section 3 in Van Baren et al., 2026). The soils in the Netherlands are dominated by mineral soils, mainly sandy soils, and clay soils (of fluvial or marine origin). Organic soils, used mainly as meadowland, cover about 11.0% of the land area, one third of them being peaty soils.

The Netherlands has an intensive agricultural system with high inputs of nutrients and organic matter. The majority of agricultural land in 2024 was grassland (53.8%) or arable farming land (29.7%). Green fodder crops occupied an additional 11.4% of agricultural land. The remaining land is fallow or used for horticulture, fruit trees, et cetera. For further information on how these remaining areas are divided between the LULUCF classes of Cropland and Grassland, see 4.B and 4.C in section 6.2. In 2024, 69.7% of agricultural grassland was permanent grassland. Natural agricultural grassland made up 9.3% of the total, while the remaining 21.0% is temporary grassland, on which grass and green fodder crops are cultivated in rotation (CBS, 2025). Since 1990, the agricultural land area has decreased by about 5%, mainly because of conversion to settlements/infrastructure and nature.

Table 6.1 presents the sources and sinks in the LULUCF sector in 1990, 2023, and 2024. For 1990 and 2024, total net emissions are 3.8 Mt CO₂ eq and 3.7 Mt CO₂ eq, respectively. The results for 2023 have been added to give insight into interannual changes. Sector 4 (LULUCF) accounted for about 2.6% of net national total CO₂ equivalent emissions in 2024. See Figure 6.1 for the emissions per land-use category for the entire time period.

CO₂ emissions from the drainage of organic soils, such as peat soils and peaty soils, were the largest source of emissions in the LULUCF sector (Figure 6.2). Across all land-use categories, organic soils emitted a total of 4.40 Mt CO₂ in 2024 (5.36 Mt CO₂ in 1990). It is the chief contributor to the net emissions from Cropland (4.B), Grassland (4.C), and Settlements (4.E). These areas are drained for agricultural and urban water management, which results in peat decomposition. Additionally, drainage ditches on organic soils emitted 12.0 kt CH₄ (0.3 Mt CO₂ eq) in 2023, compared to 13.1 kt CH₄ (0.4 Mt CO₂ eq) in 1990.

Forests constitute the major net CO₂ sink with -2.4 Mt CO₂ in 2024, which includes Forest land remaining forest land (4.A.1) and Land converted to forest land (4.A.2). Compared to 2023 the net CO₂ sink stayed stable.

Figure 6.1 Summary of GHG emissions (positive) and removals (negative), differentiated by land-use category (kt CO₂ eq)

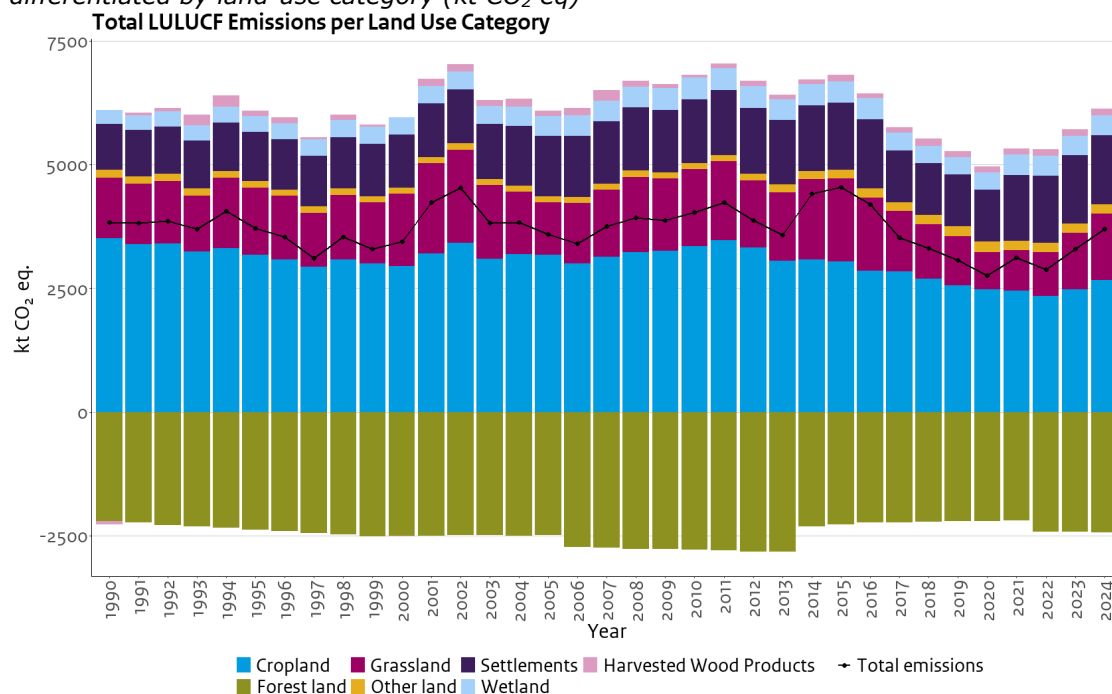
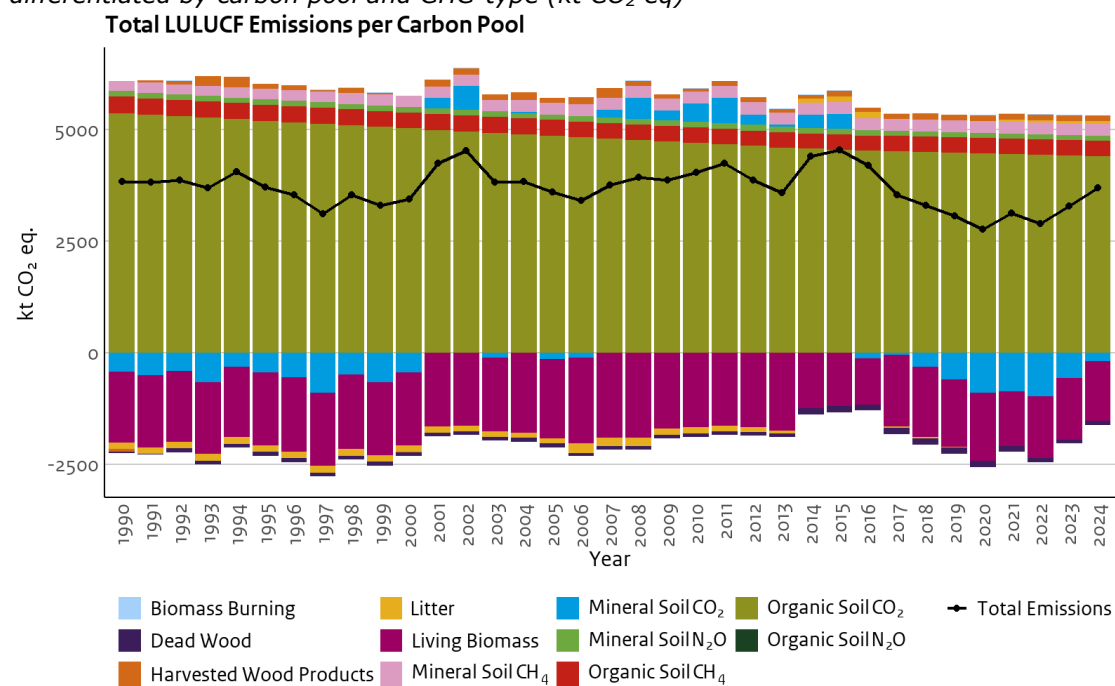


Figure 6.2: Summary of GHG emissions (positive) and removals (negative), differentiated by carbon pool and GHG-type (kt CO₂ eq)



Emissions take the form of CO₂ unless explicitly stated otherwise.

Table 6.1 Overview of the Land use, land-use change and forestry (LULUCF) sector in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
4. Total land-use categories	CO ₂	0.00	3.1	2.6	3.0	-4.5%	80.5%	2.5%	2.1%
	CH ₄		0.59	0.61	0.61	3.8%	16.4%	3.3%	0.42%
	N ₂ O		0.13	0.11	0.11	-14.6%	3.1%	1.7%	0.08%
	All		3.8	3.3	3.7	-3.6%	100.0%		2.6%
4.A. Forest land	CO ₂		-2.2	-2.4	-2.4	-9.7%	-65.8%	-2.1%	-1.7%
4.A.1. Forest land remaining forest Land	CO ₂	L,T	-1.3	-1.8	-1.8	-35.8%	-47.7%	-1.5%	-1.2%
4.A.2. Land converted to forest land	CO ₂	L1	-0.92	-0.68	-0.67	27.2%	-18.1%	0.56%	-0.46%
4.B. Cropland	CO ₂		3.5	2.5	2.7	-23.8%	70.1%	2.2%	1.8%
4.B.1. Cropland remaining cropland	CO ₂	L	1.6	0.95	1.1	-30.1%	29.6%	0.93%	0.76%
4.B.2. Land converted to cropland	CO ₂	L,T	1.8	1.5	1.5	-18.5%	40.5%	1.3%	1.0%
Land converted to cropland N ₂ O		L2	0.08	0.06	0.06	-25%	2.2%	0.9%	0.02%
4.C. Grassland	CO ₂		0.96	0.90	1.1	14.7%	29.9%	0.93%	0.77%
4.C.1. Grassland remaining grassland	CO ₂	L,T	1.8	1.6	1.8	4.0%	49.8%	1.6%	1.3%
4.C.1. Grassland remaining grassland	CH ₄	L2	0.26	0.23	0.23	12%	21%	1.3%	0.16%
4.C.2. Land converted to grassland	CO ₂	L,T	-0.81	-0.68	-0.74	8.8%	-19.9%	0.62%	-0.51%
4.D. Wetlands	CO ₂	0.00	0.00	0.04	0.03	2462.6%	0.93%	0.03%	0.02%
	CH ₄		0.29	0.36	0.36	24.0%	9.8%	2.0%	0.25%
4.D.1. Wetlands remaining wetlands	CO ₂		IE,NA,NO	IE,NA,NO	IE,NA,NO		0.00%	0.00%	0.00%
	CH ₄		0.22	0.31	0.32	40.4%	8.5%	1.7%	0.22%
4.D.2. Land converted to wetlands	CO ₂		0.00	0.04	0.03	2462.6%	0.93%	0.03%	0.02%
	CH ₄		0.07	0.05	0.05	-30.9%	1.3%	0.25%	0.03%
	All		0.29	0.40	0.40	36.6%	10.8%		0.28%
4.E. Settlements	CO ₂	0.00	0.89	1.3	1.4	52.4%	36.7%	1.1%	0.94%

Sector/category	Gas	Key	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
4.E.1. Settlements remaining settlements	CO ₂	L2,T	0.13	0.32	0.33	157.6%	8.8%	0.27%	0.23%
4.E.2. Land converted to settlements	N ₂ O	L2	0.77	1.0	1.0	35.0%	27.9%	0.87%	0.72%
4.F. Other land	CO ₂	0.00	0.14	0.19	0.19	32.0%	5.1%	0.16%	0.13%
4.F.1. Other land remaining other land	CO ₂		NA	NA	NA		0.00%	0.00%	0.00%
4.F.2. Land converted to other land	CO ₂	L2,T2	0.14	0.19	0.19	32.0%	5.1%	0.16%	0.13%
4.G. Harvested wood products	CO ₂	0.00	-0.07	0.12	0.13	284.2%	3.4%	0.11%	0.09%
National total GHG emissions (incl. CO ₂ LULUCF)	CO ₂		166.7	119.8	118.5	-28.9%			
	CH ₄		36.5	18.6	18.3	-50.0%			
	N ₂ O		16.1	6.6	6.6	-59.1%			
	Total		226.6	146.1	144.4	-36.3%			

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the categories to the LULUCF sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided. Emissions of CH₄ are only explicitly presented for open water under wetlands. Other emissions of CH₄ and emissions of N₂O are only presented for the total as the subdivision into the separate land-use categories will mostly result in emissions that are lower than 0.1 Mt CO₂ eq.

Key categories

When taking LULUCF categories into account in the key category analysis, the inventory comprises the following key categories:

4.A.1 Forest land remaining forest land	CO ₂	Key(L,T)
4.A.2 Land converted to forest land	CO ₂	Key(L1,)
4.B.1 Cropland remaining cropland	CO ₂	Key(L,)
4.B.2 Land converted to cropland	CO ₂	Key(L,T)
4.B.2 Land converted to cropland	N ₂ O	Key(L2,)
4.C.1 Grassland remaining grassland	CO ₂	Key(L,T)
4.C.1 Grassland remaining grassland	CH ₄	Key(L2,)
4.C.2 Land converted to grassland	CO ₂	Key(L,T)
4.E.1 Settlements remaining settlements	CO ₂	Key(L2,T)
4.E.2 Land converted to settlements	CO ₂	Key(L,T)
4.E.2 Land converted to settlements	N ₂ O	Key(L2,)
4.F.2 Land converted to other land	CO ₂	Key(L2,T2)

6.1.2 *Methodology and coverage*

Details of the methodologies applied to estimating CO₂ emissions and removals in the LULUCF sector in the Netherlands are provided in a methodological background document (Van Baren et al., 2026).

The methodology of the Netherlands for assessing emissions from LULUCF is primarily based on the 2006 IPCC Guidelines (IPCC, 2006), and the 2019 refinement to the 2006 IPCC guidelines (IPCC, 2019). It follows a carbon stock change approach that is based on inventory data subdivided into appropriate pools and land-use types, and a wall-to-wall approach to the estimation of area per land-use category. For the calculation of CH₄ emissions from open water under the Wetland category, from drainage ditches in peat meadows (Grassland) and Cropland on organic soils, the guidelines from the 2013 IPCC Wetlands supplement (IPCC, 2014) were applied.

The information on the activities and land-use categories covers the entire territorial (land and water) surface area of the European part of the Kingdom of the Netherlands. The inventory includes six land-use categories: Forest land (4.A); Cropland (4.B); Grassland (4.C); Wetlands (4.D); Settlements (4.E) and Other land (4.F). Category (4.G), Harvested Wood Products (HWP), provides information on carbon gains and losses from the HWP carbon pool.

Spatially explicit land use and land-use conversion data ('remaining' or 'land converted to') is presented in a matrix (see section 6.3) in accordance with the geographically explicit Approach 3 described in volume 4, chapter 3 of the 2006 IPCC Guidelines.

The land-use category Grassland is subdivided in two sub-categories: Grassland (non-TOF) and Trees outside forests (TOF) (see section 6.2). The sub-category Grassland (non-TOF) is the aggregation of the main sub-categories Grassland (i.e. predominantly grass vegetation), Nature (mainly heathland and peat moors) and Orchards. All IPCC categories are applicable to the Netherlands.

TOF are units of land that do not meet the minimum area requirement (0.5 ha) for the forest definition but otherwise do fulfil those requirements in terms of tree cover and tree height. Therefore, this category is included under Grassland. In terms of carbon stocks and their changes, however, the TOF category is similar to Forest land.

Conversions of land use from, to, and between Grassland (non-TOF) and TOF are monitored separately, and subsequent calculations of carbon stock changes differ from one another (see section 6.1 in Van Baren et al., 2026).

An overview of the completeness of reporting by the Netherlands is provided in Table 6.2. In this table, pools for which carbon stock changes are reported are indicated in bold type, with the appropriate tier level in brackets. 'NO' is used for pools for which there are no carbon stock changes. 'IE' indicates that carbon stock changes are included elsewhere. Pools for which carbon stock changes are not estimated are marked 'NE', with an indication of the significance of the

respective source or sink ('s' = significant, 'n.s.' = not significant) and a reference to the section where this is justified in this NIR.

The notation key NA is used in cases with a Tier 1 assumption of carbon stock equilibrium.

CH₄ emissions from flooded lands under Wetlands are reported using a Tier 1 methodology and default emission factors (see section 6.7.2).

Table 6.2 Carbon stock changes reported in the national inventory per land-use (conversion) category

From To↓	FL	CL	GL	WL	Sett	OL
FL	BG (T2) BL (T2) DD (T2) DW (T2) Litt (T2) MS (NA) OS (T3) FF (T1)	BG (T2) BL (T2) DD (T2) DW (T2) Litt (T2) MS (T2) OS (T3) FF (IE)	BG (T2) BL (T2) DD (T2) DW (T2) Litt (T2) MS (T2) OS (T3) FF (IE)	BG (T2) BL (T2) DD (T2) DW (T2) Litt (T2) MS (T2) OS (T3) FF (IE)	BG (T2) BL (T2) DD (T2) DW (T2) Litt (T2) MS (T2) OS (T3) FF (IE)	BG (T2) BL (T2) DD (T2) DW (T2) Litt (T2) MS (T2) OS (T3) FF (IE)
CL	BG (T1) BL (T2) DD (T2) DM (T2) MS (T2) OS (T3) WF (IE)	BG (NA, n.s. 6.5.1) BL (NA, n.s., 6.5.1) DD (T2) DM (NA, n.s., 6.5.1) MS (T3) OS (T3) WF (IE)	BG (T1) BL (T1, T2) DD (T2) DM (NA, n.s., 6.5.1, 6.6.1) MS (T2) OS (T3) WF (IE)	BG (T1) BL (NO) DD (T2) DM (NA, n.s., 6.5.1, 6.7.1) MS (T2) OS (T3) WF (IE)	BG (T1) BL (NO) DD (T2) DM (NA, n.s. 6.5.1, 6.8.1) MS (T2) OS (T3) WF (IE)	BG (T1) BL (NO) DD (T2) DM (NA, n.s. 6.5.1, 6.9.1) MS (T2) OS (T3) WF (IE)
GL	BG (T1, T2) BL (T2) DD (T2) DM (T2) MS (T2) OS (T3) WF (IE)	BG (T1, T2) BL (T1, T2) DD (T2) DM (NA, 6.5.1, 6.6.1) MS (T2) OS (T3) WF (IE)	BG (T2) BL (T1, T2) DD (T2) DM (NO, NA, n.s. 6.6.1) MS (T3) OS (T2, T3) WF (T1)	BG (T1, T2) BL (NO) DD (T2) DM (NA, n.s. 6.6.1, 6.7.1) MS (T2) OS (T3) WF (IE)	BG (T1, T2) BL (NO) DD (T2) DM (NA, n.s. 6.6.1, 6.8.1) MS (T2) OS (T3) WF (IE)	BG (T1, T2) BL (NO) DD (T2) DM (NA, n.s. 6.6.1, 6.9.1) MS (T2) OS (T3) WF (IE)

From To↓	FL	CL	GL	WL	Sett	OL
WL	BG (NE, n.s. 6.7.1) BL (T2) DM (T2) MS (T2) OS (T3) WF (IE)	BG (NE, n.s. 6.7.1) BL (T1) DM (NE, 6.5.1, 6.7.1) MS (T2) OS (T3) WF (IE)	BG (NE, n.s. 6.7.1) BL (T1, T2) DM (NE, 6.6.1, 6.7.1) MS (T2) OS (T3) WF (IE)	BG (NE, n.s. 6.7.1) BL (NE, n.s. 6.7.1) DM (NE, n.s. 6.7.1) MS (NA) OS (NO) WF (IE)	BG (NE, n.s. 6.7.1) BL (NO) DM (NE, n.s. 6.7.1, 6.8.1) MS (T2) OS (NO) WF (IE)	BG (NE, n.s. 6.7.1) BL (NO) DM (NE, n.s. 6.7.1, 6.9.1) MS (T2) OS (NO) WF (IE)
Sett	BG (NE, n.s. 6.8.1) BL (T2) DM (T2) MS (T2) OS (T3) WF (NO)	BG (NE, n.s. 6.8.1) BL (T1) DM (NA, 6.5.1, 6.8.1) MS (T2) OS (T3) WF (NO)	BG (NE, n.s. 6.8.1) BL (T1, T2) DM (NA, 6.6.1, 6.8.1) MS (T2) OS (T3) WF (NO)	BG (NE, n.s. 6.8.1) BL (NO) DM (NA, 6.7.1, 6.8.1) MS (T2) OS (T3) WF (NO)	BG (NA, n.s. 6.8.1) BL (NA, n.s. 6.8.1) DM (NA, 6.8.1) MS (NA) OS (T3) WF (NO)	BG (NE, n.s. 6.8.1) BL (NO) DM (NA, 6.8.1, 6.9.1) MS (T2) OS (T3) WF (NO)
OL	BG (NO, n.s. 6.9.1) BL (T2) DM (T2) MS (T2) OS (NO) WF (NO)	BG (NO, n.s. 6.9.1) BL (T1) DM (NA, 6.5.1, 6.9.1) MS (T2) OS (T3) WF (NO)	BG (NO, n.s. 6.9.1) BL (T1, T2) DM (NA, 6.6.1, 6.9.1) MS (T2) OS (T3) WF (NO)	BG (NO, n.s. 6.9.1) BL (NO) DM (NA, 6.7.1, 6.9.1) MS (T2) OS (NO) WF (NO)	BG (NO, n.s. 6.9.1) BL (NO) DM (NA, 6.8.1, 6.9.1) MS (T2) OS (T3) WF (NO)	NA

Carbon stock changes included are BG: Biomass Gain; BL: Biomass Loss; DD: Drainage Ditches (<3 m) on organic soils with methane emissions; DW: Dead Wood; Litt: Litter; DM: Dead organic Matter; MS: Mineral Soils; OS: Organic Soils; FF: Forest Fires; WF: Other Wildfires. Land use types are: FL: Forest Land; CL: Cropland; GL: Grassland; TOF: Trees Outside Forests; WL: Wetland; Sett: Settlements; OL: Other Land.

Pools for which carbon stock changes are reported are indicated in bold type, with the appropriate tier level in brackets. See the indicated sections for further justification for the use of the notation key 'NA' in the case of non-significant (n.s.) pools

Forest land remaining forest land, Land converted to forest land, Land converted to cropland, Land converted to grassland, Land converted to settlements, Land converted to other land, Grassland remaining grassland, and Settlements remaining settlements are key categories; Grassland is a key category due to the significant CH₄ and CO₂ emissions from peat soils (see sections 6.5.1, 6.6.1 and 6.8.1).

Carbon stock changes in biomass and dead organic matter

The specific methodologies applied to calculating carbon stock changes in living biomass and dead organic matter are provided in the sub-chapters dealing with the land-use categories: Forest land (6.4), Cropland (6.5), Grassland (6.6), Wetlands (6.7), Settlements (6.8) and Other land (6.9). Methodologies for harvested wood products are provided in section 6.10.

Carbon stock changes in mineral soils

The Netherlands uses a Tier 3 approach to assess carbon stock changes in mineral soils for Cropland remaining cropland and Grassland remaining grassland. For mineral soils under the other 'remaining' land-use categories, a Tier 1 assumption of dynamic equilibrium is assumed, which is reported as NA in the CRT. A Tier 2 approach is used for calculating carbon stock changes in land-use conversions on mineral soils.

Cropland remaining cropland and Grassland remaining grassland

Changes in carbon stocks in mineral soils for Cropland remaining cropland and Grassland remaining grassland are calculated by means of the RothC model (version 26.3, Coleman and Jenkinson 2014), which is applied on a national scale, as described in Lesschen et al. (2021). For further details on the methodology, see section 11.2.2 in Van Baren et al. (2026). Over time, the model provides dynamic carbon stock changes that depend on a number of input variables. The most important input data relates to crop areas, input of organic fertilisers, use of cover crops, removal of straw, and soil carbon content. A consistent time series of the input data has been made for the 1990–2024 period. Calculations are performed at 4-digit zip code level, comprising about 3400 units consisting of or containing agricultural land. Further details on the input data can be found below.

- Climate data: Monthly data for the 1990–2024 period is available per KNMI zone (14 zones) in the Netherlands. RothC requires data on monthly rainfall (mm), monthly open pan evaporation (mm), and average mean monthly air temperature (°C).
- Crop areas are based on 'Basisregistratie landbouwpercelen' (BRP, the base layer for the Land Parcel Information System (LPIS) in the Netherlands) and aggregated to 40 crop categories. Detailed data has been available from 2005 onwards, while for the 1990–2004 period, national data were downscaled on the basis of the crop distribution data from 2005.
- Crop yield is based on harvest statistics from Statistics Netherlands (CBS), for the most common crops at provincial level and for other crops at national level.
- Organic fertiliser supply is based on data from the Initiator model, which is also used in the National Emission Model for Agriculture (NEMA) for reporting on the Agriculture sector. A

distinction is made between grazing and fertiliser application on grassland and cropland. These data have been available from 2000 onwards, while for the 1990–1999 period, data from Statistics Netherlands was used. These data are based on nitrogen applications and converted by using average C/N ratios to carbon.

- Compost inputs are derived from data from the Agriculture sector, which includes data on the nitrogen inputs from compost. This is only a small supply source of carbon compared to manure.
- For cover crops (green manures and catch crops), detailed data from LPIS has been available from 2017 onwards, while for the period before, only national total areas are available, which were obtained from NEMA.
- Straw removal is based on national average data from the 'Bedrijven Informatie Netwerk' (BIN, the Dutch data for the EU Farm Accountancy Data Network (FADN)⁸) for wheat and barley straw. This information has been available from 2005 onwards, while the 2005–2007 average was used for the 1990–2004 period. For other straw crops, a fixed percentage was applied, as described in Lesschen et al. (2021)

Lesschen et al. (2021) initialised the model using soil carbon data from the 2018 national soil survey (CC-NL). The CC-NL survey comprises approximately 1150 sampling locations, with soil measurements taken at two depth intervals (0–30 cm and 30–100 cm). Soil organic carbon (SOC) stocks in the upper 30 cm were determined on the basis of the measured SOC content and soil bulk densities derived via a pedo-transfer function (Knotters et al., 2022). The data were classified into seven soil types and three land-use categories at the time of sampling. To create a spatially explicit soil carbon map, data from the CC-NL was linked to a wide range of explanatory variables, such as land use and topography. A soil pH map of the Netherlands has previously been made, using this same digital soil mapping method, see Helfenstein et al. (2022). This new soil organic carbon map has a resolution of 25m and was aggregated to average soil organic carbon (SOC) contents under mineral grassland and arable soils per 4-digit zip code area. Prior to their use in the LULUCF bookkeeping model, results of the soil carbon model are aggregated per main soil type (sand, clay, loess, and soils with human-induced organic rich topsoil (*eedrgrond*)) to annual average carbon stock changes per ha for both cropland and grassland.

The SOC balance calculations with RothC have been performed on the basis of the actual monthly climate data from the Royal Netherlands Meteorological Institute (KNMI). As the model is quite sensitive to the climate parameters, the interannual variability of the SOC balance was considerable (-0.41 to +0.25 ton C/ha). Therefore, we opted to use five-year averaged values. Each year is now simulated for five weather years (the actual year and the four years before) and the average SOC change from these simulations is used for C fluxes in the Cropland remaining cropland and Grassland remaining grassland categories. Such a five-year period is in line with the five-year accounting periods of the EU

⁸ https://agriculture.ec.europa.eu/data-and-analysis/farm-structures-and-economics/fadn_en

LULUCF regulation and also with the national forest inventory, which is based on a five-year cycle.

Land use conversions on mineral soils

For land-use conversions on mineral soils, land-use maps are overlaid with the 2014 update of the Dutch soil map and combined with the soil carbon stocks quantified for each land-use and soil-type combination (see section 3.5 in Van Baren et al., 2026). Estimates of carbon emissions from land-use change on mineral soils are also based on the 2018 national soil survey CC-NL (Knotters et al., 2022), which updates the earlier soil map unit survey by Finke et al. (2001).

Samples were taken on forest land, cropland and grassland. For conversions involving other land uses, estimates were made using the 2006 IPCC Guidelines. The assumptions were:

- For conversion to settlements: 50% is paved and has a soil carbon stock amounting to 80% of that of the former land use, 50% consists of grassland or wooded land with corresponding soil carbon stock.
- For wetlands converted to or from forest, there is no change in carbon stock.
- For other land, the carbon stock is zero (conservative assumption).

The 2006 IPCC Guidelines prescribe a twenty-year transition period in which carbon stock changes take place. This transition period in mineral soils means that land-use changes in 1971 will still have a small effect on reported carbon stock changes in 1990. These pre-1990 land-use changes are monitored through the use of a 1970 land-use map. This also means that the twenty-year transition period is included in land that was converted to another land use before 1990 (see section 3.2 in Van Baren et al., 2026).

Carbon stock changes in organic soils

On the basis of the definition of organic soils in the 2006 IPCC Guidelines, two types of organic soils are considered. First, peat soils with a peat layer of at least 40 cm within the first 120 cm, and second, peaty soils (Dutch: *moerige gronden*) with a peat layer of 5–40 cm within the first 80 cm. From a physical geography perspective, a distinction is made between two kinds of organic soil areas: coastal peatlands and upland peatlands. Coastal peatlands, contributing to around 72% of the total organic soils area, are mainly located along the coastline of the Netherlands (from the South-West to the North) and consists of the area that was historically prone to flooding by storm surges from the sea. All organic soils up to one meter above sea level are regarded as part of the coastal peatlands (Erkens & Melman, 2020). Upland peatlands are the organic soils in the rest of the Netherlands and are elevated above one meter sea level. Upland peatlands are mainly found in the provinces of North Brabant and Drenthe, in valley systems, or on watersheds.

The development of organic soil area between 1990 and 2014 and between 2014 and 2040 was assessed using overlays of three soil maps: the initial map with the average year of sampling dating from 1977; a 2014 update on the spatial extent of organic soils; and a

forecast map with the projected spatial extent of organic soils in 2040 (see section 11.3 in Van Baren et al., 2026 for details). Drainage of organic soils results in peat decomposition and loss of organic matter and thus – eventually – in the loss of peat and peaty soils. As a result, the reported total area of organic soils decreased from 528 kha in 1977 to 500 kha in 1990, and to 437 kha in 2014. The total area of organic soils for the intermediate years was linearly interpolated between 1977 and 2014. To assess the (loss of) extent of organic soils after 2014, an updated forecast map of the extent of peat and peaty soils by 2040 was used (Erkens et al., 2021; for further details, see section 11.3 in Van Baren et al. 2026). For the intermediate years, the total area of organic soils was interpolated from the two maps from 2014 and 2040.

Overlays with the land-use maps provide information on areas of organic soils under the various land-use categories. Carbon stock losses resulting from drainage of peat and peaty soils are determined for areas of Cropland, Grassland under agricultural use (excluding nature grasslands), Settlements, and part of the Forest land. These areas are intersected by drainage ditches that cover in total 1.4% of the area of Cropland on organic soil, and 5.8% for Grassland, 9.6% for Trees outside Forest and 2.8% for Forest land. For these ditches, CH₄ emissions are calculated instead of CO₂ emissions (see the section on 'emissions and removals from drainage and rewetting and other management of organic soils' below). More detailed information is provided in section 11.3.5 of Van Baren et al. (2026) and below at 'Emissions and removals from drainage and rewetting'.

Determination of EFs of organic soils

On the basis of the available models and datasets, two approaches to calculating the emission factors for cultivated coastal peatlands (72% of total organic soil area) and cultivated upland peatlands (28% of total organic soil area) have been developed (see sections 11.3.1 and 11.3.2 in Van Baren et al., 2026).

The emissions from drained organic soils for all land uses are based on insights from the 'Netherlands Research Programme on Greenhouse Gas Dynamics in Peatlands and Organic Soils (NOBV)'⁹. Since 2020, this research programme has operated a monitoring network that mainly focusses on coastal peatlands, consisting of automated transparent chambers (e.g. Aben et al., 2024) and eddy covariance towers (e.g. Buzacott et al., 2024). Since the 2025 submission, the emission inventory makes use of two process-based models: i) a hydrological model PP2D (PeatParcel 2D), and ii) a carbon model AAP (Dutch: 'Aerobe Afbraak Potentie'; English: 'Aerobic decomposition potential'), which have been calibrated and tested against measurements (see section 11.3.1 in Van Baren et al. (2026)). Both are coupled and are part of the multi-model ensemble SOMERS (Subsurface Organic Matter Emission Registration System; Erkens et al., 2022). SOMERS is deployed to calculate greenhouse gas emissions (currently only CO₂) from organic soils at land parcel level SOMERS is capable of calculating CO₂ emissions under current or modified water management. For the national greenhouse gas inventory, SOMERS uses ten-year reference

⁹ <https://www.nobveenweiden.nl/en/>

weather conditions for the period (2010–2019) to account for weather fluctuations. For the land management (parcelling, ditch water level, land level elevation) the situation of 2023 is used.

For the parcels consisting of upland drained organic soils, PP2D could not be used and instead, the groundwater level has been established on the basis of the modelled phreatic groundwater level from the National Hydrological Model (Dutch: 'Nationaal Hydrologisch Instrumentarium', English: 'Hydrological Instrumentations of the Netherlands')¹⁰. These phreatic water levels have been used as input for AAP. The outcomes of the groundwater model are for 250 * 250 meter grid cells, which have been downscaled to 25 * 25 meter grid cells on the basis of the soil map.

A second model, LUSOS (LULucf SOMers System), has been built specifically for the national greenhouse gas inventory; it utilises SOMERS output and upscales SOMERS results to a 25 * 25 meter grid, including land use beyond the parcels. These grid cells have been combined with the land cover data to allocate emissions to different land-use types in the Netherlands for a 25 * 25 meter grid.

The total emissions for the peat soils in the coastal peatlands and upland peatlands are summed in LUSOS for all land cover to derive a total emission for the Dutch peat soils and similarly for peaty soils. When the total emission per soil type is subsequently divided by the area of different types of organic soils, an implied emission factor is derived. See section 11.3.3 in Van Baren et al. (2026) for the current derived emission factors per land use and organic soil type.

Detailed information on calculations for peat and peaty soils is provided in section 11.3 of Van Baren et al. (2026).

Emissions and removals from drainage and rewetting and other management of organic soils (CRT Table 4(II))

CO₂ emissions and removals resulting from drainage and rewetting are included as carbon stock changes in organic soils under the various land-use categories (CRT categories 4.A-4.C and 4.E) and are based on the SOMERS model outcomes. Drainage of organic soils (such as peatlands), i.e. artificial lowering of the groundwater level, is a key process allowing for peat decomposition and CO₂ emission. Within the SOMERS multi-model ensemble, groundwater levels are calculated by the PP2D or NHI model on a daily basis. For these calculations, soil composition, permeability, weather conditions, and the flux derived from the regional hydrological system all serve as input. In addition, surface water levels as applied by regional water authorities are an important input parameter in the model. Because actual surface water levels are used as input for the models, the model outcomes reflect actual water management. As such, drainage and rewetting measures and their results are part of the model calculations.

Under the default assumption, organic soils are considered fully drained (100%) in all land-use classes except forests. To estimate the share of

¹⁰ <https://nhi.nu/en/>

forests on organic soils that are drained, we calculated the proportion of forested organic-soil area for which the SOMERS model predicts non-zero emissions in 2023, indicating some degree of drainage; this analysis shows that 74.1% of forests on organic soils are predicted to emit CO₂. The associated emissions of N₂O were calculated using a Tier 1 approach with the Tier 1 EF for boreal and temperate organic nutrient-rich (0.6 kg N₂O-N ha⁻¹) and nutrient-poor (0.1 kg N₂O-N ha⁻¹) forest soils. For the 1990–2017 period, an average of 79% of the forests on peat soil was on nutrient-rich peat soils and 21% on nutrient-poor peat soils (see section 11.3.4 in Van Baren et al., 2026); 100% of the forests on peaty soils were on nutrient-rich peaty soils. These ratios were subsequently applied to the Tier 1 EFs resulting in average EFs of 0.495 kg N₂O-N ha⁻¹ for N₂O emissions from drained peat soils under Forest land, and 0.6 kg N₂O-N ha⁻¹ for N₂O emissions from peaty soils.

Rewetting activities have not occurred on a large scale in the Netherlands: between 2016 and 2022, in 1516 hectares, water infiltration systems have been installed, and 7114 hectares were subject to raising of the surface water table with at least 5 cm (Nouges et al., 2025). According to model results, these measures resulted in a negligible net reduction in emissions of -61.0 kt CO₂ (see Table 4 in Nouges et al., 2025). Since water levels are an input to the SOMERS model, any effects of rewetting, where applicable, are already accounted for in the organic-soil emissions modelled in this report.

Methane (CH₄) emissions from drainage ditches in drained Forest land, Cropland and agricultural grasslands on organic soils are reported in CRT Table 4(II) using a Tier 2 approach from the 2013 IPCC wetland supplement (IPCC 2014). For the activity data, an extraction of ditches (< 3m) from the 'Large-scale Topography Basic Registry (BGT)' (Dutch: *Basisregistratie Grootchalige Topografie (BGT)*¹¹), which is a 2017 detailed digital map of all physical objects in the Netherlands, has been made and overlayed with the land-use map and the soil map. From this analysis for the land-uses Cropland, Grassland, Trees outside Forest and Forest land, a new percentage of ditch area was calculated. For further details, see section 11.3.2 in Van Baren et al. (2026).

A country-specific emission factor of 518 kg CH₄ ha⁻¹ yr⁻¹ is applied to these areas on the basis of a case study for the Netherlands by Peacock et al. (2021). This value is similar to the default emission factor for drainage ditches in shallow drained temperate grassland (i.e. 527 kg CH₄ ha⁻¹ yr⁻¹) in Table 2.3 of the 2013 IPCC wetland supplement (IPCC 2014).

Direct nitrous oxide emissions from disturbance associated with land-use conversions (CRT Table 4(III))

Nitrous oxide (N₂O) emissions from soils resulting from disturbance associated with land-use conversions were calculated for all land-use conversions using a Tier 2 methodology (see section 11.2.3 in Van Baren et al., 2026). The default EF of 0.006 kg N₂O-N/kg N as listed in the 2019 refinement to the 2006 IPCC guidelines (IPCC, 2019) for 'other N inputs in wet climates' was used. Average C:N ratios were derived

¹¹ <https://www.geobasisregistraties.nl/basisregistraties/grootchalige-topografie>

from CC-NL (Knotters et al., 2022). For aggregated soil types where conversion of land use resulted in a net gain of carbon, N₂O emissions were set to zero.

Biomass burning (CRT Table 4(IV))

For *Controlled biomass burning* in all land-use categories, the emissions of CO₂, CH₄ and N₂O are reported as 'IE' and 'NO'. The area of and emissions from occasional burning carried out in the interest of nature management are included under wildfires. Other controlled burning, such as the burning of harvest residues, is not allowed in the Netherlands (see Paragraph 3.2.15¹² of the 'Besluit activiteiten leefomgeving' ('Environment and Planning Act')).

Wildfires are rare in the Netherlands and limited information of extent and intensity of fires has only recently become available. Therefore, the emissions of CO₂, CH₄ and N₂O from wildfires are reported using a Tier 1 methodology. The area of wildfires is based on a historical series from 1980 to 1992. Emissions from forest fires are reported under Forest land remaining forest land, even though some of it may be on land converted to forest land. Emissions from other wildfires are reported under Grassland remaining grassland, even though they may be occurring on other land-use categories. Under the other land-use categories, wildfires are reported as IE.

6.1.3

Changes in this year and recalculations for years previously reported

This year, eight methodological changes have been implemented, resulting in modifications to the carbon stock changes and associated emissions and removals along (part of) the time series:

- Updated emission factor for drained organic soils for all land uses for the entire time period;
- New land-use map for 1-1-2025 resulting in updated activity data for 2021–2024;
- Updated bookkeeping model, which now incorporates land-use maps;
- Change in simulation of weather data for cropland and grassland remaining mineral soil fluxes for the complete time period;
- Updated C:N ratio for all mineral soil types for the entire time period;
- Updated emission factor for N₂O emissions for mineral soils for the complete time period;
- Fixed allocation of carbon stock for soils converting from organic to mineral soil types;
- Removal of the usage of a drainage fraction.

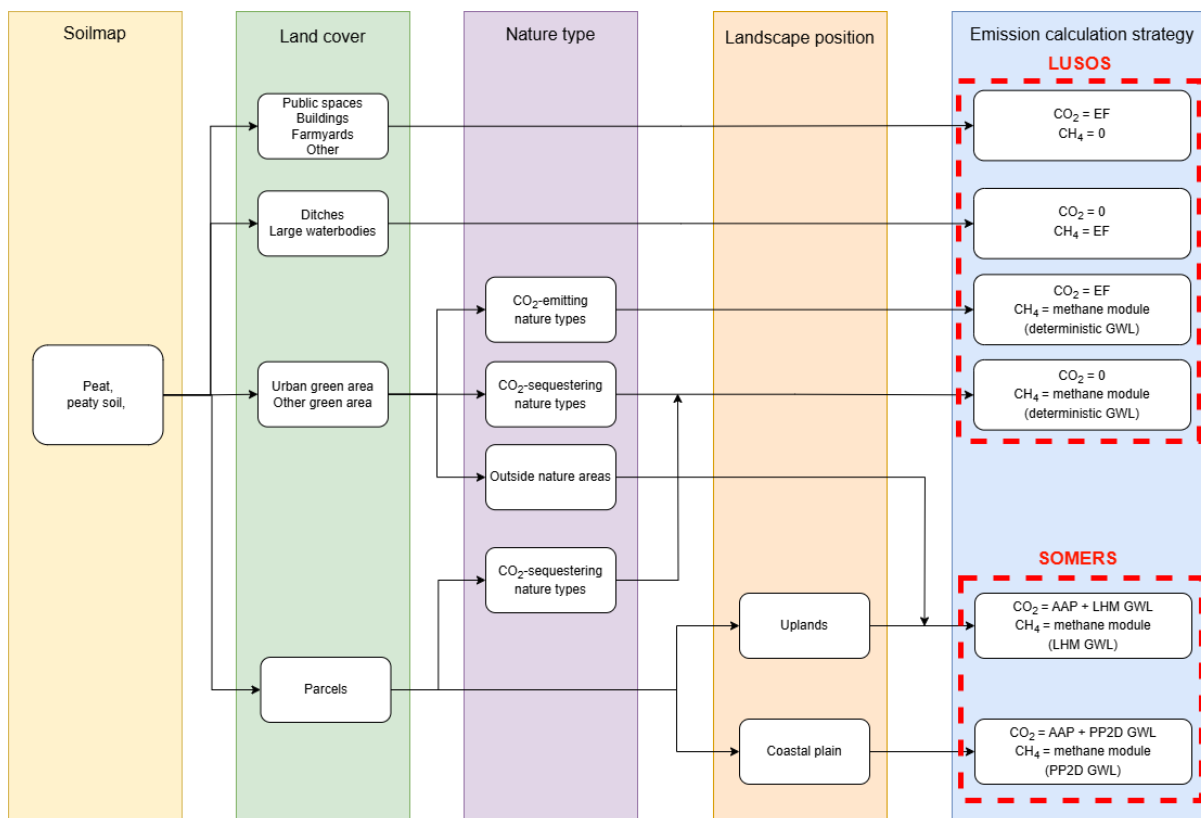
Updated emission factors for drained organics soils for all land uses for the entire time period

In the current submission, SOMERS and LUSOS have been updated and used to calculate CO₂ emissions with different strategies for different land cover and organic soil combinations, see Figure 6.3 below. See section 'Carbon stock changes in organic soils' in 6.1.2 for background

¹² <https://iplo.nl/regelgeving/regels-voor-activiteiten/milieubelastende-activiteiten-hoofdstuk-3-bal/activiteiten/afvalverbranding-plaatsvindt-ippc-installatie/>

information on this method and section 11.3 in Van Baren et al. (2026). This approach replaces the previous approach in which a SOMERS-based emission factor was calculated for all land covers.

Figure 6.3. Flowchart of emissions calculation strategies for organic soils in the Netherlands used in the LUSOS and SOMERS model ensembles



Land cover is adopted from the 'Large-scale Topography Basic Registry (BGT)' (Dutch: *Basisregistratie Grootchalige Topografie (BGT)*¹³) which is based on the 1:10 000 topographic map of the Netherlands. Subsequently, land cover is further divided by nature type. On the basis of the national nature management plans (Dutch: 'natuurbeheerplannen') nature types in which CO₂ emissions from organic soils can be expected (drained meadows, forests, heather) are separated from nature types that have active peat formation (reed land, quaking bogs, fenlands, et cetera). Last, agricultural parcels are classified according to whether they are located within the coastal plain or the upland of the Netherlands. See Figure 6.3 above for the flowchart on which the definitive emission factor is based.

For the upland drained organic soils, the methodology has been updated compared to the previous submission. For the parcels in this area, a modelled phreatic groundwater level from the National Hydrological Model (Dutch: 'Nationaal Hydrologisch Instrumentarium', English: 'Hydrological Instrumentations of the Netherlands')¹⁴ was used. The outcomes of the groundwater model are for 250 * 250 meter grid cells,

¹³ <https://www.geobasisregistraties.nl/basisregistraties/grootchalige-topografie>

¹⁴ <https://nhi.nu/en/>

which have been downscaled to 25 * 25 meter grid cells on the basis of the soil map. These grid cells have been combined with the land cover data to allocate emissions to different land-use types in the upland Netherlands (specifically parcels and nature areas with CO₂-emitting nature types). This specific improvement resulted in a reported decrease by around 0.5 Mt CO₂ for this area compared to the previous submission.

The hydrological resistance in the groundwater model for drained shallow organic soils (<1.2 m thickness) in the coastal plain has been improved (Melman et al. (2024)). The geological build-up influencing hydrological resistance is now treated more consistently with the approach used for thicker peat layers. This has changed the modelled groundwater levels for these areas, but only resulted in a small net change in emission.

An additional step is that a distinction is made for different nature types with organic soils. For nature types that are characterised by peat forming vegetation (reed, sedges, sphagnum mosses, et cetera) net annual emission of CO₂ is highly unlikely. In fact, these areas are (long-term) sinks for CO₂. Therefore, as a first step, the emission of CO₂ from these areas is conservatively considered zero (emission factor = 0 ton CO₂/ha/yr). The area with peat forming vegetation is relatively small, so only a limited amount of carbon is expected to be sequestered. This lowered the emissions from organic soils by ~0,2 Mt CO₂ compared to last year's national inventory. Nonetheless, this will be researched further in the coming years to further improve insights into carbon dynamics in these systems.

For the organic soils in the coastal plain, an updated version of the surface water level database has been used, in which some errors were corrected. In this version, the water level/drainage information for the year 2023 is used, instead of the information for the year 2022. This modification resulted in a spatially differential increase and a reduction of emissions but overall, it resulted in a net increase in reported emissions by ~0.1 Mt CO₂ compared to the previous submission.

For land use other than parcels, for which direct CO₂ calculations are available (either with the national groundwater model or with the parcel-based groundwater model), an emission factor has been used (see Figure 6.3). For CO₂, there are two options: i) the EF is zero (sequestering nature types with peat forming vegetation or ditches/larger water bodies); or ii) the EF is an implied emission factor (for public spaces/farm yards/infrastructure/other – largely part of 'Settlements' – and for CO₂ emitting nature types). This implied emission factor is provided in Table 6.3 and is based on the average emission of peat soils and peaty soils (separately) as modelled by SOMERS calculations for coastal plain parcels with peat or peaty soil. Subsequently, this implied emission factor has been applied to the complete time series. This means that the long-term trend of decreasing emissions from organic soils since 1990 is solely the result of the slow decline in the extent of organic soils due to peat oxidation and its subsequent loss (see paragraph 6.1.2). The total emissions from all organic soils are shown in Figure 6.4. On average, total CO₂ emissions

decreased by 708 kt CO₂ throughout the time series compared to the previous submission.

For more detailed information on organic soils calculations see also section 11.3 in Van Baren et al. (2026).

In the years to come, this method will be further developed to include annual variation and to take the temporal effect of mitigation measures into account.

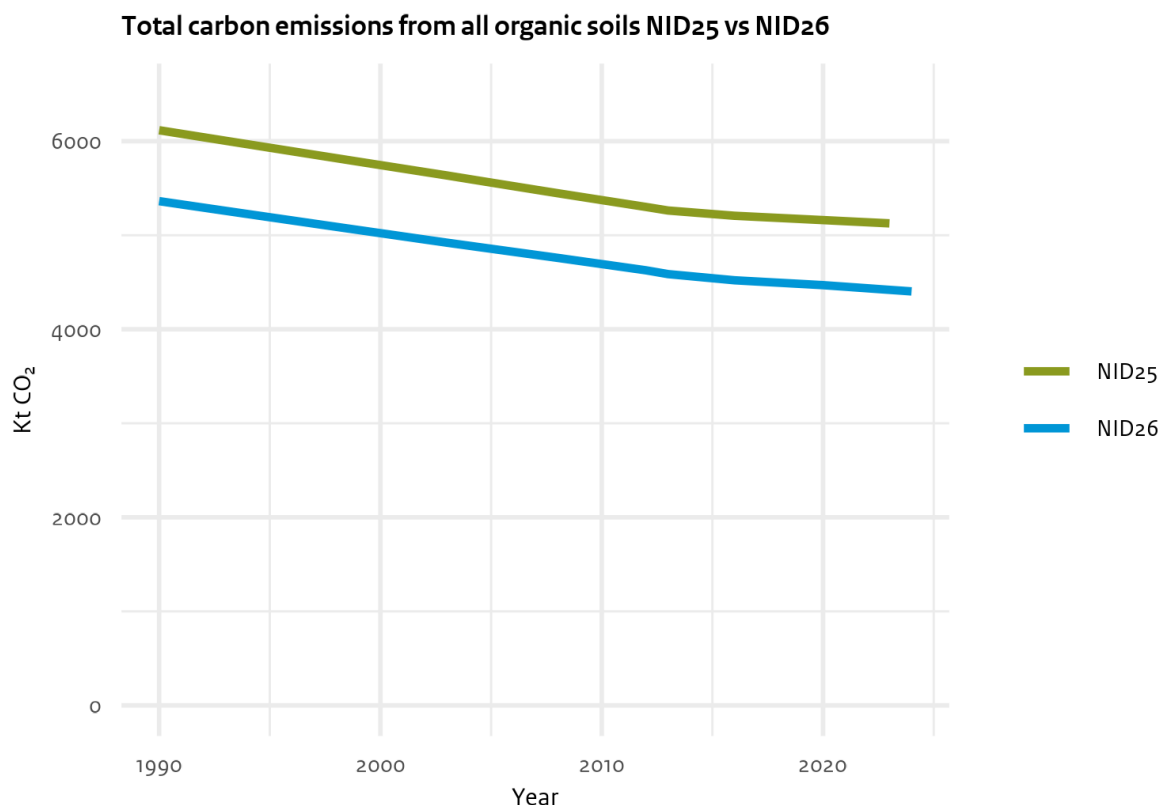
Table 6.3 Emission factors (ton CO₂ per hectare per year) used for all organic soils. Current submission.

Land-use	ton CO₂/ha/year	
Grassland	peaty	-12.3
	peat	-10.7
Trees outside forest	peaty	-12.7
	peat	-8.8
Cropland	peaty	-15.1
	peat	-14.4
Forest land	peaty	-11.3
	peat	-6.5
Settlements	peaty	-12.5
	peat	-10.6

Table 6.4 Emission factor (ton CO₂ per hectare per year) used in the previous submission for all organic soils on all land uses

ton CO₂/ha/year	
Soil	NID25
Peaty	-13.77
Peat	-14.60

Figure 6.4 Total CO₂ emissions from organic soils from all land uses as reported in the submissions of 2025 and 2026.



New land-use map for 1-1-2025 resulting in updated activity data for 2021–2024

Land-use monitoring in the Netherlands is based on a spatially explicit, wall-to-wall mapping approach (see section 6.3). Whereas maps up to 2021 were derived from the '*Historisch Grondgebruik Nederland*' (HGN) and '*Basiskaart Natuur*' (BN), activity data from 2024 onwards will be derived from the *Landelijk Grondgebruik Nederland* (LGN) (English: The Land Use Database of the Netherlands) dataset. The BN is no longer produced on a regular basis or used for monitoring nature development, while the LGN is updated annually, incorporates a broader set of up-to-date underlying data products, and is foreseen to be actively developed in the coming years. A complete overview of LGN data sources is provided in section 3 of Hazeu et al. (2023). See also section 3.2 in Van Baren et al. (2026).

Land-use classes in the LGN are defined using the Multi-Reclass-Tool (MRT), a rule-based table in which each row represents a land-use class and each column specifies the logical conditions a pixel must meet, per underlying dataset, to be assigned to that class. The MRT operates hierarchically: once a pixel satisfies the criteria of a given row, all subsequent rows are no longer evaluated for that pixel.

Because LGN draws on a larger number of geospatial data products and supports a wider range of applications, its classification scheme is more detailed than that of the BN. In addition, class definitions differ

substantially between the two products. To ensure consistency in the land-use change matrix for LULUCF reporting; therefore, the LGN was not reclassified directly into the main LULUCF categories. Instead, the existing MRT was reconfigured to generate a new set of land-use classes that fit within existing BN classes as closely as possible. This alignment was largely possible because both mapping approaches rely, in part, on the same key data source: TOPNL, a public vector map of highly detailed geographical features in the Netherlands, including roads, buildings, green areas, and administrative boundaries produced by the Dutch Kadaster (Land Registry Office). By reconfiguring the MRT to match the class criteria outlined in the BN documentation, the differences between 2021 and 2025 resulting from the change in mapping approach were minimised. Nonetheless, the change in mapping approach likely caused some changes in activity data that were not reflected by actual land-use change. For further information, please refer to section 3.2 in Van Baren et al. (2026).

Given that the previous submission relied on extrapolation of the land-use trend between 2017 and 2021 towards more recent years, the introduction of a new spatially explicit land-use map had pronounced effects on LULUCF emissions in recent years. The recalculations were estimated by comparing total post-2021 emissions between the NID25 and the NID26, and subtracting the effects of other methodological changes from the differences.

Table 6.5 Changes in emissions compared to NID25 due to introduction of new land-use map

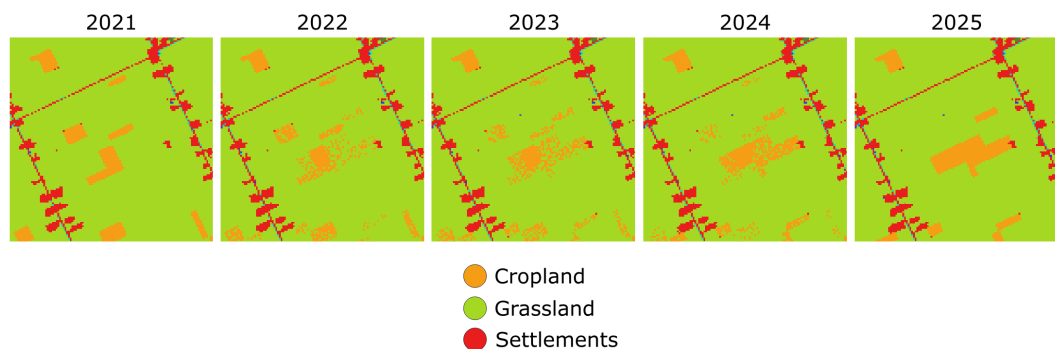
Year	2021	2022	2023
Estimated effect of introduction of new land-use map (kt CO ₂ eq)	+517	+788	+827

Updated bookkeeping model, which now incorporates annual land-use maps

Spatially explicit land-use and soil maps are only available for several interspaced years (LU: 1970, 1990, 2004, 2009, 2013, 2017, 2021, and 2025; Soil: 1977, 2014, 2040). In earlier versions of the LULUCF bookkeeping model, pixels with identical land-use and soil histories were grouped into a single 'trajectory'. These trajectories were then proportionally split up to simulate land-use changes in the years between the available maps (see section 3.6 in Van Baren et al. (2025)). From the 2026 submission onwards, the Dutch bookkeeping model incorporates spatially explicit inputs in the form of rasters, meaning that every grid cell is now treated as its own trajectory. This creates a new challenge, as it requires a spatially explicit way to interpolate land-use and soil maps for the years that fall between the known map years. The updated approach works as follows: for any two known map years (t_a and t_b), all cells that change category (land-use or soil type) between those years (N) are identified. These cells are grouped together according to what land-use or soil group they originate from, and what group they change into (N_g). Every year, a random sample of $N_g/(t_b - t_a)$ cells change from the category at t_a into the category at t_b . For example, if 250 cells with land-use type Forest in 2004 become land-use type Grassland in 2009, $250/(2009-2004) = 50$ of these Forest cells will be selected randomly and changed to Grassland in 2005, 50 more in 2006,

et cetera. These changes are made without considering the spatial context. As a result, a forest patch may appear to change gradually over several years, even if the actual change occurred all at once. The maps were created using a random number seed that depends on the year of the map at t_a . This guarantees that the same inputs will always produce the same interpolated maps.

Figure 6.5 Example of grassland transitioning towards cropland between two maps, 2021 and 2025.



Comparing model runs with and without the spatially explicit interpolation of land-use changes shows that the updated method decreased emissions by variable amounts, the largest effect occurring in the early part of the time series ($\sim 1990\text{--}2000$); see Figure 6.6 and Table 6.6 below. This is mainly because, under the old approach, several corrections were applied to the land-use values derived from the 1970 map. This had an effect spanning twenty years (until 2009) due to the twenty-year land-use transition period. These corrections were meant to reduce the number of trajectories to a manageable level (see section 3.2 in Van Baren et al., 2025). Since the new method treats every pixel as its own trajectory, and the total number of pixels is fixed at approximately 67 million, there is no longer any need to apply these corrections.

Figure 6.6 Total LULUCF emissions based on the NID25 data, compared to a rerun using the same inputs but with spatially interpolated annual maps

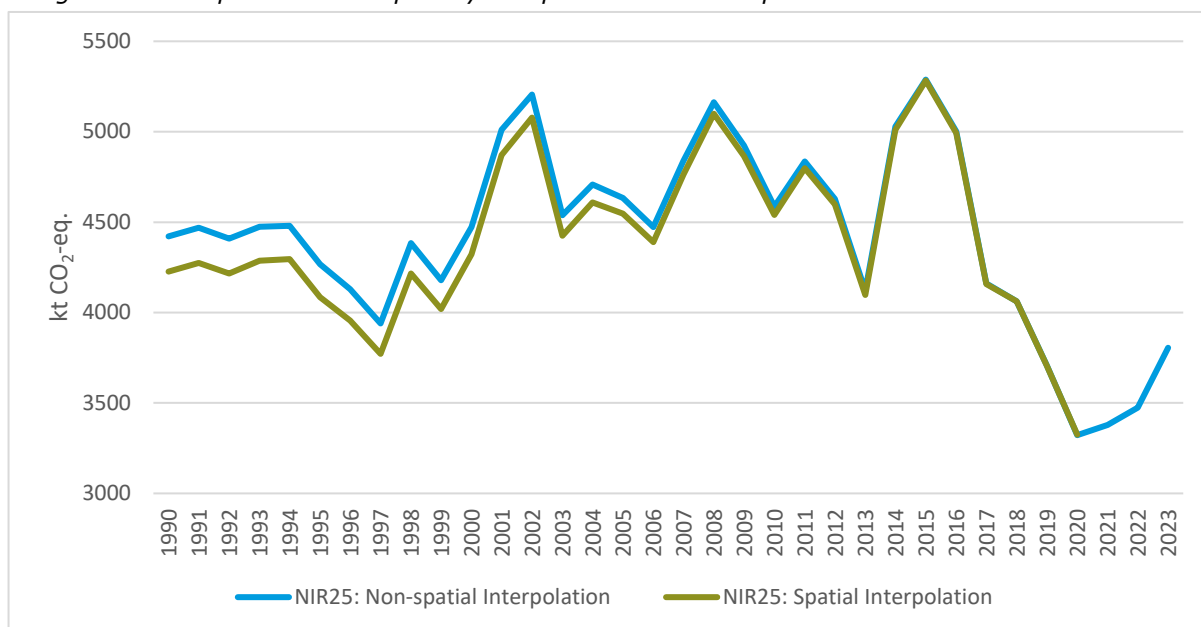


Table 6.6 Changes in emissions (kt CO₂ eq) compared to NID25 due to the introduction of spatial interpolation

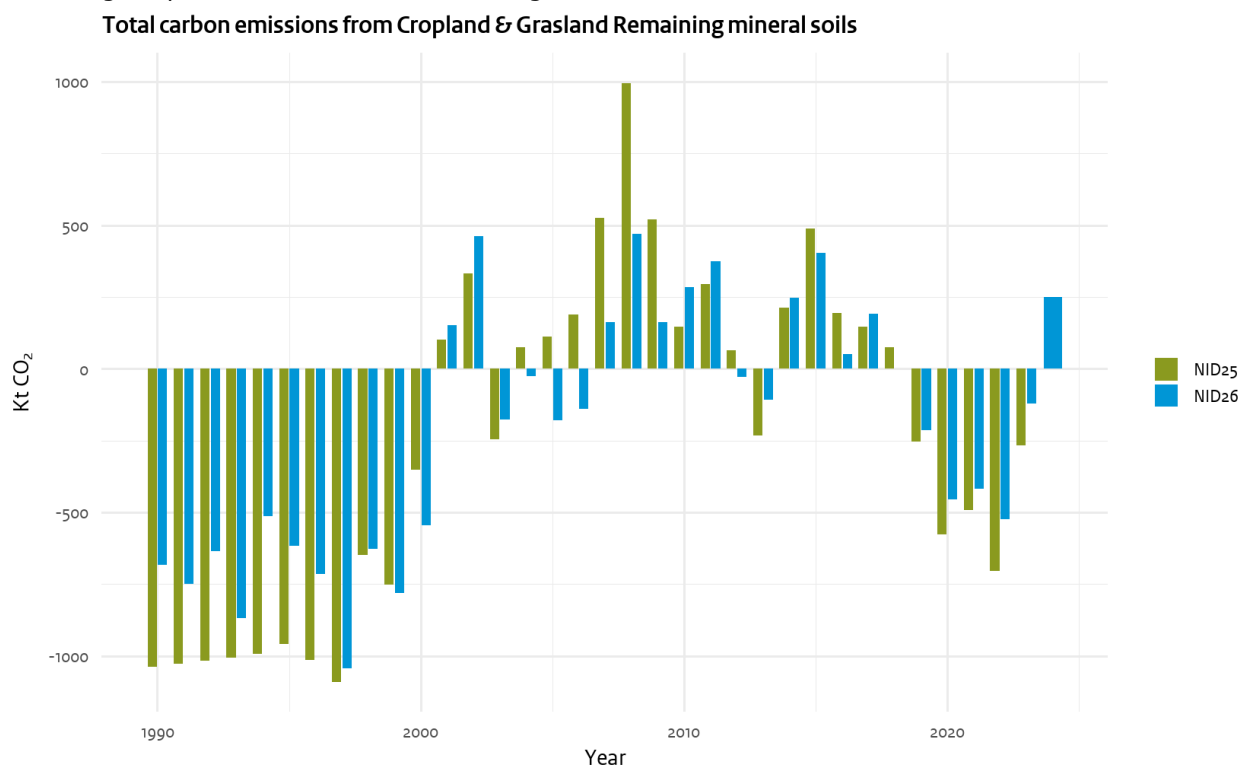
Year	1990	1995	2000	2005	2010	2015	2020
Spatial vs non-spatial interpolation: difference in emissions (kt CO ₂ eq)	-194.09	-180.70	-149.73	-85.79	-46.44	-5.42	2.91

Change in simulation of weather data for cropland and grassland remaining mineral soil fluxes for the complete time period

The carbon stock changes for mineral soils under Cropland remaining cropland and Grassland remaining grassland are simulated by the soil organic carbon model RothC; see section 6.1.2 carbon stock changes in mineral soils above or section 11.2.2. in Van Baren et al. (2026). The model is sensitive to changes in weather data; therefore, it was previously decided to average the SOC changes over a period of five years (using a moving average) to reduce high interannual variability in stock changes. This approach improves alignment with the long-term nature of SOC dynamics and with the method used to determine stock changes in biomass on the basis of the national forest inventory. However, averaging the results also resulted in averaging the changes in SOC due to changes in activity and soil and crop management data. To address this issue, we modified the simulation. From this submission onwards, only the weather data are averaged, as opposed to the final result (total SOC change). Each year is now simulated for five weather years, the actual year and the four years before, and the average SOC change from these simulations is used. In this way, the changes in crop and soil management are better reflected in the actual years. Although this modification affects individual annual estimates – resulting in lower or higher emissions or removals for specific years – the overall SOC stock changes over the full time period remain similar.

Over the entire time period, this has a fluctuating result for the emissions from mineral soils on Cropland and Grassland remaining. See Figure 6.3 for a comparison between the previous and current submissions.

Figure 6.7 summed CO₂ emissions (kiloton) from mineral soils for Cropland remaining Cropland and Grassland remaining Grassland.



