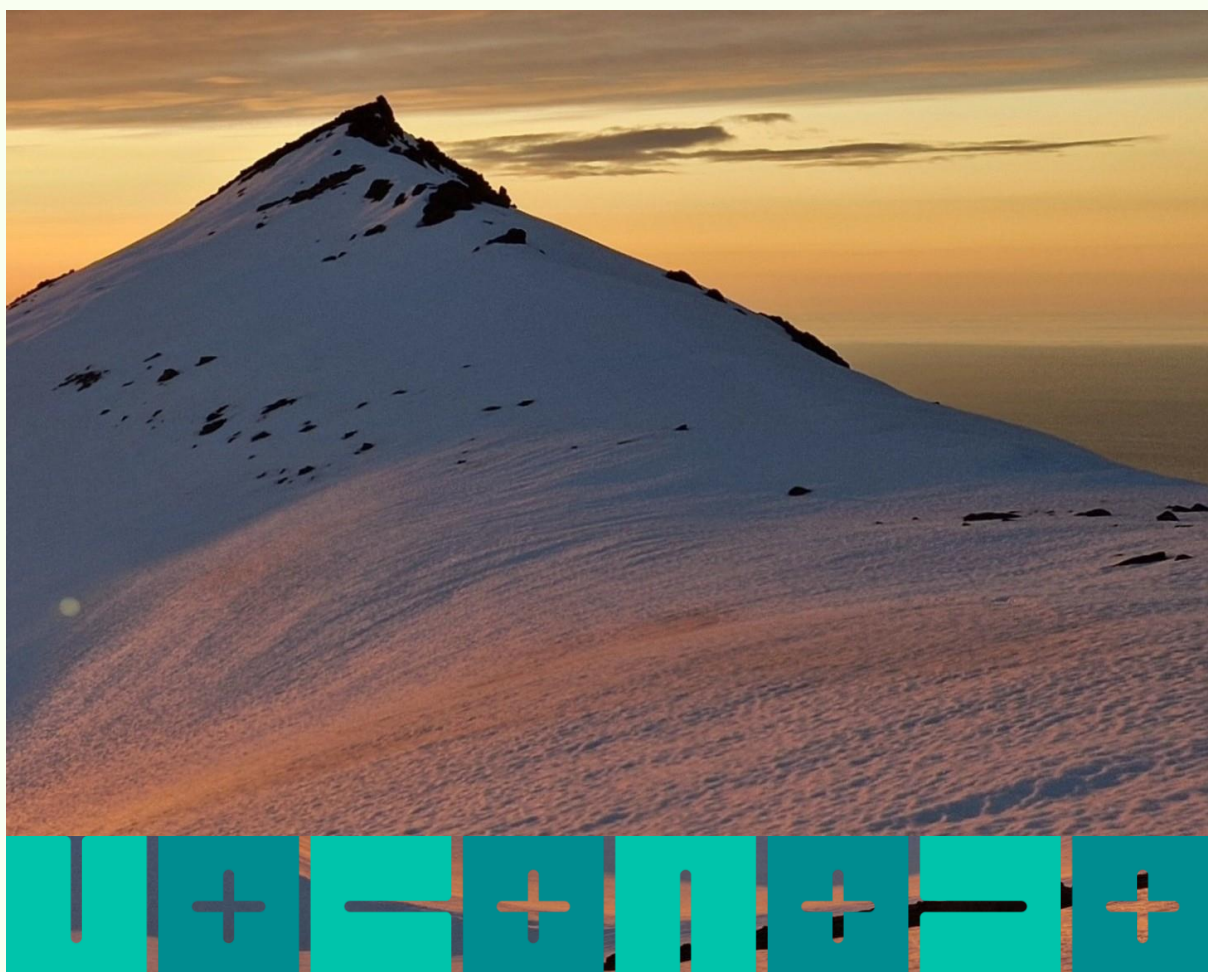


National Inventory Document

Emissions of Greenhouse Gases in Iceland from
1990 to 2024

Submitted under the United Nations Framework Convention on Climate Change



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Preface

The United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement require Parties to submit annually to the UNFCCC national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. Rules and guidelines on reporting to the UNFCCC and the Paris Agreement are detailed in Decision 18/CMA.1 and related UNFCCC decisions. Iceland is cooperating with the European Union to reach the emission reduction target for 2030 stated in their respective Nationally Determined Contribution (NDC), and this submission also complies with the EU's legislation on greenhouse gas inventories, as per Art. 26 and Annex V, Parts 1 and 2 of Regulation (EU) 2018/1999 as incorporated into the EEA Agreement through Joint Committee Decision 269/2019, and other relevant legislation.

According to the above-mentioned reporting obligations, Iceland has prepared a National Inventory Report (NIR) covering emissions and removals in the years 1990-2024. The NIR consists of this national inventory document (NID) together with the associated Common Reporting Tables (CRT).

The NIR is compiled by the Icelandic Environment and Energy Agency (IEEA – Umhverfis- og orkustofnun, a joint institution of part of the former Environment Agency of Iceland (EAI, Umhverfisstofnun) and the National Energy Authority (NEA, Orkustofnun) which began operations 1 January 2025) and by Land and Forest Iceland (LFI - Land og skógur). The IEEA is responsible for all chapters apart from those concerning Land Use, Land-Use Change and Forestry (LULUCF), which are written by the LFI. Jón Guðmundsson from the Agricultural University of Iceland (AUI-Landbúnaðarháskóli Íslands) is acknowledged for his extensive contribution to the LULUCF chapters.

Icelandic Environment and Energy Agency, Reykjavík, 15 April 2026

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List of Abbreviations

2006 Guidelines	2006 IPCC Guidelines for Greenhouse Gas Inventories
2019 Refinements	2019 Refinements to the 2006 IPCC Guidelines
AAU	Assigned Amount Units
AD	Activity Data
ADEM	Arctic Digital Elevation Model
AGB	Above Ground Biomass
AUI	Agricultural University of Iceland (<i>Landbúnaðarháskóli Íslands</i>)
BAT	Best Available Technology
BEP	Best Environmental Practice
BGB	Below Ground Biomass
BOD	Biological Oxygen Demand
C ₂ F ₆	Hexafluoroethane
C ₃ F ₈	Octafluoropropane
CER	Certified Emission Unit
CF	Cultivated Forest
CF ₄	Tetrafluoromethane
CFC	Chlorofluorocarbon
CH ₄	Methane
CKD	Cement Kiln Dust
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
COD	Chemical Oxygen Demand
COP	Conference of the Parties
COPERT	Computer Programme to calculate Emissions from Road Transport
CP2	Second Commitment Period to the Kyoto Protocol
CRT	Common Reporting Tables
CS	Country Specific
CSC	Carbon Stock Change
D0.5	Diameter at height of 0.5m
DBH	Diameter at Breast Height
DOC	Degradable Organic Carbon
DOM	Dead Organic Matter
DW	Dead Wood
EAI	The Environment Agency of Iceland (<i>Umhverfisstofnun</i>)
EF	Emission Factor
ERT	Expert Review Team
ERU	Emission Reduction Unit

EU	European Union
EU ETS	European Union Greenhouse Gas Emission Trading System
FL	Forest Land
FLrFL	Forest Land remaining Forest Land
FeSi	Ferrosilicon
GDP	Gross Domestic Product
Gg	Gigagrams
GHG	Greenhouse Gases
GIS	Geographic Information System
GPS	Global Positioning System
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbons
HFC	Hydrofluorocarbon
HMI	Habitat Map of Iceland
HWP	Harvested Wood Products
IAAC	Icelandic Agricultural Advisory Centre (<i>Ráðgjafamiðstöð landbúnaðarins</i>)
IEEA	Icelandic Environment and Energy Agency (<i>Umhverfis- og orkustofnun</i>)
IEF	Implied Emission Factor
IFD	Icelandic Farmland Database
IFVA	Icelandic Food and Veterinary Association (<i>Matvælastofnun</i>)
IGLUD	Icelandic Geographic Land Use Database
INFI	Icelandic National Forest Inventory
IPCC	Intergovernmental Panel on Climate Change
ITA	Icelandic Transport Authority (<i>Samgöngustofa</i>)
ITL	International Transaction Log
IW	Industrial Waste
kha	Kilohectare
KP	Kyoto Protocol
LA	Level Assessment
LB	Living biomass
LcFL	Land Converted to Forest Land
LFI	Land and Forest Iceland
LUC	Land Use Classes
LULUCF	Land Use, Land-use Change, and Forestry
MAC	Mobile Air Conditioning
MACS	Mobile Air-Conditioning Systems
MCF	Methane Conversion Factor (Agriculture) / Methane Correction Factor (Waste)
MEEC	Ministry of the Environment, Energy, and Climate (<i>Umhverfis-, orku- og loftslagsráðuneytið</i>)
MFAF	Ministry of Food, Agriculture, and Fisheries (<i>Matvælaráðuneytið</i>)
MMR	Monitoring Mechanism Regulation
MSW	Municipal Solid Waste

N ₂ O	Nitrous Oxide
NA	Not Applicable
NBF	Natural Birch Forest
NBS	Natural Birch Shrubland
NBW	Natural Birch Woodland
NEA	National Energy Authority (<i>Orkustofnun</i>)
NF ₃	Nitrogen Trifluoride
NFI	National Forest Inventory
NID	National Inventory Document
NIR	National Inventory Report
NIRA	The National Inventory on Revegetation Area
NMVOC	Non-Methane Volatile Organic Compounds
NO	Not Occurring
NO _x	Nitrogen Oxides
NPA	National Planning Agency (<i>Skipulagsstofnun</i>)
NPCI	National Power Company of Iceland (<i>Landsvirkjun</i>)
NSII	Natural Science Institute of Iceland (<i>Náttúrufræðistofnun</i>)
ODS	Ozone Depleting Substances
OECD	Organisation for Economic Co-operation and Development
OTH	Other
OX	Oxidation Factor
PFC	Perfluorocarbons
POP	Persistent Organic Pollutant
QA/QC	Quality Assurance/Quality Control
RI	Registers Iceland (<i>Þjóðskrá Íslands</i>)
RMU	Removal Unit
SEF	Standard Electronic Format
SF ₆	Sulphur Hexafluoride
Si	Silicon
SI	Statistics Iceland (<i>Hagstofa Íslands</i>)
SiO	Silicon Monoxide
SiO ₂	Quartz
SO ₂	Sulphur Dioxide
SO ₂ e	Sulphur Dioxide Equivalents
SOC	Soil Organic Carbon
SOCmin	Soil Organic Carbon in mineral soils
SOCorg	Soil Organic Carbon in organic soils
SSPP	Systematic Sampling of Permanent Plots
SWD	Solid Waste Disposal
SWDS	Solid Waste Disposal Sites
t/t	Tonne per Tonne

TA	Trend Assessment
TACCC	Transparency, Accuracy, Consistency, Completeness, Comparability
TOW	Total Organics in Wastewater
UNFCCC	United Nations Framework Convention on Climate Changes

Global Warming Potentials of Greenhouse Gases

Greenhouse gas	Chemical formula	GWP – AR5
Carbon dioxide	CO ₂	1
Methane	CH ₄	28
Nitrous oxide	N ₂ O	265
Sulphur hexafluoride	SF ₆	23,500
Perfluorocarbons (PFCs):		
Tetrafluoromethane (PFC 14)	CF ₄	6,630
Hexafluoroethane (PFC 116)	C ₂ F ₆	11,100
Octafluoropropane (PFC 218)	C ₃ F ₈	8,900
Hydrofluorocarbons (HFCs):		
HFC-23	CHF ₃	12,400
HFC-32	CH ₂ F ₂	677
HFC-125	C ₂ HF ₅	3,170
HFC-134a	C ₂ H ₂ F ₄ (CH ₂ FCF ₃)	1,300
HFC-143a	C ₂ H ₃ F ₃ (CF ₃ CH ₃)	4,800
HFC-152a	C ₂ H ₄ F ₂ (CH ₃ CHF ₂)	138
HFC-227ea	C ₃ HF ₇	3,350

Source: Table 8.A.1 of Chapter 8 of the Contribution of WG1 to the Fifth Assessment report (AR5 - WGI), 100-yr time horizon.

The Global Warming Potentials (GWPs) used in this submission are based on the 100-year time horizon GWPs presented in the **Fifth Assessment Report (AR5)** of the IPCC, as required by the Annex to Decision 18/CMA.1, Decision 6/CP.27 and Commission Delegated Regulation (EU) 2020/1044.

Executive Summary

ES.1 Background

Iceland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1993, the Kyoto Protocol in 2002 and the Doha amendment to the Kyoto protocol in 2015, and the Paris Agreement was ratified in 2016. The UNFCCC and the Paris Agreement require that the Parties report annually on their greenhouse gas emissions by sources and removals by sinks. To comply with this requirement, Iceland has prepared a National Inventory Report (NIR), which consists of this national inventory document (NID) together with the associated Common Reporting Tables (CRT), following the guidelines given in Decision 18/CMA.1 and 5/CMA.3.

This report, together with the associated CRT tables, is also submitted to the EU in accordance with Art. 26 and Parts 1 and 2 of Annex 5 of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, in accordance with the incorporation of the relevant EU acts into the Agreement on the European Economic Area (the EEA Agreement). The submission to the EU also includes relevant Annexes to Commission Implementing Regulation (EU) 2020/1208.

The responsibility of compiling and submitting the emissions data lies with the Icelandic Environment and Energy Agency (IEEA, a newly formed joint institution of part of what used to be the Environment Agency of Iceland (EAI, Umhverfisstofnun) and what used to be the National Energy Authority (NEA, Orkustofnun); the merger took place 1 January 2025. The data and NID sections concerning emissions and removals from the Land Use, Land Use Change and Forestry (LULUCF) sector are managed by Land and Forest Iceland (LFI, a joint institution of the Soil Conservation Service of Iceland and the Icelandic Forest Service which began operations 1 January 2024). The national inventory and reporting system is continually being developed and improved.

After Iceland's ratification of the Kyoto Protocol in 2002, various climate change policies, strategies and plans were published, yet without significant associated funding. The Paris Agreement was ratified in 2016. In September 2018, the Icelandic government published a new Climate Change Action Plan¹, containing a collection of 34 actions and associated funding of 49 million Euros for the period 2019-2023. An update of the 2018 action plan was published in June 2020², with an associated budget of 46 billion Icelandic kr. (300 million Euros) for the period 2020-2024. An updated climate action plan, which was prepared in accordance with the Climate Act (Act No 70/2012), was published in 2024³. The plan included

¹ [Aðgerðaaætlun í loftslagsmálum 2018-2030](#): Climate Action plan 2018-2030, in Icelandic

² [Aðgerðaaætlun í loftslagsmálum til 2030](#): Climate Action plan, updated second edition, in Icelandic

³ [2024 Climate action plan \(in Icelandic\)](#)

150 climate actions, some of which were new while others were carried over from the previous action plan. Since its publication, work has been focused on assessing the mitigation potential of individual actions and prioritising them, resulting in a consolidated two-year implementation plan that is now in place for 2025-2026⁴. The action plan is a key foundation for achieving Iceland's commitments towards the EU for the year 2030 and Iceland's nationally determined contribution (NDC) for 2030 and 2035, as well as its carbon neutrality goal, which is set to be achieved by no later than 2040.

Iceland's current and previous obligations and targets on greenhouse gas emissions and removals are listed here below:

- Under the **Paris Agreement**, Iceland is cooperating with the EU member states and Norway to achieve the Parties' respective Nationally Determined Contributions (NDC). Iceland's 2030 NDC, as revised in 2025, reflects this cooperation, which involves compliance with three sets of EU legislation, as incorporated in the EEA Agreement. For the period 2021-2030 the commitments under the cooperation are as follows:
 - Iceland will continue participation in the **EU Emissions Trading Scheme**,
 - Iceland will reduce emissions falling under the scope of the EU's **Effort Sharing Regulation** (Regulation (EU) 2018/842 - ESR), which include amongst others, emissions from road transport, fishing ships, agriculture and waste management. The ESR provides for country-specific targets for 2030, according to which the target currently in force in Iceland is 29% reduction relative to 2005, as it was calculated in line with the EU's former overall goal of 40% reduction in emissions in 2030 relative to 1990.
 - At the time of this writing, work is in progress to incorporate a new target in line with EU's updated target of 55% reduction in emissions in 2030 relative to 1990; the new ESR-target is expected to amount to 41% reduction in emissions in 2030 relative to 2005.
 - Iceland's 2030 **NDC** states that Iceland is committed to a target of 41% net reduction of greenhouse gas emissions by 2030 compared to 2005, in the sectors covered by the scope of the EU's Effort Sharing Regulation (ESR).
 - Iceland will also reduce net emissions falling under the scope of the EU's **LULUCF Regulation** (Regulation (EU) 2018/841⁵). The LULUCF regulation, as it currently applies to Iceland, requires compliance with the so-called no-debit rule, both for the period 2021-2025 and for the period 2026-2030. This

⁴ See also the [2025 Progress Report on the Climate Action Plan](#) published by the interministerial committee for the climate action plan (in Icelandic)

⁵ The Effort Sharing Regulation (EU) 2018/842 and the LULUCF Regulation (EU) 2018/841 were taken up into the [EEA Agreement with Joint Committee Decision nr. 269/2019](#). Work is underway to incorporate the updated ESR and LULUCF regulations into the EEA Agreement, including the new ESR and the new LULUCF targets.

requires that the sum of net emissions for all accounting categories (as defined in the LULUCF regulation) does not exceed zero when relevant accounting rules are applied. The LULUCF regulation was amended in line with EU's updated target of 55% reduction in emissions in 2030 relative to 1990, and whilst the 2021-2025 target remains unchanged, the 2026-2030 target was changed to country-specific decreases in net emissions (or increase in net removals, as appropriate). The 2030 target for Iceland has not yet been determined as work is still in progress to determine Iceland's 2030 LULUCF target.

- The **second commitment period of the Kyoto Protocol** ran for eight years, from 2013 to 2020. In 2015, the European Union (EU), its Member States and Iceland agreed⁶ that Iceland would participate in the joint fulfilment of commitments of the Union for the second commitment period of the Kyoto Protocol. According to this agreement, Iceland was allocated 15,327,217 t CO₂e for the second commitment period, covering emissions within the Scope of the EU's Effort Sharing Decision (Decision No 406/2009/EC). Iceland acquired 3,403,857 units from a EU Member State in order to match Iceland's emissions for the years 2013-2020. Iceland surrendered the appropriate amount of units within the True Up Period, and submitted its True Up Period report on 20 October 2023.
- For the **first commitment period of the Kyoto Protocol**, from 2008 to 2012, the greenhouse gas emissions were not to increase by more than 10% from the level of emissions in 1990. Decision 14/CP.7 on the "Impact of single project on emissions in the commitment period" allowed Iceland to report certain industrial process carbon dioxide (CO₂) emissions separately and not include them in national totals; to the extent they caused Iceland to exceed its assigned amount. For the first commitment period, from 2008 to 2012, the CO₂ emissions falling under decision 14/CP.7 were not to exceed 8,000,000 tonnes. Iceland complied with its obligations under the first commitment period.

ES.2 Summary of National Emission and Removal Related Trends

Greenhouse gases that must be estimated and reported in national greenhouse gas inventories are the following, as per the Annex to Decision 18/CMA.1:

- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous oxide (N₂O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)

⁶ <http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2010941%202014%20INIT>

- Sulphur hexafluoride (SF₆)
- Nitrogen fluoride (NF₃)

Iceland reports emissions of CO₂, CH₄, N₂O, HFCs, PFCs, and SF₆. To the best of the inventory team's knowledge, NF₃ is neither produced nor used in Iceland, and is not imported in products either. In addition, there is currently no industry operating in Iceland that might emit NF₃.

Emissions that are reported in CO₂ equivalents are calculated using Global Warming Potentials (GWPs) based on the 100-year time horizon GWPs presented in the Fifth Assessment Report (AR5) of the IPCC, as per Decision 18/CMA.1 and Commission Delegated Regulation (EU) 2020/1044.

The distribution of reported greenhouse gas emissions for the inventory reporting sectors (as defined by the UNFCCC and EU emissions inventories rules) since 1990 excluding LULUCF is shown in Figure ES.1 and including LULUCF in Figure ES.2, and a summary of Iceland's national emissions for selected years since 1990 is presented in Table ES.1. The LULUCF sector is the largest contributor to Iceland's emissions profile, with emissions of more than double the combined emissions from the other sectors across the time series. The Energy and Industrial Processes sectors, when combined, contribute approximately 80% of emissions to the national total excluding LULUCF. The emissions from the Agriculture and Waste sectors are considerably smaller.

LULUCF emissions have remained relatively constant since 1990. The greatest change in the trend over the time series is the increase in the contribution of Industrial Processes to total emissions. This is primarily due to the expansion of the metal production industry in Iceland across the timeline. The effect of the Covid-19 pandemic can be seen in a dip of the national totals in 2020.

A more detailed consideration of emissions trends can be found in Chapter 2.

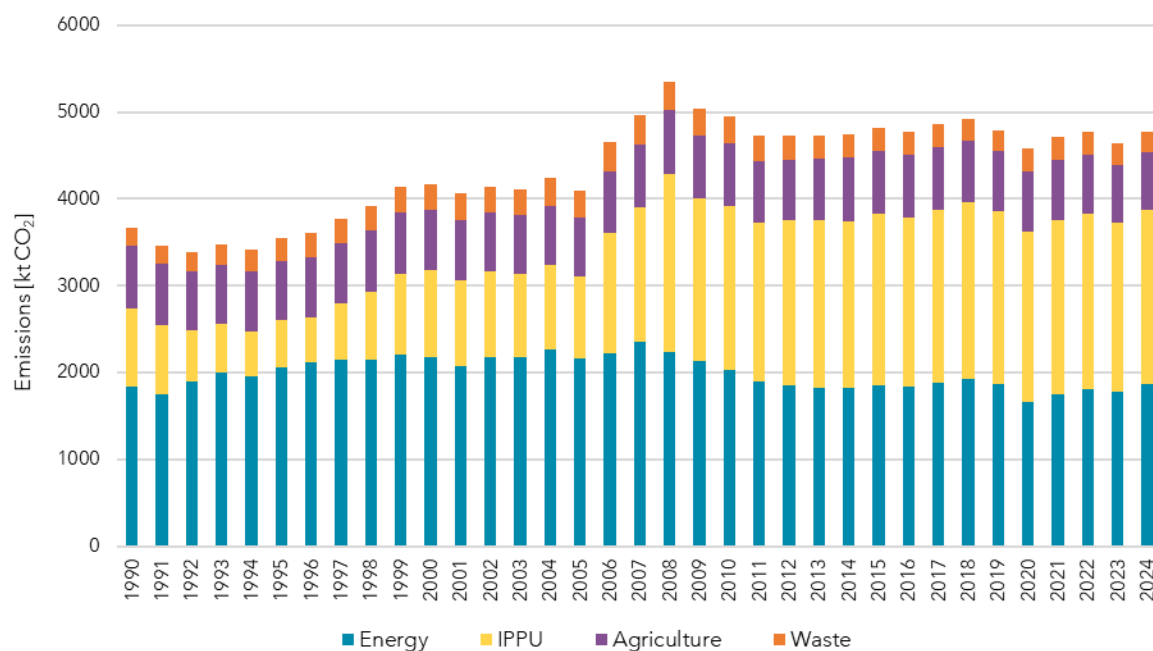


Figure ES.1 Emissions of greenhouse gases by sector, without LULUCF, since 1990, [kt CO₂e, calculated using GWP from AR5]

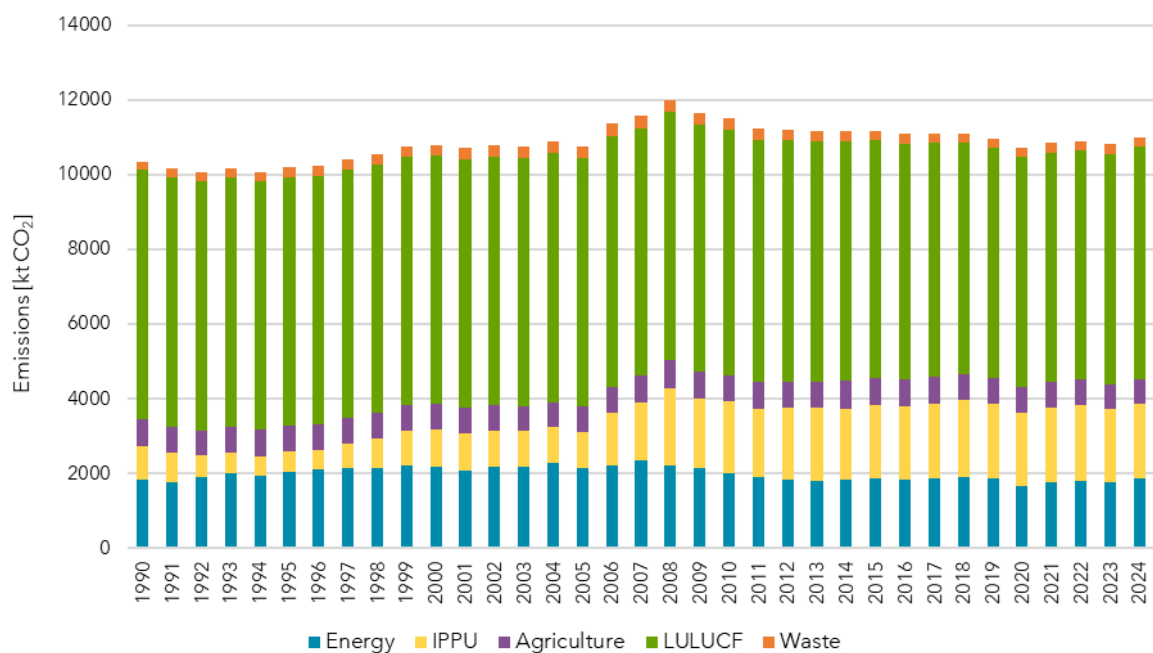


Figure ES.2 Emissions of greenhouse gases by sector, with LULUCF, since 1990, [kt CO₂e, calculated using GWP from AR5]

Table ES.1 Emissions of greenhouse gases by sector, since 1990, [kt CO₂e, calculated using GWP from AR5]

	1990	1995	2000	2005	2010	2015	2020	2023	2024	Change 1990- 2024	Change 2023- 2024
1 Energy	1841	2058	2185	2156	2026	1860	1669	1782	1866	1.4%	4.8%
2 Industrial Processes	902	552	992	951	1895	1966	1959	1948	2008	123%	3.1%
3 Agriculture	712	679	695	678	714	726	687	660	662	-7.1%	0.23%
4 Land Use, Land Use Change and Forestry	6686	6639	6627	6649	6556	6357	6154	6163	6216	-7.0%	0.87%
5 Waste	212	260	296	314	309	269	263	254	243	14%	-4.5%
Total with LULUCF	10354	10188	10794	10748	11499	11178	10734	10807	10995	6%	1.7%
Total without LULUCF	3667	3549	4167	4099	4944	4820	4579	4644	4779	30%	2.9%

The greenhouse gas emissions profile for Iceland is unusual in many respects:

- Emissions from generation of electricity and from space heating are very low owing to the use of renewable energy sources (geothermal and hydropower).
- A large share (80-90%) of emissions from the Energy sector stem from mobile sources (Transport, Mobile Machinery, and commercial fishing vessels; excluding emissions from International Aviation and Navigation).
- Emissions from the Land Use, Land-use Change, and Forestry (LULUCF) sector are high in comparison to other sectors and to other parties. These emissions can be attributed to drainage of wetlands in the latter half of the 20th Century, which had largely ceased by 1990, as there are significant CO₂ emissions from drained organic soils. These emissions of CO₂ continue for a long time after drainage.
- Individual sources of industrial process emissions have a significant proportional impact on emissions at the national level. Expansion in existing metal production capacity as well as start of new operations is reflected in the country's emission profile, as for instance the start of two new aluminium smelters in 1998 and 2007, respectively.

ES.3 Key Category Analysis

According to the IPCC definition, a key category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both. Total emissions from the key categories amount to 95% of the total

emissions included in the inventory. Key Categories are determined with Approach 1 described in Volume 1, Chapter 4 of the 2006 IPCC Guidelines.

The results of the key category analysis including LULUCF are shown in Table ES.2, and the key category analysis excluding LULUCF is shown in Table ES.3 below. More detailed Key Category Analysis tables can be found in Annex 1, including the percentage contribution of each category to the total emissions.

Iceland's key categories may highlight a broader scope of activities than many Parties due to the relatively small anthropogenic emissions from power generation in Iceland. The results highlight the importance of Iceland's industrial sectors, as well as domestic navigation, where the fishing sector plays a significant role in the national economy.

Table ES.2 Key categories of Iceland's greenhouse gas inventory (including LULUCF). ✓ = Key source category

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
Energy (CRT sector 1)					
1A2	Fuel combustion - Manufacturing Industries and Construction	CO ₂	✓	✓	✓
1A3b	Road Transportation	CO ₂	✓	✓	✓
1A4c	Agriculture/Forestry/Fishing	CO ₂	✓	✓	✓
1B2d	Fugitive Emissions from Fuels - Other (Geothermal)	CO ₂	✓	✓	✓
IPPU (CRT sector 2)					
2A1	Mineral Products: Cement	CO ₂	✓		
2C2	Ferroalloys Production	CO ₂	✓	✓	✓
2C3	Aluminium Production	CO ₂	✓	✓	✓
2C3	Aluminium Production	PFCs	✓		✓
Agriculture (CRT sector 3)					
3A1	Enteric Fermentation - Cattle	CH ₄	✓	✓	
3A2	Enteric Fermentation - Sheep	CH ₄	✓	✓	✓
3D1	Direct N ₂ O Emissions from Managed Soils	N ₂ O	✓	✓	
Land use, Land use change and Forestry (CRT sector 4)					
4A1	Forest Land Remaining Forest Land	CO ₂		✓	✓
4A2	Land Converted to Forest land	CO ₂		✓	✓
4B1	Cropland Remaining Cropland	CO ₂	✓	✓	✓
4B2	Land Converted to Cropland	CO ₂	✓	✓	✓
4C1	Grassland Remaining Grassland	CO ₂	✓	✓	✓
4C2	Land Converted to Grassland	CO ₂	✓	✓	✓
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO ₂	✓	✓	
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH ₄	✓	✓	
Waste (CRT sector 5)					
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH ₄		✓	✓

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
5A2	Unmanaged Waste Disposal Sites	CH ₄	✓		✓

Table ES.3 Key categories of Iceland's greenhouse gas inventory (excluding LULUCF). ✓ = Key source category.

IPCC source category		Gas	Level 1990	Level 2024	Trend
Energy (CRT sector 1)					
1A2	Fuel combustion - Manufacturing Industries and Construction	CO ₂	✓	✓	✓
1A3a	Domestic Aviation	CO ₂	✓		
1A3b	Road Transportation	CO ₂	✓	✓	✓
1A3d	Domestic Navigation	CO ₂	✓		✓
1A4b	Residential Combustion	CO ₂	✓		✓
1A4c	Agriculture/Forestry/Fishing	CO ₂	✓	✓	✓
1B2d	Fugitive Emissions from Fuels - Other (Geothermal)	CO ₂	✓	✓	✓
IPPU (CRT sector 2)					
2A1	Mineral Industry - Cement	CO ₂	✓		✓
2B10	Fertiliser Production	N ₂ O	✓		✓
2C2	Ferroalloys Production	CO ₂	✓	✓	✓
2C3	Aluminium Production	CO ₂	✓	✓	✓
2C3	Aluminium Production	PFCs	✓	✓	✓
2F1	Refrigeration and Air Conditioning	HFCs		✓	
Agriculture (CRT sector 3)					
3A1	Enteric Fermentation - Cattle	CH ₄	✓	✓	✓
3A2	Enteric Fermentation - Sheep	CH ₄	✓	✓	✓
3A4	Enteric Fermentation - Other	CH ₄	✓		
3B1	Manure Management - Cattle	CH ₄	✓	✓	
3D1	Direct N ₂ O Emissions from Managed Soils	N ₂ O	✓	✓	✓
3D2	Indirect N ₂ O Emissions from Managed Soils	N ₂ O	✓	✓	
Waste (CRT sector 5)					
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH ₄	✓	✓	✓
5A2	Unmanaged Waste Disposal Sites	CH ₄	✓		✓

ES.4 Improvements

Various improvements were planned and implemented for the most recent submission. Below is a summary of the key improvements for each sector. A detailed discussion of every improvement implemented in this submission can be found in the appropriate chapter.

In the **Energy** sector, the fuel attribution to 1A2gvii, 1A3eii, and 1A4cii Mobile Machinery was updated. In 1A3b Road Transport, the vehicle stock data is now obtained from the Icelandic Transport Authority for the whole timeline. CO₂ emissions resulting from the unintentional combustion of lubricants were double counted previously as they were reported both under 1A3b and under 2D1. They are now reported as part of the CO₂ emissions total from lubricant combustion in category 2D1 only. Biofuels are now included in the activity data for 1B2av and 1B2bv Fugitive Emissions from Fuels. Issues regarding the Reference Approach will be a point of focus in the next submissions. The IEAA is working to improve the data reported in the Reference Approach, as well as identify the reasons for discrepancies between the Reference Approach and the Sectoral Approach (SA).

For this submission, the main change done for the **IPPU** sector was a tier upgrade in 2D3a Domestic Solvent Use along with the re-evaluation of customs categories used in the activity data for 2F1b Domestic Refrigeration, 2G4 Other: Tobacco and 2H2 Food and Beverages. For future submissions, it is planned to continue updating the 2F sector with ongoing efforts to obtain more information about pre-charged amounts and recovery efficiency, and to add emissions linked to heat pumps. It is also planned to improve the estimation of emissions from spirit production through actual production data from distilleries.

In the **Agriculture** sector, calculations were updated to the 2019 IPCC Refinements in most cases where an update is provided. The 2019 IPCC Refinements are now applied for most of the 3A, 3B and 3D subsectors. The cattle categories within the category Growing Cattle were changed to increase the transparency of calculations. New data were obtained from the Icelandic Agricultural Advisory Centre (IAAC) on cattle and sheep livestock characterisation, manure management and use of straw in housing with solid storage. The IAAC also updated the methodology to estimate feed digestibility and provided updated input data related to feed digestibility.

Updated livestock characterisation was also obtained for goats and horses. Updated information was obtained on the types of inorganic fertilisers imported to Iceland and on the amount of fertiliser use in forestry. Emissions from crop residues from the cultivation of brassicas were added to the inventory.

Regarding planned improvements for future submissions, country-specific emission factors are being developed at the Agricultural University of Iceland for methane emissions from enteric fermentation in dairy cows. When available, they will be incorporated into the inventory. A research project has been launched with the aim to establish country specific methane production capacity (B₀) and methane conversion factors (MCFs) from slurry and pit storage in cattle and sheep farming. Results, expected in 2027, will be incorporated in the 2028 submission. Preliminary steps will be undertaken to define a country specific $Frac_{LeachMS}$ based on a 2021 UNFCCC review recommendation.

In the **LULUCF** sector, various improvements were made for the 2026 submission. For 4A Forest land, a new country specific EF is now used for mineral soil for 4A2 Land converted to

Forest land, Afforestation natural birch forest 1-50 years old and Afforestation natural birch shrubland 1-50 years old, both for 4C Grassland and 4F Other land. Changes have been made to how fertiliser use in forestry is reported. Previously, all fertilisers were classified as inorganic, whereas they are now divided into organic and inorganic fertiliser.

Cropland: Revised estimates for relevant subcategories include annual below-ground biomass (BGB) losses, Dead organic matter (DOM) carbon stock changes, and recalculated mineral soil carbon stock changes for 4B2b Grassland converted to Cropland.

Grassland: Updates to subcategories include revised mineral soil carbon stock changes for Grazing areas and Grassland without grazing, recalculated living biomass (including BGB) and DOM carbon stock changes for revegetation subcategories, and updated mineral soil carbon stock change (CSC) EFs for the subcategory 4C2b Cropland converted to Grassland.

Wetlands: Emissions and removals for the subcategory Intact mires – grazing areas (previously classified as intact mires – managed) were re-evaluated and are now reported as NA, as methodologies from the IPCC Wetlands Supplement were found not to be applicable.

Settlements: Methodological updates for relevant subcategories include the inclusion of direct and indirect N₂O emissions and annual carbon stock changes in BGB and DOM for 4E2 Land converted to Settlements.

In the **Waste** sector, some inconsistencies remain between the reporting of landfill gas between the Energy and the Waste sectors, which will be addressed in future submissions.

Regarding emissions from Anaerobic Digestion, a value of 5% is currently used for unintentional leakage, as suggested in the 2006 IPCC Guidelines. This estimate is considered conservative, as the facility is new, and leakage is expected to be negligible. The IEAA intends to refine this estimate with the data provider and facility experts in the coming years.

The wastewater category (5D) has now been updated according to the IPCC 2019 Refinements. The Industrial Wastewater category is currently only calculated for fish processing on land. N₂O emissions from fish processing wastewater discharge were added as part of the upgrade to the 2019 Refinements methodology and a country-specific value for wastewater generation per ton of fish was derived from collected data. Preparations have been made for assessing other major industries with organic load in Iceland. Currently, they are assumed to be included in the industrial and commercial co-discharge factor, but the plan is to estimate these industries specifically, as relevant data becomes available.

Most of the comments and suggestions received during the 2022 reviews have been addressed. Two comments remain, regarding separation of municipal solid waste and industrial waste, which is not possible for the time being due to lack of data; and fixing discrepancies between CH₄ in the Waste and Energy sectors.

The treatment of MSW at GAJA biogas and composting plant in years 2020-2023 did not deliver usable compost. Corrections were made in the 2026 submission to include emissions from composting of this waste for years 2022-2023. It has yet to be reviewed how this influences the amount of waste landfilled, depending on how this unusable compost was disposed of. This will be assessed in future submissions.

1 National circumstances, institutional arrangements, and crosscutting information

1.1 Background Information

The 1992 United Nations Framework Convention on Climate Change (UNFCCC) was ratified by Iceland in 1993 and entered into force in 1994. One of the requirements under the Convention is that Parties are to report their national anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol, using methodologies agreed upon by the Conference of the Parties to the Convention (COP). Iceland has been Party to the Paris Agreement since 2016 and fulfils its obligations towards the UNFCCC by fulfilling the obligations listed in Art. 13 of the Paris Agreement as implemented by Decision 18/CMA.1. Amongst other obligations, Parties to the Paris Agreement are to report a National Inventory Report (NIR), which consists of this national inventory document (NID) together with the associated Common Reporting Tables (CRT), following the guidelines outlined in Decisions 18/CMA.1 and 5/CMA.3. The NIR is also submitted to the European Union (EU) in accordance with Art. 26 and Parts 1 and 2 of Annex V of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, as incorporated into the European Economic Area (EEA) agreement by Decision of the EEA Joint Committee No 269/2019. The report also includes the information needed as per the Annexes to Commission Implementing Regulation (EU) 2020/1208, as listed in Decision of the EEA Joint Committee No 223/2021.

1.1.1 Paris Agreement (from 2021 onwards)

1.1.1.1 2021-2030 – EU/EEA obligations

Under the Paris Agreement, Iceland is cooperating with the EU member states and Norway to achieve the Parties' respective Nationally Determined Contributions (NDC). This cooperation involves compliance with following sets of EU legislation, as incorporated in the EEA Agreement and relating to the period 2021-2030:

- a) **Directive 2003/87/EC** establishing a scheme for greenhouse gas emission allowance trading within the Community (The **EU ETS Directive**). The main activities covered by the EU ETS in Iceland are the production of aluminium, ferrosilicon and silicon metal, as well as relevant domestic and international flights (those airlines which operate domestic flights and/or flights within the EEA and which fall within the scope of the ETS Directive). Emissions from large ships (over 5000 gross tonnage) have recently been added to the scope of the ETS Directive. Iceland has been participating in the EU ETS since 2013.

The EU ETS Directive was incorporated into Annex XX of the EEA Agreement through Decision of the Joint Committee (JCD) No 146/2007. Subsequent amendments to the EU ETS Directive, as well as relevant delegated and implementing acts, were also incorporated into Annex XX of the EEA Agreement. As the EU ETS is set up, there are no country-specific emission reduction targets; rather, the whole system is designed to provide for decreasing emissions through a cap-and-trade mechanism covering all EEA Member States. Companies within the scope of the ETS Directive are responsible for complying with the Directive, among other things through yearly surrendering of emission allowances.