Interannual variability generally decreased as a consequence of the averaging of results over a five-year period in terms of input weather data.

Update C:N ratio for all mineral soil types for the entire time period

For the calculation of N₂O emissions from disturbance associated with land-use conversions, the C:N ratio of the mineral soils is used to calculate the loss of nitrogen, which, in turn, is used to calculate the related N₂O emissions. Previously, the C:N ratio was based on a limited set of data from literature. This year the C:N ratios per soil-type and land-use combination were updated on the basis of the data from the Dutch Soil Sampling Programme from 2018 (Van Tol-Leenders et al. 2019), in which both the carbon and the total nitrogen content of the soil were determined (Table 6.7). On the basis of these data, new C:N ratios were derived for the six soil types under three land uses (cropland, grassland and forest land), using a total of 1047 soil samples from the 0–30 cm soil layer. In combination with the next methodological update, this results in an increase of N₂O emissions in categories 4(III).A – 4(III).E. by about 20 kt CO₂ eq for the entire time period. See section 11.2.3 in Van Baren et al. (2026).

Table 6.7 New and old C:N ratios.

Land use	Soil Type	NEW Average C:N Ratios	OLD Average C:N Ratio
Cropland	Clay Soil	10.2	15
Grassland	Clay Soil	10.3	15
Forest/nature	Clay Soil	12.4	15
Cropland	Loamy Soils	10.4	15
Grassland	Loamy Soils	10.2	15
Forest/nature	Loamy Soils	17	15
Cropland	Sandy Earth Soils	13.6	15
Grassland	Sandy Earth Soils	13	15
Forest/nature	Sandy Earth Soils	15.4	15
Cropland	Other Sandy Soils	15	22.1
Grassland	Other Sandy Soils	14.2	22.1
Forest/nature	Other Sandy Soils	26.8	22.1

Updated emission factor for N₂O emissions for mineral soils for the complete time period

In previous submissions, the default emission factor of 0.01 kg N₂O-N per kg N mineralised from mineral soil was used to account for nitrogen mineralisation resulting from soil carbon losses. The 2019 Refinement, however, provides more disaggregated emission factors in volume 4, chapter 11 table 11.1. This table lists a default value of 0.006 for 'Other N inputs in wet climates', which is considered the most appropriate factor for nitrogen inputs associated with soil-carbon loss under Dutch climatic conditions. To ensure consistency with the methodologies applied in the Agriculture sector, the emission factor for N mineralisation in LULUCF has been updated accordingly. In combination with the previous methodological update, this results in an increase of N₂O emissions in categories 4(III).A–4(III).E. by about 20 kt CO₂ eq for the complete time period. See also Agriculture emission category 3.D.1.e.

Fixed allocation of carbon stock for soils converting from organic to mineral soil types

The LULUCF bookkeeping model uses carbon stock values defined for each land-use and soil-type combination to calculate changes in carbon stocks in mineral soils resulting from land-use change (see section 11.2 in Van Baren et al., 2026). Emissions from organic soils are calculated using a separate methodology (see section 11.3 in Van Baren et al., 2026). This raises the question of how to treat pixels that shift from organic to mineral soils as a result of peat drainage and oxidation. In previous versions of the model, pixels that transitioned from organic to mineral soils were assigned a soil carbon stock of zero at the moment of transition. In the updated approach, these pixels are now assigned an appropriate mineral-soil carbon stock. This change allows emissions and removals associated with subsequent land-use changes on these converted soils to be modelled correctly. Over the entire time period,

this has resulted in a net range between 4.8 higher and 3.8 lower kt CO₂ emissions for the LULUCF sector compared to the previous submission.

Removal of the usage of a drainage fraction

The drainage fraction was originally introduced for forest land. Unlike cropland and grassland on organic soils, which are nearly always drained, most forest areas on organic soils in the Netherlands are not. As a result, it was not feasible to apply a single emission factor to all forests on organic soils. The drainage fraction was meant to scale the emission factor back to account for this, and was set to a fixed percentage of 24.2% on the basis of analyses of land-use maps (see section 11.3.2 in Van Baren et al., 2026 for further details).

Under the updated approach, emissions from organic soils are calculated using a spatially explicit emissions map for 2023 derived from the SOMERS model, as described earlier in section 6.1.3. For other years, implied emission factors derived from the 2023 map are applied. These implied emission factors are computed separately for each land-use/soil combination by summing the emissions across all pixels within a given combination and dividing them by the area of that combination. Consequently, the emission factor for forests on organic soils now reflects the real emissions per unit of area associated specifically with forests on organic soil pixels. Because emission factors are now derived directly and consistently for each land-use/soil combination, the risk of overestimating forest emissions through an incorrect drainage assumption is eliminated. Therefore, the drainage fraction is no longer required and has been removed from the LULUCF bookkeeping model.

The difference in emissions resulting from this methodological change mainly relates to the CO₂ emissions from organic soils, which have been described above in more detail. Moreover, the area of ditches on organic soils, from which methane emissions are calculated, is connected to the amount of drained organic soils; see section 6.1.2 on emissions and removals from drainage and rewetting, or section 11.3.2. in Van Baren et al. (2026) for further details. By changing the drainage fraction, the same ditch fraction is now applied to a larger area, resulting in higher methane emissions for Forest land throughout the time period. On average, methane emissions over the complete time period for Forest land increased by 6.6 kt CO₂ eq compared to the previous submission.

6.2 Land-use definitions and the land representation approach(es) used and their correspondence to the land use, land-use change and forestry categories

This section provides an overview of land-use definitions and the classification systems used in the Netherlands, and of how they correspond to the land use, land-use change, and forestry categories that need to be covered. The Netherlands has defined the various land-use categories in line with the descriptions provided in the 2006 IPCC Guidelines. For more detailed information, see section 2 in Van Baren et al. (2026).

6.2.1 *Forest land (4.A)*

The Netherlands has chosen to define the land-use category Forest land as 'all land with woody vegetation, now or expected in the near future (e.g. clear-cut areas to be replanted, young afforestation areas)'. The following criteria define this category:

- Forests are patches of land exceeding 0.5 ha, with:
 - o a minimum width of 30 m;
 - o a tree crown cover of at least 20%; and
 - o a tree height of at least 5 m, or, if this is not the case now, these thresholds are likely to be achieved at the particular site.

This definition conforms to FAO reporting standards and falls within the ranges set by the Kyoto Protocol.

6.2.2 *Cropland (4.B)*

The Netherlands has chosen to define Cropland as 'arable land and nurseries (including tree nurseries)'. Intensively managed grasslands are not included in this category; they are reported under Grassland. For part of the Netherlands' agricultural land, rotation between cropland and grassland is frequent, but exact data on where this occurs is not available. Currently, the situation on the topographical map is used as a guideline, which entails that lands under agricultural crops and classified as arable lands at the time of recording are being reported under Cropland, and that lands with grass vegetation at the time of recording are being classified as Grassland.

6.2.3 *Grassland (4.C)*

From the NIR 2018 onwards, two distinct sub-categories have been identified within the Grassland category, and these are assessed in a spatially explicit manner. They are (1) Trees outside forests (TOF), and (2) Grassland (non-TOF). Both are explained below.

Trees outside forests (TOF)

Trees outside forests (TOF) are wooded areas that comply with the Forest land definition except for their surface area (<0.5 ha or less than 30 m width). They represent fragmented forest plots as well as groups of trees in parks and natural terrains, as well as most woody vegetation lining roads and fields.

Grassland (non-TOF)

Any type of terrain that is predominantly covered by grass vegetation is reported under Grassland (non-TOF). The category also includes vegetation that falls below, and is not expected to reach, the thresholds used in the Forest land category. It is further split into the following sub-categories:

- Grassland vegetation, i.e. all areas predominantly covered by grass vegetation (whether natural, recreational, or cultivated);
- Nature, i.e. all natural areas not covered by grassland vegetation. This mainly consists of heathland and peat moors and may have the occasional tree as part of its typical vegetation structure.
- Orchards, i.e. areas with standard fruit trees, dwarf varieties or shrubs. These do not conform to the Forest land definition and,

while agro-forestry systems are mentioned in the definition of Cropland, the main undergrowth of orchards in the Netherlands is grass. Therefore, orchards are reported under Grassland (non-TOF). A separate carbon stock for orchards is being estimated as part of an area-weighted averaged carbon stock in grasslands (see section 6.6 below and Van Baren et al. (2026)).

- In the calculations, orchards are not explicitly spatially included. Instead, statistics on areas of orchards are used. See section 6.1.1 in Van Baren et al. (2026) for details.

6.2.4 *Wetlands (4.D)*

The Netherlands is characterised by wet areas. Many of these areas are covered by grassy vegetation and those are included under Grassland. Some wetlands are covered by rougher vegetation, consisting of wild grasses or shrubs, and those are reported under Grassland, in the sub-category Nature. Forested wetlands (e.g. willow coppices) are included in Forest land. As a result, only reed marshes and open water bodies in the Netherlands are included in the Wetland land-use category. This includes natural open water in rivers, but also man-made open water in canals, ditches, and artificial lakes. It includes bare areas that are under water only part of the time as a result of tidal influences, and very wet areas without vegetation. It also includes 'wet' infrastructure for boats, i.e. waterways as well as the water in harbours and docks.

Since the submission of the NIR 2024, the Wetlands land-use category has been further stratified, and as from 2025, the category Flooded Land has contained the following sub-categories: reservoirs, freshwater ponds, and canals and ditches. These Wetlands sub-categories used to be reported as Open water; therefore, the total area of Wetlands has not changed compared to the previous submissions:

- Reservoirs: inland sweet water lakes larger than 8 ha. Excludes the IJsselmeer and Markermeer.
- Freshwater ponds: inland sweet water ponds smaller than 8 ha.
- Canals and ditches (>3 m): constructed linear waterbodies.

Reservoirs and freshwater ponds have only been included if they were created after the year 1900. All canals and ditches are included. Sub-categories of flooded land are distinguished using distinct methodological approaches (see section 6.7.2 of this NID and sections 2.5 and 3.2 in Van Baren et al., 2026). In the current CRT, stratification into these flooded-land sub-categories has not yet been implemented into Table 4.D due to technical limitations relating to the LULUCF accounting model output structure and post-processing. Consequently, emissions are reported under Other wetland. Similarly, in Table 4(II), emissions are reported under Flooded land without further stratification. Further disaggregation is planned for future submissions through increased flexibility in model outputs, allowing additional land-use classes to be incorporated into the CRT.

6.2.5 *Settlements (4.E)*

In the Netherlands, the main categories included under the Settlements category are (1) built-up areas and (2) urban areas and transport infrastructure. Built-up areas include any constructed item, independent of the type of construction material, that is (expected to be) permanent,

is fixed to the soil surface, and serves as a place of residence or location for trade, traffic, and/or work. It includes housing, industrial areas, office buildings, shops and warehouses, as well as filling stations and greenhouses.

Urban areas include all roads, with the exception of forest roads as these are included in the official forest definition. They also include train tracks, (paved) open spaces in urban areas, car parks, and graveyards. Though some of the latter categories are occasionally covered by grass, the distinction cannot consistently be made from a study of available maps. As grass graveyards are not managed as grassland, their inclusion in the land-use category Settlements conforms better to the rationale of the land-use classification.

6.2.6 *Other land (4.F)*

The Netherlands uses this land-use category to report surfaces of bare soil not included in any other category. This mostly includes almost bare sands and the earliest stages of succession on sand in coastal areas (beaches, dunes and sandy roads), or uncultivated land alongside rivers. It does not include bare areas that emerge from shrinking and expanding water surfaces; these are included in Wetland. In general, the amount of carbon in Other land is limited.

6.2.7 *Land-use change matrices*

Data for the matrices is derived from the land-use maps as presented in section 6.3 below. Dates of the land-use maps are preceded by abbreviations of the products from which they are derived: *Historisch Grondgebruik Nederland* (HGN), *Basiskaart Natuur* (BN), and *Landelijk Grondgebruik Nederland* (LGN).

Table 6.8 Land use and land-use change matrix aggregated to the six UNFCCC land-use categories for the 1970–1990 period (ha) with Grassland (GL) divided into GL (non-TOF) and GL (TOF)

HGN 1970	BN 1990							Total
	FL	CL	GL (non-TOF)	G (TOF)	WL	Sett	OL	
FL	288,366	6068	19,057	2375	1611	7242	987	325,706
CL	25,105	668,783	190,123	3486	12,873	54,117	413	954,901
GL-non TOF	32,948	307,798	1,222,135	7378	25,224	90,158	1874	1,687,515
GL-TOF	2684	2243	5754	3667	403	2796	169	17,716
WL	2179	6747	18,820	580	746,087	5395	4118	783,926
Sett	9445	27,690	48,551	3108	4530	249,427	715	343,466
OL	1522	352	3523	206	3600	468	31,285	40,957
<i>Total</i>	362,249	1,019,682	1,507,962	20,801	794,328	409,602	39,562	4,154,187

Table 6.9 Land use and land-use change matrix aggregated to the six UNFCCC land-use categories for the 1990–2004 period (ha) with Grassland (GL) divided into GL (non-TOF) and GL (TOF)

	BN 2004							
BN 1990	FL	CL	GL (non-TOF)	G (TOF)	WL	Sett	OL	Total
FL	334,348	1,220	14,592	2852	1503	7035	699	362,249
CL	12,527	739,425	176,854	2039	6823	81,813	201	1,019,682
GL-non TOF	18,075	196,624	1,190,957	4474	18,642	78,283	907	1,507,962
GL-TOF	2350	386	3314	11,335	318	2988	110	20,801
WL	888	596	9094	328	777,793	2837	2791	794,328
Sett	1456	1626	10,993	1078	1391	392,936	122	409,602
OL	552	8	2547	98	2582	630	33,144	39,562
Total	370,197	939,885	1,408,352	22,206	809,052	566,522	37,974	4,154,187

Table 6.10 Land use and land-use change matrix aggregated to the six UNFCCC land-use categories for the 2004–2009 period (ha) with Grassland (GL) divided into GL (non-TOF) and GL (TOF)

	BN 2009							
BN 2004	FL	CL	GL (non-TOF)	GL (TOF)	WL	Sett	OL	Total
FL	357,622	352	5223	1,514	703	4575	208	370,197
CL	2012	813,514	108,507	296	1796	13,732	27	939,885
GL-non TOF	7129	106,576	1,243,564	1,706	10,615	37,714	1047	1,408,352
GL-TOF	1701	137	1198	16,892	126	2122	30	22,206
WL	374	177	9633	92	796,572	1441	762	809,052
Sett	4598	4368	23,125	1,556	3035	529,603	237	566,522
OL	209	2	506	29	890	137	36,201	37,974
Total	373,645	925,126	1,391,756	22,086	813,737	589,323	38,512	4,154,187

Table 6.11 Land use and land-use change matrix aggregated to the six UNFCCC land-use categories for the 2009–2013 period (ha) with Grassland (GL) divided into GL (non-TOF) and GL (TOF)

	BN 2013							
BN2009	FL	CL	GL (non-TOF)	GL (TOF)	WL	Sett	OL	Total
FL	360,356	1319	6257	1483	699	3327	204	373,645
CL	2484	794,119	116,032	311	1410	10,743	28	925,126
GL-non TOF	8095	145,435	1,194,348	1590	10,850	30,922	516	1,391,756
GL-TOF	1346	219	1532	17,212	164	1582	31	22,086
WL	651	305	6183	112	803,186	1353	1948	813,737
Sett	2535	3199	20,664	815	4477	557,496	135	589,323
OL	444	1	970	49	1825	328	34,897	38,512
Total	375,912	944,597	1,345,986	21,572	822,611	605,751	37,759	4,154,187

Table 6.12 Land use and land-use change matrix aggregated to the six UNFCCC land-use categories for the 2013–2017 period (ha) with Grassland (GL) divided into GL (non-TOF) and GL (TOF)

	BN 2017							
BN 2013	FL	CL	GL (non-TOF)	GL (TOF)	WL	Sett	OL	Total
FL	356,773	1665	9353	2022	804	4890	404	375,912
CL	903	762,661	170,219	246	1676	8868	24	944,597
GL-non TOF	4822	103,147	1,197,260	1504	9191	28,670	1394	1,345,986
GL-TOF	1141	205	1658	16,548	146	1834	41	21,572
WL	837	291	6717	192	807,534	4340	2700	822,611
Sett	1036	2583	21,378	711	1571	578,275	196	605,751
OL	215	7	735	34	1415	484	34,869	37,759
Total	365,726	870,559	1,407,320	21,256	822,338	27,360	39,628	4,154,187

Table 6.13 Land use and land-use change matrix aggregated to the six UNFCCC land-use categories for the 2017–2021 period (ha) with Grassland (GL) divided into GL (non-TOF) and GL (TOF)

	BN 2021							
BN 2017	FL	CL	GL (non-TOF)	GL (TOF)	WL	Sett	OL	Total
FL	356,579	675	5115	1157	263	1578	359	365,726
CL	762	707,797	154,279	130	1023	6541	27	870,559
GL-non TOF	4398	125,580	1,251,360	870	5473	18,691	948	1,407,320
GL-TOF	693	218	1502	17,928	82	739	96	21,256
WL	301	332	4394	65	812,751	1471	3024	822,338
Sett	707	2103	18,554	371	1545	603,850	229	627,360
OL	361	5	2967	42	2258	166	33,828	39,628
Total	363,801	836,710	1,438,171	20,563	823,394	633,037	38,511	4,154,187

Table 6.14 Land use and land-use change matrix aggregated to the six UNFCCC land-use categories for the 2021–2025 period (ha) with Grassland (GL) divided into GL (non-TOF) and GL (TOF)

	LGN 2025							
BN 2021	FL	CL	GL (non-TOF)	GL (TOF)	WL	Sett	OL	Total
FL	351,845	345	5,435	1355	519	4160	143	363,801
CL	821	673,953	149,077	499	2710	9630	20	836,710
GL-non TOF	4683	140,780	1,254,676	1667	8294	24,884	3185	1,438,171
GL-TOF	1249	91	1203	16,673	217	1122	8	20,563
WL	340	74	2423	104	817,033	2078	1343	823,394
Sett	1025	1959	16339	693	2247	610,625	149	633,037
OL	268	2	1944	24	3003	581	32,689	38,511
Total	360,231	817,203	1,431,098	21,014	834,024	653,080	37,536	4,154,187

As can be observed from the land-use change matrices above, land use is dynamic in a densely populated country like the Netherlands. For example, conversion of Grassland to Cropland and vice versa is especially common. Temporary rotations of this type are frequent, but the total areas of grassland and cropland remain relatively stable.

When comparing the seven land-use change matrices, the different lengths of time between the available land-use maps should be considered, as this has an effect on the annualised land-use changes. The long period between 1990 and 2004 means that some interannual changes, such as Cropland-Grassland rotations, are not captured. For instance, Cropland might have been converted to Grassland in 1992, and converted back to Cropland in 1995, but these changes will not be visible when we compare the 1990 and 2004 land-use maps. The more recent maps are closer together timewise and thus, they are better able to capture short-term rotations between Grassland and Cropland.

Between 1970 and 2013, forest area steadily increased, followed by a sharp decline between 2013 and 2017. In the 2017–2021 period, there was also a net loss of forest area, but the gross changes make clear that deforestation rates more than halved in comparison to the 2013–2017 period.

More detailed analyses of the land-use maps (see Schelhaas et al., 2021) make clear that between 2004 and 2017, deforestation rates increased for two principal reasons. First, deforestation took place as part of nature development, and specifically Natura 2000 development, under which areas of heathland and shifting sand have increased at the cost of forest land. Second, farmers' contracts under the set-aside forest regulation and other national regulations from the 1980s aimed at temporarily increasing forest production capacity and addressing the perceived over-production in agriculture, came to an end in 1995, with the result that forests established in the 1980s and early 1990s are now being converted back into agricultural land use.

Despite the relatively high deforestation rates in earlier periods, until 2013 the rate of afforestation exceeded the deforestation rate. However, it can be inferred from the 2013–2017 matrix that afforestation rates have decreased considerably, resulting in a net decrease in forest area since 2013. In principle, deforestation needs to be compensated by afforestation of an equal area elsewhere. An exception to this rule was for conversion to priority nature on the basis of ecological arguments, e.g. through Natura 2000 development or management plans. In such cases, forest conversion could take place without compensation. There were also signs that there is a lack of monitoring and enforcement of the compensation rule at local government level. In the meantime, the latest land-use change matrix indicates that in the years between 2017 and 2021, net deforestation occurred, but at a considerably lower rate than between 2013 and 2017. As a result of increased policy attention, in 2020, a new forest strategy was implemented with the aim of increasing forest area in the Netherlands by 10% compared to the 2017 level. It now also ensures compensation in cases where forest is converted to other priority nature types. This effect will be visible in future land-use changes.

6.3 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

One consistent approach has been used for all land-use categories. The Netherlands applies full and spatially explicit land-use mapping that allows geographical stratification at 25 * 25 meter (0.0625 ha) pixel resolution (Kramer et al., 2009). This corresponds to the wall-to-wall approach used for reporting under the UNFCCC (approach 3 in volume 4 chapter 3 of IPCC, 2006).

Harmonised and validated digital topographical maps representing land use on 1 January 1970, 1990, 2004, 2009, 2013, 2017, 2021, and 2025 were used for wall-to-wall map overlays (Van Baren et al., 2026; Kramer and Clement, 2015; Kramer and Clement, 2016; Kramer et al. 2007, 2009; Kramer & Clement, 2022; Kramer & Los, 2022), resulting in seven national-scale land use and land-use change matrices covering the following periods: 1970–1990 (Table 6.8), 1990–2004 (Table 6.9), 2004–2009 (Table 6.10), 2009–2013 (Table 6.11), 2013–2017 (Table 6.12), 2017–2021 (Table 6.13), and 2021–2025 (Table 6.14). As we described in section 6.1.3, as from the 2026 submission, the Dutch LULUCF bookkeeping model has the capacity to perform spatially explicit calculations of carbon stock changes and uses annual land-use and soil maps. The annual land-use and soil maps are overlayed to create trajectories corresponding to the land-use and soil values for each pixel across the time series. For trajectories that changed from one mineral soil type to another, we assumed the 1977 value to be the same as the 2014 value, as the new map is considered to be more accurate than the old one. The soil maps were adjusted accordingly.

The land-use maps used for 1970 and 1990 are based on maps of historic land use in the Netherlands (*Historisch grondgebruik Nederland*, HGN). The 2004–2021 maps are based on a set of maps originally used for monitoring nature development in the Netherlands (*Basiskaart Natuur*, BN). After 2009, these maps were no longer used for monitoring nature development, but in order to guarantee consistency in the land-use change matrix for LULUCF reporting, they were produced on request as a basis for the LULUCF monitoring up to 2021. Starting from 2025, LULUCF land-use maps are derived from an annually produced land-use mapping product (*Landelijk Grondgebruik Nederland*, LGN), see section 6.1.3 for further information and section 3.2 in Van Baren et al. (2026) for further details on the mapping methodology.

The classification of forest areas on the underlying topographical maps that is used to compile the LULUCF maps accounts for management interventions to prevent harvested areas from being classified as deforestation. Additional information on (planned) destinations of areas and subsidy schemes is used to support the classification.

Please note that for comparison purposes with CRT tables, map dates are always 1 January of the year indicated and hence reflect the situation at the end of the previous inventory year.

6.4 Forest land (4.A)

6.4.1 *Category description*

Reported in this category of land use are CO₂ emissions and sinks caused by changes in forests. All forests in the Netherlands are classified as temperate: 19.5% coniferous, 44.8% broadleaved, while the remainder is a mixture of the two according to the 7th Dutch National Forest Inventory. The share of mixed and broadleaved forests has grown strongly in recent decades (Schelhaas et al., 2022¹⁵). In the Netherlands, with its high population density and strong pressure on land, all forests are managed. Consequently, no sub-division is applied between managed and unmanaged forest land. Where such a sub-division is asked for in the CRT, the notation key NO is used in the tables for unmanaged forests.

Units of land that meet all the requirements for Forest land except the minimum area (0.5 ha) or width (30 m) are reported as Trees outside forests (TOF) under the Grassland category.

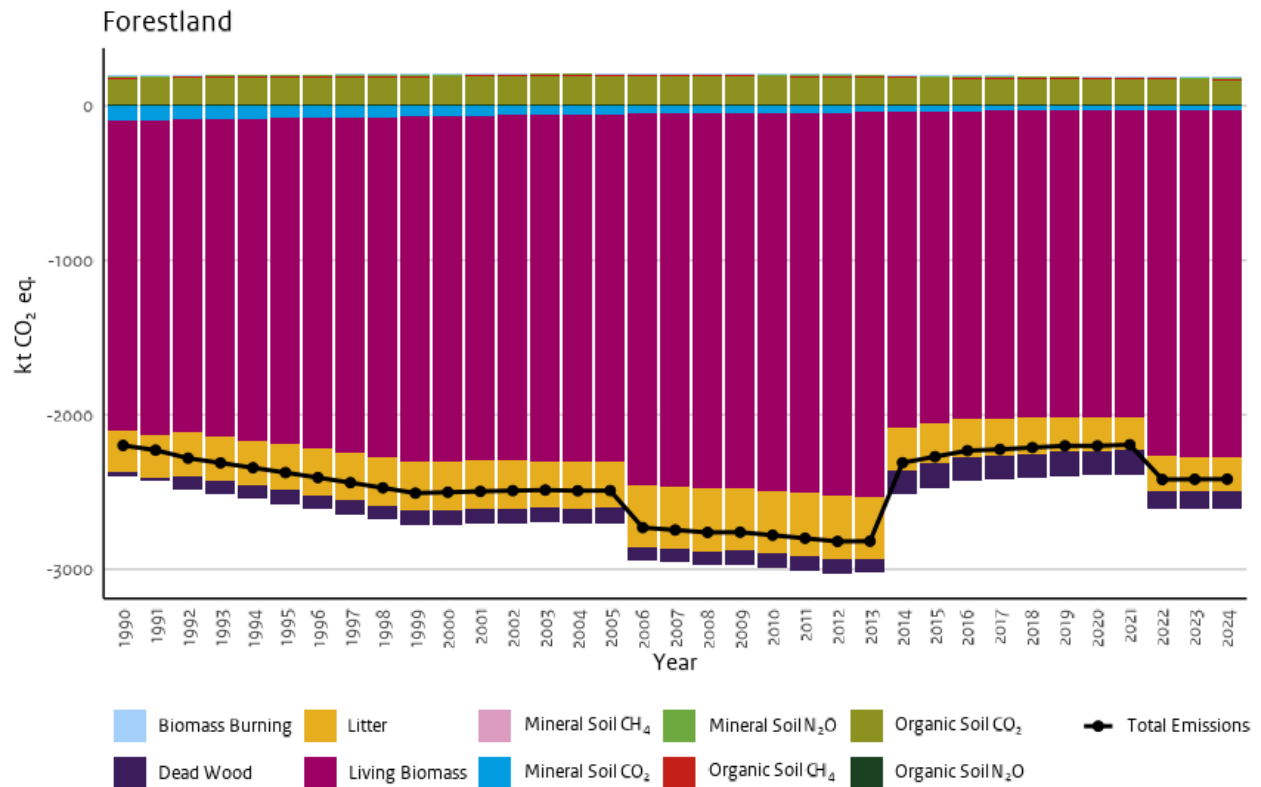
The Forest land category includes two sub-categories:

- Forest land remaining forest land (4.A.1): includes estimates of changes to the carbon stock in various carbon pools in Forest land;
- Land converted to forest land (4.A.2): includes estimates of changes in land use to forest land over the twenty-year transition period, since 1970;

See Figure 6.8 for the emissions from different pools from Forest land. Negative emissions are mainly driven by living biomass.

¹⁵ Report on the 7th Forest Inventory with results in Dutch only. For an English summary of the results and an English summary flyer 'State of the Forests in the Netherlands', see: <https://edepot.wur.nl/576640>

Figure 6.8 Summary of GHG emissions (positive) and removals (negative), differentiated by pool and gas type in Forest land (kt CO₂ eq).



Emissions take the form of CO₂ unless explicitly stated otherwise.

6.4.2 Methodological issues

Removals and emissions of CO₂ from forestry and changes in woody biomass stock are estimated using a country-specific Tier 2 methodology. The chosen approach follows the 2006 IPCC Guidelines, which suggest a stock difference approach. The basic assumption is that the net flux can be derived by converting the change in growing stock volumes in the forest into volumes of carbon. Detailed descriptions of the methods and EFs used can be found in the methodological background report for the LULUCF sector (section 4 in Van Baren et al., 2026). The Netherlands' national inventory follows the carbon cycle of a managed forest and wood products system. Changes in carbon stock are calculated for above-ground biomass (AGB), below-ground biomass (BGB), dead wood, and litter in forests.

National Forest Inventories

Data on forests is based on five National Forest Inventories (NFI) carried out in 1988–1991 (HOSP: Schoonderwoerd and Daamen, 1999), 2001–2005 (NFI-5: Daamen and Dirkse, 2005), 2012–2013 (NFI-6: Schelhaas et al., 2014), 2017–2021 (NFI-7: Schelhaas et al., 2022), and 2024 being the third year out of five from the NFI-8. As these inventories most accurately describe the state of Dutch forests, they were applied in the calculations for Forest land remaining forest land, Land converted to forest land, and Forest land converted to other land use. Thus, they represent the state of the forest at five moments in time (1 January);

1992 (HOSP), 2006 (NFI-5), 2014 (NFI-6), 2022 (NFI-7), and 2025 (NFI-8).

Changes in carbon stocks in living biomass in forests were calculated using plot-level data from the HOSP, NFI-5 NFI-6, NFI-7, and the first three years of NFI-8 inventories. From the NFI-7 onwards, a continuous forest inventory with permanent sample plots has been carried out. This means that the calculations for the carbon stock will change from the NFI-8 onwards. NFI-7 contains data measured from 2017 to 2021, covering the entire Dutch forest; the first year of the NFI-8 measured the same plots in 2023 as were measured in 2018. The data used for the carbon stock calculations with date 2025 contains forest measurements from 2019 to 2024 to represent the entire Dutch forest. In addition, changes in activity data were assessed using several databases of tree biomass information, with allometric equations to calculate AGB, BGB, and forest litter.

More detailed descriptions of the methods and EFs used can be found in section 4.2.1 of Van Baren et al. (2026).

6.4.2.1 Forest land remaining forest land

The net change in carbon stocks for Forest land remaining forest land is calculated as the difference in carbon contained in the forest between two points in time. Carbon in the forest is derived from the growing stock volume, making use of other forest traits routinely determined in forest inventories. With the repeated measures, changes in biomass and carbon stocks were assessed for the 1992–2006, 2006–2014, and 2014–2022 periods, and annually from 2022 onwards, where the continuous forest inventory is based on a five-year moving average. The interannual changes during the years in between these periods were determined using linear interpolation.

An exception was made for units of Forest land remaining forest land that were afforested between twenty and thirty years ago. These are reported under Forest land remaining forest land, but the calculation of living biomass, dead wood, and litter carbon stock changes in these units follows the approach used for Land converted to forest land (see section 6.4.2.2).

Living biomass

For each plot measured during the NFIs, information is available on the tree species, their standing stock (stem volumes), and the forest area they represent. On the basis of this information, the biomass is estimated directly for each tree measured using the following calculation steps for all NFIs unless otherwise stated (for further details see section 4.2.1 in Van Baren et al., 2026):

- 1) Using the species-specific wood density, based on IPCC default values, the stem volume is converted to stem biomass. The other biomass compartments (foliage, branches, and roots) are estimated using the allometric equations that include only diameter at breast height (DBH) as independent variables, provided in a study by Forrester et al. (2017) based on a Europe-wide dataset of biomass observations. Total tree biomass is calculated as the sum of all compartments, and totals per ha are

calculated from the individual biomasses and the plot size. For the HOSP dataset (1990, i.e. NFI4)) this first step is carried out differently as individual tree observations are not available. A species-specific biomass conversion and expansions factor (BCEF) at the plot level was derived from the NFI-5 data (average year 2006), using the reported main species, and applied it to the plot-level volume estimations for the HOSP.

- 2) Average growing stocks (in $\text{m}^3 \text{ ha}^{-1}$), average BCEFs (tonnes biomass m^{-3}), and average root-to-shoot ratios are calculated (see Table 6.15 below and Van Baren et al. (2026)). These are weighted for the representative area of each of the NFI plots for each NFI.
- 3) On the basis of the distribution of total biomass per hectare between coniferous and broadleaved trees, the relative share of coniferous and broadleaved forest is determined.
- 4) The average growing stock, average BCEFs, average root-to-shoot ratios, and shares of coniferous and broadleaved forests are linearly interpolated between the NFIs to estimate these parameters for all the intermediate years.
- 5) The average annual above-ground and below-ground biomasses (tonnes dry matter ha^{-1}) are estimated by combining annual average growing stock, BCEF, and root-to-shoot ratios.
- 6) Using the relative share of coniferous and broadleaved forests and the differentiated T1 carbon fractions for conifers and broadleaved species, above-ground and below-ground biomass is converted to carbon amounts.

The result of this assessment provides the average net carbon stock changes in living (above ground and below ground) biomass for an average ha of forest in the Netherlands per year. This is multiplied by the area of Forest land remaining forest land in a given year to assess the total net carbon stock changes in living biomass for Forest land remaining forest land in that year.

Losses from wood harvesting are not taken into account separately, as these are already included in the differences in the average carbon stocks between the forest inventories. However, since the harvested wood is part of the gross changes in carbon stocks, it is added to the net changes as calculated in the steps above to assess gross carbon stock gains in living biomass and, simultaneously, it is considered under the gross carbon stock losses in living biomass for reporting gains and losses (see section 4.2.1 in Van Baren et al. (2026) for details). In other words the harvest is added to the gross gains and subtracted from the gross losses. The net effect remains the same as assessed in the steps above.

In several review reports, the expert review team (ERT) referred to the apparent high growth rates of biomass in Dutch forests, indicating that it is among the highest in Annex I countries. Dutch experts consider this a misinterpretation of the results. Although the increase in growing stock in Dutch forests appears to be higher than in other countries, the volume growth rates are not. However, the low harvest intensities in the Netherlands, with only about 55% of the increment being harvested, and the specific age class structure of Dutch forests (see Schelhaas

et al. (2022)¹⁶, and annex 5 in Van Baren et al. (2026)), result in a strong net increase in growing stock over time.

Table 6.15 Average growing stock (GS; m³ ha⁻¹), BCEF (tonnes dry matter (d.m.) per m³ stemwood volume) above-ground biomass (AGB; tonnes dry matter ha⁻¹), below-ground biomass (BGB; tonnes d.m. ha⁻¹)

Year	Growing stock (m³ ha⁻¹)	BCEF (tonnes d.m. m⁻³)	AGB (tonnes d.m. ha⁻¹)	BGB (tonnes d.m. ha⁻¹)
1990	152	0.712	108	24
1991	155	0.713	110	24
1992	158	0.713	113	25
1993	161	0.714	115	25
1994	164	0.714	117	26
1995	167	0.715	119	26
1996	170	0.715	121	26
1997	172	0.716	123	27
1998	175	0.716	126	27
1999	178	0.717	128	27
2000	181	0.718	130	28
2001	184	0.718	132	28
2002	187	0.719	134	29
2003	190	0.719	137	29
2004	193	0.720	139	29
2005	196	0.720	141	30
2006	199	0.721	143	30
2007	201	0.724	145	31
2008	203	0.727	148	31
2009	206	0.730	150	32
2010	208	0.733	152	32
2011	210	0.735	155	32
2012	213	0.738	157	33
2013	215	0.741	159	33
2014	217	0.744	162	34
2015	219	0.748	164	34
2016	220	0.751	165	35
2017	222	0.755	167	35
2018	223	0.759	169	36
2019	224	0.762	171	36
2020	226	0.766	173	36
2021	227	0.769	175	37

¹⁶ Available at: <https://edepot.wur.nl/571720> providing information on age class distribution (chapter 7, 'Kiemjaar'), harvesting (chapter 15, 'Velling') and growing stock (chapter 16, 'Mutaties houtvoorraad'). A flyer with key figures explained in English is available at <https://edepot.wur.nl/576640>, including information on age, growing stock, and harvests.

Year	Growing stock (m ³ ha ⁻¹)	BCEF (tonnes d.m. m ⁻³)	AGB (tonnes d.m. ha ⁻¹)	BGB (tonnes d.m. ha ⁻¹)
2022	229	0.773	177	37
2023	230	0.776	179	38
2024	232	0.779	181	38
2025	234	0.782	183	38

All values are dated 1 January of the specified year. Values in between the years are linearly interpolated.

Dead wood

Dead wood volume is available from the forest inventory datasets. The calculation of carbon stock changes in dead wood in forests follows the approach to the calculation of carbon emissions from living biomass, i.e. using a thirty-year transition period from the moment of land-use change towards forest land, and is conducted for lying and standing deadwood (see section 4.2.1 in Van Baren et al., 2026). For deadwood, a wood density equalling 60% of the values for fresh wood was used..

Litter

As of the NIR 2024, the carbon stock changes in litter in forests have followed the same approach as the calculation of carbon emissions from living biomass with one difference. The build-up period to full carbon stock is the same for litter, thirty years after the land-use change, but after these thirty years, no change in carbon stock is reported. For Forest land remaining forest land, this means that after ten years of being in the remaining category, no carbon stock changes are reported anymore.

Data for the carbon stock of litter is a combination of litter thickness measurements from the NFIs and carbon content measurements from De Jong et al. (2023). For the full method description, see section 4.2.1 in Van Baren et al. (2026).

Effects of wood harvests on biomass gains and losses

Net carbon stock changes in biomass in Forest land remaining forest land are based on the information from the forest inventories. As a result, the effect of harvesting wood on carbon in the remaining forest biomass is already implicitly included in the carbon stock differences between the various forest inventories. Thus, the gross gains in biomass between the inventories were higher than calculated from the inventories' stock differences. Therefore, the carbon in the biomass of the harvested wood in a given year was added to the carbon stock changes in living biomass. At the same time, this identical amount of carbon was reported under carbon stock losses from living biomass, resulting in the net change as determined from the carbon stock differences between the forest inventories. As a consequence, the net stock change is gradual, but the gains and losses are more erratic.

Forest fires

In the Netherlands, no recent statistics are available on the occurrence and intensity of wildfires in forests (forest fires). The area of burnt forest is based on a historical series from 1980 to 1992 for which the annual

number of forest fires and the total area burnt is available (Wijdeven et al., 2006). The average annual area of forest fires (37.8 ha) from the 1980–1992 period has been used for all years from 1990 onwards (section 12.2 in Van Baren et al., 2026). Other nature fires are reported under Grassland; see section 6.6.2. on wildfires.

Emissions of CO₂, CH₄ and N₂O from forest fires are reported at Tier 2 level according to the method described in the 2006 IPCC Guidelines (IPCC, 2006: volume 4, equation 2.27):

$$L_{fire} = A * M_B * C_f * G_{ef} * 10^{-3}$$

Where:

- L_{fire} = amount of greenhouse gas emissions from fire, tonnes of each GHG e.g. CH₄, N₂O, etc.
- A = area burnt in ha
- M_B = mass of fuel available for combustion, tonnes ha⁻¹. This includes biomass, ground litter and dead wood. C_f = combustion factor, dimensionless (default values in IPCC, 2006: volume 4, table 2.6)
- G_{ef} = emission factor, g kg⁻¹ dry matter burnt (default values in IPCC, 2006: volume 4, table 2.5)

The mass of fuel for forest fires is based on the average annual carbon stock in living biomass, litter, and dead wood (Tables 6.15 and 6.16). These values change annually, depending on forest growth and harvesting. Because burnt sites are also part of the NFI, the loss of carbon due to forest fires is covered in the carbon stock changes derived from the NFI. Yet, forest fires are very infrequent, mostly cover small areas, and have a relatively mild impact on biomass. As a result, it is not clear if the NFI fully covers information on forest fires and their emissions. The approach followed may thus include some double counting of these emissions, and therefore, it is considered conservative.

With the available data, it is not possible to distinguish between forest fires in Forests remaining forests and Land converted to forest land. Therefore, total emissions from forest fires are reported in CRT Table 4(IV) under 'Wildfires for forests remaining forests'.

The UNFCCC reviewer of the NIR 2019 suggested available geospatial techniques for the identification of forest fires such as the European Forest Fire Information System (EFFIS) as a possible data source to improve fire activity data after 1992. An earlier attempt to improve wildfire activity data by testing various remote sensors and geospatial techniques showed that the potential for remote sensing is limited in the case of the Netherlands (see Roerink & Arets, 2016). Because forest fires are infrequent, usually have a low intensity, and cover relatively small areas, none of the geospatial approaches was very effective in detecting the relevant forest fires and wildfires. Moreover, the cost of monitoring and analysis was considered to be disproportionate to the potential quality improvement for the GHG inventory (see Roerink & Arets, (2016), and section 12.3 in Van Baren et al. (2026) for further details).

We have investigated other possible improvements in wildfire statistics in the Netherlands using the EFFIS data reported in its annual fire reports from 2000. Until 2017, the Netherlands did not submit a report to EFFIS, but the EFFIS reports also include independent rapid damage assessments to provide reliable and harmonised estimates of the areas affected by forest fires in collaborating countries. Although the Netherlands is included in these assessments, EFFIS's resolution of fire detection of 50 ha (older years), or, more recently, 30 ha, is larger than the area of most forest fires and wildfires in the Netherlands. As a result, they remain largely undetected in the EFFIS system. Since 2004, only fourteen wildfires have been included in the EFFIS data for the Netherlands (see section 12.3 in Van Baren et al. (2026), for further details). Because an average area of 37.8 ha is taken into account in the calculations emissions for wildfires have been reported. We will further explore possible sources of improved wildfire activity data by combining geospatial analyses with the information registered by the Netherlands Fire Service. Given the currently small extent of wildfires in the Netherlands, an important prerequisite will be that such approaches should be cost-effective and proportionate to the expected emissions from wildfires.

Emissions from fertiliser use in forests

Fertilisers are principally not applied to forestry in the Netherlands. Therefore, in CRT Table 4(I) direct nitrous oxide (N₂O) emissions from nitrogen (N) inputs for Forest land remaining forest land are reported as NO.

6.4.2.2

Land converted to forest land

Removals and emissions of CO₂ from forestry and changes in woody biomass stock are estimated using a country-specific Tier 2 methodology. The approach chosen follows the 2006 IPCC Guidelines.

Living biomass

Changes in carbon stocks in AGB and BGB in Land converted to forest land are estimated using the following set of assumptions and calculation steps:

1. The EF is calculated for each annual set of newly established units of Forest land separately. Thus, the specific age of the reforested/afforested units of land is taken into account.
2. At the time of afforestation, carbon stocks in AGB and BGB are zero.
3. The specific growth curve of new forests is unknown, but analyses of NFI plot data make clear that carbon stocks in newly planted forests reach the carbon stock of average forests in thirty years. Consequently, carbon stocks in AGB or BGB on units of newly established Forest land increase annually by the difference between the carbon stock in AGB or BGB at that time and the carbon stock in AGB or BGB of the average forest under Forest land remaining forest land, divided by the number of years left to reach an age of thirty years. This will result in twenty years of this build-up of carbon being reported in Land converted to Forest land and ten years in Forest land remaining Forest land.

For Cropland and Grassland converted to forest land, biomass loss in the year of conversion is calculated using Tier 1 default values.

Conversion from Grassland (TOF) to Forest land may occur when areas surrounding units of Trees outside forests are converted to Forest land and the total forested area becomes larger than the lower limit of the forest definition (i.e. 0.5 ha). For these conversions from Trees outside forests to Forest land, it is assumed that the biomass remains and the forest continues to grow as in Forest land remaining forest land.

Litter and dead wood

The specific accumulation of dead wood and litter in newly established forest plots is unknown, but from NFI measurements, the litter thickness and presence of deadwood is known. Therefore, the carbon build-up in litter and dead wood follows the approach used for the calculation of carbon emissions from living biomass (see section 4.2.2 in Van Baren et al., 2026).

Emissions from forest fires

All emissions from forest fires are included under Forest land remaining forest land and are reported here as IE.

Emissions from fertiliser use in forests

Fertilisers are minimally applied to forestry in the Netherlands. Therefore, in CRT Table 4(I), direct N₂O emissions from N inputs for Land converted to forest land are reported as NO.

6.4.2.3 Forest land converted to other land-use categories

Living biomass

It is assumed that with the change from Forest land to other land-use categories, all carbon stored in above-ground and below-ground biomass, as well as in dead wood and litter is lost. For living biomass, the amount of carbon lost depends on the accumulated carbon since the forest was established, whereas for units of land in the Land converted to forest land category and in Forest land remaining forest land established less than thirty years ago, the carbon stocks are determined by the young forest approach as explained above in sections 6.4.2.1 and 6.4.2.2 (see also section 4.2.2 in Van Baren et al., 2026).

Conversion from Forest land to Grassland (TOF) occurs when surrounding forest is converted to other land uses and the remaining forest area becomes smaller than the lower limit of the forest definition (i.e. 0.5 ha). For these conversions from Forest land to Trees outside forests, it is assumed that no loss of biomass occurs. Even though it is shown as a loss in the CRT, an equal amount of gain in biomass is reported in TOF converted to Forest Land.

Table 6.16 Emission factors (EF) for dead organic matter carbon stocks in mature (> 30 year) forest land (Mg C ha⁻¹)

Year	EF dead wood (Mg C/ha)	EF litter (Mg C/ha)
1990	0.38	28.5
1991	0.40	28.6
1992	0.41	28.7
1993	0.49	28.7
1994	0.56	28.8
1995	0.63	28.8
1996	0.70	28.9
1997	0.77	29.0
1998	0.84	29.0
1999	0.91	29.1
2000	0.98	29.1
2001	1.05	29.2
2002	1.12	29.3
2003	1.19	29.3
2004	1.26	29.4
2005	1.33	29.4
2006	1.40	29.5
2007	1.46	30.2
2008	1.52	31.0
2009	1.58	31.7
2010	1.64	32.5
2011	1.70	33.2
2012	1.76	33.9
2013	1.82	34.7
2014	1.88	35.4
2015	1.99	35.3
2016	2.10	35.1
2017	2.21	35.0
2018	2.33	34.8
2019	2.44	34.7
2020	2.55	34.5
2021	2.66	34.4
2022	2.77	34.2
2023	2.85	34.2
2024	2.93	34.2
2025	3.00	34.2

All values represent the stock on 1 January for the specified year.

Dead wood

Total emissions from the dead wood component following deforestation are calculated by multiplying the total area deforested by the average carbon stock in dead wood, as estimated by the calculations for Forest

land remaining forest land. Thus, it is assumed that, with deforestation, all carbon stored in dead wood is lost to the atmosphere. National averages are used as there is no record of the spatial occurrence of specific forest types. This loss is also applied to Grassland (TOF) (see section 4.2.3 in Van Baren et al. (2026) and resulting emission factors in Table 6.16), which includes both standing and lying dead wood.

Litter

Total emissions from the litter component following deforestation are calculated by multiplying the total area deforested by the average carbon stock in litter, as estimated by the calculations for Forest land remaining forest land. National averages are used for the EFs as there is no record of the spatial occurrence of specific forest types.

The average carbon stock in the litter layer has been estimated at the national level (De Jong et al., 2023). Litter thickness data from the NFIs and carbon content estimates from De Jong et al. (2023) are combined to calculate carbon content for litter. See section 4.2.1 and annex 3 in Van Baren et al. (2026) for the full methodology.

Carbon stock changes per area of litter pool of the area of deforestation is high compared to those reported by other parties. These high values are related to the large share of the forest area that is on poor Pleistocene soils characterised by relatively thick litter layers. Additional information on geomorphological aspects is provided in Schulp et al. (2008) and De Waal et al. (2012) (see section 4.2.3 in Van Baren et al. (2026) and the resulting emission factors in Table 6.16 above).

6.4.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The analysis in Annex 2 presented in Table A2.3 provides estimates of uncertainty by IPCC source category that are based on error propagation. This analysis combines uncertainty estimates of forest statistics, land use and land-use change data (topographical data), and the uncertainties in the method used to calculate the annual growth in carbon increases and removals. The uncertainty range in CO₂ emissions from 4.A (Forest land) is calculated at +10% to -12%. For N₂O and CH₄, uncertainties are much higher, up to 400% for N₂O, due to large uncertainties in emission factors. See table 13.7 in Van Baren et al. (2026) for details.

The Netherlands also applies an improved uncertainty assessment to the LULUCF sector as a whole with better representation of uncertainties in the land-use matrix, using Monte Carlo simulations for combining different types of uncertainties (see section 13.4 in Van Baren et al. (2026) for details).

Time-series consistency

To ensure time-series consistency in Forest land remaining forest land, the same approach to activity data, land-use area, and emissions calculation is used for all years up to the reporting year. More detailed information is provided in section 6.4.2.1.

To ensure time-series consistency in Land converted to forest land, the same approach to activity data, land-use area, and emissions calculation

is used for all years. More detailed information is provided in section 6.4.2.2.

6.4.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1. Additional Forest land-specific QA/QC includes:

- During the measurements of the four forest inventories, specific QA/QC measures were implemented to prevent errors in measurements and reporting (see annex 1.1 in Van Baren et al. (2026)).

6.4.5 *Category-specific recalculations*

Several of the methodological changes described in section 6.1.3 have an effect on Forest land and resulted in recalculations for the entire time series:

- The updated emission factors for organic soils resulted in lower emissions from Forest land.
- The introduction of a new land-use map influenced the activity data post-2021 of all land-use categories, including Forest land.
- Spatial interpolation of annual maps influenced the activity data of all land-use categories, including Forest land.
- The new C:N ratio and emission factor for indirect N₂O emissions had a small impact on emissions from all land-use categories, including Forest land.
- Assigning carbon stocks to mineral soils resulting from degradation of organic soils affected mineral soil emissions from Forest land.
- Removal of the drainage fraction marginally increased the surface area of drainage ditches on Forest land on organic soils, resulting in a slight increase in CH₄ emissions.

6.4.6 *Category-specific planned improvements*

No category-specific improvements have been planned.

6.5 **Cropland (4.B)**

6.5.1 *Category description*

Emissions resulting from the disturbance of mineral soils due to land-use changes to Cropland and emissions resulting from the lowering of the ground water table in organic soils under Cropland are significant. For mineral soils, different methods are applied for areas of Cropland remaining cropland and Land converted to cropland (see sections 11.2.1 and 11.2.2, respectively, in Van Baren et al., 2026). As a result of these high emissions from mineral soils and drained organic soils, the Cropland category is a key source. The carbon stock gains and losses in living biomass in Grassland converted to Cropland also strongly contribute to the emissions and removals in the Cropland category, but this contribution remains below the threshold of 25% of gains/losses in the category for it to be a significant pool under the Cropland category.

Because Cropland in the Netherlands mainly consists of annual cropland where annual biomass gains are harvested each year, no net accumulation of carbon stocks in biomass over time is expected in Cropland (IPCC, 2006). On the basis of estimates using the Tier 1 EFs,

the carbon pool biomass gains and dead organic matter (DOM) in Cropland remaining cropland and Land converted to cropland can be considered not significant. Therefore, following the Tier 1 method in the 2006 IPCC Guidelines, carbon stock changes in living biomass are not estimated for Cropland remaining cropland.

Even if we apply the unrealistically high average EF for biomass gains and losses of Land converted to cropland to the area of Cropland remaining cropland, the resulting carbon stock changes remain well below the significance level (i.e. 25% of gains/losses in the category). Therefore, in CRT Table 4.B, these carbon stock changes are reported with the notation key NA.

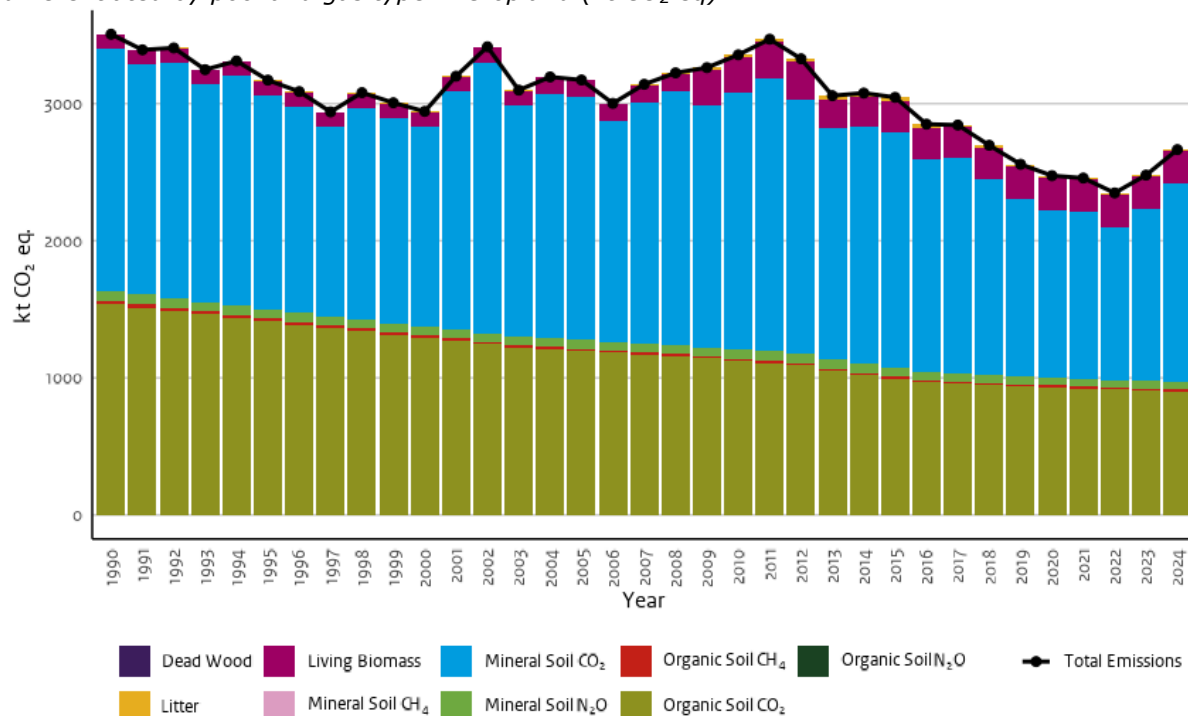
There are significant carbon stock changes in biomass in orchards, which in the Netherlands, predominantly consist of fruit trees. Because of the mainly grassy vegetation between trees, orchards are included under Grassland (see section 6.6).

Dead organic matter in annual cropland is expected to be negligible and, applying a Tier 1 method, it is assumed that dead wood and litter stocks (DOM) are not present in Cropland (IPCC, 2006). Therefore, carbon stock gains in DOM are not estimated in land-use conversions to Cropland, nor are carbon stock losses in conversions from Cropland to other land uses.

Carbon stock losses for conversions to Cropland depend on the carbon stocks in DOM in the 'converted from' land-use category. Currently, carbon stocks in DOM are only included under Forest land.

Emissions for the complete time period are presented in Figure 6.9. Emissions are mainly driven by organic and mineral soils.

Figure 6.9 Summary of GHG emissions (positive) and removals (negative), differentiated by pool and gas type in Cropland (kt CO₂ eq).



Emissions take the form of CO₂ unless explicitly stated otherwise.

6.5.2 Methodological issues

With regard to soil emissions, a twenty-year transition period starting in 1990 is included, while carbon stock changes in biomass are considered to be instantaneous on conversion. In CRT Table 4.B, the area associated with the transition period for soil is reported.

Living biomass

The value of emissions and removals of CO₂ from carbon stock changes in living biomass for Land converted to cropland is calculated using a Tier 1 approach. This value is also used for determining emissions for Cropland converted to other land-use categories (4.A.2, 4.C.2, 4.D.2, 4.E.2, 4.F.2).

Soils

Carbon stock changes in mineral soils for Cropland remaining cropland are calculated using a Tier 3 methodology, applying the RothC model. Carbon stock changes in mineral soils for land-use changes involving Cropland and emissions from drained organic soils under Cropland are calculated using Tier 2 methodologies. Further information on the methodologies is provided in section 6.1.2, and further details are provided in section 11.2.2 of Van Baren et al. (2026).

6.5.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The analysis in Annex 2, Table A2.3 provides estimates of uncertainties for each IPCC source category that are based on error propagation. The uncertainties in the Dutch analysis of carbon levels depend on the factors that feed into the calculations (calculation of the organic

substances in the soil profile and conversion to a national level) and data on land use and land-use change (topographical data). The uncertainty range in the CO₂ emissions for 4.B (Cropland) is calculated at 45%. For N₂O and CH₄, uncertainties are much higher due to uncertainties in emission factors (see Van Baren et al. (2026) for details).

The Netherlands also applies an improved uncertainty assessment to the LULUCF sector as a whole, with better representation of uncertainties in the land-use matrix, using Monte Carlo simulations for combining different types of uncertainties (see section 13.4 in Van Baren et al. (2026) for details).

Time-series consistency

To ensure time-series consistency in Cropland remaining Cropland, the same approach to activity data, land-use area, and emissions calculation is used for all years up to the reporting year. More detailed information is provided in section 6.4.2.1.

To ensure time-series consistency in Land converted to Cropland, the same approach to activity data, land-use area, and emissions calculation is used for all years. More detailed information is provided in section 6.4.2.2.

6.5.4 Category-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

6.5.5 Category-specific recalculations

Several of the methodological changes described in section 6.1.3 have an effect on Cropland and resulted in recalculations for the entire time series:

- The updated emission factors for organic soils resulted in lower emissions from Cropland.
- The introduction of a new land-use map influenced the activity data post 2021 of all land-use categories, including Cropland.
- Spatial interpolation of annual maps influenced the activity data of all land-use categories, including Cropland.
- The new approach to standardising weather data had an influence on the modelled mineral soil carbon flux for Cropland remaining cropland.
- The new C:N ratio and emission factor for indirect N₂O emissions had a small impact on emissions from all land-use categories, including cropland.
- Assigning carbon stocks to mineral soils resulting from degradation of organic soils affected mineral soil emissions from cropland.

6.5.6 Category-specific planned improvements

Organic soil emission calculations (CO₂ and CH₄) are planned to be developed further in the coming years.

6.6 Grassland (4.C)

6.6.1 *Category description*

Under the Grassland category, two main sub-categories are identified: (1) Trees outside forests (TOF) and (2) Grassland (non-TOF); see section 6.2. Conversions of land use to, from, and between Grassland (non-TOF) and TOF are separately monitored, and each takes a different approach to calculating the carbon stock changes.

Trees outside forests (TOF)

The Trees outside forests (TOF) category is determined in a spatially explicit way and experiences carbon stock changes similar to those of Forest land (see section 6.4.2 in Van Baren et al., (2026)). For land-use conversion to TOF, the same biomass increase and associated changes in carbon stocks are assumed as for Land converted to forest land. For conversions from TOF to other land uses, however, no losses of dead wood or litter are assumed. As the patches are smaller and any edge effects are thus larger than in forests, the uncertainty regarding dead wood and litter accumulation is even higher for TOF than for Forest land. Moreover, for small patches and linear woody vegetation, the chance of dead wood removal is high, and disturbance effects on litter may prevent accumulation. Therefore, the conservative estimate of no carbon accumulation in these pools has been applied.

Conversion from Forest land to TOF may occur if connected units of Forest land are converted to other land uses and the remaining area no longer complies with the forest definition. Such units of land are considered to remain with tree cover, but losses of carbon in dead wood and litter will occur.

Grassland (non-TOF)

As described for Cropland, emissions resulting from the lowering of the ground water table in organic soils under Grassland (non-TOF) are significant. Therefore, these are explicitly calculated for areas of Grassland remaining grassland (non-TOF) and for Land converted to grassland (non-TOF) (see section 11.3 in Van Baren et al., (2026)).

For carbon stock changes in living biomass in grassland vegetation and nature remaining in these categories, a Tier 1 method is applied, assuming no change in carbon stocks occurs (IPCC, 2006; for details see section 6.1.1 in Van Baren et al., (2026)). In orchards, an increase in carbon stocks can be expected as the fruit trees age (see section 6.6.2 below). As a result of changing areas of grassland vegetation and orchards, the average carbon stocks in Grassland remaining grassland (non-TOF) change across years, reflected in the carbon stock changes in biomass in Grassland remaining grassland (non-TOF).

Carbon stock gains in living biomass for Land converted to grassland (non-TOF) are calculated using a Tier 1 approach (see section 6.6.2 on living biomass). Carbon stocks in Grassland (non-TOF) depend on carbon stocks per unit of area of grassland vegetation, nature and orchards and the relative contribution made by these categories to the Grassland (non-TOF) area. This value is also used to determine carbon stock losses in biomass for Grassland converted to other land-use categories.

Dead organic matter (DOM) in grassland and orchards is expected to be negligible. While dead wood and litter may be formed in orchards, common orchard management that includes pruning and the removal of dead wood and litter will prevent build-up of large amounts of DOM. Even if we applied a value of 10% of annual carbon stock gains in biomass as an estimate of carbon stock gains in DOM in Grassland, this would make up only 1% of the carbon stock gains and losses in the Grassland category. Therefore, the Tier 1 approach is used (IPCC, 2006), assuming no build-up of DOM, which is reported as 'NE'.

This means that the carbon stock gains in DOM are not included in land-use conversions to Grassland (non-TOF), nor are the carbon stock losses included in conversions from Grassland (non-TOF) to other land-use categories. Carbon stock losses for conversions to Grassland (non-TOF) will depend on the carbon stocks in DOM in the 'converted from' land-use category. Currently, carbon stocks in DOM are only included under Forest land.

Land converted to grassland that changes from one Grassland (non-TOF) category to another within the twenty-year transition period (i.e. from grassland vegetation to nature or the other way around, see section 6.1.1 in Van Baren et al., (2026)), is still reported in the land converted to Grassland (non-TOF) category until the end of the twenty-year transition period.

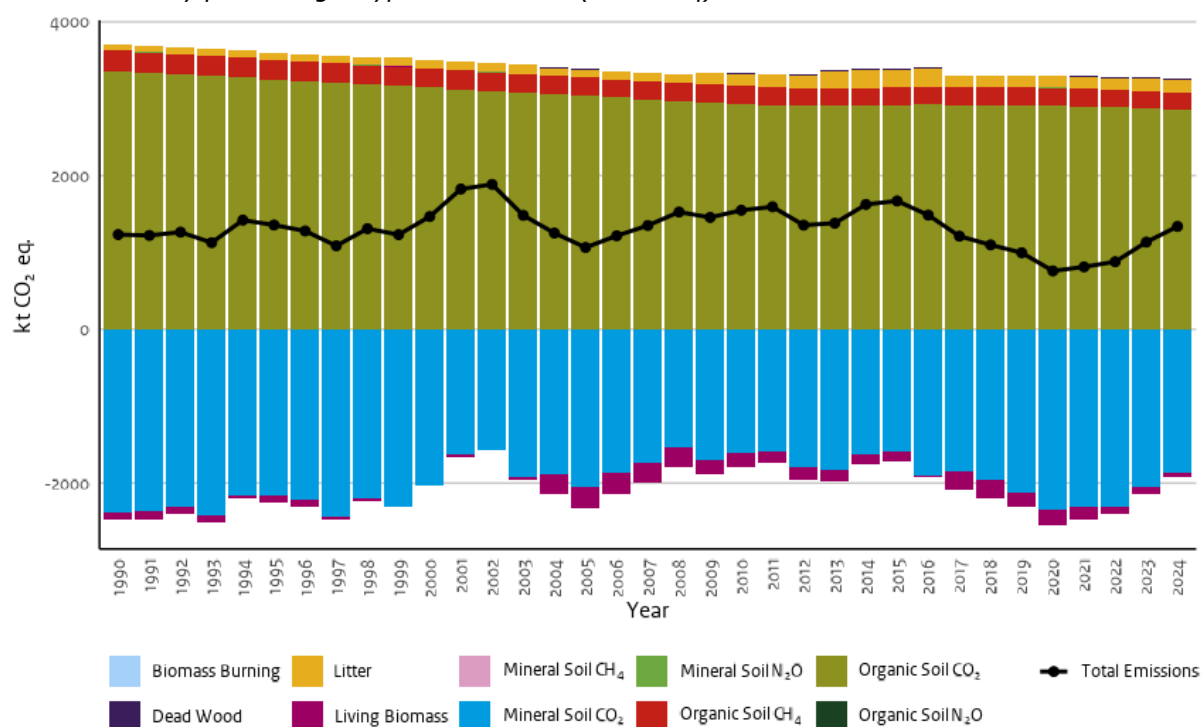
Conversions between Grassland (non-TOF) and TOF

Whereas conversions between Grassland (non-TOF) and TOF are reported under Grassland remaining grassland, the two categories are considered separately in the calculations.

Conversions from Grassland (non-TOF) to TOF will result in the loss of Grassland (non-TOF) biomass in the year of conversion and subsequent growth of biomass (in the form of trees) in TOF. Conversion from TOF to Grassland (non-TOF) will involve a loss of carbon stocks in biomass from TOF and an increase in carbon stocks in Grassland (non-TOF); the same applies to conversions from other land-use categories. The changes in carbon stocks in mineral soils will also be included using a twenty-year transition period, similar to conversions between Forest land and Grassland (non-TOF).

Emissions from Grassland are presented in Figure 6.10. Emissions are mainly driven by organic soils. Negative emissions are driven by mineral soils.

Figure 6.10 Summary of GHG emissions (positive) and removals (negative), differentiated by pool and gas type in Grassland (kt CO₂ eq).



Emissions take the form of CO₂ unless explicitly stated otherwise.

6.6.2 Methodological issues

With regard to soil emissions, a twenty-year transition period is included starting from 1970, while carbon stock changes in biomass are considered to be instantaneous on conversion. In the CRT, the area associated with the transition period for soil is reported.

Living biomass

Grassland non-TOF

Carbon stock changes due to changes in biomass in land-use conversions to and from Grassland (non-TOF) are calculated using Tier 1 default carbon stocks. For the whole Grasslands (non-TOF) category, including grassland vegetation, nature, and orchards, an average carbon stock per unit of land is calculated from the carbon stocks per unit area of grassland vegetation, nature, and orchards, weighted for their relative contribution to the Grassland (non-TOF) category. Therefore, average carbon stocks for Grassland (non-TOF) will fluctuate over time as a result of varying relative contributions by the various vegetation types to the total Grassland (non-TOF) area (see Table 6.17).

Default values for dry matter and carbon factors are used to determine carbon stocks in living biomass in grassland vegetation and nature. Combined, these amount to 6.4 ton C per ha (section 6.2 in Van Baren et al., 2026). Carbon stocks in living biomass in orchards are based on an average age of trees in orchards¹⁷ and a Tier 1 biomass accumulation rate of 2.1 ton C ha⁻¹ yr⁻¹ (IPCC, 2006). The average age of fruit

¹⁷ <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/81735NED/table?ts=1517993072950>

orchards changed over time from 10.4 years in 1997 to 13 years in 2017¹⁸. Between the measurement years (1997, 2002, 2007, 2012, and 2017), the age developments were interpolated and linearly extrapolated before and after on the basis of the two adjacent measured ages. Subsequently, the average ages of fruit orchard trees are multiplied by the Tier 1 biomass accumulation of 2.1 tonnes ha⁻¹ yr⁻¹ to calculate the average carbon stock in orchard biomass (tC ha⁻¹) (Table 6.17). The standard Tier1 value for grassland biomass is also added to this, as fruit trees in the Netherlands are typically underplanted with grass. Areas of orchards published by Statistics Netherlands (CBS) between 1992 and 2016¹⁹ and from 2017 onwards²⁰ are used to assess the area-weighted average carbon stocks in Grassland non-TOF (Table 6.17). The two Statistics Netherlands time series used include mostly the same fruit tree categories. Only in the case of other stone fruit trees ('overige steenvruchtbomen'), the more recent time series (since 2015) also includes, on average, 700 ha of high-standard fruit trees, which were not recorded separately before. Because of the relatively small effect, this is estimated to have no net emissions (around -4 kt CO₂), and it was decided not to correct this.

Net carbon stock changes in both mineral and organic soils for land-use changes involving Grassland are calculated using the methodology provided in sections 11.2 and 11.3 in Van Baren et al. (2026).

¹⁸ <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/81735NED/table?ts=1517993072950>

¹⁹ <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/70671NED/table?fromstatweb>

²⁰ <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/84470NED/table?ts=1582625476425>

Table 6.17 Area and carbon stocks (CS) in living biomass for orchards and grass vegetation and combined average carbon stocks per area of Grassland (non-TOF)

	Orchard			Grass vegetation		Total		Average
Year	Area (kha)	CS ha ⁻¹ (tC)	CS (tC)	Area (kha)	CS (tC)	Area (kha)	CS (tC)	CS (tC/ha)
1990	25.0	22.7	566.9	1426.4	9117.7	1451.4	9684.5	6.67
1991	24.7	22.6	557.3	1419.7	9074.9	1444.4	9632.2	6.67
1992	24.4	22.5	548.3	1413.0	9032.0	1437.4	9580.3	6.67
1993	24.2	22.4	540.9	1406.2	8988.7	1430.4	9529.6	6.66
1994	24.1	22.3	537.3	1399.3	8944.3	1423.4	9481.6	6.66
1995	23.1	22.2	512.8	1393.3	8905.9	1416.4	9418.7	6.65
1996	22.9	22.1	506.5	1386.5	8862.4	1409.4	9368.8	6.65
1997	23.0	22.0	504.9	1379.4	8817.4	1402.4	9322.3	6.65
1998	22.4	21.9	489.7	1373.0	8776.4	1395.4	9266.1	6.64
1999	21.9	21.8	476.5	1366.5	8734.9	1388.4	9211.4	6.63
2000	20.5	21.7	444.4	1360.9	8699.0	1381.4	9143.4	6.62
2001	19.5	21.6	420.6	1354.9	8660.7	1374.4	9081.3	6.61
2002	19.2	21.5	413.3	1348.2	8617.6	1367.4	9030.9	6.60
2003	18.4	21.8	400.9	1342.0	8578.2	1360.4	8979.1	6.60
2004	18.3	22.1	405.0	1338.5	8555.8	1356.9	8960.9	6.60
2005	18.1	22.4	405.3	1335.2	8534.6	1353.3	8939.9	6.61
2006	18.2	22.7	412.6	1331.6	8511.3	1349.7	8923.9	6.61
2007	18.5	23.0	424.4	1327.7	8486.8	1346.2	8911.2	6.62
2008	18.6	23.3	432.8	1324.0	8463.2	1342.6	8896.0	6.63
2009	18.8	23.6	442.8	1312.1	8387.2	1330.9	8830.0	6.63
2010	18.6	23.8	442.4	1300.7	8314.0	1319.2	8756.4	6.64
2011	18.3	24.1	441.4	1289.3	8241.0	1307.6	8682.4	6.64
2012	17.9	24.4	437.4	1278.0	8168.7	1295.9	8606.1	6.64
2013	18.2	25.0	455.4	1292.5	8261.4	1310.7	8716.8	6.65
2014	18.3	25.6	468.2	1307.2	8355.4	1325.4	8823.6	6.66
2015	18.5	26.2	485.2	1321.7	8448.4	1340.2	8933.6	6.67
2016	19.1	26.8	512.4	1335.9	8539.1	1355.0	9051.5	6.68
2017	18.6	28.2	519.6	1344.5	8593.9	1363.0	9113.5	6.69
2018	18.4	29.1	533.9	1352.6	8646.1	1371.0	9179.9	6.70
2019	18.4	29.9	538.1	1360.7	8697.5	1379.1	9235.6	6.70
2020	18	30.7	549.1	1369.1	8751.1	1387.1	9300.2	6.70
2021	17.9	31.6	563.3	1375.9	8795.1	1393.2	9358.4	6.72
2022	17.8	32.4	550.3	1384.2	8847.8	1402.7	9398.0	6.70
2023	17	32.4	545.5	1393.2	8905.8	1410.3	9451.3	6.70
2024	16.8	28.2	519.6	1401.6	8959.32	1418.5	9478.9	6.68

Trees outside forests

At present, dedicated growth and increment data for Trees Outside Forests (TOF) is not available. Consequently, the growth rates from

forest land are applied as the closest scientifically reasonable proxy (see section 6.4). Under national definitions, one of the main differences between Forest land and TOF is the spatial extent: areas smaller than 0.5 ha are classified as trees outside forests, while their structural and ecological characteristics remain broadly comparable to those of forest stands. While stand size may influence growth dynamics to some degree, the species composition, site conditions, and management practices for many tree groups outside forests are similar to those observed in small forest patches. In the absence of measured data, this proxy approach is consistent with good practice. It is assumed that no build-up of dead wood or litter occurs and that no harvesting takes place. Instead, all the wood included in the national harvest statistics is assumed to be harvested from forest land.

Wildfires

There are no recent statistics available on the occurrence and intensity of wildfires in the Netherlands. Emissions of CO₂, CH₄ and N₂O from wildfires are reported according to the Tier 1 method described in the 2006 IPCC Guidelines.

The area of wildfires is based on a historical series from 1980 to 1992, for which the annual number of forest fires and the total burnt area are available (Wijdeven et al., 2006). Forest fires are reported under Forest land (see section 6.4.2). The average annual area of other wildfires is 210 ha (Arets et al., 2023). This includes all land-use categories. Most wildfires in the Netherlands, however, are associated with heath and grassland. Therefore, all other emissions from wildfires, except forest fires, are included under Grassland remaining grassland. CO₂, CH₄, and N₂O emissions from wildfires are based on the default carbon stock in living biomass on Grassland (non-TOF).

Areas of cultivated organic soils

In drained areas with cultivated organic soils, the 5.8% reduction for drainage ditches is considered, as no carbon stock losses and associated CO₂ emissions are calculated for them. While the total area of organic soil is included in CRT Table 4.C, the carbon stock changes are solely based on the cultivated areas minus 5.8% for drainage ditches. To improve transparency, a comparison between the various areas is presented in Table 6.18.

Table 6.18 Areas (kha) of peat and peaty soil in total Grassland (non-TOF) compared to the part considered to be drained cultivated grassland reported in CRT Table 3.D.

Year	Area grassland (non-TOF)			Area drained cultivated grassland		
	Peat	Peaty	Total	Peat	Peaty	Total
	kha					
1990	217,224	93,475	310,700	204,625	88,054	292,679
1991	215,666	92,923	308,590	203,158	87,534	290,692
1992	214,126	92,368	306,494	201,707	87,011	288,718
1993	212,606	91,819	304,425	200,274	86,494	286,768
1994	211,070	91,276	302,347	198,828	85,982	284,811
1995	209,548	90,730	300,278	197,395	85,468	282,862
1996	208,047	90,204	298,251	195,981	84,972	280,953

Year	Area grassland (non-TOF)			Area drained cultivated grassland		
	Peat	Peaty	Total	Peat	Peaty	Total
	kha					
1997	206,545	89,680	296,226	194,566	84,479	279,044
1998	205,062	89,116	294,178	193,168	83,947	277,116
1999	203,589	88,566	292,155	191,781	83,429	275,210
2000	202,120	88,041	290,161	190,397	82,934	273,332
2001	200,645	87,512	288,157	189,007	82,437	271,444
2002	199,173	86,987	286,161	187,621	81,942	269,563
2003	197,729	86,450	284,179	186,261	81,436	267,697
2004	196,173	85,898	282,071	184,795	80,916	265,710
2005	194,671	85,312	279,983	183,380	80,364	263,744
2006	193,146	84,762	277,908	181,943	79,846	261,789
2007	191,626	84,211	275,837	180,512	79,327	259,839
2008	190,126	83,671	273,797	179,099	78,818	257,917
2009	189,145	83,056	272,201	178,175	78,238	256,413
2010	188,242	82,440	270,682	177,324	77,659	254,983
2011	187,304	81,821	269,125	176,440	77,075	253,515
2012	186,350	81,190	267,540	175,542	76,481	252,023
2013	185,903	81,865	267,768	175,121	77,117	252,237
2014	185,756	82,419	268,174	174,982	77,638	252,620
2015	185,588	83,045	268,632	174,823	78,228	253,052
2016	185,420	83,630	269,050	174,666	78,780	253,445
2017	185,287	83,654	268,941	174,541	78,802	253,343
2018	185,164	83,676	268,841	174,425	78,823	253,248
2019	185,049	83,713	268,762	174,316	78,858	253,174
2020	184,925	83,752	268,677	174,199	78,894	253,093
2021	184,524	83,434	267,958	173,822	78,595	252,416
2022	184,135	83,066	267,201	173,455	78,248	251,703
2023	183,713	82,692	266,406	173,058	77,896	250,954
2024	183,268	82,387	265,655	172,638	77,608	250,247

All areas are dated on 1 January of the years indicated.

6.6.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The analysis in Annex 2, Table A2.3 provides estimates of uncertainties by IPCC source category, based on error propagation. The uncertainty range for CO₂ emissions in category 4.C Grassland (non-TOF) is calculated at a maximum of 75%. For CH₄ and N₂O, uncertainties are much higher, mainly due to uncertainties in emission factors (see section 13.5 and table 13.7 in Van Baren et al. (2026) for details). The Netherlands also applies an improved uncertainty assessment to the LULUCF sector as a whole, with better representation of uncertainties in the land-use matrix, using Monte Carlo simulations for combining different types of uncertainties (see section 13 in Van Baren et al. (2026) for details). There is currently no Monte Carlo uncertainty assessment that is based on the TOF category, but uncertainties are likely to be similar to those of Forest land – except that the uncertainty relating to the land-use map may be larger as a result of the inherently small patches of TOF.

Time-series consistency

To ensure time-series consistency, the same approach to activity data, land-use area, and emissions calculation is used for all years. Removals in the later years are the result of carbon stock gains in mineral soil that are mainly due to the relatively large areas of Cropland converted to grassland since 2013. Interannual changes in implied EFs in mineral soils are the result of shifts in trends of land-use changes. Carbon stock changes in mineral soils are based on combinations of land-use change and soil type. Therefore, the mix of combinations of land-use changes and soil types include changes over time. Moreover, actual annual land-use changes, mixed with the timing of the twenty-year transition periods for carbon stock changes in soils, further affects the interannual changes in the implied EFs calculated on the basis of the total area in a specific conversion category (e.g. Cropland converted to grassland).

6.6.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

6.6.5 *Category-specific recalculations*

Several of the methodological changes described in section 6.1.3 have an effect on Grassland and resulted in recalculations for the entire time series:

- The updated emission factors for organic soils resulted in lower emissions from Grassland.
- The introduction of a new land-use map influenced the activity data post 2021 of all land-use categories, including Grassland.
- Spatial interpolation of annual maps influenced the activity data of all land-use categories, including Grassland.
- The new approach to standardising weather data had an influence on the modelled mineral soil carbon flux for Grassland remaining grassland.
- The new C:N ratio and emission factor for indirect N₂O emissions had a small impact on emissions from all land-use categories, including Grassland.
- Assigning carbon stocks to mineral soils resulting from degradation of organic soils affected mineral soil emissions from Grassland.

6.6.6 *Category-specific planned improvements*

The national forest inventory (NFI) cycle uses the LULUCF land-use map as the basis for selecting measurement locations. Data collection for the current NFI cycle will continue through 2027, and measurements in areas classified as trees outside forests will be included. This will enable a dedicated subset of plots to be extracted specifically for TOF analysis. In the current plan, approximately 20,000 hectares are designated as TOF areas, with a sampling density of one measurement point per 100 hectares. Measurement methodologies will broadly follow the established protocols used in regular NFI sampling to ensure consistency and comparability.

Organic soil emission (CO₂ and CH₄) calculations are planned to be developed further in the coming years.

6.7 Wetlands (4.D)

6.7.1 Category description

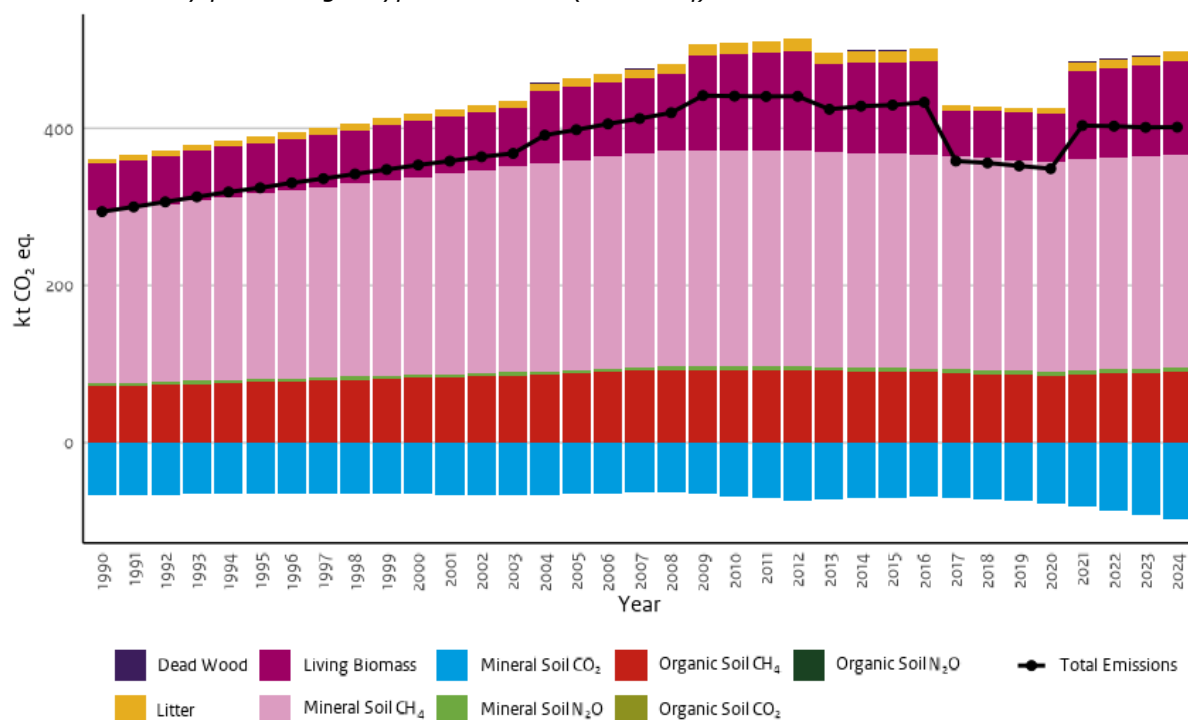
The Wetland land-use category mainly consists of open water (bodies). Therefore, for 4.D.1 (Wetland remaining wetland), no changes in carbon stocks in living biomass and soil have been estimated. For land-use conversions from Wetland to other land uses, no carbon stock losses in living biomass are assumed to occur; these will be reported as not occurring (NO). For land-use changes from Forest land, Cropland and Grassland to Wetland (4.D.2), losses in carbon stocks in living biomass and net carbon stock changes in soils are included.

Because the Wetland category is mainly open water, dead organic matter (DOM) is assumed to be negligible. Therefore, no carbon stock gains in DOM are included in land-use conversions to Wetland, nor are carbon stock losses included in conversions from Wetland to other land-use categories. Carbon stock losses for conversions to Wetland will depend on the carbon stocks in DOM in the 'converted from' land-use category. Currently, carbon stocks in DOM are only included under Forest land.

In the Netherlands, land use on peat areas is mainly grassland, cropland, or settlements. Emissions from drainage of organic soils are included in carbon stock changes in organic soils for these land-use categories.

Emissions from Wetlands are presented in Figure 6.11. Emissions mainly come from methane emissions on flooded land.

Figure 6.11 Summary of GHG emissions (positive) and removals (negative), differentiated by pool and gas type in Wetland (kt CO₂ eq).



Emissions take the form of CO₂ unless explicitly stated otherwise.

6.7.2 *Methodological issues*

Living biomass

Carbon stocks in living biomass and DOM on flooded land and in open water are considered to be zero. For conversion from other land uses to Wetland, the Netherlands applies a stock difference method, assuming that all the carbon in biomass and organic matter that existed before conversion is emitted.

Emissions from fertiliser use in Wetland

The Wetland land-use category mainly consists of open water, on which no direct nitrogen inputs occur.

Wetlands activity data

A Tier 1 approach is applied to Wetlands. To achieve this, a water type map (Clement & Puijenbroek, 2010) was used to reclassify Wetlands into different Flooded land types, which were reported as Open water in previous submissions. Reservoirs, freshwater ponds, canals, and ditches were classified. In a first step, Tier 1 methodologies are now applied to that part of open water that is human-made, i.e. all canals and ditches, reservoirs, and freshwater ponds created since 1900. For these water bodies, it is clear that the emissions have an anthropogenic cause. A further description of the method is provided in section 3.2 of Van Baren et al. (2026). In the current submission, the various areas of flooded land as well as reeds are not specified in the CRT Table 4.D. Therefore, emissions from flooded land (reservoirs, freshwater ponds, canals, and ditches) are all reported under Open water at the moment. Areas for the various Wetland categories per year are presented in Table 6.19.

Table 6.19 Areas (ha) of the different sub-categories for the land-use category
Wetlands

Year	Open water	Reed	Reser-voirs	Fresh-water ponds	Canals	Ditches	Total Wet-lands
1990	741,690	21,292	6060	5772	14,763	5804	795,380
1991	741,933	21,740	6063	5788	14,891	6016	796,432
1992	742,177	22,189	6,067	5804	15,019	6228	797,484
1993	742,421	22,638	6070	5820	15,147	6441	798,536
1994	742,664	23,087	6073	5836	15,275	6653	799,588
1995	742,908	23,536	6076	5852	15,403	6865	800,639
1996	743,151	23,985	6079	5868	15,531	7077	801,691
1997	743,395	24,433	6082	5884	15,659	7289	802,742
1998	743,639	24,882	6086	5900	15,786	7501	803,794
1999	743,882	25,331	6089	5916	15,914	7713	804,846
2000	744,126	25,780	6092	5932	16,042	7925	805,897
2001	744,369	26,229	6095	5949	16,170	8138	806,949
2002	744,613	26,677	6098	5965	16,298	8350	808,001
2003	744,856	27,126	6101	5981	16,426	8562	809,052
2004	745,705	26,891	6098	5971	16,544	8781	809,990
2005	746,553	26,656	6096	5961	16,661	9000	810,926
2006	747,401	26,420	6093	5951	16,779	9219	811,863
2007	748,250	26,185	6091	5941	16,896	9437	812,800
2008	749,098	25,950	6088	5931	17,014	9656	813,737
2009	751,266	26,027	6086	5913	17,000	9664	815,956
2010	753,433	26,104	6083	5896	16,987	9672	818,174
2011	755,601	26,181	6081	5879	16,973	9679	820,393
2012	757,768	26,258	6079	5861	16,959	9687	822,611
2013	757,723	26,369	6075	5847	16,937	9594	822,543
2014	757,677	26,479	6071	5832	16,915	9500	822,475
2015	757,631	26,590	6067	5818	16,893	9407	822,406
2016	757,586	26,700	6063	5804	16,871	9314	822,338
2017	758,075	26,638	6054	5796	16,833	9205	822,602
2018	758,564	26,575	6045	5789	16,796	9097	822,866
2019	759,053	26,512	6037	5782	16,758	8988	823,130
2020	759,543	26,450	6028	5775	16,720	8880	823,394
2021	762,232	26,244	6031	5783	16,741	9021	826,052
2022	764,922	26,038	6034	5792	16,761	9162	828,709
2023	767,612	25,832	6038	5801	16,781	9303	831,366
2024	770,301	25,626	6041	5810	16,801	9443	834,024

Methane and carbon dioxide emissions from Flooded Land

Methane and carbon dioxide emissions from all land uses converted to Flooded land and remaining Flooded land are calculated using a Tier 1 approach from the 2019 refinements to the 2006 IPCC guidelines (IPCC 2019). For the climate zone definition, Cool Temperate is used. Carbon dioxide emissions only occur on land converted to Reservoirs. Methane emissions from ditches and canals on organic soils are calculated using a country-specific emission factor from Peacock et al. (2021). For details on the method used, see section 7.2 in Van Baren et al. (2026).

6.7.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The analysis in Annex 2, Table A2.3 provides estimates of uncertainties according to IPCC source categories that are based on error propagation. The uncertainty range in the CO₂ emissions for 4.D Wetlands is calculated at 75% (see section 13.5 and table 13.7 in Van Baren et al. (2026) for details).

The Netherlands also applies an improved uncertainty assessment to the LULUCF sector as a whole, with better representation of uncertainties in the land-use matrix, using Monte Carlo simulations for combining different types of uncertainties (see section 13.4 in Van Baren et al. (2026) for details).

Time-series consistency

To ensure time-series consistency, the same approach to activity data, land-use area, and emissions calculation has been used for all years.

6.7.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

6.7.5 *Category-specific recalculations*

Several of the methodological changes described in section 6.1.3 have an effect on Wetlands and resulted in recalculations for the entire time series:

- The introduction of a new land-use map influenced the activity data post-2021 of all land-use categories, including Wetlands.
- Spatial interpolation of annual maps influenced the activity data of all land-use categories, including Wetlands.
- The new C:N ratio and emission factor for indirect N₂O emissions had a small impact on emissions from all land-use categories, including Wetlands.

6.7.6 *Category-specific planned improvements*

Increasing the flexibility of the LULUCF bookkeeping model is a priority so that activity data can be disaggregated in the CRT in future submissions. Additionally, improved and higher-tier approaches for assessing emissions and removals from Wetlands are being assessed. This will result in improved methodologies to be included in future submissions. This is expected to be a stepwise process with successive improvements in successive years. At the moment, all data and emissions on flooded land are included under Other wetlands in CRT Table 4.D. In future submissions this will be divided in flooded land categories.

6.8 Settlements (4.E)

6.8.1 *Category description*

The land-use category Settlements includes all developed land, including transportation infrastructure and human settlements of any size, unless already included under other categories. In peat soils under Settlements, the lowering of the groundwater table also causes oxidation of peat that, in turn, results in high emissions. Together with loss of carbon stocks in biomass resulting from conversion of Forest land

to settlement and Grassland to settlement, these are significant sources of CO₂.

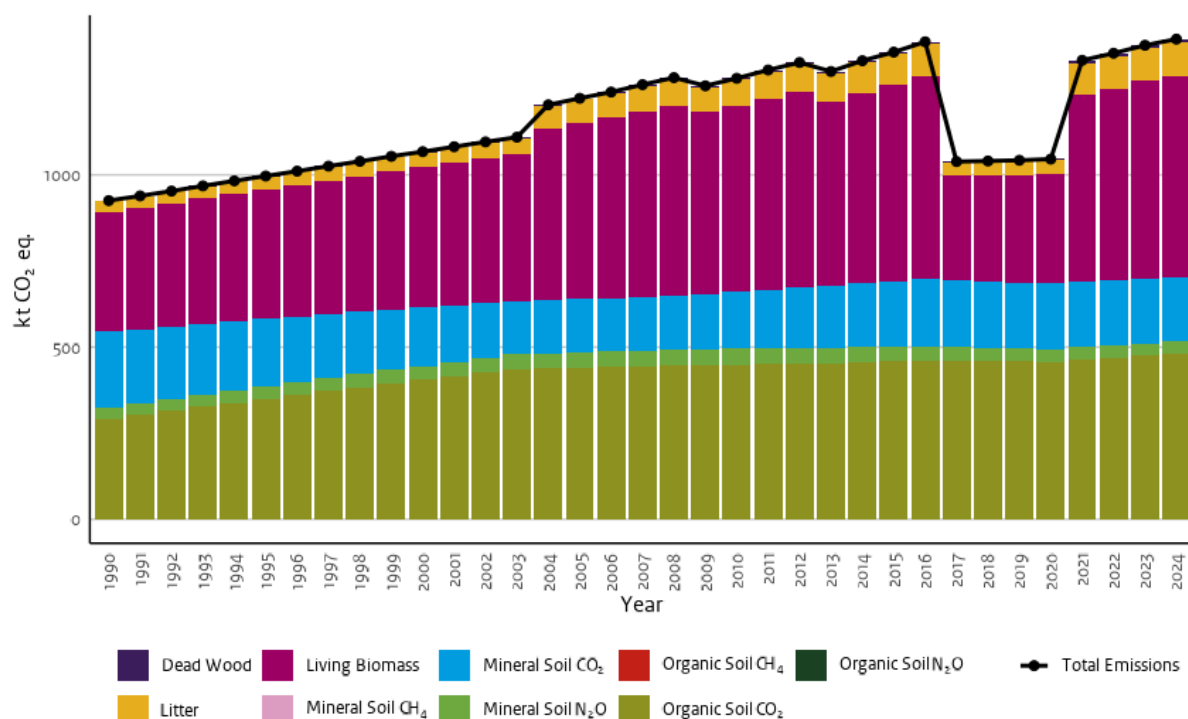
Although settlements also include areas with grass and trees, biomass gains and losses are expected to be in balance. Therefore, the Netherlands applies the Tier 1 method, assuming no change in carbon stocks in biomass in 4.E.1 (Settlements remaining settlements). Moreover, thanks to the high resolution of the land-use grid, areas of land of 25 * 25 meter or more within urban areas meeting the criteria for Forest land, Grassland. or Trees outside forests will be reported under those land-use categories and not under Settlements (see chapter 3 in Van Baren et al., 2026). In other words, the major pools of carbon in urban areas are covered by other land-use categories.

As no additional data are available on carbon stocks in biomass and DOM in Settlements, and because conversions to Settlements are more frequent than conversions from Settlements to other land uses, it is more conservative not to report carbon stock gains and losses for biomass and DOM in Settlements resulting from conversions to and from Settlements.

It is also assumed that no carbon stock changes occur in mineral soils under Settlements remaining settlements. For conversions from other land uses to Settlements, the Netherlands applies a stock difference method, assuming that all the carbon in living biomass and organic matter that existed before conversion is emitted at once.

Emissions from Settlements are presented in Figure 6.12. Emissions mainly originate from land converted to Settlements in the form of carbon losses from the previous land-use (living biomass). Moreover, emissions from organic soils also occur on Settlements.

Figure 6.12 Summary of GHG emissions (positive) and removals (negative), differentiated by pool and gas type in Settlements (kt CO₂ eq)



Emissions take the form of CO₂ unless explicitly stated otherwise.

6.8.2 Methodological issues

The methodology for calculating carbon stock losses in biomass for Forest land converted to settlements is provided in section 6.4. Sections 6.5 (Cropland) and 6.6 (Grassland) describe the methodology for calculating carbon stock losses in biomass for conversions from Cropland and Grassland to settlements. Land use conversions from Wetlands or Other land to settlements will not result in carbon stock changes in living biomass.

Emissions from fertiliser use in Settlements

Under Settlements, direct N₂O emissions from the use of fertilisers and compost by private consumers and hobby farmers are reported under 3.D.a.1 (Inorganic N fertilisers) and 3.D.a.2 (Organic N fertilisers). 3.D.a.1 and 3.D.a.2 also include fertilisers used outside agriculture; see section 5.4 Agricultural soils (3.D).

6.8.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The analysis in Annex 2, Table A2.3 provides estimates of uncertainties for each IPCC source category that are based on error propagation. The uncertainty range in CO₂ emissions for 4.E (Settlements) is calculated at 70%. For N₂O, uncertainties are much higher due to uncertainties in emission factors (see section 13.5 and table 13.7 in Van Baren et al. (2026) for details). The Netherlands also applies an improved uncertainty assessment to the LULUCF sector as a whole, providing a better representation of uncertainties in the land-use matrix, using

Monte Carlo simulations for combining different types of uncertainties (see section 13.4 in Van Baren et al. (2026) for details).

Time-series consistency

To ensure time-series consistency, the same approach to activity data, land-use area, and emissions calculation is used for all years.

6.8.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

6.8.5 *Category-specific recalculations*

Several of the methodological changes described in section 6.1.3 have an effect on Settlements and resulted in recalculations for the entire time series:

- The updated emission factors for organic soils resulted in lower emissions from Settlements.
- The introduction of a new land-use map influenced the activity data post 2021 of all land-use categories, including Settlements.
- Spatial interpolation of annual maps influenced the activity data of all land-use categories, including Settlements.
- The new C:N ratio and emission factor for indirect N₂O emissions had a small impact on emissions from all land-use categories, including Settlements.
- Assigning carbon stocks to mineral soils resulting from degradation of organic soils affected mineral soil emissions from Settlements.

6.8.6 *Category-specific planned improvements*

Looking into the possibility of including biomass at a higher Tier.

6.9 Other land (4.F)

6.9.1 *Category description*

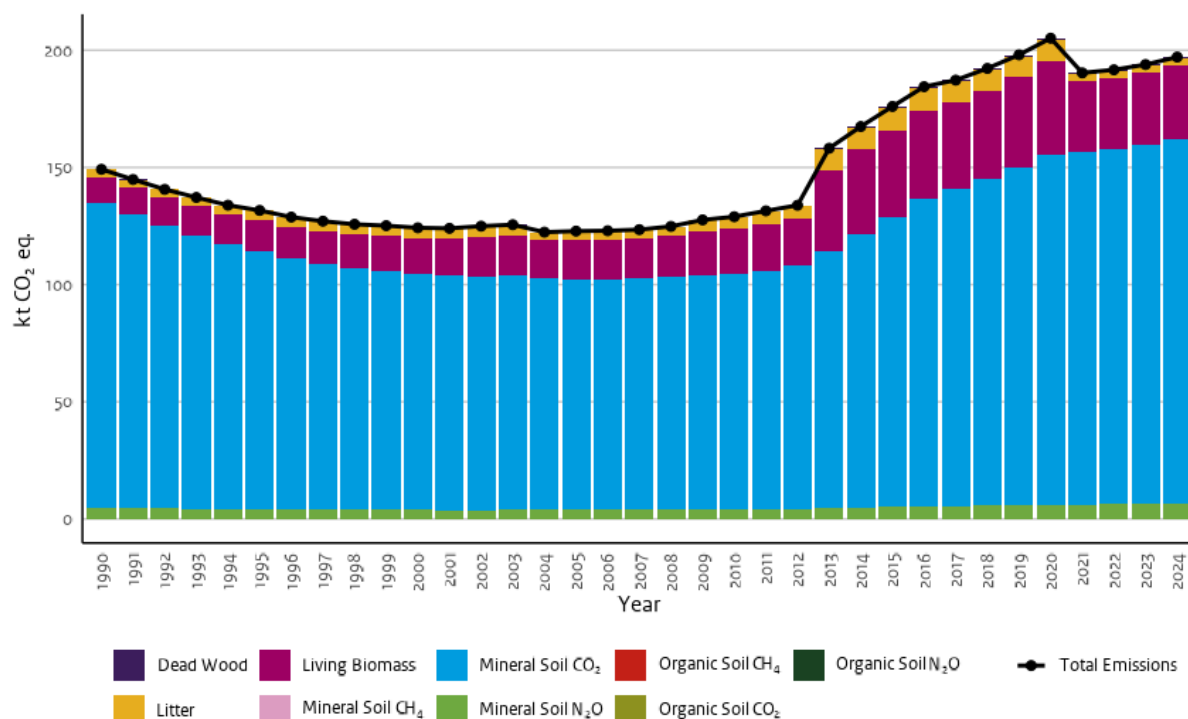
In the Netherlands, the land-use category 4.F (Other land) is used to report areas of bare soil not included in any other category. These include coastal dunes and beaches with little or no vegetation, inland dunes, and sand drifts, i.e. areas where the vegetation has been removed to create spaces for early succession species (and which are kept bare by the wind). Inland bare sand dunes have developed as a result of heavy overgrazing. For a long time, this was combatted by forest planting. However, these inland dunes and shifting sands provide a habitat to some species that have now become rare. As a conservation measure in certain areas, these habitats have now been restored by removing vegetation and topsoil.

No carbon stock changes occur on Other land remaining other land. For units of land converted from other land uses to the Other land category, the Netherlands assumes that all the carbon in living biomass and DOM that existed before conversion is lost and no gains on Other land exist. Carbon stock changes in mineral and organic soils on land converted to Other land are calculated and reported.

Similarly, land-use conversions from Other land to the other land-use categories involve no carbon stock losses from biomass or DOM.

Emissions from Other land are presented in Figure 6.13. Emissions only occur on land converted to Other land.

Figure 6.13 Summary of GHG emissions (positive) and removals (negative), differentiated by pool and gas type in Other land (kt CO₂ eq)



Emissions take the form of CO₂ unless explicitly stated otherwise.

6.9.2 Methodological issues

The methodology for calculating carbon stock changes in biomass for Forest land converted to Other land is provided in section 6.4. Sections 6.5 (Cropland) and 6.6 (Grassland) provide the methodology for calculating carbon stock changes in biomass in conversions from Cropland and Grassland to other land. Land use conversions from Wetland or Settlements to other Land will not result in carbon stock changes in living biomass.

6.9.3 Uncertainty assessment and time-series consistency

Uncertainty assessment

The analysis in Annex 2, Table A2.3 provides estimates of uncertainties for each IPCC source category that are based on error propagation. The uncertainty in CO₂ emissions for 4.F Other Land is calculated at 150%. Uncertainties for N₂O emission are even higher due to the uncertainties in emission factors (see section 13.5 and table 13.7 in Van Baren et al. (2026) for details). The Netherlands also applies an improved uncertainty assessment to the LULUCF sector as a whole, providing a better representation of uncertainties in the land-use matrix, using Monte Carlo simulations for combining different types of uncertainties (see section 13.4 in Van Baren et al. (2026) for details).

Time-series consistency

To ensure time-series consistency, the same approach to activity data, land-use area, and emissions calculation is used for all years.

6.9.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

6.9.5 *Category-specific recalculations*

Several of the methodological changes described in section 6.1.3 have an effect on Other land and resulted in recalculations for the entire time series:

- The introduction of a new land-use map influenced the activity data post 2021 of all land-use categories, including Other land.
- Spatial interpolation of annual maps influenced the activity data of all land-use categories, including Other land.
- The new C:N ratio and emission factor for indirect N₂O emissions had a small impact on emissions from all land-use categories, including Other land.

6.9.6 *Category-specific planned improvements*

No improvements have been planned.

6.10 **Harvested wood products (4.G)****6.10.1** *Category description*

The Netherlands calculates sources and sinks from Harvested wood products (HWP) on the basis of the changes in the pools, as suggested in the 2013 IPCC KP guidance (IPCC, 2014). These HWP emissions and removals are reported in the CRT using Approach B2.

6.10.2 *Methodological issues*

The approach taken to calculate the HWP pools and fluxes follows guidance in section 2.8 of the 2013 IPCC KP guidance (IPCC, 2014). Carbon from HWP allocated to Deforestation is reported using instantaneous oxidation (Tier 1) as the calculation method. The remainder of the carbon is added to the respective HWP pools. As no country-specific methodologies or half-life constants exist, the calculation for the HWP pools follows the Tier 2 approach outlined in the 2013 IPCC KP guidance (i.e. applying equations 2.8.1–2.8.6 in that guidance; see chapter 10 in Van Baren et al., 2026).

Four categories of HWP are taken into account: Sawnwood, Wood panels, Other industrial round wood, and Paper and paperboard. Emissions from wood harvested for energy purposes are included in carbon stock losses in living biomass under Forest land remaining forest land but are not used as an inflow to the HWP pool. As a result, these emissions are accounted for as instantaneous oxidation.

The distribution of material inflow into the various HWP pools is based on the data reported from 1961 onwards to the FAO for its statistics on imports, production, and exports of the various wood product categories (see CRT Table 4.Gs2), including those for industrial round wood and wood pulp as a whole.

To assess carbon amounts in the various HWP categories, the default carbon conversion factors for the aggregated HWP categories Sawnwood, Wood-based panels, and Paper and paperboard from the 2013 IPCC KP guidance (see Table 6.20) have been used. For the category Other industrial round wood, the values for Sawnwood have been used, as the latter category includes certain types of round wood use, such as the use of whole stems as piles in building foundations and road and waterworks, and as fences and poles. These are considered applications with a long to very long lifetime, for which the 35-year half-life is considered appropriate.

To calculate the inflow of domestically produced paper, equation 2.8.2 from the 2013 IPCC KP guidance (IPCC, 2014) is applied to reported quantities of production, imports, and exports of paper and paperboard:

$$f_{PULP}(i) = \frac{PULP_p(i) - PULP_{EX}(i)}{PULP_p(i) + PULP_{IM}(i) - PULP_{EX}(i)}$$

Where:

- $f_{PULP}(i)$ = share of domestically produced pulp for the domestic production of paper and paperboard in year i .
- $PULP_p(i)$ = production of wood pulp in year i , kt C yr⁻¹
- $PULP_{IM}(i)$ = import of wood pulp in year i , kt C yr⁻¹
- $PULP_{EX}(i)$ = export of wood pulp in year i , kt C yr⁻¹

However, after 1993, the results give a negative value, indicating that there is no more production of pulp from domestic wood. In line with the instructions in the 2013 IPCC KP guidance (IPCC, 2014) these negative values are set to zero.

The paper and cardboard produced in the Netherlands is produced from imported cellulose (wood pulp) and recycled waste paper (Teeuwen et al., 2023). Therefore, using the production approach to HWP implies that no gains in paper and paperboard are expected.

Table 6.20 Tier 1 default carbon conversion factors and half-life factors for the HWP categories

HWP category	C conversion factor (Megagram C per m ³ air dry volume)	Half-lives (years)
Sawn wood	0.229	35
Wood-based panels	0.269	25
Other industrial round wood	0.229	35
Paper and paperboard	0.386	2

6.10.3 Uncertainty assessment and time-series consistency Uncertainty assessment

The analysis in Annex 2, Table A2.3 provides estimates of uncertainties for each IPCC source category that are based on error propagation. As both activity data and emission factors have low uncertainty, the total uncertainty in the CO₂ emissions for 4.G Harvested wood products is calculated at around 1% (see section 13.5 and table 13.7 in Van Baren et al. (2026) for details).

The Netherlands also includes HWP in the improved uncertainty assessment of the LULUCF sector as a whole, using Monte Carlo simulations to combine different types of uncertainties (see section 13.4 in Van Baren et al. (2026) for details).

Time-series consistency

Annual changes in carbon stocks in HWP are erratic by nature because they depend on highly variable inputs of wood production, imports, and exports. Net CO₂ emissions and removals in the 1990–2023 period range between -68 kt CO₂ (removals) and +232 kt CO₂.

6.10.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

6.10.5 *Category-specific recalculations*

No recalculations have been performed this year.

6.10.6 *Category-specific planned improvements*

No category-specific improvements are foreseen.

7 Waste (CRT sector 5)

Major changes in the Waste sector compared to the National Inventory Report 2025

Emissions:	In 2024, total GHG emissions from the Waste sector decreased further by 3.5% compared to 2023 and by 82.4% compared to 1990.
New Key categories:	5.B Biological treatment of solid waste: composting N ₂ O (T2) is a new key source compared to the NIR 2025
Methodologies and recalculations:	In category 5.B.2 Biological treatment of waste, emissions from organic waste treated in industrial digesters were added to the inventory. In category 5.D.2 Industrial wastewater treatment, the amount of N₂O has been recalculated for the years 1990–2015 and the amount of CH₄ has been recalculated for the years 2000–2015. In category 5.D.3 Effluents, the amounts of N₂O and CH₄ have been recalculated for the year 2023.

7.1 Overview of the sector and background information

The national inventory of the Netherlands comprises four source categories in the Waste sector:

- Solid waste disposal on land (5.A): CH₄ emissions;
- Composting and digesting of biomass waste (including manure) (5.B): CH₄ and N₂O emissions;
- Incineration of waste in open air (5.C): CO₂, CH₄, and N₂O emissions. Incineration of waste in waste incineration plant is included in 1.A.1.a: CO₂ CH₄ and N₂O emissions;
- Wastewater treatment and discharge (5.D): CH₄ and N₂O emissions.

Table 7.1 Overview of the Waste sector (5) in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key	1990	2023	2024	2024 vs 1990	Contribution by the category in 2024 (%) to the		
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
5 Waste	CO ₂		IE,NA,NO	IE,NA,NO	IE,NA,NO		0.00%	0.00%	0.00%
	CH ₄		15.8	2.4	2.2	-85.8%	78.4%	12.3%	1.6%
	N ₂ O		0.55	0.61	0.62	12.1%	21.6%	9.4%	0.43%
	All		16.3	3.0	2.9	-82.4%	100.0%		2.0%
5.A. Solid waste disposal on land	CH ₄	L,T	15.3	1.9	1.8	-88.4%	62.1%	9.7%	1.2%
5.B. Biological treatment of solid waste									
	CH ₄	L2,T	0.005	0.25	0.24	5010.9%	8.5%	1.3%	0.17%
	N ₂ O	T2	0.006	0.09	0.10	1559.5%	3.4%	1.5%	0.07%
	All		0.01	0.34	0.34	3120.2%	11.9%		0.24%
5.C. Incineration and open burning of waste	CO ₂		IE,NA,NO	IE,NA,NO	IE,NA,NO		0.00%	0.00%	0.00%
	CH ₄		0.004	0.003	0.003	-29.0%	0.10%	0.02%	0.002%
	N ₂ O		0.002	0.002	0.002	-21.4%	0.06%	0.02%	0.001%
	All		0.006	0.004	0.005	-26.5%	0.16%		0.003%
5.D. Wastewater treatment and discharge									
	N ₂ O	L,T1	0.54	0.51	0.52	-4.3%	18.2%	7.9%	0.36%
	CH ₄		0.42	0.21	0.22	-48.0%	7.7%	1.2%	0.15%
	All		0.97	0.72	0.74	-23.3%	25.9%		0.51%
Total national emissions (incl LULUCF)	CO ₂		166.7	119.8	118.5	-28.9%			
	CH ₄		36.5	18.6	18.3	-50.0%			
	N ₂ O		16.1	6.6	6.6	-59.1%			
	Total		226.6	146.1	144.4	-36.3%			

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the Waste sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

Table 7.1 presents the contribution made by the emissions from the Waste sector to the national GHG emissions, as well as the key sources in this sector. The list of all (key and non-key) sources in the Netherlands is included in Annex 1.

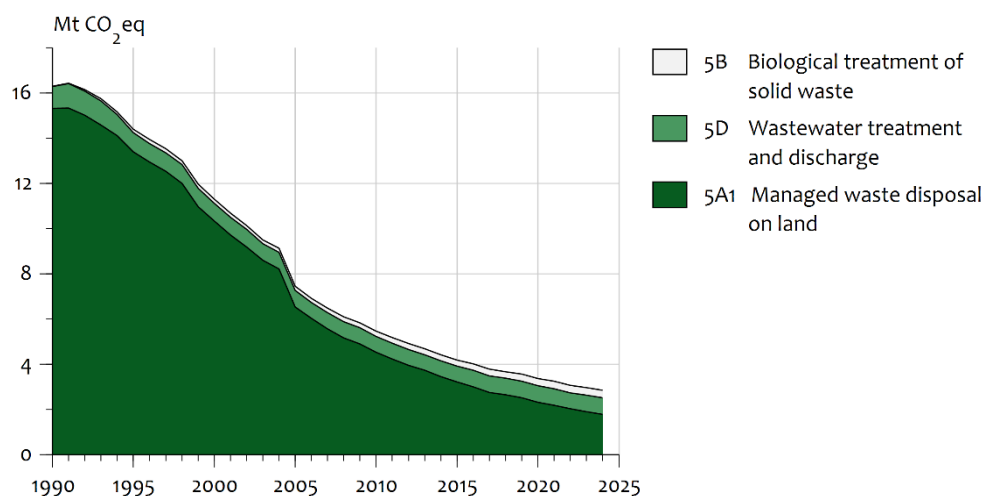
CO₂ emissions from the anaerobic decay of waste in landfill sites are not included, as they are considered to be part of the carbon cycle rather than a net source. The Netherlands does not report emissions from waste incineration facilities for municipal waste in the Waste sector under category 5.C, but under CRT 1.A.1.a. These facilities also produce electricity and/or heat used for energy purposes. Methodological issues

concerning this source category are briefly discussed in section 7.4. The methodology is described in detail in section 2.3.2.1 of the methodology report (Honig et al., 2026).

In 2024, the Waste sector accounted for 2.0% of national total emissions, compared to 7.2% in 1990. Emissions of CH₄ and N₂O accounted for 78.4% and 21.6% of CO₂ equivalent emissions from this sector, respectively. CH₄ emissions from Waste, of which 81% originates from landfills, accounted for 12.3% of total CH₄ emissions in 2024. N₂O emissions from the Waste sector originate from biological treatment of solid waste and from wastewater treatment. Fossil fuel-related emissions from waste incineration, mainly CO₂, are included in fuel combustion emissions from the Energy sector (CRT 1.A.1.a).

Between 1990 and 2024, emissions from the Waste sector decreased by 82.4% (from 16.3 Mt CO₂ eq in 1990 to 2.9 Mt CO₂ eq in 2024; see Figure 7.1), mainly due to an 88.4% reduction in CH₄ from landfills. Between 2023 and 2024, CH₄ emissions from landfills decreased by 6.6%.

Figure 7.1 Sector 5 Waste – trend and emissions levels of source categories, 1990–2024



Decreased methane emissions from landfills since 1990 are the result of:

- increased recycling of waste;
- a considerable reduction in the amount of municipal solid waste (MSW) disposal at landfills;
- a decreasing organic waste fraction in the waste disposed;
- increased methane recovery from landfills (from 4% in 1990 to 15% in 2024).

As indicated above, emissions from waste incineration plants (WIPs) are included in CRT category 1.A.1.a Other fossil fuels (see section 3.2.4.1) and therefore not included in Figure 7.1. These emissions accounted for 0.6 Mt CO₂ eq in 1990 (601 kt CO₂ and 0.07 kt N₂O emissions). In 2024, these emissions increased significantly to 2.5 Mt CO₂ eq (2416 kt CO₂ and 0.36 kt N₂O) due to an increase in incineration capacity.

7.2 Solid waste disposal on land (5.A)

7.2.1 *Category description*

In 2024, there were nineteen operational landfill sites in the Netherlands. In the past, waste was landfilled on a few thousand sites; these older sites still contribute to the national emissions of methane. As a result of anaerobic degradation of organic material in the landfill body, all landfills produce CH₄ and CO₂. Landfill gas comprises about 50% (volume) CH₄ and 50% (volume) CO₂. Due to a slight overpressure, landfill gas migrates into the atmosphere. CH₄ recovery currently occurs at 52 sites in the Netherlands. The gas is extracted before it is emitted into the atmosphere and is subsequently used as an energy source or flared off. The emissions from the recovered landfill gas as an energy source are included in CRT sector 1 – Energy. In either case, the CH₄ in the extracted gas is not released into the atmosphere. When the CH₄ passes through the landfill cover, it may be degraded (oxidised) to some extent by bacteria; this results in lower CH₄ emissions.

The anaerobic degradation of organic matter in landfills can take many decades. Not all factors influencing this process are known. Each landfill site has unique characteristics including concentration and type of organic matter, moisture, and temperature. The chief factors determining the decrease in net CH₄ emissions are lower quantities of organic carbon deposited in landfills (organic carbon content multiplied by the total amount of landfilled waste) and higher methane recovery rates from landfills (see sections 7.2.2 and 7.2.3).

In 2024, solid waste disposal on land accounted for 62.1% of total emissions from the Waste sector and 1.2% of total national CO₂ equivalent emissions (see Table 7.1).

Dutch policies are directly aimed at reducing the amount of waste sent to landfill sites. As a result, many older and smaller sites were closed in the 1990s. This required enhanced prevention of waste production and increased recycling of waste and incineration of waste. In the early 1990s, the government introduced bans on the landfilling of certain categories of waste; for example, the organic fraction of household waste²¹. Another means of reducing landfilling was raising landfill taxes in line with the higher costs of incinerating waste. As a result of these policies, the amount of waste sent to landfills decreased from 14 million tons in 1990 to 2.1 million tons in 2024, thereby reducing emissions from this source category significantly.

7.2.2 *Methodological issues*

A more detailed description of the method and EFs used can be found in section 2.3.2.2 of Honig et al. (2026).

Data on the amount of waste disposed at landfill sites is mainly derived from the annual survey performed by the Working Group on Waste Registration (WAR) at all landfill sites in the Netherlands. These data are documented in Ministerie van Infrastructuur en Waterstaat (2026), which also presents the annual amount of CH₄ recovered from landfill sites.

²¹ In extreme circumstances, e.g. an increase in demand for incineration capacity due to unprecedented supply, the regional government can grant an exemption from these 'obligations'.

In order to calculate CH₄ emissions from landfill sites, it is assumed for modelling purposes that all waste is disposed at one landfill site. As stated above, however, characteristics of individual sites can vary substantially. CH₄ emissions from this 'national landfill' are calculated using a first-order decomposition model (first-order decay function) with an annual input of the total amounts deposited, the characteristics of the landfilled waste, and the amount of landfill gas extracted. This is equivalent to the IPCC Tier 2 methodology. Since landfills are a key category of CH₄ emissions, the present methodology is in line with the 2006 IPCC Guidelines (IPCC, 2006).

The parameters used in the landfill emissions model are :

- Total amount of landfilled waste (see Table 7.2);
- fraction of degradable organic carbon (DOC) (see Table 7.2);
- CH₄ generation (decomposition) rate constant (k-value): 0.094 up to and including 1989, decreasing to 0.0693 in 1995, further decreasing to 0.05 in 2005 (IPCC default value), and remaining constant thereafter; this corresponds to a half-life of 14.0 years;
- CH₄ oxidation factor for managed landfills (IPCC default value): 10%;
- fraction of DOC actually dissimilated (DOCF): 0.58 until 2004 (see Oonk et al., 1994), annually determined from 2005 onwards on the basis of the composition of waste disposed. This is in line with the 2019 IPCC refinements;
- methane correction factor (MCF): 1.0 (IPCC default value);
- fraction of methane in landfill gas produced: 57.4% for the years up to 2004 (see Oonk, 2016), decreasing by 50% in 2005 (IPCC default value), and remaining constant thereafter;
- amount of recovered landfill gas, published in the annual report titled 'Waste processing in the Netherlands' (Ministerie van Infrastructuur en Waterstaat, 2025);
- time delay from deposit of waste to start production of methane gas: set at 6 months (IPCC default value). On average, this means that waste landfilled in year x starts to contribute to methane emissions in year x+1.

A selection of these parameters are discussed in the following sub-sections.

Amount of waste landfilled

Table 7.2 provides an overview of landfilled waste, its degradable organic carbon content (DOC) and the fraction of the degradable organic content that actually dissimilates (DOCF).

Table 7.2 Amounts of landfilled waste, degradable organic carbon content (DOC) and degradable organic carbon that dissimilates (DOCf)

Year	Amount landfilled (Mt)	Degradable organic carbon (kg/ton)	Degradable organic carbon that dissimilates (%)
1945	0.1	132	58
1950	1.2	132	58
1955	2.3	132	58
1960	3.5	132	58
1965	4.7	132	58
1970	5.9	132	58
1975	8.3	132	58
1980	10.6	132	58
1985	16.3	132	58
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
2011	1.9	31	37
2012	3.3	32	29
2013	2.7	33	34
2014	2.2	34	35
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

Between 1945 and 1970, a number of municipalities kept detailed records of their waste collection. In addition, information was available about which municipalities had their waste incinerated or composted. All other municipal waste was landfilled.

This information, in combination with data on landfilling from various sources (SVA, 1973; Statistics Netherlands, 1988, 1989; Nagelhout, 1989) and data on the years 1950, 1955, 1960, 1965, and 1970, identified and published by Van Amstel et al. (1993), was used to compile the dataset, departing from the assumption that during World War II hardly any waste was landfilled. These data are also used in the first-order decay model, while missing years (1945–1950, 1951–1954, 1956–1959, 1961–1964, and 1966–1969) have been interpolated linearly (Spakman et al., 2003).

Accurate data on production and waste treatment has been available from 1970 onwards (Spakman et al., 2003). Landfill site operators systematically monitor the amount of waste deposited (weight and composition) at each waste site. Since 1993, monitoring has occurred by weighing the amount of waste land filled and by regulating landfilling via compulsory environmental permits.

Data on the amounts of landfilled waste since 1991 is supplied by the WAR (Rijkswaterstaat) and included in the annual report 'Waste processing in the Netherlands'. Information on how these data are gathered and the scope of the information used can be found in these reports, available from the WAR since 1991 (Ministry of Infrastructure & Water Management, 2026).

Since 2005, landfill operators have been obliged to register their waste according to European Waste List (EWL) codes. Landfill operators also use EWL codes for the annual survey by the WAR so the WAR has a complete overview of the landfilled waste for every EWL code.

Fraction of degradable organic carbon

The amount of degradable organic carbon (DOC) for the 1945–1990 period was determined at 132 kg/ton (Spakman et. al., 2003). In the 1991–1997 period, the fraction of degradable organic carbon (DOC_f) value slowly declined due to the start of separate organic waste collection from households in 1992 and the introduction of landfill bans for municipal waste in 1995.

Rijkswaterstaat gathers information on the amounts and composition of a large number of waste flows as part of its work to draw up its annual 'Netherlands Waste in Figures' report (Ministerie van Infrastructuur en Waterstaat, 2026). The results of several other research projects also helped to determine the composition of landfilled waste. This method was used until 2004. In the 2000–2004 period, effects of the policy of reducing the amount of DOC being landfilled (especially in waste from households) resulted in a decrease in the DOC value from 110 kg/ton in 2000 to 74 kg/ton in 2004.

From 2005 onwards, all landfilled waste has been included in the figures. This includes waste streams with a low DOC content (contaminated soil, dredging spoils) or no DOC at all (inert waste). This results in a low average DOC value of a ton of landfilled waste (ranging from 34.4 to 79.6 kg/ton) compared to the IPCC default values (144–168 kg/ton).

An amount of degradable carbon is determined for each EWL code (Cuperus et al., 2011), and DOC values are allotted to ten separate groups of waste streams. Each type of waste (corresponding to an EWL code) that is allowed to be landfilled (liquid waste may not be landfilled, for example) is allocated to one of these groups. Each group has an individual DOC content. As an illustration, Table 7.3 presents the waste stream groups, their DOC values and the amounts landfilled in 2024. Table 7.4 presents the amounts landfilled per waste stream group in the 2005–2024 period.

Table 7.3 Amount of waste landfilled in 2024 and the DOC value of each group

Waste stream group	Amount landfilled (ton)	DOC value (kg/ton)	Total DOC landfilled (ton)
Waste from households	52,937	182	9,635
Bulky household waste	0	NO	0
Commercial waste	0	NO	0
Cleansing waste	19,905	43.4	864
Waste that contains high level of DOC	49,209	112	5511
Stabilised organic waste	245,069	130	31,859
Waste that contains low level of DOC	853,634	44	37,560
Contaminated soil	235,066	11.5	2703
Dredging spoils	18,153	42.4	770
Inert waste	617,961	0	0
Wood waste	1267	430	545
Total	2,093,202		89,446

Table 7.4 Amount of waste 2005–2024 by waste stream group (kt)

Waste stream group	2005	2010	2015	2020	2022	2023	2024
Waste from households	347	22	153	34	20	23	53
Bulky household waste	22	0	0	0	0	0	0
Cleansing waste	62	6	5	7	7	3	20
Waste that contains high content of DOC	97	26	80	61	48	43	49
Stabilised organic waste	555	159	167	351	233	174	245
Waste that contains low content of DOC	965	604	738	913	766	1101	854
Contaminated soil	735	633	218	205	252	227	235
Dredging spoils	232	194	140	23	29	24	18
Inert Waste	486	481	841	815	738	650	618
Wood waste	7	0	0	1	2	0	1
Total	3,509	2,126	2,342	2,409	2,094	2,246	2,093

The DOC values were determined from the composition of mixed household waste (Cuperus et al., (2011): Table B3.2), the composition of other waste streams, and expert judgement (Cuperus et al., (2011): Annex 3). The average DOC value of a ton of waste landfilled is calculated by dividing the total DOC landfilled by the amount landfilled.

Degradable organic carbon that decomposes (DOCf)

The fraction of degradable organic carbon that decomposes (DOCf) is an estimate of the amount of carbon ultimately released from solid waste disposal sites (SWDS) and reflects the fact that some degradable

organic carbon does not decompose or degrades very slowly under anaerobic conditions in the SWDS.

Before 2005, a country-specific value of 0.58 was used (Oonk et al., 1994). An attempt made in 2011 to validate the country-specific parameters (DOCf and k-value) for the model was unsuccessful (Cuperus et al., 2011). The method to determine the DOCf factor was refined in the 2019 IPCC refinements. These refinements describe research showing that various components of biodegradable waste dissimilate differently within a landfill under anaerobic conditions. For example, organic kitchen and garden waste and sewage sludge are dissimilated by 70%, while wood only does so by 10%. From 2005 onwards, the DOCf factor has been calculated annually by multiplying the composition of the waste by the dissimilation factor per component (see Tabel 7.2). In this calculation, only biodegradable components are taken into account. Non-biodegradable components are excluded, while the amount of biodegradable organic carbon already corrects this. Table 7.5 presents the calculated DOCf factor per waste stream.

Table 7.5 Calculated DOCf factor by waste stream group

Waste stream group	DOCf value per waste stream group
Waste from households	0.58
Bulky household waste	0.40
Cleansing waste	0.50
Waste that contains high level of DOC	0.70
Stabilised organic waste	0.30
Waste that contains low level of DOC	0.21
Contaminated soil	0.50
Dredging spoils	0.50
Inert Waste	0.50
Wood waste	0.10

k-value

The k-value is a rate constant relating to the half-life value for waste to decay to half its initial mass. The assumption is that the majority of degradable waste landfilled in the Netherlands consists of paper, wood, and textiles (slowly degrading) and not of sewage sludge or food waste (rapid degrading). For example, paper, wood, and textiles can be found in construction and demolition waste and in waste from shredding vehicles and electronic equipment.

The IPCC default value lies between 0.03 and 0.06 for slowly degrading waste (wood, paper, textiles) in a wet and temperate climate zone. In the 1989–2004 period, a country-specific value for k (0.094) was determined by means of a validation of a landfill gas model (Oonk, 1994). Due to changing waste composition as a result of waste policies in the early 1990s, the value was changed to 0.0693 for the years 1990–2004 (Spakman, 2003). A new attempt to validate the landfill gas model to derive improved parameters (Cuperus et al., 2011) was unsuccessful. Therefore, a default value of 0.05 for the k-value has been

used in the Dutch model from 2005 onwards. The value of 0.05 is in the range for slowly degrading waste in a wet and temperate climate zone (table 3.3 in IPCC 2006, chapter 3 on solid waste disposal).

Degradable waste is not landfilled in large quantities in the Netherlands. There is still a quantity of landfilled mixed municipal waste (EWL code 200301). In theory, this code applies to several waste streams, such as waste from households and commercial waste. In fact, in recent years, only commercial waste has been landfilled, because waste from households is incinerated.

If residues from waste treatment have to be landfilled, in most cases, this is because they are not combustible or recyclable. In some cases, waste incinerator operators argue that the caloric value is too high as well, mainly due to a high content of plastics in the residues. Residues do not generally contain rapidly degrading waste such as food waste or sewage sludge.

Other waste streams landfilled in large quantities, such as contaminated soil (EWL code 170504) and sludges from physicochemical treatment (EWL code 190206: in fact, mainly residues from soil remediation), have a low DOC value. It is reasonable to assume that these residues only contain slowly degrading waste, because the organic content is stabilised.

Methane correction factor (MCF)

All sites in operation after World War II can be regarded as being managed in conformity with the IPCC Guidelines, according to which they must have controlled waste placement (i.e. waste is directed to specific deposition areas and there is a degree of control over scavenging animals and any outbreaks of fire) and feature at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling.

Many landfill sites are situated near urban areas. In order to prevent odour and scavenging animals (birds, rats), the management of landfill sites has been closely monitored since the start of the 20th century. A major study conducted in 2005 (NAVOS, 2005) investigated about 4000 old landfill sites and concluded that:

- From 1930 onwards, a method of placing the waste in defined layers and covering it with ashes, soil, sand or dirt from street sweeping became common practice.
- In the early 1970s, the waste sector introduced a 'code of practice' in which a method of environmentally friendly landfilling was described.
- During the 1970s and early 1980s, national legislation introduced an obligation to landfill in a controlled manner. Some old permits for landfill sites (from the early 1970s) entailed obligations to compact and cover the waste and to deposit waste in specific parts of the site covering a certain maximum size instead of using the whole area simultaneously. Several permits also paid attention to fire prevention.

On the basis of these findings, waste disposal sites can be generally considered as having been managed throughout the relevant period. Therefore, the Netherlands uses the MCF of 1 in its model, following the default-value for managed landfills (table 3.1 in IPCC 2006, chapter 3 on solid waste disposal).

A few landfill sites are semi-aerobic. At three selected landfill sites, research is currently being conducted on how the site should be managed after it is closed. This is a long-term study; the first results will be published in 2029. The management of a landfill following its closure is the responsibility of the regional authorities. A few parts of these landfills are semi-aerobic, but emissions from all waste landfilled at these sites are included in the emissions from anaerobic landfills.