- b) **Regulation (EU) 2018/842** on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement – also known as the Effort Sharing Regulation (**ESR**). In Iceland, the main activities and sectors within the scope of the ESR are road transport, fishing, agriculture, waste and F-gases.

The ESR was incorporated into Protocol 31 of the EEA Agreement through Decision of the Joint EEA Committee (JCD) No 269/2019; relevant delegated and implementing acts were also incorporated into Protocol 31 through subsequent Joint Committee Decisions. The ESR provides for country-specific targets for 2030, according to which the target currently in force in Iceland is 29% reduction relative to 2005, as it was calculated in line with the EU's former overall goal of 40% reduction in emissions in 2030 relative to 1990.

At the time of this writing, work is in progress to incorporate a new target in line with EU's updated target of 55% reduction in emissions in 2030 relative to 1990 into the EEA agreement, through incorporation of Regulation (EU) 2023/857 amending the ESR into the EEA Agreement; the new ESR-target is expected to amount to 41% reduction in emissions in 2030 relative to 2005.

- c) **Regulation (EU) 2018/841** on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework – also known as **the LULUCF Regulation**.

This regulation was incorporated into Protocol 31 of the EEA Agreement through Decision of the Joint EEA Committee (JCD) nr. 269/2019; relevant delegated and implementing acts were also incorporated into Protocol 31 through subsequent Joint Committee Decisions. The LULUCF regulation, as it currently applies to Iceland, requires compliance with the so-called no-debit rule, both for the period 2021-2025 and for the period 2026-2030. This requires that the sum of net emissions for all accounting categories (as defined in the LULUCF regulation) does not exceed zero when relevant accounting rules are applied. The LULUCF

regulation was amended through Regulation (EU) 2023/839, in line with EU's updated target of 55% reduction in emissions in 2030 relative to 1990, and whilst the 2021-2025 target remains unchanged, the 2026-2030 target was changed to country-specific decreases in net emissions (or increase in net removals, as appropriate). The 2030 target for Iceland has not yet been determined as work is still in progress to determine Iceland's 2030 LULUCF target and to incorporate Regulation (EU) 2023/839 into the EEA Agreement, parallel to the incorporation of Regulation (EU) 2023/857.

1.1.1.2 2021-2030 – Iceland's Nationally Determined Contribution

As stated above, Iceland is cooperating with the EU member states and Norway to achieve the Parties' respective Nationally Determined Contributions (NDC). Iceland's 2030 NDC reflects this cooperation. Iceland's 2030 NDC states⁷ the following:

"Iceland is committed to a target of 41 per cent net reduction of greenhouse gas emissions by 2030 compared to 2005, in the sectors covered by the scope of the EU's Effort Sharing Regulation (ESR), including emissions from road transport, energy production, fisheries, product use, agriculture and waste management. Iceland cooperates with the European Union and Norway on this target, within the framework of their climate cooperation agreement. The other sectors are regulated by the LULUCF regulation and the EU Emissions Trading System (EU-ETS) directive, thus Iceland's overall target is economy-wide, as the combination of the three pillars of the climate cooperation (ESR, LULUCF, EU-ETS) covers emissions from all sectors and greenhouse gases."

1.1.1.3 2031-2035 – Iceland's Nationally Determined Contribution

Iceland plans to fulfil its Nationally Determined Contributions (NDC) for 2035 through domestic measures and in continued cooperation with the European Union and Norway. Iceland's 2035 NDC states⁸ the following:

"Iceland intends to continue its cooperation with the European Union on climate targets within the framework of the climate cooperation. Iceland's 2035 NDC reflects this cooperation, and Iceland's quantified targets are twofold:

Iceland is committed to a target of 50–55 per cent net reduction of greenhouse gas emissions by 2035 compared to 2005, in the sectors within the scope of the EU's Effort

⁷ See Iceland's 2030 Nationally Determined Contribution (NDC) [Nationally Determined Contribution \(NDC 2030\)](#) as communicated to the UNFCCC in September 2025.

⁸ See Iceland's 2035 Nationally Determined Contribution (NDC) [Nationally Determined Contribution \(NDC 2035\)](#) as communicated to the UNFCCC in September 2025.

Sharing Regulation (ESR), including emissions from road transport, energy production, fisheries, product use, agriculture and waste management.

Iceland is committed to a target of an annual net reduction of 400–500 kt CO₂e from the LULUCF sector by 2035 compared to 2025 levels.

In addition to the above quantified targets, Iceland regulates emissions from industry, aviation and navigation that fall under the EU-ETS Directive. Iceland will support the advancement of new technologies, such as carbon capture, utilisation and storage of CO₂, with a focus on industries that fall under the EU-ETS directive.

Iceland's overall target is economy-wide, as the combination of the three pillars of the climate cooperation (ESR, LULUCF, EU-ETS) covers emissions from all sectors and greenhouse gases."

Iceland reserves the right to revisit and revise its tripartite target when provisions to reach carbon neutrality in 2040 have been further defined by domestic legislation (see section 1.2.2), when technological advancement and readiness make carbon capture, utilisation and storage of CO₂ from industry under the EU-ETS Directive feasible, or the provisions of the climate cooperation with the EU are further defined.

1.1.2 Second Commitment Period of the Kyoto Protocol (Doha Amendment – 2013-2020)

In 2015 a Joint Fulfilment Agreement⁹ was concluded between the European Union (EU), its Member States and Iceland. This Agreement addressed Iceland's participation in these parties' joint fulfilment of commitments in the second commitment period of the Kyoto Protocol. Iceland's individual assigned amount was established at 15,327,217 AAUs, covering the emissions falling under the scope of Directive No 406/2009/EC¹⁰.

According to Article 4 and Annex I, of the Joint Fulfilment Agreement, Regulation (EU) No 525/2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change ("MMR") as well as all Delegated and Implementing Acts based on Regulation (EU) No 525/2013 were to be binding upon Iceland. This included for instance Commission Implementing Regulation (EU) No 749/2014, which further detailed the content and format required for the various reporting requirements under Regulation (EU) No 525/2013. The legal acts were rendered applicable in Iceland in 2015 with an amendment to Act No 70/2012, cf. Act No 62/2015.

⁹ https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2015.207.01.0017.01.ENG

¹⁰ Effort Sharing Directive, covering total emissions minus ETS emissions, minus LULUCF emissions, minus international bunkers, and including removal units as eligible under Art. 3.3 and 3.4 of the Kyoto Protocol.

At the end of the second commitment period, Iceland's emissions amounted to a total of 23,020,117 t CO₂e within the scope defined in the Joint Fulfilment Agreement; during the true-up period in the summer of 2023, Iceland complied with its obligation to the EU and the Kyoto Protocol by:

- Retiring 15,327,217 AAUs, which were assigned to Iceland according to the Joint Fulfilment Agreement with the EU,
- Retiring 4,299,126 RMUs from Revegetation, Afforestation/Deforestation and Forest Management,
- Acquiring 3,403,857 AAUs from Slovakia and subsequently retiring them.

Iceland concluded the true-up period by submitting its true-up report to the UNFCCC on 20 October 2023. After the review of the true-up report which took place in February 2024, Iceland was deemed to have met its commitments towards the Kyoto Protocol.

1.1.3 First Commitment Period of the Kyoto Protocol (2008-2012)

For the first commitment period of the Kyoto Protocol, the greenhouse gas emissions were not to increase by more than 10% from the level of emissions in 1990. Iceland's Assigned Amount Units (AAUs) for the first commitment period were decided in Iceland's Initial Report under the Kyoto Protocol and amounted to 18,523,847 tonnes of carbon dioxide equivalents (CO₂e). Decision 14/CP.7 on the "Impact of single project on emissions in the commitment period" allowed Iceland to report certain industrial process carbon dioxide (CO₂) emissions separately and not include them in national totals; to the extent they caused Iceland to exceed its assigned amount. For the first commitment period, from 2008 to 2012, the CO₂ emissions falling under decision 14/CP.7 were not to exceed 8,000,000 tonnes.

At the end of the commitment period, a total of 1,542,761 RMUs were available from Art. 3.3 and Art. 3.4 activities and 33,125 AAUs, CERs and ERUs from Joint Implementation Projects, resulting in an available assigned amount of 20,098,931 AAUs. Emissions from Annex A sources (including those falling under the scope of Decision 14/CP.7) for the entire CP1 were 23,356,066 tonnes CO₂e, corresponding to 3,257,140 tonnes CO₂e in excess of Iceland's available assigned amount. Two projects fulfilled the provisions of Decision 14/CP.7, with a total of 5,912,964 tonnes CO₂e. Of these emissions, 2,655,824 tonnes were reported under the national totals, to match the total available number of AAUs, and 3,257,140 tonnes were reported separately under decision 14/CP.7. Iceland was thus in compliance with its commitments.

1.1.4 Climate Strategies and action plans

After Iceland's ratification of the Kyoto Protocol in 2002, Iceland published various climate change policies, strategies and plans, yet without significant associated funding.

In September 2018, the Icelandic government published a new Climate Change Action Plan¹¹, containing a collection of 34 actions and associated funding of 6.8 billion Icelandic kr. (49 million Euros) for the period 2019-2023. An update of the 2018 action plan was published in June 2020¹², with an associated budget of 46 billion Icelandic kr. (300 million Euros) for the period 2020-2024. The 2020 action plan has two main goals: achieving the emission reductions as per Iceland's commitments to the Paris Agreement for 2030 and reaching carbon-neutrality in 2040. To reach these goals the revised action plan set forth 48 actions which mostly focus on electrification of the transport sector and increased efforts in afforestation, revegetation, and wetland restoration. The revision of the plan also contained significantly improved analysis to estimate the individual and collective mitigation gains of the measures presented.

According to the Climate Act as it is currently in force, the government shall, in consultation with stakeholders, review and update the Climate Action Plan every four year based on international commitments and the government's goals. Climate measures shall be developed and put in motion by an interministerial committee. The committee shall also prepare an annual progress report on the status of implementation of the climate plan and its measures, emissions development and whether the development is in accordance with the Climate Plan. The first progress report was published in September 2021, and the second report in July 2022 (Ministry of the Environment and Natural Resources^{13,14}) to follow up on the progress of the 2020 Climate Action Plan.

An updated climate action plan, which was prepared in accordance with the Climate Act, was published in 2024¹⁵. The plan included 150 climate actions, some of which were new and others were carried over from the previous action plan. The plan was subjected to public consultation in the summer of 2024, and a new interministerial committee was appointed (in Icelandic: *Verkefnisstjórn vegna gerðar og eftirfylgni áætlana á sviði loftslagsmála*) to lead the ongoing work of implementation and further development of the action plan. Since its publication, work has been focused on assessing the mitigation potential of individual actions, resulting in a consolidated and effective two-year implementation plan that is now in place for 2025-2026. The action plan is a key foundation for achieving Iceland's commitments towards the EU for the year 2030 and Iceland's nationally determined contribution (NDC) for 2030 and 2035, as well as its carbon neutrality goals, which are set to be achieved by no later

¹¹ [Aðgerðaáætlun í loftslagsmálum 2018-2030](#): Climate Action plan 2018-2030, in Icelandic

¹² [Aðgerðaáætlun í loftslagsmálum til 2030](#): Climate Action plan, updated second edition, in Icelandic

¹³ 2021 Stöðuskýrsla [Progress report on the Climate Action Plan](#), published September 2021 (in Icelandic)

¹⁴ 2022 Stöðuskýrsla [Progress report on the Climate Action Plan](#), published July 2022 (in Icelandic)

¹⁵ [2024 Aðgerðaáætlun Climate action plan \(in Icelandic\)](#).

than 2040. The Ministry of Environment, Energy and Climate recently published a progress report on the 2024 action plan and the new implementation plan.¹⁶

1.2 National System for Estimation of Greenhouse Gases

1.2.1 Institutional Arrangements

The Climate Act No 70/2012 (see below) establishes the national system for the estimation of greenhouse gas emissions. In accordance with this Act, the Icelandic Environment and Energy Agency (IEEA – in Icelandic, *Umhverfis- og orkustofnun*, an agency under the auspices of the Ministry of the Environment, Energy, and Climate (MEEC – in Icelandic, *Umhverfis-, orku- og loftslagsráðuneyti*)) carries the overall responsibility for the national inventory. The IEEA is a newly formed institution, consisting of part of what used to be the Environment Agency of Iceland (EAI, *Umhverfisstofnun*) and what used to be the National Energy Authority (NEA, *Orkustofnun*); the merger took place 1 January 2025. The IEEA compiles and maintains the greenhouse gas emission inventory, except for the LULUCF sector which is compiled by Land and Forest Iceland (LFI, a joint institution of the Soil Conservation Service of Iceland and the Icelandic Forest Service, which began operations 1 January 2024). The IEEA reports to the UNFCCC and to the EU, as well as to the EFTA (European Free Trade Association).

The Climate Act specifies that the IEEA is allowed to request all data and information needed for the inventory from relevant authorities, agencies, companies, and individuals; the obligations are further elaborated in Regulation No 520/2017 on data collection and information from institutions related to Iceland's inventory.

The UNFCCC national focal point is within the MEEC (Mrs. Helga Barðadóttir, Deputy Director, Head of Division) and is responsible for approving the final inventory before its submission to the UNFCCC.

¹⁶ 2025 Stöðuskýrsla [Progress report on the Climate Action Plan](#), published November 2025 (in Icelandic)

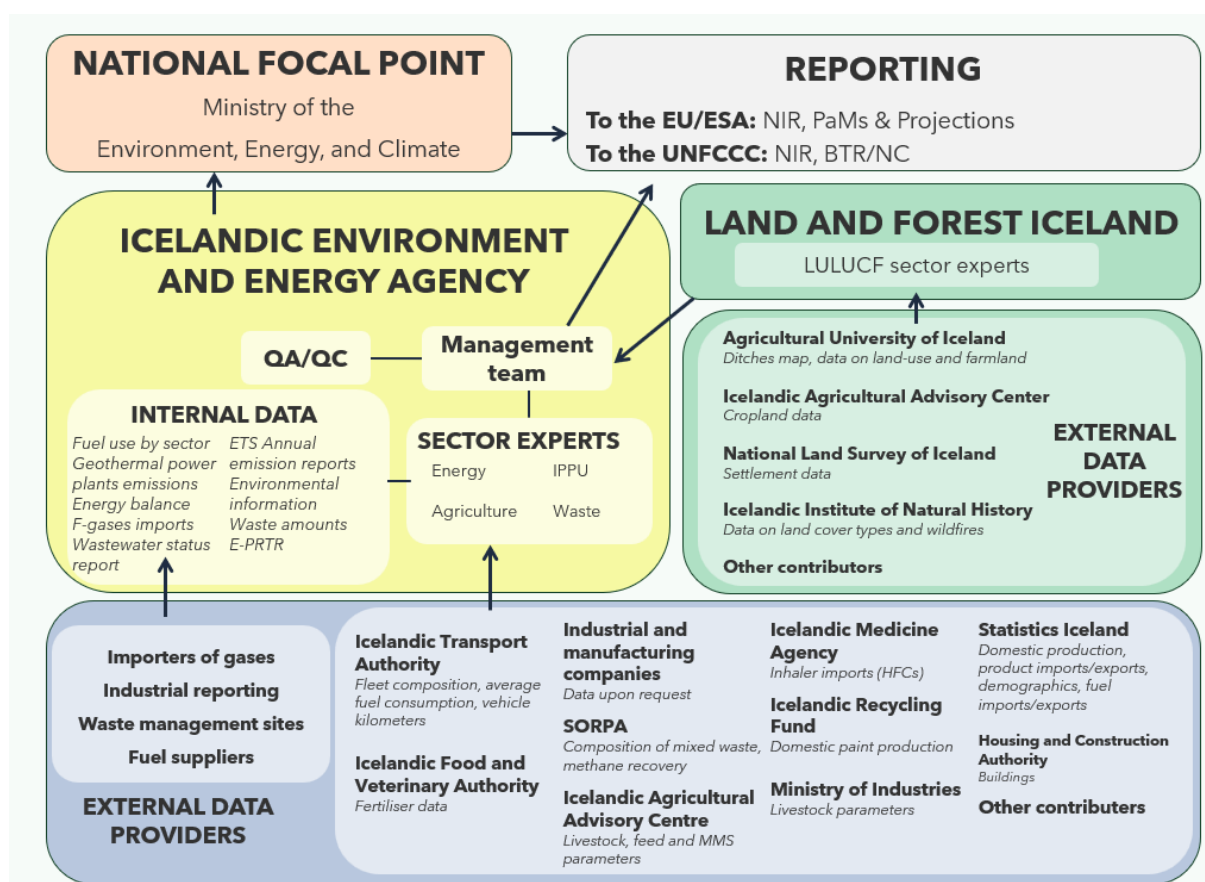


Figure 1.1 Information flow and distribution of responsibilities in the Icelandic emission inventory system for reporting to the UNFCCC.

1.2.2 National Legislation

1.2.2.1 Implementation of EU legislation

Iceland's and Norway's cooperation with the EU Member States for the 2030 emissions targets was agreed upon with the uptake in October 2019 of relevant EU legislation into Protocol 31 to the European Economic Area (EEA) Agreement¹⁷. This includes the LULUCF Regulation (Regulation (EU) 2018/841) and the Effort Sharing Regulation (Regulation (EU) 2018/842) (as mentioned above), as well as relevant articles of the Governance of the Energy Union Regulation (Regulation (EU) 2018/1999) pursuant to the rules regarding the greenhouse gas inventories and replacing the MMR Regulation (Regulation (EU) No 525/2013). Subsequently, additional acts were added to the EEA Agreement^{18,19}, including Commission Implementing Regulation (EU) 2020/1208 on structure, format, submission processes and review of information to be reported, as well as Commission Delegated

¹⁷ See [Joint Committee Decision No 269/2019](#).

¹⁸ Joint Committee Decision No 223/2021 incorporating Commission Implementing Regulation (EU) 2020/1208 and Commission Delegated Regulation (EU) 2020/1044

¹⁹ [Joint Committee Decision No 29/2022](#) on Annual Emission Allocations under the ESR

Regulation (EU) 2020/1044 on GWP, reporting guidelines and union inventory system. Furthermore, Iceland's Annual Emission Allocations (AEAs) determined according to Art. 4 of the ESR were added to the EEA Agreement.

Iceland has implemented the LULUCF Regulation and the ESR through the Climate Act No 70/2012 (see below). The EU ETS Directive (No 2003/87/EC) is implemented through Icelandic Act No 96/2023 and covers the activities of operators of installations, aircraft operators and shipping companies that fall under the scope of the EU Emissions Trading System (EU ETS). Accounting and compliance with the ESR and LULUCF obligations will be done through the EU's Union Registry, as governed by Regulation (EU) 2019/1122 and other relevant delegated and implementing acts, as incorporated into the EEA Agreement.

1.2.2.2 Climate Act No 70/2012

In June 2012 the Icelandic Parliament passed a law on matters relating to the climate, the Climate Act (Act No 70/2012). The objectives of the Climate Act and its subsequent amendments are the following:

- To reduce greenhouse gas emissions efficiently and cost-effectively,
- To increase carbon removal from the atmosphere,
- To promote adaptations to the consequences of climate change,
- To create conditions for the government to fulfil its international obligations regarding climate change, and
- To reach carbon neutrality no later than 2040.

The main clauses of Act No 70/2012 relating to the greenhouse gas inventory state that:

- the Icelandic Environment and Energy Agency (IEEA) is the responsible entity for the national inventory for greenhouse gases and carbon removals from the atmosphere in line with Iceland's international obligations. The same agency is also responsible for the national registry (Art. 4 and 6)
- the IEEA can request data e.g. from government bodies and companies that are needed for the inventory (Art. 6). The implementation of the clauses relating to the inventory is regulated by Icelandic Regulation No 520/2017 as described below,
- Act No 70/2012 serves to implement the Effort Sharing Regulation (EU) 2018/842 and the LULUCF Regulation (EU) 2018/841 into Icelandic law (Art. 6a and 6b); these regulations were incorporated into the EEA Agreement in relation to the cooperation between EU, Iceland and Norway towards the 2030 goals pertaining to the Paris Agreement (see above, chapter 1.1.1)

At the time of writing, the Climate Act No 70/2012 is under complete revision by the Ministry of the Environment, Energy and Climate, amongst other things to reflect changes to the various institutions responsible for the inventory, and the incorporation of updated EU regulations concerning the targets for greenhouse gas emission reductions by 2030.

1.2.2.3 Regulation No 520/2017

Icelandic Regulation No 520/2017²⁰ on data collection and information from institutions relates to Iceland's inventory on greenhouse gas emissions and removal of carbon from the atmosphere and was adopted in June 2017. The regulation establishes formally the data provision modalities, such as content, format and deadlines for data submission to the IEEA.

This regulation will be updated to reflect the most recent legal framework once the Climate Act No 70/2012 has undergone the revisions mentioned above in the previous section.

1.2.2.4 Icelandic Act No 96/2023 on the EU Emissions Trading System

Icelandic Act No 96/2023 on the EU Emissions Trading System (EU ETS) implements EU Directive 2003/87/EC in Iceland and covers the activities of operators of installations, aircraft operators and shipping companies that are within the scope of the EU ETS. Under the System, the emitters pay for their greenhouse gas emissions and the EU ETS is based on a "cap and trade" principle, where emissions allowances, giving right to emit one tonne of CO₂ equivalent can be traded.

The IEEA is the competent authority for the EU ETS in Iceland; more information on the ETS system in Iceland can be found on the website of the Icelandic Environment and Energy Agency²¹.

1.2.3 Planned Improvements to the National System

In order to better implement the requirements of Articles 26 to 29 of Commission Implementing Regulation (EU) 2020/1208 pertaining to the establishment, operation and functioning of national inventory systems, there are plans to set up a steering committee for the inventory, as a part of the national system. It is expected that such a committee will be coordinated by the IEEA and be composed of representatives from Land and Forest Iceland, as well as other major data providers and stakeholders. The aim of such a committee will be, amongst other things, to enhance the QA of the inventory as well as serving as a platform for formal approval of improvements needed. Furthermore, it is planned to establish separate working groups for various key subsectors of the inventory, to enhance collaboration between experts in the air emission inventories unit, various ministries as well as experts from other institutions, industry, universities, and research centres.

²⁰ <https://www.reglugerd.is/reglugerdir/eftir-raduneytum/umhverfis--og-audlindaraduneyti/nr/0520-2017>

²¹ <https://uos.is/ets>

1.3 Inventory Preparation: Data Collection, Processing, and Storage

1.3.1 Data Collection

The data collection for individual sectors or subsectors is described in the corresponding sections of the sectoral chapters. Below is an overview of the main data collection process:

- The IEEA and LFI collect the bulk of data necessary to calculate emissions (e.g. activity data and emission factors), for their respective sectors. Activity data is collected from various institutions and companies, as well as inhouse, as listed and illustrated above in Section 1.2.1.
- Information on fuel use reported by all companies under the EU ETS (as per Directive 2003/87/EC) is used directly in the inventory calculations.
- According to Icelandic Regulation No 990/2008 on Environmental Information, industry is required to report annually information on the amount of raw material, water, energy and fuel consumed, the amount of discharged pollutants, and waste generated. Environmental information is then made publicly available on the website of the IEEA. The regulation was amended by Icelandic Regulation No 206/2025. Previously, select environmental information was reported pursuant to Icelandic Regulation on Green Accounting No 851/2002, which has been repealed. Environmental information is now reported in accordance with Regulation No 990/2008, which also governs the reporting of data to the European Pollutant Release and Transfer Register (E-PRTR) according to Regulation (EC) No 166/2006.
- The IEEA (previously the NEA) collects fuel sales data by sector; however, the sectoral split does not entirely match that of the IPCC, thus the IEEA processes the data to ensure correct attribution to the IPCC codes as per the CRT.
- LFI provides information on revegetated areas and assesses other land-use categories on the basis of its own geographical database and other available supplementary land-use information. Land and Forest Iceland provides information on forest land, natural birch shrubland through its National Forest Inventory, and harvested wood products built on annual forest statistics published in the Journal of the Icelandic Forest Association.

Emission factors are taken mainly from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006), the 2019 Refinements and the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (IPCC, 2014). Country specific emission factors are used where available.

1.3.2 Processing

A new annual cycle begins with an initial planning of activities for the inventory cycle by the emissions inventories unit and major data providers as needed, considering internal QA/QC procedures as well as the most recent recommendations from the UNFCCC and EU reviews, during which time the improvement plan for the next submission is put together and approved. Initial emission estimates are produced for the approximated inventory submission as per Art. 26(2) of Regulation (EU) 2018/1999 on 31 July for the year y-1, depending on availability of data.

After compilation of activity data, emission estimates and uncertainties are calculated, and quality checks performed to validate results. When and where possible, improvements are worked on during the emission estimates compilation. All emission estimates are imported into the CRT Reporter software.

A series of internal review activities are carried out annually to detect and rectify any anomalies in the estimates, e.g., time series variations, with priority given to emissions from industrial plants falling under the EU ETS, other key categories and for those categories where data and methodological changes have recently occurred; more details on the QA/QC activities can be found in Chapter 1.5 below.

The greenhouse gas inventory is submitted to the EU and the EFTA by 15 January and 15 March as per Art. 26 of Regulation (EU) 2018/1999 and as incorporated into Protocol 31 of the EEA Agreement. By 15 April, after approval by the Ministry of the Environment, Energy and Climate, the greenhouse gas inventory is submitted to the UNFCCC by the IEEA, with a copy submitted to the EU and EFTA.

Procedures for calculations, processing and compilation for the various categories, as well as for data submission, are recorded in the IEEA's Quality manual, and are revisited and updated regularly.

1.3.3 Data storage

Microsoft Dynamics is used as a customer relationship management (CRM) system to store email communications concerning the greenhouse gas inventory at the IEEA. Digital copies of paper documents, e.g., written letters, are also stored in the CRM system. The system runs on its own virtual server and uses a MS SQL server 2019 running on a separate server. Both servers are running Windows Server 2019.

Each staff member at the Icelandic Environment and Energy Agency has a subscription to Microsoft Office 365 and emails are sent and received using Microsoft Office 365 servers hosted in Ireland.

Numerical data, calculations and other related documents are stored on a file server running Windows Server 2019. EA's virtual servers are running on IBM BladeCenter.

Opin kerfi (formerly known as Premis), a local IT company, hosts the IEEA's servers. Their hosting is fully ISO-9001 and ISO-27001 certified. The server and backup rooms are in two locations, the primary server room for IEEA is in Sauðárkrókur (a town in northern Iceland) and the disaster recovery room storing off-site backups is in Reykjavík city (located in southwestern Iceland). The rooms are separated by roughly a 200 km straight line.

Backups are taken daily and a subset of those is regularly set for at least 15 months storage.

The land-use database IGLUD is stored on LFI's servers, as well as spreadsheets containing calculations regarding land-use classes and harvested wood products.

1.3.4 Training and Capacity-building Activities for Inventory Compilers

The Icelandic inventory experts have proactively sought and engaged in training and capacity building activities. These training and capacity building activities aim to support individuals within the inventory team and include both courses and workshops on generally applicable skills (including, for example, enhanced knowledge in data-processing software, project management, and effective communication) as well as sector-specific training (including visits to companies and sector-specific courses and workshops). The main recent capacity-building activities are outlined below.

- Training by the consulting company which has been helping staff at the IEEA for several years (Aether Ltd.). Examples from the last few years include:
 - **Agriculture:** Aether staff was consulted in the preparation and the process of updating to the 2019 IPCC Refinements.
 - **LULUCF:** During 2023 and 2025 the Icelandic LULUCF teams worked on improving the compilation file for activity data and emissions/removals in collaboration with Aether staff. During the 2025 LULUCF review, Aether, together with the EEA LULUCF expert, provided support and facilitated capacity-building within the LULUCF sector.
 - **Uncertainties** (all sectors, including LULUCF): General, as well as sector-specific training sessions were organised in late 2020/early 2021 with Aether to provide an overview of uncertainty analyses, as well as to go over the uncertainty analysis of each sector with sectoral experts at Aether.
- Participation in capacity building activities proposed by the EU, yearly sector-specific capacity-building webinars, among them:
 - **IPPU:** Capacity building with technical exchange between country experts and ESR review experts on F-gas emissions in 2024.

- **Agriculture:** Capacity building with technical exchange between country experts and ESR review experts on issues which arose during the update to the 2019 Refinements.
- **LULUCF:** Annually participation to LULUCF Workshops organised by Joint Research Centre's European Commission.
- **Waste:** Capacity building with technical exchange between country experts and ESR review experts on issues related to earlier improvements in subsectors 5A and 5D which had not been approved in the 2024 review, as well as discussions on future improvements in the Waste sector.
- **All sectors:** Capacity-building webinars organised by the EU's DG Climate action.
- Participation in a Nordic inventory experts' working group, where inventory compilers from Norway, Sweden, Finland, Denmark, and Iceland meet once a year with separate sector-specific sessions, including general/QA/QC, and discuss various aspects of the inventory compilation, ranging from technical aspects of emission estimates to logistical issues with submission to EU and/or UNFCCC.
- Participation in a Nordic expert group on F gases funded by the Nordic Council of Ministers, discussing and comparing methods and parameters used by the various Nordic countries.
- Participation in the annual training session for the COPERT model, organised by the European Environment Agency and carried out by EMISIA, the developer of the software. The training includes an overview of the software, information on the latest updates, a Q&A session with the participants. This one and a half day training is attended by the members of the emissions inventories unit every year.
- Waste disposal site visits.
- Course on Icelandic agriculture organised specifically for the inventory experts by the Agricultural University of Iceland.
- Course on the Icelandic LULUCF organised by the LULUCF inventory compilers at Land and Forest Iceland (LFI) for the inventory compilers of other sectors at the IEEA.
- Continuing education taken by individual inventory experts, including for example courses in advanced Excel, in programming with R, data visualization and communication, and in organic agriculture.
- One inventory compiler at LFI and two inventory compilers at the IEEA completed the UNFCCC NIR/BTR reviewer training in 2024 (LULUCF sector) and 2025 (Energy and Agriculture sectors, respectively). The LULUCF and the Agriculture expert both took part in BTR reviews in 2025 organised by the UNFCCC Secretariat.

1.3.5 Capacity and Staffing

At the time of this writing, the emissions inventories unit for the sectors covered by the IEEA (all except LULUCF) and for the overall project management amounts to a total of 8 positions; the IEEA emissions inventories unit also includes a 30% lawyer position. The same emissions

inventories unit is also responsible for producing the data and report on policies, measures and projections of greenhouse gases as submitted to the EU, as well as on the annual air pollutant inventory reported to the Convention on Long-range Transport of Atmospheric Pollutants (CLRTAP); Other projects also include participating in the ongoing work of implementation and further development of the Climate action plan, with two team members taking part in the work of the Interministerial Committee for the Climate Action Plan.

The LULUCF inventory team at LFI consists of approximately 16 people. About two-thirds are working full time on the project but others are part-time. In addition to those employees, about 10 summer workers are hired for each field season.

1.4 Key Category Analysis

According to the IPCC definition, a key category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's national greenhouse gas emissions totals in terms of the absolute level of emissions, the trend in emissions, or both. Total emissions from the key categories amount to 95% of the total emissions included in the inventory. Key Categories are determined with Approach 1 described in Volume 1, Chapter 4 of the 2006 IPCC Guidelines.

The results of the key category analysis including LULUCF are shown in Table 1.1, and the key category analysis excluding LULUCF is shown in Table 1.2 below. More detailed Key Category Analysis tables can be found in Annex 1, including the percentage contribution of each category to the total emissions.

Iceland's key categories highlight a broader scope of activities than many Parties due to the relatively small anthropogenic emissions from power generation in Iceland. The results highlight the importance of Iceland's industrial sectors, as well as domestic navigation, where the fishing sector plays a strong role in the national economy.

Table 1.1 Key categories of Iceland's greenhouse gas inventory (including LULUCF). ✓ = Key source category.

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
Energy (CRT sector 1)					
1A2	Fuel combustion - Manufacturing Industries and Construction	CO ₂	✓	✓	✓
1A3b	Road Transportation	CO ₂	✓	✓	✓
1A4c	Agriculture/Forestry/Fishing	CO ₂	✓	✓	✓
1B2d	Fugitive Emissions from Fuels - Other (Geothermal)	CO ₂	✓	✓	✓
IPPU (CRT sector 2)					
2A1	Mineral Products: Cement	CO ₂	✓		
2C2	Ferroalloys Production	CO ₂	✓	✓	✓
2C3	Aluminium Production	CO ₂	✓	✓	✓
2C3	Aluminium Production	PFCs	✓		✓

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
Agriculture (CRT sector 3)					
3A1	Enteric Fermentation - Cattle	CH ₄	✓	✓	
3A2	Enteric Fermentation - Sheep	CH ₄	✓	✓	✓
3D1	Direct N ₂ O Emissions from Managed Soils	N ₂ O	✓	✓	
Land use, Land use change and Forestry (CRT sector 4)					
4A1	Forest Land Remaining Forest Land	CO ₂		✓	✓
4A2	Land Converted to Forest land	CO ₂		✓	✓
4B1	Cropland Remaining Cropland	CO ₂	✓	✓	✓
4B2	Land Converted to Cropland	CO ₂	✓	✓	✓
4C1	Grassland Remaining Grassland	CO ₂	✓	✓	✓
4C2	Land Converted to Grassland	CO ₂	✓	✓	✓
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO ₂	✓	✓	
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH ₄	✓	✓	
Waste (CRT sector 5)					
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH ₄		✓	✓
5A2	Unmanaged Waste Disposal Sites	CH ₄	✓		✓

Table 1.2 Key categories of Iceland's greenhouse gas inventory (excluding LULUCF). ✓ = Key source category.

IPCC source category		Gas	Level 1990	Level 2024	Trend
Energy (CRT sector 1)					
1A2	Fuel combustion - Manufacturing Industries and Construction	CO ₂	✓	✓	✓
1A3a	Domestic Aviation	CO ₂	✓		
1A3b	Road Transportation	CO ₂	✓	✓	✓
1A3d	Domestic Navigation	CO ₂	✓		✓
1A4b	Residential Combustion	CO ₂	✓		✓
1A4c	Agriculture/Forestry/Fishing	CO ₂	✓	✓	✓
1B2d	Fugitive Emissions from Fuels - Other (Geothermal)	CO ₂	✓	✓	✓
IPPU (CRT sector 2)					
2A1	Mineral Industry - Cement	CO ₂	✓		✓
2B10	Fertiliser Production	N ₂ O	✓		✓
2C2	Ferroalloys Production	CO ₂	✓	✓	✓
2C3	Aluminium Production	CO ₂	✓	✓	✓
2C3	Aluminium Production	PFCs	✓	✓	✓
2F1	Refrigeration and Air Conditioning	HFCs		✓	
Agriculture (CRT sector 3)					
3A1	Enteric Fermentation - Cattle	CH ₄	✓	✓	✓
3A2	Enteric Fermentation - Sheep	CH ₄	✓	✓	✓

IPCC source category		Gas	Level 1990	Level 2024	Trend
3A4	Enteric Fermentation - Other	CH ₄	✓		
3B1	Manure Management - Cattle	CH ₄	✓	✓	
3D1	Direct N ₂ O Emissions from Managed Soils	N ₂ O	✓	✓	✓
3D2	Indirect N ₂ O Emissions from Managed Soils	N ₂ O	✓	✓	
Waste (CRT sector 5)					
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH ₄	✓	✓	✓
5A2	Unmanaged Waste Disposal Sites	CH ₄	✓		✓

1.5 Quality Assurance & Quality Control (QA/QC)

The objective of QA/QC activities in national greenhouse gas inventories is to improve transparency, consistency, comparability, completeness and accuracy.

1.5.1 Background Information on Iceland's QA/QC Activities

The web application Notion developed by Notion Labs inc. is used as a QA/QC systems management by the emissions inventories unit at the IEEA. It provides a centralised basis for the unit to design, manage, and record its QA/QC activities and improvement plan.

Each sector has a live improvement plan. Every item on the plan includes a record of which review report suggested the improvement, if relevant, and is assigned to a sectoral expert. The sectoral expert is then responsible for assessing the feasibility and timeframe for each improvement. The ongoing QA/QC activities ensure that over time, Iceland's inventory submissions continue to improve in quality.

QC procedures are outlined in a general guidance document, where general and sector-specific QC activities are listed. The QC guidance document is in line with the QC activities listed in Table 6.1 in the 2006 IPCC guidelines. QC activities are clearly outlined in detail and documented in the guidance document in a centralised location (Notion) along with the live improvement plan.

Each subsector has a live progress list for every step of the inventory cycle:

- Implementation of planned improvements
- Compilation of the input data and calculations of emissions
- QC activities
- Report writing
- CRT upload

All steps are time-bound and assigned to one or more inventory experts who are responsible for completing the task and signing it as complete.

1.5.2 Roles and Responsibilities Overview

The overall responsibility over the inventory lies with the head of emissions inventories unit at the Icelandic Environment and Energy Agency (IEEA). This position has oversight over the completion of QA/QC activities, submission, improvements planning, review coordination and communication with the National Focal Point. The head of unit is assisted by the NIR coordinator who oversees daily tasks relating to the generation of the NIR.

In addition to the overall responsibility for the inventory, the emissions inventories unit is responsible for the Energy, IPPU, Agriculture and Waste sectors. The LULUCF sector is managed by the inventory team at Land and Forest Iceland (LFI) (see below).

Within the emissions inventories unit at the IEEA there are two sectoral subgroups, the Energy/IPPU group and the Agriculture/Waste group. Data collection, processing, QC, and improvements are conducted within each group, in collaboration with the NIR coordinator and the head of unit. The various roles within the emissions inventories unit are described below:

- Head of emissions inventories unit – overall responsibility for the accurate and timely production and submission of the inventories, according to the rules and deadlines specified in relevant domestic and international legislation; the head of unit is responsible for the communication with the Icelandic ministries, as well as communication and coordination with the EU Commission, ESA and UNFCCC experts and expert review teams.
- NIR coordinator – responsible for leading the day-to-day tasks required for producing the greenhouse gas inventory.
- Sectoral experts – main knowledge holders on individual inventory sectors. They are responsible for data collection, processing and QC activities. Each sector comprises three to four sectoral experts; prior to each submission cycle, it is decided how roles are divided between the sectoral experts, making sure that QC activities are done by someone other than the individual who did the calculations. In addition, each NID chapter is proof-read by one of the experts not involved in the writing of the chapter. Sectoral experts are responsible for communication with relevant data providers.
- Lawyer – responsible for all the legal aspects of the inventory work, such as examining new legal texts, implementing EU regulation into domestic legislation, as well as understanding Iceland's various air pollutants and greenhouse gases commitments.

The LULUCF part of the inventory is overseen by Land and Forest Iceland. The overall responsibility over the LULUCF inventory work lies with the inventory team leader at Land and Forest Iceland (LFI), who has overall responsibility for the completion of QA/QC activities, submission, improvements planning and review coordination. Within the inventory team at the LFI there are two sectoral subgroups within the team, one responsible for the forestry

sector, including shrubland, deforestation and harvested wood products but the other for all other LULUCF sectors. The various roles within the inventory team are described below:

- Data experts – oversee country-specific data compilation and manage field campaigns.
- Inventory team leader – overall responsibility for the accurate and timely production and submission of the inventories, according to the rules and deadlines specified in relevant domestic and international legislation; The team leader is responsible for the communication with the Icelandic ministries and foreign entities as needed.
- GIS coordinator – compiles and maintains the IGLUD database.
- Two sectoral coordinators – responsible for leading the work on producing the greenhouse gas inventory for;
 - Forest land, shrubland, deforestation and harvested wood products
 - All other LULUCF categories, respectively.

1.5.3 Quality Assurance (QA)

Iceland's greenhouse gas inventory is subjected yearly to reviews by experts mandated by the European Commission and periodically by experts mandated by the UNFCCC. Results from these reviews are considered annually and decisions are taken on how the recommendations will be taken forward in the development and improvement of the inventory and the national system.

The most recent review by the EU took place in February 2026 as per Art. 37.4 of Regulation (EU) 2018/1999. Iceland underwent a comprehensive review that took place in spring/summer 2025 as per Art. 38(1a) of Regulation (EU) 2018/1999. This Article has not yet been incorporated into the EEA Agreement and therefore Iceland underwent the comprehensive review on a voluntary basis. The most recent review by the UNFCCC took place in the autumn of 2022, with a centralised UNFCCC review in September 2022. The review led to a resubmission of the inventory, and Iceland's official 2022 Submission was version v.4. The next UNFCCC review of the inventory is planned for the autumn 2026, as part of Iceland's first Biannual Transparency Report (BTR1).