Fraction of methane generated in landfill gas

Most models of CH₄ formation in landfills and emissions from landfills are based on landfills of municipal solid waste. This type of waste was landfilled in the Netherlands until the early 1990s, but Dutch waste policy has changed since then. The landfilling of waste with large amounts of biodegradables (such as household waste) was first discouraged and then banned. Food and garden waste are now collected separately and composted. Other types of household waste are mostly incinerated and or recycled. As a result, existing models have been modified to deal with this changed waste composition.

Another explanation for a lower fraction of methane generated in landfill gas is the reduced methane content in the landfill gas being formed. Landfill gas is produced from a broad range of materials. Cellulose and hemicellulose, for example, produce gas with a theoretical methane concentration of about 50%. Proteins and fats, however, produce gas with a significantly higher methane concentration. When waste is landfilled, it is conceivable that the more readily degradable components decompose first, resulting in a methane concentration that gradually declines, e.g. from 57% to approximately 50%. Since less and less readily degradable material is landfilled in the Netherlands, it is likely that the observed decline is at least partially the result of a decline in CH₄ concentration in the gas formed (Oonk, 2011).

On the basis of measurements by Coops et al. (1995), the amount of methane in landfill gas was determined at 60%. In earlier research, the amount of CO₂ absorbed in seepage water was not included. Research by Oonk (2016), estimated that 2–10% of the CO₂ is dissolved by the leachate within the landfill before the CO₂ is emitted. In the calculations, 10% of the CO₂ is removed, resulting in a fraction of methane in landfill gas of 57.4% for the 1990–2004 period. From 2005 onwards, the IPCC default value of 50% methane has been used.

Recovered landfill gas

The amounts of recovered landfill gas are recorded annually by the WAR. The WAR also collects data on the distribution of recovered gas between landfill gas engines and flares by all operators of landfill sites. Emissions from gas engines are reported under CRT 1.A.4.a.

At most landfill sites, the amount of recovered landfill gas is measured. Only the percentage of methane in older landfill sites is estimated. In 2024, the methane content and amount of recovered landfill gas at four landfill sites was estimated. Table 7.6 presents the amounts of recovered landfill gas, the average methane content, and the amount flared or used for energy purposes.

Table 7.6 Amount of landfill gas recovery

Parameter	1990	2000	2005	2015	2020	2022	2023	2024
Free emission of landfill gas (million m ³)	1564	1055	770	376	270	236	219	205
Free emission of methane (kt)	547	369	233	115	83	72	68	63
Recovered landfill gas (million m ³)	64	162	130	60	51	46	47	44
Amount used for energy purposes (million m ³)	48	119	98	43	23	22	24	23
Amount combusted in flares (million m ³)	16	43	32	17	28	23	22	21
Percentage of methane in recovered landfill gas (%)	57.4	57.4	53.2	49.6	46.1	45.4	41.0	41.8
Amount recovered methane (kt)	25	63	47	20	16	14	13	12
Amount recovered methane useful applied (kt)	19	46	35	15	7	7	7	6
Amount recovered methane flared (kt)	6	17	12	6	9	7	6	6

Use of country-specific values before 2005

Between 1990 and 2004, the Netherlands used a landfill gas model containing country-specific values. The country-specific values for DOC_f and the k-value were derived from the study by Oonk et al. (1994). The k-value was later adjusted in a study by Spakman (2003), as a result of the changes in the composition and degradability of the waste. In 2010, the Netherlands tried to validate the country-specific values by means of a study by Tauw. The conclusion of this study (Cuperus et al., 2011) was that it was not possible to validate the country-specific values. Therefore, the landfill model has used the IPCC default values for DOC_f and the k-value from 2005 onwards. The assumption was made that the country-specific values were still applicable until 2004.

Changing parameters over time

Trend information on IPCC Tier 2 method parameters that change over time is provided in Table 7.7. The integration time for the emissions calculation is defined as the period from 1945 to the year for which the calculation is made.

Table 7.7 Parameters used in the IPCC Tier 2 method that change over time (additional information on solid waste handling)

Parameter	1990	2000	2005	2010	2015	2020	2023	2024
Fraction DOC in landfilled waste	0.13	0.11	0.06	0.03	0.04	0.04	0.04	0.04
CH ₄ generation rate constant (k)	0.09	0.07	0.05	0.05	0.05	0.05	0.05	0.05
Number of SWDS recovering CH ₄	45	55	50	53	54	52	52	52
Fraction CH ₄ in landfill gas	0.57	0.57	0.5	0.5	0.5	0.5	0.5	0.5

7.2.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

The uncertainty analysis in Annex 2 provides estimates of uncertainties by IPCC source category and gas that are based on error propagation. The uncertainty in CH₄ emissions from SWDS is estimated at approximately 24%. The uncertainty in the activity data and the EF is estimated to be 0.3% and 24%, respectively. For a more detailed analysis of these uncertainties, see Rijkswaterstaat, (2014).

Time-series consistency

The estimates for all years are calculated from the same model, which means that the methodology is consistent throughout the time series. Due to the continuity in the data provided, the time series uses consistent activity data.

7.2.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures discussed in Chapter 1, and the specific QA/QC described in the document on the QA/QC of outside agencies (Wanders, 2021).

In general, the QA/QC procedures within the Waste sector are:

- checking activity data against other sources within the monitoring of waste, for example the notifications of landfill operators at the 'Landelijk Meldpunt Afvalstoffen';
- checking trends in the resulting emissions.

Several explanations are given for differences between deposited amounts in the WAR and data at Eurostat:

1) Eurostat uses the start of the cycle and then estimates how the waste is processed. The WAR asks landfill operators to estimate how much waste is landfilled.

2) A number of waste materials deposited deep underground or in salt mines are included in the Eurostat data. In the WAR, these quantities are missing.

3) Waste landfilled abroad (for example, highly leachable waste or residues from waste processing) are not included in the WAR but are included in the Eurostat data.

7.2.5 *Category-specific recalculations*

There are some updated figures with regard to the amount of extracted landfill gas in the 2021–2023 period. This results in small decreases of methane emissions ranging from -7500 kg methane (-210 tons CO₂ eq) in 2021 to -240 ton methane (-6712 tons CO₂ eq) in 2023.

7.2.6 *Category-specific planned improvements*

No improvements have been planned.

7.3 **Biological treatment of solid waste (5.B)**

7.3.1 *Category description*

This source category consists of CH₄ and N₂O emissions from:

- the composting and digesting of separately collected organic waste from households;
- organic waste from gardens and horticulture;
- other organic waste (including residues from the food-processing industry and expired products from supermarkets and catering industry);
- emissions from manure from agriculture.

Emissions from the small-scale composting of garden waste and food waste by households are not estimated, as these are assumed to be negligible.

The amount of composted and digested organic waste increased from a negligible amount in 1990 to 4.9 million tons in 2024. In 2023, this treatment accounted for 7.1% of the emissions in the Waste sector (see Table 7.1). The biological treatment of solid waste is a key source of CH₄ emissions.

7.3.2 *Methodological issues*

Detailed information on activity data and EFs can be found in section 2.3.2.3 of Honig et al. (2026).

The activity data for the amount of organic waste composted at industrial composting facilities derives mainly from the annual survey performed by the WAR at all industrial composting sites in the Netherlands (Ministerie van Infrastructuur en Waterstaat, 2026). Amounts of organic waste treated by green waste composting plants and industrial digestion plants were collected from the Landelijk Meldpunt Afvalstoffen, which registers waste numbers, as required by Dutch legislation. All amounts are on a wet weight basis.

The amount of animal manure used in digesters is based on registered manure transports (data from the Netherlands Enterprise Agency (RVO)). The emissions are calculated using the National Emissions Model Agriculture (NEMA) described in Chapter 5, and the methodology report for agricultural emissions (Van der Zee et al., 2026).

Table 7.8 Total amount of treated collected organic waste from households and green waste from gardens and companies (Mt)

Year	Organic waste from households		Other organic waste	
	Composted (5.B.1.a)	Digested (5.B.2.a)	Composted (5.B.1.b)	Digested (5.B.2.b)
1990	228	-	-	-
1995	1566	44	1900	-
2000	1602	72	2370	-
2005	1688	55	2408	24
2009	1509	81	2317	262
2010	1269	167	2221	365
2011	1210	207	2265	513
2012	1213	322	2214	514
2013	1170	373	2071	615
2014	1136	504	1862	663
2015	1093	560	1782	758
2016	1139	543	2149	786
2017	1163	572	2199	808
2018	1179	542	2241	697
2019	1222	541	2073	870
2020	1351	534	2066	922
2021	1387	487	2139	1027
2022	1178	495	1852	1080
2023	1272	471	1862	1130
2024	1333	449	2094	1064

In 2010, an independent study on the EFs was conducted (DHV, 2010). The EFs were compared to those in other, predominantly European, countries. The current EF is backed up by most of the data considered relevant, as discussed in the 2010 study by DHV. DHV used studies of measurements carried out at German, Dutch, and Austrian composting plants (DHV, 2010).

The EF for other organic waste composted in the open air is derived from a study by the Austrian Umweltbundesamt (Lampert et al., 2011). In 2025, emissions that occur during the processing of organic waste in industrial digesters are included for the first time, thanks 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 have been 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 CH₄ and N₂O 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).

7.3.3 *Uncertainty assessment and time-series consistency*

Uncertainty assessment

Emissions from this source category are calculated using an average EF obtained from the literature. The uncertainty in annual CH₄ and N₂O emissions is estimated at 73% and 61%, respectively. The uncertainty is mainly determined from uncertainties in the EF (72% for CH₄ and 60% for N₂O); whereas the uncertainty in the activity data are about 10%. For a more detailed analysis of these uncertainties, see Rijkswaterstaat (2014).

Time-series consistency

Consistent methodologies have been used to estimate emissions from these sources throughout the time series.

7.3.4 *Category-specific QA/QC and verification*

The source categories are covered by the general QA/QC procedures, discussed in Chapter 1, and the specific QA/QC described in the document for the QA/QC of outside agencies (Wanders, 2021).

In general, the QA/QC procedures within the Waste sector are:

- checking activity data against other sources within the monitoring of waste;
- checking trends in the resulting emissions;
- checking EFs against EFs in other European countries.

7.3.5 *Category-specific recalculations*

The category 'other organic waste digested' (CRT-category 5.B.2.b other organic waste) that was shown in previous submissions is now included in the category 'waste from households digested' (CRT-category 5.B.2.b organic waste households). This re-allocation has no effect on the amount of emissions.

The category 'other organic waste digested' includes the waste treated in industrial digesters. This category is new compared to the previous submissions (see section 7.3.2) and leads to an increase in CH₄ emissions by +84 tons (2354 tons CO₂ eq) in 2005 to +3956 tons (110,769 tons CO₂ eq) in 2023, compared to the previous submission. Emissions from N₂O increased by 1.4 tons (382 tons CO₂ eq) in 2005 and by 67.8 (17,972 tons CO₂ eq) tons in 2023, compared to the previous submission.

A small correction has been made to the amount of cattle manure digested in 2023. This causes CH₄ emissions to increase by 50 kilograms (+1.4 tons CO₂ eq).

7.3.6 *Category-specific planned improvements*

No improvements have been planned.

7.4 **Waste incineration (5.C)**

7.4.1 *Category description*

This category mainly comprises emissions from activities of the waste incineration facilities that process municipal solid waste and other waste streams.

In general, open burning of waste does not occur in the Netherlands, as it is prohibited by law. However, bonfires (wood burning) are occasionally allowed, and since 2020, they have been included in the inventory. Bonfires occur mainly at New Year's Eve and Easter. They are fuelled by biomass waste (wooden pallets, organic degradable waste, pruning woods). Due to regulations during the COVID-19 period, many bonfires were cancelled in 2020 and 2021. During the process of open burning, emissions of N₂O and CH₄ occur. This is a minor source.

Emissions from the source category Waste incineration, which takes place in Waste Incinerations plants (WIPs), are included in category 1.A.1 (Energy industries) as part of the source 1.A.1.a (Public electricity and heat production). This is because all municipal waste incineration facilities in the Netherlands also produce electricity and/or heat for energy purposes. According to the 2006 IPCC Guidelines, these activities should be included in CRT category 1.A.1.a (Public electricity and heat production: Other fuels); see section 3.2.4. All waste incinerators in the Netherlands that treat mixed municipal waste are grate furnaces.

This source category comprises no key categories.

7.4.2 *Methodological issues*

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. Activity data are based on an inventory of large bonfires (including the actual size of these bonfires) as reported in the media, combined with an overview of smaller bonfires (with an average size). In these bonfires, mainly pruning wood or pallets are burned. Emission factors are adopted from the IPCC 2006 Guidelines (volume 5, chapter 5 for pruning wood and volume 2, chapter 2, table 2.5 for pallet wood)

Detailed information on activity data and EFs (waste incineration in WIPs) can be found in section 38 of Visschedijk et al. (2025).

7.4.3 *Uncertainty assessment and time-series consistency*

Uncertainty Bonfires

Uncertainties in the bonfire-related emissions (both CH₄ and N₂O) are high: over 300%. This relates to uncertainties in activity data as well as in EFs.

Time-series consistency

Consistent methodologies have been used throughout the time series for this source category. Time-series consistency of the activity data are considered to be good due to the continuity of the data provided by the WAR.

7.4.4 *Category-specific QA/QC and verification*

The data on the amounts of waste incinerated is also checked when performing the annual R1 test. Incineration plants must provide incinerated amounts and energy figures for their R1 test. According to the waste legislation in the Waste Framework Directive (2008/98/EC), the results of this test determine whether an incinerator is a recovery plant or a disposal plant.

The source categories are covered by the general QA/QC procedures, discussed in Chapter 1, and the specific QA/QC described in the document for the QA/QC of outside agencies (Wanders et al., 2021).

7.4.5 *Category-specific recalculations*

There have been no category-specific recalculations.

7.4.6 *Category-specific planned improvements*

EFs for household waste are planned to be updated; especially the carbon content, the biogenic part of carbon, the energy content and the biogenic part of the energy, and the biogenic part of the mass of several components of household waste.

7.5 **Wastewater treatment and discharge (5.D)**

7.5.1 *Category description*

This source category includes emissions from industrial wastewater, domestic (urban) wastewater, septic tanks, and indirect emissions from surface waters because of discharges. In 2024, only 0.34% of the Dutch population was not connected to a closed sewer system, and these households were obliged to treat wastewater in a small-scale on-site treatment system (a septic tank or a more advanced system).

Subcategory **5.D.1 Domestic wastewater**: In 2024, urban wastewater (the mixture of domestic, industrial and commercial wastewater, including urban run-off) was treated aerobically in 313 public wastewater treatment plants (WWTPs). During wastewater treatment, the biological breakdown of degradable organic compounds (DOC) and nitrogen compounds results in CH₄ and N₂O emissions. The treatment of residual wastewater sludges is mainly accomplished by anaerobic digesters. Incidental venting of biogas also results in CH₄ emissions. Following eventual on-site sludge digestion and dewatering processes, almost all sludges from domestic WWTPs are incinerated in mono-incinerators, co-incinerated in power plants, or exported to cement factories in neighbouring countries. For a time series of final treatment of sludges from domestic WWTP, see [Statline Urban wastewater treatment \(2025\)](#). In this Statline table, the 2024 data will be added by the end of March 2026. These data are already being used for the calculation of the 2024 emissions.

Subcategory **5.D.2 Industrial wastewater** includes CH₄ emissions from the operational anaerobic industrial WWTPs (IWWTPs) (2024: 46 plants) as well as N₂O emissions from aerobic biological industrial WWTPs (2024: 153 plants).

Subcategory **5.D.3 Other (Septic tanks and waste water effluent)**: The discharge of effluents, as well as other direct discharges from households and companies result in indirect N₂O and CH₄ emissions from surface water due to the natural breakdown of residual nitrogen compounds and residual organic compounds. As 0.34% of the resident population is still connected to a septic tank, CH₄ emissions from septic tanks are also calculated, but these are very small compared to those from public WWTPs.

In 2024, N₂O emissions from category 5.D (see Tables 7.1 and 7.9) contributed about 7.9% of total N₂O emissions and 0.36% in total CO₂ equivalent emissions. In the 1990–2024 period, N₂O emissions from domestic wastewater (5.D.1) increased by 16%. N₂O emissions from industrial wastewater (5.D.2) increased by 11%. Indirect N₂O emissions from waste water effluent (5.D.3) decreased by 66%. Overall, the N₂O emissions from category 5.D decreased by 4% compared to 1990.

The contribution by 5.D Wastewater treatment and discharge to national total CH₄ emissions in 2024 was 1.2%, or 0.15% of total GHG emissions in CO₂ equivalents. Since 1994, CH₄ emissions from public WWTPs have decreased due to the 1990 introduction of a new sludge stabilisation system in one of the largest WWTPs. As the operation of the plant took a few years to optimise, venting emissions were higher in the introductory period (1991–1994) than under subsequent normal operating conditions. Over the 1990–2024 period, CH₄ emissions from category 5.D wastewater treatment and discharge decreased by 48%. The amount of wastewater and sludge being treated has not changed much over time. Therefore, the interannual changes in methane emissions can be explained by varying fractions of methane being incidentally vented instead of flared or used for energy purposes. It should be noted that emissions from the combustion of biogas at wastewater treatment facilities are allocated to category 1.A.4 (Fuel combustion – other sectors) because this combustion is partly used for heat or power generation at the treatment plants.

Table 7.9 presents the trend in GHG emissions from the various types of wastewater handling.

Table 7.9 Wastewater handling emissions of CH₄ and N₂O (kt/year)

	1990	2000	2010	2015	2020	2023	2024
CH ₄ domestic WWTP ¹⁾	5.84	4.36	4.69	4.45	4.78	4.39	4.63
CH ₄ industrial WWTP	0.289	0.394	0.389	0.388	0.389	0.362	0.360
CH ₄ septic tanks	3.93	1.99	0.677	0.634	0.516	0.411	0.402
Indirect CH ₄ from effluents	4.99	3.14	2.46	2.22	2.32	2.36	2.47
Net CH ₄ emissions	15.05	9.88	8.21	7.69	8.01	7.52	7.83
CH ₄ recovered ²⁾ and/or flared	33.2	40.6	45.3	49.6	60.2	60.7	61.2
N ₂ O domestic WWTP	1.41	1.46	1.52	1.54	1.62	1.61	1.64
N ₂ O industrial WWTP	0.140	0.141	0.111	0.141	0.139	0.153	0.156
Indirect N ₂ O from effluents	0.501	0.302	0.174	0.168	0.167	0.172	0.172
Total N ₂ O emissions	2.05	1.90	1.80	1.85	1.92	1.93	1.97

1) Including emissions caused by venting of biogas at public WWTPs.

2) Includes use for energy purposes on site at public WWTPs only and/or flared as well as off-site use. Related combustion emissions are reported under category 1.A.4.

The Waste sector comprises the following key category:

5.D Wastewater treatment and discharge N₂O

7.5.2 *Methodological issues*

Activity data and EFs

Most of the activity data on domestic wastewater treatment is collected by Statistics Netherlands via annual questionnaires that cover all public WWTPs and is presented in StatLine (Statistics Netherlands, 2025); see also [Statline](#) for detailed statistics on wastewater treatment. Table 7.10 outlines the development in the main activity data with respect to domestic wastewater treatment.

Data on anaerobic and aerobic industrial WWTPs also stems from Statistics Netherlands (Statistics Netherlands, 2018), but that time series only covers the 1990–2016 period. For the years 2017–2022, the data was reconstructed using information from a recently installed AER reporting module, resulting in actual data on the population of industrial WWTPs for the years 2016–2023. On the basis of these new results, the activity data on the years 2016–2022 was reconstructed in the previous submission. The new information source also revealed that some aerobic IWWTPs were already in place in the 1990–2015 period, and that some anaerobic IWWTPs were already in place in the 2000–2015 period. Using this information, both N₂O as CH₄ emissions were recalculated for these years, resulting in minor changes. See section 7.5.5 for further details.

Due to varying weather conditions, the volumes of treated domestic wastewater and of the total load of DOC and total nitrogen of domestic wastewater can fluctuate from year to year, depending on the amount of run-off rainwater that enters the sewerage systems. In the method developed for calculating methane emissions from domestic WWT, the DOC (or total organics in wastewater, TOW) is based on an organic load expressed in terms of chemical oxygen demand (COD). In the calculation of the COD of sewage sludge, the average content of 1.4 kg COD per kg organic dry solids is used (STOWA, 2014). Organic dry solids weights are determined by measurements of sewage sludge at all public WWTPs.

Nitrogen loads in the incoming wastewater of domestic WWTPs are determined by measurements at all WWTPs. This is a longstanding standard procedure and covers the complete 1990–2024 time series. All these data have been collected by Statistics Netherlands.

It can be concluded from Table 7.10 that in the last years, the DOC of treated domestic wastewater and sludge produced has shown minor fluctuations over time. In 2024, methane emissions from domestic WWTPs increased by 6% compared to 2023. Fluctuations in the TOW of the influent as well in the organic fraction of the sludge can result in interannual changes in the CH₄ emissions from the water-line of the plants. Moreover, there are interannual changes in the amount of sludge digested or varying fractions of CH₄ being vented instead of flared or used for energy purposes. All the related activity data is compiled on the basis of measurements on each domestic WWTP of flows of sludge, wastewater, biogas, and contents of dry solids, COD and inorganic fraction.

Emissions from the subcategory Septic tanks have decreased steadily since 1990. This can be explained by the increased number of households connected to the sewerage system in the Netherlands (who, therefore, no longer use septic tanks; see Table 7.10).

Total direct discharges of N have also decreased steadily over the whole period from 1990 due to improved wastewater treatment and prevention measures. However, in 2023 and 2024, the nitrogen discharges were somewhat higher again due to loss of performance of domestic WWTP. This was caused by very large wastewater volumes due to extremely high precipitation.

Detailed information on activity data and EFs can be found in section 2.3.2.4 of Honig et al. (2026).

Table 7.10 Activity data on domestic and industrial wastewater handling and discharges to surface water

Domestic (urban) WWTPs:

	Unit	1990	2000	2010	2015	2020	2023	2024
Treated volume	Mm ³ /yr	1711	2034	1934	1957	1938	2245	2229
TOW as COD ¹⁾ load	kt/year	933	921	953	999	1056	1003	1018
Nitrogen load	kt/year	81.4	84.7	87.9	89.1	93.7	93.0	95.0
Sludge DOC as COD ¹⁾²⁾	kt/year	365	431	476	505	533	529	510
Sludge dry solids to digesters	kt/year	246	285	327	351	400	398	410
Biogas recovered ³⁾	mln m ³ /yr	74	87.9	98.5	107	130	131	132
Biogas flared	mln m ³ /yr	8.96	6.15	7.36	7.41	9.79	6.29	7.35
Biogas vented	1000 m ³ /yr	2524	284	1066	82.3	131	68.5	42.7
Actual PE load WWTP ⁴⁾	1000	23,798	23,854	24,745	25,686	27,031	26,036	26,382

Industrial WWTPs:

	Unit	1990	2000	2010	2015	2020	2023	2024
TOW as COD ¹⁾ anaerobic WWTPs	kt/year	144	194	192	190	194	181	181
Biogas recovered ³⁾	Mio m ³ /year					71.1 ⁵⁾	69.0 ⁵⁾	65.8 ⁵⁾
Nitrogen load to aerobic WWTPs	kt/year	8.08	8.14	6.43	8.17	8.06	8.83	9.00

Septic tanks:

	Unit	1990	2000	2010	2015	2020	2023	2024
Resident population ⁶⁾	1000	14,952	15,926	16,615	16,940	17,442	17,877	17,994
Inhabitants with septic tanks	% of pop.	4	1.9	0.62	0.57	0.45	0.35	0.34

Discharges to surface water:

	Unit	1990	2000	2010	2015	2020	2023	2024
Nitrogen discharges ⁷⁾ , total	kt/yr	63.79	38.45	22.13	21.35	21.28	21.91	21.91
- Via effluents from UWWTP ⁸⁾	kt/yr	42.68	30.44	17.69	17.05	16.96	18.18	18.18
- Via industrial discharges ⁹⁾	kt/yr	12.71	4.51	2.36	2.29	2.02	1.64	1.64
- Via other direct discharges ¹⁰⁾	kt/yr	8.40	3.51	2.07	2.01	2.30	2.09	2.09
COD discharges, total	kt/yr	178	112	87.8	79.2	83.5	84.3	87.0
- Via effluents from UWWTPs	kt/yr	131	91.0	75.5	69.8	72.3	76.4	79.1
- Via industrial discharges	kt/yr	46.8	21.1	12.3	9.48	11.2	7.90	7.95

- 1) Chemical oxygen demand.
- 2) Primary and secondary sludge produced, prior to eventual sludge digestion.
- 3) Sum of measured biogas, total for energy conversion, flaring, venting, and external deliveries.
- 4) Pollution Equivalents (PE) represent the total load of biodegradable substances in the mixture of domestic and industrial wastewater treated in urban WWTPs (UWWTPs).
- 5) Total amount of biogas recovered; partly estimated.
- 6) Average population over a year.
- 7) Sum of domestic and industrial discharges of N in wastewater to surface water. 2024 values are copied from 2023 and will be updated next year.
- 8) Including discharges from combined sewer overflows and storm water sewers.
- 9) All direct discharges of companies to surface waters.
- 10) Direct discharges of households, agricultural companies, and traffic activities.

CH₄ emissions from domestic wastewater treatment (5.D.1)

In 2024, 99.7% of the population was connected to closed sewer systems, which were in turn connected to 313 public WWTPs. All public WWTPs in the Netherlands are of the advanced aerobic treatment type, with nutrient removal steps. In addition, sludge digestion is carried out in the larger plants. In these plants, sludges from smaller plants (in the vicinity) are digested, also.

For category 5.D.1 (Domestic wastewater treatment), CH₄ emissions from three types of processes are calculated:

1. Wastewater treatment process emissions: small amounts of methane can be formed during certain wastewater treatment process steps, and, for example, there can be small emissions from the influent cellars, anaerobic zones created for phosphorus removal, and anaerobic pockets in zones with poor aeration.
2. Anaerobic sludge digestion emissions: in addition to the methane recovered and used for energy processes, uncontrolled CH₄ emissions can arise from sludge digestion process equipment.
3. Emissions from incidental venting of biogas: the incidental venting of biogas produced in anaerobic sludge digesters is also a source of CH₄ emissions.

Detailed information on activity data and EFs can be found in sections 2.3.2.4.2 and 2.3.2.4.3 of Honig et al. (2026). The calculation of emissions from these processes is summarised below.

1. Wastewater treatment process emissions

Methane emissions from the wastewater treatment process are calculated using a Tier1 method with the default emission factor and country-specific activity data. The default emission factor for centralised aerobic treatment is 0.0075 kg CH₄/kg COD and is now based on the maximum CH₄ producing capacity (B_0) and methane correction factor (MCF) from the 2019 Refinement to the 2006 IPCC Guidelines (IPCC, 2019).

The country-specific activity data on the influent COD and the amounts of sludge produced in all public WWTPs are derived from the annual survey conducted by Statistics Netherlands among the Water Boards and are based on monitoring at the WWTPs following strict procedures. For the years from 1990 until the present, data on influent COD is available for each treatment plant.

Data on the sludge produced annually is available for the years 1990 until 2016, for 2018, 2020, 2022, 2023, and 2024. Due to a re-evaluation of the statistical programme, these data have only been inventoried for even years from 2016 to 2022. For odd years (2017, 2019 and 2021), the data from the previous year is used as a best estimate; see also section 2.3.2.4.2 in Honig et al. (2026).

The COD of sludge is calculated using the conversion factor 1.4 kg COD per kg organic solids (STOWA, 2014). Organic solids are calculated as total dry solids minus the inorganic fraction. The total dry solids are measured at each public WWTP; the inorganic fraction is calculated on the basis of measurements of the ash content.

Table 7.10 provides the time series of the values of influent COD and the COD of sludge produced.

2. Anaerobic sludge digestion emissions

Emissions of CH₄ from anaerobic sludge digestion are calculated for the entire time series using the default Tier 1 method from the 2019 Refinement (IPCC, 2019) and are based on an EF per kg dry solids of sludge going into the digesters, being 0.002 kg CH₄/kg ingoing dry solids. The emissions are calculated per WWTP with sludge digestion facilities. In 2024, 65 urban WWTPs (UWWTPs) were equipped with sludge digesters. See also section 2.3.2.4.2 in Honig et al. (2026).

Default activity data on the ingoing dry solids amount at public WWTPs with sludge digesters is derived from the annual survey conducted by Statistics Netherlands among the Water Boards.

3. Emissions from incidental venting of biogas

Incidental venting of biogas at public WWTPs is recorded by the plant operators and reported to Statistics Netherlands. In 2024, the amount of CH₄ emitted by the venting of biogas was 0.0188 kt CH₄, equalling 0.4% of total CH₄ emissions from the category Domestic wastewater. In the last decade, this value ranged between 0.3% and 9%, so the vented amount of biogas in 2024 was relatively low.

Recovered biogas is largely used for energy generation purposes, but a small amount is flared, vented, or delivered to third parties. Table 7.10 provides data on the recovery of CH₄ (total) and CH₄ combusted via flaring. See also section 2.3.2.4.3 in Honig et al. (2026).

CH₄ emissions from anaerobic industrial wastewater treatment (5.D.2)

For the 1990–2016 period, the activity data for this subcategory stems from an annual survey by Statistics Netherlands which stopped in 2017. Until the NIR 2025, the data on the population for the years 2016–2022 was constructed and maintained on basis of irregular sources: literature, wastewater related news-bulletins providing information on specific industries, et cetera. However, in the previous submission the population and activity data of IWWTPs for the 2016–2022 period could be updated because the Annual Environmental Reporting (AER) system was extended with a module for IWWTPs. This resulted in small changes in methane emissions for the years 2016–2022 compared to the previous submission. The new AER data also revealed some necessary changes to be made regarding the population of anaerobic IWWTPs for the 2000–2015 period as well as changes in aerobic biological IWWTPs for the 1990–2015 period. This revised activity data are implemented in the current submission. For an overview of recalculations, see section 7.5.5.

In the calculation of methane emissions from anaerobic industrial wastewater treatment, the Netherlands uses country-specific activity data for the TOW, as well as a country-specific fraction for losses of methane by leakage. Recovered biogas is generally used as fuel in energy processes. Emissions from biogas combustion are included in the Energy sector. A more detailed description of the method and the EF

used can be found in sections 2.1.3 (combustion of biogas) and 2.3.2.4.5 of Honig et al. (2025).

In the Netherlands, little information is available on the actual load of COD treated in the IWWTPs. Thus, the TOW has to be determined in an alternative way. The TOW is estimated by using statistics on the design capacity of the IWWTPs and an assumed average loading rate of 80% of the design capacity (Oonk, 2004). The design capacity is expressed in terms of a standardised value for quantifying organic pollution in Dutch industrial wastewater: Pollution Equivalents (PE). One PE equals an amount of 40 kg COD per year. Data on the design capacity is available from Statistics Netherlands (2018). For the most recent years, data from the Annual Environmental Reporting system could also be used.

TOW (expressed as COD) is thus calculated as:

$$\text{TOW} = \text{PE} * 0.8 * 40$$

Where:

PE = total design capacity in Pollution Equivalents

0.8 = average loading rate (80%)

40 = kg COD per PE per year (factor to calculate from PE to COD).

Using the default maximum CH₄ producing capacity (B₀) of 0.25 kg CH₄/kg COD (IPCC, 2019), a default Methane Conversion Factor of 0.8 (IPCC, 2019), and a methane loss (Mrind) of 1% from the digestion process (Oonk, 2004), the Emission Factor is calculated as B₀ * MCF * Mrind = 0.002 kg CH₄/kg COD. A further description of the method and the EF used can be found in section 2.3.2.4.5 of Honig et al. (2026). Table 7.10 provides the time series of total TOW for IWWTPs.

In 2024, 72% of the anaerobic capacity was installed in the food and beverage industry. Other sectors with anaerobic wastewater treatment are waste processing facilities (12%), the chemical industry (10%), and the paper and cardboard industry (6%).

Numerical estimate of the recovered CH₄ in anaerobic industrial wastewater treatment plants available for 2020–2024

In response to a 2016 review question, it was investigated whether the data on biogas production from industrial anaerobic wastewater treatment plants can be derived or estimated from information becoming available via the individual Annual Emission (e-PRTR) Reports. This could only be carried out for the 2019–2024 period (see also Table 7.10).

The total amount of IWWTP biogas recovered in 2024 equalled 52.8 million m³, but this only includes data from 32 out of the 46 anaerobic IWWTPs, equalling 83% of total TOW treated. For the remaining 14 plants, no data are available, but on the basis of the amount of TOW, this missing volume can be estimated at an additional 12.9 million m³. Total recovery can then be estimated at 65.8 million m³ biogas.

No specific information is available on the methane content of biogas from anaerobic industrial wastewater treatment plants. If the average value for biogas from domestic wastewater sludge digestion

(0.44 kg CH₄/m³ biogas, see Honig et al., 2025) is used, a total recovery of 28.9 kt CH₄ can be calculated for 2024. Applying a loss by leakage of 1% of total CH₄ recovered (Honig et al., 2025), this results in an emission of 0.289 kt CH₄. This figure can be compared to the current country-specific method, resulting in an emission of 0.360 kt CH₄ (+24%). Given the uncertain factors of both methods, this difference is acceptable.

The methane (CH₄) implied emission factor (IEF) is based on gross CH₄ emissions and is calculated as follows:

IEF = Gross CH₄ emission (= Net CH₄ emission + CH₄ recovered or flared) / total organic product.

For the years 1990–1999, there is no data on the CH₄ recovery, resulting in a relatively low IEF. But from 2020 onwards, availability of data on CH₄ recovery has resulted in a higher numerator in the calculation of the IEF and thus in a higher IEF.

CH₄ emissions from septic tanks (5.D.3)

Emissions of methane from septic tanks are calculated using IPCC default values for B₀ and MCF and the IPCC value of TOW of 60 g BOD (biological oxygen demand) per connected person per day (IPCC, 2006: Table 6.4). Detailed information on activity data and EFs can be found in section 2.3.2.4.4 of Honig et al. (2026).

Table 7.10 presents the time series of the percentage of the population connected to septic tanks. This percentage decreased from 4% in 1990 to 0.34% in 2024. These data derive from surveys, estimates, and expert judgement by various organisations in the Netherlands, such as Rioned, (2009, 2016), WHO (2025), and the National Water Authorities.

Indirect CH₄ emissions from surface water as a result of discharge of domestic and industrial effluents (5.D.3, Wastewater effluents)

Indirect methane emissions from surface water as a result of discharge of domestic and industrial effluents are calculated using the Tier 1 default emission factor of 0.028 kg CH₄/kg COD discharged as provided in the 2019 Refinement of the IPCC 2006 Guidelines (IPCC, 2019).

The country-specific activity data on kg COD discharged per year via industrial and domestic effluents is derived from the wastewater statistics (see [Statline](#)) and from the Netherlands' PRTR database. These COD loads to surface water are based on frequent monitoring of all domestic WWTPs and of all industrial discharges. Detailed information on the method and activity data can be found in section 2.3.2.4.8 of Honig et al. (2026).

N₂O emissions from centralised wastewater treatment (5.D.1)

N₂O emissions from domestic wastewater handling are calculated with methodology provided by the 2019 Refinement (IPCC, 2019), but the Dutch Tier2 method uses a country-specific emission factor of 0.011 kg N₂O-N/kg N (De Haas & Andrews, 2022) and country-specific activity data on the total influent loads of nitrogen at all domestic WWTPs in the Netherlands. The activity data derives from the wastewater statistics (see [Statline](#)) and is based on frequent monitoring of the incoming wastewater at all domestic WWTPs. Detailed information on the

method and activity data can be found in section 2.3.2.4.2 of Honig et al. (2026).

The influent data on total nitrogen includes the loads from households, from industrial and commercial activities as well as the loads from urban run-off into the sewerage system. This means that the total incoming nitrogen load at domestic wastewater treatment plants does not have to be calculated on the basis of standard parameters and coefficients, such as consumption of proteins per capita per year. Table 7.10 provides a time series of total nitrogen load of the influent. In 2024, total nitrogen in the influent equalled 95.0 million kg N.

As wastewater treated at public WWTPs is a mixture of household wastewater, (urban) run-off rainwater, and wastewater from industries and services, the N₂O emissions are reported under category 5.D.1 (Domestic and commercial wastewater). Moreover, as the Netherlands does not make use of equation 6.10 to calculate total nitrogen loads, the standard parameters on population, protein consumption, fraction of nitrogen in protein, fraction of non-consumed protein, and fraction of industrial nitrogen are reported as 'NA' in the additional information table of CRT (table 5.D).

N₂O emissions from aerobic industrial wastewater treatment (5.D.2)

For the calculation of N₂O emissions from aerobic industrial wastewater treatment, a Tier2 method is used on the basis of an adjusted emission factor of 0.011 kg N₂O-N/kg N (De Haas & Andrews, 2022) and country-specific activity data on the total influent loads of nitrogen at all industrial aerobic WWTPs in the Netherlands.

The activity data stems from a time series of aerobic industrial wastewater plants derived from statistics on industrial wastewater sludges (see Statline), as well as from data on total nitrogen discharged from the Dutch PRTR database. In this submission the population of aerobic IWWTPs was improved for the 1990–2015 period (see also section 7.5.5).

For most of the IWWTPs, an effluent load could be coupled. For the remaining installations, the effluent load was estimated on the basis of the plant size and derived estimators such as total nitrogen discharged per population equivalent design capacity. Subsequently, influent nitrogen loads were estimated using the default removal rate of 0.40 for secondary treatment, as provided by table 6.10.c in the IPCC 2019 Refinement document.

A more detailed description of the method, the EF used as well as the activity data can be found in section 2.3.2.4.6 of Honig et al. (2026).

Indirect N₂O emissions from surface water as a result of discharge of domestic and industrial effluents (5.D.3, Wastewater effluents)

For the calculation of indirect (or better: 'delayed') N₂O emissions from wastewater effluents, the Netherlands uses the default EF of 0.005 kg N₂O-N/kg N discharged (IPCC, 2019) and country-specific activity data on N_{Effluent,DOM}.

The country-specific activity data on kg N discharged per year via industrial, domestic, and commercial effluents is derived from the wastewater statistics (see [Statline](#)) and from the Netherlands'

PRTR database (regarding both sources: 2024 data was not yet available). For 2024, we used data on 2023 as best estimate. Most of the effluent loads of total nitrogen are determined by frequent monitoring of treated wastewater flows or – in the case of discharges from sewer overflows – estimated using a model. The loads do not have to be estimated by means of standard factors. This means that equation 6.8 (updated) from the 2019 Refinement document, is not used. As the Netherlands does not make use of the right-hand part of equation 6.8 and related equation 6.10, information on population, protein consumption, fraction of nitrogen in protein, fraction of non-consumed protein, and fraction of industrial nitrogen values are reported as 'NA' in the additional information table of CRT Table 5.D.

Detailed information on the method used can be found in section 2.3.2.4.7 of Honig et al. (2026). Table 7.10 provides a time series of the activity data: total N discharges.

Emissions not calculated within category 5.D

Within category 5.D, the following emissions are not estimated (NE) or not occurring (NO):

- Direct N₂O emissions from septic tanks (5.D.3: NO). Direct emissions of N₂O from septic tanks are not calculated since they are unlikely to occur, given the anaerobic circumstances in these tanks. Indirect N₂O emissions from septic tank effluents are included in CRT category 5.D.3 (Indirect N₂O emissions from surface water as a result of discharge of domestic and industrial effluents).
- CH₄ emissions from industrial sludge treatment (5.D.2). From a survey among IWWTPs conducted by Statistics Netherlands in 2016, it can be concluded that anaerobic sludge digestion within industries is applied at only two industrial WWTPs. These data have not been published on www.cbs.statline.nl for reasons of confidentiality. Via a rough estimate, it was calculated that the methane emissions from this source amount to approximately 6.2 tons of CH₄ per year, equalling 0.00085% of national methane emissions in 2016. Therefore, forthcoming CH₄ emissions are reported as NE for the years 1990–2024.

7.5.3 *Uncertainty assessment and time-series consistency* *Uncertainty assessment*

The uncertainty analysis in Annex 2 provides estimates of uncertainties by IPCC source category and gas that are based on error propagation. The uncertainty in annual N₂O and CH₄ emissions from wastewater handling is estimated to be 29% and 41%, respectively.

The uncertainty in activity data for domestic WWT is based on expert judgement (Ramirez, 2006) and is estimated to be 25%. The annual loads of DOC_{influent}, DOC_{sludge}, N_{influent} and N_{effluent} are calculated on the basis of wastewater and sludge sampling and analysis, as well as on the basis of flow measurements at all the WWTPs; all these measurements can involve uncertainty.

For industrial WWT the uncertainty in activity data are based on IPCC (2019) and is estimated to be 30%.

The uncertainty in the EFs for CH₄ differs per type of emission source and is estimated to range between 32% and 300% (IPCC, 2019). For N₂O, the uncertainty also varies per emission source and is estimated to be between 15% and 100% (IPCC, 2019; De Haas & Andrews, 2022).

An international study (GWRC, 2011), in which the Dutch public wastewater sector participated, showed that particularly N₂O EFs are highly variable across WWTPs, as well as within an individual WWTP across seasons or even at different times of day. Moreover, the same study concluded that the use of a generic EF (such as the IPCC default) to estimate N₂O emissions from an individual WWTP is inadequate. Currently, the Dutch wastewater sector is conducting an extensive monitoring programme at Dutch urban wastewater treatment plants. One of the goals is to gain insight in the factors that influence N₂O and CH₄ emissions. Of course, monitoring results will also be used to develop country-specific emission factors. Results are to be expected in 2–4 years' time.

Time-series consistency

The same methodology has been used to estimate emissions annually, providing good time-series consistency. The time-series consistency of the activity data are very good thanks to the continuity in the data provided by Statistics Netherlands.

7.5.4 Category-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures, as discussed in Chapter 1. Statistical data are covered by the specific QA/QC procedures of Statistics Netherlands (CBS).

The Dutch wastewater sector will continue to conduct research aimed at more precisely determining the factors and circumstances that result in the formation of CH₄ and N₂O in public WWTPs.

7.5.5 Category-specific recalculations

There were a number of recalculations due to definitive or revised activity data. Basic methods did not change for category 5.D. Table 7.11 provides an overview of the differences compared to the previous submission.

In 2023, the indirect CH₄ emissions from surface water as a result of the discharge of domestic and industrial effluents (5.D.3. Wastewater effluents) decreased by 0.11 kt CH₄ (-5%) compared to the previous submission. This change results from replacing provisional by definitive activity data.

In 2023, the indirect N₂O emissions from surface water as a result of the discharge of domestic and industrial effluents (5.D.3) increased by 0.016 kt N₂O (+10%) compared to the previous submission. This difference is mainly caused by a much higher nitrogen discharge from domestic WWTPs, because of lower treatment efficiencies. The lower treatment efficiencies were caused by all-time high wastewater volumes due to excessive precipitation in 2023. These effects were not yet considered in the estimates made for the previous submission.

In the previous submission, the population of anaerobic and aerobic biological industrial wastewater treatment plants for the years 2016–2022 was updated with new information from the AER reporting module. This relatively new information source also revealed that some aerobic IWWTPs were already in place in the 1990–2015 period, and that some anaerobic IWWTPs were already in place in the 2000–2015 period. Using this information, both N₂O as CH₄ emissions were recalculated for these years. See table 7.11.

In addition to the table, it can be added that for CH₄, the emissions did not change for the 1990–1999 and 2016–2022 periods compared to the previous submission. For N₂O, the figures for 2016–2022 did not change, either.

Table 7.11 Differences as a result of recalculations in category 5.D Wastewater treatment and discharge, compared to the previous submission

	Unit	1990	2000	2010	2015	2023
5.D.2 CH ₄ from anaerobic IWWTP	kt	-	0.004	0.006	0.008	-
5.D.3 indirect CH ₄ from surface water	kt	-	-	-	-	-0.112
Total difference CH₄	kt	-	0.004	0.006	0.008	-
	%	-	0.04	0.07	0.10	-1.48
5.D.2 N ₂ O from aerobic IWWTP	kt	0.011	0.015	0.017	0.027	-
5.D.3 indirect N ₂ O from surface water	kt	-	-	-	-	0.016
Total difference N₂O	kt	0.011	0.015	0.017	0.027	0.016
	%	0.6	0.8	0.9	1.5	0.8

7.5.6 Category-specific planned improvements

In the next submission, in the NID and the CRT, the reporting of indirect N₂O emissions as a result of nitrogen discharges will be reported separately for domestic sources and industrial sources.

8 Other (CRT sector 6)

The Netherlands allocates all GHG emissions to sectors 1 to 5.
Therefore, no sources of GHG emissions are included in sector 6.

9 Indirect carbon dioxide and nitrous oxide emissions

9.1 Description of sources of indirect emissions in the GHG inventory

Methane, carbon monoxide (CO), and NMVOC emissions are oxidised to CO₂ in the atmosphere. This chapter describes indirect CO₂ emissions as a result of this atmospheric oxidation.

As the Netherlands assumes 100% oxidation during the combustion of fuels, no indirect CO₂ emissions from methane, CO, and NMVOC originating from combustion processes are reported. The reported indirect CO₂ emissions originate from the use and/or evaporation of NMVOC in the following sectors:

1. Energy (energy, transport, and refineries);
2. IPPU (consumers, commercial and governmental institutions, industry, and construction and building industries);
3. Agriculture (manure storage, manure application, silage storage, cultivating crops);
Indirect CO₂ emissions from agriculture originate from NMVOC in pesticides. These emissions are accounted for in the CRT under 'other product use' (category 2. IPPU).
4. Waste (managed waste disposal sites, open burning of waste, domestic wastewater).

Indirect CO₂ emissions decreased from 0.92 Mt in 1990 to 0.44 Mt in 2024, mainly as a result of the Dutch policy to reduce NMVOC emissions.

The source category 6 Indirect emissions (CO₂) is a key category.

Table 9.1 Overview of the category Indirect CO₂ emissions in the base year and the last two years of the inventory (in Mt CO₂ eq)

Sector/category	Gas	Key				2024 vs 1990	Contribution by the category in 2024 (%) to the		
			1990	2023	2024				
			Emissions in Mt CO ₂ eq			%	sector	total gas	total CO ₂ eq
Indirect CO ₂ emissions	CO ₂	T	0.92	0.43	0.44	-52.1%	0.31%	0.37%	0.30%

The middle column shows the change (%) over the last year of the inventory compared to the base year. On the right-hand side of the table, the contribution by last year's inventory's emissions from the category to the sector, to the total national emissions of the specific gas, and to the total national emissions (in CO₂ eq) are provided.

The Netherlands only reports indirect emissions of N₂O as part of the agricultural and LULUCF sectors; see CRT tables 3 and 4.

9.2 Methodological issues

Indirect CO₂ emissions are calculated as follows:

$$CO_2 \text{ (in kt)} = NMVOC \text{ emission (in kt)} * C * 44/12$$

Where:

C = default IPCC carbon content (C) of 0.6

NMVOC emissions data per sector is obtained from the Dutch PRTR.

9.3 Uncertainty assessment and time-series consistency

On the basis of expert judgement, the uncertainty in NMVOC emissions is estimated at circa 25% and the uncertainty in carbon content is estimated at 10%, resulting in an uncertainty in CO₂ emissions of approximately 27%. Consistent methodologies and activity data have been used to estimate indirect CO₂ emissions.

9.4 Category-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

9.5 Category-specific recalculations

There have been no category-specific recalculations.

9.6 Category-specific planned improvements

No improvements have been planned.

10 Recalculations and improvements

Major recalculations and improvements compared to the National Inventory Report 2025

For the NIR 2026, the most recent data (2024) has been added to the inventory and corresponding CRTs using the Enhanced Transparency Framework (ETF) tooling.

As a result of recommendations to the (annual) submission from the internal and external reviews (UNFCCC and EU), improvements have been made to both the CRT and the NID.

Recalculations have been performed as a result of changes of method and/or on the basis of new, improved activity data and/or improved EFs. Furthermore, error corrections of the data in the previous submission have been performed, resulting in changes in emissions over the entire 1990–2023 period.

For details of the effects of and justification for the recalculations, see Chapters 3–7.

10.1 Explanation of and justification for recalculations, including in response to the review process

For the NIR 2026, the Netherlands used the ETF GHG Inventory reporting tool (December 2025).

Previous ERT reviews by the UNFCCC and the EU review reports suggested there was still room for improvement in the Dutch GHG inventory. Where possible and taking into consideration overall priorities, the review recommendations have been incorporated into this NID and CRT, and accordingly, into the methodology reports.

The UNFCCC review issues (mainly those from the most recent review in April 2025) are listed in Annex 10, as are the actions undertaken to resolve them.

Besides these externally induced improvements, additional improvements have been made as a result of our own QA/QC program:

- methodological changes and data improvements;
- changes in source allocation;
- error corrections.

Methodological changes and data improvements

The improvements to QA/QC activities in the Netherlands implemented in recent years (the process of assessing and documenting methodological changes) are still in place. This process includes a brief checklist for timely discussion on proposed changes for the 2026 inventory with relevant experts and information users (among others, policymakers). This process improves the peer review and timely

documentation of the background to and justifications for changes made in the current inventory.

The most significant recalculations in this submission (compared to the NIR 2025) are described per sector below. Table 10.1 shows the impact per category, for the years 1990, 2000, 2010, 2020, and 2023.

Energy sector

- For sector 1.A., the biomass consumption data, and therefore all emissions from biomass, has been updated for the complete time series. Due to a change in methodology, biomass activity data numbers are no longer rounded to 1 decimal, resulting in small recalculations for all years. With this update, several errors were also corrected. Further details on the impacts can be found in Chapter 3.
- The national energy statistics are updated annually and have now been updated for the years 2015–2023. This results in multiple recalculations in several sectors, ranging from small (a few tonnes of CO₂) to significant changes (up to 20 kt CO₂). The largest updates are for LPG and natural gas usages. The biogenic share of natural gas has also been updated, resulting in a reallocation of CO₂ from gaseous fuels to biomass. Further details can be found in Chapter 3.
- There have been reallocations for diesel use. Diesel use from recreational craft has been reallocated from 1.A.3.b. Road Transport to 1.A.3.d. Domestic Navigation for the years 2014–2023. Diesel for military land equipment has been reallocated from 1.A.2.g.vii Off-road vehicles and other machinery to 1.A.5.b. Mobile – Military use for the entire time series.
- There has been an update to the non-road mobile machinery model and its transfer to the energy statistics. This impacts the lifetimes of machines and the machinery fleet. Also, additional machinery types were added to the model. This results in recalculations for 1.A.2. and 1.A.4. for the full time series. The decrease in 1.A.2. mainly results from a strong decrease under 1.A.2.g.vii Off-road vehicles and other machinery. The increase in 1.A.4. mainly results from an increase of emissions from liquid fuels under 1.A.4.a.ii. Commercial/institutional, off-road vehicles and other machinery.
- The update of the non-road mobile machinery model also results in relatively small recalculations under 1.A.3 due to changes and reallocations of fuel usages. For example, some diesel use under 1.A.3.b. has been reallocated to non-road mobile machinery under 1.A.4.a.ii.

The above recalculations and error correction changed the total CO₂ eq emissions in the Energy sector by -0.26% in 1990 to -0.19% in 2023 compared to the previous submission.

IPPU sector

- For 2.B Chemical industry (2.B.1. Ammonia production and 2.B.10.b Other process emissions), some minor recalculations have been performed for 2020 and 2023. For 2.B.1, the amount of fossil natural gas used changed due to an update in the share of biogenic versus non-biogenic natural gas. This resulted in a

decrease of emissions from fossil natural gas. For 2.B.10.b, emissions changed due to an error correction.

- In Sector 2.D, CO₂ emissions are recalculated for 2.D.1 and 2.D.3.
- For 2.D.1 Lubricant use, emissions are recalculated for the entire time series. This results from an error correction in the CRT. Emissions from lubricant use of motorcycles were previously allocated to 1.A.3.b.iv., but are now allocated to 2.D.1 Lubricant use, as is also the case for other vehicle types.
- For 2.D.3 Ureum use in SCR, CO₂ emissions have been updated for 2018–2023. New vehicle types were included in Ureum-use, resulting in an increase in emissions.
- In Sector 2.G Other product manufacture and use, CH₄ and N₂O emissions are recalculated for the entire time series. These recalculations result from updates in emissions from smoking (cigars and cigarettes), as now, the illegal import of cigars and cigarettes is also taken into account, resulting in an increase of emissions under 2.G.4.
- For 2.H Other industry, there are recalculations for 2020 and 2023. These result from a reallocation from combustion to process emissions, leading to an increase in 2.H.
- For HFC emissions in 2.F.1 Stationary refrigeration, there is always a two-year time-lag for making the data available. Therefore, emissions for 2022 and 2023 were now updated. The 2021 emissions are also recalculated due to error correction. Before, 2022–2023 values were equal to the erroneous value for 2021. Now, the value for 2021 has been corrected and 2022–2024 are equal to the newly available data for 2022. This results in an increase of HFC emissions for 2021–2023.

The above recalculations changed the total CO₂ eq emissions in the IPPU sector by +0.01% in 1990 to +1.32% in 2023 compared to the previous submission.

Agriculture sector

- CH₄ emissions from Enteric Fermentation under 3.A have been recalculated for the full time series. Emission factors for enteric fermentation of Goats (3.A.4.d) and Sheep (3.A.2) have been updated to the Tier 1 emission factor from the 2019 IPCC Guidelines, resulting in an increase of emissions. For goats, the EF increased from 5 to 9 kg CH₄ per goat. For sheep, it increased from 8 to 9 kg CH₄ per sheep.
- N₂O emissions from 3.B Manure management have been recalculated for the full time series. The amount of treated manure has been updated for Cattle (3.B.1.a and 3.B.1.c) and Swine (3.B.3). The amount of treated manure has been harmonised, meaning that the fraction of the amounts of manure in storage and treatment has been equated for all emission calculations. Emissions from swine have been recalculated from 2006 onwards, as this was the first year with swine manure treatment.
- The increase in emissions ranged between 859 kg N₂O (2008) and 61,319 kg N₂O in 2022. Emissions from cattle were recalculated for the entire time series. The increase in emissions ranged

between 871 kg N₂O in 1990 (0.1%) and 14,612 kg N₂O in 2022 (1.5%).

- CH₄ emissions from poultry manure management have been recalculated, resulting from an error correction. This leads to a decrease in emissions ranging between 121,250 kg CH₄ (1.4%) in 1998 and 1,547,610 kg CH₄ in 2017 (50.5%).
- Indirect N₂O emissions in 3.B.5 have been recalculated as NH₃ and NO_x emissions were updated. The increase in emissions from 3.B.5 ranged between 9 kg N₂O in 1990 (0.001%) and 19,486 kg N₂O in 2020 (2.4%).
- N₂O emissions from Inorganic N fertilisers in 3.D.1.a. have increased for the years 2019–2023. A new, higher estimate of ammonia emissions from goat housing also increases the N-content in the rinsing liquid and, therefore, causes an increase in N₂O emissions ranging between 0.003 and 0.01%.
- N₂O emissions from 3.D.1.e Mineralisation/immobilisation associated with loss/gain of soil organic matter and from 3.D.1.f Cultivation of organic soils have been recalculated on the basis of new insights from the LULUCF sector. Furthermore, for 3.D.1.e, the emission factor has been updated to the value from the 2019 IPCC refinement.
- Indirect N₂O emissions from Manure application in 3.D.2. have been updated, mainly due to the previous recalculation, as well as to multiple small changes to the NH₃ and NO_x emissions from manure management that affecting the amount of manure available for application.
- Definitive usage rates of inorganic fertilisers, compost, liming, and urea application differ from the preliminary rates. This affects the N₂O emissions from Agricultural soils (3.D), and the CO₂ emissions from Liming (3.G) and Urea application (3.H).

The above recalculations changed the total CO₂ eq emissions in the Agriculture sector by +0.20% in 1990 and by +0.43% in 2023 compared to the previous submission.

LULUCF sector

- The emission factor for drained organic soils has been updated on the basis of new Dutch measurements, replacing a single emission factor with differentiated CO₂ estimates by soil type, land use, nature type, and region. This results in a strong decrease of CO₂ emissions by about 700 kt for the complete time series, affecting emissions in 4.A-C and 4.E.
- The emission factor for N₂O from nitrogen mineralisation due to soil carbon loss was updated from 0.01 to 0.006 kg N₂O-N per kg N, now in line with the 2019 IPCC refinement. In combination with the next methodological update, this results in an increase of N₂O emissions in categories 4(III).A–4(III).E. by about 20 kt CO₂ eq for the entire time period.
- N₂O emissions from land-use change disturbances are now calculated using updated C:N ratios based on a Dutch soil sampling campaign. In combination with the previous methodological update, this results in an increase of N₂O emissions in categories 4(III).A–4(III).E. by about 20 kt CO₂ eq throughout the time period.

- Carbon stock changes for mineral soils under Cropland and Grassland now use five-year weather-averages. This results in updates in carbon stock changes in 4.B.1 Cropland remaining cropland and 4.C.1 Grassland remaining grassland for the complete time series, with changing impact on emissions (increase/decrease) for different years.
- A new land-use maps for 1-1-2025 results in updated activity data for 2021–2023. This leads to the following increases in emissions for the entire LULUCF sector for all land uses: by 436, 689, and 695 kt CO₂ eq for the years 2021, 2022, and 2023, respectively.
- A new spatial interpolation method allows for making annual land-use and soil maps. Therefore, the model has been updated to use spatially explicit raster inputs for activity data. This impacts the entire time series for all land uses. It results in a decrease in emissions over the 1990–2020 period for the whole LULUCF sector, from 194 kt CO₂ eq in 1990 in a decreasing trend towards 2020, at which point the difference is 0.
- The allocation of carbon stock for soils converting from organic to mineral soil types has been updated. Throughout the time period, this resulted in recalculated emissions for the entire LULUCF sector, ranging from 4.8 kt CO₂ increases to 3.8 kt CO₂ decreases.
- The introduction of spatially explicit emission factors for each land-use and soil combination eliminated the need for a variable fixed drainage fraction for Forest land category 4.A. This results in increased methane emissions (average increase by 6.6 kt CO₂ eq) over the entire time period for Forest land (4(II).A.).

The above recalculations changed the total CO₂ eq emissions in the LULUCF sector by -13.15% in 1990 and by -13.57 % in 2023 compared to the previous submission. For further details on the methodological updates, see section 6.1.3. of this submission.

Waste sector

- In category 5.A, updated figures with regard to the amount of extracted landfill gas have resulted in a small decrease of methane emissions between 2021 and 2023.
- Now, digestion of 'Other organic waste' is now also added to 5.B, resulting in an increase in CH₄ and N₂O emissions.
- For category 5.D Wastewater treatment and discharge, the CH₄ and N₂O emissions from 5.D.2 Industrial wastewater show small increases for the years 1990–2015 due to revised activity data. For 5.D.3 Wastewater effluent, the N₂O and CH₄ emissions were updated for 2023, as provisional data were replaced by definitive activity data. N₂O emissions slightly increased, while CH₄ emissions showed a small decrease.

The above recalculations changed the total of CO₂ eq emissions in the Waste sector by 0.02% in 1990 and by 4.33% in 2023 compared to the previous submission.

The total changes in GHG emissions per sector compared to the previous submission are presented in Table 10.1 (in kt CO₂ eq) for the years

1990, 2000, 2010, 2020, and 2023. Positive values represent recalculations which increased the emissions compared to the 2025 submission and negative values represent decreased emissions in the 2026 submission.

Recalculations in the Energy, IPPU, and LULUCF sectors dominate the changes in the National emissions compared to the 2025 submission.

The decrease in total GHG emissions for all years is below -0.6% GHG compared to the 2025 submission.

Table 10.1 Summary of recalculations for the 1990–2023 period (kt CO₂ eq)

Gas(es)		1990	2000	2010	2020	2023
CO ₂ , CH ₄ , N ₂ O	1.A.1 Energy Industries	-0.8	-2.3	-9.3	-4.0	-24.5
CO ₂ , CH ₄ , N ₂ O	1.A.2. Manufacturing industries and construction	-525.8	-597.1	-478.6	-41.6	-79.1
CO ₂ , CH ₄ , N ₂ O	1.A.3. Transport	15.2	23.7	17.9	-451.1	-263.9
CO ₂ , CH ₄ , N ₂ O	1.A.4. Other sectors	40.6	182.9	497.8	388.2	120.4
CO ₂ , CH ₄ , N ₂ O	1.A.5. Other	73.0	57.3	56.7	31.4	40.9
CO ₂ , CH ₄ , N ₂ O	2.B. Chemical industry	0.0	0.0	0.0	3.4	-42.0
CO ₂	2.D. Non-energy products from fuels and solvent use	2.4	2.1	1.4	0.5	0.3
CH ₄ , N ₂ O	2.G. Other product manufacture and use	0.1	0.1	0.1	0.1	0.1
CO ₂	2.H. Other	0.0	0.0	0.0	0.0	0.6
HFC	2.F.1. Refrigeration and air conditioning	0.0	0.0	0.0	0.0	239.8
HFC	2.F.6. Other applications	0.0	0.0	0.0	-15.4	-26.3
CH ₄	3.A Enteric Fermentation	54.5	56.5	71.1	97.6	97.3
CH ₄ , N ₂ O	3.B Manure management	0.2	-4.4	-30.0	-16.4	-16.4
N ₂ O	3.D Agricultural soils	-4.7	-33.7	-28.0	-19.2	-4.9
CO ₂	3.G Liming	0.0	0.0	0.0	0.0	3.0
CO ₂	3.H Urea application	0.0	0.0	0.0	0.0	-0.9
CO ₂ , CH ₄ , N ₂ O	4 LULUCF	-581.1	-1032.8	-547.4	-557.9	-516.2
CH ₄	5.A Solid waste disposal	0.0	0.0	0.0	0.0	-6.7
CH ₄ , N ₂ O	5.B Biological treatment of solid waste	0.0	0.0	41.6	105.0	128.7
CH ₄ , N ₂ O	5.D Waste water Handling	3.0	4.2	4.6	0.0	1.1
Total Difference		-923.4	-1343.5	-402.1	-479.54	-348.6
	<i>Total emissions NIR 2025*</i>	227,542	224,643	219,441	168,300	146,441
	Total emissions NIR 2026*	226,618	223,299	219,039	167,820	146,092

*: including LULUCF and indirect CO₂ emissions

10.2 Implications for emission and removal levels

This section summarises the implications of the changes described in section 10.1 for the emissions levels reported in the GHG emissions inventory.

For the base year 1990, the recalculations resulted in a decreased GHG emission total compared to the previous submission, amounting to -0.41% (including LULUCF and indirect CO₂).

For 2023, the recalculated emissions decreased by -0.24% compared to the previous submission (including LULUCF and indirect CO₂).

Table 10.1 is not presenting the emissions changes per individual gas. In Table 10.2 the changes per individual gas and per sector in 1990 and 2023 are elaborated.

Table 10.2 Summary of the emission changes due to recalculations per gas and per sector (kt CO₂ eq) for 1990 and 2023, compared to the NIR 2025

Gas	1990	2023
CO₂		
1 Energy	-396.6	-204.7
2 IPPU	2.4	-40.9
3 Agriculture	0.0	2.1
4 LULUCF	-606.1	-547.4
5 Waste	NA	NA
Indirect emissions	0.0	0.0
CH₄		
1 Energy	-0.6	31.8
2 IPPU	0.1	0.0
3 Agriculture	54.5	57.6
4 LULUCF	8.7	18.9
5 Waste	0.0	100.9
N₂O		
1 Energy	-0.6	-33.3
2 IPPU	0.0	0.0
3 Agriculture	-4.4	18.4
4 LULUCF	16.2	12.3
5 Waste	3.0	22.1
HFCs		
2 IPPU	0.0	213.5
PFCs		
2 IPPU	0.0	0.0
SF₆		
2 IPPU	0.0	0.0

In relation to the abovementioned changes (and others), figures for emissions of precursor gases changed over the entire time series. The explanation for the recalculations can be found in the IIR report (Staats et al., 2026).

10.3 Implications for emission and removal trends, including time-series consistency

The recalculations (including error corrections) have further improved both the accuracy and the time-series consistency of the estimated emissions.

Table 10.3 presents the changes made due to the recalculations for 1990, 2000, 2010, 2015, 2020, 2022, and 2023 (compared to the CRT 2025). It appears from Table 10.3 that the recalculations (including LULUCF) changed national emissions in 2022 and 2023 to a small extent (-0.7% and -0.3%, respectively), compared to the previous CRT. Changes to the 1990 emissions (base year) are in the same order of magnitude (-0.4%).

Table 10.3 Differences between the NIR 2025 and NIR 2026 for the 1990–2023 period due to recalculations (units: Mt CO₂ eq; for F-gases: kt CO₂ eq)

Gas	Source	1990	2000	2010	2020	2023
CO ₂ [Mt]	NIR 2026	165.8	174.5	185.9	139.0	119.3
	NIR 2025	166.8	175.9	186.3	139.6	120.1
	<i>Difference</i>	<i>-0.6%</i>	<i>-0.8%</i>	<i>-0.3%</i>	<i>-0.5%</i>	<i>-0.7%</i>
CH ₄ [Mt CO ₂ eq]	NIR 2026	36.5	27.9	22.4	19.7	18.6
	NIR 2025	36.5	27.9	22.3	19.5	18.4
	<i>Difference</i>	<i>0.2%</i>	<i>0.2%</i>	<i>0.3%</i>	<i>0.9%</i>	<i>1.1%</i>
N ₂ O [Mt CO ₂ eq]	NIR 2026	16.1	14.3	7.9	7.5	6.6
	NIR 2025	16.1	14.4	7.9	7.5	6.6
	<i>Difference</i>	<i>0.1%</i>	<i>-0.1%</i>	<i>0.0%</i>	<i>0.1%</i>	<i>0.3%</i>
PFCs [kt CO ₂ eq]	NIR 2026	2396.6	1715.2	290.5	61.8	41.9
	NIR 2025	2396.6	1715.2	290.5	61.8	41.9
	<i>Difference</i>	<i>0.0%</i>	<i>0.0%</i>	<i>0.0%</i>	<i>0.0%</i>	<i>0.0%</i>
HFCs [kt CO ₂ eq]	NIR 2026	4697.2	4029.3	1978.0	1011.4	901.9
	NIR 2025	4697.2	4029.3	1978.0	1026.9	688.4
	<i>Difference</i>	<i>0.0%</i>	<i>0.0%</i>	<i>0.0%</i>	<i>-1.5%</i>	<i>31.0%</i>
SF ₆ [kt CO ₂ eq]	NIR 2026	213.1	235.6	108.1	128.4	105.3
	NIR 2025	213.1	235.6	108.1	128.4	105.3
	<i>Difference</i>	<i>0.0%</i>	<i>0.0%</i>	<i>0.0%</i>	<i>0.0%</i>	<i>0.0%</i>
Total [Mt CO ₂ eq]	NIR 2026	226.6	223.3	219.0	167.8	146.1
	NIR 2025	227.5	224.6	219.4	168.3	146.4
	<i>Difference</i>	<i>-0.4%</i>	<i>-0.6%</i>	<i>-0.2%</i>	<i>-0.3%</i>	<i>-0.2%</i>

10.4 Areas of improvement and/or capacity-building in response to the review process

10.4.1 *Response to the review process*

Audit, public and peer review

The NIR is subject to a (when possible, annual) process of a general public review and a peer review, as well as to an audit for a specific sector or topic.

The peer review, carried out by an independent expert party, pays special attention to a specific sector or topic, and checks the report for transparency, readability and consistency with 2006 IPCC Guidelines (IPCC, 2006) and the 2019 Refinement (IPCC, 2019), as relevant. The audit, carried out by staff not directly involved in the inventory development, looks at the procedures taken in the development of the inventory and available documentation of various steps. As such, they can help verify how effectively the inventory development process complies with the specifications and steps outlined in the QC plan. This also includes forward-looking consideration of the resilience of inventory activities in the face of potential changes in personnel, resources, or (the availability of) data.

The peer review of the NIR 2025 (VITO, 2025) looked at GHG emissions from the category Transport, which included the following sub-categories:

- 1.A.3.b. Road transportation
- 1.D.1.a. International aviation (aviation bunkers) – Memo item
- 1.D.1.b. International navigation (marine bunkers) – Memo item
- Non Road Mobile Machinery (NRMM) included in other sub-categories (i.e. 1.A.2.b; 1.A.4.a; 1.A.4.b; and 1.A.4.c.ii Off-road Vehicles and Other Machinery).

Overall, the peer review confirmed a high level of detail in the activity data. The use of country-specific information was based on the most recent insights, and also confirmed that emissions are mostly correctly calculated in accordance with the 2006 IPCC guidelines. Nonetheless, the review report suggests some (minor) points of improvements/corrections and clarifications of the documentation to further strengthen reporting for the category Transport. These are helpfully summarised in short checklists per chapter within the peer review report.

For instance, in the methodology report, observed variations in the diesel emission factor (and heating value) are explained up to 2016, but the accompanying tables also show variation afterwards, which the peer review found to be insufficiently explained. Another example found in the peer review concerns (minor) inconsistencies between the NID and the CRT, such as for CO₂ emissions from urea-based catalysts; or inconsistencies in terminology for fuels under international navigation (marine bunkers). The report also includes more forward looking recommendations, such as conducting further research on the impact of biokerosene usage on greenhouse gas emissions in the aviation sector, considering the anticipated increase in usage of sustainable aviation

fuels (SAFs) and the impact thereof. More detail on the various recommendations is provided in the peer review report (VITO, 2025).

The recommendations mentioned in the peer review report were collated and maintained within the overarching NIR issue list as relevant, in order to track the implementation of recommended improvements in the preparation of the NIR 2026 and subsequent submissions.

Peer reviews in past years have focused on the following sectors and categories:

- IPPU (DNV, 2024)
- Agriculture (CLM, 2023)
- Energy (CE Delft, 2022)
- LULUCF (South Pole, 2021)
- Waste and wastewater (Oonk, 2020)
- Transport (VITO, 2019);
- Reference approach and waste incineration (CE Delft, 2018);
- N₂O and CO₂ emissions from Agriculture (Kuikman, 2017);
- Energy (excluding transport) (CE Delft, 2014);
- Industrial process emissions (Royal Haskoning DHV, 2013);
- LULUCF (Somogyi, 2012);
- Waste (Oonk, 2011);
- Transport (Hanschke et al., 2010);
- Combustion and process emissions in industry (Neelis and Blinde, 2009);
- Agriculture (Monteny, 2008).

In general, the conclusion of these peer reviews has been that the Dutch NIR adequately describes how the Netherlands calculates the emissions of greenhouse gases. The major recommendations refer to the readability and transparency of the NIR, with some suggestions for textual improvement.

Public review

A public review was conducted, which sought to focus on emissions in the Industry sector (both combustion emissions as covered in the Energy chapter and process emissions as covered in the IPPU chapter). The preferred format is a commenting round in writing. Due to the detailed nature of the inventory and the relatively specific expertise required to follow certain topics, the request was sent out through the contact persons of involved institutions to nominate any contacts with relevant expertise in the particular field of study (but who are themselves not directly involved in the inventory process). This commenting round resulted in a limited – albeit useful – response, perhaps due to the relatively broad, cross-sectoral nature of the topic; and the usual challenges new readers may face in engaging with the particular format and subject matter of the NIR. Following up on discussions to improve the response rate, further adjustments of the public review process are under consideration, such as incorporating review practices from other countries, which do not set a predefined subject and window for commenting but leave commenting opportunities open throughout the year following the publication of the NIR. The website of the Emission Registration also provides an option for public review. On the website, the NID and its corresponding

methodology reports can be easily accessed:

<https://www.emissieregistratie.nl/documentatie>. Public feedback is accepted via the e-mail address emissieregistratie@rivm.nl.

UNFCCC review

An in-country review was conducted on the NIR2024 from 31 March to 4 April 2025. The definitive review report was received in November 2025 and is used to structure Annex 10, which includes responses to each of the findings, as well as relevant developments since subsequent submissions.

ESR review and EU initial checks

Until 2022, an annual ESD review was conducted by an EU expert review team in line with Article 19(1) of Regulation (EU) No 525/2013 (the 'Monitoring Mechanism Regulation', MMR).

In 2025, 2027, and 2032, comprehensive EU ESR reviews will be conducted in line with the Regulation 2018/1999 on governance of the Energy Union and climate action in order to determine the annual targets of net GHG emissions reductions of the Member States. The 2025 comprehensive review (April–June), which comes out of the EU Effort Sharing Regulation (ESR) and LULUCF Regulation, served to formally establish annual emissions allocations (AEAs) for each EU member state for the 2026–2029 period. Preliminary values for these AEAs were already available, but the definitive values for all member states were to be based on their emissions for the years 2021–2023 as provided in the NIR2025 (the average thereof is used in the calculation of the trajectory for 2026–2029 towards the 2030 target). In cases where the reviewers found significant issues, technical corrections could potentially be applied to the emission figures of the relevant member state to ensure the correct calculation of AEAs. In the case of the Netherlands, all review questions were clearly addressed and no significant issues were found.

In the years when no comprehensive reviews take place, potential issues are still identified during the initial checks of the draft NIR from 15 January. These issues can potentially result in improvements of (the descriptions in) the NIR.

10.4.1.1 Completeness of the NIR

The Netherlands' GHG emission inventory includes all sources identified by the revised Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC, 2006), and for a significant part, by the 2019 Refinement to the 2006 IPCC Guidelines, with the exception of the following, very minor, sources:

- CO₂ from Asphalt roofing (2.A.4.d) due to negligible amounts (below threshold);
- CO₂ from Road paving (2.A.4.d) due to negligible amounts (below threshold);
- CH₄ emissions from Other livestock (alpacas) (3.A.1) due to negligible amounts (below threshold);
- CH₄ and N₂O emissions from the decomposition of manure from other livestock (alpacas) (3.A.2) due to negligible amounts (below threshold);
- CH₄ from enteric fermentation in Poultry (3.A.4) due to missing EFs;

- Direct N₂O emissions from Septic tanks (5.D.3) due to missing method and negligible amounts (below threshold);
- Part of CH₄ from Industrial wastewater (5.D.2 sludge) due to negligible amounts (below threshold);
- Precursor emissions (i.e. CO, NO_x, NMVOC) and SO₂) from memo item 'International bunkers' (international transport), as these emissions are not part of the national total.

For more detailed information on this issue, see Annex 6.

10.4.1.2 Completeness of ETF tables

As the source categories Industrial processes in the Netherlands often relate to only a few companies, it is generally not possible to report detailed and disaggregated data. Activity data are confidential and not reported when a source category comprises three or fewer companies. During (in-country) reviews, however, these data will be made available to the ERT on request.

10.4.1.3 Planned improvements

The Netherlands' National System was established at the end of 2005, in line with the requirements of the Kyoto Protocol and the EU Monitoring Mechanism, as a result of the implementation of a monitoring improvement programme (see section 1.6). The conclusion of the initial review (2007) was that the Netherlands' National System had been established in accordance with the guidelines for National Systems set out in Article 5, section 1 of the Kyoto Protocol (decision 19/CMP.1) and that it met the implementation requirements of the general functions of a National System, as well as the specific functions of inventory planning, inventory preparation, and inventory management. The latest UNFCCC review from 2025 confirmed that the Netherlands' inventory and inventory process are in line with the guidelines for national arrangements.

Notwithstanding the transition from the Kyoto Protocol to the Paris Agreement and the replacement of the EU Monitoring Mechanism by the Governance Regulation of the Energy Union, the national arrangements for the preparation of the inventory (including quality assurance and control procedures) must still be implemented and maintained, similar to the previous requirements. With regard to quality assurance and quality control procedures, the QA/QC programme for the Netherlands' national arrangements was revised and updated in 2023, as detailed further below ([Quality assurance and quality control](#), RVO, 2023).

Monitoring improvement

The National System includes an annual evaluation and improvement process. The evaluation is based on experience in previous years and the results of UN and EU reviews, peer reviews, and audits. Where needed, improvements are included in the update of the QA/QC programme (RVO, 2023).

QA/QC programme

The QA/QC programme was revised and updated. Previously, this programme covered a fixed period of about one year and the entire

document was updated annually. From 2023 onwards, a slightly revised structure has been incorporated.

As the core aspects of the QA/QC programme are cyclical, the programme is described with a more indefinite time frame to enable a broader time-horizon. Outcomes of specific QA/QC activities continue to be reported in the relevant sections of the NIR. At the same time, the annual experiences from reviews and improvement actions will also still be captured at a more granular level in the annual internal memo 'Main QA/QC experiences inventory' (RVO) shared with the NIE Advisory Board (this document will be held available for reviews). This internal document describes in a concise manner the key actions taken that year and reflection on the implementation thereof, as well as incorporating learnings from (bi)annual reviews and evaluations. Any practical considerations therein will subsequently feed into finetuning the overall QA/QC programme. As such, the programme will continue to be reviewed as part of the evaluation and improvement cycle and is to be updated as appropriate, in line with relevant reporting guidelines from the EU and UNFCCC.

The QA/QC programme continues the assessment of long-term improvement options on the basis of the 2006 IPCC Guidelines and the 2019 Refinement to the 2006 IPCC Guidelines. Improvement actions for new methodologies and changes of EF will be performed as governed by the annual Work Plan (RIVM, 2025).

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Annex 1 Key categories

A1.1 Introduction

As explained in the 2006 Guidelines (IPCC, 2006), a key source category is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct GHGs in terms of the absolute level of emissions, the trend in emissions, or both.

For the identification of key categories in the Netherlands' inventory (Key Category Analysis or KCA), national emissions are allocated to the Intergovernmental Panel on Climate Change's potential key source list, as presented in chapter 4, table 4.1 of the 2019 IPCC Guidelines (volume 1). For KCA, no major modifications with respect to the 2006 IPCC Guidelines have occurred.

As suggested in the guidance, carbon dioxide (CO₂) emissions from stationary combustion (1.A.1, 1.A.2, and 1.A.4) are aggregated by fuel type. CO₂, methane (CH₄), and nitrous oxide (N₂O) emissions from mobile combustion – road vehicles (1.A.3) – are assessed separately. Other mobile sources are not assessed separately by gas. Fugitive emissions from oil and gas operations (1.B) are important sources of GHG emissions in the Netherlands. The most important gas/source combinations in this category are assessed separately. Emissions in other IPCC sectors are disaggregated, as suggested by the IPCC.

The first step of the KCA (IPCC Approach 1 method) consists of ranking the list of source category/gas combinations according to their contribution to annual national total emissions and to the national total trend. In both cases, the absolute level of emissions is considered. In Approach 1, key categories are identified using a pre-determined cumulative emission threshold. Key categories are those that, when listed in descending order of magnitude, add up to 95% of the total national inventory level. The second step of the KCA (IPCC Approach 2 method) requires the incorporation of the uncertainty per category before ordering the list of shares. Here, a total contribution of up to 90% to the overall uncertainty has been used to avoid the inclusion of too many small sources. In this step, total uncertainties per category are calculated using error propagation, using the uncertainty estimates for both activity data and emission factors as presented in Annex 2 (for details of the uncertainty analysis see the methodology report (RIVM reports 2026-0019, 2026-0023, 2026-0021, 2026-0020, WOt-technical report 298).

Table A1.1 presents the key sources that are added when uncertainties are included (Approach 2 analysis). Table A1.2 shows the results of both approaches. In the latter table, a key source is indicated with '1'. The Approach 1 method (without uncertainties) results in 43 categories for annual level assessment (emissions in 2024) and 49 categories for the trend assessment, out of a total of 139 source categories. The inclusion of uncertainties (Approach 2 method) results in 45 categories for annual level assessment (emissions in 2024) and 41 categories for the trend assessment, out of a total of 139 source categories.

A combination of Approaches 1 and 2 for both level and trend assessment shows a total of 67 key categories. As expected, the incorporation of uncertainty in the level and trend assessments increases the importance of highly uncertain sources.

Table A1.1 Additional key categories after incorporation of uncertainty data

Category	Name	Gas	Key category
1.A.4.b	Residential:all fuels	CH ₄	Key(L2,)
2.B.8	Chemical industry: Petrochemical and carbon black production	CH ₄	Key(L2,T2)
3.A.3	Swine	CH ₄	Key(L2,)
3.B.5	Indirect emissions	N ₂ O	Key(L2,T2)
4.B.2	Land converted to cropland	N ₂ O	Key(L2,)
4.C.1	Grassland remaining grassland	CH ₄	Key(L2,)
4.E.2	Land converted to settlements	N ₂ O	Key(L2,)
4.F.2	Land converted to other land	CO ₂	Key(L2,T2)
5.B	Biological treatment of solid waste: composting	N ₂ O	Key(,T2)

In this annex, we also include information on key categories in 1990; Table A1.3 shows the results. Since 1990 is the base year, key sources can only be based on a level assessment. This results in 54 key sources (level 1 and 2, including LULUCF).

Table A1.2 Key category list identified by level and trend assessments for **2024** emissions, **including** LULUCF sources.

CRT	Source category	Gas	Key source	Approach 1 level recent year (excl.uncertainty)	Approach 1 trend (excl.uncertainty)	Approach 2 level recent year (incl. uncertainty, error propagation)	Approach 2 trend (incl. uncertainty, error propagation)
1A1	Energy Industries: all fuels	CH ₄	Non-key	0	0	0	0
1A1	Energy Industries: all fuels	N ₂ O	Non-key	0	0	0	0
1A1a	Public Electricity and Heat Production: liquids	CO ₂	Non-key	0	0	0	0
1A1a	Public Electricity and Heat Production: solids	CO ₂	Key(L,T)	1	1	1	1
1A1a	Public Electricity and Heat Production: gaseous	CO ₂	Key(L1,T1)	1	1	0	0
1A1a	Public Electricity and Heat Production: other fuels: waste incineration	CO ₂	Key(L,T)	1	1	1	1
1A1b	Petroleum Refining: liquids	CO ₂	Key(L,T)	1	1	1	1
1A1b	Petroleum Refining: gaseous	CO ₂	Key(L1,T1)	1	1	0	0
1A1c	Manufacture of Solid Fuels: solids	CO ₂	Key(L,T)	1	1	1	1
1A1c	Manufacture of Solid Fuels: gaseous	CO ₂	Key(L1,T1)	1	1	0	0
1A2	Manufacturing Industries and Construction: liquids	CO ₂	Key(L1,T1)	1	1	0	0
1A2	Manufacturing Industries and Construction: solids	CO ₂	Key(L,)	1	0	1	0
1A2	Manufacturing Industries and Construction: gaseous	CO ₂	Key(L,T1)	1	1	1	0
1A2	Manufacturing Industries and Construction: all fuels	CH ₄	Non-key	0	0	0	0
1A2	Manufacturing Industries and Construction: all fuels	N ₂ O	Non-key	0	0	0	0

CRT	Source category	Gas	Key source	Approach 1 level recent year (excl.uncertainty)	Approach 1 trend (excl.uncertainty)	Approach 2 level recent year (incl. uncertainty, error propagation)	Approach 2 trend (incl. uncertainty, error propagation)
1A3 excl 1A3b	Other	CH ₄	Non-key	0	0	0	0
1A3 excl 1A3b	Other	N ₂ O	Non-key	0	0	0	0
1A3a	Domestic aviation	CO ₂	Non-key	0	0	0	0
1A3b	Road transportation: gasoline	CO ₂	Key(L,T)	1	1	1	1
1A3b	Road transportation: diesel oil	CO ₂	Key(L,T)	1	1	1	1
1A3b	Road transportation: LPG	CO ₂	Key(,T)	0	1	0	1
1A3b	Road transportation: gaseous	CO ₂	Non-key	0	0	0	0
1A3b	Road transportation	CH ₄	Non-key	0	0	0	0
1A3b	Road transportation	N ₂ O	Key(L2,T)	0	1	1	1
1A3c	Railways	CO ₂	Non-key	0	0	0	0
1A3d	Domestic navigation	CO ₂	Key(L1,T1)	1	1	0	0
1A3e	Other	CO ₂	Non-key	0	0	0	0
1A4 excl 1A4c	Liquids	CO ₂	Key(L1,)	1	0	0	0
1A4	Solids	CO ₂	Non-key	0	0	0	0
1A4	Other Sectors: all fuels	N ₂ O	Non-key	0	0	0	0
1A4a	Commercial/Institutional: gaseous	CO ₂	Key(L,T1)	1	1	1	0
1A4a	Commercial/Institutional: all fuels	CH ₄	Non-key	0	0	0	0
1A4b	Residential gaseous	CO ₂	Key(L,T)	1	1	1	1
1A4b	Residential:all fuels	CH ₄	Key(L2,)	0	0	1	0
1A4c	Agriculture/forestry/fishing: liquids	CO ₂	Key(L1,)	1	0	0	0

CRT	Source category	Gas	Key source	Approach 1 level recent year (excl.uncertainty)	Approach 1 trend (excl.uncertainty)	Approach 2 level recent year (incl. uncertainty, error propagation)	Approach 2 trend (incl. uncertainty, error propagation)
1A4c	Agriculture/forestry/fishing: gaseous	CO ₂	Key(L,T)	1	1	1	1
1A4c	Agriculture/forestry/fishing: all fuels	CH ₄	Key(L,T)	1	1	1	1
1A5b	Military use: liquids	CO ₂	Non-key	0	0	0	0
1A5b	Military use: liquids	CH ₄	Non-key	0	0	0	0
1A5b	Military use: liquids	N ₂ O	Non-key	0	0	0	0
1B1b	Solid fuel transformation	CO ₂	Non-key	0	0	0	0
1B1b	Solid fuel transformation	CH ₄	Non-key	0	0	0	0
1B2	Fugitive emissions from oil and gas operations	CO ₂	Key(L1,T1)	1	1	0	0
1B2a	Oil	CH ₄	Non-key	0	0	0	0
1B2b	Natural gas	CH ₄	Non-key	0	0	0	0
1B2c	Venting and flaring	CH ₄	Key(,T)	0	1	0	1
2A1	Cement production	CO ₂	Key(,T1)	0	1	0	0
2A2	Lime production	CO ₂	Non-key	0	0	0	0
2A3	Glass production	CO ₂	Non-key	0	0	0	0
2A4a	Ceramics	CO ₂	Non-key	0	0	0	0
2A4b	Other uses of soda ash	CO ₂	Non-key	0	0	0	0
2A4d	Other	CO ₂	Key(L,T)	1	1	1	1
2B	Fluorochemical production	HFC	Key(,T)	0	1	0	1
2B1	Ammonia production	CO ₂	Key(L,T)	1	1	1	1
2B10	Other	CO ₂	Key(L,T)	1	1	1	1
2B10	Other	N ₂ O	Key(L2,T)	0	1	1	1
2B2	Nitric acid production	N ₂ O	Key(,T)	0	1	0	1

CRT	Source category	Gas	Key source	Approach 1 level recent year (excl.uncertainty)	Approach 1 trend (excl.uncertainty)	Approach 2 level recent year (incl. uncertainty, error propagation)	Approach 2 trend (incl. uncertainty, error propagation)
2B4	Caprolactam production	N ₂ O	Key(,T)	0	1	0	1
2B7	Soda ash production	CO ₂	Non-key	0	0	0	0
2B8	Petrochemical and carbon black production	CO ₂	Key(L,T)	1	1	1	1
2B8	Chemical industry: Petrochemical and carbon black production	CH ₄	Key(L2,T2)	0	0	1	1
2B9	Fluorochemical production	PFC	Non-key	0	0	0	0
2C1	Iron and steel production	CO ₂	Non-key	0	0	0	0
2C3	Aluminium production	CO ₂	Key(,T1)	0	1	0	0
2C3	Aluminium production	PFC	Key(,T1)	0	1	0	0
2D1	Lubricant use	CO ₂	Non-key	0	0	0	0
2D2	Paraffin wax use	CO ₂	Key(L2,T)	0	1	1	1
2D2	Paraffin wax use	CH ₄	Non-key	0	0	0	0
2D3	Other	CO ₂	Non-key	0	0	0	0
2E	Electronic Industry	PFC	Non-key	0	0	0	0
2F1	Refrigeration and air conditioning	HFC	Key(L,T)	1	1	1	1
2F6	Other	HFC	Key(,T)	0	1	0	1
2G	Other product manufacture and use	CO ₂	Non-key	0	0	0	0
2G	Other product manufacture and use	CH ₄	Non-key	0	0	0	0
2G	Other product manufacture and use	N ₂ O	Non-key	0	0	0	0
2G2	SF ₆ use	SF ₆	Non-key	0	0	0	0
2H	Other industrial	CO ₂	Non-key	0	0	0	0
3A1	Mature dairy cattle	CH ₄	Key(L,T)	1	1	1	1

CRT	Source category	Gas	Key source	Approach 1 level recent year (excl.uncertainty)	Approach 1 trend (excl.uncertainty)	Approach 2 level recent year (incl. uncertainty, error propagation)	Approach 2 trend (incl. uncertainty, error propagation)
3A1	Other mature cattle	CH ₄	Non-key	0	0	0	0
3A1	Young cattle	CH ₄	Key(L,)	1	0	1	0
3A2, 3A4	Other	CH ₄	Key(L,)	1	0	1	0
3A3	Swine	CH ₄	Key(L2,)	0	0	1	0
3B1	Mature dairy cattle	CH ₄	Key(L,T)	1	1	1	1
3B1	Other mature cattle	CH ₄	Non-key	0	0	0	0
3B1	Growing cattle	CH ₄	Key(L1,)	1	0	0	0
3B1	Mature dairy cattle	N ₂ O	Non-key	0	0	0	0
3B1	Other mature cattle	N ₂ O	Non-key	0	0	0	0
3B1	Growing cattle	N ₂ O	Non-key	0	0	0	0
3B2	Sheep	N ₂ O	Non-key	0	0	0	0
3B2, 3B4	Other	CH ₄	Non-key	0	0	0	0
3B3	Swine	CH ₄	Key(L,T)	1	1	1	1
3B3	Swine	N ₂ O	Non-key	0	0	0	0
3B4	Poultry	CH ₄	Key(,T)	0	1	0	1
3B4	Other livestock	N ₂ O	Non-key	0	0	0	0
3B5	Indirect emissions	N ₂ O	Key(L2,T2)	0	0	1	1
3Da	Direct emissions from agricultural soils	N ₂ O	Key(L,T)	1	1	1	1
3Db	Indirect emissions from managed soils	N ₂ O	Key(L,T)	1	1	1	1
3G	Liming	CO ₂	Non-key	0	0	0	0
3H	Ureum use	CO ₂	Non-key	0	0	0	0

CRT	Source category	Gas	Key source	Approach 1 level recent year (excl.uncertainty)	Approach 1 trend (excl.uncertainty)	Approach 2 level recent year (incl. uncertainty, error propagation)	Approach 2 trend (incl. uncertainty, error propagation)
4A1	Forest land remaining forest land	CO ₂	Key(L,T)	1	1	1	1
4A1	Forest land remaining forest land	N ₂ O	Non-key	0	0	0	0
4A1	Forest land remaining forest land	CH ₄	Non-key	0	0	0	0
4A2	Land converted to forest land	CO ₂	Key(L1,)	1	0	0	0
4A2	Land converted to forest land	N ₂ O	Non-key	0	0	0	0
4A2	Land converted to forest land	CH ₄	Non-key	0	0	0	0
4B1	Cropland remaining cropland	CO ₂	Key(L,)	1	0	1	0
4B1	Cropland remaining cropland	N ₂ O	Non-key	0	0	0	0
4B1	Cropland remaining cropland	CH ₄	Non-key	0	0	0	0
4B2	Land converted to cropland	CO ₂	Key(L,T)	1	1	1	1
4B2	Land converted to cropland	N ₂ O	Key(L2,)	0	0	1	0
4B2	Land converted to cropland	CH ₄	Non-key	0	0	0	0
4C1	Grassland remaining grassland	CO ₂	Key(L,T)	1	1	1	1
4C1	Grassland remaining grassland	N ₂ O	Non-key	0	0	0	0
4C1	Grassland remaining grassland	CH ₄	Key(L2,)	0	0	1	0
4C2	Land converted to grassland	CO ₂	Key(L,T)	1	1	1	1
4C2	Land converted to grassland	N ₂ O	Non-key	0	0	0	0
4C2	Land converted to grassland	CH ₄	Non-key	0	0	0	0
4D1	Wetlands remaining wetlands	CO ₂	Non-key	0	0	0	0
4D1	Wetlands remaining wetlands	N ₂ O	Non-key	0	0	0	0
4D2	Land converted to wetlands	CO ₂	Non-key	0	0	0	0
4D2	Land converted to wetlands	N ₂ O	Non-key	0	0	0	0

CRT	Source category	Gas	Key source	Approach 1 level recent year (excl.uncertainty)	Approach 1 trend (excl.uncertainty)	Approach 2 level recent year (incl. uncertainty, error propagation)	Approach 2 trend (incl. uncertainty, error propagation)
4E1	Settlements remaining settlements	CO ₂	Key(L2,T)	0	1	1	1
4E1	Settlements remaining settlements	N ₂ O	Non-key	0	0	0	0
4E2	Land converted to settlements	CO ₂	Key(L,T)	1	1	1	1
4E2	Land converted to settlements	N ₂ O	Key(L2,)	0	0	1	0
4F1	Other land remaining other land	CO ₂	Non-key	0	0	0	0
4F1	Other land remaining other land	N ₂ O	Non-key	0	0	0	0
4F2	Land converted to other land	CO ₂	Key(L2,T2)	0	0	1	1
4F2	Land converted to other land	N ₂ O	Non-key	0	0	0	0
4G	Harvested wood products	CO ₂	Non-key	0	0	0	0
4H	Other	N ₂ O	Non-key	0	0	0	0
5A	Solid waste disposal	CH ₄	Key(L,T)	1	1	1	1
5B	Biological treatment of solid waste: composting	CH ₄	Key(L2,T)	0	1	1	1
5B	Biological treatment of solid waste: composting	N ₂ O	Key(,T2)	0	0	0	1
5C	Open burning of waste	CH ₄	Non-key	0	0	0	0
5C	Open burning of waste	N ₂ O	Non-key	0	0	0	0
5D	Wastewater treatment and discharge	CH ₄	Non-key	0	0	0	0
5D	Wastewater treatment and discharge	N ₂ O	Key(L,T1)	1	1	1	0
6	Indirect CO ₂	CO ₂	Key(L1,)	1	0	0	0
	SUM			43	49	45	41

Table A1.3 Key source list identified by level assessments for **1990** emissions (*including* LULUCF sources)

CRT	Source category	Gas	Key source	Approach 1 level 1990 (excl. uncertainty)	Approach 2 level 1990 (incl. uncertainty, error propagation)
1A1	Energy Industries: all fuels	CH ₄	Non-key	0	0
1A1	Energy Industries: all fuels	N ₂ O	Non-key	0	0
1A1a	Public Electricity and Heat Production: liquids	CO ₂	Non-key	0	0
1A1a	Public Electricity and Heat Production: solids	CO ₂	Key(L,)	1	1
1A1a	Public Electricity and Heat Production: gaseous	CO ₂	Key(L1,)	1	0
1A1a	Public Electricity and Heat Production: other fuels: waste incineration	CO ₂	Key(L1,)	1	0
1A1b	Petroleum Refining: liquids	CO ₂	Key(L,)	1	1
1A1b	Petroleum Refining: gaseous	CO ₂	Key(L1,)	1	0
1A1c	Manufacture of Solid Fuels: solids	CO ₂	Key(L,)	1	1
1A1c	Manufacture of Solid Fuels: gaseous	CO ₂	Key(L1,)	1	0
1A2	Manufacturing Industries and Construction: liquids	CO ₂	Key(L1,)	1	0
1A2	Manufacturing Industries and Construction: solids	CO ₂	Key(L,)	1	1
1A2	Manufacturing Industries and Construction: gaseous	CO ₂	Key(L,)	1	1
1A2	Manufacturing Industries and Construction: all fuels	CH ₄	Non-key	0	0
1A2	Manufacturing Industries and Construction: all fuels	N ₂ O	Non-key	0	0
1A3 excl 1A3b	Other	CH ₄	Non-key	0	0
1A3 excl 1A3b	Other	N ₂ O	Non-key	0	0

CRT	Source category	Gas	Key source	Approach 1 level 1990 (excl. uncertainty)	Approach 2 level 1990 (incl. uncertainty, error propagation)
1A3a	Domestic aviation	CO ₂	Non-key	0	0
1A3b	Road transportation: gasoline	CO ₂	Key(L,)	1	1
1A3b	Road transportation: diesel oil	CO ₂	Key(L,)	1	1
1A3b	Road transportation: LPG	CO ₂	Key(L1,)	1	0
1A3b	Road transportation: gaseous	CO ₂	Non-key	0	0
1A3b	Road transportation	CH ₄	Non-key	0	0
1A3b	Road transportation	N ₂ O	Non-key	0	0
1A3c	Railways	CO ₂	Non-key	0	0
1A3d	Domestic navigation	CO ₂	Key(L1,)	1	0
1A3e	Other	CO ₂	Non-key	0	0
1A4 excl 1A4c	Liquids	CO ₂	Key(L1,)	1	0
1A4	Solids	CO ₂	Non-key	0	0
1A4	Other Sectors: all fuels	N ₂ O	Non-key	0	0
1A4a	Commercial/Institutional: gaseous	CO ₂	Key(L,)	1	1
1A4a	Commercial/Institutional: all fuels	CH ₄	Non-key	0	0
1A4b	Residential gaseous	CO ₂	Key(L,)	1	1
1A4b	Residential:all fuels	CH ₄	Key(L2,)	0	1
1A4c	Agriculture/forestry/fishing: liquids	CO ₂	Key(L1,)	1	0
1A4c	Agriculture/forestry/fishing: gaseous	CO ₂	Key(L,)	1	1
1A4c	Agriculture/forestry/fishing: all fuels	CH ₄	Non-key	0	0
1A5b	Military use: liquids	CO ₂	Non-key	0	0
1A5b	Military use: liquids	CH ₄	Non-key	0	0
1A5b	Military use: liquids	N ₂ O	Non-key	0	0

CRT	Source category	Gas	Key source	Approach 1 level 1990 (excl. uncertainty)	Approach 2 level 1990 (incl. uncertainty, error propagation)
1B1b	Solid fuel transformation	CO ₂	Non-key	0	0
1B1b	Solid fuel transformation	CH ₄	Non-key	0	0
1B2	Fugitive emissions from oil and gas operations	CO ₂	Key(L1,)	1	0
1B2a	Oil	CH ₄	Non-key	0	0
1B2b	Natural gas	CH ₄	Key(L2,)	0	1
1B2c	Venting and flaring	CH ₄	Key(L,)	1	1
2A1	Cement production	CO ₂	Non-key	0	0
2A2	Lime production	CO ₂	Non-key	0	0
2A3	Glass production	CO ₂	Non-key	0	0
2A4a	Ceramics	CO ₂	Non-key	0	0
2A4b	Other uses of soda ash	CO ₂	Non-key	0	0
2A4d	Other	CO ₂	Key(L2,)	0	1
2B	Fluorochemical production	HFC	Key(L,)	1	1
2B1	Ammonia production	CO ₂	Key(L,)	1	1
2B10	Other	CO ₂	Key(L,)	1	1
2B10	Other	N ₂ O	Non-key	0	0
2B2	Nitric acid production	N ₂ O	Key(L,)	1	1
2B4	Caprolactam production	N ₂ O	Key(L,)	1	1
2B7	Soda ash production	CO ₂	Non-key	0	0
2B8	Petrochemical and carbon black production	CO ₂	Key(L2,)	0	1
2B8	Chemical industry: Petrochemical and carbon black production	CH ₄	Key(L2,)	0	1
2B9	Fluorochemical production	PFC	Non-key	0	0
2C1	Iron and steel production	CO ₂	Non-key	0	0

CRT	Source category	Gas	Key source	Approach 1 level 1990 (excl. uncertainty)	Approach 2 level 1990 (incl. uncertainty, error propagation)
2C3	Aluminium production	CO ₂	Non-key	0	0
2C3	Aluminium production	PFC	Key(L1,)	1	0
2D1	Lubricant use	CO ₂	Non-key	0	0
2D2	Paraffin wax use	CO ₂	Non-key	0	0
2D2	Paraffin wax use	CH ₄	Non-key	0	0
2D3	Other	CO ₂	Non-key	0	0
2E	Electronic Industry	PFC	Non-key	0	0
2F1	Refrigeration and air conditioning	HFC	Non-key	0	0
2F6	Other	HFC	Non-key	0	0
2G	Other product manufacture and use	CO ₂	Non-key	0	0
2G	Other product manufacture and use	CH ₄	Non-key	0	0
2G	Other product manufacture and use	N ₂ O	Non-key	0	0
2G2	SF ₆ use	SF ₆	Non-key	0	0
2H	Other industrial	CO ₂	Non-key	0	0
3A1	Mature dairy cattle	CH ₄	Key(L,)	1	1
3A1	Other mature cattle	CH ₄	Non-key	0	0
3A1	Young cattle	CH ₄	Key(L,)	1	1
3A2, 3A4	Other	CH ₄	Key(L1,)	1	0
3A3	Swine	CH ₄	Key(L2,)	0	1
3B1	Mature dairy cattle	CH ₄	Key(L,)	1	1
3B1	Other mature cattle	CH ₄	Non-key	0	0
3B1	Growing cattle	CH ₄	Non-key	0	0
3B1	Mature dairy cattle	N ₂ O	Non-key	0	0
3B1	Other mature cattle	N ₂ O	Non-key	0	0

CRT	Source category	Gas	Key source	Approach 1 level 1990 (excl. uncertainty)	Approach 2 level 1990 (incl. uncertainty, error propagation)
3B1	Growing cattle	N ₂ O	Non-key	0	0
3B2	Sheep	N ₂ O	Non-key	0	0
3B2, 3B4	Other	CH ₄	Non-key	0	0
3B3	Swine	CH ₄	Key(L ₁ ,)	1	1
3B3	Swine	N ₂ O	Non-key	0	0
3B4	Poultry	CH ₄	Key(L ₂ ,)	0	1
3B4	Other livestock	N ₂ O	Non-key	0	0
3B5	Indirect emissions	N ₂ O	Key(L ₂ ,)	0	1
3Da	Direct emissions from agricultural soils	N ₂ O	Key(L ₁ ,)	1	1
3Db	Indirect emissions from managed soils	N ₂ O	Key(L ₁ ,)	1	1
3G	Liming	CO ₂	Non-key	0	0
3H	Ureum use	CO ₂	Non-key	0	0
4A1	Forest land remaining forest land	CO ₂	Key(L ₁ ,)	1	0
4A1	Forest land remaining forest land	N ₂ O	Non-key	0	0
4A1	Forest land remaining forest land	CH ₄	Non-key	0	0
4A2	Land converted to forest land	CO ₂	Key(L ₁ ,)	1	0
4A2	Land converted to forest land	N ₂ O	Non-key	0	0
4A2	Land converted to forest land	CH ₄	Non-key	0	0
4B1	Cropland remaining cropland	CO ₂	Key(L ₁ ,)	1	1
4B1	Cropland remaining cropland	N ₂ O	Non-key	0	0
4B1	Cropland remaining cropland	CH ₄	Non-key	0	0
4B2	Land converted to cropland	CO ₂	Key(L ₁ ,)	1	1
4B2	Land converted to cropland	N ₂ O	Key(L ₂ ,)	0	1
4B2	Land converted to cropland	CH ₄	Non-key	0	0

CRT	Source category	Gas	Key source	Approach 1 level 1990 (excl. uncertainty)	Approach 2 level 1990 (incl. uncertainty, error propagation)
4C1	Grassland remaining grassland	CO ₂	Key(L ₁)	1	1
4C1	Grassland remaining grassland	N ₂ O	Non-key	0	0
4C1	Grassland remaining grassland	CH ₄	Key(L ₂)	0	1
4C2	Land converted to grassland	CO ₂	Key(L ₁)	1	1
4C2	Land converted to grassland	N ₂ O	Non-key	0	0
4C2	Land converted to grassland	CH ₄	Non-key	0	0
4D1	Wetlands remaining wetlands	CO ₂	Non-key	0	0
4D1	Wetlands remaining wetlands	N ₂ O	Non-key	0	0
4D2	Land converted to wetlands	CO ₂	Non-key	0	0
4D2	Land converted to wetlands	N ₂ O	Non-key	0	0
4E1	Settlements remaining settlements	CO ₂	Non-key	0	0
4E1	Settlements remaining settlements	N ₂ O	Non-key	0	0
4E2	Land converted to settlements	CO ₂	Key(L ₁)	1	1
4E2	Land converted to settlements	N ₂ O	Non-key	0	0
4F1	Other land remaining other land	CO ₂	Non-key	0	0
4F1	Other land remaining other land	N ₂ O	Non-key	0	0
4F2	Land converted to other land	CO ₂	Key(L ₂)	0	1
4F2	Land converted to other land	N ₂ O	Non-key	0	0
4G	Harvested wood products	CO ₂	Non-key	0	0
4H	Other	N ₂ O	Non-key	0	0
5A	Solid waste disposal	CH ₄	Key(L ₁)	1	1
5B	Biological treatment of solid waste: composting	CH ₄	Non-key	0	0
5B	Biological treatment of solid waste: composting	N ₂ O	Non-key	0	0

CRT	Source category	Gas	Key source	Approach 1 level 1990 (excl. uncertainty)	Approach 2 level 1990 (incl. uncertainty, error propagation)
5C	Open burning of waste	CH ₄	Non-key	0	0
5C	Open burning of waste	N ₂ O	Non-key	0	0
5D	Wastewater treatment and discharge	CH ₄	Non-key	0	0
5D	Wastewater treatment and discharge	N ₂ O	Non-key	0	0
6	Indirect CO ₂	CO ₂	Key(L _r)	1	1
	SUM			43	40

A1.2 Changes in key categories compared to the previous submission

The use of emissions data for 2024 and a refinement within the LULUCF category have resulted in clear changes in key categories in comparison to the previous NIR. Two categories that were key in the previous submission are no longer a key category:

1A1	Energy Industries: all fuels	N ₂ O
2A2	Lime production	CO ₂

Following the refinement of the key source analysis for the LULUCF category, which entails the switch to performing the analysis on the level of subcategories, there are twelve new key sources. Outside of the LULUCF category, there is one new key source compared to the previous NIR, Biological treatment of solid waste: composting.

4A1	Forest land remaining forest land	CO ₂
	Land converted to forest land	CO ₂
4B1	Cropland remaining cropland	CO ₂
4B2	Land converted to cropland	CO ₂
4B2	Land converted to cropland	N ₂ O
4C1	Grassland remaining grassland	CO ₂
4C1	Grassland remaining grassland	CH ₄
4C2	Land converted to grassland	CO ₂
4E1	Settlements remaining settlements	CO ₂
4E2	Land converted to settlements	CO ₂
4E2	Land converted to settlements	N ₂ O
4F2	Land converted to other land	CO ₂
5B	Biological treatment of solid waste: composting	N ₂ O

A1.3 Changes in key categories in 2024 compared to 1990

Table A1.4 shows the result of a comparison of the key categories in 1990 (level) and 2024 (level and trend). A comparison, based on a level assessment only, shows two additional key categories in 2024 compared to 1990. Twelve additional categories (shaded in table A1.4) are added, when the trend analysis is also considered.

Table A1.4 Additional key categories in 2024 (compared to 1990)

1.A.3.b	Road transportation	N ₂ O	Key(L2,T)
1.A.4.c	Agriculture/forestry/fishing: all fuels	CH ₄	Key(L,T)
2.A.1	Cement production	CO ₂	Key(,T1)
2.B.10	Other	N ₂ O	Key(L2,T)
2.C.3	Aluminium production	CO ₂	Key(,T1)
2.D.2	Paraffin wax use	CO ₂	Key(L2,T)
2.F.1	Refrigeration and air conditioning	HFC	Key(L,T)
2.F.6	Other	HFC	Key(,T)
3.B.1	Growing cattle	CH ₄	Key(L1,)
4.E.1	Settlements remaining settlements	CO ₂	Key(L2,T)
4.E.2	Land converted to settlements	N ₂ O	Key(L2,)
5.B	Biological treatment of solid waste: composting	CH ₄	Key(L2,T)
5.B	Biological treatment of solid waste: composting	N ₂ O	Key(,T2)
5.D	Wastewater treatment and discharge	N ₂ O	Key(L,T1)

A1.4 Approach 1 key category assessment (level and trend excluding uncertainties)

In Table A1.5, the source ranking is conducted according to their contribution to the 2024 annual emissions total, and in Table A1.6 according to the base-year-to-2024 trend. This results in 43 level key sources and 49 trend key sources.

Table A1.5 Source ranking using IPCC Approach 1 **level** assessment for 2024 emissions, including LULUCF (amounts in kt CO₂ eq). Lines in **bold** represent the key sources.

CRT Category		Gas	2024 estimate (kt CO ₂ eq)	Level assessment %	Cumulative total %
1A3b	Road transportation: gasoline	CO ₂	12293.9	8.20	8.20
1A1a	Public Electricity and Heat Production: gaseous	CO ₂	11883.1	7.92	16.12
1A2	Manufacturing Industries and Construction: gaseous	CO ₂	11731.1	7.82	23.94
1A1a	Public Electricity and Heat Production: solids	CO ₂	10946.8	7.30	31.24
1A4b	Residential gaseous	CO ₂	10907.5	7.27	38.51
1A3b	Road transportation: diesel oil	CO ₂	10642.3	7.09	45.60
2B10	Other	CO ₂	7253.5	4.84	50.44
1A1b	Petroleum Refining: liquids	CO ₂	6806.3	4.54	54.97
3A1	Mature dairy cattle	CH ₄	6031.9	4.02	59.00
1A4c	Agriculture/forestry/fishing: gaseous	CO ₂	5844.8	3.90	62.89
1A4a	Commercial/Institutional: gaseous	CO ₂	4450.7	2.97	65.86
1A2	Manufacturing Industries and Construction: solids	CO ₂	4212.0	2.81	68.67
3Da	Direct emissions from agricultural soils	N ₂ O	3645.6	2.43	71.10
1A1a	Public Electricity and Heat Production: other fuels: waste incineration	CO ₂	2415.7	1.61	72.71
3A1	Young cattle	CH ₄	2004.9	1.34	74.04
4C1	Grassland remaining grassland	CO ₂	1843.6	1.23	75.27
1A1b	Petroleum Refining: gaseous	CO ₂	1829.8	1.22	76.49
5A	Solid waste disposal	CH ₄	1777.0	1.18	77.68
4A1	Forest land remaining forest land	CO ₂	1766.4	1.18	78.85
3B1	Mature dairy cattle	CH ₄	1645.0	1.10	79.95
1A2	Manufacturing Industries and Construction: liquids	CO ₂	1573.4	1.05	81.00
1A4c	Agriculture/forestry/fishing: liquids	CO ₂	1529.3	1.02	82.02

CRT Category		Gas	2024 estimate (kt CO₂ eq)	Level assessment %	Cumulative total %
3B3	Swine	CH ₄	1510.8	1.01	83.03
4B2	Land converted to cropland	CO ₂	1498.4	1.00	84.03
2F1	Refrigeration and air conditioning	HFC	1373.2	0.92	84.94
2B1	Ammonia production	CO ₂	1343.7	0.90	85.84
1B2	Fugitive emissions from oil and gas operations	CO ₂	1215.1	0.81	86.65
1A3d	Domestic navigation	CO ₂	1138.6	0.76	87.41
1A4c	Agriculture/forestry/fishing: all fuels	CH ₄	1135.2	0.76	88.16
4B1	Cropland remaining cropland	CO ₂	1097.3	0.73	88.89
4E2	Land converted to settlements	CO ₂	1034.2	0.69	89.58
1A1c	Manufacture of Solid Fuels: gaseous	CO ₂	956.8	0.64	90.22
1A1c	Manufacture of Solid Fuels: solids	CO ₂	956.6	0.64	90.86
1A4 excl 1A4c	Liquids	CO ₂	878.0	0.59	91.44
4C2	Land converted to grassland	CO ₂	736.6	0.49	91.94
4A2	Land converted to forest land	CO ₂	669.0	0.45	92.38
3A2, 3A4	Other	CH ₄	571.0	0.38	92.76
2A4d	Other	CO ₂	546.3	0.36	93.13
2B8	Petrochemical and carbon black production	CO ₂	544.7	0.36	93.49
5D	Wastewater treatment and discharge	N ₂ O	520.9	0.35	93.84
3Db	Indirect emissions from managed soils	N ₂ O	490.3	0.33	94.16
3B1	Growing cattle	CH ₄	465.4	0.31	94.47
6	Indirect CO₂	CO ₂	439.4	0.29	94.77
3A3	Swine	CH ₄	437.6	0.29	95.06
1A3b	Road transportation: LPG	CO ₂	356.8	0.24	95.30
2B8	Chemical industry: Petrochemical and carbon black production	CH ₄	327.5	0.22	95.51
4E1	Settlements remaining settlements	CO ₂	325.6	0.22	95.73
1B2b	Natural gas	CH ₄	319.0	0.21	95.94
2B10	Other	N ₂ O	309.4	0.21	96.15

CRT Category		Gas	2024 estimate (kt CO₂ eq)	Level assessment %	Cumulative total %
1A4b	Residential:all fuels	CH ₄	290.2	0.19	96.34
1A3b	Road transportation	N ₂ O	275.3	0.18	96.53
2D2	Paraffin wax use	CO ₂	254.3	0.17	96.70
5B	Biological treatment of solid waste: composting	CH ₄	244.7	0.16	96.86
2F6	Other	HFC	223.3	0.15	97.01
5D	Wastewater treatment and discharge	CH ₄	219.2	0.15	97.16
1A1a	Public Electricity and Heat Production: liquids	CO ₂	211.0	0.14	97.30
1A5b	Military use: liquids	CO ₂	199.8	0.13	97.43
3B5	Indirect emissions	N ₂ O	195.6	0.13	97.56
4F2	Land converted to other land	CO ₂	190.5	0.13	97.69
1A1	Energy Industries: all fuels	N ₂ O	180.0	0.12	97.81
4C1	Grassland remaining grassland	CH ₄	175.5	0.12	97.92
2A2	Lime production	CO ₂	166.4	0.11	98.03
3B1	Mature dairy cattle	N ₂ O	163.5	0.11	98.14
1A3b	Road transportation: gaseous	CO ₂	137.0	0.09	98.23
2G2	SF ₆ use	SF ₆	132.4	0.09	98.32
3B1	Growing cattle	N ₂ O	129.0	0.09	98.41
4G	Harvested wood products	CO ₂	126.3	0.08	98.49
1A1	Energy Industries: all fuels	CH ₄	119.8	0.08	98.57
3A1	Other mature cattle	CH ₄	111.7	0.07	98.65
2A4b	Other uses of soda ash	CO ₂	104.3	0.07	98.72
5B	Biological treatment of solid waste: composting	N ₂ O	96.3	0.06	98.78
2D1	Lubricant use	CO ₂	95.1	0.06	98.84
1B2c	Venting and flaring	CH ₄	86.2	0.06	98.90
3B4	Other livestock	N ₂ O	86.1	0.06	98.96
3B3	Swine	N ₂ O	85.7	0.06	99.02
1A3e	Other	CO ₂	84.4	0.06	99.07
2A4a	Ceramics	CO ₂	83.4	0.06	99.13

CRT Category		Gas	2024 estimate (kt CO₂ eq)	Level assessment %	Cumulative total %
2B2	Nitric acid production	N ₂ O	72.7	0.05	99.18
2B4	Caprolactam production	N ₂ O	68.3	0.05	99.22
1B1b	Solid fuel transformation	CO ₂	65.5	0.04	99.27
1A4a	Commercial/Institutional: all fuels	CH ₄	65.3	0.04	99.31
1A2	Manufacturing Industries and Construction: all fuels	CH ₄	60.0	0.04	99.35
2G	Other product manufacture and use	N ₂ O	59.3	0.04	99.39
1A3c	Railways	CO ₂	59.1	0.04	99.43
2A3	Glass production	CO ₂	57.2	0.04	99.47
2B	Fluorochemical production	HFC	56.7	0.04	99.50
4B2	Land converted to cropland	N ₂ O	56.2	0.04	99.54
1A3b	Road transportation	CH ₄	55.8	0.04	99.58
3H	Ureum use	CO ₂	52.1	0.03	99.61
4C2	Land converted to grassland	CH ₄	50.9	0.03	99.65
2G	Other product manufacture and use	CH ₄	50.4	0.03	99.68
1A4	Other Sectors: all fuels	N ₂ O	47.7	0.03	99.71
2D3	Other	CO ₂	38.7	0.03	99.74
4E2	Land converted to settlements	N ₂ O	34.4	0.02	99.76
4D2	Land converted to wetlands	CO ₂	34.3	0.02	99.79
1A2	Manufacturing Industries and Construction: all fuels	N ₂ O	34.3	0.02	99.81
3B4	Poultry	CH ₄	33.5	0.02	99.83
2H	Other industrial	CO ₂	30.8	0.02	99.85
3G	Liming	CO ₂	29.8	0.02	99.87
1A3a	Domestic aviation	CO ₂	27.2	0.02	99.89
3B2, 3B4	Other	CH ₄	25.6	0.02	99.91
2E	Electronic Industry	PFC	24.3	0.02	99.92
1B2a	Oil	CH ₄	18.0	0.01	99.93
1A3 excl 1A3b	Other	CH ₄	13.1	0.01	99.94
1A3 excl 1A3b	Other	N ₂ O	8.7	0.01	99.95

CRT Category		Gas	2024 estimate (kt CO ₂ eq)	Level assessment %	Cumulative total %
3B1	Other mature cattle	CH ₄	8.4	0.01	99.95
4B1	Cropland remaining cropland	CH ₄	7.2	0.00	99.96
4A1	Forest land remaining forest land	CH ₄	6.9	0.00	99.96
4F2	Land converted to other land	N ₂ O	6.6	0.00	99.97
4A2	Land converted to forest land	N ₂ O	6.5	0.00	99.97
4D2	Land converted to wetlands	N ₂ O	5.6	0.00	99.98
2C1	Iron and steel production	CO ₂	5.6	0.00	99.98
4B2	Land converted to cropland	CH ₄	5.4	0.00	99.98
1B1b	Solid fuel transformation	CH ₄	4.8	0.00	99.99
4A1	Forest land remaining forest land	N ₂ O	3.7	0.00	99.99
5C	Open burning of waste	CH ₄	3.0	0.00	99.99
1A5b	Military use: liquids	N ₂ O	2.5	0.00	99.99
3B1	Other mature cattle	N ₂ O	2.2	0.00	99.99
5C	Open burning of waste	N ₂ O	1.6	0.00	100.00
4A2	Land converted to forest land	CH ₄	1.5	0.00	100.00
3B2	Sheep	N ₂ O	1.3	0.00	100.00
4C1	Grassland remaining grassland	N ₂ O	1.0	0.00	100.00
2D2	Paraffin wax use	CH ₄	0.8	0.00	100.00
2B9	Fluorochemical production	PFC	0.8	0.00	100.00
2G	Other product manufacture and use	CO ₂	0.6	0.00	100.00
1A5b	Military use: liquids	CH ₄	0.4	0.00	100.00
4C2	Land converted to grassland	N ₂ O	0.3	0.00	100.00
1A4	Solids	CO ₂	0.2	0.00	100.00
4D1	Wetlands remaining wetlands	N ₂ O	0.1	0.00	100.00
2C3	Aluminium production	CO ₂	0.0	0.00	100.00
2A1	Cement production	CO ₂	0.0	0.00	100.00
2B7	Soda ash production	CO ₂	0.0	0.00	100.00
2C3	Aluminium production	PFC	0.0	0.00	100.00

CRT Category		Gas	2024 estimate (kt CO ₂ eq)	Level assessment %	Cumulative total %
4B1	Cropland remaining cropland	N ₂ O	0.0	0.00	100.00
4D1	Wetlands remaining wetlands	CO ₂	0.0	0.00	100.00
4E1	Settlements remaining settlements	N ₂ O	0.0	0.00	100.00
4F1	Other land remaining other land	CO ₂	0.0	0.00	100.00
4F1	Other land remaining other land	N ₂ O	0.0	0.00	100.00
4H	Other	N ₂ O	0.0	0.00	100.00
	Total		150006		

Table A1.6 Source ranking using IPCC Approach 1 **trend** assessment for 2024 emissions compared to the base year, **including** LULUCF (kt CO₂ eq). Lines in **bold** represent the key sources.

CRT category		Gas	1990 Estimate (kt CO ₂ eq)	2024 Estimate (kt CO ₂ eq)	Trend Assessment %	% Contribution to trend	Cumulative Total %
5A	Solid waste disposal	CH ₄	15320.81	1777.0	8.39	12.47	12.47
1A1a	Public Electricity and Heat Production: solids	CO ₂	25862.18	10946.8	5.98	8.89	21.36
1A3b	Road transportation: gasoline	CO ₂	10675.43	12293.9	5.53	8.22	29.58
2B2	Nitric acid production	N ₂ O	5410.86	72.7	3.53	5.25	34.83
1A1a	Public Electricity and Heat Production: gaseous	CO ₂	13329.14	11883.1	3.34	4.96	39.79
2B	Fluorochemical production	HFC	4697.19	56.7	3.07	4.57	44.36
2B10	Other	CO ₂	6738.86	7253.5	2.97	4.41	48.77
3A1	Mature dairy cattle	CH ₄	5805.20	6031.9	2.33	3.47	52.24
1A3b	Road transportation: diesel oil	CO ₂	13008.47	10642.3	2.27	3.38	55.62
1A1a	Public Electricity and Heat Production: other fuels: waste incineration	CO ₂	601.46	2415.7	2.08	3.10	58.72
1A4b	Residential gaseous	CO ₂	19894.08	10907.5	2.04	3.04	61.76
2C3	Aluminium production	PFC	2373.87	0.0	1.58	2.35	64.11
1A3b	Road transportation: LPG	CO ₂	2740.42	356.8	1.46	2.17	66.28
2F1	Refrigeration and air conditioning	HFC	0.00	1373.2	1.41	2.10	68.38
1A1b	Petroleum Refining: gaseous	CO ₂	1042.21	1829.8	1.19	1.77	70.15
1A4c	Agriculture/forestry/fishing: gaseous	CO ₂	7328.73	5844.8	1.13	1.67	71.82
1A4c	Agriculture/forestry/fishing: all fuels	CH ₄	81.10	1135.2	1.11	1.66	73.48
1B2c	Venting and flaring	CH ₄	1669.84	86.2	1.02	1.52	75.00
3B3	Swine	CH ₄	3772.82	1510.8	0.96	1.43	76.43
4A1	Forest land remaining forest land	CO ₂	1301.17	1766.4	0.95	1.41	77.84
3B1	Mature dairy cattle	CH ₄	1212.74	1645.0	0.88	1.31	79.15
1B2	Fugitive emissions from oil and gas operations	CO ₂	774.75	1215.1	0.73	1.09	80.24

CRT category		Gas	1990 Estimate (kt CO₂ eq)	2024 Estimate (kt CO₂ eq)	Trend Assessment %	% Contribution to trend	Cumulative Total %
4C1	Grassland remaining grassland	CO ₂	1772.20	1843.6	0.71	1.06	81.31
1A2	Manufacturing Industries and Construction: liquids	CO ₂	3465.70	1573.4	0.69	1.03	82.34
1A3d	Domestic navigation	CO ₂	725.52	1138.6	0.69	1.02	83.36
1A2	Manufacturing Industries and Construction: gaseous	CO ₂	19044.25	11731.1	0.63	0.94	84.29
1A4a	Commercial/Institutional: gaseous	CO ₂	7757.82	4450.7	0.59	0.88	85.18
4E2	Land converted to settlements	CO ₂	766.11	1034.2	0.55	0.82	86.00
3Da	Direct emissions from agricultural soils	N ₂ O	6340.85	3645.6	0.48	0.71	86.71
3Db	Indirect emissions from managed soils	N ₂ O	1438.43	490.3	0.45	0.68	87.38
1A1c	Manufacture of Solid Fuels: solids	CO ₂	916.35	956.6	0.37	0.55	87.94
2B4	Caprolactam production	N ₂ O	657.97	68.3	0.37	0.55	88.49
1A1b	Petroleum Refining: liquids	CO ₂	9968.19	6806.3	0.36	0.53	89.02
2B8	Petrochemical and carbon black production	CO ₂	335.61	544.7	0.34	0.50	89.52
3B4	Poultry	CH ₄	543.85	33.5	0.33	0.49	90.00
4B2	Land converted to cropland	CO ₂	1837.96	1498.4	0.32	0.47	90.47
2A1	Cement production	CO ₂	415.80	0.0	0.28	0.41	90.89
2B1	Ammonia production	CO ₂	1660.22	1343.7	0.28	0.41	91.29
2C3	Aluminium production	CO ₂	408.42	0.0	0.27	0.40	91.70
4E1	Settlements remaining settlements	CO ₂	126.41	325.6	0.25	0.37	92.07
5B	Biological treatment of solid waste: composting	CH ₄	4.79	244.7	0.25	0.37	92.44
2A4d	Other	CO ₂	481.20	546.3	0.24	0.36	92.80
2F6	Other	HFC	0.00	223.3	0.23	0.34	93.14
1A3b	Road transportation	N ₂ O	90.30	275.3	0.22	0.33	93.47
4C2	Land converted to grassland	CO ₂	807.29	736.6	0.22	0.33	93.80
1A1c	Manufacture of Solid Fuels: gaseous	CO ₂	1184.23	956.8	0.19	0.29	94.09

CRT category		Gas	1990 Estimate (kt CO₂ eq)	2024 Estimate (kt CO₂ eq)	Trend Assessment %	% Contribution to trend	Cumulative Total %
2D2	Paraffin wax use	CO ₂	102.55	254.3	0.19	0.29	94.38
5D	Wastewater treatment and discharge	N ₂ O	544.18	520.9	0.17	0.26	94.63
2B10	Other	N ₂ O	219.41	309.4	0.17	0.26	94.89
3A2, 3A4	Other	CH ₄	630.88	571.0	0.17	0.25	95.14
6	Indirect CO ₂	CO ₂	917.19	439.4	0.16	0.24	95.37
1A4 excl 1A4c	Liquids	CO ₂	1571.02	878.0	0.14	0.21	95.59
1A3e	Other	CO ₂	342.22	84.4	0.14	0.21	95.80
1A3b	Road transportation: gaseous	CO ₂	0.00	137.0	0.14	0.21	96.01
2B8	Chemical industry: Petrochemical and carbon black production	CH ₄	301.79	327.5	0.14	0.20	96.21
1A4c	Agriculture/forestry/fishing: liquids	CO ₂	2533.55	1529.3	0.12	0.17	96.38
1A4	Solids	CO ₂	162.72	0.2	0.11	0.16	96.54
3B1	Growing cattle	CH ₄	563.27	465.4	0.10	0.15	96.70
4F2	Land converted to other land	CO ₂	144.30	190.5	0.10	0.15	96.84
1A1	Energy industries: all fuels	N ₂ O	131.30	180.0	0.10	0.15	96.99
5B	Biological treatment of solid waste: composting	N ₂ O	5.80	96.3	0.10	0.14	97.13
3G	Liming	CO ₂	183.15	29.8	0.09	0.14	97.27
4G	Harvested wood products	CO ₂	68.58	126.3	0.08	0.13	97.39
1A2	Manufacturing industries and construction: solids	CO ₂	6623.36	4212.0	0.08	0.12	97.52
4B1	Cropland remaining cropland	CO ₂	1569.73	1097.3	0.08	0.12	97.64
4A2	Land converted to forest land	CO ₂	919.52	669.0	0.08	0.11	97.75
1A3b	Road transportation	CH ₄	197.09	55.8	0.07	0.11	97.86
2G	Other product manufacture and use	N ₂ O	200.03	59.3	0.07	0.11	97.97
1A1	Energy industries: all fuels	CH ₄	77.00	119.8	0.07	0.11	98.07
1B2b	Natural gas	CH ₄	596.78	319.0	0.07	0.10	98.18

CRT category		Gas	1990 Estimate (kt CO₂ eq)	2024 Estimate (kt CO₂ eq)	Trend Assessment %	% Contribution to trend	Cumulative Total %
2A2	Lime production	CO ₂	162.68	166.4	0.06	0.09	98.27
1A1a	Public electricity and heat production: liquids	CO ₂	233.21	211.0	0.06	0.09	98.36
2A4b	Other uses of soda ash	CO ₂	68.56	104.3	0.06	0.09	98.45
3A3	Swine	CH ₄	584.43	437.6	0.06	0.09	98.54
3B1	Mature dairy cattle	N ₂ O	169.06	163.5	0.06	0.08	98.63
5D	Wastewater treatment and discharge	CH ₄	421.28	219.2	0.06	0.08	98.71
3B4	Other livestock	N ₂ O	53.91	86.1	0.05	0.08	98.79
3H	Ureum use	CO ₂	1.51	52.1	0.05	0.08	98.87
1A5b	Military use: liquids	CO ₂	386.68	199.8	0.05	0.08	98.94
3B1	Growing cattle	N ₂ O	130.47	129.0	0.05	0.07	99.01
2B7	Soda ash production	CO ₂	63.78	0.0	0.04	0.06	99.07
3A1	Other mature cattle	CH ₄	235.39	111.7	0.04	0.06	99.14
2D3	Other	CO ₂	0.00	38.7	0.04	0.06	99.20
2D1	Lubricant use	CO ₂	87.33	95.1	0.04	0.06	99.25
1A4b	Residential:all fuels	CH ₄	502.97	290.2	0.04	0.05	99.31
4C2	Land converted to grassland	CH ₄	23.56	50.9	0.04	0.05	99.36
2A3	Glass production	CO ₂	142.35	57.2	0.04	0.05	99.42
4D2	Land converted to wetlands	CO ₂	1.45	34.3	0.03	0.05	99.47
1A4a	Commercial/Institutional: all fuels	CH ₄	53.63	65.3	0.03	0.05	99.52
3B5	Indirect emissions	N ₂ O	346.87	195.6	0.03	0.04	99.56
3A1	Young cattle	CH ₄	3138.05	2004.9	0.03	0.04	99.60
1A3a	Domestic aviation	CO ₂	84.77	27.2	0.03	0.04	99.65
2C1	Iron and steel production	CO ₂	43.68	5.6	0.02	0.03	99.68
4C1	Grassland remaining grassland	CH ₄	240.90	175.5	0.02	0.03	99.71
1A4	Other Sectors: all fuels	N ₂ O	45.59	47.7	0.02	0.03	99.74
1A2	Manufacturing Industries and Construction: all fuels	CH ₄	65.14	60.0	0.02	0.03	99.77

CRT category		Gas	1990 Estimate (kt CO₂ eq)	2024 Estimate (kt CO₂ eq)	Trend Assessment %	% Contribution to trend	Cumulative Total %
2H	Other industrial	CO ₂	72.48	30.8	0.02	0.02	99.79
1A2	Manufacturing Industries and Construction: all fuels	N ₂ O	30.39	34.3	0.01	0.02	99.81
4E2	Land converted to settlements	N ₂ O	32.84	34.4	0.01	0.02	99.83
2G	Other product manufacture and use	CH ₄	57.86	50.4	0.01	0.02	99.85
1A3 excl 1A3b	Other	CH ₄	2.52	13.1	0.01	0.02	99.87
2E	Electronic Industry	PFC	22.74	24.3	0.01	0.01	99.88
3B1	Other mature cattle	CH ₄	24.83	8.4	0.01	0.01	99.90
2A4a	Ceramics	CO ₂	140.14	83.4	0.01	0.01	99.91
4B2	Land converted to cropland	N ₂ O	76.63	56.2	0.01	0.01	99.92
1B1b	Solid fuel transformation	CO ₂	110.44	65.5	0.01	0.01	99.93
2G2	SF ₆ use	SF ₆	213.05	132.4	0.01	0.01	99.94
3B3	Swine	N ₂ O	124.71	85.7	0.01	0.01	99.94
1A3 excl 1A3b	Other	N ₂ O	6.07	8.7	0.00	0.01	99.95
4A1	Forest land remaining forest land	CH ₄	5.17	6.9	0.00	0.01	99.96
4F2	Land converted to other land	N ₂ O	4.89	6.6	0.00	0.01	99.96
1B2a	Oil	CH ₄	22.77	18.0	0.00	0.00	99.97
1B1b	Solid fuel transformation	CH ₄	12.26	4.8	0.00	0.00	99.97
4D2	Land converted to wetlands	N ₂ O	3.84	5.6	0.00	0.00	99.98
3B2	Sheep	N ₂ O	6.41	1.3	0.00	0.00	99.98
4B1	Cropland remaining cropland	CH ₄	14.13	7.2	0.00	0.00	99.98
4A1	Forest land remaining forest land	N ₂ O	2.80	3.7	0.00	0.00	99.99
3B1	Other mature cattle	N ₂ O	6.17	2.2	0.00	0.00	99.99
3B2, 3B4	Other	CH ₄	37.75	25.6	0.00	0.00	99.99
1A5b	Military use: liquids	N ₂ O	5.25	2.5	0.00	0.00	99.99
2B9	Fluorochemical production	PFC	0.00	0.8	0.00	0.00	99.99

CRT category		Gas	1990 Estimate (kt CO₂ eq)	2024 Estimate (kt CO₂ eq)	Trend Assessment %	% Contribution to trend	Cumulative Total %
4A2	Land converted to forest land	CH ₄	3.54	1.5	0.00	0.00	99.99
2D2	Paraffin wax use	CH ₄	0.17	0.8	0.00	0.00	100.00
4B2	Land converted to cropland	CH ₄	7.41	5.4	0.00	0.00	100.00
4A2	Land converted to forest land	N ₂ O	10.79	6.5	0.00	0.00	100.00
2G	Other product manufacture and use	CO ₂	0.19	0.6	0.00	0.00	100.00
5C	Open burning of waste	N ₂ O	2.06	1.6	0.00	0.00	100.00
1A3c	Railways	CO ₂	90.73	59.1	0.00	0.00	100.00
5C	Open burning of waste	CH ₄	4.23	3.0	0.00	0.00	100.00
4C1	Grassland remaining grassland	N ₂ O	1.80	1.0	0.00	0.00	100.00
1A5b	Military use: liquids	CH ₄	0.89	0.4	0.00	0.00	100.00
4D1	Wetlands remaining wetlands	N ₂ O	0.06	0.1	0.00	0.00	100.00
4C2	Land converted to grassland	N ₂ O	0.36	0.3	0.00	0.00	100.00
4B1	Cropland remaining cropland	N ₂ O	0.00	0.0	0.00	0.00	100.00
4D1	Wetlands remaining wetlands	CO ₂	0.00	0.0	0.00	0.00	100.00
4E1	Settlements remaining settlements	N ₂ O	0.00	0.0	0.00	0.00	100.00
4F1	Other land remaining other land	CO ₂	0.00	0.0	0.00	0.00	100.00
4F1	Other land remaining other land	N ₂ O	0.00	0.0	0.00	0.00	100.00
4H	Other	N ₂ O	0.00	0.0	0.00	0.00	100.00
	Total		231441	150006			

A1.5 Approach 2 key category assessment including uncertainties (error propagation)

Using the uncertainty estimate for each key source as a weighting factor (see Annex 2), the key source assessment was performed again.