Some sections of the NID are sent to experts within the appropriate field, for instance to double-check any assumptions or descriptions of relevant sectors. A recent example is the sections on ferroalloy and aluminium production within IPPU, which were sent to the major producers for review, to verify the accuracy of the information and to identify whether any improvements or clarifications were needed.

Further Quality Assurance is provided by Iceland's collaboration with consultants at Aether Ltd., who assist with and review sector-specific methodological choices and calculations. As part of this collaboration, the calculations for the Agriculture and Waste sectors were revised and improved in recent years, whereas the calculations for the Energy sector were revised in

2018. In 2019, F gases and the Agriculture sector were largely reviewed and improved. The LULUCF sector underwent a thorough review and update for this submission; more details about this review can be found in Chapter 6.

Furthermore, Iceland participates in various international experts' groups which aim at discussing and enhancing the overall quality of the inventory, as described in chapter 1.3.4 on training and capacity building.

1.5.4 Quality Control (QC)

The IEEA emissions inventories unit uses notation protocols in the calculation files to document changes, possible issues, and necessary improvements. QC activities include the following:

- Are appropriate activity data, methods, calculations, units, emission factors and notation keys used?
- Are all data sources well referenced/documented?
- Are the emission estimate files consistent with summary files and CRT outputs?
- Are there recalculations since the last submission, and if so, are they properly documented?
- Documentation of performed checks within the emission estimation files and on separate document to track progress and enhance transparency.
- Linking the yearly improvement plan to the outcomes of the QA/QC activities per sector.

The NIR coordinator makes sure to allocate time for all inventory compilers during the inventory preparation cycle for performing the above-mentioned quality checks and assists the compilers regarding the tasks to be carried out.

The general QC procedures in the guidance document are updated regularly, as the sectors continue to be improved. Current sector specific QC check are given in Table 1.4. An example of a general checklist all sectors must complete is given in Table 1.3, and details of how to perform the checks and in what order are given in a guidance document. As staff changes and general time restrictions could affect QC procedures, the checklist is divided into three sections: minimum requirements, which must be carried out each year and do not necessarily require a deep knowledge of the sector and then further controls and checks which require a certain experience within the sector and take also longer time to be performed. It is planned to align the QC procedures between the IEEA and LFI.

Table 1.3 QC checks performed during the inventory cycle

Check	Description
1. Activity data	
Activity data source	Is the appropriate data source being used for activity data and is it up to date?

Check	Description
Correct units	Check that the correct units are being used
Consistency	Is the data consistent with previous years?
Documentation	Has the data source been documented and archived correctly?
Colour Coding	Has colour coding been used in a consistent and accurate manner? Are there any significant data gaps or weaknesses?
Notation keys	Review the use of notation keys and the associated assumption to ensure they are correct.
Recalculation	Check values against previous submission. Give reasons where the two values do not match.
Time series consistency	Use recalculations to check for outliers in the data and if the data is time-series consistent.
2. Emission Factors	
Correct units	Check that the correct units and conversion factors are being used. Check unit carry through in calculations.
Emission factor applicability	Where default emission factors are used, are they correct? Is source information provided?
Documentation	Are all emissions factors and conversion factors documented and referenced correctly?
Colour Coding	Has colour coding been used in a consistent and accurate manner? Are there any significant data gaps or weaknesses?
Recalculation	Check values against previous submission. Give reasons where the two values do not match.
Time series consistency	Are the emission factors time series consistent? Use recalculations to check for outliers and make sure any changes between years are explained and documented correctly.
3. Emission Calculations	
Method validity	Are the calculation methods used valid and appropriate?
Correct units	Check that the correct units are being used
Documentation	Is there sufficient documentation?
Notation keys	Review the use of notation keys and the associated assumption to ensure they are correct.
Colour coding	Has colour coding been used in a consistent and accurate manner? Are there any significant data gaps or weaknesses?
Recalculation	Check values against previous submission. Give reasons where the two values do not match.
Time series consistency	Are the emission factors time series consistent? Use recalculations to check for outliers and make sure any changes between years are explained and documented correctly.
Uncertainty	Check all uncertainty calculations. Make sure appropriate equations are being used and check if all uncertainty estimations are sufficiently documented.
4. CRT	
Completeness	Make sure all emissions are reported in the CRT file
Notation keys	Review the use of notation keys and the associated assumption to ensure they are correct.
Accuracy	Cross check emissions in CRT reporting tables with calculation files.

Table 1.4 Sector-specific QC procedures.

Sector	QC Checks
Energy	• Identification and documentation of discrepancies between the sectoral approach and the reference approach. • Cross-checks with fuel sales data (previously from the National Energy Authority (<i>Orkustofnun</i>) (NEA)) with total input data in calculations files to ensure that all fuels are accounted for. • Meetings are held in order to address discrepancies between energy statistics and data used in the inventory. Activity data for the whole time series is checked and the attribution between IPCC subsectors is discussed.
IPPU	• Calculations of CO₂ and PFC emissions from activities falling under the EU ETS Directive (2003/87/EC) are cross-checked with the annual emission reports verified by accredited EU ETS verifiers (according to Article 67 of Directive 2003/87/EC) since 2013. This applies to activities within CRT categories 2.A.4.d, 2.C.2 and 2.C.3. • Participation in a Nordic expert group on F gases, funded by the Nordic Council of Ministers, discussing, and comparing methods and parameters used by the various Nordic countries. • Visits with the inspection team of the IEEA to factories/companies to increase transparency, knowledge, and accuracy through active dialogue with experts in the various fields. • Review of the IPPU chapter in this NID by external stakeholders (every few year).
Agriculture	• For the category Mature Dairy Cattle, the correlation between milk yield and feed digestibility is checked. • Data reported under CRT 3B and 3D is checked to assure consistency between N deposited on pasture, range and paddock and urine and dung deposited by grazing animals. • A comparison between the Icelandic country-specific (CS) data on imports of synthetic fertiliser and fertiliser usage data from the International Fertiliser Association (IFA) and synthetic fertiliser consumption estimates from the Food and Agriculture Organization of the United Nations (FAO). • To ensure that no double counting or omissions occur during the nitrogen calculations in the N flow tool, a nitrogen balance is carried out, where the total input of nitrogen (animal excretion plus addition through bedding minus loss in the manure management system) should match the amount of nitrogen available for application to soil as animal manure.
LULUCF	• For the 2026 submission the following Q/C procedures were applied in accordance with Chapter 6 of the 2006 IPCC Guidelines: ◦ Estimates were developed on parallel by Icelandic team and an external party (Aether). Any inconsistency between the results was discussed and clarified ◦ A comprehensive checklist was created to track checks applied and results, as well as to identify checks that could be implemented in following submissions. For more detailed information see section 6.1.4.
Waste	• The Waste sector emissions are presented to the interdisciplinary waste expert group at the IEEA as needed for comments. • For the subsector 5B2 Anaerobic Digestion at Biogas Facilities we use methane production data directly from the only such plant in Iceland and combine that data with the default 5% methane leakage from the IPCC guidelines to estimate the emissions. We compare the half IEF with the IPCC default EFs. • Data on methane recovery and flaring from waste operators is compared to data on fuel sales statistics. • Assumptions and activity data processing in subsector 5D Wastewater are reviewed by a wastewater specialist at IEEA.

Additional checks are done according to the reporting requirements listed in Part 1 of Annex V to Regulation (EU) 2018/1999:

Checks performed on recalculations referred to in point (d) of Part 1 of Annex V to Regulation (EU) 2018/1999

As per Article 9 of Regulation (EU) 1020/1208, Member States shall report the reasons for recalculations of greenhouse gas emissions and removals referred to in point (d) of Part 1 of

Annex V to Regulation (EU) 2018/1999. A comparison between the emissions reported in the current submission and those of the previous year is carried out on a sub-sectoral and gas-by-gas basis using a dedicated comparison file. Any changes in emissions or notation keys, together with their underlying reasons, are documented in this file. This check helps ensure that all recalculations are captured and that their rationale is clearly documented.

The recalculations are explained and documented on a sub-sectoral basis in the relevant recalculation sections of this report.

Checks performed on the consistency of the emissions reported in the greenhouse gas inventories, for the year X-2, with the verified emissions reported under Directive 2003/87/EC

Data and emissions pertaining to EU ETS under Directive 2003/87/EC ("The ETS Directive"), as calculated in the inventory, are systematically cross-checked against the EU ETS annual emission reports; such a comparison is done via Annex XII to Commission Implementing Regulation (EU) 2020/1208. The comparison can also be found in Annex 4: ETS vs. Non-ETS of this report. 40% of the emissions reported by Iceland (without LULUCF) are covered by the EU ETS and are checked by accredited verifiers within the EU-ETS rules, and therefore are of the highest quality.

Checks performed on the consistency of the emissions reported in the greenhouse gas inventory, for the year x-2, with the data used to prepare inventories of air pollutants pursuant to Directive (EU) 2016/2284

As per Article 15 of Regulation (EU) 1020/1208, EU member states, Iceland and Norway are to perform checks on the consistency of the data used to estimate emissions in preparation of the greenhouse gas inventories with the data used to prepare inventories of air pollutants pursuant to Directive (EU) 2016/2284, for the year X-2 and for the air pollutants CO, SO₂, NO_x, and NMVOCs. Directive (EU) 2016/2284 has not yet been incorporated into the EEA Agreement, and thus Iceland is not reporting according to that directive. However, as these checks are useful in terms of QA/QC, Iceland performed similar checks with the data reported under the CLRTAP.

Reported data on air pollutants is generally consistent with data reported under CLRTAP for CO, SO₂ and NO_x, and each of these pollutants was under the required threshold of $\pm 5\%$ difference required by Article 15 of Regulation (EU) 2020/1208. However, NMVOCs were above this threshold, and therefore, Iceland decided to report information of all four air pollutants in accordance with the format set out in Annex XIII to Regulation (EU) 2020/1208. NMVOCs had an absolute difference of 0.35 kt of NMVOCs (or 5.8%), with more NMVOCs being reported under CLRTAP than in the greenhouse gas inventory. The reason for these differences is that different methodologies are used for calculating emissions from the Domestic Aviation and International Aviation sectors. Emissions for the greenhouse gas inventory are calculated by using fuel sales, while emissions for CLRTAP are calculated using

country-specific landing and take-off data. Aviation emissions reported in Transport (CRT 1A3) in the greenhouse gas inventory include both LTO (landing and take-off) and CCD (climb/cruise/descent) for domestic aviation but no emissions for international aviation whereas the emissions reported under CLRTAP include both domestic and international flights but only the LTO phases in the national totals.

Checks performed on the consistency of the emissions reported in the greenhouse gas inventory, for the year x-2, with the energy data reported pursuant to Regulation (EC) 1099/2008

In these checks, apparent consumption reported in the greenhouse gas inventory under the Reference Approach of the Energy sector, are compared with apparent consumption as reported under Regulation (EC) 1099/2008. Since the only data available to the emissions inventories unit for the Reference Approach is the dataset reported under Regulation (EC) 1099/2008, there is no difference between the two. The relevant annexes are reported separately to the ESA and to the EU.

1.5.5 Planned Improvements for QA/QC Activities

It is planned to interlink QA/QC activities with the key category analysis and the uncertainty analysis in order to prepare a prioritised improvement plan at the sectoral level as well as for the inventory work in general.

It is also planned to coordinate and standardise the QC procedures between the IEEA and LFI.

1.6 Uncertainty Analysis

The uncertainty analysis is based on the Approach 1 – error propagation of the 2006 IPCC Guidelines (Vol.1, Chapter 3, Table 3.2). The uncertainties of activity data are collected from data providers, evaluated based on expert judgements, or derived from the values proposed in the 2006 IPCC Guidelines. The uncertainties of default emission factors are derived from the values proposed in the 2006 IPCC Guidelines or the 2023 EMEP/EEA Guidebook. The error propagation is used to estimate the uncertainty for each category, the inventory as a whole and the latest inventory year compared to the base year.

The complete uncertainty analysis is reported in Annex 2: Assessment of Uncertainty, with Table A2.1 reporting the uncertainties including LULUCF and Table A2.2 excluding LULUCF. The results of the uncertainty estimation are summarised here below:

Table 1.5 Uncertainties 2024.

	With LULUCF		Without LULUCF	
	Uncertainty 2024 [%]	Trend [%]	Uncertainty 2024 [%]	Trend [%]
CO ₂	27.5%	45.3%	2.0%	3.0%

	With LULUCF		Without LULUCF	
CH ₄	3.0%	1.4%	2.6%	4.3%
N ₂ O	1.3%	0.74%	2.9%	2.4%
HFCs	0.64%	0.0007%	1.5%	0.0019%
PFCs	0.080%	0.60%	0.18%	2.1%
SF ₆	0.0063%	0.0068%	0.014%	0.019%
Total greenhouse gases	27.7%	45.3%	4.6%	6.2%

1.7 General Assessment of Completeness

The emissions reported in this inventory cover all activities within Iceland's jurisdiction. In the case of temporal coverage, CRT tables are reported for the whole time series from 1990 to 2024. Regarding sectoral coverage, all sources considered to be above the threshold of significance²² are reported.

²² As per paragraph 32 of the annex to Decision 18/CMA.1, emissions from a category should only be considered insignificant if the likely level of emissions is below 0.05 % of the national total GHG emissions (without LULUCF).

2 Trends in Greenhouse Gases

This chapter presents the trends in greenhouse gas emissions and removals. Greenhouse gas emissions are compiled under five sectors. Emissions which are reported but excluded from the national totals are included as memo items. These sectors are defined as:

- **Energy:** Emissions from fuel combustion, dominated by carbon dioxide (CO₂) released from the conversion of carbon in fuel to CO₂ and generation of heat. The Energy sector also includes emissions of nitrous oxide (N₂O), methane (CH₄) and other carbon rich volatile organic compounds associated with fugitive emissions from fuel production and storage. In many countries, this sector is dominated by big fossil fuel users including Electricity Generation and Road Transport. This is, however, somewhat different in Iceland due to electricity being produced mostly by hydroelectric and geothermal sources. The Energy sector is thus dominated by Road Transport and the fishing industry. Emissions from geothermal power plants is also reported under the Energy sector.
- **Industrial Processes and Product Use (IPPU):** Non-fuel related emissions from industrial processes and use of products. In recent years, this sector has been largely dominated by CO₂ emissions from metal production. Emissions also occur because of the use of fluorinated substitutes for Ozone Depleting Substances (ODS), otherwise referred to as "F-gases," used mostly in air conditioning and refrigeration applications.
- **Agriculture:** Non-energy use emissions from livestock and crop production. This category can be broadly split into emissions from livestock and emissions from agricultural soils. The main sources of emissions from livestock are CH₄ released from animals due to enteric fermentation, a digestive process which produces CH₄, and from the management of animal manure which releases CH₄ and N₂O. The application of organic manure and synthetic fertiliser to land results in both direct and indirect N₂O from soils. Finally, liming and the application of carbon-containing fertilisers releases CO₂.
- **Land Use, Land-Use Change, and Forestry (LULUCF):** Emissions and removals from land use. This sector focuses on the different carbon pools; living biomass, dead organic matter divided into litter and deadwood, soil organic matter, and harvested wood products. Removals occur through carbon sequestration driven mostly by revegetation and afforestation activities, whereas emissions are dominated by land-management practices such as the drainage of mineral and organic soils. Land is categorised into one of six land uses: Forest Land, Cropland, Grassland, Wetland, Settlements, and Other Land.
- **Waste:** Non-energy use emissions associated with the management of solid and liquid waste. Emissions from waste are split into four main categories: Solid Waste Disposal, Biological Treatment of Solid Waste, Incineration and Open Burning of Waste, and Wastewater Treatment and Discharge. The main gases emitted are CH₄

through the anaerobic (absence of oxygen) decomposition of solid or liquid waste, N₂O from the oxygenation of protein rich compounds (e.g., foods) in the waste and wastewater streams and CO₂ from incineration of fossil-based waste materials (e.g., plastic). CH₄ is emitted in solid waste disposal sites where organic matter decays over a period of many years, at a declining rate. Anaerobic conditions in wastewater treatment produce CH₄ and aerobic conditions can produce N₂O. The biological treatment of waste, such as composting, also results in CH₄ emissions (from anaerobic decomposition) and N₂O emissions from oxidation of nitrogen rich materials (e.g., protein). Incineration and open burning of fossil-based wastes (e.g., increasingly plastics) are the most important sources of CO₂ emissions from waste incineration activities.

- **Memo:** Emissions which are not included in the national totals in accordance with international reporting agreements, include International Navigation, International Aviation, and CO₂ from biomass (bio-CO₂).

2.1 Emission Trends Overview

According to the annex to Decision 18/CMA.1, the following gases must be reported in national greenhouse gas inventories:

- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous oxide (N₂O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF₆)
- Nitrogen fluoride (NF₃)

Iceland reports emissions of CO₂, CH₄, N₂O, HFCs, PFCs, and SF₆. There are no imports of products containing NF₃ nor industries potentially using that type of gas (e.g., semiconductors, LCD manufacture, solar panels, and chemical lasers), therefore there are no emissions of NF₃ occurring in Iceland.

Total amounts of greenhouse gas emitted in Iceland during the period from 1990 to the most recent inventory year are presented in the following figures and tables, expressed in terms of contribution by gas and sector in kt CO₂ equivalents (CO₂e) and using Global Warming Potentials (GWPs) based on the 100-year time horizon GWPs presented in the Fifth Assessment Report (AR5) of the IPCC²³.

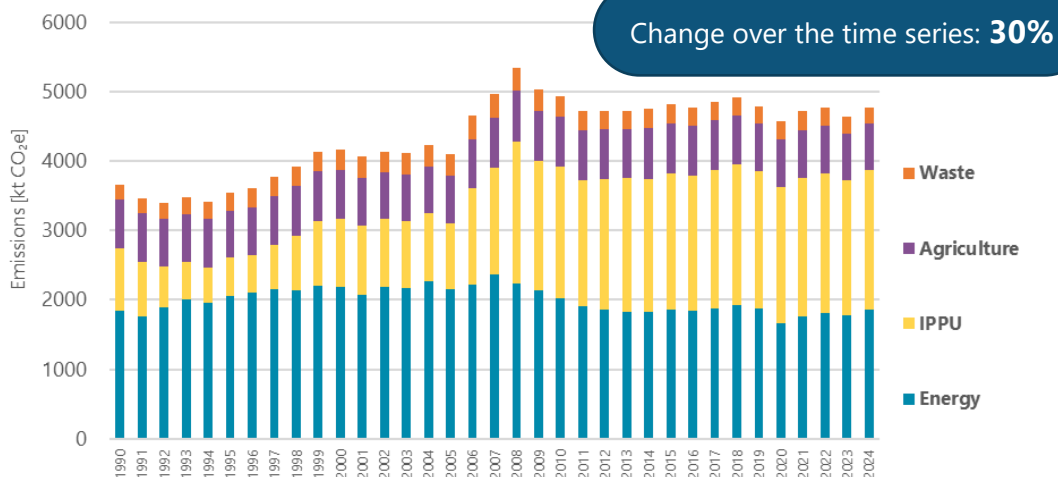
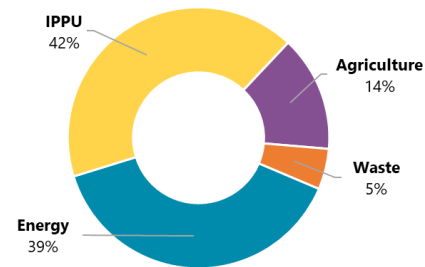
Iceland also reports precursor and indirect greenhouse gas emissions; these include:

²³ as required by the Annex to Decision 18/CMA.1, Decision 6/CP.27 and Commission Delegated Regulation (EU) 2020/1044.

- Nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and carbon monoxide (CO) which contribute to the formation of the greenhouse gas ozone; and
- Sulphur dioxides (SO_x) and ammonia (NH_3) which affects climate by increasing the level of aerosols that in turn have a cooling effect on the atmosphere.

The emission trends for precursors and indirect greenhouse gases are presented separately in Section 2.3.

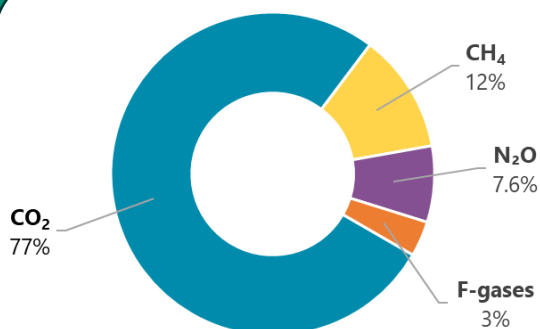
In the most recent inventory year, the Industrial Processes sector was the largest contributor of greenhouse gas emissions in Iceland (without LULUCF), followed by Energy, Agriculture, and Waste.



By the middle of the 1990s, economic growth started to gain momentum in Iceland. The main driver behind increased emissions since 1990 is the expansion of the metal production sector:

- There was one aluminium plant in 1990
- Second aluminium plant opened in 1998
- Third aluminium plant opened in 2007

The contribution of IPPU to total emissions (without LULUCF) has increased over the time series, overtaking emissions from the Energy sector in 2012.



Total greenhouse gas emissions (excluding LULUCF) increased by approximately a third since 1990, mostly due to the expansion of the metal production industry. Emissions from the energy sector are dominated by fuel combustion in road transport and fishing, whereas the emissions due to electricity production and district heating are relatively small and almost exclusively linked to CO₂ emissions from geothermal power plants.

Figure 2.1 Overview of greenhouse gas emissions (without LULUCF), from top to bottom: (1) emission by sector for the latest year (2) emission by sector over the time series and (3) emissions by gas for the latest year.

Overall Trend

Since 1990, Iceland's total greenhouse gas emissions have increased by almost a third (excluding LULUCF). This trend of increasing emissions is dominated by:

- The expansion of the metal industry, in particular the aluminium production sector;
- Increases in emissions from geothermal energy utilisation due to an increase in electricity production, which increased 21-fold since 1990; and
- CO₂ emissions from the Road transport sector almost doubling since 1990 due to increases in population, in number of cars per capita, more mileage driven, and an increase in the share of larger vehicles; these changes can partly be attributed to a significant increase in the number of tourists in Iceland since 2010.

In contrast, annual emissions from commercial fishing have seen an overall decline since 1990, with greenhouse gas emissions decreasing by approximately 32% over the time series. Emissions from both domestic flights and navigation have also declined since 1990.

LULUCF net emissions were mostly constant from 1990 to 2008, and there was a slight decrease in emissions from 2008 to 2022. Despite the continued increase in removals from Forest land and Grassland between 1990 and 2024, net LULUCF emissions increase over the period 2022-2024. This upward trend is driven by a slight increase in annual conversions of Wetlands and Grasslands to Cropland, and is primarily attributable to the implementation of Habitat Map of Iceland (HMI), the adoption of new methodological approaches for land-use identification, and the integration of high-precision GPS measurement data from the Icelandic Agricultural Advisory Centre (IAAC).

Emissions during 1990-1999

Total emissions show a slight decrease between 1990 and 1992. From 1994-1999, total emissions increased slightly.

By the middle of the 1990s, economic growth started to gain momentum in Iceland. The main driver behind increased emissions since 1990 is the expansion of the metal production sector. In 1990, 88 thousand tonnes of aluminium were produced in one aluminium plant in Iceland. A second aluminium plant was established in 1998 and a third one in 2007.

Emissions during 2000-2007

Emissions plateaued from 2000 to 2005 but increased more rapidly between 2005 and 2007.

The overall increasing trend of greenhouse gas emissions until 2005 was counteracted to some extent by a decrease in emissions of PFCs, which was caused by improved technology and process control in the aluminium industry. Increased emissions due to an increase in production capacity of the aluminium industry (since 2006) led to a trend of overall increase in greenhouse gas emissions between 2006 and 2008, when emissions from the aluminium sector peaked.

Until 2007, Iceland experienced one of the highest GDP growth rates among OECD countries. A knock-off effect of the increased levels of economic growth until 2007 was an increase in construction, especially residential building in the capital area. The construction of a large hydropower plant (Kárahnjúkar, built from 2002 to 2007) led to a further increase in emissions in Iceland.

Emissions during 2008-2011

Between 2008 and 2011, annual emissions steadily decreased.

In the autumn of 2008, Iceland was hit by an economic crisis when three of the largest banks collapsed. The blow was particularly hard owing to the large size of the banking sector in relation to the overall economy as the sector's worth was about ten times the annual GDP of Iceland. The crisis resulted in a serious contraction of the economy followed by an increase in unemployment, a depreciation of the currency, the Icelandic Króna (ISK), and a drastic increase in external debt. Private consumption contracted by 20% between 2007 and 2010. Emissions of greenhouse gas decreased from most sectors between 2008 and 2011. Emissions from fuel combustion in the transport and construction sectors decreased each year between 2008 and 2011 due to the economic crisis.

Emissions during 2011-2018

Between 2011 and 2018, annual emissions showed a slight upward trend.

While emissions from fishing and fuel combustion in stationary industries declined during this period, this reduction was largely offset by increased emissions from road transport, partly driven by a rise in visitors to Iceland. Additionally, emissions from the aluminium, ferrosilicon, and silicon metal industries increased.

Emissions since 2018

Since 2018, annual emissions have generally declined despite some fluctuations, with a sharper drop in 2020 due to the COVID-19 pandemic.

The overall decrease can be attributed in part to continued reductions in emissions from fishing, as well as declines in road transport, off-road vehicles and machinery, agriculture (due to lower livestock numbers), and F-gases (thanks to a transition to refrigerants with lower global warming potential).

By 2024, aluminium production had grown nearly tenfold compared to 1990, and emissions from the IPPU sector had more than doubled. To support this expansion, significant investments were made in increasing power capacity. These investments were substantial relative to the size of Iceland's economy.

Table 2.1 Greenhouse gas emissions by sector in Iceland [kt CO₂e, calculated using GWP from AR5]

Sector	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024
1 Energy	1841	2058	2185	2156	2026	1860	1669	1782	1866	1.4%	4.8%
2 IPPU	902	552	992	951	1895	1966	1959	1948	2008	123%	3.1%
3 Agriculture	712	679	695	678	714	726	687	660	662	-7.1%	0.23%
4 LULUCF	6686	6639	6627	6649	6556	6357	6154	6163	6216	-7.0%	0.87%
5 Waste	212	260	296	314	309	269	263	254	243	14%	-4.5%
Total with LULUCF	10354	10188	10794	10748	11499	11178	10734	10807	10995	6%	1.7%
Total without LULUCF	3667	3549	4167	4099	4944	4820	4579	4644	4779	30%	2.9%
International bunkers (memo items)	249	241	465	426	380	828	341	1300	1331	434%	2.4%

Emissions by gases

The largest contributor to total greenhouse gas emissions without LULUCF (see Table 2.2) and with LULUCF (Table 2.3 and Figure 2.2) is CO₂, followed by CH₄, N₂O, and fluorinated gases (PFCs, HFCs, and SF₆). Over the time series, emissions of CO₂ have increased the most, and PFCs emissions have decreased significantly.

- The main contributors to CO₂ emissions are drained wetlands (LULUCF), process-related fuels in the metal industry (IPPU) and fuel combustion (Energy).
- CH₄ emissions originate mostly from grasslands (LULUCF), livestock (Agriculture) and solid waste disposal (Waste).
- N₂O emissions mainly come from agricultural soils and manure management (Agriculture) as well as fuel combustion (Energy).
- HFC emissions originate almost exclusively from refrigerants used in refrigeration and air conditioning (IPPU), whereas PFC emissions are for the most part emitted during aluminium production (IPPU).
- SF₆ emissions in Iceland are very small and are mostly linked to leakage in electrical equipment (IPPU).

Table 2.2 Greenhouse gas emissions by gas, without LULUCF [kt CO₂e].

GHG	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024	% total in latest year
CO ₂	2221	2468	2933	2977	3627	3547	3337	3508	3677	66%	4.8%	77%
CH ₄	617	623	655	656	681	645	609	588	570	-7.6%	-3.1%	12%
N ₂ O	383	391	400	378	370	377	363	353	364	-4.9%	3.3%	7.6%
HFCs	0.63	3.2	43	57	107	157	198	125	108	17013%	-13%	2.3%
PFCs	445	62	135	28	154	93	68	68	59	-87%	-14%	1.2%

GHG	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024	% total in latest year
SF ₆	1.1	1.3	1.4	2.6	4.8	1.6	3.3	1.9	1.6	44%	-16%	0.034%
Total	3667	3549	4167	4099	4944	4820	4579	4644	4779	30%	2.9%	100%

Table 2.3 Greenhouse gas emissions by gas, with LULUCF [kt CO₂e].

GHG	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024	% total in latest year
CO ₂	8346	8538	8981	9035	9574	9292	8876	9050	9270	11%	2.4%	84%
CH ₄	1171	1186	1229	1243	1283	1250	1219	1202	1185	1.2%	-1.4%	11%
N ₂ O	390	397	406	384	377	383	369	361	372	-4.6%	3.1%	3.4%
HFCs	0.63	3.2	43	57	107	157	198	125	108	17013%	-13%	0.98%
PFCs	445	62	135	28	154	93	68	68	59	-87%	-14%	0.53%
SF ₆	1.1	1.3	1.4	2.6	4.8	1.6	3.3	1.9	1.6	44%	-16%	0.015%
Total	10354	10188	10794	10748	11499	11178	10734	10807	10995	6.2%	1.7%	100%

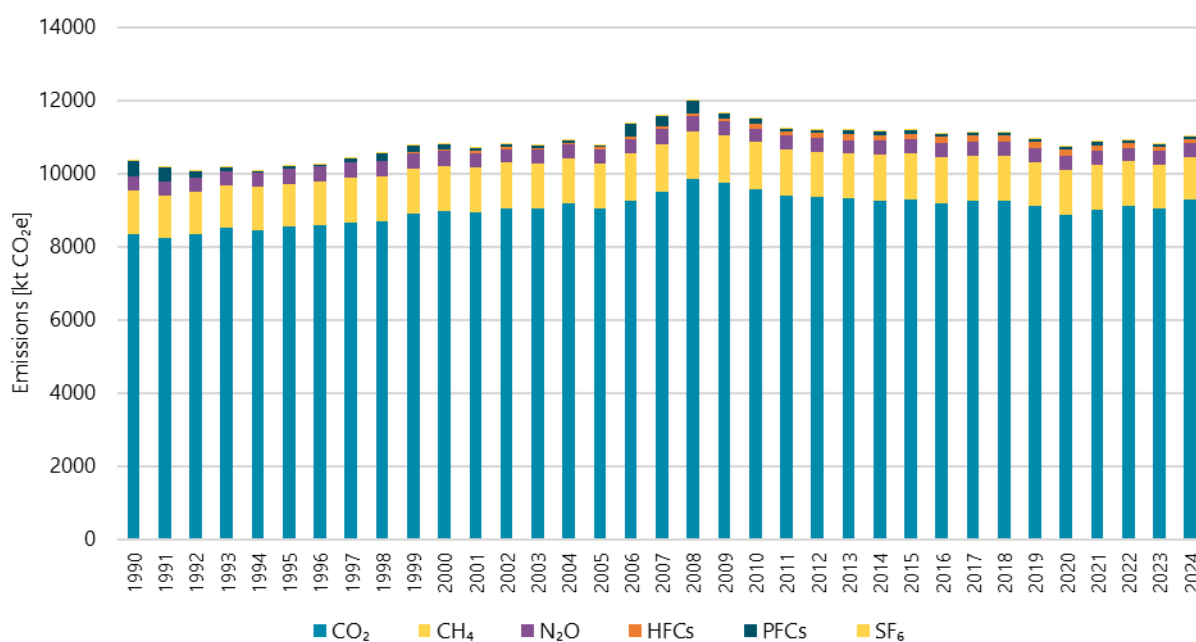


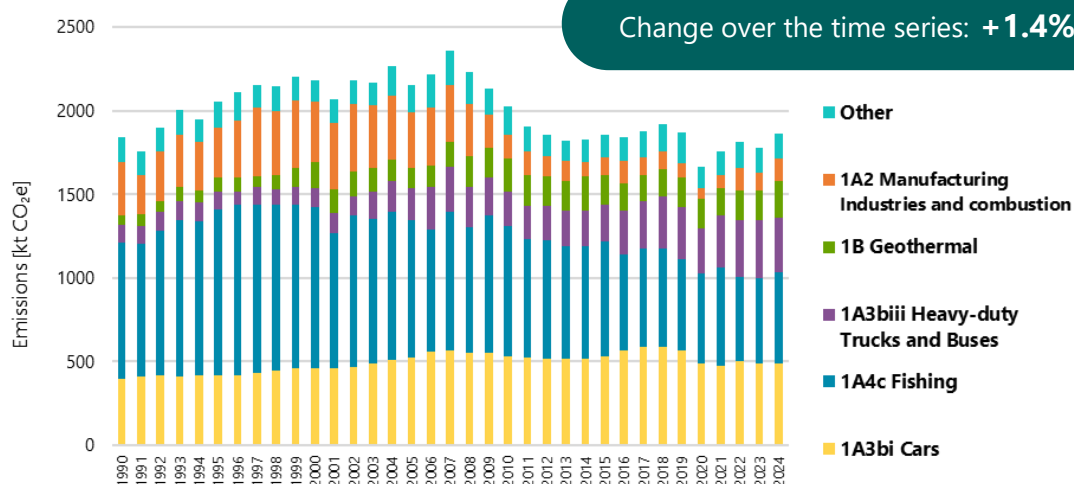
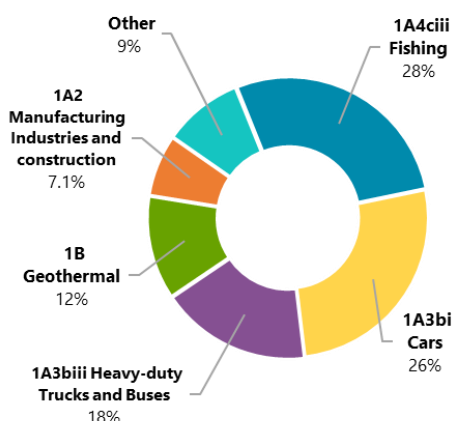
Figure 2.2 Total emissions, with LULUCF, for the reported time series disaggregated by gases.

2.2 Emission Trends by Sector and by Gas

2.2.1 Energy (CRT Sector 1)

Iceland ranks first among OECD countries in the per capita consumption of primary energy. However, the proportion of domestic renewable energy in the total energy budget is approx. 85%, which is a much higher share than in most other countries, with close to 100% of the energy demand covered by hydro-, geothermal, and wind power. The cool climate and sparse population lead to high energy and transportation needs. Together with Road Transport, the fishing industry dominate emissions of the Energy sector.

39% of total emissions (excl. LULUCF)



The Energy sector is dominated by CO₂ emissions from Road Transport and the fishing industry. CO₂ emissions from geothermal energy exploitation have increased since 1990 with the opening of new geothermal power plants. CO₂ sequestration projects are ongoing to capture CO₂ emissions from geothermal plants and mineralise CO₂ underground for permanent storage.

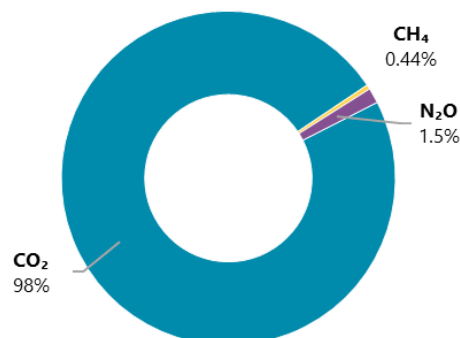


Figure 2.3 Overview of emissions from the Energy sector, from top to bottom: (1) emission by subsector for the latest year, (2) emission by subsector over the time series and (3) emissions by gas for the latest year.

Key export industries such as fisheries and metal production are energy intensive. The metal industry uses around three-quarters of the total electricity produced in Iceland. Iceland relies heavily on its geothermal energy sources for space heating (over 90% of all homes) and electricity production (30% of electricity) and on hydropower for electricity production (70% of the electricity).

The development of the energy sources in Iceland can be divided into three phases:

1. The electrification of the country and harnessing the most accessible geothermal fields (ca. 1900-1940), mainly for space heating.
2. Harnessing the resources for power-intensive industry. This began in 1966 with agreements on the building of an aluminium plant, and in 1979 a ferrosilicon plant began production.
3. Following the oil crisis of 1973-1974, efforts were made to use domestic sources of energy to replace oil, particularly for space heating and fishmeal production. Oil has almost disappeared as a source of energy for space heating in Iceland, and domestic energy has replaced oil in industry and in other fields where such replacement is feasible and economically viable.

The emission trends are discussed in more detail below by subsector. These are categorised into fuel combustion, which covers all direct emissions from oxidation of fuel for generating heat or mechanical work to a process, and geothermal and fugitive emissions, which covers emissions from the extraction, transformation, and transportation of primary energy carriers. Emissions from Transport have significantly increased since 1990, whilst emissions from Fishing and Manufacturing Industries, and Construction have decreased, as can be seen in Table 2.4. The causes of these emission trends are discussed below.

Energy Industries

The Energy sector includes emissions from energy industries, i.e. electricity generation and heat plants (emissions from geothermal power plants are reported separately under Geothermal Energy). Iceland relies heavily on renewable energy sources for electricity and heat production, thus emissions from this sector are very low (accounting for just >1% of the sector's total emissions for the whole times series). The sources of emissions from electricity and heat production are:

- Electricity produced with fuel combustion occurs at two locations (two islands, Flatey and Grímsey), which are located far from the distribution system.
- Backup systems in some electricity facilities using fuel combustion to be used if problems occur in the distribution system.
- Electric boilers to produce heat from electricity are used at some district heating facilities which lack access to geothermal energy sources. They depend on curtailable energy. These heat plants have back-up fuel combustion in case of an electricity shortage or problems in the distribution system.

Emissions from the Energy Industry sector are relatively low, although they show some degree of fluctuation over time. In 1995, there were issues in the electricity distribution system (snow avalanches in the Westfjords region (Vestfirðir) and icing in the northern part of the country) that resulted in higher emissions that year. Unusual weather conditions during the winter of 1997/1998 led to unfavourable water conditions for the hydropower plants. This created a shortage of electricity which was met by burning oil for electricity and heat production. In 2007, a new aluminium plant was established. Due to the delay of the Kárahnjúkar hydropower project, the aluminium plant was initially supplied with electricity from the distribution system. This led to electricity shortages for the district heating systems and industry depending on curtailable energy, leading to increased fuel combustion and emissions.

Manufacturing Industries and Construction

Increased emissions from the Manufacturing Industries and Construction categories over the period 1990-2002 are explained mostly by increased activity in fishmeal production during the period. Since 2002, emissions from fishmeal production have decreased, partly due to replacement of oil with electricity, apart from an increase in recent years due to challenge of electricity shortage. Emissions from fuel combustion at the cement plant decreased rapidly due to the collapse of the Construction sector, and in 2011 the plant closed.

Transport

Emissions from the Transport sector have increased by over half across the time series. The largest increase in emissions is from Road Transport, owing to substantial increases in the national population, the number of cars per capita, total mileage driven, the number of larger vehicles, and tourism, all of which have increased the vehicle fleet significantly since 1990. Emissions from Road Transport peaked in 2018 after a decreasing trend from the previous 2007 peak followed by a rise in road emissions since 2012. In recent years, there has been a significant increase in the number of fuel-efficient and electric vehicles; a reversal of the trend from 2002-2007 when large, fuel-inefficient vehicles were imported. New registrations of electric vehicles and plug-in hybrids have been increasing rapidly since 2014. Emissions from both Domestic Aviation and Navigation have declined since 1990. This decrease in Navigation and Aviation has compensated for rising emissions in the Transport sector to some extent.

Fishing

The fishing industry dominates the Other sector (1A4). Emissions from fisheries rose from 1990-1996 because a substantial portion of the fishing fleet was operating in unusually distant fishing grounds. From 1996, the emissions have generally been decreasing and reached levels below those of 1990 in 2011. Emissions remain below 1990 levels, however there are large annual variations mainly due to variations in fish stock size, distribution, and fishing conditions.