The inclusion of uncertainty data in both level and trend assessment results in 67 key sources on a total of 139 sources. They include four LULUCF sources: 4B2 Land converted to cropland N₂O, CO₂; 4C1 Grassland remaining grassland CH₄; 4E2 Land converted to Settlements N₂O CO₂; and 4F2 Land converted to other land CO₂. Tables A1.7 and A1.8 show the results of the inclusion of uncertainty data in the level and trend assessment, respectively.

Table A1.7 Source ranking using IPCC Approach 2 **level** assessment for 2024 emissions, including LULUCF (kt CO₂ eq). Lines in **bold** represent the key sources.

CRT category		Gas	kt CO ₂ eq 2024	Share %	Uncertainty estimate%	Level * uncertainty%	Share L*U%	Cum. Share L*U%
2B10	Other	CO ₂	7253.5	4.84	28.14	1.36	7.86	7.86
1A1b	Petroleum Refining: liquids	CO ₂	6806.3	4.54	25.94	1.18	6.80	14.67
4C1	Grassland remaining grassland	CO ₂	1843.6	1.23	75.00	0.92	5.33	19.99
3Da	Direct emissions from agricultural soils	N ₂ O	3645.6	2.43	34.78	0.85	4.89	24.88
2B1	Ammonia production	CO ₂	1343.7	0.90	84.74	0.76	4.39	29.27
3Db	Indirect emissions from managed soils	N ₂ O	490.3	0.33	214.09	0.70	4.04	33.31
3A1	Mature dairy cattle	CH ₄	6031.9	4.02	15.13	0.61	3.52	36.83
1A2	Manufacturing Industries and Construction: solids	CO ₂	4212.0	2.81	20.86	0.59	3.38	40.21
1A1a	Public Electricity and Heat Production: solids	CO ₂	10946.8	7.30	7.57	0.55	3.19	43.40
3B5	Indirect emissions	N ₂ O	195.6	0.13	400.41	0.52	3.02	46.42
4E2	Land converted to settlements	CO ₂	1034.2	0.69	69.00	0.48	2.75	49.17
4B2	Land converted to cropland	CO ₂	1498.4	1.00	44.00	0.44	2.54	51.71
3B1	Mature dairy cattle	CH ₄	1645.0	1.10	38.05	0.42	2.41	54.12
1A4c	Agriculture/forestry/fishing: all fuels	CH ₄	1135.2	0.76	48.77	0.37	2.13	56.25
4C2	Land converted to grassland	CO ₂	736.6	0.49	75.00	0.37	2.13	58.38

CRT category		Gas	kt CO₂ eq 2024	Share %	Uncertainty estimate%	Level * uncertainty%	Share L*U%	Cum. Share L*U%
1A4b	Residential gaseous	CO ₂	10907.5	7.27	5.01	0.36	2.10	60.49
4B1	Cropland remaining cropland	CO ₂	1097.3	0.73	44.00	0.32	1.86	62.35
1A1c	Manufacture of Solid Fuels: solids	CO ₂	956.6	0.64	47.83	0.31	1.76	64.11
5A	Solid waste disposal	CH ₄	1777.0	1.18	23.69	0.28	1.62	65.73
2F1	Refrigeration and air conditioning	HFC	1373.2	0.92	28.88	0.26	1.53	67.26
2B8	Petrochemical and carbon black production	CO ₂	544.7	0.36	70.71	0.26	1.48	68.74
1A3b	Road transportation: diesel oil	CO ₂	10642.3	7.09	3.61	0.26	1.48	70.22
2A4d	Other	CO ₂	546.3	0.36	69.68	0.25	1.47	71.69
3B3	Swine	CH ₄	1510.8	1.01	24.34	0.25	1.42	73.11
1A2	Manufacturing industries and construction: gaseous	CO ₂	11731.1	7.82	3.01	0.24	1.36	74.47
1A3b	Road transportation: gasoline	CO ₂	12293.9	8.20	2.83	0.23	1.34	75.81
1A4c	Agriculture/forestry/fishing: gaseous	CO ₂	5844.8	3.90	5.01	0.20	1.13	76.93
4F2	Land converted to other land	CO ₂	190.5	0.13	152.00	0.19	1.12	78.05
2D2	Paraffin wax use	CO ₂	254.3	0.17	101.98	0.17	1.00	79.05
2B8	Chemical industry: Petrochemical and carbon black production	CH ₄	327.5	0.22	70.71	0.15	0.89	79.94
4B2	Land converted to cropland	N ₂ O	56.2	0.04	400.00	0.15	0.87	80.81
4E1	Settlements remaining settlements	CO ₂	325.6	0.22	69.00	0.15	0.87	81.67
2B10	Other	N ₂ O	309.4	0.21	70.10	0.14	0.84	82.51
4A1	Forest land remaining forest land	CO ₂	1766.4	1.18	12.00	0.14	0.82	83.32
3A1	Young cattle	CH ₄	2004.9	1.34	9.29	0.12	0.72	84.04
1A1a	Public electricity and heat production: other fuels: waste incineration	CO ₂	2415.7	1.61	7.54	0.12	0.70	84.74
3A3	Swine	CH ₄	437.6	0.29	40.51	0.12	0.68	85.43
1A4b	Residential:all fuels	CH ₄	290.2	0.19	57.10	0.11	0.64	86.06
5D	Wastewater treatment and discharge	N ₂ O	520.9	0.35	30.13	0.10	0.60	86.67

CRT category		Gas	kt CO₂ eq 2024	Share %	Uncertainty estimate%	Level * uncertainty%	Share L*U%	Cum. Share L*U%
5B	Biological treatment of solid waste: composting	CH ₄	244.7	0.16	60.81	0.10	0.57	87.24
3A2. 3A4	Other	CH ₄	571.0	0.38	25.72	0.10	0.57	87.81
4C1	Grassland remaining grassland	CH ₄	175.5	0.12	79.00	0.09	0.53	88.34
1A3b	Road transportation	N ₂ O	275.3	0.18	50.03	0.09	0.53	88.87
4E2	Land converted to settlements	N ₂ O	34.4	0.02	400.00	0.09	0.53	89.40
1A4a	Commercial/Institutional: gaseous	CO ₂	4450.7	2.97	2.99	0.09	0.51	89.91
2A2	Lime production	CO ₂	166.4	0.11	75.17	0.08	0.48	90.40
1B2b	Natural gas	CH ₄	319.0	0.21	38.31	0.08	0.47	90.87
1A1a	Public Electricity and Heat Production: gaseous	CO ₂	11883.1	7.92	1.03	0.08	0.47	91.34
2F6	Other	HFC	223.3	0.15	53.85	0.08	0.46	91.80
6	Indirect CO ₂	CO ₂	439.4	0.29	26.93	0.08	0.46	92.26
3B1	Mature dairy cattle	N ₂ O	163.5	0.11	67.92	0.07	0.43	92.68
1A1	Energy industries: all fuels	N ₂ O	180.0	0.12	54.65	0.07	0.38	93.06
5D	Wastewater treatment and discharge	CH ₄	219.2	0.15	41.68	0.06	0.35	93.42
3B1	Growing cattle	CH ₄	465.4	0.31	18.03	0.06	0.32	93.74
3B1	Growing cattle	N ₂ O	129.0	0.09	63.40	0.05	0.32	94.05
4A2	Land converted to forest land	CO ₂	669.0	0.45	12.00	0.05	0.31	94.36
2D1	Lubricant use	CO ₂	95.1	0.06	70.71	0.04	0.26	94.62
1B2	Fugitive emissions from oil and gas operations	CO ₂	1215.1	0.81	4.98	0.04	0.23	94.86
2A4a	Ceramics	CO ₂	83.4	0.06	70.71	0.04	0.23	95.08
5B	Biological treatment of solid waste: composting	N ₂ O	96.3	0.06	61.22	0.04	0.23	95.31
1A4	Other sectors: all fuels	N ₂ O	47.7	0.03	117.36	0.04	0.22	95.53
1A2	Manufacturing industries and construction: liquids	CO ₂	1573.4	1.05	3.38	0.04	0.20	95.73
2A4b	Other uses of soda ash	CO ₂	104.3	0.07	50.00	0.03	0.20	95.93
1A1c	Manufacture of Solid Fuels: gaseous	CO ₂	956.8	0.64	5.38	0.03	0.20	96.13
1A3d	Domestic navigation	CO ₂	1138.6	0.76	4.42	0.03	0.19	96.32

CRT category		Gas	kt CO₂ eq 2024	Share %	Uncertainty estimate%	Level * uncertainty%	Share L*U%	Cum. Share L*U%
1A4c	Agriculture/forestry/fishing: liquids	CO ₂	1529.3	1.02	3.27	0.03	0.19	96.52
3B4	Other livestock	N ₂ O	86.1	0.06	55.43	0.03	0.18	96.70
1B2c	Venting and flaring	CH ₄	86.2	0.06	53.05	0.03	0.18	96.88
3B3	Swine	N ₂ O	85.7	0.06	52.24	0.03	0.17	97.05
2G2	SF ₆ use	SF ₆	132.4	0.09	33.54	0.03	0.17	97.22
4C2	Land converted to grassland	CH ₄	50.9	0.03	79.00	0.03	0.15	97.37
1A1a	Public electricity and heat production: liquids	CO ₂	211.0	0.14	18.69	0.03	0.15	97.53
1A4 excl 1A4c	Liquids	CO ₂	878.0	0.59	4.46	0.03	0.15	97.68
1A1	Energy Industries: all fuels	CH ₄	119.8	0.08	29.93	0.02	0.14	97.82
1A2	Manufacturing Industries and Construction: all fuels	N ₂ O	34.3	0.02	99.03	0.02	0.13	97.95
2A3	Glass production	CO ₂	57.2	0.04	50.00	0.02	0.11	98.06
1A3b	Road transportation	CH ₄	55.8	0.04	48.87	0.02	0.11	98.16
4F2	Land converted to other land	N ₂ O	6.6	0.00	400.00	0.02	0.10	98.26
4D2	Land converted to wetlands	CO ₂	34.3	0.02	76.00	0.02	0.10	98.36
4A2	Land converted to forest land	N ₂ O	6.5	0.00	400.00	0.02	0.10	98.46
2G	Other product manufacture and use	CH ₄	50.4	0.03	50.01	0.02	0.10	98.56
1A4a	Commercial/Institutional: all fuels	CH ₄	65.3	0.04	36.84	0.02	0.09	98.65
3A1	Other mature cattle	CH ₄	111.7	0.07	20.89	0.02	0.09	98.74
4D2	Land converted to wetlands	N ₂ O	5.6	0.00	400.00	0.01	0.09	98.83
1A2	Manufacturing Industries and Construction: all fuels	CH ₄	60.0	0.04	36.96	0.01	0.09	98.92
2B4	Caprolactam production	N ₂ O	68.3	0.05	30.48	0.01	0.08	99.00
1A3b	Road transportation: LPG	CO ₂	356.8	0.24	5.39	0.01	0.07	99.07
1A1b	Petroleum Refining: gaseous	CO ₂	1829.8	1.22	1.03	0.01	0.07	99.14
4A1	Forest land remaining forest land	N ₂ O	3.7	0.00	400.00	0.01	0.06	99.20
1A3b	Road transportation: gaseous	CO ₂	137.0	0.09	10.00	0.01	0.05	99.25

CRT category		Gas	kt CO ₂ eq 2024	Share %	Uncertainty estimate%	Level * uncertainty%	Share L*U%	Cum. Share L*U%
3H	Ureum use	CO ₂	52.1	0.03	25.02	0.01	0.05	99.30
1B2a	Oil	CH ₄	18.0	0.01	72.01	0.01	0.05	99.35
3B4	Poultry	CH ₄	33.5	0.02	37.16	0.01	0.05	99.40
3B2. 3B4	Other	CH ₄	25.6	0.02	47.44	0.01	0.05	99.45
1A3 excl 1A3b	Other	N ₂ O	8.7	0.01	133.95	0.01	0.04	99.49
1A5b	Military use: liquids	CO ₂	199.8	0.13	5.49	0.01	0.04	99.53
2D3	Other	CO ₂	38.7	0.03	26.93	0.01	0.04	99.58
1B1b	Solid fuel transformation	CO ₂	65.5	0.04	15.00	0.01	0.04	99.61
5C	Open burning of waste	CH ₄	3.0	0.00	316.23	0.01	0.04	99.65
2G	Other product manufacture and use	N ₂ O	59.3	0.04	14.43	0.01	0.03	99.68
2B	Fluorochemical production	HFC	56.7	0.04	15.07	0.01	0.03	99.72
3G	Liming	CO ₂	29.8	0.02	25.09	0.00	0.03	99.74
1A3 excl 1A3b	Other	CH ₄	13.1	0.01	49.72	0.00	0.03	99.77
2E	Electronic Industry	PFC	24.3	0.02	25.50	0.00	0.02	99.79
2B2	Nitric acid production	N ₂ O	72.7	0.05	7.81	0.00	0.02	99.82
4B1	Cropland remaining cropland	CH ₄	7.2	0.00	79.00	0.00	0.02	99.84
4A1	Forest land remaining forest land	CH ₄	6.9	0.00	79.00	0.00	0.02	99.86
5C	Open burning of waste	N ₂ O	1.6	0.00	316.23	0.00	0.02	99.88
4B2	Land converted to cropland	CH ₄	5.4	0.00	79.00	0.00	0.02	99.89
4C1	Grassland remaining grassland	N ₂ O	1.0	0.00	400.00	0.00	0.01	99.91
1A5b	Military use: liquids	N ₂ O	2.5	0.00	114.80	0.00	0.01	99.92
3B1	Other mature cattle	CH ₄	8.4	0.01	32.66	0.00	0.01	99.93
1A3a	Domestic aviation	CO ₂	27.2	0.02	9.22	0.00	0.01	99.94
1A3c	Railways	CO ₂	59.1	0.04	3.60	0.00	0.01	99.95
3B1	Other mature cattle	N ₂ O	2.2	0.00	77.77	0.00	0.01	99.95
1A3e	Other	CO ₂	84.4	0.06	2.02	0.00	0.01	99.96

CRT category		Gas	kt CO₂ eq 2024	Share %	Uncertainty estimate%	Level * uncertainty%	Share L*U%	Cum. Share L*U%
2H	Other industrial	CO ₂	30.8	0.02	5.39	0.00	0.01	99.97
3B2	Sheep	N ₂ O	1.3	0.00	112.05	0.00	0.01	99.97
4C2	Land converted to grassland	N ₂ O	0.3	0.00	400.00	0.00	0.00	99.98
4G	Harvested wood products	CO ₂	126.3	0.08	1.00	0.00	0.00	99.98
4A2	Land converted to forest land	CH ₄	1.5	0.00	79.00	0.00	0.00	99.99
2D2	Paraffin wax use	CH ₄	0.8	0.00	111.80	0.00	0.00	99.99
1B1b	Solid fuel transformation	CH ₄	4.8	0.00	11.24	0.00	0.00	99.99
4D1	Wetlands remaining wetlands	N ₂ O	0.1	0.00	400.00	0.00	0.00	100.00
1A5b	Military use: liquids	CH ₄	0.4	0.00	78.19	0.00	0.00	100.00
2C1	Iron and steel production	CO ₂	5.6	0.00	5.83	0.00	0.00	100.00
2G	Other product manufacture and use	CO ₂	0.6	0.00	53.85	0.00	0.00	100.00
2B9	Fluorochemical production	PFC	0.8	0.00	20.00	0.00	0.00	100.00
1A4	Solids	CO ₂	0.2	0.00	50.25	0.00	0.00	100.00
2C3	Aluminium production	CO ₂	0.0	0.00	5.39	0.00	0.00	100.00
2A1	Cement production	CO ₂	0.0	0.00	11.00	0.00	0.00	100.00
2B7	Soda ash production	CO ₂	0.0	0.00	5.00	0.00	0.00	100.00
2C3	Aluminium production	PFC	0.0	0.00	0.00	0.00	0.00	100.00
4H	Other	N ₂ O	0.0	0.00	0.00	0.00	0.00	100.00
	Total		150006					

Compared to the Approach 1 level key sources, 1A3b Road transportation: gasoline CO₂ and 1A1a Public Electricity and Heat Production: gaseous CO₂, with the highest shares in the national total, are not at the top of the list when uncertainty estimates are included. As Table A1.7 shows, three smaller but more uncertain sources are among the top five level key sources:

- 2B10 Other CO₂
- 1A1b Petroleum Refining: liquids CO₂
- 4C1 Grassland remaining grassland CO₂

The uncertainty in these emissions is estimated to be in the range of 25–75%, an order of magnitude higher than the 1% uncertainty for CO₂ from 1A1a Public Electricity and Heat Production: gaseous., and the 3% for 1A3b Road transportation: gasoline CO₂.

Table A1.8 Source ranking using IPCC Approach 2 **trend** assessment for 2024 emissions compared to the base year, including LULUCF (kt CO₂ eq). Lines in **bold** represent the key sources.

CRT category		Gas	kt CO ₂ eq 1990	kt CO ₂ eq 2024	Trend assessment %	Uncertainty estimate %	Trend * uncertainty %	% Contr. to trend	Cumulative %
5A	Solid waste disposal	CH ₄	15320.8	1777.0	8.39	23.7	1.99	14.90	14.90
3Db	Indirect emissions from managed soils	N ₂ O	1438.4	490.3	0.45	214.1	0.97	7.30	22.20
2B10	Other	CO ₂	6738.9	7253.5	2.97	28.1	0.84	6.27	28.47
1B2c	Venting and flaring	CH ₄	1669.8	86.2	1.02	53.1	0.54	4.08	32.55
1A4c	Agriculture/Forestry/Fisheries: all fuels	CH ₄	81.1	1135.2	1.11	48.8	0.54	4.07	36.62
4C1	Grassland remaining grassland	CO ₂	1772.2	1843.6	0.71	75.0	0.54	4.02	40.64
2B	Fluorochemical production	HFC	4697.2	56.7	3.07	15.1	0.46	3.47	44.12
1A1a	Public Electricity and Heat Production: solids	CO ₂	25862.2	10946.8	5.98	7.6	0.45	3.40	47.51
2F1	Refrigeration and airconditioning	HFC	0.0	1373.2	1.41	28.9	0.41	3.06	50.57
4E2	Land converted to settlements	CO ₂	766.1	1034.2	0.55	69.0	0.38	2.86	53.43
3A1	Mature dairy cattle	CH ₄	5805.2	6031.9	2.33	15.1	0.35	2.65	56.08
3B1	Mature dairy cattle	CH ₄	1212.7	1645.0	0.88	38.1	0.34	2.52	58.61
2B2	Nitric acid production	N ₂ O	5410.9	72.7	3.53	7.8	0.28	2.07	60.68
2B8	Petrochemical and carbon black production	CO ₂	335.6	544.7	0.34	70.7	0.24	1.79	62.46
3B3	Swine	CH ₄	3772.8	1510.8	0.96	24.3	0.23	1.76	64.22
2B1	Ammonia production	CO ₂	1660.2	1343.7	0.28	84.7	0.23	1.75	65.97
2D2	Paraffin wax use	CO ₂	102.6	254.3	0.19	102.0	0.20	1.48	67.44
1A1c	Manufacture of Solid Fuels: solids	CO ₂	916.3	956.6	0.37	47.8	0.18	1.34	68.78
4E1	Settlements remaining settlements	CO ₂	126.4	325.6	0.25	69.0	0.17	1.30	70.08

CRT category		Gas	kt CO ₂ eq 1990	kt CO ₂ eq 2024	Trend assessment %	Uncertainty estimate %	Trend * uncertainty %	% Contr. to trend	Cumulative %
2A4d	Other	CO ₂	481.2	546.3	0.24	69.7	0.17	1.26	71.34
3Da	Direct emissions from agricultural soils	N ₂ O	6340.8	3645.6	0.48	34.8	0.17	1.25	72.59
4C2	Land converted to grassland	CO ₂	807.3	736.6	0.22	75.0	0.16	1.23	73.82
1A1a	Public Electricity and Heat Production: other fuels: waste incineration	CO ₂	601.5	2415.7	2.08	7.5	0.16	1.18	75.00
1A3b	Road transportation: gasoline	CO ₂	10675.4	12293.9	5.53	2.8	0.16	1.17	76.17
4F2	Land converted to other land	CO ₂	144.3	190.5	0.10	152.0	0.15	1.14	77.31
5B	Biological treatment of solid waste: composting	CH ₄	4.8	244.7	0.25	60.8	0.15	1.13	78.44
4B2	Land converted to cropland	CO ₂	1838.0	1498.4	0.32	44.0	0.14	1.04	79.49
2F6	Other	HFC	0.0	223.3	0.23	53.9	0.12	0.93	80.41
3B4	Poultry	CH ₄	543.8	33.5	0.33	37.2	0.12	0.91	81.33
2B10	Other	N ₂ O	219.4	309.4	0.17	70.1	0.12	0.90	82.23
3B5	Indirect emissions	N ₂ O	346.9	195.6	0.03	400.4	0.12	0.90	83.13
4A1	Forest land remaining forest land	CO ₂	1301.2	1766.4	0.95	12.0	0.11	0.85	83.99
2B4	Caprolactam production	N ₂ O	658.0	68.3	0.37	30.5	0.11	0.84	84.83
1A3b	Road transportation	N ₂ O	90.3	275.3	0.22	50.0	0.11	0.84	85.67
1A4b	Residential gaseous	CO ₂	19894.1	10907.5	2.04	5.0	0.10	0.77	86.44
2B8	Chemical industry: Petrochemical and carbon black production	CH ₄	301.8	327.5	0.14	70.7	0.10	0.72	87.16
1A1b	Petroleum Refining: liquids	CO ₂	9968.2	6806.3	0.36	25.9	0.09	0.69	87.85
1A3b	Road transportation: diesel oil	CO ₂	13008.5	10642.3	2.27	3.6	0.08	0.62	88.46
1A3b	Road transportation: LPG	CO ₂	2740.4	356.8	1.46	5.4	0.08	0.59	89.05
5B	Biological treatment of solid waste: composting	N ₂ O	5.8	96.3	0.10	61.2	0.06	0.44	89.49

CRT category		Gas	kt CO ₂ eq 1990	kt CO ₂ eq 2024	Trend assessment %	Uncertainty estimate %	Trend * uncertainty %	% Contr. to trend	Cumulative %
1A4c	Agriculture/Forestry/Fisheries: gaseous	CO ₂	7328.7	5844.8	1.13	5.0	0.06	0.42	89.91
1A4	Solids	CO ₂	162.7	0.2	0.11	50.2	0.05	0.41	90.32
4E2	Land converted to settlements	N ₂ O	32.8	34.4	0.01	400.0	0.05	0.40	90.72
1A1	Energy Industries: all fuels	N ₂ O	131.3	180.0	0.10	54.7	0.05	0.40	91.12
5D	Wastewater treatment and discharge	N ₂ O	544.2	520.9	0.17	30.1	0.05	0.39	91.52
2A2	Lime production	CO ₂	162.7	166.4	0.06	75.2	0.05	0.35	91.87
6	Indirect CO ₂	CO ₂	917.2	439.4	0.16	26.9	0.04	0.32	92.19
3A2. 3A4	Other	CH ₄	630.9	571.0	0.17	25.7	0.04	0.32	92.51
3B1	Mature dairy cattle	N ₂ O	169.1	163.5	0.06	67.9	0.04	0.28	92.80
1B2	Fugitive emissions from oil and gas operations	CO ₂	774.7	1215.1	0.73	5.0	0.04	0.27	93.07
1A3b	Road transportation	CH ₄	197.1	55.8	0.07	48.9	0.04	0.27	93.34
4B1	Cropland remaining cropland	CO ₂	1569.7	1097.3	0.08	44.0	0.04	0.27	93.61
1A1a	Public Electricity and Heat Production: gaseous	CO ₂	13329.1	11883.1	3.34	1.0	0.03	0.26	93.87
2A4b	Other uses of soda ash	CO ₂	68.6	104.3	0.06	50.0	0.03	0.23	94.10
2A1	Cement production	CO ₂	415.8	0.0	0.28	11.0	0.03	0.23	94.33
1A3d	Domestic navigation	CO ₂	725.5	1138.6	0.69	4.4	0.03	0.23	94.56
3B4	Other livestock	N ₂ O	53.9	86.1	0.05	55.4	0.03	0.22	94.78
3B1	Growing cattle	N ₂ O	130.5	129.0	0.05	63.4	0.03	0.22	94.99
4C2	Land converted to grassland	CH ₄	23.6	50.9	0.04	79.0	0.03	0.22	95.21
2D1	Lubricant use	CO ₂	87.3	95.1	0.04	70.7	0.03	0.21	95.42
4B2	Land converted to cropland	N ₂ O	76.6	56.2	0.01	400.0	0.03	0.20	95.62
1B2b	Natural gas	CH ₄	596.8	319.0	0.07	38.3	0.03	0.20	95.82
4D2	Land converted to wetlands	CO ₂	1.5	34.3	0.03	76.0	0.03	0.20	96.02
3A3	Swine	CH ₄	584.4	437.6	0.06	40.5	0.02	0.18	96.20

CRT category		Gas	kt CO ₂ eq 1990	kt CO ₂ eq 2024	Trend assessment %	Uncertainty estimate %	Trend * uncertainty %	% Contr. to trend	Cumulative %
1A2	Manufacturing Industries and Construction: liquids	CO ₂	3465.7	1573.4	0.69	3.4	0.02	0.18	96.38
5D	Wastewater treatment and discharge	CH ₄	421.3	219.2	0.06	41.7	0.02	0.17	96.55
3G	Liming	CO ₂	183.2	29.8	0.09	25.1	0.02	0.17	96.72
1A4	Other Sectors: all fuels	N ₂ O	45.6	47.7	0.02	117.4	0.02	0.16	96.89
1A1	Energy Industries: all fuels	CH ₄	77.0	119.8	0.07	29.9	0.02	0.16	97.05
1A4b	Residential:all fuels	CH ₄	503.0	290.2	0.04	57.1	0.02	0.16	97.21
1A2	Manufacturing Industries and Construction: gaseous	CO ₂	19044.2	11731.1	0.63	3.0	0.02	0.14	97.35
3B1	Growing cattle	CH ₄	563.3	465.4	0.10	18.0	0.02	0.14	97.49
2A3	Glass production	CO ₂	142.4	57.2	0.04	50.0	0.02	0.14	97.62
1A4a	Commercial/Institutional: gaseous	CO ₂	7757.8	4450.7	0.59	3.0	0.02	0.13	97.76
1A2	Manufacturing Industries and Construction: solids	CO ₂	6623.4	4212.0	0.08	20.9	0.02	0.13	97.89
4C1	Grassland remaining grassland	CH ₄	240.9	175.5	0.02	79.0	0.02	0.12	98.00
1A2	Manufacturing Industries and Construction: all fuels	N ₂ O	30.4	34.3	0.01	99.0	0.01	0.11	98.11
2C3	Aluminium production	CO ₂	408.4	0.0	0.27	5.4	0.01	0.11	98.22
4F2	Land converted to other land	N ₂ O	4.9	6.6	0.00	400.0	0.01	0.11	98.33
1A3b	Road transportation: gaseous	CO ₂	0.0	137.0	0.14	10.0	0.01	0.11	98.44
3H	Ureum use	CO ₂	1.5	52.1	0.05	25.0	0.01	0.10	98.54
4D2	Land converted to wetlands	N ₂ O	3.8	5.6	0.00	400.0	0.01	0.10	98.63
1A1b	Petroleum Refining: gaseous	CO ₂	1042.2	1829.8	1.19	1.0	0.01	0.09	98.72
1A4a	Commercial/Institutional: all fuels	CH ₄	53.6	65.3	0.03	36.8	0.01	0.09	98.81
1A1a	Public Electricity and Heat Production: liquids	CO ₂	233.2	211.0	0.06	18.7	0.01	0.09	98.90
2D3	Other	CO ₂	0.0	38.7	0.04	26.9	0.01	0.08	98.98
1A1c	Manufacture of Solid Fuels: gaseous	CO ₂	1184.2	956.8	0.19	5.4	0.01	0.08	99.06
2G	Other product manufacture and use	N ₂ O	200.0	59.3	0.07	14.4	0.01	0.08	99.13

CRT category		Gas	kt CO ₂ eq 1990	kt CO ₂ eq 2024	Trend assessment %	Uncertainty estimate %	Trend * uncertainty %	% Contr. to trend	Cumulative %
4A2	Land converted to forest land	CO ₂	919.5	669.0	0.08	12.0	0.01	0.07	99.20
3A1	Other mature cattle	CH ₄	235.4	111.7	0.04	20.9	0.01	0.07	99.27
4A1	Forest land remaining forest land	N ₂ O	2.8	3.7	0.00	400.0	0.01	0.06	99.33
1A2	Manufacturing Industries and Construction: all fuels	CH ₄	65.1	60.0	0.02	37.0	0.01	0.05	99.38
2G	Other product manufacture and use	CH ₄	57.9	50.4	0.01	50.0	0.01	0.05	99.43
1A3 excl 1A3b	Other	N ₂ O	6.1	8.7	0.00	133.9	0.01	0.05	99.48
1A4 excl 1A4c	Liquids	CO ₂	1571.0	878.0	0.14	4.5	0.01	0.05	99.52
1A3 excl 1A3b	Other	CH ₄	2.5	13.1	0.01	49.7	0.01	0.04	99.57
2A4a	Ceramics	CO ₂	140.1	83.4	0.01	70.7	0.01	0.04	99.61
1A4c	Agriculture/Forestry/Fisheries: liquids	CO ₂	2533.6	1529.3	0.12	3.3	0.00	0.03	99.64
3B2	Sheep	N ₂ O	6.4	1.3	0.00	112.0	0.00	0.03	99.66
1A5b	Military use: liquids	CO ₂	386.7	199.8	0.05	5.5	0.00	0.02	99.68
4A1	Forest land remaining forest land	CH ₄	5.2	6.9	0.00	79.0	0.00	0.02	99.70
1A3e	Other	CO ₂	342.2	84.4	0.14	2.0	0.00	0.02	99.73
3A1	Young cattle	CH ₄	3138.0	2004.9	0.03	9.3	0.00	0.02	99.75
3B3	Swine	N ₂ O	124.7	85.7	0.01	52.2	0.00	0.02	99.77
1A3a	Domestic aviation	CO ₂	84.8	27.2	0.03	9.2	0.00	0.02	99.79
3B1	Other mature cattle	CH ₄	24.8	8.4	0.01	32.7	0.00	0.02	99.81
2E	Electronic Industry	PFC	22.7	24.3	0.01	25.5	0.00	0.02	99.82
1B2a	Oil	CH ₄	22.8	18.0	0.00	72.0	0.00	0.02	99.84
2B7	Soda ash production	CO ₂	63.8	0.0	0.04	5.0	0.00	0.02	99.86
4A2	Land converted to forest land	N ₂ O	10.8	6.5	0.00	400.0	0.00	0.01	99.87

CRT category		Gas	kt CO ₂ eq 1990	kt CO ₂ eq 2024	Trend assessment %	Uncertainty estimate %	Trend * uncertainty %	% Contr. to trend	Cumulative %
2G2	SF ₆ use	SF ₆	213.1	132.4	0.01	33.5	0.00	0.01	99.89
4B1	Cropland remaining cropland	CH ₄	14.1	7.2	0.00	79.0	0.00	0.01	99.90
3B1	Other mature cattle	N ₂ O	6.2	2.2	0.00	77.8	0.00	0.01	99.91
2C1	Iron and steel production	CO ₂	43.7	5.6	0.02	5.8	0.00	0.01	99.92
1A5b	Military use: liquids	N ₂ O	5.3	2.5	0.00	114.8	0.00	0.01	99.93
1B1b	Solid fuel transformation	CO ₂	110.4	65.5	0.01	15.0	0.00	0.01	99.94
5C	Open burning of waste	N ₂ O	2.1	1.6	0.00	316.2	0.00	0.01	99.94
2H	Other industrial	CO ₂	72.5	30.8	0.02	5.4	0.00	0.01	99.95
5C	Open burning of waste	CH ₄	4.2	3.0	0.00	316.2	0.00	0.01	99.96
2D2	Paraffin wax use	CH ₄	0.2	0.8	0.00	111.8	0.00	0.01	99.96
4G	Harvested wood products	CO ₂	68.6	126.3	0.08	1.0	0.00	0.01	99.97
4C1	Grassland remaining grassland	N ₂ O	1.8	1.0	0.00	400.0	0.00	0.01	99.98
4A2	Land converted to forest land	CH ₄	3.5	1.5	0.00	79.0	0.00	0.00	99.98
3B2. 3B4	Other	CH ₄	37.8	25.6	0.00	47.4	0.00	0.00	99.98
4B2	Land converted to cropland	CH ₄	7.4	5.4	0.00	79.0	0.00	0.00	99.99
4D1	Wetlands remaining wetlands	N ₂ O	0.1	0.1	0.00	400.0	0.00	0.00	99.99
4C2	Land converted to grassland	N ₂ O	0.4	0.3	0.00	400.0	0.00	0.00	99.99
1B1b	Solid fuel transformation	CH ₄	12.3	4.8	0.00	11.2	0.00	0.00	100.00
2G	Other product manufacture and use	CO ₂	0.2	0.6	0.00	53.9	0.00	0.00	100.00
2B9	Fluorochemical production	PFC	0.0	0.8	0.00	20.0	0.00	0.00	100.00
1A5b	Military use: liquids	CH ₄	0.9	0.4	0.00	78.2	0.00	0.00	100.00
2C3	Aluminium production	PFC	2373.9	0.0	1.58	0.0	0.00	0.00	100.00
1A3c	Railways	CO ₂	90.7	59.1	0.00	3.6	0.00	0.00	100.00
4H	Other	N ₂ O	0.0	0.0	0.00	0.0	0.00	0.00	100.00
	Total		231441	150006					

Annex 2 Uncertainty assessment

A2.1 Description of methodology used for estimating uncertainty

In this NIR an Approach 1 assessment has been performed to estimate the uncertainty in total national GHG emissions and emissions trends. The assessment is carried out on the basis of error propagation (IPCC Guidelines 2006). Total uncertainty per CRT category is derived from uncertainties in both emission factors (EF) and activity data (AD). Details of the uncertainty analysis can be found in the methodology reports (RIVM reports 2026-0019, 2026-0023, 2026-0021, 2026-0020, and WOt-technical report 298). The results of this analysis for both level and trend are presented in table A2.1.

Uncertainties for the activity data and EFs are derived from a mixture of empirical data and expert judgement and are presented here as half the 95% confidence interval. The reason for halving the 95% confidence interval is that the value then corresponds to the familiar plus or minus value when uncertainties are loosely quoted as 'plus or minus x%'. Since 2012, all data on uncertainty for each source has been included in the PRTR database. At the start of the NIR compilation, the Task Forces are asked to submit new uncertainty information, which is included in the annual key category analysis of the NIR.

Table A2.1 Level and trend uncertainty estimates (based on error propagation) relating to 2023 emissions (trend: 1990–2023)

	Uncertainty in emissions level	Uncertainty in emissions trend
CO ₂	±3%	±1% of 29% decrease
CH ₄	±8%	±5% of 51% decrease
N ₂ O	±28%	±5% of 59% decrease
F-gases	±23%	±6% of 75% decrease
Total	±3%	±1% of 36% decrease

Details of the Approach 1 calculation can be found in Table A2.3. It should be stressed that most uncertainty estimates in Table A2.3 are ultimately based on collective expert judgement and, therefore, are rather uncertain themselves (usually in the order of 50%). Nevertheless, these estimates help to identify the most important uncertainty sources. For this purpose, a reasonable order-of-magnitude estimate of the uncertainty in activity data and in EFs is usually sufficient. Uncertainty estimates are a means to identify and prioritise inventory improvement activities, rather than an objective in themselves.

Part of the uncertainty is due to an inherent lack of knowledge concerning the sources. Another part, however, can be attributed to elements of the inventory whose uncertainty could be reduced over time by dedicated research initiated by either the NIE or other researchers. Table A2.2 ranks the ten sources contributing most to the *trend* uncertainty in the national total emissions including LULUCF in 2024 (based on Approach 1).

Table A2.2 Ten sources contributing most to trend uncertainty in the national total in 2024 emissions (uncertainty assessment based on error propagation)

CRT cat.	Category	Gas	Uncertainty introduced into the trend in total national emissions (%)
5.A	Solid waste disposal	CH ₄	14.9
3.D.b	Indirect emissions from managed soils	N ₂ O	7.3
2.B.10	Other	CO ₂	6.3
1.B.2c	Venting and flaring	CH ₄	4.1
1.A.4.c	Agriculture/Forestry/Fisheries: all fuels	CH ₄	4.1
4.C.1	Grassland remaining grassland	CO ₂	4.0
2.B	Fluorochemical production	HFC	3.5
1.A.1a	Public Electricity and Heat Production: solids	CO ₂	3.4
2.F.1	Refrigeration and airconditioning	HFC	3.1
4.E.2	Land converted to settlements	CO ₂	2.9

Table A2.3 Detailed level and trend uncertainty assessment 1990–2024 with the categories of the IPCC potential key source list (without adjustment for correlation sources), including LULUCF. Ranked in order of their contribution to the variance in 2024

CRT category		Gas	CO ₂ eq base year (kt)	CO ₂ eq last year (kt)	AD uncertainty %	AD uncertainty %	EF Uncertainty estimate %	EF Uncertainty estimate %	Combined Uncertainty estimate %	Combined Uncertainty estimate %	Contribution to variance in last year	Inventory trend in national emissions compared to base year %	Uncertainty introduced into the trend in total national emissions %
					(-)	(+)	(-)	(+)	(-)	(+)		(% BY)	(-) and (+)
2B10	Other	CO ₂	6738.9	7253.5	8.9%	8.9%	26.7%	26.7%	28.1%	28.1%	0.20	7.6%	35.0%
1A1b	Petroleum Refining: liquids	CO ₂	9968.2	6806.3	5.0%	5.0%	25.5%	25.5%	25.9%	25.9%	0.15	-31.7%	5.1%
4C1	Grassland remaining grassland	CO ₂	1772.2	1843.6	0.0%	0.0%	75.0%	75.0%	75.0%	75.0%	0.09	4.0%	23.7%
3Da	Direct emissions from agricultural soils	N ₂ O	6340.8	3645.6	8.4%	8.4%	33.8%	33.8%	34.8%	34.8%	0.08	-42.5%	6.0%
2B1	Ammonia production	CO ₂	1660.2	1343.7	16.6%	16.6%	83.1%	83.1%	84.7%	84.7%	0.06	-19.1%	10.5%
3Db	Indirect emissions from managed soils	N ₂ O	1438.4	490.3	33.1%	33.1%	211.5%	211.5%	214.1%	214.1%	0.05	-65.9%	40.1%
3A1	Mature dairy cattle	CH ₄	5805.2	6031.9	2.0%	2.0%	15.0%	15.0%	15.1%	15.1%	0.04	3.9%	15.5%
1A2	Manufacturing Industries and Construction: solids	CO ₂	6623.4	4212.0	1.8%	1.8%	20.8%	20.8%	20.9%	20.9%	0.04	-36.4%	0.1%
1A1a	Public Electricity and Heat Production: solids	CO ₂	25862.2	10946.8	1.1%	1.1%	7.5%	7.5%	7.6%	7.6%	0.03	-57.7%	18.4%
3B5	Indirect emissions	N ₂ O	346.9	195.6	18.1%	18.1%	400.0%	400.0%	400.4%	400.4%	0.03	-43.6%	4.6%
4E2	Land converted to settlements	CO ₂	766.1	1034.2	0.0%	0.0%	69.0%	69.0%	69.0%	69.0%	0.02	35.0%	16.7%
4B2	Land converted to cropland	CO ₂	1838.0	1498.4	0.0%	0.0%	44.0%	44.0%	44.0%	44.0%	0.02	-18.5%	6.4%

CRT category		Gas	CO ₂ eq base year (kt)	CO ₂ eq last year (kt)	AD uncertainty %	AD uncertainty %	EF Uncertainty estimate %	EF Uncertainty estimate %	Combined Uncertainty estimate %	Combined Uncertainty estimate %	Contribution to variance in last year	Inventory trend in national emissions compared to base year %	Uncertainty introduced into the trend in total national emissions %
					(-)	(+)	(-)	(+)	(-)	(+)		(% BY)	(-) and (+)
3B1	Mature dairy cattle	CH ₄	1212.7	1645.0	2.0%	2.0%	38.0%	38.0%	38.1%	38.1%	0.02	35.6%	14.7%
1A4c	Agriculture/Forestry/Fisheries : all fuels	CH ₄	81.1	1135.2	4.9%	4.9%	48.5%	48.5%	48.8%	48.8%	0.01	1299.8%	23.3%
4C2	Land converted to grassland	CO ₂	-807.3	-736.6	0.0%	0.0%	75.0%	75.0%	75.0%	75.0%	0.01	-8.8%	7.4%
1A4b	Residential gaseous	CO ₂	19894.1	10907.5	5.0%	5.0%	0.3%	0.3%	5.0%	5.0%	0.01	-45.2%	0.2%
4B1	Cropland remaining cropland	CO ₂	1569.7	1097.3	0.0%	0.0%	44.0%	44.0%	44.0%	44.0%	0.01	-30.1%	1.9%
1A1c	Manufacture of Solid Fuels: solids	CO ₂	916.3	956.6	17.9%	17.9%	44.4%	44.4%	47.8%	47.8%	0.01	4.4%	7.3%
5A	Solid waste disposal	CH ₄	15320.8	1777.0	0.3%	0.3%	23.7%	23.7%	23.7%	23.7%	0.01	-88.4%	84.0%
2F1	Refrigeration and airconditioning	HFC	0.0	1373.2	14.6%	14.6%	24.9%	24.9%	28.9%	28.9%	0.01	1373181304.9 %	15.2%
2B8	Petrochemical and carbon black production	CO ₂	335.6	544.7	50.0%	50.0%	50.0%	50.0%	70.7%	70.7%	0.01	62.3%	7.3%
1A3b	Road transportation: diesel oil	CO ₂	13008.5	10642.3	3.0%	3.0%	2.0%	2.0%	3.6%	3.6%	0.01	-18.2%	2.1%
2A4d	Other	CO ₂	481.2	546.3	29.6%	29.6%	63.1%	63.1%	69.7%	69.7%	0.01	13.5%	6.7%
3B3	Swine	CH ₄	3772.8	1510.8	8.6%	8.6%	22.8%	22.8%	24.3%	24.3%	0.01	-60.0%	9.0%
1A2	Manufacturing Industries and Construction: gaseous	CO ₂	19044.2	11731.1	3.0%	3.0%	0.3%	0.3%	3.0%	3.0%	0.01	-38.4%	0.0%
1A3b	Road transportation: gasoline	CO ₂	10675.4	12293.9	2.0%	2.0%	2.0%	2.0%	2.8%	2.8%	0.01	15.2%	4.9%

CRT category		Gas	CO ₂ eq base year (kt)	CO ₂ eq last year (kt)	AD uncertainty %	AD uncertainty %	EF Uncertainty estimate %	EF Uncertainty estimate %	Combined Uncertainty estimate %	Combined Uncertainty estimate %	Contribution to variance in last year	Inventory trend in national emissions compared to base year %	Uncertainty introduced into the trend in total national emissions %
					(-)	(+)	(-)	(+)	(-)	(+)		(% BY)	(-) and (+)
1A4c	Agriculture/Forestry/Fisheries : gaseous	CO ₂	7328.7	5844.8	5.0%	5.0%	0.3%	0.3%	5.0%	5.0%	0.00	-20.2%	0.1%
4F2	Land converted to other land	CO ₂	144.3	190.5	0.0%	0.0%	152.0%	152.0%	152.0%	152.0%	0.00	32.0%	6.6%
2D2	Paraffin wax use	CO ₂	102.6	254.3	100.0%	100.0%	20.0%	20.0%	102.0%	102.0%	0.00	148.0%	1.7%
2B8	Chemical industry: Petrochemical and carbon black production	CH ₄	301.8	327.5	50.0%	50.0%	50.0%	50.0%	70.7%	70.7%	0.00	8.5%	3.0%
4B2	Land converted to cropland	N ₂ O	76.6	56.2	0.0%	0.0%	400.0%	400.0%	400.0%	400.0%	0.00	-26.7%	1.3%
4E1	Settlements remaining settlements	CO ₂	126.4	325.6	0.0%	0.0%	69.0%	69.0%	69.0%	69.0%	0.00	157.6%	7.5%
2B10	Other	N ₂ O	219.4	309.4	49.6%	49.6%	49.6%	49.6%	70.1%	70.1%	0.00	41.0%	3.7%
4A1	Forest land remaining forest land	CO ₂	-1301.2	-1766.4	0.0%	0.0%	12.0%	12.0%	12.0%	12.0%	0.00	35.8%	5.0%
3A1	Young cattle	CH ₄	3138.0	2004.9	0.9%	0.9%	9.2%	9.2%	9.3%	9.3%	0.00	-36.1%	0.0%
1A1a	Public Electricity and Heat Production: other fuels: waste incineration	CO ₂	601.5	2415.7	4.2%	4.2%	6.3%	6.3%	7.5%	7.5%	0.00	301.6%	5.7%
3A3	Swine	CH ₄	584.4	437.6	6.4%	6.4%	40.0%	40.0%	40.5%	40.5%	0.00	-25.1%	1.2%
1A4b	Residential:all fuels	CH ₄	503.0	290.2	10.0%	10.0%	56.2%	56.2%	57.1%	57.1%	0.00	-42.3%	0.8%

CRT category		Gas	CO ₂ eq base year (kt)	CO ₂ eq last year (kt)	AD uncertainty %	AD uncertainty %	EF Uncertainty estimate %	EF Uncertainty estimate %	Combined Uncertainty estimate %	Combined Uncertainty estimate %	Contribution to variance in last year	Inventory trend in national emissions compared to base year %	Uncertainty introduced into the trend in total national emissions %
					(-)	(+)	(-)	(+)	(-)	(+)		(% BY)	(-) and (+)
5D	Wastewater treatment and discharge	N ₂ O	544.2	520.9	26.2%	26.2%	15.0%	15.0%	30.1%	30.1%	0.00	-4.3%	1.2%
5B	Biological treatment of solid waste: composting	CH ₄	4.8	244.7	10.4%	10.4%	59.9%	59.9%	60.8%	60.8%	0.00	5010.9%	6.4%
3A2, 3A4	Other	CH ₄	630.9	571.0	14.9%	14.9%	21.0%	21.0%	25.7%	25.7%	0.00	-9.5%	1.6%
4C1	Grassland remaining grassland	CH ₄	240.9	175.5	0.0%	0.0%	79.0%	79.0%	79.0%	79.0%	0.00	-27.2%	0.8%
1A3b	Road transportation	N ₂ O	90.3	275.3	1.7%	1.7%	50.0%	50.0%	50.0%	50.0%	0.00	204.9%	4.8%
4E2	Land converted to settlements	N ₂ O	32.8	34.4	0.0%	0.0%	400.0%	400.0%	400.0%	400.0%	0.00	4.7%	2.4%
1A4a	Commercial/Institutional: gaseous	CO ₂	7757.8	4450.7	3.0%	3.0%	0.3%	0.3%	3.0%	3.0%	0.00	-42.6%	0.1%
2A2	Lime production	CO ₂	162.7	166.4	75.0%	75.0%	5.0%	5.0%	75.2%	75.2%	0.00	2.3%	0.1%
1B2b	Natural gas	CH ₄	596.8	319.0	1.5%	1.5%	38.3%	38.3%	38.3%	38.3%	0.00	-46.5%	1.0%
1A1a	Public Electricity and Heat Production: gaseous	CO ₂	13329.1	11883.1	1.0%	1.0%	0.3%	0.3%	1.0%	1.0%	0.00	-10.8%	0.4%
2F6	Other	HFC	0.0	223.3	20.0%	20.0%	50.0%	50.0%	53.9%	53.9%	0.00	223345246.0%	5.0%
6	Indirect CO ₂	CO ₂	917.2	439.4	25.0%	25.0%	10.0%	10.0%	26.9%	26.9%	0.00	-52.1%	0.6%
3B1	Mature dairy cattle	N ₂ O	169.1	163.5	2.5%	2.5%	67.9%	67.9%	67.9%	67.9%	0.00	-3.3%	1.7%
1A1	Energy Industries: all fuels	N ₂ O	131.3	180.0	1.0%	1.0%	54.6%	54.6%	54.7%	54.7%	0.00	37.1%	2.3%

CRT category		Gas	CO ₂ eq base year (kt)	CO ₂ eq last year (kt)	AD uncertainty %	AD uncertainty %	EF Uncertainty estimate %	EF Uncertainty estimate %	Combined Uncertainty estimate %	Combined Uncertainty estimate %	Contribution to variance in last year	Inventory trend in national emissions compared to base year %	Uncertainty introduced into the trend in total national emissions %
					(-)	(+)	(-)	(+)	(-)	(+)		(% BY)	(-) and (+)
5D	Wastewater treatment and discharge	CH ₄	421.3	219.2	13.5%	13.5%	39.4%	39.4%	41.7%	41.7%	0.00	-48.0%	0.9%
3B1	Growing cattle	CH ₄	563.3	465.4	1.0%	1.0%	18.0%	18.0%	18.0%	18.0%	0.00	-17.4%	0.8%
3B1	Growing cattle	N ₂ O	130.5	129.0	24.6%	24.6%	58.4%	58.4%	63.4%	63.4%	0.00	-1.1%	1.2%
4A2	Land converted to forest land	CO ₂	-919.5	-669.0	0.0%	0.0%	12.0%	12.0%	12.0%	12.0%	0.00	-27.2%	0.4%
2D1	Lubricant use	CO ₂	87.3	95.1	50.0%	50.0%	50.0%	50.0%	70.7%	70.7%	0.00	8.9%	0.9%
1B2	Fugitive emissions from oil and gas operations	CO ₂	774.7	1215.1	0.8%	0.8%	4.9%	4.9%	5.0%	5.0%	0.00	56.8%	1.6%
2A4a	Ceramics	CO ₂	140.1	83.4	50.0%	50.0%	50.0%	50.0%	70.7%	70.7%	0.00	-40.5%	0.1%
5B	Biological treatment of solid waste: composting	N ₂ O	5.8	96.3	10.8%	10.8%	60.3%	60.3%	61.2%	61.2%	0.00	1559.5%	2.5%
1A4	Other Sectors: all fuels	N ₂ O	45.6	47.7	11.4%	11.4%	116.8%	116.8%	117.4%	117.4%	0.00	4.6%	1.0%
1A2	Manufacturing Industries and Construction: liquids	CO ₂	3465.7	1573.4	2.8%	2.8%	1.9%	1.9%	3.4%	3.4%	0.00	-54.6%	0.5%
2A4b	Other uses of soda ash	CO ₂	68.6	104.3	0.0%	0.0%	50.0%	50.0%	50.0%	50.0%	0.00	52.1%	1.3%
1A1c	Manufacture of Solid Fuels: gaseous	CO ₂	1184.2	956.8	2.0%	2.0%	5.0%	5.0%	5.4%	5.4%	0.00	-19.2%	0.4%
1A3d	Domestic navigation	CO ₂	725.5	1138.6	4.0%	4.0%	1.8%	1.8%	4.4%	4.4%	0.00	56.9%	0.5%
1A4c	Agriculture/Forestry/Fisheries : liquids	CO ₂	2533.6	1529.3	2.9%	2.9%	1.5%	1.5%	3.3%	3.3%	0.00	-39.6%	0.1%

CRT category		Gas	CO ₂ eq base year (kt)	CO ₂ eq last year (kt)	AD uncertainty %	AD uncertainty %	EF Uncertainty estimate %	EF Uncertainty estimate %	Combined Uncertainty estimate %	Combined Uncertainty estimate %	Contribution to variance in last year	Inventory trend in national emissions compared to base year %	Uncertainty introduced into the trend in total national emissions %
					(-)	(+)	(-)	(+)	(-)	(+)		(% BY)	(-) and (+)
3B4	Other livestock	N ₂ O	53.9	86.1	12.7%	12.7%	53.9%	53.9%	55.4%	55.4%	0.00	59.8%	1.2%
1B2c	Venting and flaring	CH ₄	1669.8	86.2	49.3%	49.3%	19.7%	19.7%	53.1%	53.1%	0.00	-94.8%	8.6%
3B3	Swine	N ₂ O	124.7	85.7	16.4%	16.4%	49.6%	49.6%	52.2%	52.2%	0.00	-31.3%	0.1%
2G2	SF ₆ use	SF ₆	213.1	132.4	30.0%	30.0%	15.0%	15.0%	33.5%	33.5%	0.00	-37.8%	0.0%
4C2	Land converted to grassland	CH ₄	23.6	50.9	0.0%	0.0%	79.0%	79.0%	79.0%	79.0%	0.00	115.9%	1.3%
1A1a	Public Electricity and Heat Production: liquids	CO ₂	233.2	211.0	4.5%	4.5%	18.1%	18.1%	18.7%	18.7%	0.00	-9.5%	0.5%
1A4 excl 1A4c	Liquids	CO ₂	1571.0	878.0	4.2%	4.2%	1.4%	1.4%	4.5%	4.5%	0.00	-44.1%	0.1%
1A1	Energy Industries: all fuels	CH ₄	77.0	119.8	1.6%	1.6%	29.9%	29.9%	29.9%	29.9%	0.00	55.6%	0.9%
1A2	Manufacturing Industries and Construction: all fuels	N ₂ O	30.4	34.3	3.5%	3.5%	99.0%	99.0%	99.0%	99.0%	0.00	12.7%	0.7%
2A3	Glass production	CO ₂	142.4	57.2	0.0%	0.0%	50.0%	50.0%	50.0%	50.0%	0.00	-59.8%	0.7%
1A3b	Road transportation	CH ₄	197.1	55.8	1.8%	1.8%	48.8%	48.8%	48.9%	48.9%	0.00	-71.7%	1.5%
4F2	Land converted to other land	N ₂ O	4.9	6.6	0.0%	0.0%	400.0%	400.0%	400.0%	400.0%	0.00	35.4%	0.6%
4D2	Land converted to wetlands	CO ₂	-1.5	34.3	0.0%	0.0%	76.0%	76.0%	76.0%	76.0%	0.00	-2462.6%	1.2%
4A2	Land converted to forest land	N ₂ O	10.8	6.5	0.0%	0.0%	400.0%	400.0%	400.0%	400.0%	0.00	-39.7%	0.1%
2G	Other product manufacture and use	CH ₄	57.9	50.4	9.8%	9.8%	49.0%	49.0%	50.0%	50.0%	0.00	-12.8%	0.3%

CRT category		Gas	CO ₂ eq base year (kt)	CO ₂ eq last year (kt)	AD uncertainty %	AD uncertainty %	EF Uncertainty estimate %	EF Uncertainty estimate %	Combined Uncertainty estimate %	Combined Uncertainty estimate %	Contribution to variance in last year	Inventory trend in national emissions compared to base year %	Uncertainty introduced into the trend in total national emissions %
					(-)	(+)	(-)	(+)	(-)	(+)		(% BY)	(-) and (+)
1A4a	Commercial/Institutional: all fuels	CH ₄	53.6	65.3	15.5%	15.5%	33.4%	33.4%	36.8%	36.8%	0.00	21.7%	0.5%
3A1	Other mature cattle	CH ₄	235.4	111.7	2.0%	2.0%	20.8%	20.8%	20.9%	20.9%	0.00	-52.5%	0.4%
4D2	Land converted to wetlands	N ₂ O	3.8	5.6	0.0%	0.0%	400.0%	400.0%	400.0%	400.0%	0.00	45.9%	0.6%
1A2	Manufacturing Industries and Construction: all fuels	CH ₄	65.1	60.0	3.3%	3.3%	36.8%	36.8%	37.0%	37.0%	0.00	-7.9%	0.3%
2B4	Caprolactam production	N ₂ O	658.0	68.3	20.0%	20.0%	23.0%	23.0%	30.5%	30.5%	0.00	-89.6%	3.6%
1A3b	Road transportation: LPG	CO ₂	2740.4	356.8	5.0%	5.0%	2.0%	2.0%	5.4%	5.4%	0.00	-87.0%	1.2%
1A1b	Petroleum Refining: gaseous	CO ₂	1042.2	1829.8	1.0%	1.0%	0.3%	0.3%	1.0%	1.0%	0.00	75.6%	0.1%
4A1	Forest land remaining forest land	N ₂ O	2.8	3.7	0.0%	0.0%	400.0%	400.0%	400.0%	400.0%	0.00	32.2%	0.3%
1A3b	Road transportation: gaseous	CO ₂	0.0	137.0	10.0%	10.0%	0.3%	0.3%	10.0%	10.0%	0.00	137018656.9%	0.0%
3H	Ureum use	CO ₂	1.5	52.1	25.0%	25.0%	1.0%	1.0%	25.0%	25.0%	0.00	3339.7%	0.0%
1B2a	Oil	CH ₄	22.8	18.0	2.0%	2.0%	72.0%	72.0%	72.0%	72.0%	0.00	-20.9%	0.1%
3B4	Poultry	CH ₄	543.8	33.5	2.6%	2.6%	37.1%	37.1%	37.2%	37.2%	0.00	-93.8%	5.2%
3B2, 3B4	Other	CH ₄	37.8	25.6	27.6%	27.6%	38.6%	38.6%	47.4%	47.4%	0.00	-32.2%	0.0%
1A3 excl 1A3b	Other	N ₂ O	6.1	8.7	4.0%	4.0%	133.9%	133.9%	133.9%	133.9%	0.00	43.1%	0.3%
1A5b	Military use: liquids	CO ₂	386.7	199.8	5.1%	5.1%	2.0%	2.0%	5.5%	5.5%	0.00	-48.3%	0.0%
2D3	Other	CO ₂	0.0	38.7	25.0%	25.0%	10.0%	10.0%	26.9%	26.9%	0.00	38722303.6%	0.2%

CRT category		Gas	CO ₂ eq base year (kt)	CO ₂ eq last year (kt)	AD uncertainty %	AD uncertainty %	EF Uncertainty estimate %	EF Uncertainty estimate %	Combined Uncertainty estimate %	Combined Uncertainty estimate %	Contribution to variance in last year	Inventory trend in national emissions compared to base year %	Uncertainty introduced into the trend in total national emissions %
					(-)	(+)	(-)	(+)	(-)	(+)		(% BY)	(-) and (+)
1B1b	Solid fuel transformation	CO ₂	110.4	65.5	0.0%	0.0%	15.0%	15.0%	15.0%	15.0%	0.00	-40.7%	0.0%
5C	Open burning of waste	CH ₄	4.2	3.0	100.0%	100.0%	300.0%	300.0%	316.2%	316.2%	0.00	-29.0%	0.0%
2G	Other product manufacture and use	N ₂ O	200.0	59.3	10.2%	10.2%	10.2%	10.2%	14.4%	14.4%	0.00	-70.3%	0.3%
2B	Fluorochemical production	HFC	4697.2	56.7	0.0%	0.0%	15.1%	15.1%	15.1%	15.1%	0.00	-98.8%	19.7%
3G	Liming	CO ₂	183.2	29.8	25.1%	25.1%	0.9%	0.9%	25.1%	25.1%	0.00	-83.7%	0.0%
1A3 excl 1A3b	Other	CH ₄	2.5	13.1	4.0%	4.0%	49.6%	49.6%	49.7%	49.7%	0.00	421.3%	0.3%
2E	Electronic Industry	PFC	22.7	24.3	5.0%	5.0%	25.0%	25.0%	25.5%	25.5%	0.00	6.8%	0.1%
2B2	Nitric acid production	N ₂ O	5410.9	72.7	5.0%	5.0%	6.0%	6.0%	7.8%	7.8%	0.00	-98.7%	9.0%
4B1	Cropland remaining cropland	CH ₄	14.1	7.2	0.0%	0.0%	79.0%	79.0%	79.0%	79.0%	0.00	-49.3%	0.1%
4A1	Forest land remaining forest land	CH ₄	5.2	6.9	0.0%	0.0%	79.0%	79.0%	79.0%	79.0%	0.00	32.7%	0.1%
5C	Open burning of waste	N ₂ O	2.1	1.6	100.0%	100.0%	300.0%	300.0%	316.2%	316.2%	0.00	-21.4%	0.0%
4B2	Land converted to cropland	CH ₄	7.4	5.4	0.0%	0.0%	79.0%	79.0%	79.0%	79.0%	0.00	-27.4%	0.0%
4C1	Grassland remaining grassland	N ₂ O	1.8	1.0	0.0%	0.0%	400.0%	400.0%	400.0%	400.0%	0.00	-46.4%	0.0%
1A5b	Military use: liquids	N ₂ O	5.3	2.5	7.3%	7.3%	114.6%	114.6%	114.8%	114.8%	0.00	-53.2%	0.0%
3B1	Other mature cattle	CH ₄	24.8	8.4	2.0%	2.0%	32.6%	32.6%	32.7%	32.7%	0.00	-66.0%	0.1%
1A3a	Domestic aviation	CO ₂	84.8	27.2	8.6%	8.6%	3.4%	3.4%	9.2%	9.2%	0.00	-68.0%	0.0%

CRT category		Gas	CO ₂ eq base year (kt)	CO ₂ eq last year (kt)	AD uncertainty %	AD uncertainty %	EF Uncertainty estimate %	EF Uncertainty estimate %	Combined Uncertainty estimate %	Combined Uncertainty estimate %	Contribution to variance in last year	Inventory trend in national emissions compared to base year %	Uncertainty introduced into the trend in total national emissions %
					(-)	(+)	(-)	(+)	(-)	(+)		(% BY)	(-) and (+)
1A3c	Railways	CO ₂	90.7	59.1	3.0%	3.0%	2.0%	2.0%	3.6%	3.6%	0.00	-34.9%	0.0%
3B1	Other mature cattle	N ₂ O	6.2	2.2	2.0%	2.0%	77.7%	77.7%	77.8%	77.8%	0.00	-64.1%	0.1%
1A3e	Other	CO ₂	342.2	84.4	2.0%	2.0%	0.3%	0.3%	2.0%	2.0%	0.00	-75.3%	0.0%
2H	Other industrial	CO ₂	72.5	30.8	2.0%	2.0%	5.0%	5.0%	5.4%	5.4%	0.00	-57.5%	0.0%
3B2	Sheep	N ₂ O	6.4	1.3	5.4%	5.4%	111.9%	111.9%	112.0%	112.0%	0.00	-80.5%	0.1%
4C2	Land converted to grassland	N ₂ O	0.4	0.3	0.0%	0.0%	400.0%	400.0%	400.0%	400.0%	0.00	-10.2%	0.0%
4G	Harvested wood products	CO ₂	-68.6	126.3	0.0%	0.0%	1.0%	1.0%	1.0%	1.0%	0.00	-284.2%	0.1%
4A2	Land converted to forest land	CH ₄	3.5	1.5	0.0%	0.0%	79.0%	79.0%	79.0%	79.0%	0.00	-56.4%	0.0%
2D2	Paraffin wax use	CH ₄	0.2	0.8	100.0%	100.0%	50.0%	50.0%	111.8%	111.8%	0.00	395.9%	0.0%
1B1b	Solid fuel transformation	CH ₄	12.3	4.8	2.0%	2.0%	11.1%	11.1%	11.2%	11.2%	0.00	-60.9%	0.0%
4D1	Wetlands remaining wetlands	N ₂ O	0.1	0.1	0.0%	0.0%	400.0%	400.0%	400.0%	400.0%	0.00	128.0%	0.0%
1A5b	Military use: liquids	CH ₄	0.9	0.4	7.8%	7.8%	77.8%	77.8%	78.2%	78.2%	0.00	-53.2%	0.0%
2C1	Iron and steel production	CO ₂	43.7	5.6	3.0%	3.0%	5.0%	5.0%	5.8%	5.8%	0.00	-87.2%	0.0%
2G	Other product manufacture and use	CO ₂	0.2	0.6	50.0%	50.0%	20.0%	20.0%	53.9%	53.9%	0.00	218.6%	0.0%
2B9	Fluorochemical production	PFC	0.0	0.8	0.0%	0.0%	20.0%	20.0%	20.0%	20.0%	0.00	810334.0%	0.0%
1A4	Solids	CO ₂	162.7	0.2	50.0%	50.0%	5.0%	5.0%	50.2%	50.2%	0.00	-99.9%	0.2%
2C3	Aluminium production	CO ₂	408.4	0.0	2.0%	2.0%	5.0%	5.0%	5.4%	5.4%	0.00	-100.0%	0.6%
2A1	Cement production	CO ₂	415.8	0.0	5.0%	5.0%	10.0%	10.0%	11.0%	11.0%	0.00	-100.0%	1.2%

CRT category		Gas	CO ₂ eq base year (kt)	CO ₂ eq last year (kt)	AD uncertainty %	AD uncertainty %	EF Uncertainty estimate %	EF Uncertainty estimate %	Combined Uncertainty estimate %	Combined Uncertainty estimate %	Contribution to variance in last year	Inventory trend in national emissions compared to base year %	Uncertainty introduced into the trend in total national emissions %
					(-)	(+)	(-)	(+)	(-)	(+)		(% BY)	(-) and (+)
2B7	Soda ash production	CO ₂	63.8	0.0	0.0%	0.0%	5.0%	5.0%	5.0%	5.0%	0.00	-100.0%	0.1%
2C3	Aluminium production	PFC	2373.9	0.0	0.0%	0.0%	0.3%	0.3%	0.0%	0.0%	0.00	-100.0%	0.2%

A2.2 Uncertainties 1990 emissions

Since the late nineties, the Netherlands has set up a programme for improving the quality of the greenhouse gas inventory, motivated by the requirements of the Kyoto Protocol. At the start of this programme, a workshop was held involving all the experts engaged in the inventory programme; at that time still under the lead of the Ministry of Housing, Spatial Planning and the Environment (VROM). The results of this workshop have been reported in Van Amstel et al. (2000). As far as can be recollected at this time, this was the first systematic attempt to assess the uncertainties of greenhouse gas emissions in the Netherlands. Table A2.5 shows the assessment of the uncertainties in the respective gases at that time, which is based on expert judgement. To facilitate a comparison to the current Approach 1 analysis, the emissions per source category in 1990, combined with uncertainty insights per source category following the current procedure, are added in a separate column.