Geothermal Energy

Emissions from geothermal energy have accounted for 3-5% of the total annual greenhouse gas emissions (excluding LULUCF) in Iceland since 2015. Iceland relies heavily on geothermal energy for space heating (over 90% of the homes) and electricity production (approximately 30% of the total electricity production in recent years). Table 2.4 shows the emissions from geothermal energy since 1990. Electricity production using geothermal power increased over 20-fold during this period resulting in an increase in emissions. Emissions from geothermal utilisation are site- and time-specific and exhibit significant variations between different wells and well sites, as well as by the time of extraction. At some power plants, CO₂ is captured and reinjected into the basaltic subsurface where it mineralises and remains permanently stored in mineral form.

Distribution of Oil Products

Emissions from distribution of oil and gas products are a minor source in Iceland (<1 kt CO₂e). There are no other transportation emissions in Iceland and no coal, oil, or gas production emissions.

Memo Items

Emissions from International Aviation and marine bunker fuels are excluded from national totals as outlined in the IPCC Guidelines. These emissions are presented separately for information purposes but are included in Table 2.4. Greenhouse gas emissions from marine and aviation bunkers have increased more than fivefold since 1990, partly due to increased tourism in recent years.

CO₂ emissions from biomass are also reported as Memo Items and are excluded from national totals. These emissions have been reported since 2003 and have been rapidly increasing over recent years due to increase in the use of biofuels.

Table 2.4 Total greenhouse gas emissions from the Energy sector [kt CO₂e].

Energy Sector	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024
1A1 Energy industries	14	15	6.6	3.4	8.6	4.2	2.6	11	15	14%	41.0%
1A2 Manufacturing industries	313	303	364	339	143	111	60	110	133	-58%	21%
1A3 Transport	600	629	660	826	877	878	878	968	940	57%	-2.8%
1A3a Domestic Aviation	34	30	28	26	21	21	13	23	20	-39%	-8.9%
1A3b Road Transport	531	558	615	773	814	828	837	929	906	70%	-2.48%
1A3d Domestic navigation	33	38	13	23	35	27	25	17	13	-59%	-20%
1A3e Other transportation	2.5	3.0	4.0	4.5	6.2	2.7	2.3	0.08	1.0	-59%	1227%

Energy Sector	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024
1A4 Other sectors	852	1026	994	839	788	694	551	514	549	-36%	6.78%
1A4a Commercial/Institutional	8.1	7.8	6.7	4.9	1.7	2.1	1.6	2.3	2.4	-70%	5.8%
1A4b Residential	28	22	21	13	8.5	6.0	6.7	4.3	4.5	-84%	4.5%
1A4c Fishing	760	922	892	742	727	621	509	485	520	-32%	7.1%
1A5 Other	0.1	1.6	4.6	29	14	0.19	0.36	1.8	4.6	3677%	160%
1B2 Fugitive emissions	62	83	155	120	195	173	178	177	224	264%	26%
1B2d Geothermal	61	82	154	119	195	172	177	177	223	266%	26%
1 Total emissions	1841	2058	2185	2156	2026	1860	1669	1782	1866	1.4%	4.8%
1D1a International Aviation (Memo)	221	238	410	424	380	679	263	968	1007	355%	4.1%
1D1b International Navigation (Memo)	28	3.4	54	1.8	0.25	149	78	333	324	1053%	-2.7%
1D3 CO ₂ from Biomass	2.4	6.3	7.5	10	8	40	60	50	84	3410%	66.6%

2.2.2 Industrial Processes and Product Use (CRT sector 2)

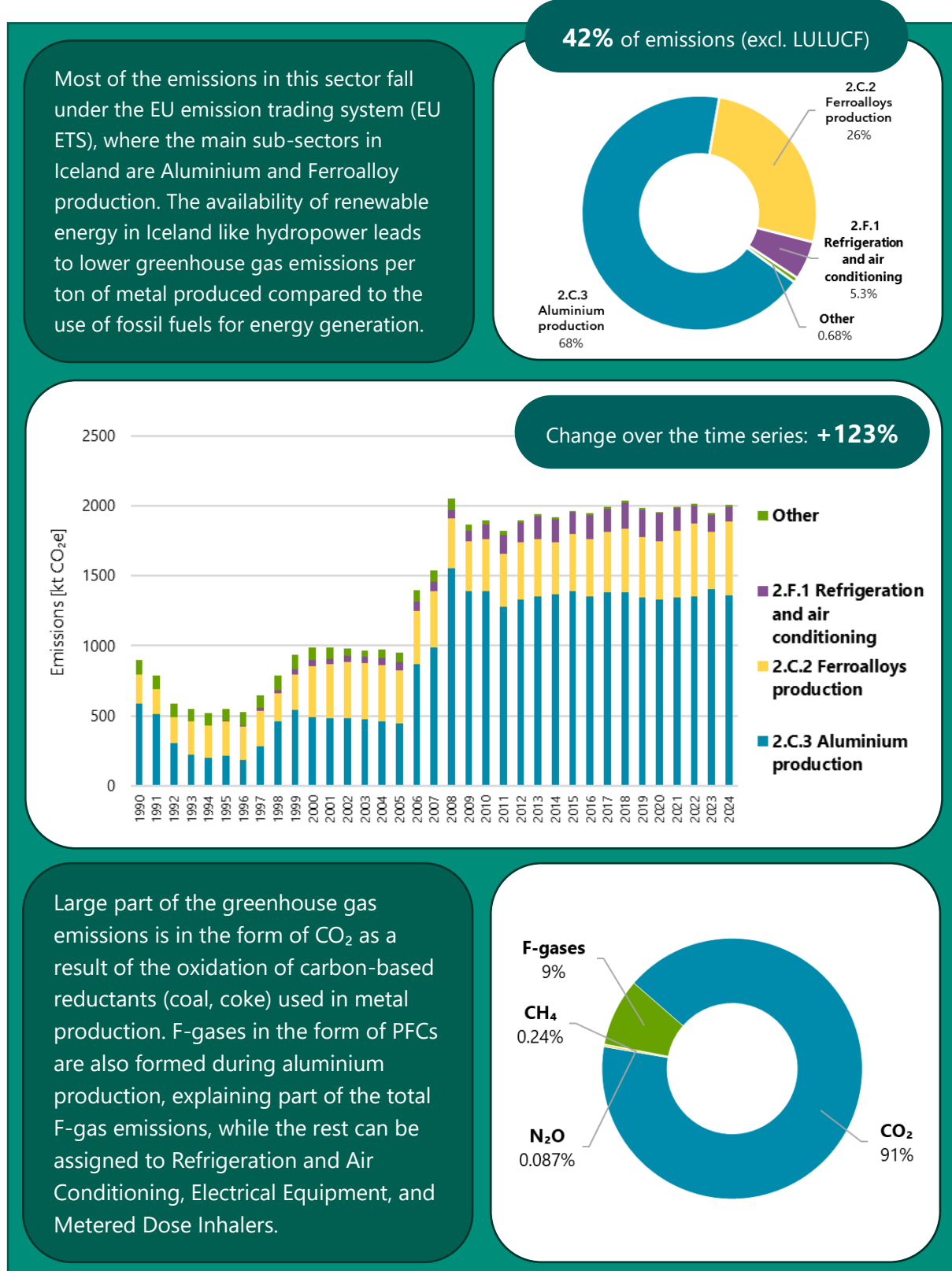


Figure 2.4 Overview of emissions from the IPPU sector, from top to bottom: (1) emission by subsector for the latest year, (2) emission by subsector over the time series and (3) emissions by gas for the latest year.

The Industrial Processes and Product Use (IPPU) sector is the second largest contributor to national greenhouse gas emissions after LULUCF. The emissions from this sector are dominated by CO₂, hydrofluorocarbons (HFCs) and perfluorocarbon (PFC). HFCs are used as substitutes for ozone depleting substances (ODS) in refrigeration systems. Perfluorocarbon emissions in Iceland come mostly from the aluminium industry (tetrafluoromethane, CF₄, and hexafluoroethane, C₂F₆), and to a small extent from refrigeration equipment (hexafluoroethane (C₂F₆) commercially known as PFC116, and octafluoropropane (C₃F₈), commercially known as PFC-218).

Emissions from IPPU have increased over the time series primarily due to the expansion of energy-intensive industry, primarily from metal production (aluminium smelting and ferroalloy production), see Table 2.5. Metal production accounts for over 90% of the IPPU sector emissions in recent years.

Aluminium Production

Aluminium Production is the main source within the metal production category, accounting for most of the total Industrial Processes emissions across the time series. Aluminium is produced at three plants. The production technology in all aluminium plants is based on using centre worked prebaked anode cells. The main energy source is electricity, and industrial process CO₂ emissions are mainly due to the anodes that are consumed during electrolysis. In addition, the production of aluminium gives rise to emissions of PFCs. Due to the expansion of the existing aluminium plant in 1997 and the establishment of a second aluminium plant in 1998, emissions increased from 1997 to 1999. From 2000, the emissions showed a steady downward trend until 2005. The PFC reduction was achieved through improved technology and process control and led to a 98% decrease in the amount of PFC emitted per tonne of aluminium produced during the period of 1990 to 2005. In 2006, the PFC emissions rose significantly due to an expansion of one smelter, but PFC emissions per tonne of aluminium decreased from 2007 to 2011 through improved process technology. The third aluminium plant was established in 2007 and reached full production capacity in 2008. PFC emissions per tonne of aluminium are generally high during start up and usually rise during expansion. PFC emission declined in 2009 and 2010 through improved process technology until December 2010 at the third smelter, when a rectifier was damaged in fire. This led to increased PFC emissions leading to higher emissions at the plant in 2010 than in 2009. Since 2010 the average PFC emissions for all three aluminium smelters is around 0.1 t CO₂e/t Al produced.

Ferroalloy Production

Ferroalloy Production accounts for approximately a quarter of Industrial Processes emissions. CO₂ is emitted due to the use of coal and coke as reducing agents and from the consumption of electrodes and other carbon-containing additives (carbon blocks, electrode casings and limestone). In 1998 a power shortage caused a temporary closure of the ferrosilicon plant, resulting in exceptionally low emissions that year. In 1999, however, the plant was expanded

(addition of the third furnace) and emissions have therefore increased considerably since 1990. In late 2016, a silicon metal plant opened, which contributed slightly to the increase in emissions from this subsector for 2017, however it ceased operations in mid-2017. Another silicon plant started its operations in May 2018.

Mineral Production and chemical industry

Mineral Production emissions have significantly decreased since 1990. Cement production was the dominant contributor until 2011 when the sole cement plant shut down. CO₂ derived from carbon in the shell sand used as raw material is the source of CO₂ emissions from cement production. Emissions from the cement industry reached a peak in 2000 but declined until 2003, partly because of cement imports. In 2004 to 2007 emissions increased again because of increased activity related to the construction of the Kárahnjúkar hydropower plant (built 2002 to 2007) although most of the cement used for the project was imported. Today, the remaining emissions from the mineral production sector come from mineral wool production.

Emissions from the chemical industry ceased in 2005. The production of fertilisers, which used to be the main contributor to process emissions from the chemical industry was closed in 2001. No chemical industry has been in operation in Iceland after the closure of a diatomite (silica) production facility in 2004.

F-gases

Imports of HFCs (F-gases) started in 1993 and have increased steadily until 2018. In 2019 a tax scheme was established, putting a tax on the import of F-gases according to their global warming potential. Since 2019 the import has been decreasing. No HFC/PFCs were routinely used for refrigeration before 1993 and the only HFCs reported before then is HFC-134 in Metered Dose Inhalers, therefore the increase since 1990 is very large. Refrigeration and air conditioning are the main uses of HFCs in Iceland, and the fishing industry plays a notable role. HFCs stored in refrigeration units constitute banks of refrigerants which emit HFCs during use due to leakage. Very minor amounts of PFCs are used in certain refrigerant blends, and the PFC emissions from refrigeration and air conditioning is on the order of a few tens of tons of CO₂e.

The main source of SF₆ emissions is leakage from electrical equipment such as gas insulated switchgear. Emissions have been increasing since 1990 due to the expansion of the Icelandic electricity distribution. The peak in leakage in 2010 was caused by two unrelated accidents during which the SF₆ contained in equipment leaked into the atmosphere. The peak in 2018 was due to equipment breakdown that caused leakage.

Solvents and other sources

The use of solvents and products containing solvents (CRT sector 2D3) leads to emissions of non-methane volatile organic compounds (NMVOC), which are regarded as indirect

greenhouse gases as the NMVOC compounds are oxidised to CO₂ in the atmosphere over time. These CO₂ emissions are also included in this inventory.

Also included in the IPPU sector are emissions of N₂O from medical and other uses and emissions of CO₂ from lubricants and paraffin wax use. Other sources of emissions included in the Icelandic inventory are CH₄ and N₂O emissions from tobacco, as well as greenhouse gas and precursor emissions from firework use. Historically, Industrial Processes has been an important source of N₂O, but emissions have been significantly reduced since the shutdown of the fertiliser plant in 2001.

Table 2.5 Greenhouse gas emissions from Industrial Processes and Product Use [kt CO₂e].

Industry Sector	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024
2A Mineral Products	52	38	65	55	10	0.72	0.89	0.97	0.92	-98%	-4.7%
2B Chemical Industry	42	36	16	0	0	0	0	0	0	-100%	–
2C Metal Production	795	462	853	825	1764	1797	1748	1811	1888	138%	4.2%
2D Non-energy Products from Fuels and Solvent Use	6.4	7.1	7.6	7.9	5.3	6.4	7.0	7.8	8.4	30%	7.4%
2F Product Uses as Substitutes for Ozone Depleting Substances	0.63	3.2	43	57	107	157	198	125	108	17024%	-13%
2G Other Product Manufacture and Use	6.6	5.3	5.8	6.1	8.3	4.6	5.8	3.8	3.4	-48%	-10%
2 Total emissions	902	552	992	951	1895	1966	1959	1948	2008	123%	3.1%

Table 2.6 Total HFC, PFC and SF₆ emissions from F-gas consumption [kt CO₂e].

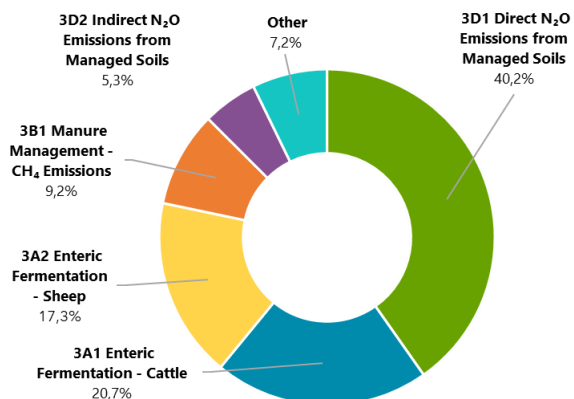
GHG	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024
HFCs	0.63	3.2	43	57	107	157	198	125	108	17013%	-13%
PFCs	445	62	135	28	154	93	68	68	59	-87%	-14%
SF ₆	1.1	1.3	1.4	2.6	4.8	1.6	3.3	1.9	1.6	44%	-16%

2.2.3 Agriculture (CRT sector 3)

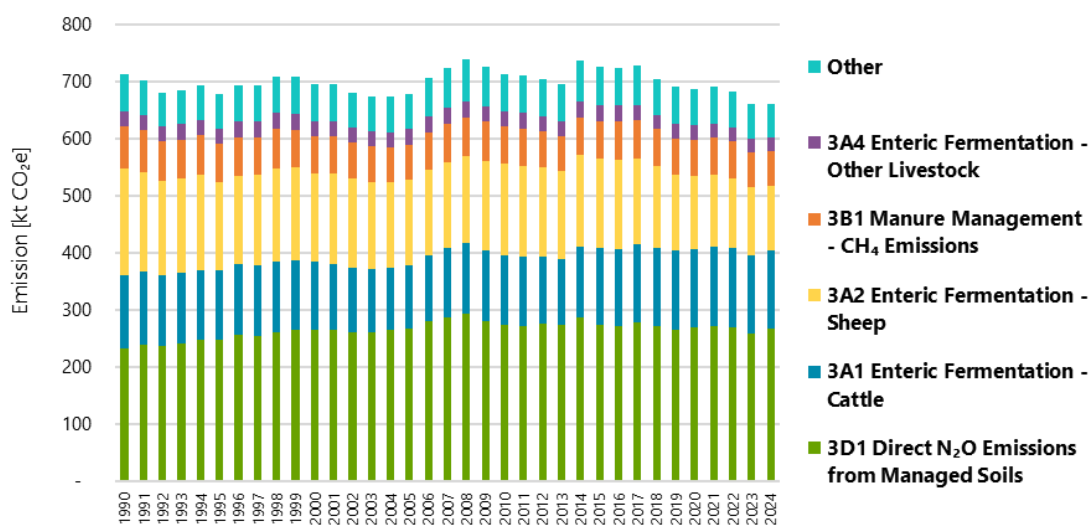
Emissions are dominated by agricultural soils and enteric fermentation throughout the time series.

Approximately 90% of emissions from enteric fermentation are attributed to the two largest livestock categories: Sheep and Cattle.

14% of total emissions (excl. LULUCF)



Change over the time series: -7.1%



Enteric fermentation is the main source of CH₄. Agriculture is the main source of N₂O emissions. They are generated from agricultural soils and manure management.

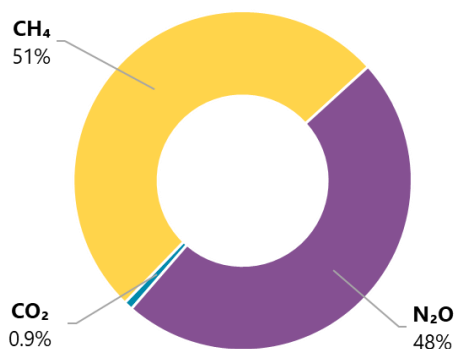


Figure 2.5 Overview of emissions from the Agriculture sector, from top to bottom: (1) emission by subsector for the latest year, (2) emission by subsector over the time series and (3) emissions by gas for the latest year.

Iceland is self-sufficient in all major livestock products, such as meat, milk, and eggs. Traditional livestock production is grassland based, and most farm animals are native breeds, e.g., dairy cattle, sheep, horses, and goats, which are of an ancient Nordic origin, one breed for each species. These animals are generally smaller than the breeds common elsewhere in Europe. Beef production, however, is partly through imported breeds, as is most poultry and all pork production. There is not much arable crop production in Iceland, due to a cold climate and short growing season. Cropland in Iceland consists mainly of cultivated hayfields, but potatoes, barley, root crops and brassicas are grown on limited acreage. Emissions from agriculture are closely coupled with livestock population sizes, especially cattle and sheep. N₂O emissions from drained organic soils are also a large part of emissions from agriculture. A decrease in livestock population size of sheep since 1990 is mostly counteracted by increased emissions from cultivation of organic soils (Figure 2.5 and Table 2.7). The emissions from Agriculture have stayed relatively stable since 1990.

Table 2.7 Greenhouse gas emissions from Agriculture sector [kt CO₂e].

Agriculture Sector	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990-2024	Changes 2023-2024
3A Enteric Fermentation	340	305	302	289	311	319	293	282	277	-19%	-1.9%
3B Manure Management	101	89	88	84	89	91	83	80	79	-22%	-1.9%
3D Agricultural Soils	273	284	303	302	311	314	305	291	301	10%	3.7%
3G Liming	0.023	3.1E-6	0.0022	2.4	1.9	1.3	3.6	4.9	2.5	10758%	-49%
3H Urea Application	0	0	0	0	0	0.007	1.6	1.8	2.0	–	11%
3I Other Carbon-Containing Fertilisers	0.0	2.4	2.8	2.1	2.1	1.8	1.8	1.3	1.1	–	-14%
Total emissions	712	679	695	678	714	726	687	660	662	-7.1%	0.2%

Enteric Fermentation

The amount of enteric methane emitted by livestock is driven primarily by the number of animals, their digestive systems and the type and amount of feed consumed. Cattle and sheep are the largest sources of enteric CH₄ emissions in Iceland. Due to a decrease in sheep population, emissions from enteric fermentation and manure management of sheep have decreased by almost 40% since 1990. Cattle now surpass sheep as the livestock category with the highest emissions from enteric fermentation. The only non-ruminant livestock category with substantial CH₄ emissions is horses. The population size of horses has been relatively stable from 1990, and therefore, their CH₄ emissions are fairly constant.

Manure Management

The emissions from manure depend on several factors: animal type, feeding, manure management system, duration of storage, and climate conditions. The relevant greenhouse gases emitted from this source category are CH₄ and N₂O.

Organic material in manure is transformed to CH₄ in an anaerobic environment by microbiological processes. During storage and handling of manure, some nitrogen is converted into N₂O. Cattle and sheep are responsible for about three quarters of emissions from manure management. Other important livestock categories for emissions from manure management are swine, horses, and poultry.

N₂O emissions from manure management include indirect emissions from manure management as atmospheric deposition of nitrogen on soils and water surfaces, due to nitrogen volatilisation.

Agricultural Soils

The largest sources of emissions are cultivated and uncultivated drained organic soils, accounting for 50-70% of the total emissions from agricultural soils (CRT 3D).

N₂O is produced naturally in soils through the microbial processes of nitrification and denitrification. However, certain agricultural activities lead to N₂O emissions. In Iceland, the largest effect on N₂O emission is the drainage of organic soils, which stimulates the microbial activity in the soils, i.e. the nitrification and denitrification processes. Other activities include the application of inorganic and organic fertilisers, and the deposition of urine and dung by grazing animals, along with crop residues which are left on fields.

Emissions from agricultural soils have increased on average since 1990, mainly due to an increase in drainage of uncultivated organic soils between 1990 and 2005.

Liming, Urea Application and Other Carbon-Containing Fertilisers

Combined CO₂ emissions from liming (3G), urea application (3H) and other carbon containing fertilisers (3I) account for around 1% of the total greenhouse gas emissions from the agricultural sector.

Emissions from liming arise from the use of limestone, dolomite, and shell sand. It is assumed that all liming occurs on cropland and that the bulk occurs on organic soils, since liming is considered unnecessary for mineral soils which typically have high pH level. In recent years, there has been a rapid increase in the import of dolomite, which coincides with the significant calcification effort by Icelandic farmers. Farmers are encouraged to practice calcification as it improves the uptake of nutrients from fertilisers in soils significantly and, therefore, soils at the optimum pH level require less fertilisation.

2.2.4 Land Use, Land-use Change, and Forestry (LULUCF, CRT sector 4)

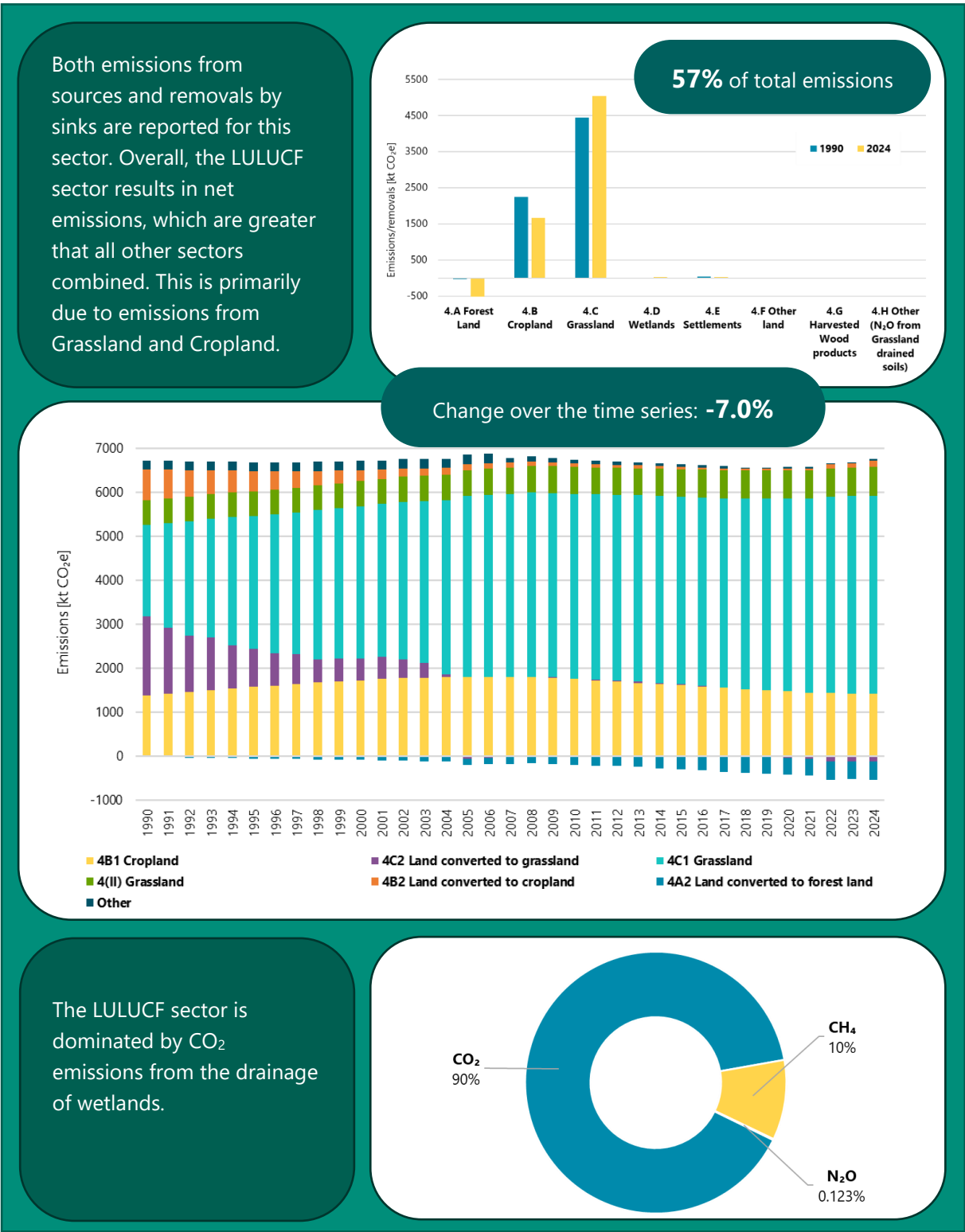


Figure 2.6 Overview of emissions and removals from the LULUCF sector, from top to bottom: (1) absolute emission and removals by subsector for the latest year, (2) emission and removals by subsector over the time series (4A-4F are due to changes in carbon stocks and 4(II) are due to soil management) and (3) absolute emissions and removals by gas for the latest year.

LULUCF net emissions have remained relatively stable across the time series, with net emissions in the year 2024 within 7.0% of the 1990 levels.

4A Forest land

Increased removals in Forest Land are primarily driven by two factors:

- Afforestation, which expands the area of land classified as Forest Land, and
- Age-related changes in forest growth, as maturing stands accumulate carbon more rapidly during their middle growth phases.

These combined dynamics lead to higher net CO₂ removals over time as young plantations enter periods of accelerated biomass increment.

4B Cropland

The decrease in net emissions from Cropland is primarily driven by a reduction in active cultivation of Cropland after 1990, decreasing the total land base generating emissions. The active Cropland area is relatively stable for the last years of the timeline (2021-2024), which are based on map data.

Within this category, cultivation of organic soils remains by far the dominant emission source. The overall downward trend in Cropland net emissions is a result of decreasing cropland area.

4C Grassland

There is an increase trend in net emission for Grassland, mainly driven by conversion of Cropland on organic soils to Grassland. This trend is somewhat counteracted by the improvement of degraded land on mineral soils under the subcategories 4C1 Grazing areas and 4C1 Grassland without grazing under Grassland remaining grassland.

4D Wetlands

The area of Wetlands rewetted soils has increased due to ongoing restoration efforts. These areas exhibit higher CO₂ removals as hydrology is restored, along with higher CH₄ emissions, which is a typical response of rewetted organic soils. As a result, the total CO₂e emissions from Wetland now show a slightly increasing trend over the most recent last years.

4E Settlements

The emissions trend from Settlements shows an increase from 1990 to 2009 of 33 kt CO₂e (126%). From 2009 to 2024, emissions from Settlements show a decreasing trend. This trend is primarily driven by the annual area of land converted to Settlements, which is now fully represented using geographically explicit data.

Table 2.8 Greenhouse gas emissions and removals from the LULUCF [kt CO₂e].

LULUCF Sector	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024
4A Forest Land	-31	-57	-94	-146	-312	-417	-514	-537	-534	1627%	-0.5%
4B Cropland	2245	2180	2119	2071	1962	1793	1617	1635	1666	-26%	1.9%
4C Grassland	4440	4459	4535	4647	4834	4922	4995	5023	5040	13.5%	0.350%
4D Wetlands	3	15	19	19	21	16	16	17	17	545%	0.001%
4E Settlements	31	42	49	58	51	43	40	25	27	-13%	6%
4F Other land	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	–	–
4G Harvested Wood products	NO	NO	0.0032	0.0031	-0.033	-0.038	-0.041	-0.22	-0.19	–	-11%
4 Total emissions	6686	6639	6627	6649	6556	6357	6154	6163	6216	-7.0%	0.9%

2.2.5 Waste (CRT sector 5)

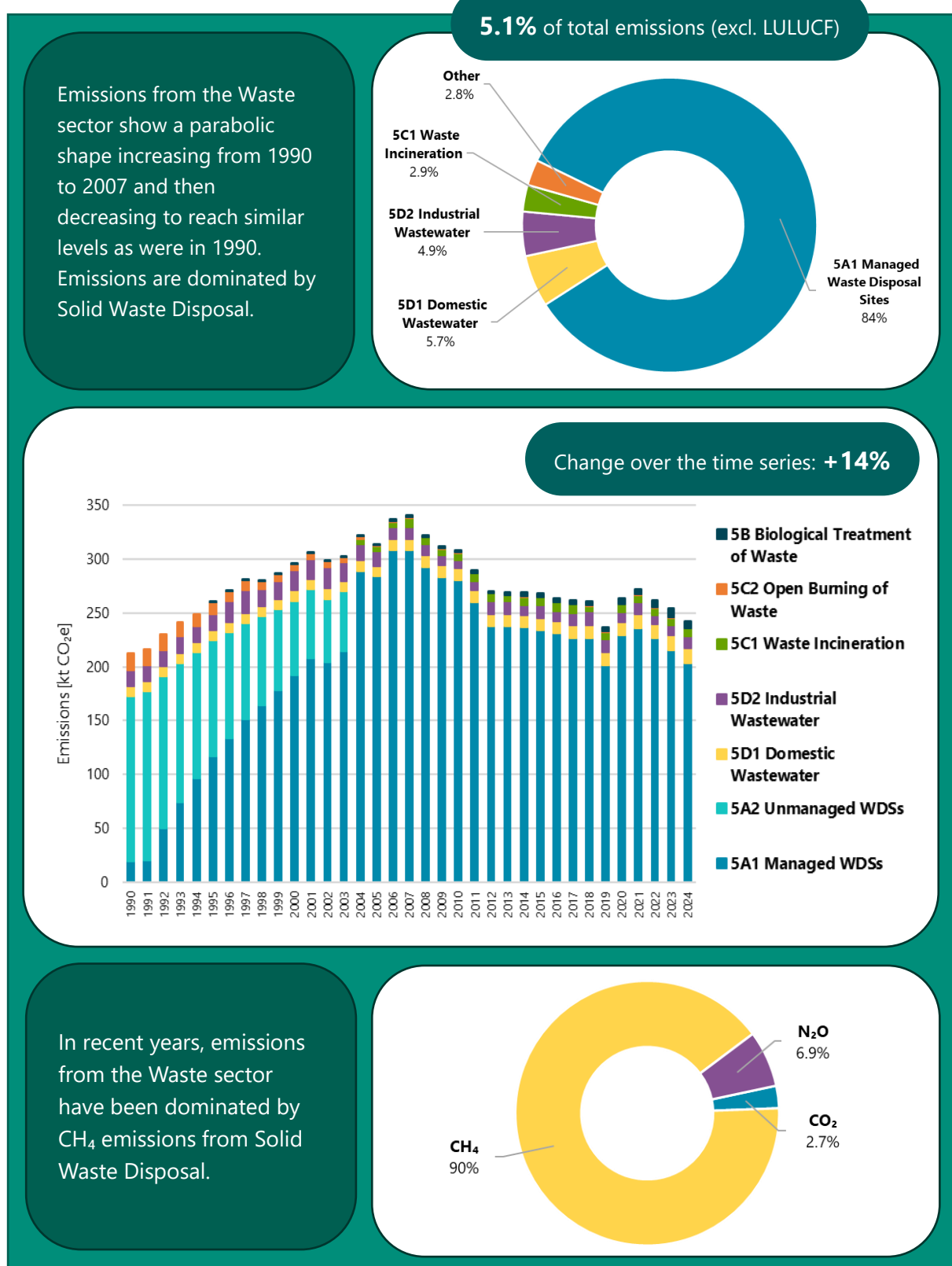


Figure 2.7 Overview of emissions from the Waste sector, from top to bottom: (1) emission by subsector for the latest year, (2) emission by subsector over the time series and (3) emissions by gas for the latest year.

The largest share of emissions from the Waste sector are CH₄ emissions from Solid Waste Disposal. The remaining emissions are from Wastewater Treatment and Discharge, Waste Incineration, and Biological Treatment of Waste, i.e. Composting and Anaerobic Digestion. The trend in Waste emissions is discussed below.

Solid Waste Disposal (SWD)

An increase in Solid Waste Disposal (SWD) emissions between 1990 and 2006 was caused by the accumulation of degradable organic carbon in recently established managed, anaerobic solid waste disposal sites (SWDS) which are characterised by higher CH₄ production potential than the unmanaged SWDS they succeeded. The decrease in emissions from the waste sector since 2006 is caused by a decrease in SWD emissions which is due to a rapidly decreasing share of waste landfilled since 2004 and by an increase in CH₄ recovery at SWDS.

Biological Treatment of Waste (Composting and Anaerobic Digestion)

Biological Treatment of Waste consists of Composting and Anaerobic Digestion. Emissions from Composting have been steadily increasing from 1995, when composting started. Emissions from Anaerobic Digestion started in 2020, when GAJA biogas and composting plant opened in the capital area. Improved collection of organic waste has led to a rapid increase of the emissions in recent years.

Incineration and Open Burning of Waste

The significant decrease in emissions from Incineration and Open Burning of Waste from 1990 is due to a decrease in the amount of waste incinerated and a change in waste incineration technology. During the early 1990s waste was either burned in open pits or in waste incinerators at low or varying temperatures. Since the mid-1990s, increasing amounts of waste are incinerated in proper waste incinerators that control combustion temperatures which lead to lower emissions per waste amount incinerated. From 2011, only one incineration plant has been in operation in Iceland.

Wastewater Treatment and Discharge

Wastewater Treatment and Discharge emissions have been relatively stable since 1990. Emissions from Domestic Wastewater have increased due to an increase in population. Industrial Wastewater emissions are based on the amount of fish processed in Iceland, and there are some annual fluctuations which cause changes in emissions.

Table 2.9 Greenhouse gas emissions from the Waste sector [kt CO₂e].

Waste Sector	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024
5A Solid Waste Disposal	173	225	261	284	280	234	230	216	203	18%	-5.8%
5B Biological Treatment of Solid Waste	NO	0.35	0.35	0.88	2.7	3.7	5.6	8.3	6.5	–	-22%

Waste Sector	1990	1995	2000	2005	2010	2015	2020	2023	2024	Changes 1990- 2024	Changes 2023- 2024
5C Incineration and Open Burning of Waste	16	11	6.3	5.6	6.7	7.6	6.8	6.8	7.5	-52%	9.8%
5D Wastewater Treatment and Discharge	24	24	28	24	19	24	21	23	26	6.5%	9.6%
5 Total emissions	212	260	296	314	309	269	263	254	243	14%	-4.5%

2.2.6 Carbon Dioxide (CO₂)

Carbon dioxide (CO₂) is by far the main contributor to greenhouse gas emissions in Iceland. The largest share of carbon dioxide emissions originates from the LULUCF sector, predominantly from Grassland. The historical trend in carbon dioxide emissions is dominated by an increase in emissions within IPPU, primarily from metal production. Figure 2.8 shows the carbon dioxide emissions by sectors.

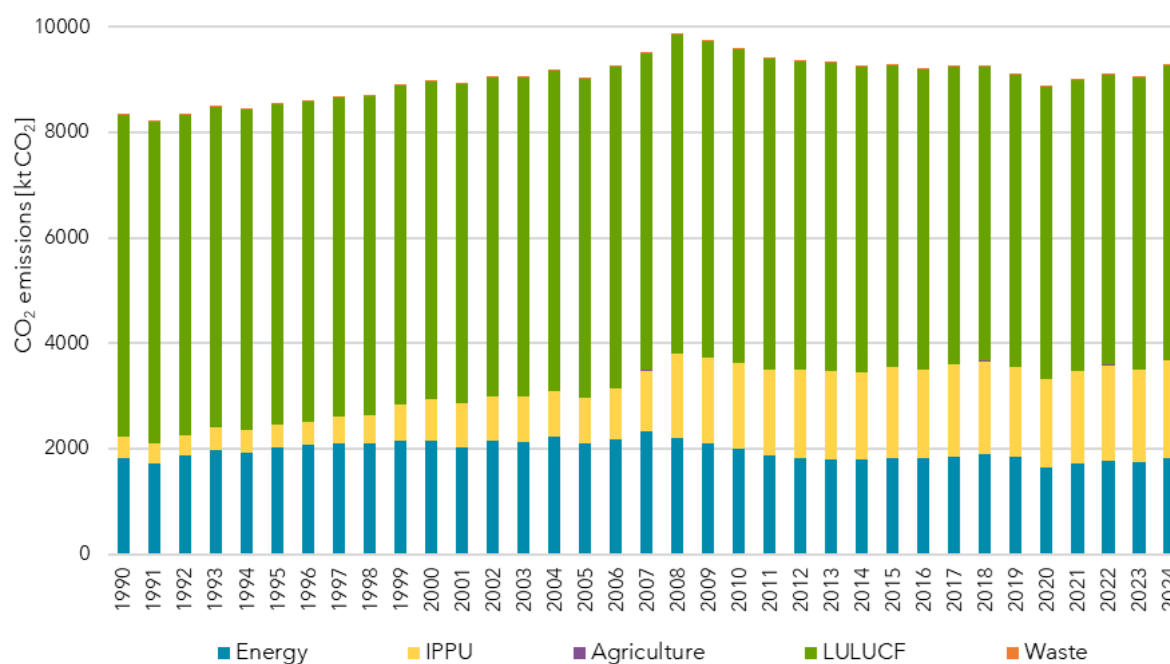


Figure 2.8 Carbon dioxide (CO₂) emissions in Iceland, divided by sectors.

2.2.7 Methane (CH₄)

Methane (CH₄) is the second largest contributor to greenhouse gas emissions in Iceland. The largest share of methane emissions originates from the LULUCF sector, predominantly from Grassland. The methane emissions have been relatively stable with slight increase in the LULUCF sector and decrease in agriculture due to reduction in livestock numbers. Figure 2.9 shows the methane emissions by sectors.

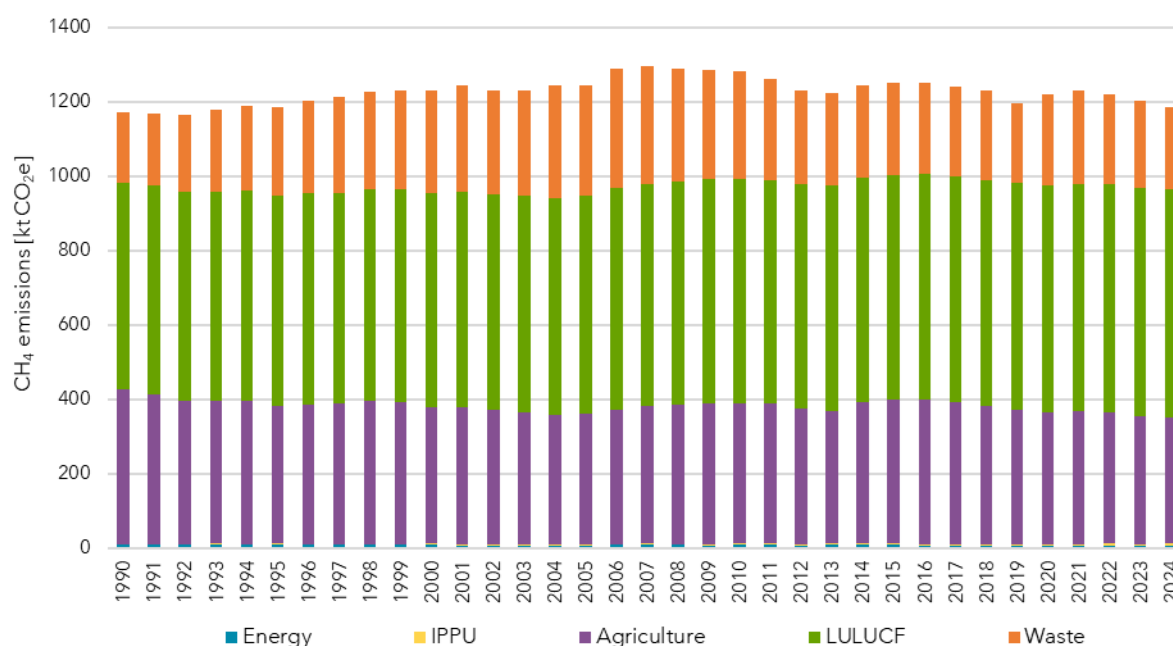


Figure 2.9 Methane (CH₄) emissions in Iceland, divided by sectors.

2.2.8 Nitrous Oxide (N₂O)

Nitrous oxide (N₂O) is the third contributor to greenhouse gas emissions in Iceland. Most nitrous oxide emissions are from the Agriculture sector, predominantly from Agricultural Soils. The trend in nitrous oxide emissions is dominated by decrease in emissions within IPPU after a fertiliser production plant stopped production in 2001, and a decrease in emissions within Energy mostly due to decrease in diesel oil in fishing and agriculture machinery. Figure 2.10 shows the nitrous oxide emissions by sectors.

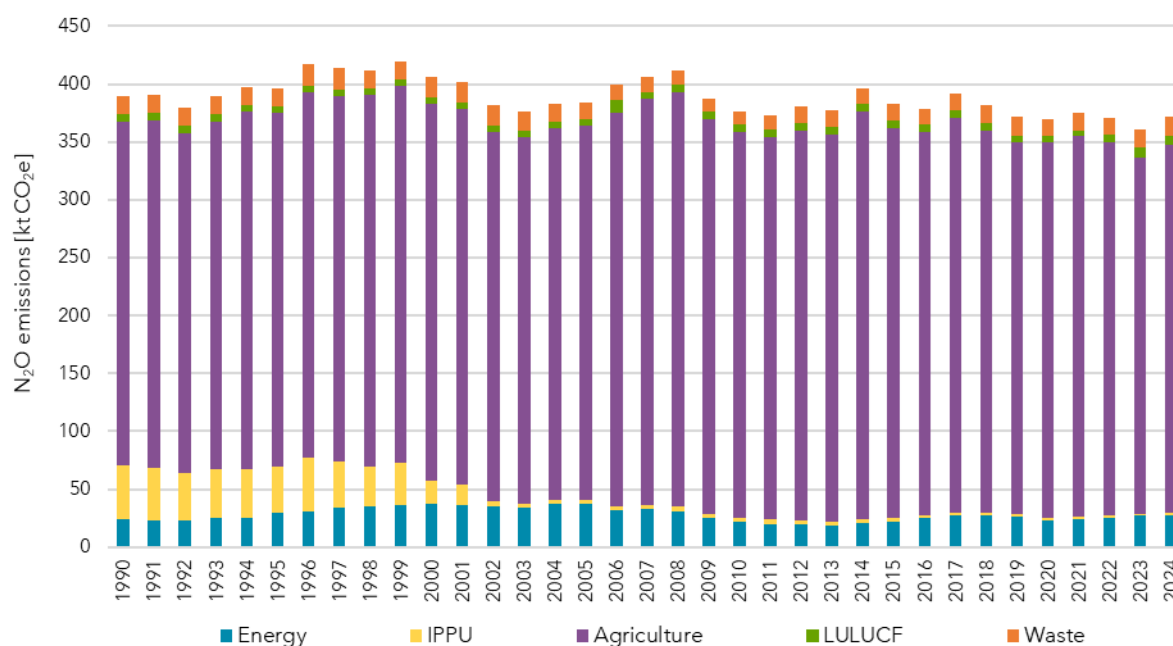


Figure 2.10 Nitrous oxide (N₂O) emissions in Iceland, divided by sectors.

2.2.9 Hydrofluorocarbons (HFCs)

Hydrofluorocarbons (HFCs) contribute a minor amount to greenhouse gas emissions in Iceland. All HFC emissions are from the IPPU sector, predominantly from refrigeration. The trend in HFC emissions is dominated by increase in emissions from refrigeration due to an increase in substitutes for ozone depleting substances. There has however been a decrease in recent years. Figure 2.11 shows the HFCs emissions by sectors.

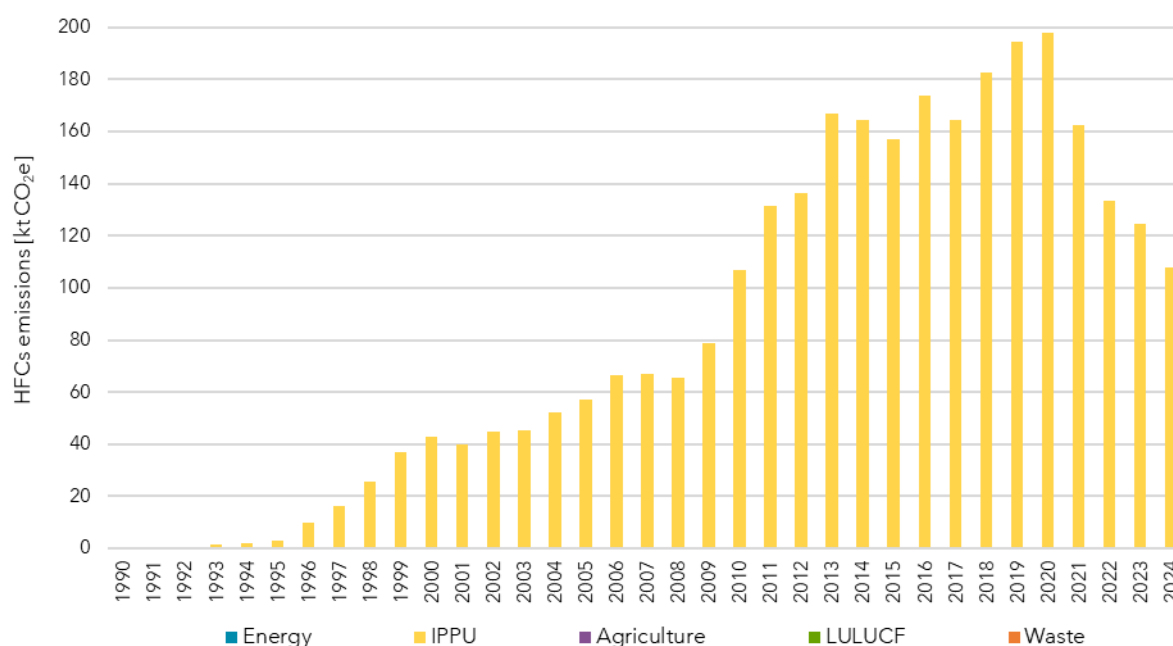


Figure 2.11 Hydrofluorocarbons (HFCs) emissions in Iceland, divided by sectors.

2.2.10 Perfluorocarbons (PFCs)

Perfluorocarbons (PFCs) cause an insignificant amount of greenhouse gas emissions in Iceland. All PFC emissions are from the IPPU sector, predominantly from aluminium production. The trend in PFC emissions is dominated by changes in the aluminium production. Aluminium production using the Hall-Héroult electrolytic process produces PFC emissions when the alumina ore content of the electrolytic bath falls below a critical level required for electrolysis. This is called the Anode effect, where carbon from the anode combines with fluorine from the dissociated molten cryolite bath, producing CF_4 and C_2F_6 . Figure 2.12 shows the PFCs emissions by sectors.

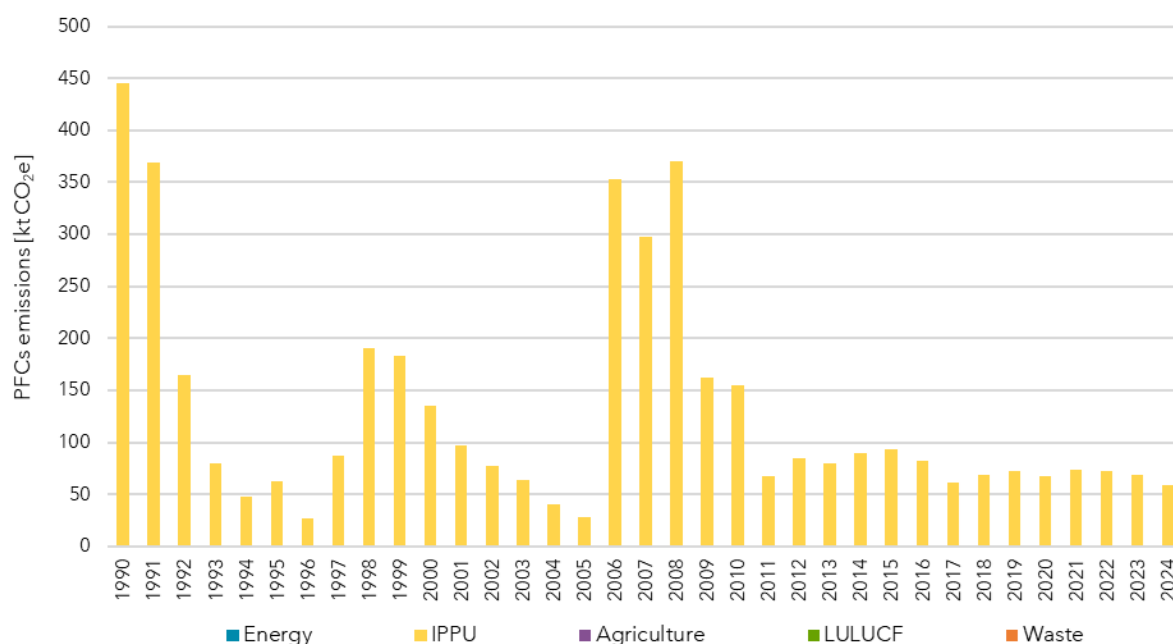


Figure 2.12 Perfluorocarbons (PFCs) emissions in Iceland, divided by sectors.

2.2.11 Sulphur Hexafluoride (SF₆)

Sulphur hexafluoride (SF₆) causes an insignificant amount of greenhouse gas emissions in Iceland. All SF₆ emissions are from the IPPU sector, predominantly from Electrical Equipment. The trend in SF₆ emissions is dominated by leakages in electrical equipment. Figure 2.13 shows the SF₆ dioxide emissions by sectors.

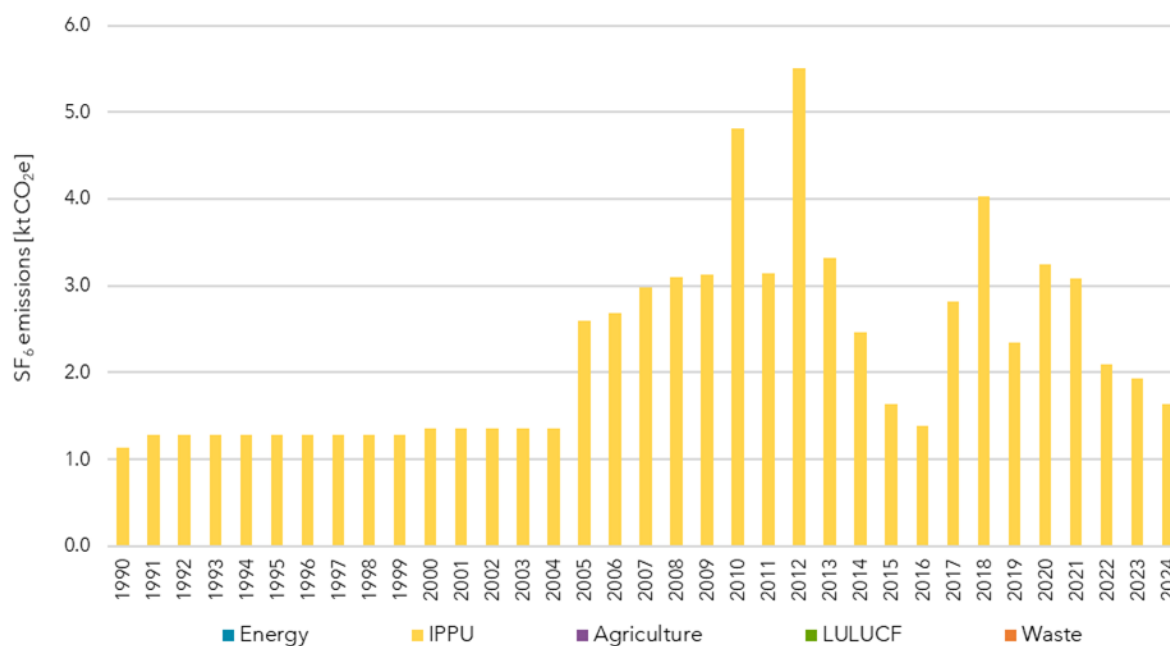


Figure 2.13 Sulphur hexafluoride (SF₆) emissions in Iceland, divided by sectors.

2.2.12 Nitrogen Trifluoride (NF₃)

There are no nitrogen trifluoride (NF₃) emissions in Iceland.

2.3 Emission Trends for Ozone Precursors and Indirect Greenhouse Gases

Nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and carbon monoxide (CO) in the atmosphere can lead to the formation of the greenhouse gas Ozone (O₃). Sulphur dioxide (SO₂) and Ammonia (NH₃) affect climate by increasing the level of aerosols that have in turn a cooling effect on the atmosphere. Data presented here, and submitted to the UNFCCC, is in accordance with guidelines for reporting air pollutants under the CLRTAP²⁴. The emissions presented in this section are from the energy, IPPU, agriculture

²⁴ Convention on Long-Range Transboundary Air Pollution, find out more at: <https://www.ceip.at/>

and waste sectors as no indirect emissions from the LULUCF sector have been compiled to date.

2.3.1 Nitrogen Oxides (NO_x)

The main source of NO_x in Iceland is the Energy sector, as can be seen in Figure 2.14. The main contributors to this sector are commercial fishing and transport, followed by manufacturing industries and construction. In industrial processes, the main NO_x source is ferroalloys production.

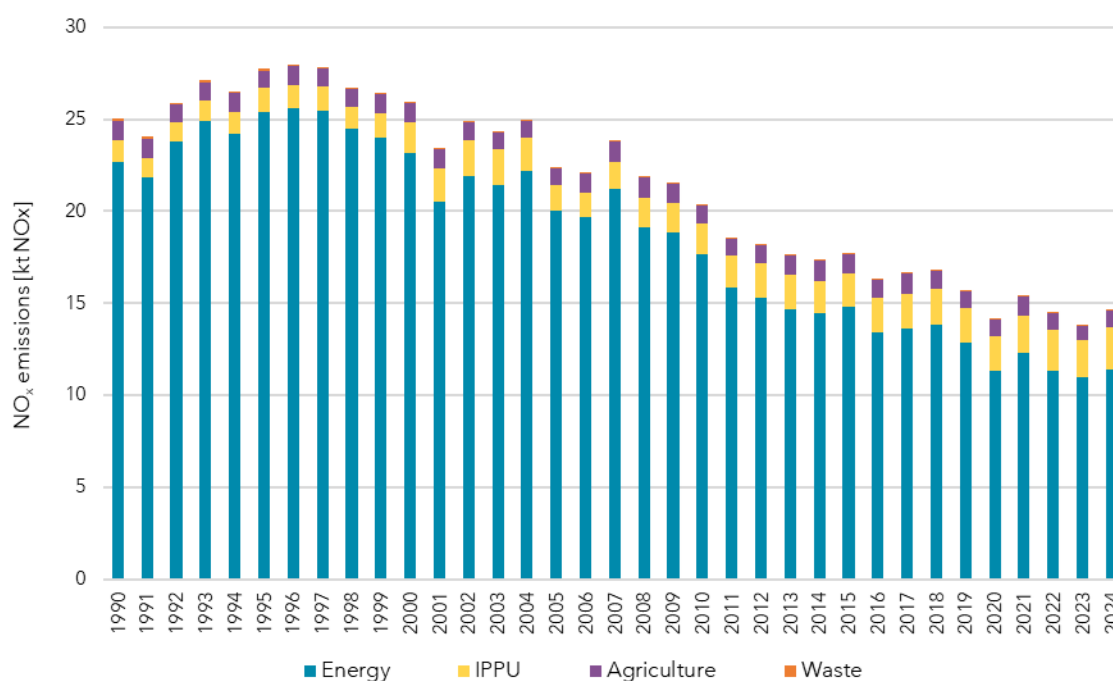


Figure 2.14 Emissions of NO_x by sector for the reported time series [kt].

2.3.2 Non-Methane Volatile Organic Compounds (NMVOC)

The main sources of NMVOCs are the Industrial processes, followed by Agriculture and the Energy sector, as can be seen in Figure 2.15. In the energy sector, NMVOC emissions are dominated by road transport. These emissions decreased rapidly after the use of catalytic converters in all new vehicles became obligatory in 1995. In Industrial processes, NMVOC are mostly emitted in various solvent uses, as well as in food and beverage production. In the Agriculture sector, manure management is the greatest source of NMVOC. The total emissions have been showing a general downward trend since 1990.

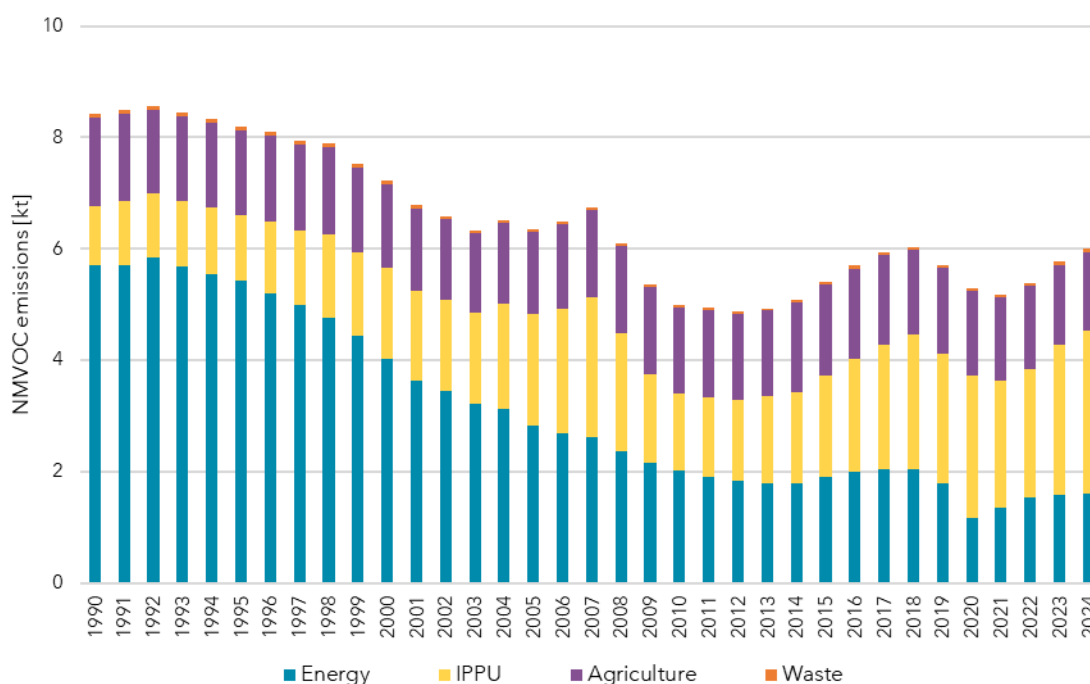


Figure 2.15 Emissions of NMVOC by sector for the reported time series [kt].

2.3.3 Carbon Monoxide (CO)

Industrial Processes are the most prominent contributors to CO emissions in Iceland, as can be seen in Figure 2.16. Within industrial processes, almost all the CO emissions are due to primary Aluminium production. It is worth mentioning that emissions from road transport have decreased rapidly after the use of catalytic converters in all new vehicles became obligatory in 1995. Total CO emissions have almost doubled since 1990.

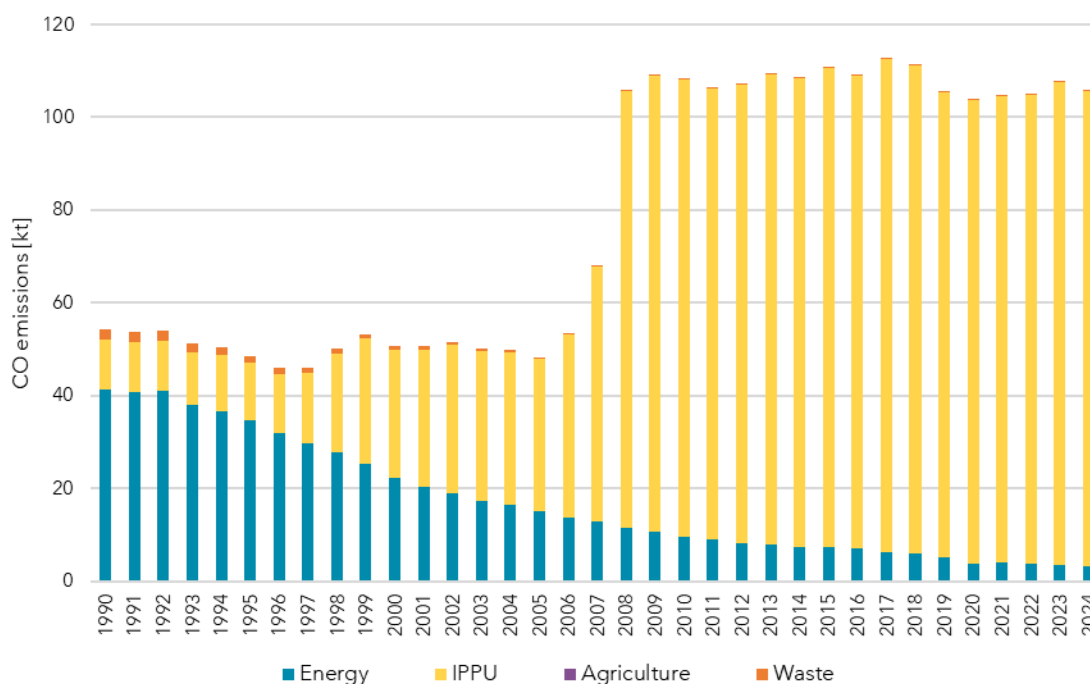


Figure 2.16 Emissions of CO by sector for the reported time series [kt].

2.3.4 Sulphur Dioxide (SO₂)

Geothermal energy exploitation is by far the largest source of SO₂ emissions in Iceland. Sulphur emitted from geothermal power plants is in the form of hydrogen sulphide and is reported here in kt SO₂-equivalents. Emissions have doubled since 1990 due to an increase in electricity production at geothermal power plants. Other significant sources of SO₂ in Iceland are industrial processes, as can be seen in Figure 2.17.

Emissions from industrial processes are dominated by metal production. Until 1996 industrial process sulphur dioxide emissions were relatively stable. Since then, the metal industry has expanded, leading to an increase in SO₂ emissions. The fishmeal industry is the main contributor to SO₂ emissions from fuel combustion in the sector Manufacturing Industries and Construction. Emissions from the fishmeal industry increased from 1990 to 1997 but have declined since as fuel has been replaced with electricity and production has decreased.

SO₂ from the fishing fleet depend upon the use of residual fuel oil. When fuel prices rise, the use of residual fuel oil rises and the use of gas oil drops. This leads to higher sulphur emissions as the sulphur content of residual fuel oil is significantly higher than in gas oil. The rising fuel prices since 2008 have led to higher SO₂ emissions from the commercial fishing fleet in recent years. As a result of this, emissions have decreased at a lower rate compared to fuel consumption.

Across the time series, annual SO₂ emissions in Iceland have more than doubled.

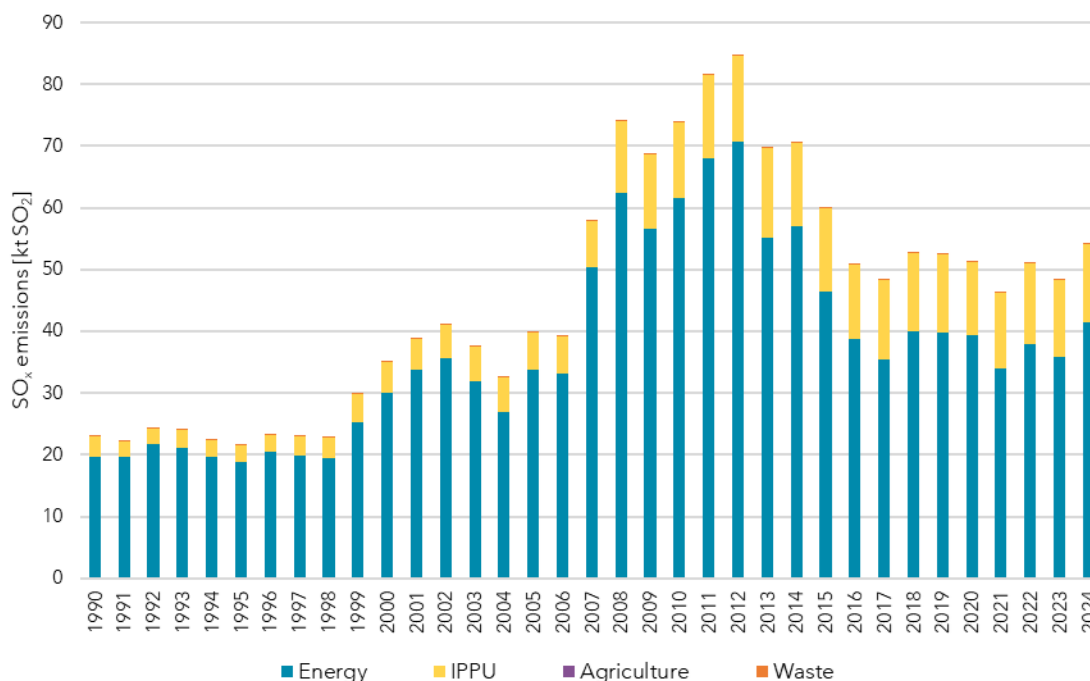


Figure 2.17 Emissions of SO₂ by sector for the reported time series [kt SO₂].

2.3.5 Ammonia (NH₃)

The main source of NH₃ is the Agriculture sector. Most emissions come from manure - manure management, animal manure applied to soils, and manure deposition of grazing animals on pastures. Emissions have been fluctuating around 5 kt NH₃ since 1990, see Figure 2.18. The trend in NH₃ emissions is relatively steady which is driven by relatively little overall variability in livestock numbers.

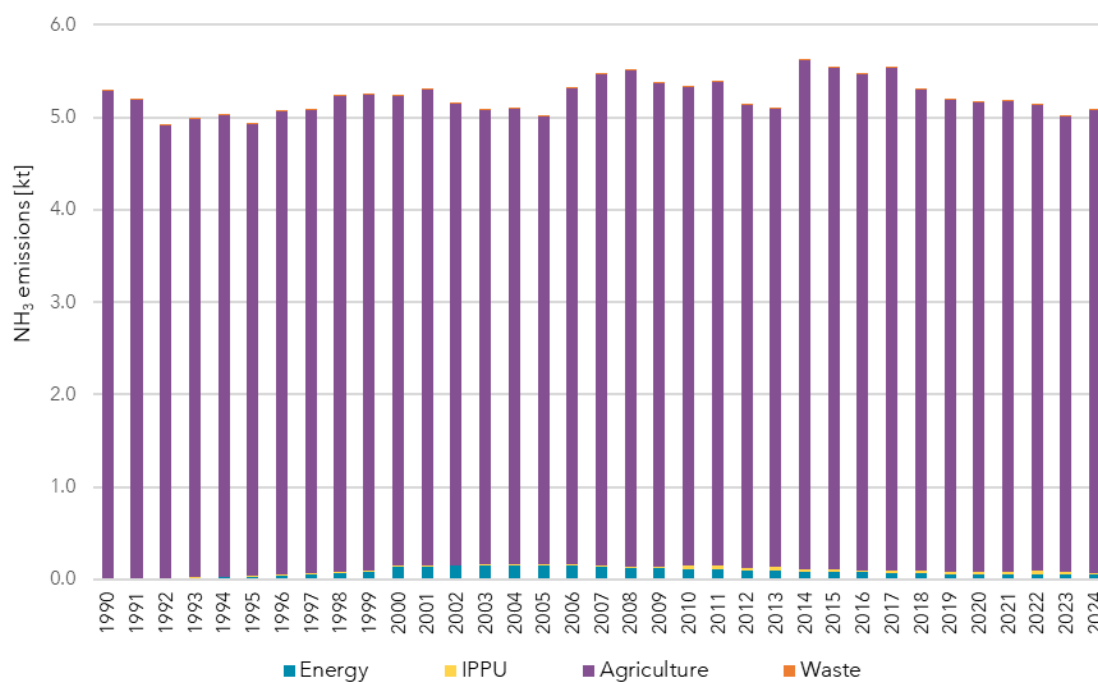


Figure 2.18 Emissions of NH₃ by sector for the reported time series [kt].

3 Energy (CRT sector 1)

3.1 Overview

The Energy sector contains all emissions from fuel combustion, energy production, and distribution of fuels.

The Energy sector is reported under five main chapters:

- Stationary Combustion (CRT 1A1, 1A2, 1A4 and 1A5)
- Transport and Other Mobile Sources (CRT 1A2, 1A3, and 1A4)
- Fugitive Emissions Including Geothermal Energy Production (CRT 1B)
- CO₂ Transport and Storage (CRT 1C)
- Reference Approach, Feedstocks, and Non-energy Use of Fuels (CRT 1AB, 1AC, and 1AD)

3.1.1 Methodology

Emissions from fuel combustion activities are estimated at the sector level based on methodologies suggested by the 2006 IPCC Guidelines. They are calculated by multiplying energy use by source and sector with pollutant-specific emission factors. In all calculations, the oxidation factor was set to the default value of 1. Emissions from Road Transport are estimated using COPERT 5.9.2. which uses a Tier 3 methodology to estimate N₂O and CH₄ emissions, and a Tier 2 methodology to estimate CO₂ emissions. A more detailed description can be found in Chapter 3.3.3 Road Transport (CRT 1A3b). Information of tier methodology for each subsector can be seen in Table 3.1.

Table 3.1. Methodological information for all estimated subsectors in Energy.

Sources	Methodology		
	CO ₂	CH ₄	N ₂ O
1A Fuel Combustion Activities			
1. Energy Industries			
a. Public Electricity and Heat Production	T2, T1	T1	T1
2. Manufacturing Industries and Construction			
a. Iron and Steel	T2, T1	T1	T1
b. Non-Ferrous Metals	T2, T1	T1	T1
c. Chemicals	T1	T1	T1
e. Food Processing, Beverages, and Tobacco	T2, T1	T1	T1
f. Non-Metallic Minerals	T2, T1	T1	T1
g. Transport Equipment	T2	T1	T1
3. Transport			
a. Domestic Aviation	T1	T1	T1

Sources	Methodology		
b.i. Cars	T2	T3	T3
b.ii. Light-duty Trucks	T2	T3	T3
b.iii. Heavy-duty Trucks and Buses	T2	T3	T3
b.iv. Motorcycles	T2	T3	T3
d. Water-borne Navigation	T2, T1	T1	T1
e. Other Transportation	T2, T1	T1	T1
4. Other Sectors			
a. Commercial/Institutional	T2, T1	T1	T1
b. Residential	T2, T1	T1	T1
ci. Agriculture/Forestry/Fishing - Stationary	T1	T1	T1
cii. Agriculture/Forestry/Fishing - Off-road vehicles	T2	T1	T1
ci. Agriculture/Forestry/Fishing - Fishing	T2, T1	T1	T1
5. Non-specified Elsewhere			
a. Stationary	T2, T1	T1	T1
1B Fugitive Emissions			
2. Oil and Natural Gas and Other Emissions from Energy Production			
a5. Oil – Distribution of Oil Products	T1	T1	NA
b5. Natural gas	NA	T1	NA
d. Other – Geothermal Energy	T2	T2	NA
1D Memo Items			
1. International Bunkers			
a. International Aviation	T1	T1	T1
b. International Navigation	T2, T1	T1	T1
3. CO ₂ Emissions from Biomass	T1	T1	T1

3.1.2 Key Category Analysis

The key sources for the first and latest inventory years and the timeline trend in the Energy sector are shown in Table 3.2 (compared to total emissions without LULUCF) and Table 3.3 (compared to total emissions with LULUCF).

Table 3.2. Key categories (excluding LULUCF) for the Energy sector.

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
1A2	Fuel combustion - Manufacturing Industries and Construction	CO ₂	✓	✓	✓
1A3a	Domestic Aviation	CO ₂	✓		
1A3b	Road Transportation	CO ₂	✓	✓	✓
1A3d	Domestic Navigation	CO ₂	✓		✓
1A4b	Residential Combustion	CO ₂	✓		✓
1A4c	Agriculture/Forestry/Fishing	CO ₂	✓	✓	✓

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
1B2d	Fugitive Emissions from Fuels - Other (Geothermal)	CO ₂	✓	✓	✓

Table 3.3. Key categories (including LULUCF) for the Energy sector

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
1A2	Fuel combustion - Manufacturing Industries and Construction	CO ₂	✓	✓	✓
1A3b	Road Transportation	CO ₂	✓	✓	✓
1A4c	Agriculture/Forestry/Fishing	CO ₂	✓	✓	✓
1B2d	Fugitive Emissions from Fuels - Other (Geothermal)	CO ₂	✓	✓	✓

3.1.3 Completeness

Table 3.4 gives an overview of the IPCC source categories included in this chapter and presents the status of emission estimates from all sub-sources in the Energy sector.

Table 3.4. Energy - Completeness (E: estimated, NA: not applicable, NE: not estimated, NO: not occurring)

Sources	CO ₂	CH ₄	N ₂ O	Notes
1A Fuel Combustion Activities				
1. Energy Industries				
a. Public Electricity and Heat Production	E	E	E	
b. Petroleum Refining	NO	NO	NO	
c. Manufacture of Solid Fuels and Other Energy Industries	NO	NO	NO	
2. Manufacturing Industries and Construction				
a. Iron and Steel	E	E	E	
b. Non-Ferrous Metals	E	E	E	
c. Chemicals	E	E	E	NO since 2005
d. Pulp, Paper, and Print	NO	NO	NO	
e. Food Processing, Beverages, and Tobacco	E	E	E	
f. Non-Metallic Minerals	E	E	E	
g. Transport Equipment	E	E	E	
3. Transport				
a. Domestic Aviation	E	E	E	
b.i. Cars	E	E	E	
b.ii. Light Duty Trucks	E	E	E	
b.iii. Heavy Duty Trucks and Buses	E	E	E	
b.iv. Motorcycles	E	E	E	
b.v. Other	NO	NO	NO	
c. Railways	NO	NO	NO	

Sources	CO ₂	CH ₄	N ₂ O	Notes
d. Water-borne Navigation	E	E	E	
e. Other Transportation	E	E	E	
4. Other Sectors				
a. Commercial/Institutional	E	E	E	
b. Residential	E	E	E	
ci. Agriculture/Forestry/Fishing - Stationary	E	E	E	
cii. Agriculture/Forestry/Fishing - Off-road vehicles	E	E	E	
ci. Agriculture/Forestry/Fishing - Fishing	E	E	E	
5. Non-specified Elsewhere				
a. Stationary	E	E	E	
b. Mobile	NO	NO	NO	
1B Fugitive Emissions				
1. Solid Fuels				
a. Coal Mining and Handling	NO	NO	NO	
b. Solid Fuels Transformation	NO	NO	NO	
c. Other	NO	NO	NO	
2. Oil and Natural Gas and Other Emissions from Energy Production				
a. Oil – Distribution of Oil Products	E	E	NA	All other subsectors of 1B2a are NO
b. Natural Gas	NA	E	NA	
c. Venting and Flaring	NO	NO	NO	
d. Other – Geothermal Energy	E	E	NO	
1C CO₂ Transport and Storage				
1. Transport of CO ₂	NO	NO	NO	
2. Injections and Storage	NE	NE	NE	
3. Other	NO	NO	NO	
1D Memo Items				
1. International Bunkers				
a. International Aviation	E	E	E	
b. International Navigation	E	E	E	
2. Multilateral Operations	NE	NE	NE	
3. CO ₂ Emissions from Biomass	E	E	E	
4. CO ₂ Captured	E	E	E	

3.1.4 Source-specific QA/QC Procedures

General QA/QC activities performed for the Energy sector are listed in Chapter 1.5. Further sector-specific activities include:

- Identification and documentation discrepancies between the Sectoral Approach and the Reference Approach.
- Cross-checks of fuel sales data with total input data in calculations files to ensure that all fuels are accounted for.
- Regular meetings are held in order to address discrepancies between energy statistics and data used in the inventory. Activity data for the whole time series is checked and the attribution to IPCC subsectors is discussed.

3.1.5 Activity Data

Activity data is fuel sales data by sector obtained from the oil companies as well as emission data provided by the geothermal power plants. For the 2020 submission, a comprehensive review was performed on how the fuel sales data is attributed to IPCC sectors. For that submission, the review only included 2003-2018, because the methodology used by the NEA to collect the data changed between 2002 and 2003. In the 2021 Submission, the same attribution of fuels to IPCC categories for 1990-2002 was performed with a review of the sales statistics. Consequently, the whole time series has been reviewed and methodologies harmonised from 1990 and onwards.

The aim of the review of the fuel sales data from the NEA was to improve the transparency of the adjustments from the sales statistics to the IPCC categories. The following adjustments were required for specific IPCC categories:

- 1A1 Energy Industries – Sales statistics are used directly, and no adjustments are needed.
- 1A2 Manufacturing Industries – Adjustments are needed to transform sales statistics into IPCC categories (detailed description below).
- 1A4a and 1A4b Commercial/Residential Combustion – Sales statistics are used directly, and no adjustments are needed.
- 1A5 Other – All fuels that are categorised as Other in sales statistics without any explanation of use are attributed to this category.

Due to insufficiently detailed splits in the sales statistics between fuel used for different manufacturing industries that belong to IPCC category 1A2, some adjustments are needed to try to have this input data as accurate as possible:

- It is assumed that Environmental information reports (in accordance with Regulation No 990/2008, previously Green Accounting reports pursuant to Regulation No 851/2002 which has been repealed) and EU ETS Annual Emission Reports from 2013 are correct for each company. That data is used for 1A2a, 1A2b, 1A2c, and 1A2f; this is the known usage.
- Because these fuels are purchased from domestic oil companies, they will be subtracted from the sales statistics.

- The difference between known usage and sales statistics is attributed to the category 1A2gviii Other Industry.

These adjustments are described in Figure 3.1. For some fuel types and years, the subtraction of known use from sales statistics results in a negative number indicating that usage was more than what was sold. It is considered more likely that some data is missing from sales statistics and therefore these values will be input as zero. This will cause more fuel used than what is in the sales statistics, and a possible overestimate of emissions. This is, however, a very low amount compared to the total energy emissions.

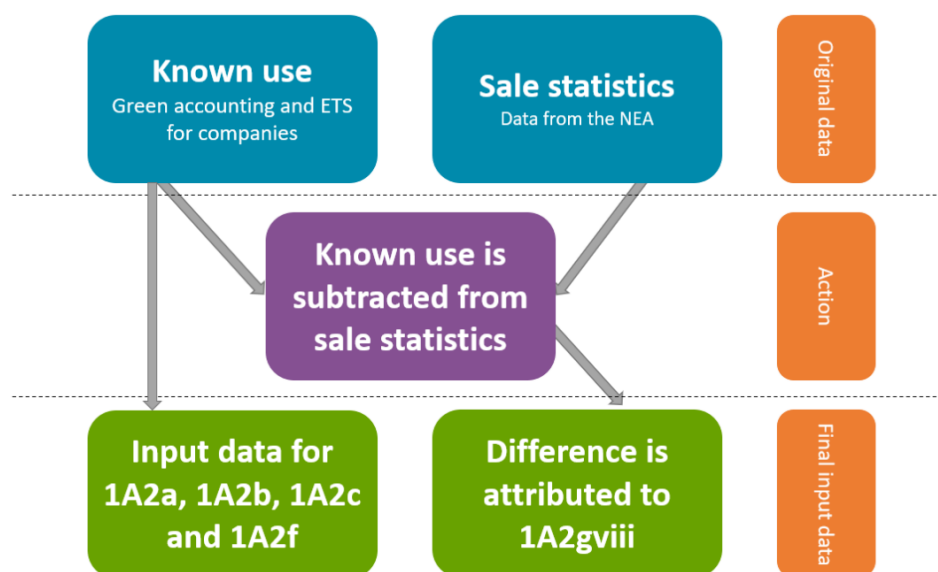


Figure 3.1. Description of adjustments in input data for IPCC category 1A2.