Table A2.5 Uncertainties Greenhouse Gas emissions in 1990 (Approach 1)

Gas	Activity	Emission level base year (Mt CO ₂ eq)	Uncertainty 1990 (%) 2000	Uncertainty 1990 (%) 2026 ⁽¹⁾
CO ₂	Energy (sector 1)	150.5	2	
	Industrial Processes and Product Use (IPPU, sector2)	12.0	25	
	(Land Use, sector 4)	3.1	(60)	
subtotal		166.7	3	2.3
CH ₄	Energy (sector 1)	3.3	25	
	Agriculture (sector 3)	16.5	25	
	Waste (sector 5)	15.8	30	
subtotal		36.5	17	8
N ₂ O	Energy (sector 1)	0.3	75	
	IPPU (sector 2)	6.5	35	
	Agriculture (sector 3)	8.6	75	
subtotal		16.1	34	12
HFC/SF ₆	Energy (sector 1)	0	50	
	IPPU (sector 2)	4.7	50	
PFC	IPPU (sector 2)	2.4	100	
subtotal		7.3	100	15⁽²⁾
Other sectors	Other (sector 6)	0.9	50	
Total emissions		226.6	4.4	2

(1) uncertainty 1990 assessed with 2026 methodology

(2) total F-gases

Note that the assessment of uncertainties for 1990 is based on a first order expert judgement, whereas uncertainties nowadays result from a more systematic approach; looking more in depth at the source category-level uncertainties.

Table A2.5 shows that overall uncertainty for the 1990 emissions is (much) smaller in the 2026 calculation.

Annex 3 Detailed methodological descriptions of individual sources or sink categories

A detailed description of methodologies per source/sink category, including a list of country-specific EFs, can be found in the relevant methodology reports on the website <http://english.rvo.nl/nie>.

These methodology reports are also integral part of this submission (see Annex 7).

Annex 4 CO₂: the national energy balance for the most recent inventory year

The national energy balance for 2024 in the Netherlands (as used for this submission) can be found on the following pages.

The national energy balance for other years is available online at: [StatLine - Energy balance sheet; supply, transformation and consumption \(cbs.nl\)](https://statline.cbs.nl/energy-balance-sheet)

Please note that because of the size, the table underneath has been split up in 2 parts.

Energy Balance the Netherlands 2024, part 1-2

Energy balance sheet the Netherlands 2024	Anthracite	Coking coal	Steam coal	Lignite	Coke-oven cokes	BKB (Braunkohlenbriketts)	Patent fuel	Coal tar	Gas works gas	Coke oven gas	Blast furnace gas	Crude oil	Natural gas liquids	Additives	Other hydrocarbons	Residual gas	Lpg
Energy supply																	
Total Primary Energy Supply (TPES)	0.1	110	61	0	3			-2				207 1	320	25		10	80
Indigenous production												14	4.3	7		10	
Imports	0.1	109	58	0	3							395 7	325	55			163
Exports					2			3				191 0	13	38			85
Bunkers																	
Stock change		0.5	2.3		2			1				9	3.7	0			1.2
Energy consumption																	
Net energy consumption	0.1	110	61	0	3			-2				207 1	320	25		10	80
Energy transformation																	
Total energy transformation input		110	60		46					1.4	23	207 1	237	25		49.4	46
Electricity and CHP transformation input			60							1.4	23					19.2	
Other transformation input		110			46							207 1	237	25		30.2	46
Total energy transformation output					49			3		15	36					203	56

Energy balance sheet the Netherlands 2024	Anthracite	Coking coal	Steam coal	Lignite	Coke-oven cokes	BKB (Braunkohlenbriketts)	Patent fuel	Coal tar	Gas works gas	Coke oven gas	Blast furnace gas	Crude oil	Natural gas liquids	Additives	Other hydrocarbons	Residual gas	Lpg
Electricity/CHP transformation output																	
Other transformation output					49			3		15	36					203	56
Total net energy transformation		110	60		-3			-3		-13	-13	207 1	237	25		- 153	-9
Net electricity/CHP transformation			60							1.4	23					19.2	
Net other transformation		110			-3			-3		-15	-36	207 1	237	25		- 172	-9
Energy sector own use																	
Total energy sector own use										6.8	8.2					74.7	1.7
Production of heat and power																	
Extraction of crude petroleum and gas																	
Coke-oven plants										5.6	1.1						
Blast furnaces										1.1	7.1						
Oil refineries																71.7	1.7
Electricity and gas supply																	
Distribution losses																	
Distribution losses																	
Final consumption																	
Total final consumption	0.1	0.1	0.3	0	6			1		6.5	4.6		83	0		88.5	87
Total final energy consumption		0.1	0.3	0	6					6.5	4.6					88.5	9.5

Energy balance sheet the Netherlands 2024	Anthracite	Coking coal	Steam coal	Lignite	Coke-oven cokes	BKB (Braunkohlenbriketts)	Patent fuel	Coal tar	Gas works gas	Coke oven gas	Blast furnace gas	Crude oil	Natural gas liquids	Additives	Other hydrocarbons	Residual gas	Lpg
Total industry		0.1	0.3		6					6.5	4.6					88.5	0.2
Iron and steel		0.1			5					6.5	4.6						
Chemical and petrochemical																88.5	
Non-ferrous metals																	
Non-metallic minerals					1												
Transport equipment																	
Machinery																	
Mining and quarrying																	
Food and tobacco			0.3														
Paper, pulp and printing																	
Wood and wood products																	
Construction																	0.1
Textile and leather																	
Other industry and non-specified																	0.1
Total transport																	5.3
Domestic aviation																	
Road transport																	5.3
Rail transport																	
Pipeline transport																	
Domestic navigation																	

Energy balance sheet the Netherlands 2024	Anthracite	Coking coal	Steam coal	Lignite	Coke-oven cokes	BKB (Braunkohlenbriketts)	Patent fuel	Coal tar	Gas works gas	Coke oven gas	Blast furnace gas	Crude oil	Natural gas liquids	Additives	Other hydrocarbons	Residual gas	Lpg
Non-specified																	
Total other sectors				0													3.9
Services, waste, water and repair				0													1.5
Households																	1
Agriculture																	1.4
Fishing																	
Non-specified																	
Total non-energy use					0			1					83	0			78
Industry (excluding the energy sector)					0			1					83	0			78
Of which chemistry and pharmaceuticals													83	0			78
Transport																	
Other sectors																	
Statistical difference																	
Statistical differences																	

Energy Balance the Netherlands 2024, part 2-2

Energy balance sheet the Netherlands 2024	Naphtha	Motor gasoline	Gasoline type jet fuel	Aviation gasoline	Kerosene type jet fuel	Other kerosene	Gas/diesel oil	Fuel oil	White spirit and industrial spirit (SBP)	Lubricants	Bitumen	Paraffin waxes	Petroleum coke	Other petroleum products	Natural gas	Biomass	Non- renewable municipal waste	Electricity
Energy supply	Energy supply																	
Total Primary Energy Supply (TPES)	214	-466		-3	-356.5	-19.9	-555.9	-243.1	7	-24.8	-10.5	1	11	-16	941.4	171.9	29	-15.2
Indigenous production														4.5	300.1	189.9	27	
Imports	792	327.2			181.6	17.8	584.6	1005.5	107.4	114.1	24.1	10	67	60	1494	53.5	3	72.1
Exports	592	785.2		3	385.2	37.8	1060.8	864.4	99.9	132.1	34.9	10	59	84	953	59.3	1	87.3
Bunkers					145.9		62.9	386.3		4.8					16.4	15.3		
Stock change	14	-8		-0	-7	0.1	-16.8	2	-0.5	-1.9	0.3	0	3.7	4	116.6	3.1		
Energy consumption	Energy consumption																	
Net energy consumption	214	-466		-3	-356.5	-19.9	-555.9	-243.1	7	-24.8	-10.5	1	11	-16	934.9	171.8	29	-18.1
Energy transformation	Energy transformation																	
Total energy transformation input	562	2.2		0	5.1	11.4	136.6	295.4	61.5	11.9	0.7	0		36	407.5	161.9	29	6.1
Electricity and CHP transformation input							0.5								362.7	89.3	29	0.8

Energy balance sheet the Netherlands 2024	Naphtha	Motor gasoline	Gasoline type jet fuel	Aviation gasoline	Kerosene type jet fuel	Other kerosene	Gas/diesel oil	Fuel oil	White spirit and industrial spirit (SBP)	Lubricants	Bitumen	Paraffin waxes	Petroleum coke	Other petroleum products	Natural gas	Biomass	Non- renewable municipal waste	Electricity
Other transformation input	562	2.2		0	5.1	11.4	136.1	295.4	61.5	11.9	0.7	0		36	44.8	72.6		5.4
Total energy transformation output	532	641.6		4	363	32.7	903.6	538.5	57.6	43.2	15.5	0	13	63	11.6	57.4		445.8
Electricity/CHP transformation output																		445.8
Other transformation output	532	641.6		4	363	32.7	903.6	538.5	57.6	43.2	15.5	0	13	63	11.6	57.4		
Total net energy transformation	29	- 639.4		-3	- 357.9	- 21.3	-767	-243.1	3.9	-31.3	14.7	-0	- 13	- 26	395.9	104.5	29	- 439.7
Net electricity/CHP transformation							0.5								362.7	89.3	29	- 445.1
Net other transformation	29	- 639.4		-3	- 357.9	- 21.3	-767.5	-243.1	3.9	-31.3	14.7	-0	- 13	- 26	33.3	15.2		5.4
Energy sector own use	Energy sector own use																	
Total energy sector own use													9.7		32.8			30.9
Production of heat and power																		13
Extraction of crude petroleum and gas															14.3			5.5
Coke-oven plants																		0.3

Energy balance sheet the Netherlands 2024	Naphtha	Motor gasoline	Gasoline type jet fuel	Aviation gasoline	Kerosene type jet fuel	Other kerosene	Gas/diesel oil	Fuel oil	White spirit and industrial spirit (SBP)	Lubricants	Bitumen	Paraffin waxes	Petroleum coke	Other petroleum products	Natural gas	Biomass	Non- renewable municipal waste	Electricity
Blast furnaces															0.6			0.5
Oil refineries													9.7		12.3			8.7
Electricity and gas supply															0.6			1.7
Distribution losses	Distribution losses																	
Distribution losses																		17
Final consumption	Final consumption																	
Total final consumption	185	173.4	0	1.5	1.3	211.2		3.1	6.5	4.2	1	15	10	506.2	67.3			373.7
Total final energy consumption		173.4	0	1.5	0.2	211.2							1.6	437.4	67.3			373.7
Total industry		0.2				19.2							1.6	139	6.8			109.7
Iron and steel						0.1								8				7.5
Chemical and petrochemical						0.1							1.6	50.7	0.1			36.5
Non-ferrous metals														1.8				3.1
Non-metallic minerals						0.1								14.6				3.5
Transport equipment														1.2				1.6
Machinery						0.1								7.5				11.3
Mining and quarrying						0.1								1.3				1

Energy balance sheet the Netherlands 2024	Naphtha	Motor gasoline	Gasoline type jet fuel	Aviation gasoline	Kerosene type jet fuel	Other kerosene	Gas/diesel oil	Fuel oil	White spirit and industrial spirit (SBP)	Lubricants	Bitumen	Paraffin waxes	Petroleum coke	Other petroleum products	Natural gas	Biomass	Non- renewable municipal waste	Electricity
Food and tobacco														39.3	0.9		24.7	
Paper, pulp and printing														7.2	1.7		6.3	
Wood and wood products														0.5	0.4		1	
Construction		0.2					18.6							2	3.5		4	
Textile and leather														1.7			1.4	
Other industry and non-specified														3.2	0.3		7.8	
Total transport		171.6		0	0.3		161.5							2.9	35.5		16	
Domestic aviation				0	0.3													
Road transport		170.1					148.4							2.4	35.2		9.9	
Rail transport							0.8								0.1		6.1	
Pipeline transport																		
Domestic navigation		1.5					12.2							0.5	0.1			
Non-specified																		
Total other sectors		1.6			1.1	0.2	30.4							295.5	24.9		248	
Services, waste, water and repair		0.5					9.6							79.3	3.5		138.1	
Households		0.7				0.2	0.3							196.2	16.2		77.9	

Energy balance sheet the Netherlands 2024	Naphtha	Motor gasoline	Gasoline type jet fuel	Aviation gasoline	Kerosene type jet fuel	Other kerosene	Gas/diesel oil	Fuel oil	White spirit and industrial spirit (SBP)	Lubricants	Bitumen	Paraffin waxes	Petroleum coke	Other petroleum products	Natural gas	Biomass	Non- renewable municipal waste	Electricity
Agriculture		0.4					14.5								19.9	5.3		31.7
Fishing							4.5											
Non-specified					1.1		1.6								0.1			0.3
Total non-energy use	185					1.1			3.1	6.5	4.2	1	15	8.7	68.8			
Industry (excluding the energy sector)	185					1.1			3.1	2.2	4.2	1	15	8.7	68.8			
Of which chemistry and pharmaceuticals	185					1.1			2.7			1	11	8.7	68.8			
Transport										2.8								
Other sectors										1.5								
Statistical difference	Statistical difference																	
Statistical differences															6.5	0.1		2.9

Annex 5 The Netherlands' fuel list and standard CO₂ emission factors. Version January 2026

Colophon

Project name	Annual update of fuel list for the Netherlands
Project number	113569/BL2026
Version number	January 2026
Project leader	P.J. Zijlema

Enclosures	0
Author	P.J. Zijlema

The initial version of this fuel list was approved by the Steering Committee Emission Registration (SCER) in 2004, and the list was subsequently updated on the basis of decisions of the Steering Committee concerning the CO₂ emission factor for natural gas at meetings held on 25 April 2006 and 21 April 2009. The Steering Committee Emission Registration delegated the authority for approving this list to the ER/Working Group on Emission Monitoring (WEM) on 21 April 2009.

The present document (the version of January 2026) is approved by WEM, after detailed discussions with the Dutch Emission Authority (NEa) and several institutes that participate in the Emission Register (ER/PRTR) project, a.o:

- CBS, Statistics Netherlands,
- PBL, Netherlands Environmental Assessment Agency,
- RIVM, National Institute for Public Health and the Environment,
- RWS, Rijkswaterstaat, an agency of the Dutch Ministry of Infrastructure and the Environment responsible for the design, construction, management and maintenance of the main infrastructure facilities in the Netherlands,
- TNO, the Dutch organization for Applied Scientific Research (TNO).

A5.1 Fuel list, version of January 2026

Name (Dutch)	Name (English)	Unit	Net Calorific Value (MJ/unit)				CO ₂ EF (kg/GJ)			
			2024	2025	2026	Ref ¹⁾	2024	2025	2026	Ref ¹⁾
	A. Liquid Fossil, Primary Fuels									
Ruwe aardolie	Crude oil	kg	42.7	42.7	42.7	CS	73.3	73.3	73.3	IPCC
Orimulsion	Orimulsion	kg	27.5	27.5	27.5	IPCC	77.0	77.0	77.0	IPCC
Aardgascondensaat	Natural Gas Liquids	kg	44.0	44.0	44.0	CS	64.2	64.2	64.2	IPCC
	Liquid Fossil, Secondary Fuels									
Motorbenzine ²⁾	Gasoline ²⁾	kg	43.3	43.3	43.3	CS	72.2	72.2	72.2	CS
Vliegtuigbenzine	Aviation gasoline	kg	44.0	44.0	44.0	CS	72.0	72.0	72.0	CS
Kerosine luchtvaart ²⁾	Jet Kerosene ²⁾	kg	43.5	43.5	43.5	CS	71.5	71.5	71.5	IPCC
Petroleum (incl. lampolie)	Other kerosene (incl. lamp oil)	kg	43.1	43.1	43.1	CS	71.9	71.9	71.9	IPCC
Leisteenolie	Shale oil	kg	38.1	38.1	38.1	IPCC	73.3	73.3	73.3	IPCC
Gas-/dieselolie ²⁾	Gas/Diesel oil ²⁾	kg	43.2	43.2	43.2	CS	72.5	72.5	72.5	CS
Zware stookolie	Residual Fuel oil	kg	41.0	41.0	41.0	CS	77.4	77.4	77.4	IPCC
LPG (incl. butaan en propaan)	LPG (incl. butane and propane)	kg	45.2	45.2	45.2	CS	66.7	66.7	66.7	CS
Ethaan	Ethane	kg	45.2	45.2	45.2	CS	61.6	61.6	61.6	IPCC
Nafta's	Naphtha	kg	44.0	44.0	44.0	CS	73.3	73.3	73.3	IPCC
Bitumen	Bitumen	kg	41.9	41.9	41.9	CS	80.7	80.7	80.7	IPCC
Smeeroliën	Lubricants	kg	41.4	41.4	41.4	CS	73.3	73.3	73.3	IPCC
Petroleumcokes	Petroleum Coke	kg	35.2	35.2	35.2	CS	97.5	97.5	97.5	IPCC
Raffinaderij grondstoffen	Refinery Feedstocks	kg	43.0	43.0	43.0	IPCC	73.3	73.3	73.3	IPCC
Raffinaderijgas	Refinery Gas	kg	45.2	45.2	45.2	CS	64.4	64.4	64.4	CS
Chemisch restgas	Chemical Waste Gas	kg	45.2	45.2	45.2	CS	61.8	61.8	61.8	CS
Overige oliën	Other oil	kg	40.2	40.2	40.2	IPCC	73.3	73.3	73.3	IPCC
Paraffine	Paraffin Waxes	kg	42.7	42.7	42.7	CS	73.3	73.3	73.3	IPCC

Name (Dutch)	Name (English)	Unit	Net Calorific Value (MJ/unit)				CO ₂ EF (kg/GJ)			
			2024	2025	2026	Ref ¹⁾	2024	2025	2026	Ref ¹⁾
Terpentine	White Spirit and SBP	kg	43.6	43.6	43.6	CS	73.3	73.3	73.3	IPCC
Overige aardolie producten	Other Petroleum Products	kg	42.7	42.7	42.7	CS	73.3	73.3	73.3	IPCC
Fossiele additieven	Fossil fuel additives	kg	44.0	44.0	44.0	CS	73.3	73.3	73.3	IPCC
B. Solid Fossil, Primary Fuels										
Antraciet	Anthracite	kg	29.3	29.3	29.3	CS	98.3	98.3	98.3	IPCC
Cokeskolen	Coking Coal	kg	28.6	28.6	28.6	CS	94.0	94.0	94.0	CS
Cokeskolen	Coking Coal (used in coke oven)	kg	28.6	28.6	28.6	CS	95.4	95.4	95.4	CS
Cokeskolen	Coking Coal (used in blast furnaces)	kg	28.6	28.6	28.6	CS	89.8	89.8	89.8	CS
Overige bitumineuze steenkool ³⁾	Other Bituminous Coal ³⁾	kg	24.3	24.3 ³⁾	24.3 ³⁾	CS	92.7	92.7	92.7	CS
Sub-bitumineuze steenkool	Sub-Bituminous Coal	kg	18.9	18.9	18.9	IPCC	96.1	96.1	96.1	IPCC
Bruinkool	Lignite	kg	20.0	20.0	20.0	CS	101.0	101.0	101.0	IPCC
Bitumineuze Leisteen	Oil Shale	kg	8.9	8.9	8.9	IPCC	107.0	107.0	107.0	IPCC
Turf	Peat	kg	9.76	9.76	9.76	IPCC	106.0	106.0	106.0	IPCC
Solid Fossil, Secondary Fuels										
Steenkool- en bruinkoolbriketten	BKB & Patent Fuel	kg	20.7	20.7	20.7	IPCC	97.5	97.5	97.5	IPCC
Cokesoven/ gascokes	Coke Oven/Gas Coke	kg	28.5	28.5	28.5	CS	106.8	106.8	106.8	CS
Cokesovengas	Coke Oven gas	MJ	1.0	1.0	1.0	CS	42.8	42.8	42.8	CS
Hoogovengas	Blast Furnace Gas	MJ	1.0	1.0	1.0	CS	247.4	247.4	247.4	CS
Oxystaalovengas	Oxy Gas	MJ	1.0	1.0	1.0	CS	191.9	191.9	191.9	CS
Fosforovengas	Fosfor Gas	Nm3	11.0	11.0	11.0	CS	143.9	143.9	143.9	CS
Steenkool bitumen	Coal tar	kg	41.9	41.9	41.9	CS	80.7	80.7	80.7	IPCC
C. Gaseous Fossil Fuels										
Aardgas ⁴⁾	Natural Gas (dry) ⁴⁾	Nm3 ae	31.65	31.65	31.65	CS	56.2 ⁴⁾	56.2 ⁴⁾	56.2 ⁴⁾	CS
Compressed natural gas (CNG) ⁴⁾	Compressed natural gas (CNG) ⁴⁾	Nm3 ae	31.65	31.65	31.65	CS	56.2 ⁴⁾	56.2 ⁴⁾	56.2 ⁴⁾	CS

Name (Dutch)	Name (English)	Unit	Net Calorific Value (MJ/unit)				CO ₂ EF (kg/GJ)			
			2024	2025	2026	Ref ¹⁾	2024	2025	2026	Ref ¹⁾
Liquified natural gas (LNG) ⁴⁾	Liquified natural gas (LNG) ⁴⁾	Nm3 ae	31.65	31.65	31.65	CS	56.2 ⁴⁾	56.2 ⁴⁾	56.2 ⁴⁾	CS
Koolmonoxide	Carbon Monoxide	Nm3	12.6	12.6	12.6	CS	155.2	155.2	155.2	CS
Methaan	Methane	Nm3	35.9	35.9	35.9	CS	54.9	54.9	54.9	CS
Waterstof	Hydrogen	Nm3	10.8	10.8	10.8	CS	0.0	0.0	0.0	CS
Biomass ⁴⁾										
Biomassa vast	Solid Biomass	kg	15.1	15.1	15.1	CS	109.6	109.6	109.6	IPCC
Houtskool	Charcoal	kg	30.0	30.0	30.0	CS	112.0	112.0	112.0	IPCC
Biobenzine ³⁾	Biogasoline ³⁾	kg	27.0	27.0 ³⁾	27.0 ³⁾	CS	70.5	70.5 ³⁾	70.5 ³⁾	CS
Biodiesel ³⁾	Biodiesels ³⁾	kg	41.2	41.2 ³⁾	41.2 ³⁾	CS	72.5	72.5 ³⁾	72.5 ³⁾	CS
Overige vloeibare biobrandstoffen	Other liquid biofuels	kg	36.0	36.0	36.0	CS	79.6	79.6	79.6	IPCC
Biomassa gasvormig	Gas Biomass	Nm3	21.8	21.8	21.8	CS	90.8	90.8	90.8	CS
RWZI biogas	Wastewater biogas	Nm3	23.3	23.3	23.3	CS	84.2	84.2	84.2	CS
Stortgas	Landfill gas	Nm3	19.5	19.5	19.5	CS	100.7	100.7	100.7	CS
Industrieel fermentatiegas	Industrial organic waste gas	Nm3	23.3	23.3	23.3	CS	84.2	84.2	84.2	CS
D Other fuels										
Afval ^{3) 6)}	Waste ^{3) 6)}	kg	9.6	9.6 ³⁾	9.6 ³⁾	CS	107.1	107.1 ³⁾	107.1 ³⁾	CS

1) IPCC: default value from the 2006 IPCC Guidelines; CS: country specific

2) This concerns only the fossil part of the fuel

3) The calorific value and/or emission factor for these fuels are updated annually. Since the values for 2025 and 2026 are not yet known, they are set equal to the value for 2024. The figures in the above list may be modified in subsequent versions of the fuel list

4) The emission factors for natural gas, CNG and LNG are updated annually. The values given in this table represent the most up-to-date values for all years concerned.

5) For reporting of emissions from biomass the following rules have to be followed:

a. Under the Convention (UNFCCC) the emissions from biomass have to be reported as memo-item, using the mentioned emission factors.

However, they do not count in the national total of greenhouse gas emissions.

b. Under EU ETS, combustion of biomass can result in zero emission if certain conditions are met. More information:

<https://www.emissieautoriteit.nl/onderwerpen/monitoring-emissies/biomassa>

6) The percentage biogenic in the heating value is 53%. The percentage biogenic in the emission factor is 63%.

A5.2 Notes on the fuel list

Netherlands Enterprise Agency (RVO) has been publishing the list of fuels and standard CO₂ emission factors for the Netherlands annually since 2004.

This list was completely revised in 2015 as a result of the obligation to follow the *2006 IPCC Guidelines* in all international reports compiled in or after 2015 (the first reporting year of the second Kyoto budget period). The list contains not only calorific values and emission factors taken from the *2006 IPCC Guidelines* but also a number of country-specific values. In 2021 the list has been updated again, taking into account the 2019 Refinement to the 2006 IPCC Guidelines (see Dröge et al, 2021).

The validity of values is governed by the following rules:

- *2006 IPCC* default emission factors are valid from 1990
- The country-specific calorific values and emission factors may be divided into the following four categories:
 - o Most country-specific calorific values and emission factors are valid from 1990
 - o A limited number of country-specific factors have an old value for the period 1990-2012 and are updated from 2013 and again updated from reporting year 2021.
 - o Based on new insights from Statistics Netherlands, the heating values and emission factors for some transport fuels have been updated.
 - o The country-specific calorific value and/or emission factor for some fuels (natural gas, biogasoline, biodiesel, other bituminous coal and waste) are updated annually. In the present document (version January 2026) these values have been updated.

Readers are referred to the TNO reports (Dröge, 2014; Dröge et al, 2021) and the relevant factsheets for further details.

Various relevant institutes, were consulted during the compilation of this list. One of the involved organisations was Statistics Netherlands (CBS), to ensure consistency with the Dutch Energy Balance Sheet.

With effect from 2015, the lists of calorific values and of emission factors will both contain columns for three successive years. In the present version of the fuel list (that for January 2026), the years in question are 2024, 2025 and 2026. The values in these columns are used for the following purposes:

1. **2024:** these values are used in 2026 for calculations concerning the calendar year 2024, which are required for international reports concerning greenhouse gas emissions pursuant to the UN Framework Convention on Climate Change (UNFCCC), the Paris Agreement and the Governance Regulation of the Energy Union (EU 2018/1999). The National Inventory Report for 2026 (NIR 2026) gives full details of greenhouse gas emissions in the Netherlands up to and including 2024. The fuel list forms an integral part of the NIR 2026.

2. **2025:** these values are used in 2026 for reports on energy consumption and CO₂ emission for the calendar year 2025 in the Electronic Environmental Annual Report (e-MJV).
3. **2026:** in 2027, these values will be used in the emission reports for calendar year 2026 by companies that participate in the European CO₂ Emissions Trading System (EU ETS) and have indicated in their monitoring plan that they use the "The Netherlands' list of energy carriers and standard CO₂ emission factors".

Annex 6 Assessment of completeness and (potential) sources and sinks

The Netherlands' emissions inventory focuses on completeness, and accuracy in the most relevant sources. This means that for all 'NE' sources, it was investigated what information was available and whether it could be assumed that a source was really (very) small/negligible. For those sources that turned out not to be small, methods for estimating the emissions were developed during the improvement programme. As a result of this process, it was decided to keep only a very few sources as 'NE', where data for estimating emissions were not available and the source was very small. Of course, (developments in) data on NE sources that indicate any (major) increase in emissions and (new) data sources for estimating emissions are checked/re-assessed on a regular basis; most recently in a study performed by DNV GL (2020).

The Netherlands' GHG emissions inventory includes all sources identified by the 2006 IPCC Guidelines, with the exception of the following (very) minor sources:

- CO₂ from asphalt roofing (2A4d) and CO₂ from road paving (2A4d), both due to negligible amounts (below threshold) and missing activity data: information on the use of bitumen is available only in a division into two groups: the chemical industry and all others. There is no information on the amount of asphalt roofing production and no information on road paving with asphalt. The statistical information on the sales (value) of asphalt roofing and asphalt for road paving ends in 2002.
As a follow-up to the 2008 review, information was collected from the branch organisation for roofing, indicating that the number of producers of asphalt roofing declined from about 15 in 1990 to fewer than 5 in 2008 and that the import of asphalt roofing increased during that period.
Information has also been sourced on asphalt production (for road paving), as reported in the progress of the voluntary agreements for energy efficiency. A first estimate indicates that annual CO₂ emissions could be approximately 0.5 kt.
On the basis of the above, it was assumed that emissions related to these two categories are very low/undetectable and that the effort expended in generating activity data would, therefore, not be cost-effective. So not only the missing activity data, but also the very limited amount of emissions were the rationale behind the decision not to estimate these emissions.
- CH₄ emissions from Other livestock (alpacas) (3A1) are not included in the inventory due to negligible amounts (below threshold). Alpacas are mostly kept as pets or as a tourist attraction. Animal numbers are expected to be in the same range as mules and asses, i.e. no more than a couple of thousand animals. See paragraph 5.1.2 for the detailed justification that the emissions of this source are below threshold.
- CH₄ and N₂O emissions from the decomposition of manure from other livestock (alpacas) (3A2), due to negligible amounts (below threshold, see paragraph 5.1.2 for justification).

- CH₄ from Enteric fermentation: poultry (3A4) Enteric fermentation from poultry is not estimated due to the negligible amount of CH₄ production in this animal category. The 2019 refinement of the IPCC Guidelines (table 10.9) does not provide a default EF for enteric CH₄ emissions from poultry.
- Direct N₂O emissions from septic tanks (5D3, septic tanks): direct emissions of N₂O from septic tanks are not calculated since they are unlikely to occur, given the anaerobic circumstances in these tanks. Indirect N₂O emissions from septic tank effluent are included (IE) in CRF category 5D3 (Indirect N₂O emission from surface water as a result of discharge of domestic and industrial effluents).
- CH₄ emissions from industrial sludge treatment (5D2), due to negligible amounts: data from the survey among IWWTPs conducted by Statistics Netherlands shows that only 2 out of a total of 160 IWWTPs are equipped with anaerobic sludge digestion reactors. These data are not published on www.cbs.statline.nl for reasons of confidentiality. See paragraph 7.5.2 for justification.
- Precursor emissions (i.e. CO, NO_x, NMVOC and SO₂) from Memo item international bunkers (international transport) have not been included as these emissions are not included in national total emissions.

A number of recommendations by DNV GL, relating to the 2019 refinement of the IPCC Guidelines, will be further explored and implemented once these guidelines become mandatory for calculating greenhouse gas emissions.

Annex 7 Additional information to be considered as part of the NIR submission

List A7.1 contains the list of methodology reports that have been submitted to the UNFCCC (in a separate ZIP file) as part of the submission on 15 April 2026. These reports are to be considered as an integral part of this NIR 2026.

A7.1 List of methodology reports

ENINA (Energy, Industry, Waste):

Methodology for the calculation of emissions to air from the sectors Energy, Industry and Waste

RIVM report 2026-0019

Honig, E., Montfoort, J.A., Dröge, R., Van Mil, S.E.H., Guis, B., Baas, K., Van Huet, B., Van Hunnik, O.R.

Transport:

Methodology for the calculation of emissions from the transport sector

RIVM report 2026-0023

Witt, H.C.H., Geilenkirchen, G., Bolech, M., Dellaert, S., Van Eijk, E., Geertjes, K.

WESP:

Methodology for the calculation of emissions from product usage by consumers, construction and services

RIVM report 2026-0021

Visschedijk, A.J.H., Meesters, J.A.J., Nijkamp, M.M., Koch, W.W.R., Jansen, B.I., Dröge, R.

Agriculture:

Methodology for the calculation of emissions from agriculture

RIVM report 2026-0020

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)

Van der Zee, T.C., Bleeker, A., Bussink, W., Van Dooren, H.J.C., Mosquera, J., Huijsmans, J.F.M., Kros, H., van der Most, M., Oltmer, K., Ros, M., Schulte-Uebbing, L., Velthof, G.L., Weijers, S.

LULUCF:

Greenhouse gas reporting of the LULUCF sector in the Netherlands

Methodological background, update 2026, WOt-technical report 298, Doi: 10.18174/709657

Van Baren, S.A., E.J.M.M. Arets, Y.C. Berger Barnett, G. Erkens, N.E. Kelly, H. Kramer, J.P. Lesschen, G.W. Hazeu & J.M. Drosen

These reports are also available at the website <http://english.rvo.nl/nie>

Annex 8 Verification activities of greenhouse gas emissions using atmospheric observations

In this annex, reported Dutch greenhouse gas emissions are compared to emissions data derived from atmospheric observations using inverse modelling. This comparison allows verification of the reported emissions against an independent data source. Emissions estimates for this submission were provided by the Horizon 2020 Europe project PARIS (<https://horizoneurope-paris.eu/>) and the German project ITMS (<https://www.itms-germany.de/en>).

This annex covers the greenhouse gases methane, nitrous oxide, hydrofluorocarbons, and sulphur hexafluoride. The verification activities are planned to take place on an annual basis as part of the overall quality assurance and quality control system for the NIR. Significant differences between inventory emissions and atmospheric observations will help to point to areas deserving further investigation.

Changes from last year

This is the second iteration of this annex for the Netherlands. Besides the inclusion of the emissions from 2024, the following are the most important updates to the annex:

- Inclusion of results from the ITMS demonstrator (ITMS-D) as a second data source for methane emissions;
- Inclusion of two atmospheric transport models by the PARIS project;
- Inclusion of sulphur hexafluoride in the annex;
- Analysis of uncertainties;
- Analysis of longer time series for nitrous oxides.

A8.1 Summary

Emissions estimates derived by inverse modelling from atmospheric observations of greenhouse gas concentrations were compared to reported emissions for methane, nitrous oxide, hydrofluorocarbons, and sulphur hexafluoride. It should be noted that both the inventory and the atmospheric observations provide emissions estimates relying on assumptions without either being intrinsically closer to the true emissions in the real world.

For methane, inverse modelling indicated emissions of 6–12 Mt CO₂ eq higher than reported in the NIR (34 to 63% higher than reported emissions). This deviation cannot yet be fully explained but might be related to emissions from surface water or other (semi-)natural emissions that have not been included in the inventory so far. Also, nitrous oxide emissions from inverse modelling were about 2 Mt CO₂ eq (33%) higher than reported. For hydrofluorocarbons, inverse modelling indicated higher emissions with a deviation of almost 2 Mt CO₂ eq (188%) for all hydrofluorocarbons combined. For sulphur hexafluoride, both emissions estimates only show a slight deviation.

Table A8.1 Comparison of mean emissions estimates for 2023 (the most recent year where data from all sources is available) from the emission inventory and inverse modelling

Gas	Source	Inventory (Mt CO ₂ eq)	Inverse modelling (Mt CO ₂ eq)	Deviation (Mt CO ₂ eq)	Relative deviation (%)
Methane	PARIS	18.7 ± 1.7	25.2 ± 3.4	6.3 ± 3.8	34 ± 20
	ITMS-D		30.5 ± 4.1	11.8 ± 4.4	63 ± 24
Nitrous oxides	PARIS	6.6 ± 2.0	8.8 ± 1.6	2.2 ± 2.6	33 ± 14
HFC	PARIS	0.9 ± 0.2	2.6 ± 0.3	1.7 ± 0.4	188 ± 60
Sulphur hexafluoride	PARIS	0.1 ± 0.02	0.18 ± 0.06	0.08 ± 0.06	80 ± 62

The inventory emissions include memo-items. Relative deviation relates to the inventory emissions. Uncertainties are given as 95% confidence intervals.

A8.2 Data sources and processing

Emissions estimates derived by inverse modelling from atmospheric observations were produced and kindly provided by the PARIS project and the ITMS project. A detailed description of the PARIS datasets and applied methodologies is in preparation at the PARIS consortium and will be published in due course. The ITMS-D dataset is an updated version of the first ITMS demonstrator, which is described in detail in Bruch et al. (2025 and 2025b).

For the PARIS project, in brief, emissions were estimated from concentration measurements, using three inverse modelling algorithms: InTEM (Manning et al. 2023), ELRIS (Henne et al. 2016, Katharopoulos et al. 2023), and RHIME (Ganesan et al. 2014) as well as two atmospheric transport models: NAME (Jones et al. 2007) and FLEXPART (Bakels et al. 2024). As input for the models, prior emissions were adopted from the EDGAR emissions dataset (v8, European Commission: Joint Research, 2023) for all gases except HFC-23 and HFC-152a, for which uniform prior emissions were used. For methane, additional natural emissions from WETCHARTS (Bloom et al. 2017) were included. Atmospheric concentrations of methane and nitrous oxides were derived from *in situ* measurement stations of, among others, the European ICOS network and the UK DECC network. This includes two measurement stations in the Netherlands in Cabauw and Lutjewad. Concentrations of fluorinated gases were measured by affiliates of the AGAGE network. Until 2020, this network does not include any measurement site in the Netherlands, but one in Tacolneston (UK), on the other side of the English Channel, which provides a reasonable sensitivity to Dutch emissions. From 2021 onwards, measurements in Cabauw are included.

For the ITMS demonstrator (ITMS-D), a scaling inversion (Bruch et al., 2025) based on the Eulerian transport model ICON-ART (Schröter et al. 2018) was used. The national emission inventories were used as prior emissions for the Netherlands and Germany. Outside of these countries, emissions from CAMS-REG-ANT were used (Kuenen et al. 2022) with additional emissions from rivers, wetlands and oceans as detailed in

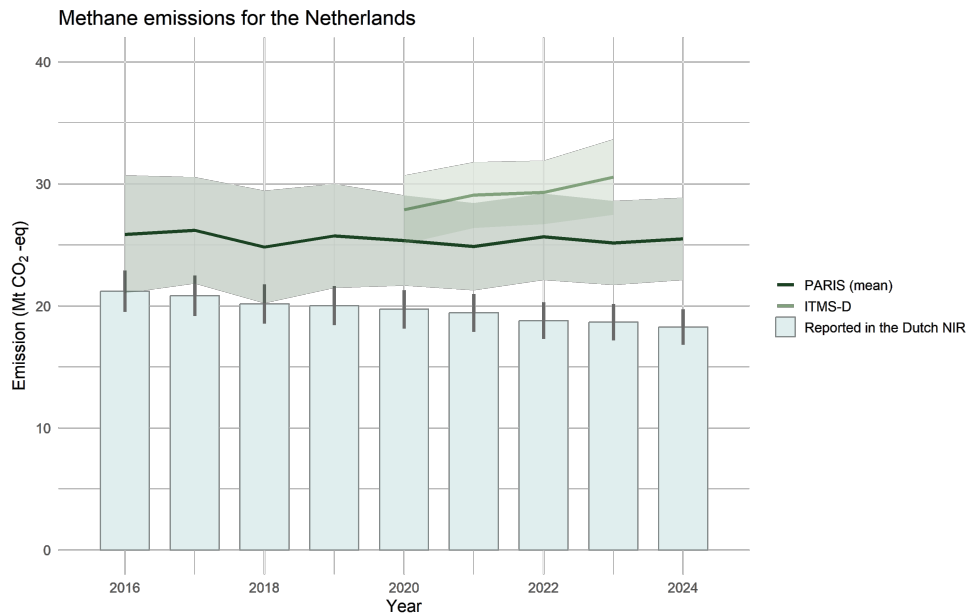
Bruch et al. (2025b). Atmospheric concentrations of methane were adopted from *in situ* measurement stations of the ICOS network.

To calculate the national Dutch emissions from these data, emissions in the grid cells within the Netherlands including the 12-mile zone were added up. For grid cells partially in the Netherlands, the emissions were distributed on the basis of the surface share of the grid cell within the Netherlands. To facilitate comparison between the spatial patterns of the reported emissions and the inverse modelling results, the reported emissions were resampled to the resolution of the inverse modelling output. Error bars and shaded areas indicate 95% confidence intervals. Note that for the comparison of emission maps and for table A8.1 emissions for the year 2023 were analysed since spatial inventory emissions and emissions from ITMS-D for 2024 were not yet available. For fluorinated gases the spatial emissions were averaged from 2020 to 2024 to reduce noise.

A8.3 Methane

A comparison of Dutch methane emissions to emissions estimates from inverse modelling is shown in Figure A8.1. It immediately shows a marked contrast between the various emissions estimates. While the reported emissions show a slight decrease from 21.2 Mt CO₂ eq in 2016 to 18.3 Mt CO₂ eq in 2024 the atmospheric inversions from both projects indicate much higher emissions at around 25 Mt CO₂ eq (PARIS) and between 27 and 30 Mt CO₂ eq (ITMS-D). While there are differences between the PARIS and ITMS-D emissions estimates, they agree with each other within the uncertainty range. Furthermore, both projects do not support the decreasing trend reported in the NIR but show constant or even increasing emissions. Considering the uncertainties of the reported emissions and the inverse modelling results, they show a clear and significant deviation, which increases over time due to the differences in emissions trends.

Figure A8.1 Comparison of the reported Dutch methane emissions with emissions estimates from inverse modelling provided by PARIS and ITMS-D



Shaded areas and error bars indicate the 95% confidence interval.

The discrepancy in the Dutch emissions is related to a mismatch between the atmospheric observations and reported emissions that take place in a broader region stretching from North-West Germany across the Netherlands to Flanders as shown in Figure A8.2 (left). This mismatch can also be seen by comparing the measured concentrations at the *in-situ* stations to the concentrations expected on the basis of the reported emissions (Figure A8.2, right) with red dots indicating where measured concentrations are higher than the concentrations modelled using inventory emissions. The illustration also shows that this mismatch is unique in the European context and is not limited to one individual measurement station.

Figure A8.2 Mismatch between emissions calculated with inverse modelling and reported emissions from ITMS-D (left) and difference between the measured methane concentrations and the concentrations predicted on the basis of the reported emissions (right).

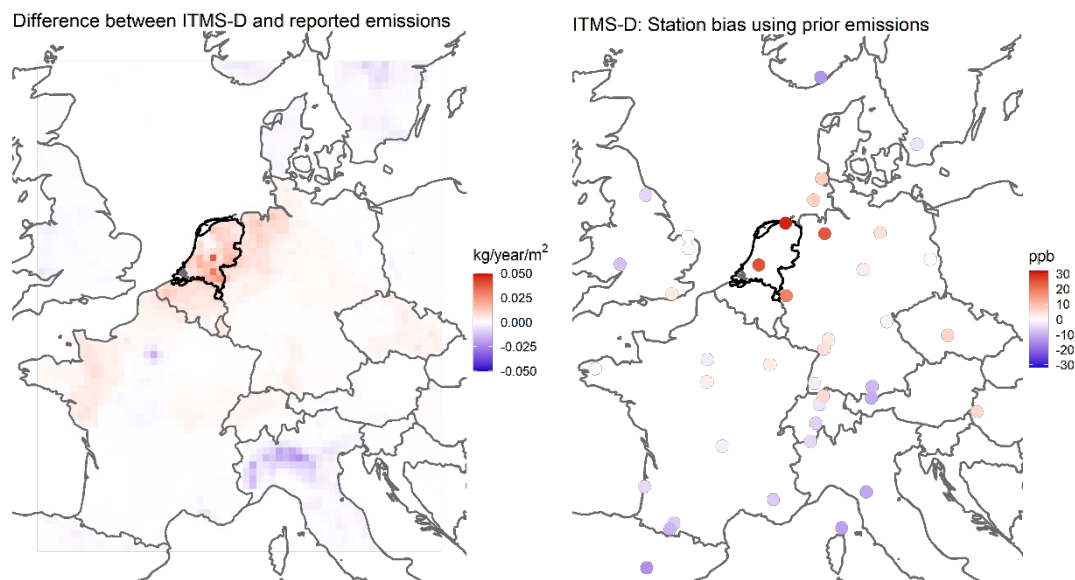
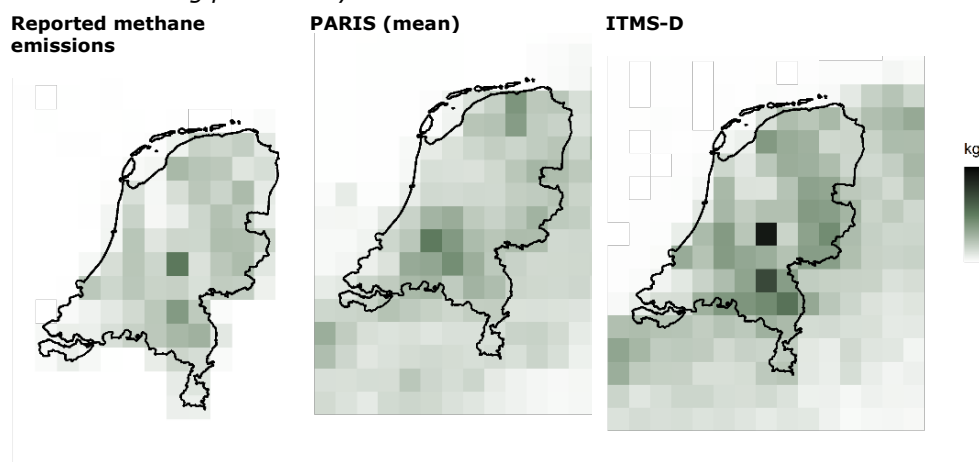


Figure A8.3 shows the spatial distribution of methane emissions within the Netherlands for the reported emissions and the emissions estimated by PARIS and ITMS-D. The distribution within the Netherlands agrees reasonably well between the three emissions datasets, with no clearly identifiable emission hotspots or any clear localisation of emissions, for example, at the coast or in agricultural regions. Note that the similarity between the spatial pattern of inventory emissions and the ITMS-D emissions is a result of the scaling approach used in their inverse modelling algorithm (Bruch et al. 2025).

Figure A8.3 Maps of methane emissions for 2023 as reported in the NIR and from inverse modelling provided by PARIS and ITMS-D.



In principle, the difference between the reported emissions and the inverse modelling results could indicate an underestimation of emissions in the Dutch inventory, i.e. emission factors that are or activity data that are too low. Considering the magnitude of the discrepancy by more than a third, this discrepancy could only be explained by an underestimation of a major emission source by a significant amount. However, Dutch emission factors for major emission sources, for example enterogastric fermentation or waste, are comparable to other countries.

It might also be possible that the difference between the three emissions estimates, at least in parts, is not due to the inventory underestimating methane emissions, but to the atmospheric inversions overestimating the Dutch methane emissions. In general, these inverse modelling systems and the underlying transport models have been applied in many situations and not found to have clear biases; however, they also have uncertainties. Therefore, different inverse algorithms and transport models were included in this comparison. And while emissions estimates produced by different approaches vary by several Mt CO₂ eq, they all agree in showing significantly higher emissions than reported. This is further supported by the mismatch between measured concentrations and the concentrations expected on the basis of inventory emissions. Taken together, it seems unlikely that a common error in these separate inverse modelling runs caused this mismatch.

These arguments point to a missing emission source as the reason for the mismatch. While the NIR reports only anthropogenic emissions, the atmospheric observations do not distinguish between anthropogenic and natural emissions. Methane emissions from draining ditches in organic soil and from wetlands are reported as LULUCF emissions as a memo-item and amount to 0.6 Mt CO₂ eq for 2023. Emissions from other open water bodies (flooded land according to CRT terminology), such as lakes, rivers, and channels, have not been included in the reported Dutch emissions so far. All inversions included emissions from water in the prior emissions. These were adopted from global emissions datasets and predicted about 1–2 Mt CO₂ eq of emissions for the Netherlands. On the basis of these data, their omission in the Dutch inventory can, therefore, not quantitatively explain the mismatch of 6–12 Mt CO₂ eq. However, as yet,

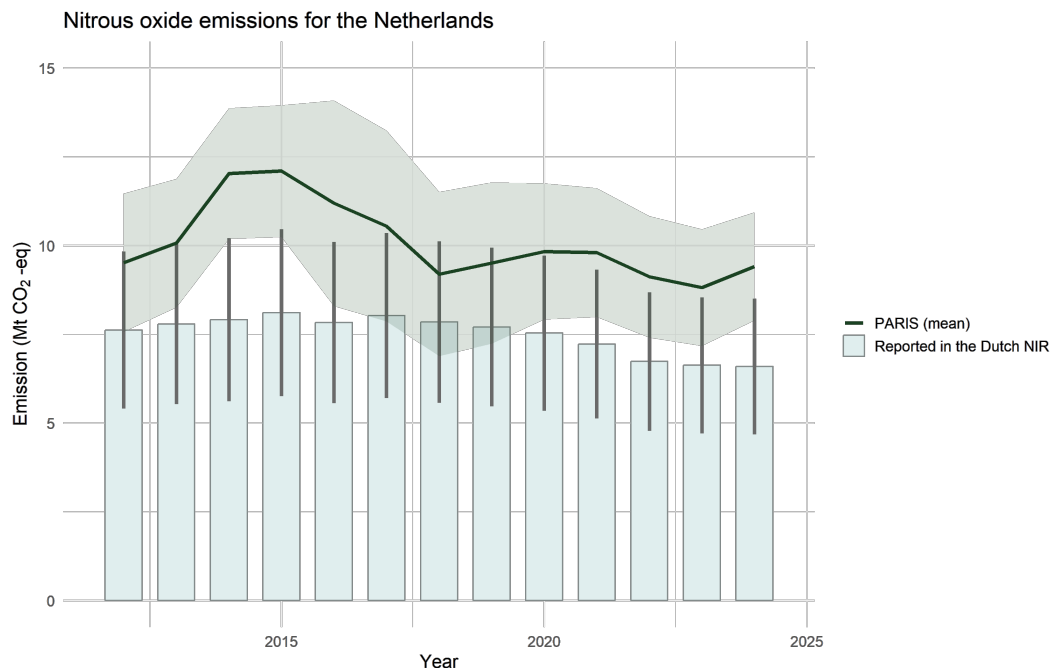
no country-specific estimates exist for emissions from open water bodies in the Netherlands, which might be higher than expected on the basis of the global data. Another possible emission source not yet included in the Dutch inventory might be the Waddenzee and emissions from the sea floor.

Since the gap between reported emissions and those derived from atmospheric observations is so large, it is possible that multiple, if not all, of the above explanations play a role here. Unfortunately, it is not yet feasible to disentangle these different effects and additional research efforts are needed.

A8.4 Nitrous oxide

A comparison of Dutch reported nitrous oxide emissions to inverse modelling results from the PARIS project is shown in Figure A8.4. It shows that atmospheric observations yield emissions that are higher than those reported. The NIR reports between 6.5 and 7.5 Mt CO₂ eq, while the atmospheric observations result in emissions around 10 and up to 12 Mt CO₂ eq. Inverse modelling results also show a larger interannual variability. When considering only the emissions from an individual year, the differences between the emissions estimates are not statistically significant.

Figure A8.4 Comparison of the reported Dutch nitrous oxide emissions to emissions estimates from inverse modelling provided by the PARIS project

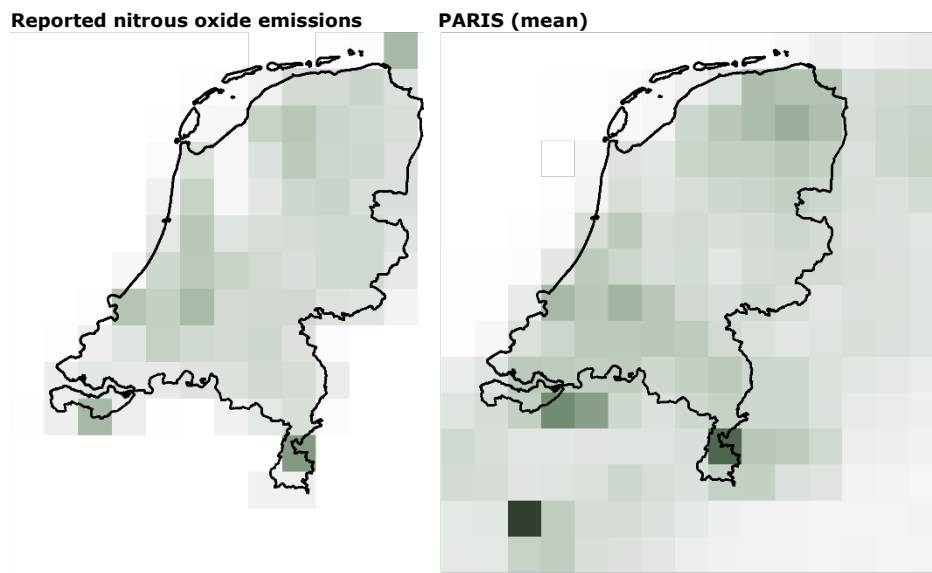


Shaded areas and error bars indicate the 95% confidence interval.

The spatial distribution of nitrous oxide emissions in the Netherlands according to inverse modelling and the emission inventory are displayed in Figure A8.5. They show qualitative agreement, both showing a background of emissions that would fit the expected soil emissions and a

hotspot of emissions in the South of the Netherlands, which coincides with a production side of chemical industry.

Figure A8.5 Maps of nitrous oxide emissions for 2023 as reported in the NIR and from inverse modelling provided by the PARIS project.



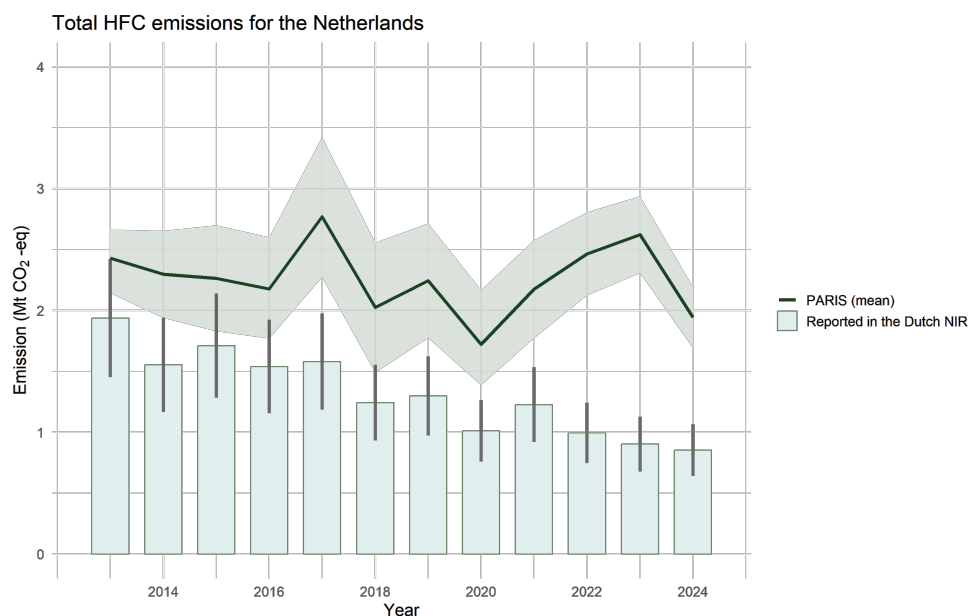
Many important N_2O emission sources, such as direct and indirect soil emissions, are associated with large uncertainties. Additionally, there are considerable biogenic emissions of N_2O . Considering these factors, the atmospheric observations agree reasonably well with the reported emissions. The deviation that was observed might also be due to relatively strong emissions in grid cells that lie directly on the border between the Netherlands and Belgium or Germany. These emissions are distributed to the countries according to the area fraction of the grid cells in the respective countries, which might allocate emissions to the wrong country. Comparing the two maps in Figure A8.5, it appears that part of emissions from the Antwerp area might be falsely attributed to the Netherlands, while emissions from the South of the Netherlands might be wrongly allocated to Germany. Additionally, the spatial localisation of emissions from atmospheric observations can contain uncertainties in the sense that emissions are not allocated to the correct grid cell.

A8.5 Hydrofluorocarbons

Atmospheric observations were used to estimate emissions of the hydrofluorocarbons (HFC) with the largest contribution to climate change in the Netherlands: HFC-23, HFC-32, HFC-125, HFC-134a, HFC-143a, and HFC-152a. While these are not all the HFCs that have been included in the reported emissions, the missing HFCs present only a small share of the overall global warming potential of the reported HFCs. A comparison of total Dutch HFC emissions to emissions estimates derived from atmospheric observations is shown in Figure A8.6. Reported emissions show a decrease from 2 Mt CO_2 eq to below 1 Mt CO_2 eq, while inverse modelling results indicate constant emissions

around 2 Mt CO₂ eq with large interannual variability, resulting in a difference to the reported emissions by more than 1 Mt CO₂ eq in 2023.