In the sales statistics, there are unspecified categories for all fuels, labelled as "Other." These fuels are accounted for in CRT category 1A5. Efforts have been made to minimize the amount of fuel that is categorized as "other" by contacting the companies in case a substantial amount of fuel is affected and making sure that it should not be attributed to another category.

3.1.6 Emissions Factors

For most categories in the Energy sector, default emission factors from the 2006 IPCC guidelines are used for emission calculations, except for gas/diesel oil where country-specific emission factors are available. The emission factors for stationary combustion are summarised in Table 3.5. Emission factors for mobile combustion are subsector-specific and are shown in the respective chapters.

Table 3.5. Emission factors used for calculations emissions from Stationary Combustion. The values are for the latest submission year.

Fuel / Factor	Value	Unit	Reference
Gas/Diesel Oil			
NCV	42.9	TJ/kt	Country specific from 2016, based on measurements
C-content	20.09	t/TJ	Country specific from 2016, based on measurements
CH ₄ emission factor	3.0	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	0.60	kg/TJ	Table 2.2, 2.3 and 2.4 2006 IPCC Guidelines, V2, Ch2
Residual Fuel Oil			
NCV	40.4	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	21.1	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	3.0	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	0.60	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2
Biomethane			
NCV	50.4	TJ/kt	Country specific from 2017, based on measurements
C-content	14.9	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	1.0	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	0.10	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2
Biodiesel			
NCV	27.0	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	19.3	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	3.0	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	0.60	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2
Waste			
NCV (biomass)	11.6	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
NCV (non-biomass)	10.0	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	–	–	Annual fluctuations between years based on composition of waste
CH ₄ emission factor	237.0	kg/kt MSW waste wet weight	Table 5.3 p.5.20 2006 IPCC Guidelines, V5, Ch5
N ₂ O emission factor	60.0	g/t MSW waste	Table 5.6 p.5.22 2006 IPCC Guidelines, V5, Ch5
LPG			
NCV	47.3	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	17.2	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	1.0	kg/TJ	Table 2.3 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	0.10	kg/TJ	Table 2.3 2006 IPCC Guidelines, V2, Ch2
Waste Oil			
NCV	40.2	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	20.0	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	30.0	kg/TJ	Table 2.3 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	4.0	kg/TJ	Table 2.3 2006 IPCC Guidelines, V2, Ch2

Fuel / Factor	Value	Unit	Reference
Petroleum Coke			
NCV	32.5	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	26.6	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	3.0	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	0.60	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2
Other Bituminous Coal			
NCV	25.8	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	25.8	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	10.0	kg/TJ	Table 2.3 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	1.5	kg/TJ	Table 2.3 2006 IPCC Guidelines, V2, Ch2
Charcoal			
NCV	29.5	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	112	t/TJ	Table 2.5 2006 IPCC Guidelines, V2, Ch2
CH ₄ emission factor	200	kg/TJ	Table 2.5 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	1.0	kg/TJ	Table 2.5 2006 IPCC Guidelines, V2, Ch2

3.2 Stationary Combustion (CRT 1A1, 1A2, 1A4, and 1A5)

3.2.1 Energy Industries (CRT 1A1ai and 1A1aiii)

Iceland has used renewable energy sources extensively for electricity and heat production for decades, and the emissions from energy industries are therefore lower than those of most other countries, which utilise a higher share of fossil fuels. It should be noted that in recent years less than 0.05% of the electricity in Iceland is produced with fuel combustion and about 90% of the energy used for house heating has geothermal origin.

1A1ai: Electricity Generation

Electricity is produced from hydropower, geothermal energy, fuel combustion, and wind power in Iceland (Table 3.6), with hydropower as the main source of electricity. Electricity was produced with fuel combustion at two localities that are located far from the distribution network (two islands, Grímsey and Flatey). Some public electricity facilities have emergency backup fuel combustion power plants which they can use when problems occur in the distribution system. Those plants are, however, seldom used, apart from testing and during maintenance. In 2013, the first wind turbines were connected and used for public electricity production.

Table 3.6. Electricity production in Iceland [GWh].

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Hydropower	4,159	4,677	6,350	7,015	12,592	13,781	13,157	14,226	13,604
Geothermal	283	290	1,323	1,658	4,465	5,003	5,961	6,006	5,986
Fuel Combustion	4.56	8.43	4.45	7.83	1.69	3.90	3.07	4.20	3.29
Wind Power	—	—	—	—	—	10.9	6.66	7.23	12.7
Total	4,446	4,976	7,678	8,681	17,059	18,799	19,127	20,244	19,606

Emissions from hydropower reservoirs are included in the LULUCF sector and emissions from geothermal power plants are reported in sector 1B2d.

1A1aiii: Heat Plants

Geothermal energy is the main source of heat production in Iceland. Some district heating facilities, which lack access to geothermal energy sources, use electric boilers to produce heat from electricity. They depend on curtailable energy. These heat plants have back-up fuel combustion systems in case of electricity shortages or problems in the distribution system. Three district heating stations burned waste to produce heat and were connected to the local distribution system. They stopped production in 2012. Emissions from these waste incineration plants are reported here.

3.2.1.1 Activity Data

1A1ai: Electricity Generation

Activity data for whole times series is numbers for fuel sold for electricity production. In the past decade, 0.01-0.02% of the annual electricity production in Iceland was via fuel combustion. Activity data for fuel combustion is given in Table 3.7. In 2007, an unusually high amount of residual fuel oil (4.5 kt) was combusted. During 2002-2009, biomethane was used for electricity production and 2017-2018 biodiesel was used. These fuels are both reported as biomass in CRT.

Table 3.7. Fuel use [kt] from Electricity Production.

	1990	1995	2000	2005	2007	2010	2015	2020	2023	2024
Gas/Diesel Oil	1.30	1.09	1.07	0.0210	1.11	1.01	1.19	0.821	2.02	4.87
Residual Fuel Oil	NO	NO	0.03	NO	4.50	NO	NO	NO	NO	NO
Biomethane	NO	NO	NO	0.919	0.0399	NO	NO	NO	NO	NO
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

1A1aiii: Heat Plants

Activity data for heat production with fuel combustion and waste incineration are given in Table 3.8. According to Annex II in the waste framework Directive 2008/98/EC incineration

facilities dedicated to the processing of municipal solid waste need to have their energy efficiency equal or above 60%-65% in order to qualify as recovery operations. Since 2013, there has been only one incineration facility in Iceland, Kalka, and it does not qualify as a recovery operation. After 2013, no solid waste was used for the production of heat.

Table 3.8. Fuel use [kt] from Heat Production.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Gas/Diesel Oil	NO	NO	NO	NO	NO	NO	NO	1.435	NO
Residual Fuel Oil	2.99	3.08	0.122	0.195	NO	0.137	NO	NO	NO
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO
Waste: fossil	NO	1.49	1.94	1.91	3.42	NO	NO	NO	NO
Waste: biogenic	NO	3.16	4.11	4.04	4.69	NO	NO	NO	NO

3.2.1.2 Emission Factors

All emission factors for this sector can be seen in Table 3.5. The IEF for energy industries is affected by the different consumption of waste and fossil fuels, as waste, gas/diesel oil, and residual fuel oil have different EFs. In years where more residual fuel oil is used, the IEF is somewhat higher than in other years.

CO₂ emission factors reflect the average carbon content of fossil fuels and are taken from the 2006 IPCC Guidelines for National greenhouse gas Inventories. For diesel, country-specific NCV values are used for 2017 and onwards and country-specific carbon content, which is reflected in the CO₂ emission factor. For other fuels and other years in the timeline, default IPCC values are used.

Emission factors for energy recovery from waste incineration are described in the Waste sector, Chapter 7.4. The emission factors are based on the fossil content of the waste incinerated and varies due to the varying waste composition each year.

3.2.1.3 Emissions

Emissions from 1A1ai and 1A1aiii have generally been decreasing over the timeline due to less dependence on fossil fuels for energy production in Iceland. In 2007, there were unusually high emissions from electricity production. That year, a new aluminium plant was established in Iceland. Because the Kárahnjúkar Hydropower Project (hydropower plant built for this aluminium plant) was delayed, the aluminium plant was supplied with electricity for a while from the distribution system. This led to electricity shortages for the district heating system and industry depending on curtailable energy leading to increased fuel combustion. In 2022 and 2024, the emissions from electricity production were unusually high due to increased use of fossil fuel. The increased use of fossil fuel was triggered by less electricity being produced by hydropower plants.

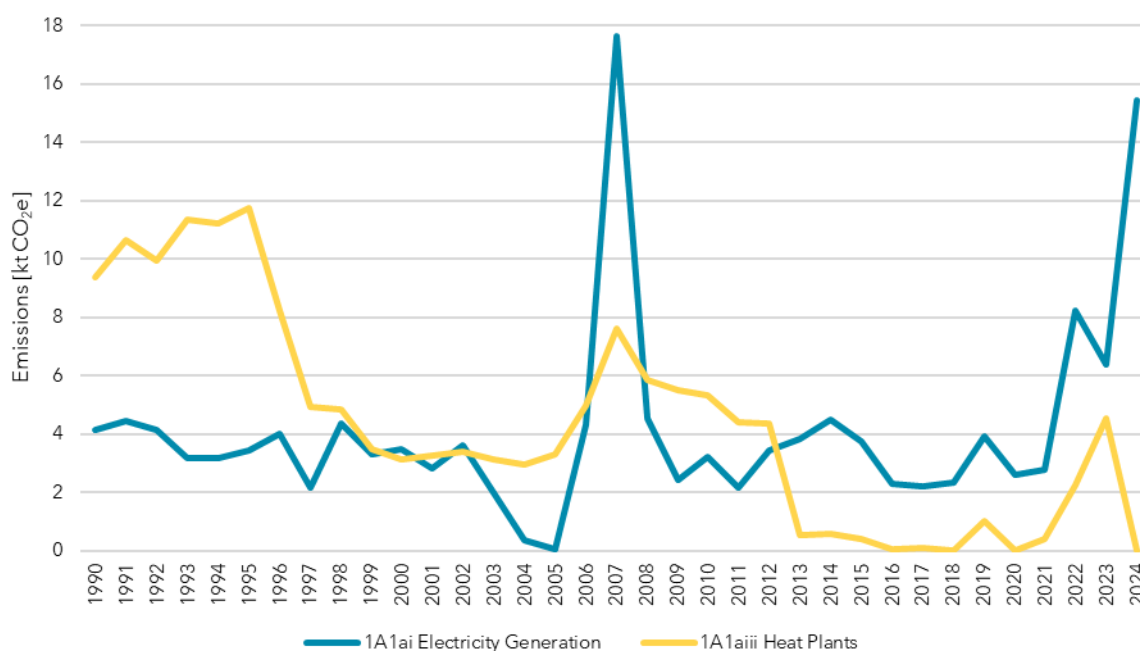


Figure 3.2. Emissions from 1A1 Energy industries.

Table 3.9. Emissions [kt CO₂e] from 1A1 Energy Industries.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
1A1ai Electricity Generation	4.13	3.47	3.48	0.069	3.22	3.76	2.62	6.40	15.4
1A1aiii Heat Plants	9.37	11.8	3.14	3.33	5.34	0.430	NO	4.55	NO
Total Emissions [kt CO₂e]	13.5	15.2	6.62	3.40	8.55	4.19	2.62	11.0	15.4

3.2.1.4 Recalculations

1A1ai: Electricity Generation

Recalculations occurred due to updates in the activity data for residual oil for the year 2000. The usage was updated from zero to 0.030 t. This led to minor recalculations as can be seen in Table 3.10.

Table 3.10. Recalculations in 1A1ai between submissions.

1A1ai Electricity Generation	2000
2025 submission [kt CO ₂ e]	3.38
2026 submission [kt CO ₂ e]	3.48
Change relative to the 2025 submission [kt CO ₂ e]	0.094
Change relative to the 2025 submission [%]	2.8%

1A1aiii: Heat Plants

No recalculations were performed for this submission for this sector.

3.2.1.5 Planned Improvements

No improvements are planned for this sector.

3.2.1.6 Uncertainties

Uncertainty for the activity data (fuel sales) is estimated by IEEA to be 5%. Emission factor uncertainties are 5% for CO₂ (2006 IPCC Guidelines default), 100% for CH₄ (central value for the default range given in the 2006 IPCC Guidelines) and 100% for N₂O (expert judgement, Aether Ltd, based on a comparison with other countries' NIRs (for instance UK NIR)). When combining the AD and EF uncertainties, the total uncertainty is 7% for CO₂, 100% for CH₄, and 100% for N₂O. The complete uncertainty analysis is shown in Annex 2.

3.2.2 Manufacturing Industries and Construction (CRT 1A2, Excluding Mobile Sources)

Table 3.11 shows the structure of the stationary combustion part of CRT sector 1A2, and the industries included under each subcategory. The mobile sources under CRT 1A2 can be seen in Section 3.3.1.

Table 3.11. Overview of stationary manufacturing industries reported in sector 1A2.

CRT code	IPCC name	Included
1A2a	Iron and Steel	Ferroalloy Production, Silicon Production, and Secondary Steel Recycling
1A2b	Non-ferrous Metals	Primary Aluminium Production
1A2c	Chemicals	Fertiliser Production (1990-2001), Diatomite Production (1990-2004)
1A2d	Pulp, Paper, and Print	NO
1A2e	Food Processing	Fishmeal Production and Other Food Processing
1A2f	Non-metallic Minerals	Cement (1990-2011), Mineral Wool
1A2gviii	Other Industries	All production that is not attributed to any of the other 1A2 subcategories.

3.2.2.1 Activity Data

The total amount of fuel sold to the manufacturing industries for stationary combustion was obtained. The sales statistics do not fully specify by which type of industry the fuel is being purchased. This division is made by the IEEA on the basis of the reported fuel use by all major industrial plants falling under Icelandic Act 96/2023 and the EU ETS Directive 2003/87/EC (metal production, fish meal production, data centre and mineral wool) and from Environmental information submitted by the industry in accordance with regulation No

990/2008 (formally called Green Accounting in accordance with regulation No 851/2002 which is no longer in force). All major industries falling under Icelandic Act 96/2023 report their fuel use to the IEEA along with other relevant information for industrial processes. The difference between the given total for the sector and the sum of the fuel use as reported by industrial facilities is categorised as 1A2gviii other non-specified industry (see Figure 3.1).

Table 3.12 shows the fuel sales statistics for the various fuel types used for stationary combustion in CRT sector 1A2:

Table 3.12. Fuel use [kt] from stationary combustion from subsectors in the Manufacturing Industry (1A2).

	1990	1995	2000	2005	2010	2015	2020	2023	2024
1A2a - Iron and Steel									
Gas/Diesel Oil	0.112	0.225	0.556	0.455	0.458	0.291	0.213	0.223	0.387
LPG	NO	NO	NO	NO	NO	0.098	0.203	0.193	0.270
1A2b - Non-ferrous Metals									
Gas/Diesel Oil	NO	NO	0.55	5.37	1.35	0.05	1.72	0.134	0.023
Residual Fuel Oil	3.93	5.16	7.51	NO	3.31	1.40	NO	NO	NO
LPG	0.409	0.312	0.671	0.655	0.605	0.389	0.230	1.262	1.363
1A2c - Chemicals									
Residual Fuel Oil	2.38	2.31	2.27	NO	NO	NO	NO	NO	NO
1A2e - Food processing, Beverages, and Tobacco (Fishmeal Production)									
Gas/Diesel Oil	NO	NO	NO	NO	2.16	NO	NO	5.33	13.8
Residual Fuel Oil	41.0	48.5	36.4	21.4	9.61	8.41	1.22	1.91	2.49
Waste Oil	NO	NO	NO	NO	1.36	1.59	0.37	4.18	1.99
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A2e - Food Processing, Beverages, and Tobacco (Other)									
Gas/Diesel Oil	NO	NO	NO	NO	2.71	3.75	3.37	2.22	1.59
Residual Fuel Oil	NO	NO	NO	NO	1.71	0.33	NO	NO	NO
1A2f - Non-metallic minerals (cement)									
Gas/Diesel Oil	NO	NO	0.0060	0.0190	0.0050	NO	NO	NO	NO
Residual Fuel Oil	0.055	NO	NO	NO	NO	NO	NO	NO	NO
Petroleum Coke	NO	NO	NO	8.13	NO	NO	NO	NO	NO
Waste Oil	NO	4.99	6.04	1.82	NO	NO	NO	NO	NO
Other Bituminous Coal	18.6	8.65	13.3	9.91	3.65	NO	NO	NO	NO
1A2f - Non-metallic Minerals (Mineral Wool)									
Gas/Diesel Oil	NO	0.146	0.170	0.156	0.074	0.106	0.128	0.139	0.164
Residual Fuel Oil	0.594	NO	NO	NO	NO	NO	NO	NO	NO
Petroleum Coke	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A2gviii - Other Industry									
Gas/Diesel Oil	4.96	0.758	7.64	9.19	NO	2.92	2.13	2.40	2.23
Residual Fuel Oil	7.91	0.162	1.00E-05	3.56	0.30	0.0523	NO	NO	NO

	1990	1995	2000	2005	2010	2015	2020	2023	2024
LPG	NO	NO	0.186	0.270	0.441	0.320	0.565	0.248	0.990
Other Bituminous Coal	NO	NO	NO	NO	NO	NO	NO	NO	NO

3.2.2.2 Emission Factors

All emission factors used for Stationary Combustion from CRT 1A2 can be seen in Table 3.5.

3.2.2.3 Emissions

Emissions from Stationary Combustion from CRT 1A2 have historically been dominated by emissions from Fishmeal Production (CRT 1A2e). Over the past years, more fishmeal factories have been using electricity instead of fossil fuels and therefore the emissions have decreased. However, in 2022, the emissions from fishmeal factories largely increased due to increased use of fossil fuel. The increased use of fossil fuel was triggered by an unusually dry season which led to less electricity being produced by hydropower plants.

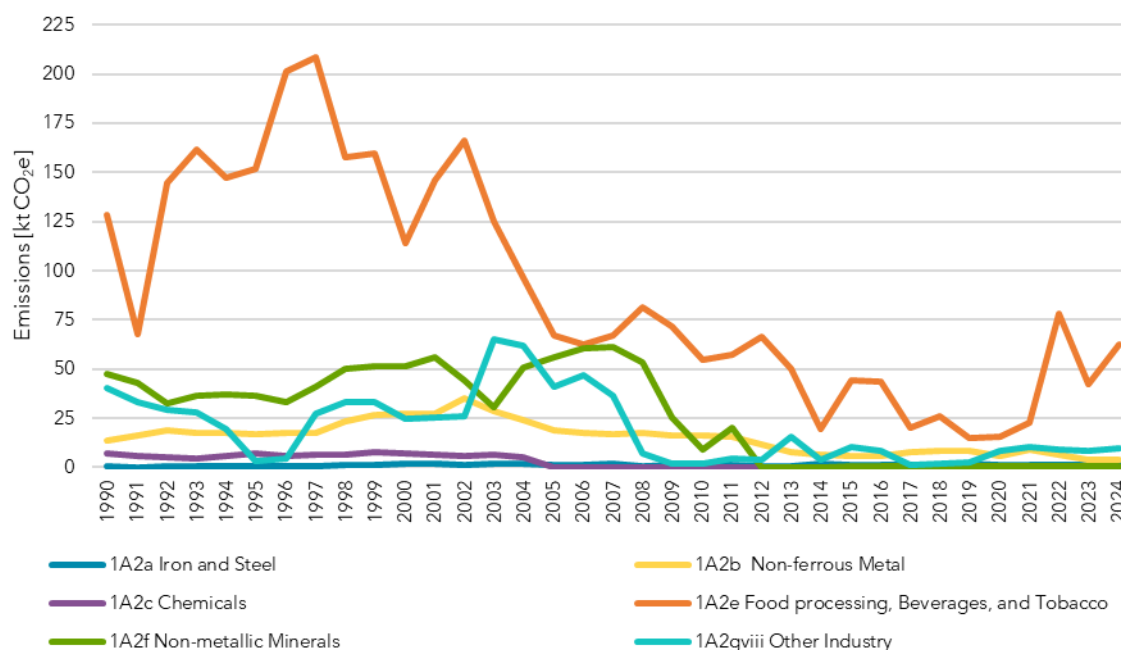


Figure 3.3. Emissions from stationary combustion of subcategories of CRT 1A2.

Table 3.13. Emissions [kt CO₂e] from stationary combustion of subcategories of CRT 1A2.

		1990	1995	2000	2005	2010	2015	2020	2023	2024
1A2a	Iron and Steel	0.35	0.714	1.76	1.45	1.46	1.22	1.28	1.28	2.03
1A2b	Non-ferrous Metals	13.5	17.1	27.3	19.0	16.5	5.69	6.16	4.19	4.14
1A2c	Chemicals	7.45	7.25	7.11	NO	NO	NO	NO	NO	NO

		1990	1995	2000	2005	2010	2015	2020	2023	2024
1A2e	Food Processing, Beverages, and Tobacco	129	152	114	67.2	55.0	44.1	15.7	42.6	62.5
1A2f	Non-metallic Minerals	47.7	36.8	51.4	56.3	9.21	0.338	0.409	0.440	0.519
1A2gviii	Other Industry	40.6	2.92	24.8	41.2	2.24	10.4	8.47	8.37	10.0
Total Emissions [kt CO₂e]		238	217	226	185	84.4	61.7	32.0	56.9	79.2

3.2.2.4 Recalculations

An updated LPG usage from one company was obtained for the year 2020 and updated diesel usage from one company was obtained for the year 2022. This led to minor recalculations within non-ferrous metals (1A2b) of -0.089 t CO₂e (-0.0014% of 1A2b emissions) for the year 2020 and 0.80 t CO₂e (0.013% of 1A2b emissions) for the year 2022.

Due to the previously mentioned activity-data adjustments, the 2020 LPG change and 2022 diesel change leads to equal and opposite adjustments in Other industry (1A2gviii): +0.089 t CO₂e (+0.0011% of 1A2gviii emissions) for the year 2020 and -0.80 t CO₂e (-0.0090% of 1A2gviii emissions) for the year 2022. The total effect of the updated LPG and diesel usage on 1A2 emissions is therefore none.

3.2.2.5 Planned Improvements

There are no planned improvements for sector 1A2.

3.2.2.6 Uncertainties

For subsectors 1A2a and 1A2b (Iron and Steel and Non-ferrous Metals, respectively), the activity data uncertainty is small, or 1.5%, due to the uncertainty constraints imposed on companies participating in the EU ETS trading scheme. The combined uncertainty for those two sectors is 5.2 % for CO₂ emissions (with an activity data uncertainty of 1.5% and emission factor uncertainty of 5% (Default 2006 IPCC Guidelines)), 100% for CH₄ emissions (with an activity data uncertainty of 1.5% and emission factor uncertainty of 100% (central value of default range, 2006 IPCC Guidelines)) and 100% for N₂O emissions (with an activity data uncertainty of 1.5% and emission factor uncertainty of 100% (expert judgement, Aether Ltd, based on the comparison with other countries NIR (for instance UK NIR))).

The uncertainty of CO₂ emissions from the other subsectors (1A2c, e, f and g) and 1A5a is 7% (with an activity data uncertainty of 5%, as estimated by the IEEA, and emission factor uncertainty of 5%), 100% for CH₄ emissions (with an activity data uncertainty of 5% and emission factor uncertainty of 100% (central value of default range, 2006 IPCC Guidelines)), and 100% for N₂O emissions (with an activity data uncertainty of 5% and emission factor uncertainty of 100% (expert judgement, Aether Ltd, based on the comparison with other

countries NIR (for instance UK NIR)). This can be seen in the quantitative uncertainty table in Annex 2.

3.2.3 Commercial / Institutional, Residential, and Agricultural Stationary Fuel Combustion (CRT 1A4ai, 1A4bi, and 1A4ci)

Since Iceland relies largely on renewable energy sources, fuel use for residential, commercial, and institutional heating is low and greenhouse gas emissions from stationary subsectors 1A4a and 1A4b are very low. Residential heating with electricity is subsidised and occurs in areas far from public heat plants. Commercial fuel combustion includes the heating of swimming pools, but only a few swimming pools in the country are heated with oil. Mobile combustion under CRT 1A4 is reported in Sections 3.3.1 and 3.3.4.

3.2.3.1 Activity Data

The IEAA collects data on fuel sales by sector. Activity data for residential use of charcoal for grilling is obtained from import numbers from Statistics Iceland (Hagstofa Íslands) (SI). Activity data for fuel combustion in the Commercial/Institutional sector, the Residential sector, and Agriculture are given in Table 3.14.

Table 3.14. Fuel use [in kt] from stationary combustion from subsectors of CRT 1A4.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
1A4ai Commercial/Institutional									
Gas/Diesel Oil	1.80	1.60	1.60	1.00	0.300	0.300	0.127	0.121	0.170
LPG	0.777	0.834	0.460	0.496	0.174	0.371	0.411	0.635	0.627
Waste: fossil	NO	0.145	0.186	0.186	0.147	NO	NO	NO	NO
Waste: biogenic	NO	0.305	0.394	0.394	0.202	NO	NO	NO	NO
1A4bi Residential									
Gas/Diesel Oil	8.82	6.94	6.03	3.24	1.34	0.994	1.060	0.414	0.440
Biodiesel	NO	NO	NO	NO	NO	NO	NO	0.0053	NO
Charcoal	0.197	0.197	0.197	0.197	0.197	0.197	0.183	0.227	0.227
LPG	NO	NO	0.72	0.93	1.42	0.93	1.10	0.97	1.01
1A4ci Agriculture									
LPG	NO	NO	NO	NO	NO	0.0040	0.0080	0.0040	0.0040

3.2.3.2 Emission Factors

All emission factors for this subsector can be seen in Table 3.5.

The IEF for the 1A4ai Commercial/Institutional shows fluctuations over the time series. From 1993 to 2012, waste was incinerated to produce heat at two locations (swimming pools, a

school building). The IEF for waste is considerably higher than for liquid fuel, influencing the overall IEF for this sector.

3.2.3.3 Emissions

Emissions from Stationary Combustion under CRT 1A4 have generally been decreasing over the past years, with some annual fluctuations. These emissions can be seen in Table 3.15 and Figure 3.4.

Table 3.15. Emissions from Stationary Combustion of subsectors under CRT 1A4 [kt CO₂e].

	1990	1995	2000	2005	2010	2015	2020	2023	2024
1A4ai Commercial/Institutional	8.06	7.80	6.74	4.93	1.71	2.07	1.64	2.28	2.42
1A4bi Residential	28.1	22.1	21.4	13.1	8.53	5.97	6.72	4.26	4.45
1A4ci Agriculture	NO	NO	NO	NO	NO	0.0120	0.0239	0.0120	0.0120
Total Emissions [kt CO₂e]	36.2	29.9	28.1	18.1	10.2	8.05	8.38	6.56	6.88

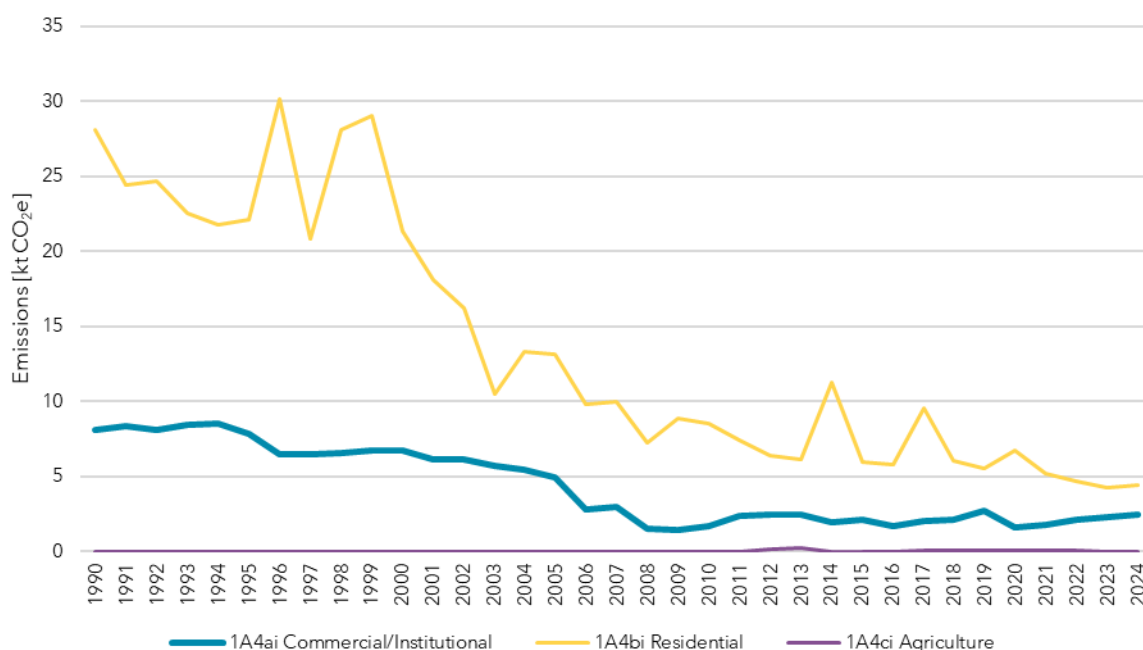


Figure 3.4. Emissions from stationary combustion of subsectors under CRT 1A4.

3.2.3.4 Recalculations

1A4ai Commercial/Institutional Stationary

No recalculations were performed for this submission for this sector.

1A4bi Residential Stationary

No recalculations were performed for this submission for this sector.

1A4ci Agricultural Stationary

No recalculations were performed for this submission for this sector.

3.2.3.5 Planned Improvements

There are no planned improvements for this sector.

3.2.3.6 Uncertainties

Uncertainty for the activity data (fuel sales) is estimated by the IEEA to be 5%. Emission factor uncertainties are 5% for CO₂ (2006 IPCC Guidelines default), 100% for CH₄ (central value for the default range given in the 2006 IPCC Guidelines), and 100% for N₂O (expert judgement, Aether Ltd, based on comparison with other countries NIR (for instance UK NIR)). When combining the AD and EF uncertainties, total uncertainty is 7% for CO₂, 100% for CH₄, and 100% for N₂O. The complete uncertainty analysis is shown in Annex 2.

3.2.4 Other (CRT 1A5)

All fuels categorised as “Other” in sales statistics without any explanation of type of use, are allocated to CRT category 1A5.

3.2.4.1 Activity Data

Activity data for 1A5 Other can be seen in Table 3.16.

Table 3.16. Fuel use [in kt] from sector 1A5 Other.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Gas/Diesel Oil	NO	0.46	1.39	8.93	2.73	NO	0.0840	0.524	1.42
Residual Fuel Oil	0.039	0.052	0.067	NO	1.63	NO	NO	NO	NO
Other Kerosene	NO	NO	NO	0.151	0.047	0.029	0.030	0.031	0.037
LPG	NO	NO	NO	NO	NO	0.032	NO	0.005	NO
Biodiesel	NO	NO	NO	NO	NO	NO	0.044	0.023	0.088
Biomethane	NO	NO	NO	NO	NO	NO	0.111	NO	0.166
Biogasoline	NO	NO	NO	NO	NO	NO	1.0E-03	NO	5.6E-03

3.2.4.2 Emission Factors

All emission factors for this sector can be seen in Table 3.5.

3.2.4.3 Emissions

In recent years, emissions from unallocated fuels from CRT 1A5 have been fluctuating below 5 kt. CO₂e. The sharp increase in emissions in 2004-2006 stems likely from fuel that should have been allocated to CRT 1A2e.

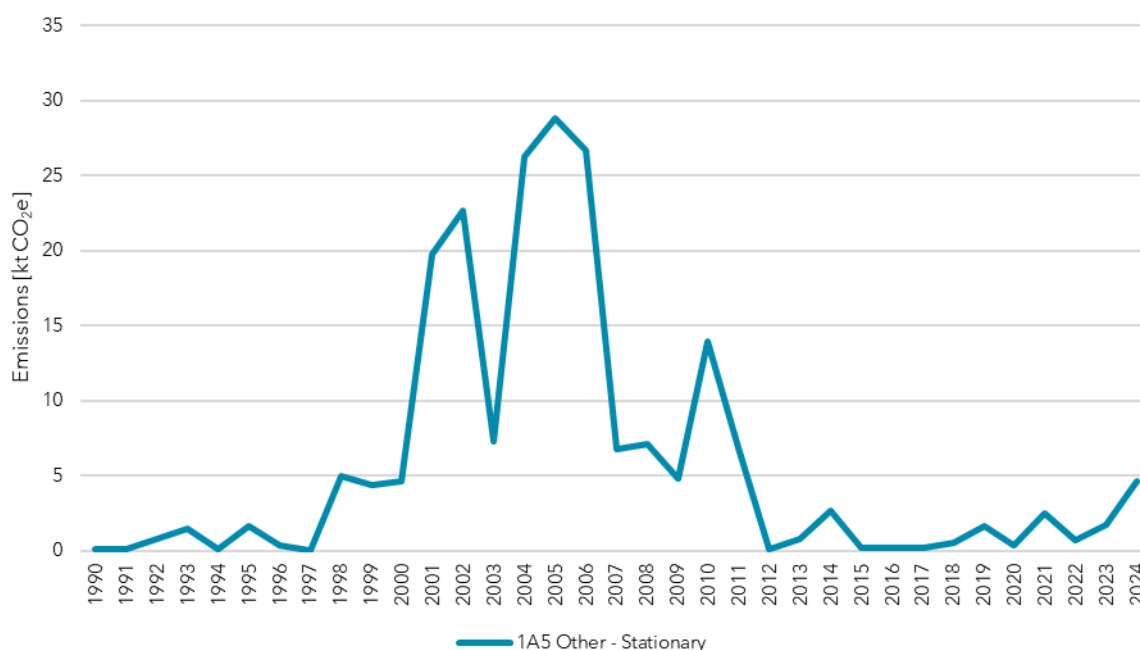


Figure 3.5. Emissions from Stationary Combustion from CRT 1A5.

Table 3.17. Emissions from Stationary Combustion from CRT 1A5 [kt CO₂e].

	1990	1995	2000	2005	2010	2015	2020	2023	2024
1A5 - Total emissions [kt CO ₂ e]	0.122	1.62	4.61	28.8	13.9	0.187	0.364	1.78	4.62

3.2.4.4 Recalculations

No recalculations were performed for this submission for this sector.

3.2.4.5 Uncertainties

The uncertainty of CO₂ emissions from 1A5 is 7% (with an activity data uncertainty of 5%, as estimated by IEEA, and emission factor uncertainty of 5%), 100% for CH₄ emissions (with an activity data uncertainty of 5% and emission factor uncertainty of 100% (central value of default range, 2006 IPCC Guidelines)), and 100% for N₂O emissions (with an activity data uncertainty of 5% and emission factor uncertainty of 100% (expert judgement, Aether Ltd, based on the comparison with other countries NIR (for instance UK NIR))). This can be seen in the quantitative uncertainty table in Annex 2.

3.2.4.6 Planned Improvements

For future submissions the IEEA will investigate where these fuels were used so they can be attributed to the correct categories.

3.3 Transport and Other Mobile Sources (CRT 1A2, 1A3, and 1A4)

3.3.1 Mobile Machinery (CRT 1A2gvii, 1A3eii, and 1A4cii)

This section includes all off-road mobile sources that are listed under CRT 1A2, 1A3, and 1A4, and which are not otherwise considered under specific CRT codes. Table 3.18 outlines the categories and data sources as covered by this section.

Table 3.18. Categories in Mobile Machinery.

CRT code	IPCC name	Data source
1A2gvii	Off-road Vehicles and Other Machinery in Construction	Extrapolated data for 1990-2020, specific data for Mobile Machinery in Construction from 2021.
1A3eii	Off-road Vehicles and Other Machinery	Extrapolated data for 1990-2020, specific data for Other Machinery from 2021.
1A4cii	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	Extrapolated data for 1990-2020, specific data for Mobile Machinery in Agriculture from 2021.

3.3.1.1 Activity Data

Before 2019, activity data related to Gas/Diesel Oil combustion in off-road mobile machinery was registered as the total of fuel directly distributed to the users by fuel delivery trucks, as opposed to fuel sold at petrol stations. No breakdown of fuel sold for off-road vehicles in agriculture, construction, or other applications is available for 1990-2018. Starting from 2019, a dedicated attribution of directly distributed fuel to categories 1A2gvii, 1A3eii, and 1A4cii was introduced. However, the relative proportion of fuel sales reported in category 1A3eii is significantly higher for 2019 (29%) and 2020 (21%) than 2021-2024 (average 1.86%), indicating possible inaccuracies in the initial allocation of fuel to these categories (see Table 3.19).

Prior to the 2023 submission, category 1A3eii, Other Off-road Vehicles and Machinery, included all emissions estimated from fuel sold to off-road machinery for 1990-2018, including Mobile Machinery in Construction (1A2gvii) and Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery (1A4cii). Categories 1A2gvii and 1A4cii were, thus, marked as "IE" in the CRT reporter. The approach followed in the submissions of 2023 to 2025 was to extrapolate the Gas/Diesel Oil split for the years 1990 to 2018 based on the average proportion of each category as reported for 2019 to 2022, while activity data for 2019 and following years was considered correctly attributed to the three categories.

Due to this proportional split projecting historic activity fluctuations across categories, in particular from construction onto agriculture, as well as the above-mentioned concerns regarding the accurate attribution of fuel to categories in 2019 and 2020, an improved approach was implemented for the 2026 submission:

Addressing the attribution inaccuracies of 2019 and 2020, the fuel assigned to 1A3eii (Other Off-road Vehicles and Machinery) in 2019 and 2020, that exceeds the average proportion of fuel attributed to 1A3eii in 2021 to 2024, was added to the fuel reported for categories 1A2gvii and 1A4cii according to the relative proportions of these two categories in the respective year, 2019 and 2020 (Table 3.19).

Table 3.19. Fuel sold in 1A2gvii, 1A3eii, and 1A4cii. Reported data and 2019 and 2020 adjusted.

	2019	2020	2021	2022	2023	2024
Fuel sold, reported [kt]						
1A2gvii - Mobile Machinery in Construction	12.31	6.41	9.87	10.36	15.09	15.38
1A4cii - Mobile Machinery in Agriculture	5.40	7.57	6.45	6.27	6.26	6.22
1A3eii - Other Mobile Machinery	7.12	3.72	0.73	0.32	0.00	0.28
Proportion of total fuel sales of these 3 categories						
1A2gvii - Mobile Machinery in Construction	50%	36%	58%	61%	71%	70%
1A4cii - Mobile Machinery in Agriculture	22%	43%	38%	37%	29%	28%
1A3eii - Other Mobile Machinery	29%	21%	4%	2%	0%	1%
Fuel sold, adjusted in 2019 and 2020 [kt]						
1A2gvii - Mobile Machinery in Construction	16.94	7.96	9.87	10.36	15.09	15.38
1A4cii - Mobile Machinery in Agriculture	7.44	9.41	6.45	6.27	6.26	6.22
1A3eii - Other Mobile Machinery	0.46	0.33	0.73	0.32	0.00	0.28

The revised fuel split between categories 1A2gvii, 1A3eii, and 1A4cii for the years 1990-2018 is based on category-specific activity data, i.e. m² of constructed building area and paved road surface (1A2gvii), as well as livestock numbers in key animal categories (cattle, sheep, horses. 1A4cii). These data are available for the entire timeline and are used to calculate the weighted totals of activity per category and year (1990-2024), with dimensionless weights representing the assumed relative fuel intensities of production or farming of units of activity data (m² or single animal) of the different types²⁵ within a category (see Table 3.20).

Table 3.20. Weighted Activity Data, categories 1A2gvii and 1A4cii.

Activity	Weight	1990	1995	2000	2005	2010	2015	2020	2023	2024
Activity in 1A2gvii - Mobile Machinery in Construction [m²]										
Buildings	1.00	485097	364013	617323	636931	323762	268420	585750	658055	635737
New roads	0.10	757636	757636	757636	693000	1161000	324000	513000	477000	477000
Weighted total		560860	439777	693086	706231	439862	300820	637050	705755	683437

²⁵ Buildings and paved roads in 1A2gvii. Cattle, adult sheep, and horses in 1A4cii.

Activity	Weight	1990	1995	2000	2005	2010	2015	2020	2023	2024
Activity in 1A4cii - Mobile Machinery in Agriculture [livestock]										
Adult sheep	0.20	548707	458367	465637	454726	477294	473553	401839	356182	344996
Cattle	1.00	74903	73199	72144	65970	72509	78776	81170	78702	76971
Horses	0.50	73867	80246	75630	76629	78849	79433	73465	68505	63452
Weighted total		221578	204995	203086	195230	207392	213203	198270	184191	177696

Category-specific fuel sales data and the calculated weighted totals of activity data of the years 2019 to 2024 are used to calculate a single average fuel factor/investment (in kg) per unit of activity data for each category (1A2gvii and 1A4cii, see Table 3.21).

Table 3.21. Category-specific Fuel Factors (Fuel per unit of Activity Data) for 1A2gvii and 1A4cii.

Category	Fuel factor	2019	2020	2021	2022	2023	2024	Average
1A2gvii	kg / m ²	27.2	12.5	17.5	17.6	21.4	22.5	19.8
1A4cii	kg / animal	37.1	47.4	33.4	33.2	34.0	35.0	36.7

The weighted sums of activity data of the years 1990 to 2018 of both categories are multiplied by these category-specific average fuel factors and equally scaled to sum up to the total fuel sales reported for 1A3eii for each year, minus the fuel that remains attributed to 1A3eii according to its average proportion in 2021 to 2024. Table 3.22 summarises the fuel attributed to categories 1A2gvii, 1A3eii, and 1A4cii at selected points along the timeline.

Table 3.22. Fuel use [in kt] from Mobile Combustion in the Construction Industry (1A2gv), Agriculture (1A4cii), and Other (1A2gvii).

	1990	1995	2000	2005	2010	2015	2020	2023	2024
1A2gvii - Mobile Machinery in Construction									
Gas/Diesel Oil	21.52	24.6	39.36	43.98	16.88	14.03	7.96	15.09	15.38
1A3eii - Other Mobile Machinery									
Gas/Diesel Oil	0.71	0.87	1.15	1.26	0.60	0.62	0.33	NO	0.28
Other Kerosene	NO	NO	NO	0.022	1.171	0.157	0.326	0.022	0.011
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A4cii - Mobile Machinery in Agriculture									
Gas/Diesel Oil	15.76	21.26	21.38	22.54	14.75	18.44	9.41	6.26	6.22

3.3.1.2 Emission Factors

All emission factors used to calculate emissions from fuel combustion from Mobile Machinery can be seen in Table 3.23. All factors, except NCV and carbon content for diesel, are from 2006 IPCC guidelines. The values in Table 3.23 represent the values used in the most recent inventory year.

Table 3.23. Emission factors for CO₂, CH₄, and N₂O from Mobile Combustion reported under 1A2gvii, 1A3eii, and 1A4cii.

Fuel / Factor	Value	Unit	Reference
Diesel Oil			
NCV	42.89	TJ/kt	Country Specific from 2016, based on measurements
C-content	20.17	t/TJ	Country Specific, based on measurements
CH ₄ emission factor	4.15	kg/TJ	Table 3.3.1 2006 IPCC Guidelines, "Industry" defaults
N ₂ O emission factor	28.60	kg/TJ	Table 3.3.1 2006 IPCC Guidelines, "Industry" defaults
Other Kerosene			
NCV	43.80	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	19.60	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	4.15	kg/TJ	Table 3.3.1 2006 IPCC Guidelines, "Industry" defaults*
N ₂ O emission factor	28.60	kg/TJ	Table 3.3.1 2006 IPCC Guidelines, "Industry" defaults*
Biodiesel			
NCV	27.00	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	19.30	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	3.00	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	0.60	kg/TJ	Table 2.2 2006 IPCC Guidelines, V2, Ch2

* These values are the EFs for diesel oil, as no specific EFs exist for other kerosene for mobile machinery, and kerosene would be used in diesel engines rather than petrol engines.

3.3.1.3 Emissions

Figure 3.6 and Table 3.24 report the emissions from Mobile Machinery. Emissions in this category increased in the beginning of the times series, but have generally been decreasing from 2008, albeit with some fluctuations.

Table 3.24. Emissions [kt CO₂e] from mobile machinery (1A2gvii, 1A3eii, and 1A4cii)

	1990	1995	2000	2005	2010	2015	2020	2023	2024
1A2gvii Mobile Machinery in Construction	75.2	86.0	138	154	59.0	49.0	27.9	52.9	53.9
1A3eii Other Mobile Machinery	2.47	3.04	4.02	4.48	6.17	2.70	2.29	0.08	1.02
1A4cii Mobile Machinery in Agriculture	55.1	74.3	74.7	78.7	51.5	64.4	32.9	21.9	21.8
Total	133	163	216	237	117	116	63.1	74.9	76.7

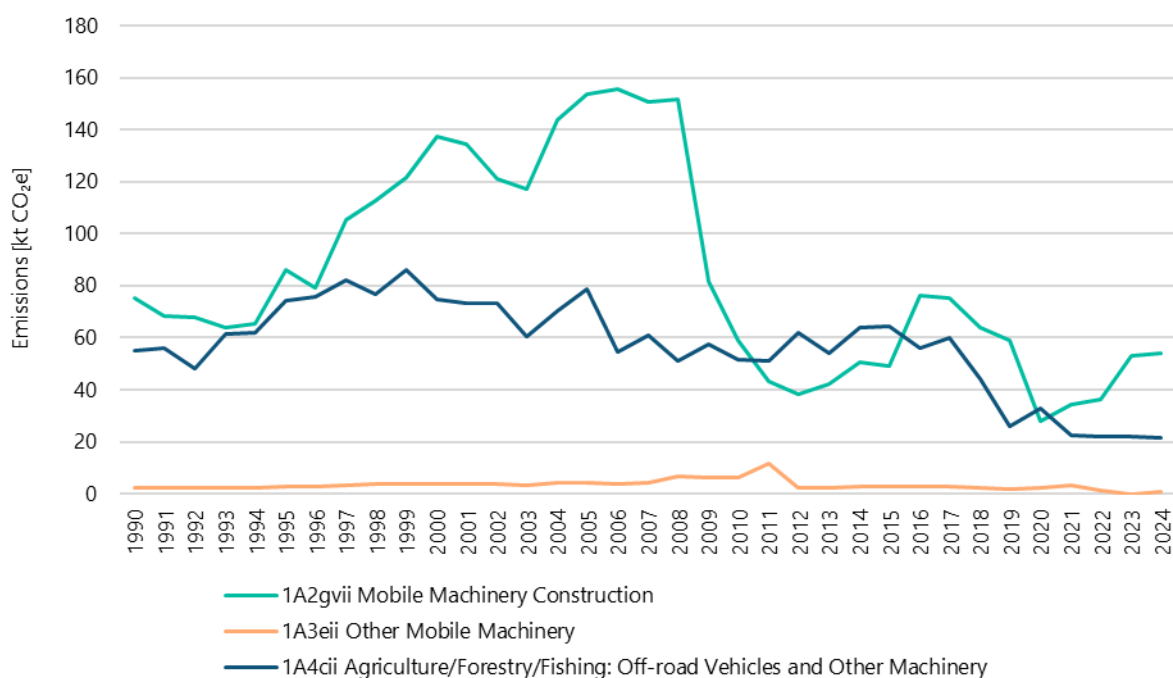


Figure 3.6. Emissions [kt CO₂e] from Mobile Machinery (1A2gvii, 1A3eii, and 1A4cii). Emissions for 1990-2020 are based on activity data calculated as outlined in section 3.3.1.1.

3.3.1.4 Recalculations

For the 2025 submission, the Gas/Diesel Oil split for the years 1990 to 2018 was extrapolated based on the average proportion of categories 1A2gvii, 1A3eii, and 1A4cii as reported for 2019 to 2022, while activity data for 2019 and following years was considered correctly attributed to these categories.

This approach was revised for the 2026 submission, with fuel for the years 1990-2018 split between categories based on category-specific activity data. Fuel assignment for the years 2019 and 2020 was corrected for suspected attribution inaccuracies. The revised approach is described in detail in section 3.3.1.1.

The recalculations affect all three categories over the entire timeline up to and including year 2020.

1A2gvii Off-road Vehicles and Other Machinery in Construction

Table 3.25. Recalculations of CO₂e emissions in 1A2gvii between submissions.

1A2gvii Construction	1990	1995	2000	2005	2010	2015	2020
2025 submission CO ₂ e [kt]	67.9	83.6	110.7	121	57.6	59.2	22.4
2026 submission CO ₂ e [kt]	75.3	85.9	137.6	154	59.0	49.1	27.9
Change relative to the 2025 submission [kt]	7.33	2.32	26.94	32.57	1.40	-10.07	5.44
Change relative to the 2025 submission [%]	10.78%	2.8%	24.3%	26.9%	2.4%	-17.0%	24.3%

1A3eii Off-road Vehicles and Other Machinery

Table 3.26. Recalculations of CO₂e emissions in 1A3eii between submissions.

1A3eii Other Mobile Machinery	1990	1995	2000	2005	2010	2015	2020
2025 submission CO ₂ e [kt]	18.53	22.81	30.20	33.15	19.80	16.69	14.15
2026 submission CO ₂ e [kt]	2.47	3.04	4.02	4.48	6.17	2.70	2.29
Change relative to the 2025 submission [kt]	-16.06	-19.77	-26.18	-28.67	-13.63	-13.99	-11.86
Change relative to the 2025 submission [%]	-86.7%	-86.7%	-86.7%	-86.5%	-68.8%	-83.8%	-83.8%

1A4cii Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery

Table 3.27. Recalculations of CO₂e emissions in 1A4cii between submissions.

1A4cii Agriculture Machinery	1990	1995	2000	2005	2010	2015	2020
2025 submission CO ₂ e [kt]	46.22	56.88	75.31	82.49	39.22	40.26	26.49
2026 submission CO ₂ e [kt]	54.96	74.33	74.55	78.59	51.45	64.33	32.91
Change relative to the 2025 submission [kt]	8.738	17.45	-0.77	-3.90	12.23	24.07	6.42
Change relative to the 2025 submission [%]	18.90%	30.68%	-1.0%	-4.7%	31.2%	59.8%	24.3%

3.3.1.5 Planned Improvements

No improvements are planned for this sector.

3.3.1.6 Uncertainties

The combined uncertainty of CO₂ from subsectors 1A2gvii, 1A3eii, and 1A4cii is 7% (with an activity data uncertainty of 5% and an emission factor uncertainty of 5%). Combined uncertainty of CH₄ from subsectors 1A2gvii and 1A3eii is 100% (with 5% activity data uncertainty and 100% emission factor uncertainty), and 50% for subsector 1A4cii (5% activity data uncertainty and 50% emission factor uncertainty). For N₂O the combined uncertainty from subsector 1A2gvii is 100% (with 5% activity data uncertainty and 100% emission factor uncertainty), 250% from subsector 1A3eii (5% activity data uncertainty and 250% emission factor uncertainty), and 140% from subsector 1A4cii (5% activity data uncertainty and 140% emission factor uncertainty). These values are summarised in the quantitative uncertainty table in Annex 2.

3.3.2 Domestic Aviation (CRT 1A3a)

3.3.2.1 Activity Data

Domestic Aviation (1A3a) includes civil flights departing from and subsequently landing in Iceland.

The total amount of jet kerosene and aviation gasoline attributed to domestic aviation is obtained from distributors and reported in the annual fuel sales statistics. Activity data, fuel sales for Domestic Aviation, are given in Table 3.28.

Table 3.28. Fuel use [kt] for Domestic Aviation.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Aviation Gasoline	1.68	1.13	1.10	0.872	0.648	0.502	0.195	0.170	0.124
Jet Kerosene	8.92	8.41	7.87	7.39	6.07	5.99	3.98	6.92	6.33

3.3.2.2 Emission Factors

The emission factors for greenhouse gases are taken from the 2006 IPCC Guidelines and are presented in Table 3.29.

Table 3.29. Emission factors for greenhouse gases for Aviation.

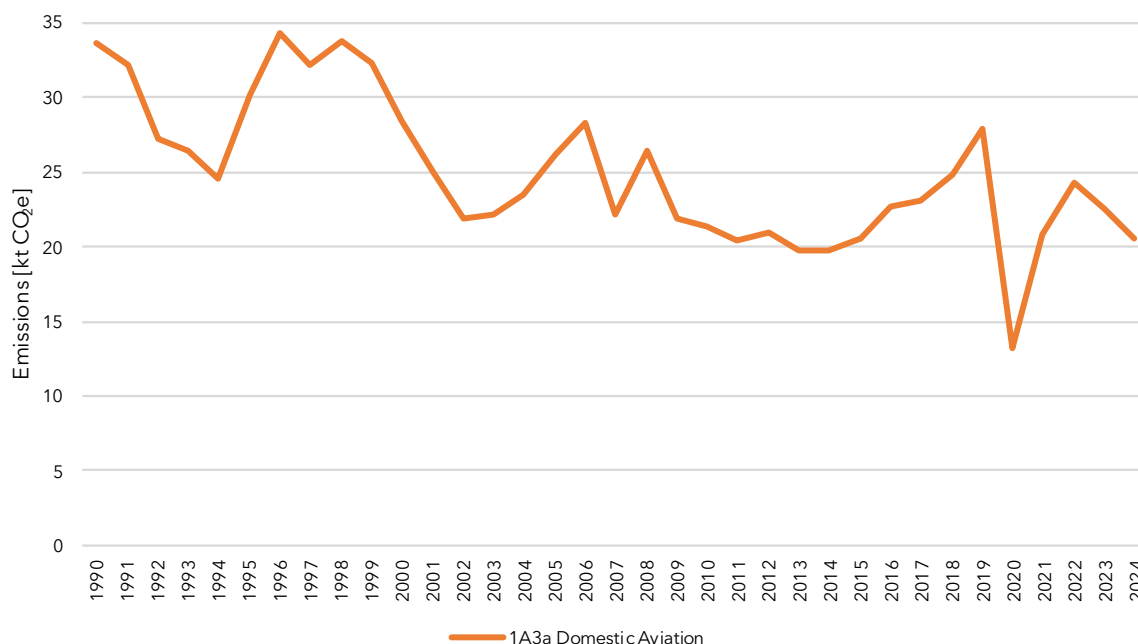
Fuel / Factor	Value	Unit	Reference
Aviation Gasoline			
NCV	44.3	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	19.1	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	0.50	kg/TJ	Table 3.6.5 2006 IPCC Guidelines, V2, Ch3
N ₂ O emission factor	2.0	kg/TJ	Table 3.6.5 2006 IPCC Guidelines, V2, CH ₄
Jet Kerosene			
NCV	44.1	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	19.5	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	0.50	kg/TJ	Table 3.6.5 2006 IPCC Guidelines, V2, Ch3
N ₂ O emission factor	2.0	kg/TJ	Table 3.6.5 2006 IPCC Guidelines, V2, CH ₄

3.3.2.3 Emissions

Emissions from 1A3a Domestic Aviation had generally been decreasing over the time period, but they increased during 2015-2019, most likely due to increase in tourism in Iceland. There was a drop in emissions in 2020 due to the COVID pandemic. These emissions can be seen in Table 3.30 and Figure 3.7.

Table 3.30. Emissions [kt CO₂e] from 1A3a Domestic aviation.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Total Emissions [kt CO ₂ e]	33.6	30.2	28.5	26.2	21.3	20.6	13.2	22.5	20.5

Figure 3.7. Emissions [kt CO₂e] from 1A3a Domestic Aviation.

3.3.2.4 Recalculations

No recalculations were performed for this submission for this sector.

3.3.2.5 Planned Improvements

No improvements are planned for this sector.

3.3.2.6 Uncertainties

Fuel sales uncertainties are estimated by IEEA to be within 5%. The uncertainty of CO₂ emissions from Domestic Aviation is 7% (with an activity data uncertainty of 5% and emission factor uncertainty of 5% (2006 IPCC Guidelines)), whilst the CH₄ emissions uncertainty is 100% (with an activity data uncertainty of 5% and emission factor uncertainty of 100% (highest value in the range given by the IPCC guidelines) and the N₂O emissions uncertainty is 150% (with an activity data uncertainty of 5% and EF uncertainty of 150%). The complete uncertainty analysis is shown in Annex 2.

3.3.3 Road Transport (CRT 1A3b)

Emissions from the Road Transport category is split into four subcategories:

- 1A3bi Cars
- 1A3bii Light-duty Trucks
- 1A3biii Heavy-duty Trucks and Buses
- 1A3biv Motorcycles

Emissions from Road Transport are estimated using COPERT²⁶ version 5.9.2 which uses a Tier 3 methodology to estimate N₂O and CH₄ emissions, and a Tier 2 methodology to estimate CO₂ emissions. All emission factors in COPERT are from the 2006 IPCC guidelines and 2023 EMEP/EEA Guidebook. These factors are default values in COPERT if country-specific data is not available.

3.3.3.1 Activity Data

Total use of diesel oil, gasoline, and biofuels in the Road Transport sector are based on the annual sales statistics and can be found in Table 3.31, along with the amounts of hydrogen and electricity attributed to road transport.

Table 3.31. Fuel use [kt] and [GWh] in Road Transport.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Gasoline	67.1	118	143	157	148	132	91.6	93.9	101
Gasoline, leaded	60.7	18.0	NO	NO	NO	NO	NO	NO	NO
Gas/Diesel Oil	36.6	36.9	47.5	83.5	106	126	168	193	179
Biomethane	NO	NO	0.006	0.039	0.595	2.18	1.44	1.57	1.61
Biodiesel	NO	NO	NO	NO	NO	11.9	13.0	2.9	20.5
Biogasoline	NO	NO	NO	NO	NO	1.93	11.0	20.7	12.2
Hydrogen	NO	NO	NO	9.0E-06	2.2E-03	NO	4.2E-04	2.1E-03	1.9E-03
Electricity [GWh]	NO	NO	NO	NO	NO	1.92	28.4	90.9	109

All of the biogasoline in Iceland is bioethanol and all the biodiesel is HVO. They do therefore not include any fossil carbon.

Vehicle Stock and Activity Data

Vehicle stock data for the entire time series were obtained from the vehicle registry maintained by the Icelandic Transport Authority. The data set allows to group vehicles according to category (cars, light duty vehicles, heavy duty trucks, buses, L-category), type of fuel, segment or weight class, and year of registration and deregistration. For a further

²⁶ Emisia SA, Thessaloniki, Greece, <https://copert.emisia.com/>

classification of vehicles according to Euro emission standards, a respective distribution data set was provided by Emisia, developer of the COPERT software. Table 3.32 summarises the vehicle stock per category.

Table 3.32. *Vehicle stock according to categories.*

Category		1990	1995	2000	2005	2010	2015	2020	2023	2024
1A3bi	Cars	108860	110993	141244	164080	171466	186652	219050	246041	248465
1A3bii	Light-duty trucks	7890	8830	10778	14354	16714	18064	22632	26367	27664
1A3biii	Heavy-duty trucks and buses	4108	4839	6068	8061	7284	8134	8973	10625	10845
1A3biv	Motorcycles	1063	441	637	2544	7419	6446	6393	6139	5984
1A3b	Road transport	121921	125103	158727	189039	202883	219296	257048	289172	292958

A comprehensive activity data set comprising yearly average driven mileage as well as lifetime cumulative activity for each vehicle class was obtained from Emisia since no suitably categorised mileage data was available from national sources. Activity shares according to driving modes (urban, rural, highway) were kept constant over the timeline, with a 35% urban share for cars and light-duty trucks, a 90% urban share for urban buses, 70% rural activities of heavy-duty trucks, and an 80% rural share driven by coaches.

An energy balancing function of COPERT was used to ensure the alignment of sold fuel and activity data per vehicle class.

Other COPERT Input Data

The following country-specific information was supplied as additional input data to COPERT:

- Average monthly temperature values were obtained from the Icelandic Met Office (Veðurstofa Íslands).
- Measurements collected by the IEEA for energy content, density, and sulphur content of fuel types were used where available.
- Measurements of carbon content (%C/%H/%O) in gasoline and diesel oil used in Road Transport were performed from fuel samples taken in 2019, 2020, and 2021. The 2019 value was applied for 1990-2019 and the 2021 value was applied for the years 2021 and following.
The measurements for gasoline were done on 5% blended fuel. The fuel volume was corrected accordingly before emissions were calculated so that the carbon content represents pure fossil gasoline.

3.3.3.2 Emission Factors

CO₂ emissions from Road Transport are calculated by COPERT on the basis of supplied energy content and carbon content values. The applied energy content and carbon content factors for gasoline and Diesel are summarised in Table 3.33.

Table 3.33. Emission factors used for calculations of emissions from Road Transport.

Fuel / Factor	1990-2015	2016	2017	2018	2019	2020	2021	2023	2024
Gasoline									
NCV [TJ/kt] ¹	44.3	44.3	44.0	43.7	43.9	43.9	44.0	43.6	43.5
C-content [t/TJ] ²	19.5	19.5	19.7	19.8	19.7	19.8	19.8	20.0	20.0
Diesel									
NCV [TJ/kt] ³	43.0	43.2	43.1	43.2	43.1	42.8	42.9	42.9	42.9
C-content [t/TJ] ²	20.1	20.0	20.0	20.0	20.0	20.2	20.2	20.2	20.2

¹ Table 1.2 2006 IPCC Guidelines, V2, Ch1 for 1990-2016, country-specific measurements from 2017.

² The country-specific measurement of carbon content was performed in 2019, 2020, and 2021. The 2019 value was applied for 1990-2019 and the 2021 value was applied for the years 2021 and following. (The C-content in t/TJ is then calculated based on the NCV and varies therefore when NCV varies.)

³ Table 1.2 2006 IPCC Guidelines, V2, Ch1 for 1990-2015, country-specific measurements from 2016.

Emission factors in COPERT for CH₄ and N₂O are defined in chapter 1.A.3.b.i-iv Road Transport 2023 of the 2023 EMEP/EEA Guidebook. The chapter outlines the dependency of emission factors on improved technology in vehicles, resulting in a decrease in IEFs for CH₄ and N₂O over the times series.

Inter-annual changes are observed in the IEFs for biomass, most prominently in 2012-2015. This is due to the introduction of new biofuels to the biomass category. Before 2012, biomethane was the only fuel reported as biomass. In 2012, biodiesel was introduced and its volume increased the first years after. In 2015, in addition, bioethanol was introduced as biofuel in Iceland. The addition of these two fuel types to the mix of biofuels used for Road Transport in Iceland affect the IEF reported for biomass, as their emission factors are different from emission factors for biomethane.

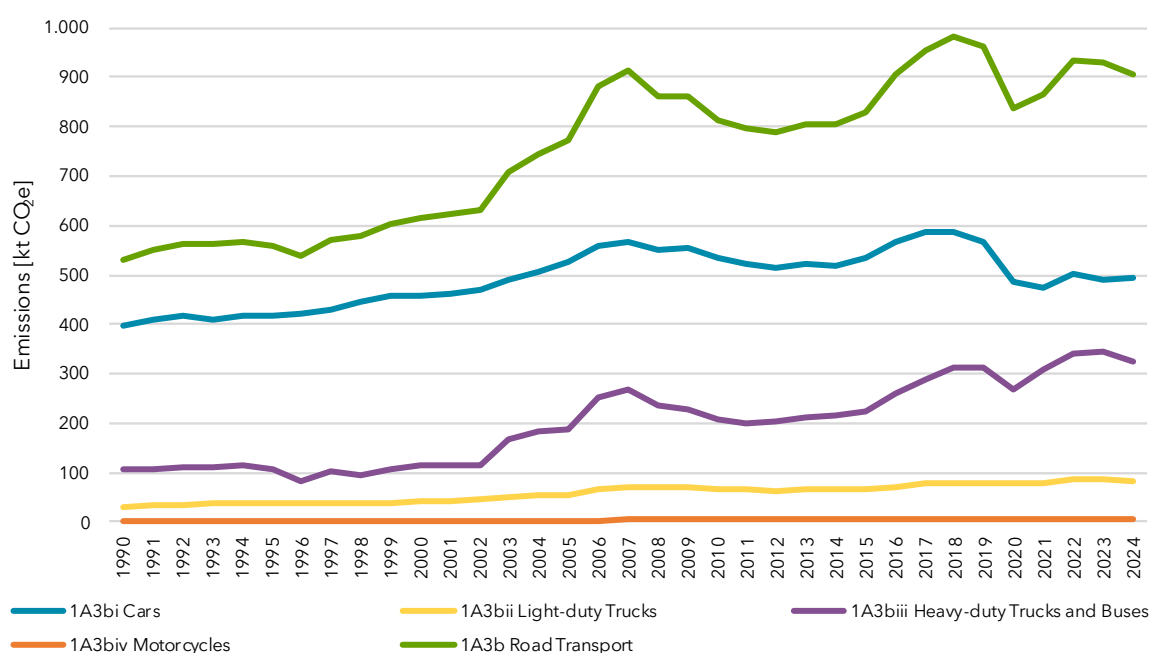
3.3.3.3 Emissions

Emissions from Road Transport have been steadily increasing from 1990-2007. In 2008, emissions started decreasing due to the Icelandic national financial crisis and they remained relatively steady until 2015. Partly due to increased tourism, emissions started increasing again in 2016, but a drop in emissions were observed in 2020 as a consequence of the COVID pandemic. In 2021, a slight increase due to the post-pandemic economic recovery can be observed, followed by a significant increase in 2022 and decrease in 2023 and 2024. The CO₂ equivalent emissions are depicted in Table 3.34 and Figure 3.8.

Only CH₄ and N₂O emissions from biofuels are included in the national totals, whereas CO₂ emissions are reported as a memo item under CRT category 1D3.

Table 3.34. Emissions from subcategories and total emissions [kt CO₂e] from 1A3b Road Transport.

Category	1990	1995	2000	2005	2010	2015	2020	2023	2024
1A3bi Passenger Cars	396	415	458	527	534	533	487	491	492
1A3bii Light-duty Trucks	29.6	37.9	41.2	55.9	66.5	66.1	77.0	87.5	84.3
1A3bii Heavy-duty Trucks and Buses	105	105	115	188	206	223	269	346	325
1A3biv Motorcycles	0.716	0.330	0.533	2.21	6.81	6.22	4.28	3.88	3.92
Total [kt CO₂e]	531	558	615	773	814	828	837	929	906

Figure 3.8. Emissions from subcategories and total emissions [kt CO₂e] from 1A3b Road Transport.

3.3.3.4 Recalculations

Vehicle Stock and Classification

In previous submissions, vehicle stock numbers were obtained from the Icelandic Transport Authority for the years starting from 2017. While for years before 2017, vehicle numbers from a dataset provided by Emisia were used. Starting from the 2026 submission, vehicle stock data for the entire time series is obtained from the vehicle registry maintained by the Icelandic Transport Authority. In that context, the classification scheme of vehicles according to category, type of fuel, segment, and years of activity based on the Icelandic vehicle registry was extended to the entire timeline.

CO₂ from Lubricant Combustion

In the past, CO₂ emissions resulting from the unintentional combustion of lubricants in road transport was estimated and reported as part of the CO₂ emissions total of 1A3b. At the same

time the respective emissions were also reported as part of the overall CO₂ emissions from combustion of lubricants under CRT category 2D1, Lubricant Use, resulting in a double counting of these emissions. Starting from the 2026 submissions, CO₂ emissions from road transport related combustion of lubricants are reported as part of the CO₂ emissions total from lubricant combustion in category 2D1 only.

Methodological Changes in COPERT

With COPERT version 5.9.1 (5.9.2 was a bugfix release) a number of methodological changes were introduced based on recent measurement data and studies²⁷. The most notable impact on emission estimates is attributed to revisions related to the consumption profile of light-duty vehicles (LDV), impacting also consumption factors for passenger cars and vans, as well as a revision of emission factors for Diesel in light-duty and heavy-duty vehicles:

Revision of consumption of LDVs running on liquid fuels

On-board fuel and energy consumption monitoring (OBFCM²⁸) data is available from 2021 onwards. Analyses of data from new cars registered in 2021 and 2022 led to notable changes in the correlation of consumed fuel and driven mileage, specifically for cars and other light-duty vehicles. The most significant outcome, implemented in the 5.9.1 release of the COPERT software, was that the consumption of liquid fuel was overestimated by an average of 14% for passenger cars and an average of 11% for vans. In the preparation of the 2026 inventory the fuel balancing feature of COPERT was used, respectively yielding fuel-adjusted mileage figures, plus 14% for cars and plus 11% for vans.

Revision of VOC and CH₄ emission factors of Diesel vehicles

Tailpipe measurement data have yielded VOC, CH₄, and N₂O emission factors for Diesel in mainly Euro 5 and 6 vehicles that deviate from the HBEFA²⁹ (Handbook of Emission Factors for Road Transport) emission factors used in the emission estimations. These data indicate that VOC and CH₄ emissions had been underestimated in Diesel fuelled passenger cars and light-duty vehicles by an order of magnitude, while they were overestimated in heavy-duty vehicles. These respective updates that were implemented in the used COPERT version led to an increase in CH₄ emissions from passenger cars and vans, as well as to an increase of N₂O and a decrease of CH₄ in heavy-duty vehicles.

Table 3.35 summarises the results of the recalculations performed on the grounds of the changes in data source and methodology outlined above as 1A3b emission totals.

²⁷ For details consult https://copert.emisia.com/wp-content/uploads/2025/10/COPERT_update_2025.pdf

²⁸ Starting from 2021, new vehicles have to be equipped with on-board fuel and energy consumption monitoring devices (OBFCM) to record the amount of fuel or electric energy used in relation to actually driven distances. See <https://climate-energy.eea.europa.eu/topics/transport/real-world-emissions/intro>

²⁹ <https://www.hbefa.net/>

Table 3.35. Summary of Road Transport recalculations done for this submission.

1A3b Road Transport	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂]	519.8	545.7	601.7	760.7	806.4	819.6	823.3	918.0	913.4
2026 submission [kt CO ₂]	519.8	545.6	601.8	760.9	806.6	819.7	823.0	916.5	911.5
Change relative to the 2025 submission [kt CO ₂]	0.01	-0.04	0.12	0.20	0.16	0.17	-0.24	-1.51	-1.91
Change relative to the 2025 submission [%]	0.002%	-0.01%	0.02%	0.03%	0.02%	0.02%	-0.03%	-0.16%	-0.21%
2025 submission [kt CH ₄]	6.24	5.65	4.23	3.33	2.36	1.84	0.78	0.79	0.79
2026 submission [kt CH ₄]	6.41	5.91	4.10	3.10	2.46	2.03	1.11	1.09	1.05
Change relative to the 2025 submission [kt CH ₄]	0.17	0.27	-0.12	-0.23	0.10	0.18	0.33	0.30	0.27
Change relative to the 2025 submission [%]	2.8%	4.7%	-2.9%	-6.9%	4.4%	9.9%	42%	38%	34%
2025 submission [kt N ₂ O]	4.67	6.84	9.82	10.94	5.73	5.36	6.21	7.18	7.12
2026 submission [kt N ₂ O]	5.00	6.85	9.27	8.95	4.86	6.51	12.77	15.71	16.03
Change relative to the 2025 submission [kt N ₂ O]	0.34	0.01	-0.54	-1.99	-0.87	1.14	6.55	8.53	8.91
Change relative to the 2025 submission [%]	7.2%	0.14%	-5.5%	-18%	-15%	21%	105%	119%	125%
2025 submission [kt CO ₂ e]	530.7	558.2	615.7	775.0	814.5	826.8	830.3	926.0	921.3
2026 submission [kt CO ₂ e]	531.2	558.4	615.2	773.0	813.9	828.3	836.9	933.3	928.6
Change relative to the 2025 submission [kt CO ₂ e]	0.52	0.24	-0.54	-2.02	-0.61	1.50	6.64	7.31	7.27
Change relative to the 2025 submission [%]	0.10%	0.04%	-0.09%	-0.26%	-0.07%	0.18%	0.80%	0.79%	0.79%

3.3.3.5 Planned Improvements

As of now, yearly average and lifetime cumulative mileage data for all years and all vehicle classes is obtained from Emisia. For future submissions, it is planned to investigate the possibility to obtain these data from domestic sources for all years available.

3.3.3.6 Uncertainties

Fuel sales uncertainties are estimated by IEEA to be within 5%. The CO₂ emission factor uncertainty is 2.8% which is based in the uncertainty of the carbon content measurements performed in 2020 on fuels used in road transport in Iceland. The emission factor uncertainties for CH₄ and N₂O are estimated to be 236% and 192%, respectively. The emission factor uncertainties for CH₄ and N₂O are found using Combined Uncertainty (for diesel, gasoline, and biomass) as per Equation 3.2 from 2006 IPCC GL, Vol 3 Chap 5 using uncertainty ranges in IPCC Volume 2 Chapter 3 Table 3.2.2.

The combined uncertainty of CO₂ emissions from road vehicles is 5.7%, CH₄ emissions it is 248% and for N₂O emissions from road vehicles is 191%. The complete uncertainty analysis is shown in Annex 2.

3.3.4 Domestic Navigation and Fishing (CRT 1A3d and 1A4ciii)

The Domestic Navigation sector (CRT 1A3d) includes all vessels of all flags which purchase fuel in Iceland and sail between two Icelandic harbours. The Fishing Ship sector (1A4ciii) includes all fishing ships of all flags which purchase fuel in Iceland.

3.3.4.1 Activity Data

1A3d Domestic Navigation

Total use of fuel for national navigation is based on annual sales statistics. Activity data for fuel combustion in Domestic Navigation are given in Table 3.36.

Table 3.36. Fuel use [in kt] in 1A3d Domestic Navigation.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Residual Fuel Oil	3.94	4.76	0.54	0.88	2.61	0.44	NO	NO	NO
Gas/Diesel Oil	6.40	7.04	3.43	6.20	8.46	7.89	7.83	5.27	4.22
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	0.005

1A4ciii Fishing

Total use of fuel for fishing is based on the annual sales statistics to fishing vessels of all flags and all destinations (domestic and international). Activity data for fuel combustion in the Fishing sector are given in Table 3.37.

Table 3.37. Fuel use [in kt] in 1A4ciii Fishing.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Residual Fuel Oil	35.6	57.2	22.3	32.6	69.9	52.4	NO	NO	NO
Gas/Diesel Oil	203	232	257	200	158	143	159	152	163
Biodiesel	NO	NO	NO	NO	NO	0.094	0.075	NO	NO

3.3.4.2 Emission Factors

Apart from Marine Diesel Oil, for which country-specific C-content values are available, default C-content and oxidation factor values are used. Default emission factors are also applied for CH₄ and N₂O for all fuel types (source: 2006 IPCC guidelines, Table 3.5.3, Volume 2, Chapter 3 for ocean-going ships). A country-specific NCV for Marine Diesel Oil based on

measurements is used from 2016 onwards. For other fuels and years, default NCVs are used. Table 3.38 summarises the applied emission factors.

Table 3.38. Emission factors for CO₂, CH₄ and N₂O for ocean-going ships.

Fuel / Factor	Value	Unit	Reference
Marine Diesel Oil			
NCV	42.89*	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1, country-specific from 2016, based on measurements
C-content	20.11*	t/TJ	Country-specific, based on measurements 2019-2021
CH ₄ emission factor	7.0	kg/TJ	Table 3.5.3 2006 IPCC Guidelines, V2, Ch3
N ₂ O emission factor	2.0	kg/TJ	Table 3.5.3 2006 IPCC Guidelines, V2, Ch3
Residual Fuel Oil			
NCV	40.4	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	21.1	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	7.0	kg/TJ	Table 3.5.3 2006 IPCC Guidelines, V2, Ch3
N ₂ O emission factor	2.0	kg/TJ	Table 3.5.3 2006 IPCC Guidelines, V2, Ch3
Biodiesel			
NCV	27.0	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1
C-content	19.3	t/TJ	Table 1.3 2006 IPCC Guidelines, V2, Ch1
CH ₄ emission factor	10.0	kg/TJ	Table 2.5 2006 IPCC Guidelines, V2, Ch2
N ₂ O emission factor	0.6	kg/TJ	Table 2.5 2006 IPCC Guidelines, V2, Ch2

*A country-specific value for the most recent inventory year

3.3.4.3 Emissions

Emissions from ocean-going ships in Iceland are dominated by the Fishing sector. Emissions from the fishing sector have decreased by approximately a third over the time series. The CO₂ equivalent emissions are shown in Table 3.39 and Figure 3.9.

Table 3.39. Emissions [kt CO₂e] from ocean-going ships.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
1A3d Domestic Navigation	32.9	37.5	12.7	22.6	35.3	26.6	25.2	16.8	13.5
1A4ciii Fishing	760	922	892	742	727	621	509	485	520
Total	793	959	904	765	762	648	535	502	533

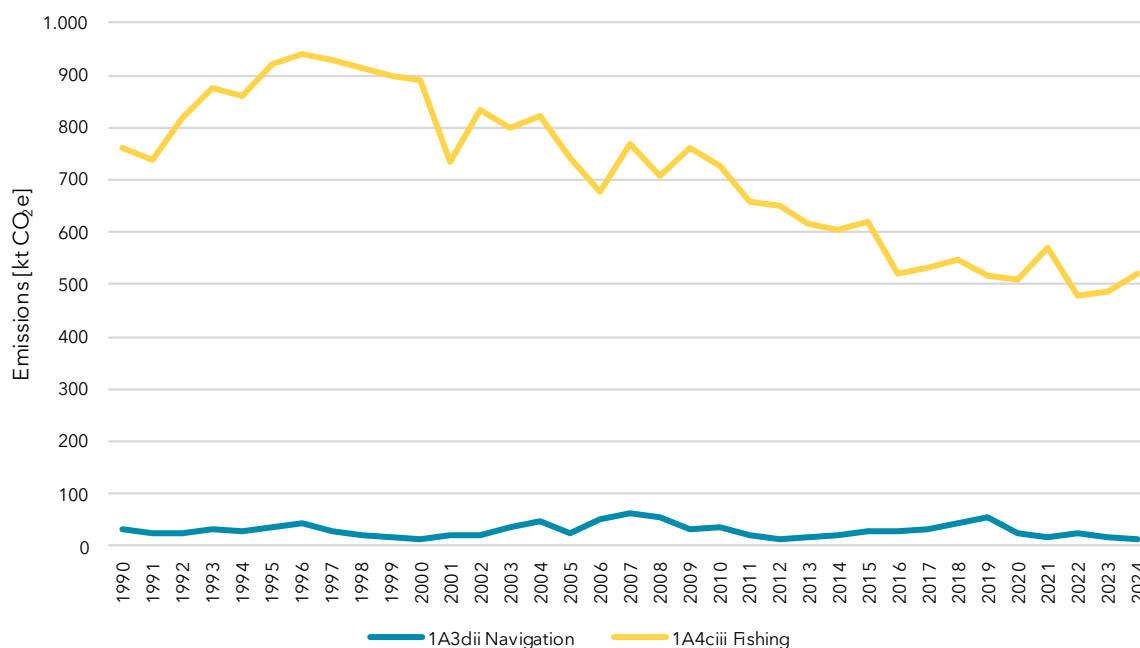


Figure 3.9. Emissions [kt CO₂e] from ocean-going ships for the whole time series.

3.3.4.4 Recalculations

No recalculations were performed for this submission for this sector.

3.3.4.5 Planned Improvements

It is planned to investigate the availability of more refined data on fleet composition/engine types in order to move to a higher tier for CH₄ and N₂O this subcategory.

3.3.4.6 Uncertainties

Fuel sales uncertainties are estimated by IEEA to be within 5%. The uncertainty of CO₂ emissions from domestic navigation is 7% (with an activity data uncertainty of 5% and emission factor uncertainty of 5%), whilst the CH₄ emissions uncertainty is 50% (with an activity data uncertainty of 5% and emission factor uncertainty of 50%) and the N₂O emissions uncertainty is 140% (with an activity data uncertainty of 5% and emission factor uncertainty of 140%). The complete uncertainty analysis is shown in Annex 2.