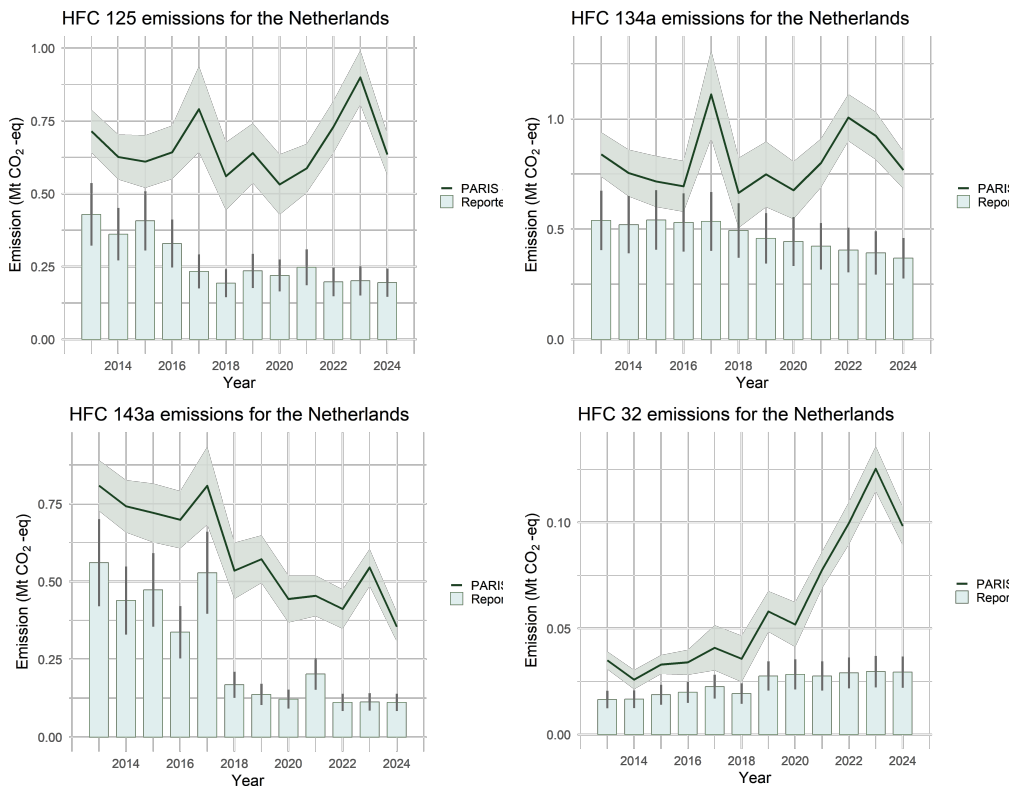
Figure A8.6 Comparison of the reported Dutch hydrofluorocarbon emissions to emissions estimates from inverse modelling provided by the PARIS project



Sum of all different reported HFCs.
Shaded areas and error bars indicate the 95% confidence interval.

Similarly, looking at individual HFCs (Figure A8.7), inverse modelling indicates higher emissions than reported. In particular for HFC-32, inverse modelling shows a much sharper increase than the inventory. It should be noted that the interannual variability from inverse modelling shows similar patterns for all HFCs, which does not seem plausible as their emissions originate from different processes.

Figure A8.7 Comparison of the reported Dutch hydrofluorocarbon emissions of individual HFCs to emissions estimates from inverse modelling provided by the PARIS project



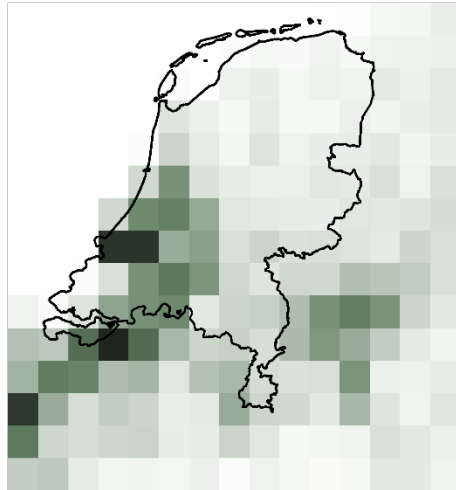
Shaded areas and error bars indicate the 95% confidence interval.

As there are no natural sources of HFCs, the discrepancy between reported emissions and inverse modelling results cannot be explained by emission sources of natural origin that are not included in the reported emissions for the individual HFCs.

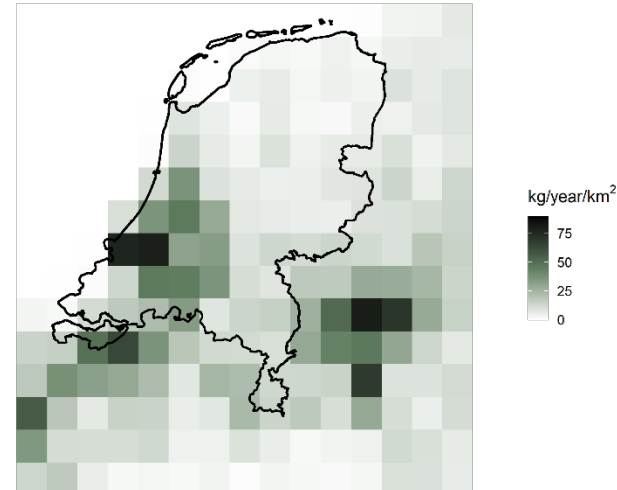
Looking at the spatial distribution of HFC emissions for a selection of HFCs as shown in Figure A8.8, most of the emissions originate in the Rotterdam area (which is a centre of industrial activity in the Netherlands) and at the border to Belgium. Emissions in grid cells that are on the border between two countries are distributed between the two countries according to the respective area fraction, which can result in incorrect allocation of the emissions. Additionally, the spatial localisation of emissions from inverse modelling can contain uncertainties as well. Therefore, the large emissions at the border between the Netherlands and Belgium indicate that emissions from the Antwerp area might be wrongly allocated to the Netherlands explaining part of the mismatch. The emission inventory itself does not produce a robust spatial distribution for HFC emissions.

Figure A8.8 Maps of emissions derived from atmospheric observations by the PARIS project for individual HFCs, mean from 2020 to 2024 of all different models

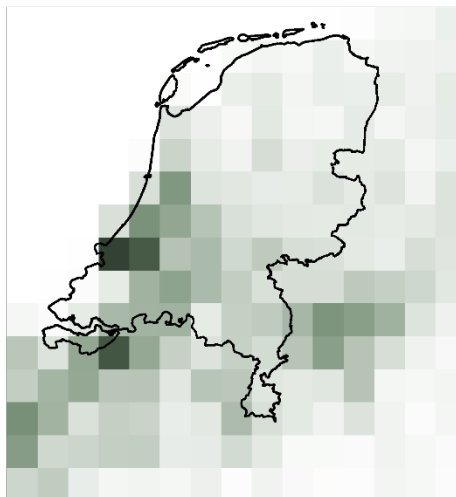
HFC 125



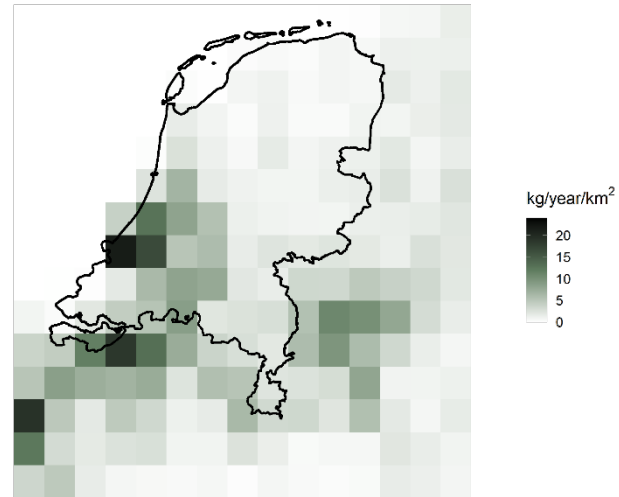
HFC 134a



HFC 143a



HFC 32



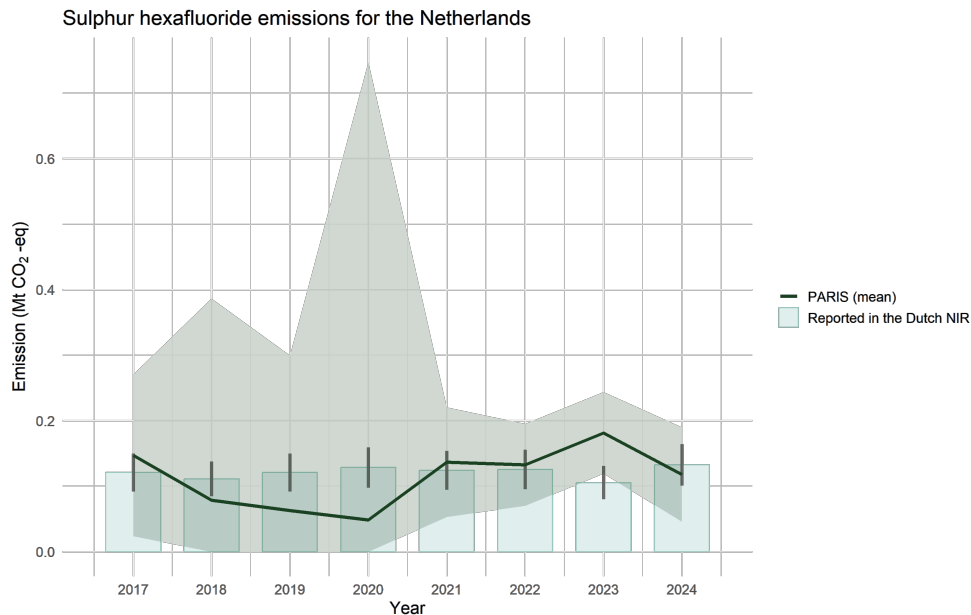
In summary, inverse modelling estimated significantly higher HFC emissions for the Netherlands. As shown in the previous version of this Annex in the National Inventory Report 2025, a combined analysis of Belgium and the Netherlands revealed generally good agreement for this combined region. This supports the interpretation that the observed discrepancy results from emission sources in the border region between the Netherlands and Belgium, which are not correctly split between the two countries. This result shows that further development is necessary to better distribute emissions in the border regions between countries. One way to achieve this could be increasing the resolution, but other approaches are also under development.

A8.6 Sulphur hexafluoride

A comparison of Dutch reported sulphur hexafluoride emissions to emissions estimates from inverse modelling is shown in Figure A8.9. It shows that atmospheric observations agree well with the inventory with

both reporting emissions around 0.1 Mt CO₂ eq, despite their significant uncertainties.

Figure A8.9 Comparison of the reported Dutch sulphur hexafluoride emissions to emissions estimates from inverse modelling provided by the PARIS project

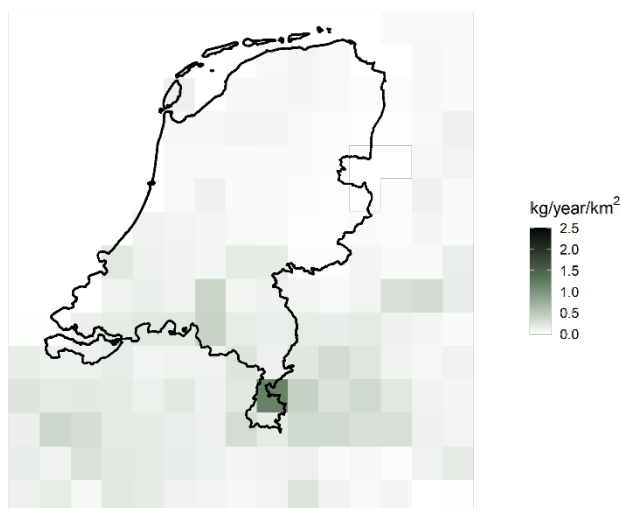


Shaded areas and error bars indicate the 95% confidence interval.

Looking at the spatial distribution of sulphur hexafluoride emissions, as shown in Figure A8.10, there is a background of emissions which fits emissions from diffuse sources such as double-glassed windows. In addition, there is a strong emission hotspot visible in the South of the Netherlands, which does not coincide with any reported industrial point source in the inventory, but is most likely related to the activities on NATO air base Geilenkirchen (Germany). At this air base, AWACS planes from several countries, including the Netherlands, are stationed. During their ascent, where they fly over the Netherlands, they emit sulphur hexafluoride, which is also reported as an emission source in the German NIR.

Figure A8.10 Maps of sulphur hexafluoride emissions from inverse modelling provided by the PARIS project, mean from 2020 to 2024 of all different models

Sulphur hexafluoride emission map, mean 2020 - 2024 (PARIS)



A8.7 Outlook

This annex represents a starting point to more activities to verify the emissions of various greenhouse gases. The results presented here illustrate both the potential and the challenges of these methods. Especially the large deviation observed for methane points to an area deserving further investigation. Another point of attention is the assignment of emissions to different countries, especially for smaller countries such as the Netherlands.

Several approaches and developments might help address these questions. Improving the spatial resolution will certainly be helpful to understand which emission sources are responsible for the deviation but will also allow better, more faithful allocation of emissions to different countries. Another possible improvement that might greatly help our understanding of these results is the generation of sector-specific emissions from atmospheric observations. This research will, where possible, be carried out in close cooperation with neighboring countries (e.g. Belgium, Germany), who face similar challenges. To facilitate these developments, the emission inventory will continue to closely collaborate with academic and institutional partners, among others the AVENGERS project funded by the European Research Council (<https://avengers-project.eu/>). We hope to be able to include results for methane from the AVENGERS project next year.

Acknowledgement

We extend our gratitude to Anita Ganesan (University of Bristol), Alistair Manning (UK Met Office) and Stephan Henne (Empa) from the PARIS project (Horizon 2020 Europe, GA101081430) and their respective teams, and to Beatrice Ellerhoff (DWD) and Valentin Bruch (DWD) from the ITMS project for providing the data, for fruitful discussion, and for their critical reading.

Annex 9 Chemical compounds, GWP, units and conversion factors

A9.1 Chemical compounds

CF ₄	Perfluoromethane (tetrafluoromethane)
C ₂ F ₆	Perfluoroethane (hexafluoroethane)
CH ₄	Methane
CO	Carbon monoxide
CO ₂	Carbon dioxide
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
HNO ₃	Nitric acid
NF ₃	Nitrogen trifluoride
NH ₃	Ammonia
NO _x	Nitrogen oxide (NO and NO ₂), expressed as NO ₂
N ₂ O	Nitrous oxide
NMVOC	Non-methane volatile organic compounds
PFCs	Perfluorocarbons
SF ₆	Sulphur hexafluoride
SO ₂	Sulphur dioxide
VOC	Volatile organic compounds (may include or exclude methane)

A9.2 GWP of selected GHGs

Table A9.1 lists the 100-year GWP of selected GHGs. Gases shown in *italics* are not emitted in the Netherlands.

Table A9.1 100-year GWP of selected GHGs

Gas	100-year GWP ¹⁾
CO ₂	1
CH ₄ ²⁾	28
N ₂ O	265
HFCs ³⁾ :	
HFC-23	12,400
HFC-32	677
HFC-41	116
HFC-43-10mee	1,650
HFC-125	3,170
HFC-134	1120
HFC-134a	1,300
HFC-143	328
HFC-143a	4,800
HFC-152	16
HFC-152a	138
HFC-161	4

Gas	100-year GWP ¹⁾
HFC-227ea	3,350
HFC-236cb	1,210
HFC-236ea	1,330
HFC-236fa	8,060
HFC-245ca	716
HFC-245fa	858
HFC-365mfc	804
PFCs ³⁾ :	
<i>CF₄</i>	<i>6,630</i>
<i>C₂F₆</i>	<i>11,100</i>
<i>C₃F₈</i>	<i>8,900</i>
<i>C₄F₁₀</i>	<i>9,200</i>
<i>c-C₄F₈</i>	<i>9,540</i>
<i>C₅F₁₂</i>	<i>8,550</i>
<i>C₆F₁₄</i>	<i>7,910</i>
<i>C₁₀F₁₈</i>	<i>7,190</i>
<i>c-C₃F₆</i>	<i>9,200</i>
SF ₆	23,500
NF ₃	16,100

- 1) GWPs calculated using a 100-year time horizon in compliance with the UNFCCC Guidelines for reporting (UNFCCC, 2013).
- 2) The GWP of methane includes the direct effects and the indirect effects due to the production of tropospheric ozone and stratospheric water vapour; the indirect effect due to the production of CO₂ is not included.
- 3) The GWP-100 of emissions reported as 'HFC-unspecified' and 'PFC-unspecified' differ per reported year. They are in the order of magnitude of 3,000 and 8,400, respectively.

Source: IPCC 5th assessment report (2013).

A9.3 Units

MJ	Mega Joule (10 ⁶ Joule)
GJ	Giga Joule (10 ⁹ Joule)
TJ	Tera Joule (10 ¹² Joule)
PJ	Peta Joule (10 ¹⁵ Joule)
Mg	Mega gram (10 ⁶ gram)
Gg	Giga gram (10 ⁹ gram)
Tg	Tera gram (10 ¹² gram)
Pg	Peta gram (10 ¹⁵ gram)
ton	metric ton (= 1,000 kilogramme = 1 Mg)
kt	kiloton (= 1,000 metric ton = 1 Gg)
Mt	Megaton (= 1,000,000 metric ton = 1 Tg)
ha	hectare (= 10 ⁴ m ²)
kha	kilo hectare (= 1,000 hectare = 10 ⁷ m ² = 10 km ²)
mln	million (= 10 ⁶)

A9.4 Conversion factors for emissions

From element basis to full molecular mass:		From full molecular mass to element basis	
C → CO ₂ :	x 44/12 = 3.67	CO ₂ → C:	x 12/44 = 0.27
C → CH ₄ :	x 16/12 = 1.33	CH ₄ → C:	x 12/16 = 0.75
C → CO:	x 28/12 = 2.33	CO → C:	x 12/28 = 0.43
N → N ₂ O:	x 44/28 = 1.57	N ₂ O → N:	x 28/44 = 0.64
N → NO:	x 30/14 = 2.14	NO → N:	x 14/30 = 0.47
N → NO ₂ :	x 46/14 = 3.29	NO ₂ → N:	x 14/46 = 0.30
N → NH ₃ :	x 17/14 = 1.21	NH ₃ → N:	x 14/17 = 0.82
N → HNO ₃ :	x 63/14 = 4.50	HNO ₃ → N:	x 14/63 = 0.22
S → SO ₂ :	x 64/32 = 2.00	SO ₂ → S:	x 32/64 = 0.50

Annex 10 Improvements made in response on the technical expert review of the first biennial transparency report (BTR 2024), March/April 2025

Sector	General
ID# TERR	2.G.1
Reporting requirement	Specified in paragraph 31 of the MPGs Notation keys
Description of area of improvement with recommendation or encouragement	The TERT noted instances where incorrect notation keys were used in the submission (e.g. in the CRTs or the methodology report Methodology for the calculation of emissions to air from the sectors Energy, Industry and Waste (Honig et al., 2024), which is listed in annex 7 to the NID). For example, in CRT 2(I).A-H, CH₄ and N₂O emissions for subcategory 2.A.4.d other (other limestone use) were reported as "IE" for 2022, but there was no explanation as to where these emissions were allocated. Similarly, in CRT 2(II).B-Hs1, for category 2.E.2, the Party reported NF₃ emissions as "IE" and AD as "NA". However, NID section 4.6.1 (p.157) states that PFC and SF₆ emissions from thin-film transistor flat panel displays (category 2.E.2), photovoltaics (category 2.E.3), heat transfer fluid (category 2.E.4) and manufacturing and other sources (category 2.E.5) do not occur in the Netherlands and are therefore not reported in the inventory. In CRT 1.B.2, the Party reported the unit of AD for subcategory 1.B.2.a.5 (distribution of oil products) as "NA" and the value of the AD as "NE". Table 1 of the above-mentioned methodology report mentions that emissions for subcategories 1.B.2.a.5 and 1.B.2.a.6 (oil – other) were not estimated. During the review, the Party confirmed that the notation key "IE" was used in error in CRT 2(I).A-H to report CH₄ and N₂O emissions for subcategory 2.A.4.d other (other limestone use) for 2022. The Party also indicated that category 2.E.2 should have been reported as "NO", as such emissions do not occur in the Netherlands. The Party indicated that these errors will be corrected in its next submission. Further, the Party confirmed that the notation keys used to report emissions in CRT 1.B.2 are correct. The Party also informed the TERT that further updates to table 1 of the methodology report are planned and that the correct notation keys (e.g. "NA" for subcategory 1.B.2.a.5 and "NO" for subcategory 1.B.2.a.6) will be applied for the next submission. However, the TERT noted that it is still unclear whether emissions for these categories do not occur or were not estimated.

Sector	General
	The TERT recommends that the Party ensure the use of the correct notation keys in its next submission and enhance its QC procedures or the application of its existing QC procedures.
NLD Response in NIR 2026	"Answers to the specific points addressed by the TERT; - Notation keys for CH₄ and N₂O in category 2A4d is corrected from 'IE' to 'NO' in the CRT 2025 submission. - In CRT 2025 PFC (incl NF₃) is reported correctly in category 2E1 instead of 2E2 as before, with IEF 'IE,NO' and emissions 'IE'. 1B2a5: the notation keys are corrected in the ENINA methodology report 2025. - 2E2: this will be corrected to 'NO' in the NIR 2026 submission. Because of technical issues we sometimes encountered during the transition to the new CRT reporting tool, we prioritized the correctness of emission data above the notation keys. In the 2026 submission, more attention will be paid to the reporting of correct notation keys. Also, the process of filling the notation keys in the reporting tool is improved as of the NIR 2026.

Sector	General
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	not applicable

Sector	General
ID# TERR	2.G.2
Reporting requirement	Specified in paragraph 35 of the MPGs QA/QC procedures
Description of area of improvement with recommendation or encouragement	The TERT noted several inconsistencies between the NID, the CRTs and the methodology report mentioned in ID# 2.G.1 above. For example, the methodology report (p.42) states that “the CO2 emissions resulting from the use of fossil fuels as feedstocks for the production of silicon carbide, carbon black, ethylene and methanol are included in the Energy sector (CRF 1.A.2.c)”. The TERT notes that according to the 2006 IPCC Guidelines (vol. 3), these emissions should be allocated to the IPPU sector. In addition, the methodology report (p.43) states that the country-specific EF for natural gas used for estimating emissions from ammonia production is confidential. However, table 5 of the methodology report (p.32) shows the country-specific CO2 EFs for natural gas for 1990–2022. In CRT 2(I).A-Hs2, CH4 emissions from sinter production were reported as “NO”, while the NID (pp.155 and 405) indicates that these emissions were not estimated because they are below the significance threshold, with a justification of why this is the case. In addition, the methodology report (p.79) states that “SF6 emissions as a result of using SF6 in the high-voltage power industry, production of semi-conductors, double glazing and electromicroscopes are all aggregated into a single figure and reported under CRF category 2.G.4 ‘Other’ due to the confidentiality of the data”. However, CRT 2(I) shows SF6 emissions reported under category 2.G.2. In CRT 4.F, the total land area for other land is reported as 11.28 kha for 2022, while in CRT 4.1 it is reported as 37.95 kha for the same year. This discrepancy is not isolated to 2022 but appears to persist throughout the time series for other land. In NID table 7.6 (section 7.2.2, pp.263–264), the Party reported that in 2022, 7 kt recovered CH4 was flared and 7 kt recovered CH4 was usefully applied, whereas in CRT 5.A.1.a, the Party reported that 7.39 kt recovered CH4 was flared and 5.04 kt recovered CH4 was used for energy recovery.

Sector	General
	During the review, the Party confirmed that emissions from the combustion of chemical waste gas occurring in the same source category (i.e. chemical sector) were reallocated to the IPPU sector for the 2024 submission but the text in the NID did not reflect this, and that this will be corrected for the next submission. The Party also clarified that the notation key "NO" used for reporting CH₄ emissions from sinter production was used in error and that this will be corrected for the next submission. In addition, the Party clarified that the statement that the country-specific EF for natural gas was confidential was incorrect and that the EF used for estimating CO₂ emissions from ammonia production was taken from table 5 of the methodology report. The Party indicated that this statement will be corrected for future submissions. The Party also explained that SF₆ emissions for categories 2.E.1, 2.G.1 and 2.G.2 were reported under category 2.G.2 and that the reference to category 2.G.4 in the methodology report was incorrect. In the case of CRT 4.F, the Party explained that the total area for category 4.F.1 in CRT 4.F appears to have been incorrectly transferred during the transition to the CRTs, resulting in a reduction of 26.67 kha in the total area reported in CRT 4.F compared with CRT 4.1. However, the Party noted that the error does not affect the net emissions reported in CRT 4.F. Further, the Party clarified that the amounts reported in NID table 7.6 are correct for the recovered CH₄. It explained that owing to problems related to the transition from the CRF tables to the CRTs, these amounts were not correctly reported in the CRTs. The Party indicated that it will correct the amounts and report consistent values in the NID and CRTs for the next submission. The TERT recommends that the Party enhance its QC procedures, or the application of its existing QC procedures, to ensure the consistency of the information reported in the NID, the CRTs and the methodology report.
NLD Response in NIR 2026	Answers to the specific points addressed by the TERT: - silicon carbide, carbon black, ethylene and methanol : see ID# TERR 4.I.3; will be correctly implemented in NIR 2026. - country specific EF for natural gas used for estimating emissions from ammonia production: see ID#TERR 4.I.2; will be correctly implemented in NIR 2026. - CH₄ emissions from sinter production: this will be corrected to 'NE' in the CRT in the NIR submission 2026. - SF₆ emissions reported under 2.G.2; see ID#TERR 4.I.4; will be correctly implemented in NIR 2026. - Total land area as reported in CRT category 4; This has been corrected in the NIR 2025 submission. - Inconsistency amount of flaring in 5A1a; the amounts in de NID are correct, the value in the CRT will be corrected in the NIR submission 2026. More in general, it is indeed correct that there were some inconsistencies between the methodology report and the CRT; special attention will be paid to this in the NIR 2026 submission.

Sector	General
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	not applicable

Sector	Energy
ID# TERR	3.E.1
Reporting requirement	Specified in paragraphs 43 and 53 of the MPGs 1. General (energy sector) – liquid fuels – CO ₂ , CH ₄ and N ₂ O
Description of area of improvement with recommendation or encouragement	The Netherlands reported in its NID (section 3.2.2.3, p.77) recalculations of emissions in comparison to its latest inventory submitted under the Convention for 2017–2018 for LNG, resulting in an increase in the estimated AD of 3 per cent for 2017 and a decrease of 2 per cent for 2018. In addition, the NID (p.77) states that “gas/diesel oil and biodiesel (international navigation) has been reallocated from biodiesel to gas/diesel oil: in 2020, 3% of the gas/diesel oil (2.4 PJ) and in 2021, 5% (4.2 PJ)”. The TERT found that the wording used to explain the reallocation of gas/diesel oil and biodiesel in 2020–2021 was not clear. Moreover, no explanatory information or justifications for the recalculations, including information on the AD used and the impact of the recalculations on the estimates of domestic navigation, were provided in the NID. The TERT notes that, according to paragraph 53 of the MPGs, each Party should report international marine bunker emissions separately; in addition, paragraph 43 of the MPGs states that each Party shall report recalculations, together with explanatory information and justifications for recalculations, in accordance with paragraphs 26–28 of the MPGs, and paragraph 28 of the MPGs states that Parties shall perform recalculations in accordance with the 2006 IPCC Guidelines. During the review, the Party provided clarification on the recalculations for 2017–2018 for LNG and the reallocation between gas/diesel oil and biodiesel in 2020–2021, explaining that this was done owing to updated information in the energy balance. The Party indicated that the impact of the recalculations on the estimates of LNG is far below the threshold of significance, resulting in an increase of 0.4 kt CO₂ eq for 2017 and a decrease of 0.65 kt CO₂ eq for 2018. With regard to the reallocation of biomass and gas/diesel oil, the Party provided AD and emission estimates in CO₂ eq, which indicate that the impact varies only slightly between the 2023 NIR and 2024 NIR for 2020–2021, and that this reallocation has no direct impact on the estimates of emissions from domestic navigation activities. The TERT encourages the Party to increase the transparency of its BTR by including detailed information on recalculations made and their impact, including information on the AD used and justifications for any recalculations, in future submissions.
NLD Response in NIR 2026	The recalculation sections in chapter 3 have been extended further, now providing more details on the updated activity data.
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	

Sector	Energy
ID# TERR	3.E.2
Reporting requirement	Specified in paragraph 19(b) of the MPGs 1. General (energy sector) – all fuels –all gases
Description of area of improvement with recommendation or encouragement	The Party reported in its NID (p.36) that many Dutch industrial subsectors consist of a single company and that information on AD is considered to be confidential business information, and therefore cannot be reported in the NID or CRTs. However, the BTR does not specify how the confidential data are collected, used and reported in the GHG inventory. During the review, the Party clarified that the national inventory team has restricted access to information on AD and EFs relating to individual companies and that the CO₂ IEF reported in the CTF tables for stationary combustion was calculated in most cases as a ratio between the CO₂ emission estimates based on company reports and AD from the energy balance. The Party also explained that for CH₄ and N₂O emissions from stationary combustion, in most cases it used AD from the energy balance and a tier 1 approach with default EFs. During consultations with experts involved in estimating fugitive emissions from oil and gas industry, it was explained that only information on the 'emission load' (absolute emission value) per source and on a gas-by-gas basis is provided to the inventory compilers. The Party further explained that this information is validated by the competent authorities collecting this information, which are not obliged to provide any detailed information to the inventory compilers. To comply with the requirements of the CRT format, the emission values reported in the Party's annual environmental report were divided by the statistical data available from the energy balance. The Party confirmed that improvements to data collection will be made in the light of the entry into force of the EU methane regulation and the related reporting requirements for oil and gas companies in the EU as of August 2028. The TERT recommends that the Netherlands enhance its data-collection procedures and provide detailed information on the institutional arrangements related to the data collection and verification process to ensure that AD collection, choice and development of methods, EFs and other parameters are in accordance with the IPCC guidelines.
NLD Response in NIR 2026	The NID paragraph 1.2.2.2 mentions indeed that many Dutch industrial (sub)sectors consist of a single company. This is the reason why for some sectors the Netherlands cannot report activity data (confidential business information) in the NID or CRT at the most detailed level. all confidential data, to the extent available, can and will be made available to the EU and UNFCCC review teams on request. As mentioned in the MR paragraph 2.4.2.1 Oil and gas extraction (Honig et al), new regulations for the oil- and gas industry came into effect. Hopefully, the Methane regulation and Industrial Emissions Portal regulation (IEP) will bring more detailed data which can be used to improve the data in the CRT.

Sector	Energy
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	NID paragraph 1.2.2.2 and MR 2.4.2.1 Oil and gas extraction (Honig et al)

Sector	Energy
ID# TERR	3.E.3
Reporting requirement	Specified in paragraphs 21 and 47 of the MPGs 1.A.3.e.i Pipeline transport – gaseous fuels – CH ₄
Description of area of improvement with recommendation or encouragement	In CRT 1.A(a)s3, estimates of CH₄ emissions for subcategory 1.A.3.e.i (pipeline transport) were reported as “IE”. The TERT noted that despite the absence of separate AD on energy consumption for pipeline transport in the Netherlands’ national energy statistics, the Party reported CO₂ and N₂O emissions from combustion during gas transport under subcategory 1.A.3.e.i. However, the Party did not explain in the NID the reason for the inconsistent reporting across gases. During the review, the Party clarified that according to the methodology report referred to in ID# 2.G.1 in table 2, CH₄ emissions from combustion of fuel during gas transport are reported together with fugitive emissions of CH₄ under subcategory 1.B.2.b.4. The Party added that there are no plans to investigate this further since Gasunie Transport Services, a subsidiary of Gasunie which is responsible for the transport of natural gas in the Netherlands, estimates the total CH₄ emissions from gas transmission without differentiating between emissions from combustion and fugitive emissions. The TERT recommends that the Netherlands improve the comparability of its reporting by using the categories from the 2006 IPCC Guidelines and by reporting separately, to the extent possible, CH₄ emissions from natural gas transport and CH₄ emissions from fuel combustion during natural gas transmission.
NLD Response in NIR 2026	The NIR and Methodology report Honig et al. mention that total emissions of CH ₄ from gas transmission are included in 1.B.2.b.iv Transmission. Also the Methodology report mentions that there are no plans to investigate this further for comparability, because no specific data for these early years are available and this is a minor allocation issue (i.e. no missing emissions, no underestimation).
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	NID paragraph 3.3.2.1 Source category description and paragraph 2.4.2.2 Oil and Gas transport MR (Honig et al)

Sector	Energy
ID# TERR	3.E.4
Reporting requirement	Specified in paragraph 43 of the MPGs 1.A.4.a.i Stationary – solid biomass – all gases
Description of area of improvement with recommendation or encouragement	The NID (p.124) provides information on recalculations of emissions in comparison to its latest inventory submitted under the Convention for 2015–2021 for subcategory 1.A.4.b.i (solid biomass). The NID (p.74) indicates that both charcoal and primary solid biofuels are considered under solid biomass. The table on page 124 of the NID provides aggregated information on the impact of the recalculations without differentiating between the types of solid biomass used, and without providing information on the change in AD. During the review, the Party provided information on the recalculations made to reflect changes in the energy balance. The TERT noted that according to the information provided by the Party, the recalculations affected not only the estimates of solid biomass but also those of biogenic natural gas; however, no information on the recalculations of the estimates of biogenic natural gas was provided in the relevant section of the NID. The TERT recommends that the Party increase the transparency of the NID by including detailed information on any recalculations made and their impact, including on all the affected AD, and justifications for recalculations.
NLD Response in NIR 2026	The recalculation sections in chapter 3 have been extended further, now providing more details on the updated activity data.
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	

Sector	Energy
ID# TERR	3.E.5
Reporting requirement	Specified in paragraph 39 of the MPGs 1.B.1 Solid fuels – coke oven coke – all gases

Sector	Energy
Description of area of improvement with recommendation or encouragement	The Party reported in its NID (section 3.3.1.2, p.129) that industrial producers in the Netherlands are not obliged to report any AD in their annual environmental reports and that only a limited data set is published by Statistics Netherlands. In addition, according to the NID, estimates of transformation losses under subcategory 1.B.1.b.ii based on the mass balance between coal inputs and coke and coke oven gas produced were not taken into consideration. Instead, an assumption of 1 per cent of losses from coke oven input was used as a conservative approach. The TERT considers that, given the incomplete AD on coke oven coke production published by Statistics Netherlands, this approach could lead to an underestimation of fugitive emissions for this subcategory. During the review, the Party clarified that the data published by Statistics Netherlands include complete AD on coke production and the AD are included in the CRTs, and the statement in the NID is inaccurate. The Party also indicated that, on the basis of detailed discussions during the 2017 annual inventory review cycle and taking into account the high level of uncertainty relating to the use of the mass balance approach, the assumption applied could be considered conservative and the remainder of the non-captured gas from the coke plant is assumed to be combusted in the coke ovens, with the corresponding emissions reported under subcategory 1.A.1.c.i. The TERT recommends that the Party improve the transparency of its reporting for subcategory 1.B.1.b.ii by providing detailed information on the rationale for the method chosen, and on the AD and EF used, and by describing their impact on the uncertainty of the final estimates.
NLD Response in NIR 2026	This has been implemented in the NID 2026, paragraph 3.3.1.2 Methodological issues
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	NID paragraph 3.3.1.2. Methodological issues

Sector	Energy
ID# TERR	3.E.6
Reporting requirement	Specified in paragraphs 39–40 of the MPGs 1.B.2 Oil, natural gas and other emissions from energy production – all fuels – CO₂, CH₄, N₂O

Sector	Energy
Description of area of improvement with recommendation or encouragement	CRT 1.B.2 does not include a description of the sources of AD for all subcategories under category 1.B.2. During the review, the Party informed the TERT that a technical error occurred during submission and indicated that this error will be corrected for the next submission. The TERT recommends that the Party report the description of AD for each subcategory under fugitive emissions from oil and natural gas industry in CRT 1.B.2 to increase the transparency of its reporting.
NLD Response in NIR 2026	The technical error is corrected, activity data and descriptions are reported in the CRT table 1.B.2
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	CRT 1.B.2

Sector	IPPU
ID# TERR	4.I.1
Reporting requirement	Specified in paragraphs 21 and 47 of the MPGs 2.A.4 Other process uses of carbonates – CO ₂
Description of area of improvement with recommendation or encouragement	The NID (annex 10, p.395) indicates that mineral wool production takes place in the Netherlands and that the associated process emissions are reported under the energy sector. The NID also indicates that the Party had aimed to reallocate these process emissions to the IPPU sector for the current submission, and that it is planning to do so for the next submission. During the review, the Party clarified that the reallocation of process emissions associated with mineral wool production was not prioritized for the 2024 submission and that it will explore the feasibility of performing such a reallocation for future submissions. It further clarified that there were no barriers to reallocating the associated process emissions to category 2.A.4. To increase comparability in accordance with the 2006 IPCC Guidelines allocation, the TERT recommends that the Party reallocate process emissions from mineral wool production to category 2.A.4.
NLD Response in NIR 2026	As reported in the 2023 NIR, for now the reallocation of process emissions associated with mineral wool production will not be performed, as the issue is below the threshold of significance. Instead other issues/points of improvement will be prioritized.
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	

Sector	IPPU
ID# TERR	4.I.2
Reporting requirement	Specified in paragraph 39 of the MPGs 2.B.1 Ammonia production – CO ₂

Sector	IPPU
Description of area of improvement with recommendation or encouragement	The methodology report referred to in ID# 2.G.1 in table 2 (p.43) states that both natural gas consumption and the country-specific EF for natural gas used for estimating emissions from ammonia production are confidential. However, table 5 of the methodology report (p.32) shows the country-specific CO2 EFs for natural gas for 1990–2022. During the review, the Party clarified that the statement that the country-specific EF was confidential was incorrect and that the EF used for estimating CO2 emissions from ammonia production was taken from table 5 of the methodology report. The Party indicated that this statement will be corrected for future submissions. To increase transparency, the TERT recommends that the Party indicate the appropriate status of confidentiality of the EF used for estimating CO2 emissions from ammonia production and provide detailed methodological information for the category.
NLD Response in NIR 2026	This has been implemented in the text of NID 2026, paragraph 4.8
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	

Sector	IPPU
ID# TERR	4.I.3
Reporting requirement	Specified in paragraph 39 of the MPGs 2.B.8 Petrochemical and carbon black production – CO2
Description of area of improvement with recommendation or encouragement	The methodology report referred to in ID# 2.G.1 in table 2 (p.42) states that “the CO2 emissions resulting from the use of fossil fuels as feedstocks for the production of silicon carbide, carbon black, ethylene and methanol are included in the Energy sector (CRF 1.A.2.c)”. The TERT notes that according to the 2006 IPCC Guidelines (vol. 3), these emissions should be allocated to the IPPU sector. During the review, the Party confirmed that emissions from the combustion of chemical waste gas occurring in the same source category (i.e. chemical sector) were reallocated to the IPPU sector for the 2024 submission, as described in the NID (e.g. pp.67, 96, 102, 135, 142, 151, 288 and 384). However, the statement in the methodology report still applies to the Netherlands’ earlier reporting because the report has not been fully updated. The Party indicated that it will correct this for the next submission.

Sector	IPPU
	To increase transparency, the TERT recommends that the Party clearly indicate in the NID, including the methodology report, under which sector and category the process emissions from petrochemical and carbon black production are reported.
NLD Response in NIR 2026	This has been implemented in both the methodology report and the text of NID 2026, paragraph 4.3
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	

Sector	IPPU
ID# TERR	4.I.4
Reporting requirement	Specified in paragraph 40 of the MPGs 2.G.2 SF6 and PFCs from other product use – SF6

Sector	IPPU
Description of area of improvement with recommendation or encouragement	The NID (p.164) states that category 2.G.2 covers SF6 emissions from soundproof windows, electron microscopes and the electronics industry, while the methodology report referred to in ID# 2.G.1 in table 2 (p.79) states, with regard to the scope of category 2.G.2, that SF6 emissions from "the production, use and end of-lifespan activities for sound-insulated glazing (2.G.2.c) and for the minor source 'production of electron microscopes'" occur under category 2.G.2. The methodology report (p.76) also states that "SF6 emissions as a result of using SF6 in the high-voltage power industry, production of semi-conductors, double glazing and electromicroscopes are all aggregated into a single figure and reported under CRF category 2.G.4 'Other' due to the confidentiality of the data". However, CRT 2(I) shows SF6 emissions reported under category 2.G.2. The TERT notes that the information provided in the NID, the CRTs and the methodology report is not consistent with regard to the scope of category 2.G.2 and the reporting of these emissions. During the review, the Party clarified that SF6 emissions resulting from the use of SF6 in the high-voltage power industry, the production of semiconductors, double glazing and electron microscopes are all aggregated into a single figure and reported under category 2.G.2, and that the reference in the methodology report that the emissions for these categories are reported under SF6 is incorrect and will be updated for the next submission. The Party further clarified that the activities under category 2.G.2 resulting in SF6 emissions include soundproof windows and electron microscopes. To increase transparency, the TERT recommends that the Party clarify the coverage of the reporting of category 2.G.2 in the CRT, including by clarifying which emissions for other categories are reported under category 2.G.2 for confidentiality reasons.
NLD Response in NIR 2026	This has been implemented in the text of NID 2026, paragraph 4.8
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	

Sector	Agriculture
ID# TERR	5.A.1 (I)
Reporting requirement	Specified in paragraph 35 of the MPGs 3. General (agriculture) – CO ₂ , CH ₄ and N ₂ O
Description of area of improvement with recommendation or encouragement	The TERT identified inconsistencies between the NID and the CRTs in relation to the reporting of: (a) AD for 2022: (1) there was a discrepancy in the number of sheep reported between the NID (910 (×1,000)) (table 5.2, p.173) and CRT 3.A (906.68 (×1,000)); (2) the number of swine was reported as 11,235 (×1,000) in the NID (table 5.2, p.173), and as 14,370.75 (×1,000) in CRT 3.A; and (3) there was a discrepancy in the number of poultry reported between the NID (89,493(×1,000)) (table 5.2, p.173) and CRT 3.A (89,452.53(×1,000)); (b) CH₄ emissions from enteric fermentation: (1) for cattle for 2022, emissions of 8.2 Tg CO₂ eq were reported in the NID (table 5.3, p.177), while emissions of 8.463 Tg CO₂ eq were reported in CRT 3; (2) for CH₄ emissions from manure management, the NID (section 5.3.1, p.182) indicates a decrease of 34.5 per cent between 1990 and 2022, while a decrease of 35.08 per cent was reported in CRT 10.S.3; and (3) for N₂O emissions from managed soils, direct emissions in 2022 were reported as 3.6 Tg CO₂ eq in the NID (table 5.8, pp.189–190) and as 1,987.66 kt CO₂ eq (equivalent to 1.987 Tg CO₂ eq) in CRT 3, and N₂O emissions from inorganic N fertilizers were reported as 3.6 kt in CRT 3.D and as 3,600 kt in NID table 5.8; (c) IEFs, for example (1) for CH₄ from enteric fermentation for swine, a default EF of 1.5 kg CH₄/animal from the 2006 IPCC Guidelines was reported in the NID (section 5.2.2, p.178) and an IEF of 1.17 kg CH₄/animal was reported in CRT 3.A; (2) for CH₄ from enteric fermentation for mules and asses, an IEF of 10 kg CH₄/animal was reported in the NID (section 5.2.2, p.179) and an IEF of 13.07 kg CH₄/animal was reported in CRT 3.A; the EF used for manure management for mules and asses was the tier 1 default EF from the 2006 IPCC Guidelines (0.76 kg CH₄/animal), while the EF value reported in CRT 3.B(a) was 0.99 kg CH₄/animal and (3) the N₂O EF for inorganic N fertilizers was reported as 0.013 kg N₂O-N/kg CO₂ in the NID (table 5.9, p.193), whereas in CRT 3.D it was reported as a much smaller value (0.0000110596450139468 kg N₂O-N/kg CO₂). Inconsistencies were also noted for parameters such as the MCF values. The Party reported the MCF values used for each livestock category in table 4.2 of a report on the methodology for calculating emissions from agriculture (van der Zee et al., 2024, p.54), and in CRT 3.B(a). However, the TERT identified an inconsistency in the reported MCF values for mature dairy cattle; table 4.2 lists a value of 0.02 (based on the IPCC default value), whereas CRT 3.B(a) reports a value of 0.17 for mature dairy cattle for dry lot.

Sector	Agriculture
	During the review, the Party acknowledged the inconsistencies in AD between the NID and the CRTs and informed the TERT these errors were due to (1) rounding; (2) accidental double counting of piglets during data transfer; (3) a typographical error; (4) a summation error; (5) errors in units used; and (6) errors in the transfer of data from the CRF tables to the CRTs, using the new ETF reporting tool. The Party also informed the TERT that these inconsistencies and errors will be corrected in its next submission. The TERT recommends that the Party ensure consistency between the NID and CRTs by using cross checks, implementing QC measures for data summation and transition, and carefully verifying tables to prevent any errors and discrepancies, including ensuring the correct use of AD and emissions in its CRTs to prevent discrepancies in the IEF values reported in the CRTs to improve overall data consistency and transparency
NLD Response in NIR 2026	The inconsistencies have been solved in the current submission. Inconsistencies were partly caused by the transition from the CRF to the CRT. A new file has been created to automate the filling of the CRT, thus reducing the chance of human error.
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	

Sector	Agriculture
ID# TERR	5.A.2
Reporting requirement	Specified in paragraph 39 of the MPGs 3.A.1 Cattle – CH₄ and N₂O 3.A.2 Sheep – CH₄ and N₂O

Sector	Agriculture
Description of area of improvement with recommendation or encouragement	The TERT identified inconsistencies in the number of livestock reported in the Party's NID and BTR1 for 2020. The Party reported the number of cattle in NID table 5.2 (p.173) as 3,719 ($\times 1,000$), while the number reported in its BTR1 (table 3.5, p.49) was 3,838 ($\times 1,000$). During the review, the Party explained that the discrepancies arose due to differences in the data sources used for reporting. The Party clarified that the number of livestock reported in the NID is based on both the national agricultural census (Statistics Netherlands) and the Identification and Registration database of the Netherlands Enterprise Agency. In contrast, the number of livestock reported in the BTR1 was derived solely from the agricultural census. The number of sheep and swine reported in the NID for 2020 (table 5.2, p.173) were 954 ($\times 1,000$) and 11,860 ($\times 1,000$) respectively, whereas the number reported in the BTR1 (table 3.5, p.49) were 890 ($\times 1,000$) and 11,950 ($\times 1,000$). The Party explained that the BTR1 figures are based exclusively on the agricultural census, whereas the NID incorporates data from both the census and the Identification and Registration database of the Netherlands Enterprise Agency. The Party also confirmed that the figures reported in the NID and CRTs are the correct numbers for the emission calculations and that it intends to reference only these figures in future BTR submissions to improve consistency and clarity. The TERT recommends that the Party ensure the use of consistent sources of the AD used for the GHG inventories, in addition to justifying their use, as appropriate, and providing references in the NID and BTR.
NLD Response in NIR 2026	The figures in the BTR will be updated to include the data of the Identification and Registration database, consistent with the data in the NIR; this will be addressed in the next BTR cycle.
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	

Sector	Agriculture
ID# TERR	5.A.3
Reporting requirement	Specified in paragraph 39 of the MPGs 3.B Manure management – CH4

Sector	Agriculture
Description of area of improvement with recommendation or encouragement	The Party reported fraction values for the MMS used for each livestock category in CRT 3.B(a). The TERT noted that the sum of the MMS fraction values for mature dairy cattle, other mature cattle and swine reported in CRT 3.B(a) do not equal 100 per cent and that the relevant values were missing from NID section 5.3.2, which made it difficult for the TERT to check the accuracy of the emission calculations. During the review, the Party explained that technical difficulties during the transition to the CRTs led to the incomplete filling of CRT 3.B(a), and provided the calculations of the MMS fraction values for mature dairy cattle, other mature cattle and swine in an attachment. The TERT recommends that the Party update the description of the methodology and AD in the NID to include missing MMS values and refine the calculation methodology used to prevent discrepancies such as rounding issues from occurring, and provide verified data in the NID and CRTs.
NLD Response in NIR 2026	The inconsistencies have been solved in the CRT 2026 and the sum of the MMS fraction values now equal 100 percent. As the inconsistencies were a result of technical difficulties in the transition to the CRT, the methodology itself has not changed. The AD MMS section will, however, be revised in the methodology background report (van der Most et al., 2026).
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	NID 5.3.6

Sector	LULUCF
ID# TERR	6.L.1
Reporting requirement	Specified in paragraph 22 of the MPGs 4. General (LULUCF) – CO2
Description of area of improvement with recommendation or encouragement	In NID figure 6.1 (p.215), the Party illustrated the changes in carbon stocks in mineral soils for cropland and grassland using the Rothamsted Carbon Model, showing notable fluctuations. For cropland, sharp increases were observed in 2005–2007, followed by significant decreases in 2008–2010 and after 2015. For grassland, there were increases in 2000–2005, followed by sharp decreases in 2008–2013 and after 2015. However, the Party did not provide an explanation for these sharp increases and decreases in soil carbon stocks in the specified years. During the review, the Party explained that the Rothamsted Carbon Model simulation outcomes are primarily driven by annual weather conditions, with carbon inputs (e.g. crop residues and manure) playing a secondary role. The Party further explained that weather strongly influences annual fluctuations in soil carbon stocks, and although a five-year average was applied to smooth variability, significant fluctuations persist, accounting for the observed patterns. The Party also indicated that there were no extreme weather events during the specified time periods. The TERT noted that given that the dynamics of soil organic carbon typically change gradually, such sharp changes warrant further scrutiny. The TERT recommends that the Netherlands transparently explain the national methodologies applied, including by providing a justification for noted fluctuations, such as summary data on weather events during key periods (e.g. carbon stock increases in mineral soils in cropland in 2005–2007 and decreases in 2008–2010, and decreases in grassland in 2008–2013), as well as an assessment of the sensitivity of the Rothamsted Carbon Model to annual weather inputs, in order to better substantiate the reported fluctuations and align the analysis with observed soil carbon dynamics.
NLD Response in NIR 2026	The Netherlands recognizes that annual fluctuations in soil carbon stock changes in mineral soils are mainly due to changes in the weather data for specific years. This is a consequence for the choice to use observed monthly weather data as input for the model, and no fixed average climate data. For the NID2026, a revised approach was used to account for the effect of weather data. Instead of averaging the results of 5 years, we simulated each year with the weather data of the previous five years, to better reflect the changes in activity data. This changed the periods where decreases and increases occurred, although there is still variability. As monthly weather data are used, for 14 different regions, it is not straightforward to explain the fluctuations. However, we will include a

Sector	LULUCF
	sensitivity analysis of the RothC model in the next methodology report. It should be noted that while the changes in carbon stock fluxes may seem large, compared to the total carbon stocks in mineral soils these changes are small (less than 1%).
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	

Sector	LULUCF
ID# TERR	6.L.2
Reporting requirement	Specified in paragraphs 21–22 of the MPGs Land representation – CO2
Description of area of improvement with recommendation or encouragement	In the NID (section 6.1.1), the Party indicated that land use in the country is predominantly agricultural (around 54 per cent), followed by open water (19 per cent), settlements (15 per cent), forestry (9 per cent) and a combined 3 per cent encompassing dunes, nature reserves, wildlife areas, heather and reed swamp, according to 2021 land-use maps (van Baren et al., 2024). The TERT noted that the description of land-use classes is not in accordance with the land-use categories in the 2006 IPCC Guidelines (vol. 4, chap. 3.2, pp.3.5–3.7). During the review, the Party explained that it chose to use specific land-use classes in order to provide a clearer picture of the extent of land use, which would be less apparent when using only the IPCC land-use categories. The TERT recommends that the Party align its detailed land-use classifications with the broader categories in the 2006 IPCC Guidelines (vol. 4, chap. 3.2, pp.3.5–3.7), while providing the context-rich breakdown of land use as additional supplementary details for enhanced comparability.
NLD Response in NIR 2026	Thank you for the recommendation. In the current submission, the Party has revised the land-use statistics in section 6.1.1 so that the primary land-use categories follow the structure of the 2006 IPCC Guidelines. The more

Sector	LULUCF
	detailed national land-use classes will be presented as supplementary information to provide additional context and maintain transparency regarding national land-use patterns.
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	6.1.1. in NID

Sector	LULUCF
ID# TERR	6.L.3
Reporting requirement	Specified in paragraphs 26–28 of the MPGs 4.A Forest land – CO ₂
Description of area of improvement with recommendation or encouragement	In a methodological background document on GHG reporting for the LULUCF sector in the Netherlands, the Party explained that the 1990 forest inventory methodology (Timber Production Statistics and Forecast) differed from those used in later inventories throughout the time series (van Baren et al., 2024; p.34). The TERT considers that using different methods and data in a time series could introduce bias because the estimated emission trend will reflect not only real changes in emissions or removals but also the pattern of methodological refinements. During the review, the Party explained that LULUCF reporting did not exist in 1990, and thus the national forest inventory was designed differently at that time; only the three most recent national forest inventories have been specifically aligned to provide consistent LULUCF data. The TERT recommends that the Party explain how it ensured time-series consistency while using data from different forest inventories, and if deemed necessary and as appropriate, make recalculations to ensure time-series consistency in line with the 2006 IPCC Guidelines.

Sector	LULUCF
NLD Response in NIR 2026	The Party appreciates the TERT's observation regarding the use of different data sources and methodologies across the time series. As noted, methodological refinements often become possible only when new data sources or improved measurement techniques become available. By their nature, these newer data sources often cannot be retrospectively applied to earlier years such as 1990. Consequently, requiring that all methods and datasets be available across the full time series would limit the Party's ability to incorporate methodological improvements consistent with good practice. To address potential inconsistencies, the methodological background report provides a detailed explanation of how data from the 1990 Timber Production Statistics and Forecast (HOSP) have been processed to ensure comparability with the more recent national forest inventory (NFI) cycles. In particular, p.36 in section 4.2.1 of the NIR25 methodology report (van Baren et al., 2025) describes how plot-level information from the HOSP was used to generate biomass estimates that are consistent with those derived from subsequent NFIs. Through this approach, the Party has taken steps to ensure time-series consistency in line with the 2006 IPCC Guidelines.
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	Section 4.2.1. of van Baren et al. 2026

Sector	LULUCF
ID# TERR	6.L.4
Reporting requirement	Specified in paragraphs 21 and 47 of the MPGs 4.B.2 Land converted to cropland – CO2

Sector	LULUCF
Description of area of improvement with recommendation or encouragement	In NID section 6.51 (p.237), the Party stated that DOM carbon stock losses for land conversions to cropland are based on DOM carbon stocks, which currently include only forest land. The 2006 IPCC Guidelines (vol. 4, chap. 5.3.2) indicate that grassland and wetlands may also have significant DOM stocks for such conversions. However, the Party did not include DOM carbon stock losses for grassland converted to cropland in its NID. During the review, the Party acknowledged that differences in DOM between cropland and grassland were not explicitly included in these conversions. It noted that, for grassland converted to cropland, the majority of carbon stock losses are from mineral and organic soils (–245 Gg C), with living biomass losses amounting to –53 Gg C, as reported in the CRTs for 2022. The Party explained that if DOM carbon stock losses were included, they would likely not exceed the biomass losses (e.g. –50 Gg C), contributing only 14 per cent to the total carbon stock change (50/[53+245]). For conversions from trees outside forests to cropland, the Party assumed zero DOM carbon stocks, stating that no losses occur, and that any prior DOM losses from conversions of forest land to trees outside forests are already captured in earlier estimates. To improve the completeness and transparency of the carbon stock change estimates, the TERT recommends that the Party explicitly account for DOM in conversions of grassland to cropland in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 5.3.2), for example, by applying a tier 1 approach as described in the 2006 IPCC Guidelines (vol. 4, chap. 5.3.2.1).
NLD Response in NIR 2026	The Party appreciates the TERT's recommendation to enhance completeness and transparency regarding DOM carbon stock changes for conversions from grassland to cropland. Upon careful review of the 2006 IPCC Guidelines, the Party notes that volume 4, chapter 5.3.2 does not identify grassland as a land-use category likely to contain significant DOM stocks prior to conversion. Instead, the Guidelines specify that forest land, agroforestry systems, and certain wetlands may have substantial DOM pools that warrant explicit estimation when converted to cropland. As stated on p. 5.31: "In general, croplands will have little or no dead wood or litter... It is likely that the same will be true of many land uses prior to conversion... The exceptions are forest, agro-forests, and wetlands converted to Cropland, which could have significant carbon in DOM pools." Regarding the suggestion to apply a tier 1 approach for DOM loss in conversions of grassland to cropland, the Party notes that this method requires default DOM stock values for both the initial and final land-use categories. Table 2.2 of volume 4, chapter 2.3.2.2 provides default DOM stocks only for forest types across climatic regions. No tier 1 default values are provided for grassland or cropland, reflecting the expectation in the Guidelines that DOM pools in these land uses are generally small and often assumed to be zero. As such, a strict tier 1 implementation for DOM is not feasible for grassland-to-cropland conversions.

Sector	LULUCF
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	

Sector	LULUCF
ID# TERR	6.L.5
Reporting requirement	Specified in paragraph 39 of the MPGs 4.C Grassland – CO2
Description of area of improvement with recommendation or encouragement	In the methodological background document on GHG reporting for the LULUCF sector in the Netherlands, the Party stated that specific data on growth and increment for trees outside forests are unavailable (van Baren et al., 2024; section 6.1.1). This led the Party to assume that biomass growth rates in trees outside forests match those of forest land. However, the Party did not provide any justification for this assumption or any details on plans and timelines for obtaining such data. During the review, the Party clarified that growth and increment data for trees outside forests will be gathered through a dedicated measurement campaign under the national forest inventory, with data collection anticipated between 2025 and 2027. To enhance transparency, the TERT recommends that the Party (1) provide a rationale in the NID for assuming that growth rates in trees outside forests are equal to those in forest land; and (2) include details of the planned 2025–2027 measurement campaign in the NID, specifying the methodology (e.g. sampling design, scope).
NLD Response in NIR 2026	The Party appreciates the TERT's recommendation to strengthen transparency regarding growth and increment estimates for trees outside forests. As such, (1) the rationale for the assumption on growth rates of trees outside forests in comparison to forest land has been included in NID section 6.6.2 under the heading 'Trees Outside Forest'; (2) details of the planned 2025-2027 measurement campaign have now been described in NID section 6.6.6.
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	6.6.6. of NID

Sector	Waste
ID# TERR	7.W.1
Reporting requirement	Specified in paragraph 39 of the MPGs 5.C.1 Waste incineration – CH4
Description of area of improvement with recommendation or encouragement	In table 32 of the report referred to in ID# 2.G.1 in table 2 (section 2.3.2.1.3, p.105), the Party stated that the CH4 EF used in this work package is in line with the default value in the 2006 IPCC Guidelines (vol. 5, chap. 5.4.2), which mention that it is good practice to apply an EF of zero. However, the Party did not indicate the type of incineration or technology. Moreover, the 2006 IPCC Guidelines state that it is good practice to apply an EF of zero for continuous incineration processes only, and that for other types of incineration or technology, the EF is not zero (e.g. the EF for batch-type fluidized bed incineration is 237 kg/Gg waste incinerated on a wet weight basis). During the review, the Party explained that all municipal waste incineration activities are based on continuous fluidized bed incineration processing and that this information will be included in the next submission. The TERT recommends that the Party clarify that all incineration processes are continuous fluidized bed incineration processes, justifying the CH4 EF used.
NLD Response in NIR 2026	All waste incinerators that treats mixed municipal waste are grate furnaces. This sentence is added to the text in 7.4.1 in the NIR submission 2026.
Paragraph or table number in: NID, CRT and/or Methodology report (MR)	NID chapter 7.4.1

Annex 11 List of abbreviations

AD	Activity Data
AER	Annual Environmental Reports
AGB	Above-Ground Biomass
AR	Afforestation and Reforestation
AER	Annual Environmental Report
BCEF	Biomass Expansion Function
BF	Blast Furnace Gas
BGB	Below-Ground Biomass
BOD	Biological Oxygen Demand
C	Carbon or Confidential information(notation code in CRF)
CBS	Statistics Netherlands
CDM	Clean Development Mechanism
CHP	Combined Heat and Power
CLRTAP	Convention on Long-Range Transboundary Transport of Air Pollutants
CO	Coke Oven Gas
COD	Chemical Oxygen Demand
CPR	Commitment Period Reserve
CRF	Common Reporting Format (of emissions data files, annexed to an NIR)
CSC	Carbon Stock Changes
D	Deforestation
DM	Dry matter
DOC	Degradable Organic Carbon
DOCf	Degradable Organic Carbon Fraction
DOM	Dead Organic Matter
DW	Dead Wood
e-AER	electronic Annual Environmental Report
ECA	Emission Control Areas
EEA	European Environment Agency
EF	Emission Factor
ENINA	Task Group Energy, Industry and Waste Handling
ER	Emission Registration (system)
ERT	Expert Review Team
ERU	Emission Reduction Unit
ETS	Emission Trading System
EU	European Union
EWL	European Waste List
EZ	Ministry of Economic Affairs
EZK	Ministry of Economic Affairs and Climate Policy (EZK)
FAO	Food and Agricultural Organization (UN)
F-gases	group of fluorinated compounds comprising HFCs, PFCs and SF ₆
FGD	Flue Gas Desulphurisation
FM	Forest Management
FMRL	Forest Management Reference Level
GE	Gross Energy
GHG	Greenhouse Gas
GWP	Global Warming Potential

HOSP	Timber Production Statistics and Forecast (in Dutch: 'Hout Oogst Statistiek en Prognose oogstbaar hout')
HWP	Harvested wood products
IE	Included Elsewhere (notation code in CRF)
IEA	International Energy Agency
IEF	Implied Emission Factor
IPPU	Industrial Processes and Product Use (sector)
IWWTP	Industrial Wastewater Treatment Plant
IPCC	Intergovernmental Panel on Climate Change
LDAR	Leak Detection and Repair
LEI	Agricultural Economics Institute
LPG	Liquefied Petroleum Gas
LULUCF	Land use, land Use Change and Forestry (sector)
MCF	methane conversion factor
MFV	Measuring Network Functions (in Dutch: 'Meetnet Functievervulling')
MR	Methane Recovery
MSW	Municipal Solid Waste
MW	Mega Watt
N	Nitrogen
NA	Not Available/Not Applicable (notation code in CRF)
NAV	Dutch Association of Aerosol Producers
NE	Not Estimated (notation code in CRF)
NEa	Netherlands Emissions Authority (Dutch Emissions Authority)
NFI	National Forest Inventory
NIC	National Inventory Compiler
NIE	National Inventory Entity
NIR	National Inventory Report (annual GHG inventory report to UNFCCC)
NL-PRTR	Netherlands'Pollutant Release and Transfer Register
NMVOC	Non-Methane Volatile Organic Compound
NO	Not Occurring (notation code in CRF)
NRMM	Non-Road Mobile Machinery
ODS	Ozone Depleting Substances
ODU	Oxidation During Use (of direct non-energy use of fuels or of petrochemical products)
OECD	Organisation for Economic Co-operation and Development
OX	OXygen furnace gas
PA	Paris Agreement
PBL	PBL Netherlands Environmental Assessment Agency (formerly MNP)
PE	Pollution Equivalent
PRTR	Pollutant Release and Transfer Register
QA	Quality Assurance
QC	Quality Control
RA	Reference Approach (vs. sectoral or national approach)
RIVM	National Institute for Public Health and the Environment
RVO	Netherlands Enterprise Agency
SA	Sectoral Approach
SCR	Selective Catalytic Reduction
SEF	Standard Electronic Format
SNCR	Selective Non-Catalytic Reduction
SWDS	Solid Waste Disposal Site

TNO	Netherlands Organisation for Applied Scientific Research
TOF	Trees Outside Forest
TOW	Total Organics in Wastewater
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UWWTP	Urban WasteWater Treatment Plant
VOC	Volatile Organic Compound
VS	Volatile Solids
WAR	Working Group for Waste Registration
WBCSD	World Business Council for Sustainable Development
WEM	Working Group Emission Monitoring
WRI	World Resources Institute
WR	Wageningen Research
WenR	Wageningen Environmental Research
WSER	Wageningen Social and Economic Research
WWTP	WasteWater Treatment Plant

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