3.3.5 International Aviation (CRT 1D1a) (memo)

This sector includes all flights to destinations other than Iceland which purchase fuel in Iceland.

3.3.5.1 Activity Data

Activity data is provided by the IEEA, which collects data on fuel sales by sector. This dataset distinguishes between national and international usage. In Iceland there is one main airport for international flights, Keflavík International Airport (KEF). Under normal circumstances almost all international flights depart and arrive from KEF, except for some flights to Greenland, the Faroe Islands, and some flights by private airplanes which depart and arrive from Reykjavík Airport. As of recent, a small number of international flights is scheduled from/to Akureyri Airport (AEY). Domestic flights sometimes depart from KEF in case of special weather conditions. Oil products sold to KEF are reported as international usage. The deviations between national and international usage are believed to level out. Fuel quanta attributed to International Aviation are shown in Table 3.40.

Table 3.40. Fuel use [in kt] from International Aviation.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Jet Kerosene	69.4	74.6	129	133	120	214	83	305	317
Aviation Gasoline	0.199	0.184	0.032	0.396	0.010	0.009	NO	NO	NO

3.3.5.2 Emission Factors

Emission factors for International Aviation are identical to those of Domestic Aviation, which are reported in Table 3.29.

3.3.5.3 Emissions

The CO₂ equivalent emissions are shown in Table 3.41.

Table 3.41. Resulting emissions [greenhouse gases, in kt CO₂e] from International Aviation.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Emissions [kt CO ₂ e]	221	238	410	424	380	679	263	968	1007

3.3.5.4 Recalculations

No recalculations were performed for this submission for this sector.

3.3.5.5 Planned Improvements

No improvements are planned for these sectors.

3.3.5.6 Uncertainties

Fuel sales uncertainties are estimated by IEEA to be within 5%. The uncertainty of CO₂ emissions from aviation is 7% (with an activity data uncertainty of 5% and emission factor uncertainty of 5% (2006 IPCC Guidelines)), whilst the CH₄ emissions uncertainty is 100% (with an activity data uncertainty of 5% and emission factor uncertainty of 100% (highest value in the range given by the IPCC guidelines)) and the N₂O emissions uncertainty is 200% (with an activity data uncertainty of 5% and emission factor uncertainty of 150%). The complete uncertainty analysis is shown in Annex 2.

3.3.6 International Navigation (CRT 1D1b) (memo)

This sector includes all vessels of all flags which purchase fuel in Iceland and sail internationally from an Icelandic harbour.

3.3.6.1 Activity Data

The reported fuel-use numbers are based on fuel sales data from the retail suppliers. Fuel data is shown in Table 3.42.

Table 3.42. Fuel use [in kt] from International Navigation.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Residual Fuel Oil	0.25	NO	2.00	0.438	0.080	13.2	NO	6.23	0.387
Gas/Diesel Oil	8.53	1.05	15.0	0.116	NO	33.6	24.3	98.0	101

3.3.6.2 Emission Factors

Emission factors for International Navigation are identical to those of Domestic Navigation and Fishing, which are reported in Table 3.38.

3.3.6.3 Emissions

CO₂ equivalent emissions associated with International Navigation are reported in Table 3.43.

Table 3.43. Resulting emissions [greenhouse gases, in kt CO₂e] from International Navigation.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Emissions [kt CO ₂ e]	28.1	3.37	54.4	1.75	0.252	149	77.9	333	324

3.3.6.4 Recalculations

No recalculations were performed for this submission for this sector.

3.3.6.5 Planned Improvements

No improvements are planned for these sectors.

3.3.6.6 Uncertainties

Fuel sales uncertainties are estimated by IEEA to be within 5%. The uncertainty of CO₂ emissions from navigation is 7% (with an activity data uncertainty of 5% and emission factor uncertainty of 5% (2006 IPCC Guidelines)), whilst the CH₄ emissions uncertainty is 50% (with an activity data uncertainty of 5% and emission factor uncertainty of 50% (highest value in the range given by the IPCC guidelines)) and the N₂O emissions uncertainty is 140% (with an activity data uncertainty of 5% and emission factor uncertainty of 140%). The complete uncertainty analysis is shown in Annex 2.

3.4 Fugitive Emissions and Geothermal Energy (CRT 1B)

3.4.1 Fugitive Emissions from Fuels (CRT 1B2av and 1B2bv)

This sector includes emissions from distribution of oil products (1B2av), which in Iceland includes distribution of gasoline, jet kerosene, other kerosene, gas/diesel oil, residual fuel oil, LPG, biogasoline and biodiesel. Distribution of biomethane is reported in distribution of gas products (1B2bv).

3.4.1.1 Activity Data

Activity data is the total fuel sold (assumed same as fuel use) and is provided in Table 3.44.

Table 3.44. Fuel use [in kt] from distribution of oil and gas products.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Gasoline	67.1	118	143	157	148	132	91.6	93.9	101
Gasoline, lead	60.7	18.0	NO	NO	NO	NO	NO	NO	NO
Aviation Gasoline	1.88	1.32	1.13	1.27	0.66	0.51	0.20	0.17	0.12
Jet Kerosene	78.32	83.0	137	141	126	220	86.9	311	323
Other Kerosene	NO	NO	NO	0.173	1.22	0.186	0.356	0.053	0.048
Gas/Diesel Oil	309	335	404	386	318	353	386	485	494
Residual Fuel Oil	98.8	121	71.2	59.1	89.1	76.5	1.22	8.15	2.88
LPG	1.19	1.15	2.03	2.35	2.64	2.14	2.52	3.32	4.26
Biogasoline	NO	NO	NO	NO	NO	1.93	11.0	20.7	12.2
Biodiesel	NO	NO	NO	NO	NO	12.0	13.1	2.94	20.6
Biomethane	NO	NO	0.0060	0.96	0.60	2.18	1.55	1.57	1.78

3.4.1.2 Emission Factors

The tier 1 emission factors are taken from Table 4.2.4 in the 2006 IPCC Guidelines. These emission factors can be seen in Table 3.45. Currently, N₂O emissions are however not included in national totals since it cannot be entered into the CRT.

Table 3.45. Emission factors for 1B2a5 and 1B2b5 Fugitive Emissions from Fuels.

Fuel / Factor	Value	Unit	Reference
Liquid Fuels			
CO ₂ emission factor	2.30E-06	Gg per 1,000 m ³ total oil transported	Table 4.2.4 2006 IPCC Guidelines Tanker Trucks and Rail Cars
CH ₄ emission factor	2.50E-05	Gg per 1,000 m ³ total oil transported	
N ₂ O emission factor	NA		
LPG			
CO ₂ emission factor	4.30E-04	Gg per 1,000 m ³ total LPG	Table 4.2.4 2006 IPCC Guidelines Liquefied Petroleum Gas
CH ₄ emission factor	NA		
N ₂ O emission factor	2.20E-09	Gg per 1,000 m ³ total LPG	
Biodiesel and bioethanol			
CO ₂ emission factor	NA		Table 4.2.4D (New), Vol. 2, Ch. 4, 2019 Refinements, Refined Product Distribution - Other
CH ₄ emission factor	NA		
N ₂ O emission factor	NA		
Biomethane			
CO ₂ emission factor	0.02	t per 1,000,000 m ³ gas consumption	Table 4.2.4J (New), Vol. 2, Ch. 4, 2019 Refinements, Gas Distribution - Greater than 50% plastic pipelines, and leak detection and repair programs are in use
CH ₄ emission factor	0.62	t per 1,000,000 m ³ gas consumption	
N ₂ O emission factor	NA		

3.4.1.3 Emissions

Emissions from distribution of oil products are estimated by multiplying the total fuel sold with emission factors. Resulting emissions are provided in Table 3.46.

Table 3.46. Resulting greenhouse gas emissions [in kt CO₂e] from distribution of oil and gas products.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Distribution of oil products (1B2av) emissions [kt CO ₂ e]	0.520	0.570	0.642	0.635	0.581	0.666	0.484	0.768	0.789
Distribution of gas products (1B2bv) emissions [kt CO ₂ e]	NO	NO	1.45E-4	0.023	0.014	0.053	0.038	0.038	0.043
Distribution of oil and gas products emissions [kt CO ₂ e]	0.520	0.570	0.643	0.659	0.596	0.719	0.521	0.806	0.832

3.4.1.4 Recalculations

The activity data for residual fuel oil for the year 2000 was updated from the fuel sale statistics. The activity data for gas/diesel oil for the year 2022 was updated from industrial reports. Biofuels are now included in the activity data. This caused recalculations for 2000-2023 that can be seen in the table below.

Table 3.47. Summary of recalculations done for this submission [kt CO₂e].

1B2av and 1B2bv Oil and Gas Distribution	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	0.6424	0.64	0.58	0.67	0.48	0.73	0.77
2026 submission [kt CO ₂ e]	0.6426	0.66	0.60	0.72	0.52	0.77	0.81
Change relative to the 2025 submission [kt CO ₂ e]	0.00017	0.02	0.01	0.05	0.04	0.04	0.04
Change relative to the 2025 submission [%]	0.026%	3.7%	2.5%	7.9%	7.8%	5.2%	5.0%

3.4.1.5 Planned Improvements

No improvements are planned for this sector.

3.4.1.6 Uncertainties

Uncertainty for the activity data (fuel sales) is estimated by the IEEA to be 5%. Emission factor uncertainties for the transport of oil products including LPG are 50% for CO₂ and 50% for CH₄ (2006 IPCC Guidelines Tier 1 emission factors for fugitive emissions from oil and gas operations), yielding combined uncertainties of 50.25% for both, CO₂ and CH₄. For the distribution of biogenic methane, Tier 1 emission factors for gas distribution defined in the 2019 Refinement to the 2006 IPCC Guidelines are used, with a CH₄ emission factor uncertainty of 120%, resulting in a combined uncertainty of 120.1% for CH₄. The complete uncertainty analysis is shown in Annex 2.

3.4.2 Geothermal Energy (CRT 1B2d)

This category includes emissions from all geothermal power plants in Iceland, mostly combined heat and power (CHP) plants but also power-only or heat-only plants. Currently there is no disaggregation between emissions associated with district heating and those associated with electricity production. All reported emissions are from geothermal systems classified as high temperature. Emissions from direct hot water use from low-temperature geothermal resources are not thought to result in significant greenhouse gas emissions (Fridriksson Th, 2016) and are not included in the inventory.

Iceland relies heavily on geothermal energy for space heating (90%) and to a significant extent for electricity production (around 30% in the past few years). In addition to CO₂, small amounts of methane and considerable quantities of sulphur in the form of hydrogen

sulphide (H₂S) are emitted from geothermal power plants. The H₂S values are stoichiometrically converted to SO₂ and reported as such.

3.4.2.1 Activity Data

The IEEA collects data from power companies regarding emissions from geothermal power plants. This includes data for CO₂, CH₄, and H₂S emissions from CHP plants, electric power plants, and one heat plant.

Table 3.48 shows the electricity production with geothermal energy and the total CO₂, CH₄ (in CO₂e), and H₂S emissions (in SO₂e).

Table 3.48. Electricity production and emissions from geothermal energy in Iceland.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Electricity Productions [GWh]	283	290	1,323	1,658	4,465	5,003	5,961	6,006	5,986
CO ₂ emissions [kt]	60.8	82.1	153	118	190	168	173	172	219
CH ₄ emissions [kt CO ₂ e]	0.22	0.23	1.04	1.30	5.12	4.31	3.82	4.56	4.57
H ₂ S emissions [kt SO ₂ e]	13.3	11.0	26.0	30.3	58.7	44.9	39.1	35.6	41.1

3.4.2.2 Method Approach

The CO₂ concentration in the geothermal steam is site- and time-specific and can vary greatly with time, as well as between areas.

The methodology used for estimating the emissions from geothermal power plants is described in the report "Gaslosun jarðvarmavirkjana á Íslandi 1970-2009" (e. Gas emissions of geothermal power plants in Iceland 1970-2009) (Baldvinsson, Þórisdóttir, & Ketilsson, 2011). The report describes the methodologies that the operating power companies (Orkuveitan, HS Orka, and Landsvirkjun) use when estimating the gas emissions. The power companies use similar methodologies, e.g., calculations based on measurements of the flow of steam through the plants and chemical analyses of the steam. HS Orka, Landsvirkjun and Orkuveitan collect samples at the well-head and at the separator-station. In the case when power plants were under construction, prior to generation of electricity, the estimated emissions are based on gas release from the individual holes that are allowed to blow steam into the atmosphere prior to their harnessing into the turbines of the prospective power plant.

Emissions of CH₄ and H₂S are also calculated in a similar way to CO₂, e.g., based on chemical measurements. H₂S has been measured for the whole time series. Methane has been measured consistently at most plants from 2008.

3.4.2.3 Emissions

Greenhouse gas emissions from geothermal energy production are subject to large fluctuations over the time series, reflecting geological and hydrological changes occurring during exploitation of the geothermal resource. The drivers for the trends in greenhouse gas emissions are complex and vary from one geothermal field to the next. Processes such as steam cap formation can lead to increased greenhouse gas concentrations if geothermal production taps from the steam cap, whereas concentrations are lower in the deeper part of the reservoir; furthermore, reinjection of fluids after heat extraction (fluids now poorer in dissolved gases) can lead to generally gas-poorer systems (see also Chapter 2.1 of Fridriksson et al., 2016: Greenhouse gases from geothermal power production, Technical Report 009/16 of the Energy Sector Management Assistance Program (The World Bank)).

In Figure 3.10, emissions from 1B2d Geothermal power can be seen for the whole timeline. The sharp increases in emissions in 1998 and 2006 are due to new power plants. In 1998, Nesjavellir started operation and in 2006 two power plants started operations, Hellisheiði and Reykjanes.

Two power plants, Hellisheiði and Nesjavellir, are currently capturing gases from their outgoing gas streams. The CarbFix project, located at the Hellisheiði and Nesjavellir power plants, has been pioneering CO₂ capture and reinjection on site into the basaltic subsurface, and has proven rapid and complete reaction to calcium carbonate precipitate (Matter, et al., 2016). Reported emissions from the Hellisheiði and Nesjavellir have been adjusted to reflect the amount of injected CO₂. The CO₂ captured and injected can be seen in Table 3.49. This is reported as recovery in CRT 1B2d but also as Memo item in CRT 1D4 (CO₂ captured for domestic storage). A sister project, SulFix, consists of separating H₂S from the stream and also reinjecting the gas into the subsurface and mineralizing on contact with the basalt host rock.

Table 3.49. Amount of CO₂ captured and injected using the Carbfix method.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2023	2024
CarbFix – Mineralised [kt CO ₂]	-0.040	-0.057	-2.78	-4.98	-8.97	-12.3	-12.1	-10.4	-11.5	-12.6	-12.1

At the George Olah Renewable Methanol Plant in Svartsengi, on the Reykjanes peninsula in southwest Iceland, Carbon Recycling International recycled part of the CO₂ emitted by Svartsengi and converted it to methanol, which was mostly exported (Carbon Recycling International, 2018). Emissions captured and utilised at the George Olah Plant were not subtracted from the total emissions of the geothermal power plant in Svartsengi. The plant has been temporarily closed since 12 April 2019.

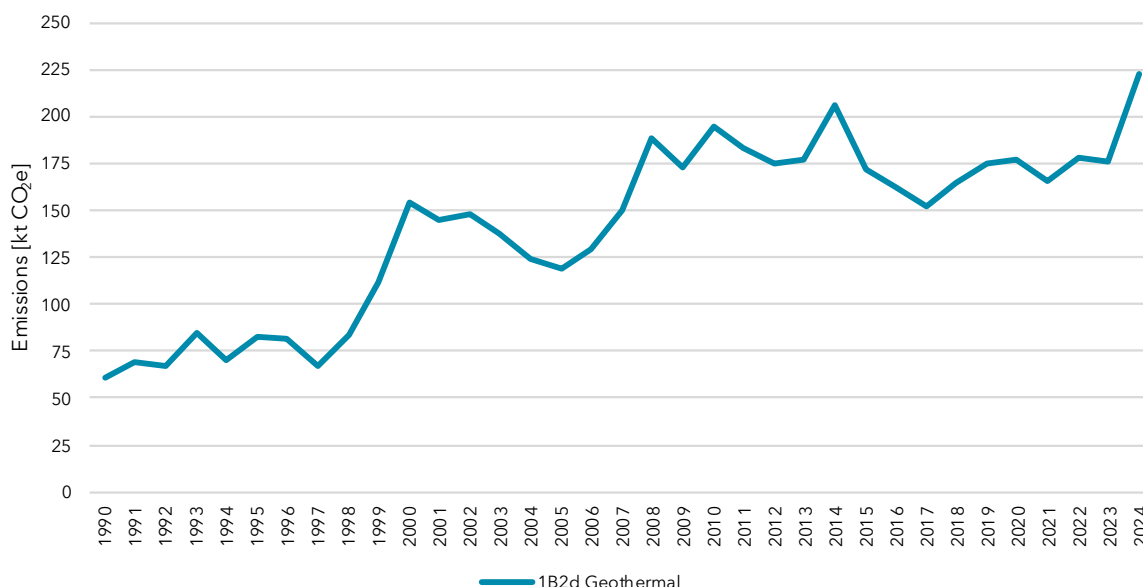


Figure 3.10. Emissions from 1B2d Geothermal Power.

3.4.2.4 Recalculations

Due to updates in activity data from the geothermal power plants, recalculations were performed for CH₄ emissions for 1990-2007, 2014-2020 and 2022-2023 and for CO₂ emissions for the whole timeline. The table below shows the recalculations.

Table 3.50. Summary of recalculations done for this submission [kt CO₂e].

	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	61.6	82.5	154.2	119.4	194.8	167.6	179.2	178.1	176.7
2026 submission [kt CO ₂ e]	61.1	82.3	154.1	119.3	194.7	172.3	177.2	177.9	176.6
Change relative to the 2025 submission [kt CO ₂ e]	-0.51	-0.16	-0.026	-0.18	-0.04	4.7	-1.9	-0.251	-0.06
Change relative to the 2025 submission [%]	-0.83%	-0.19%	-0.017%	-0.15%	-0.02%	2.8%	-1.1%	-0.14%	-0.03%

3.4.2.5 Planned Improvements

No improvements are planned for this sector.

3.4.2.6 Uncertainties

CO₂ and CH₄ emissions have an uncertainty of 10% for the CO₂ values, and of 25% for the CH₄ values. The complete uncertainty analysis is shown in Annex 2.

3.5 CO₂ Transport and Storage (CRT 1C)

Two geothermal power plants, Hellisheiði and Nesjavellir, are currently capturing gases from their outgoing gas streams. The CarbFix project, located at the Hellisheiði and Nesjavellir power plants, has been pioneering CO₂ capture and reinjection on site into the basaltic subsurface (see chapter about geothermal energy, CRT 1B2d). The 2006 IPCC Guidelines (Vol. 2, Ch. 5) provide emission estimation guidance for carbon dioxide transport, injection and geological storage only. However, no emissions estimation methods are provided for cases such as CarbFix, where CO₂ is mineralised and converted into inorganic carbonates.

At both plants, the CO₂ is injected on-site and no amount is transported. The amount of injected and stored CO₂ (activity data) is presented in Table 3.51. Monitoring of possible emissions from injection and storage is planned for the near future. Currently, the emissions from the injection and storage are reported as NE.

Table 3.51. Amount of CO₂ injected and stored.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2023	2024
Injected and stored [kt CO ₂]	0.040	0.057	2.78	4.98	8.97	12.3	12.1	10.4	11.5	12.6	12.1

3.5.1.1 Planned Improvements

Monitoring of possible emissions from injection and storage is planned for the near future.

3.5.1.2 Uncertainties

No uncertainties applicable since there are no emissions estimated.

3.6 Reference Approach, Feedstocks, and Non-Energy Use of Fuels (CRT 1AB, 1AC, and 1AD)

3.6.1 Reference Approach

Emissions calculations are conducted using the Sectoral Approach (SA), which is a “bottom-up” method that relies on fuel sales statistics as gathered and provided by IEEA. However, there is also the Reference Approach (RA), which uses a “top-down” method that relies on national energy statistics that are collected and provided to Eurostat by the IEEA. The RA is not used for reporting of emissions but rather serves as a means to check the values obtained through the SA. According to Volume 2, Chapter 6 of the IPCC guidelines, the RA and SA are likely to be within $\pm 5\%$ of each other for each fuel type.

Information regarding the acquisition of subsector-specific activity data (upon which the SA relies) can be found throughout Chapter 3, but the majority of it is provided to the IEEA (previously by the NEA which is now a part of IEEA). The RA relies on fuel imports, stock changes, and international navigation and aviation to calculate emissions. This data is also provided to the EAI (previously by the NEA which is now a part of IEEA).

Calculations for the RA are conducted according to the 2006 IPCC Guidelines, and a comparison is made with the SA for each fuel type, as well as an overall aggregated comparison for all fuel types. Currently, large discrepancies exist between the two approaches for some of the reporting years, while for other years the difference between the two approaches is less than $\pm 5\%$ (Table 3.52). The table does not include gaseous fuels because they are NO for the whole time series. Peat is not included as it is only used for non-energy purposes.

The IEEA has been working to identify the possible causes of discrepancies that are larger than $\pm 5\%$. It may not be possible to identify the exact causes of discrepancies for earlier years in the times series, however, in recent years the most likely causes of discrepancies are incorrect reporting in imports by the fuel companies that provide data to the IEEA; this incorrect reporting is likely due to the allocation of certain fuels to the wrong import category. It should be noted that this is not definitive and there may in fact be other causes for the discrepancies.

Table 3.52. Apparent consumption for the Reference and Sectoral Approaches.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Liquid fuels									
Sectoral Approach (TJ)	23,090	25,726	26,314	26,650	24,290	22,555	19,868	21,232	21,802
Reference Approach (TJ)	23,629	23,682	24,131	24,721	21,776	22,588	20,293	22,501	21,715
Difference (%)	2.3%	-7.9%	-8.3%	-7.2%	-10.3%	0.1%	2.1%	6.0%	-0.4%
Solid fuels									
Sectoral Approach (TJ)	480	223	342	256	94	NO	NO	NO	NO
Reference Approach (TJ)	335	181	361	361	103	NO	NO	NO	NO
Difference (%)	-30%	-19%	6%	41%	10%	—	—	—	—
Other fossil fuels									
Sectoral Approach (TJ)	NO	217	264	94	90	64	15	168	80
Reference Approach (TJ)	NO	7.0	9.1	9.0	17	NO	NO	NO	NO
Difference (%)	—	-97%	-97%	-90%	-81%	-100%	-100%	-100%	-100%
Total									
Sectoral Approach (TJ)	23,570	26,166	26,920	27,000	24,474	22,619	19,883	21,400	21,882
Reference Approach (TJ)	23,964	23,870	24,501	25,091	21,896	22,588	20,293	22,501	21,715

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Difference (%)	1.67%	-8.8%	-9.0%	-7.1%	-10.5%	-0.1%	2.1%	5.1%	-0.8%

The aggregated discrepancy between the RA and SA apparent consumption has exceeded the IPCC guideline of $\pm 5\%$ twice in the past five years, and more than 20 times since 1990. In the latest inventory year, total energy use calculated using the SA were 5.0% lower than those calculated using the RA.

For specific fuels, the biggest single-year differences are generally observed in jet kerosene, residual fuel oil, and LPG and these fuels are the most likely to be contributing to the aggregated discrepancies. As of this submission, the reason for the discrepancies between the RA and SA for these specific fuels is unclear, but the IEEA will continue to work to investigate.

Annex 3 shows the national energy balance, including a detailed description of the reference approach and the results of the emission comparison between the reference approach and the sectoral approach.

3.6.2 Feedstock and Non-Energy Use of Fuels

Emissions from the Use of Feedstock are estimated according to 2006 IPCC Guidelines and are accounted for in the Industrial Processes sector in the Icelandic inventory. This includes all use of anthracite, coking coal, other-bituminous coal, coke-oven coke petroleum coke, and a large part of lubricants.

4 Industrial Processes and Product Use (CRT Sector 2)

4.1 Overview

The production of raw materials is the main source of greenhouse gas emissions related to Industrial Processes. Another significant source is the use of HFCs as substitutes for ozone depleting substances in refrigeration and air-conditioning. The dominant category within the IPPU sector is metal production where almost all of the emissions are reported under the EU ETS (Directive 2003/87/EC).

4.1.1 Methodology

greenhouse gas emissions from industrial processes are calculated according to methodologies described in the 2006 IPCC Guidelines, using the highest possible tier. For the activities reported under the EU ETS, activity data and emission factors are taken from verified EU ETS annual emissions reports. For other activities, activity data is taken from Environmental information (according to Icelandic regulation No 990/2008 (formally called Green Accounting in accordance with Icelandic regulation No 851/2002 which is no longer in force)) reports, sales statistics and/or import/export statistics, or directly from the operators. Detailed methodological approaches are described for each source stream individually. As specified in the 2006 IPCC guidelines, emissions reported in this chapter include all emissions resulting from the production processes themselves. All emissions resulting from the burning of fuel as a source of energy are included in the Energy sector. Table 4.1 gives an overview of the reported emissions, calculation methods and type of emission factors. The methodologies are described under each of the CRT categories in the respective chapters.

NF₃ is reported in the Icelandic Inventory as "NO" or "NA." The Chemical Unit of the IEEA has confirmed that NF₃ is not used in Iceland and has not been imported as such (the Directorate of Customs registers all imported goods to Iceland). In addition, no industry potentially using NF₃ (e.g., semiconductors, LCD manufacture, solar panels and chemical lasers) is present.

Table 4.1. Reported emissions, calculation methods and type of emission factors used in the Icelandic inventory. PS: Plant specific, CS: Country specific, D: Default, OTH: Other.

CRT	Sector name	Reported emissions	Method	Emission factor
2A	Mineral Industry			
2A1	Cement Production (until 2011)	CO ₂	Tier 2	PS
2A4d	Mineral Wool	CO ₂	Tier 3	PS
2B	Chemical Industry			
2B10	Diatomite Production (until 2004)	CO ₂	Tier 3	PS

CRT	Sector name	Reported emissions	Method	Emission factor
2B10	Fertiliser Production (until 2001)	N ₂ O	OTH	PS
2C	Metal Industry			
2C1	Iron and Steel Production (2014-2016)	CO ₂	Tier 1	D
2C2	Ferroalloys Production	CO ₂	Tier 3/Tier 1	PS
2C2	Ferroalloys Production	CH ₄	Tier 2	D
2C3	Aluminium Production	CO ₂	Tier 3	PS
2C3	Aluminium Production	PFC	Tier 2	D
2D	Non-Energy Products from Fuels and Solvent Use			
2D1	Lubricant Use	CO ₂	Tier 1	D
2D2	Paraffin Wax Use	CO ₂	Tier 1	D
2D3a	Domestic Solvent Use	CO ₂	Tier 2b	D
2D3b	Road paving with Asphalt	CO ₂	Tier 1	D
2D3d	Other: Coating applications	CO ₂	Tier 2	D
2D3d	Other: Degreasing	CO ₂	Tier 1	D
2D3d	Other: Dry cleaning	CO ₂	Tier 2	D
2D3d	Other: Paint Manufacturing	CO ₂	Tier 2	D
2D3d	Other: Printing	CO ₂	Tier 1	D
2D3d	Other: Creosote	CO ₂	Tier 2	D
2D3d	Other: Organic Preservatives	CO ₂	Tier 2	D
2D3d	Other: De-icing	CO ₂	Tier 2	D
2D3d	Other: Urea Based Catalytic Converters	CO ₂	Tier 1	D
2F	Product Uses as Substitutes for ODS			
2F1a	Commercial Refrigeration	HFCs	Tier 2a	D
2F1a	Commercial Refrigeration	PFCs	Tier 2a	D
2F1b	Domestic refrigeration	HFCs	Tier 2a	D
2F1c	Industrial Refrigeration	HFCs	Tier 2a	D
2F1c	Industrial Refrigeration	PFCs	Tier 2a	D
2F1d	Transport Refrigeration	HFCs	Tier 2a	D
2F1d	Transport Refrigeration	PFCs	Tier 2a	D
2F1e	Mobile Air-Conditioning	HFCs	Tier 2a	D
2F1f	Stationary Air-Conditioning	HFCs	Tier 2a	D
2F4	Aerosols	HFCs	Tier 1a	D
2G	Other Product Manufacture and Use			
2G1	Use of Electric Equipment	SF ₆	Tier 2	CS
2G2b	SF ₆ and PFCs from Other Product Use	SF ₆	Tier 2	CS
2G3ab	N ₂ O from Product Use	N ₂ O	D	D
2G4	Other: Tobacco consumption	CH ₄	Tier 2	OTH
2G4	Other: Tobacco consumption	N ₂ O	Tier 2	OTH
2G4	Other: Fireworks use	CO ₂	Tier 2	OTH

CRT	Sector name	Reported emissions	Method	Emission factor
2G4	Other: Fireworks use	CH ₄	Tier 2	OTH
2G4	Other: Fireworks use	N ₂ O	Tier 2	OTH

4.1.2 Key Category Analysis

The key sources for the first and latest inventory years and the timeline trend in the Industrial processes sector are shown in Table 4.2 (compared to total emissions without LULUCF) and Table 4.3 (compared to total emissions with LULUCF).

Table 4.2. Key categories for Industrial Processes (excluding LULUCF).

IPCC source category	Gas	Level 1990	Level 2024	Trend
2A1 Mineral Industry - Cement	CO ₂	✓		✓
2B10 Fertiliser Production	N ₂ O	✓		✓
2C2 Ferroalloys Production	CO ₂	✓	✓	✓
2C3 Aluminium Production	CO ₂	✓	✓	✓
2C3 Aluminium Production	PFCs	✓	✓	✓
2F1 Refrigeration and Air Conditioning	HFCs		✓	

Table 4.3. Key categories for Industrial Processes (including LULUCF).

IPCC source category	Gas	Level 1990	Level 2024	Trend
2A1 Mineral Products: Cement	CO ₂	✓		
2C2 Ferroalloys Production	CO ₂	✓	✓	✓
2C3 Aluminium Production	CO ₂	✓	✓	✓
2C3 Aluminium Production	PFCs	✓		✓

4.1.3 Completeness

Table 4.4 gives an overview of the 2006 IPCC source categories included in this chapter and presents the status of emission estimates from all subcategories in the Industrial Processes and Product Use sector. The emissions marked “Not Estimated” are possibly occurring, but no default methodology is available to calculate them.

Table 4.4. Industrial Processes - Completeness (E: estimated, NE: not estimated, NA: not applicable, IE: included elsewhere).

Sector	Greenhouse gases						Indirect Greenhouse Gases			
	CO ₂	CH ₄	N ₂ O	HFC	PFC	SF ₆	NO _x	CO	NMVOC	SO ₂
2A Mineral Industry										
2A1 Cement Production (until 2011)	E	NA	NA	NA	NA	NA	NA	NA	NA	IE ⁵

Greenhouse gases					Indirect Greenhouse Gases					
2A2 Lime Production					NOT OCCURRING					
2A3 Glass Production					NOT OCCURRING					
2A4a Ceramics					NOT OCCURRING					
2A4b Other Uses of Soda Ash	IE ¹	NA	NA	NA	NA	NA	IE	NA	NA	NA
2A4c Non-metallurgical Magnesium Production					NOT OCCURRING					
2A4d Mineral Wool, Ferrosilicon production	E, IE ²	NA	NA	NA	NA	NA	NA	E	NA	E
2B Chemical Industry										
2B1 Ammonia Production (until 2001)	NA	NA	IE ³	NA	NA	NA	IE ³	NA	NA	NA
2B2 Nitric Acid Production					NOT OCCURRING					
2B3 Adipic Acid Production					NOT OCCURRING					
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production					NOT OCCURRING					
2B5 Carbide Production					NOT OCCURRING					
2B6 Titanium Dioxide Production					NOT OCCURRING					
2B7 Soda Ash Production					NOT OCCURRING					
2B8a Methanol production (from 2012)	NA ⁴	NA ⁴	NA	NA	NA	NA	NA	NA	NA	NA
2B9 Fluorochemical Production					NOT OCCURRING					
2B10 Other: Diatomite Production (until 2004)	E	NA	NA	NA	NA	NA	E	NA	NA	NA
2B10 Other: Fertiliser Production (until 2001)	NA	NA	E	NA	NA	NA	E	NA	NA	NA
2C Metal Industry										
2C1 Iron and Steel Production (2014-2016)	E	NA	NA	NA	NA	NA	E	E	E	E
2C2 Ferroalloys Production	E	E	NA	NA	NA	NA	E	E	E	E
2C3 Aluminium Production	E	NA	NA	NA	E	NA	E	E	NA	E
2C4 Magnesium Production					NOT OCCURRING					
2C5 Lead Production					NOT OCCURRING					
2C6 Zinc Production					NOT OCCURRING					
2C7 Other					NOT OCCURRING					
2D Non-Energy Products from Fuels and Solvent Use										
2D1 Lubricant Use	E	NA	NA	NA	NA	NA	NA	NA	NA	NA
2D2 Paraffin Wax Use	E	NA	NA	NA	NA	NA	NA	NA	NA	NA
2D3a Domestic solvent use	E	NA	NA	NA	NA	NA	NA	NA	E	NA
2D3b Road paving w. asphalt	E	NA	NA	NA	NA	NA	NA	NA	E	NA

Greenhouse gases						Indirect Greenhouse Gases				
2D3d Coating Applications	E	NA	NA	NA	NA	NA	NA	NA	E	NA
2D3e Degreasing	E	NA	NA	NA	NA	NA	NA	NA	E	NA
2D3f Dry cleaning	E	NA	NA	NA	NA	NA	NA	NA	E	NA
2D3g Paint Manufacturing	E	NA	NA	NA	NA	NA	NA	NA	E	NA
2D3h Printing	E	NA	NA	NA	NA	NA	NA	NA	E	NA
2D3i Other: Creosote	E	NA	NA	NA	NA	NA	NA	NA	E	NA
2D3i Other: Organic preservatives	E	NA	NA	NA	NA	NA	NA	NA	E	NA
2D3i Other: De-icing	E	NA	NA	NA	NA	NA	NA	NA	E	NA
2D3 Urea based catalytic converters	E	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E Electronics Industry						NOT OCCURING				
2F Product Uses as Substitutes for Ozone Depleting Substances										
2F1a Commercial Refrigeration	NA	NA	NA	E	E	NA	NA	NA	NA	NA
2F1b Domestic refrigeration	NA	NA	NA	E	NA	NA	NA	NA	NA	NA
2F1c Industrial Refrigeration	NA	NA	NA	E	E	NA	NA	NA	NA	NA
2F1d Transport Refrigeration	NA	NA	NA	E	E	NA	NA	NA	NA	NA
2F1e Mobile Air-Conditioning	NA	NA	NA	E	NA	NA	NA	NA	NA	NA
2F1f Stationary Air-Conditioning	NA	NA	NA	E	NA	NA	NA	NA	NA	NA
2F2 Foam Blowing Agents						NOT OCCURING				
2F3 Fire Protection						NOT OCCURING				
2F4 Aerosols	NA	NA	NA	E	NA	NA	NA	NA	NA	NA
2F5 Solvents						NOT OCCURING				
2F6 Other Applications						NOT OCCURING				
2G Other Product Manufacture and Use										
2G1 Use of Electric Equipment	NA	NA	NA	NA	NA	E	NA	NA	NA	NA
2G2 SF ₆ and PFCs from Other Product Uses	NA	NA	NA	NA	NA	E	NA	NA	NA	NA
2G3 N ₂ O from Product Use	NA	NA	E	NA	NA	NA	NA	NA	NA	NA
2G4 Other: Tobacco consumption	NA	E	E	NA	NA	NA	E	E	E	NA
2G4 Other: Fireworks use	E	E	E	NA	NA	NA	E	E	NA	E
2H Other										
2H1 Pulp and Paper Industry						NOT OCCURING				
2H2 Food and Beverage Industry	NA	NA	NA	NA	NA	NA	NA	NA	E	NA
2H3 Other						NOT OCCURING				

¹ CO₂ emissions linked to process use of soda ash are included in 2B10 Diatomite production (Diatomite production stopped in 2004)

² CO₂ emissions from other process use of carbonates occur both from Mineral wool production and from carbonates used in the ferroalloy industry. Mineral wool production emissions are reported under 2A4d, whereas CO₂ emissions from limestone in ferroalloy production are included in 2C2 Ferroalloy production.

³ Ammonia was produced at the fertiliser production plant that closed in 2001. Resulting emissions of N₂O and NO_x are reported under 2B10 Fertiliser production.

⁴ Methanol production uses geothermal fluids from a near-by geothermal power plant, therefore emissions linked to this activity are reported under 1B2 Geothermal Energy.

⁵ SO₂ emissions were reported by the plant and included both process-related and combustion-related SO₂ emissions, and these emissions are all reported under 1A2.

4.1.4 Source-Specific QA/QC Procedures

General QA/QC activities, as listed in Chapter 1.5, are performed for the IPPU sector. Further sector-specific activities include the following:

- Calculations of CO₂ and PFC emissions from activities falling under the EU ETS Directive (2003/87/EC) are cross-checked with the annual emission reports verified by accredited EU ETS verifiers (according to Article 67 of Directive 2003/87/EC) since 2013. This applies to activities within CRT categories 2.A.4.d, 2.C.2 and 2.C.3.
- Participation in a Nordic expert group on F gases, funded by the Nordic Council of Ministers, discussing, and comparing methods and parameters used by the various Nordic countries.
- Regular visits with the inspections team of the IEAA to factories/companies to increase transparency, knowledge, and accuracy through active dialogue with the field.
- Review of the IPPU chapter in this NID by external stakeholders.

4.2 Mineral Products (CRT 2A)

4.2.1 Cement Production (CRT 2A1)

The single operating cement plant in Iceland was closed in 2011. The plant produced cement from shell sand and rhyolite in a rotary kiln using a wet process. Emissions of CO₂ originate from the calcination of the raw material, calcium carbonate, which comes from shell sand in the production process. The resulting calcium oxide is heated to form clinker and then crushed to form cement.

4.2.1.1 Methodology

Emissions are calculated according to the Tier 2 method of the 2006 IPCC Guidelines (Equation 2.2, Volume 3, Chapter 2), based on clinker production data and data on the CaO content of the clinker. Cement Kiln Dust (CKD) is non-calcined to fully calcined dust produced in the kiln. CKD may be partly or completely recycled in the kiln. Any CKD that is not recycled

can be considered lost to the system in terms of CO₂ emissions. Emissions are thus corrected with plant specific cement kiln dust correction factor.

Equation 2.2

$$\text{CO}_2 \text{ emissions} = M_{cl} * EF_{cl} * CF_{ckd}$$

Where:

CO₂ emissions = emissions of CO₂ from cement production, tonnes

M_{cl} = weight (mass) of clinker production, tonnes

EF_{cl} = clinker emission factor, tonnes CO₂/tonnes clinker; $EF_{cl} = 0.785 \times \text{CaO content}$

CF_{ckd} = emissions correction factor for non-recycled cement kiln dust, dimensionless

Process-specific data on clinker production, the CaO content of the clinker and the amount of non-recycled CKD were collected by the EAI directly from the cement production plant. Data on clinker production is only available from 2003 onwards. Historical clinker production data has been calculated as 85% of cement production, which was the average proportion for 2003 and 2004.

The production at the cement plant decreased slowly between 2000 and 2004. The construction of the Kárahnjúkar hydropower plant (building time from 2002 to 2007) along with increased activity in the construction sector (from 2003 to 2007) increased demand for cement, and the production at the cement plant increased again between 2004 and 2007, although most of the cement used in the country was imported. In 2011, clinker production at the plant was significantly less than in 2007, due to the collapse of the construction sector. Late 2011 the plant ceased operation.

Table 4.5. Clinker production and CO₂ emissions from cement production from 1990-2011. The cement factory ceased its activities in 2011.

Year	Cement Production [t]	Clinker Production [t]	CaO Content of Clinker	EF _{cl}	CF _{ckd}	CO ₂ Emissions [kt]
1990	114,100	96,985	63.0%	0.495	108%	51.6
1995	81,514	69,287	63.0%	0.495	108%	36.8
2000	142,604	121,213	63.0%	0.495	108%	64.4
2005	126,123	99,170	63.0%	0.495	110%	53.9
2010	33,489	18,492	63.3%	0.497	108%	9.9
2011	38,048	35,441	64.2%	0.504	110%	19.6
2012	-	-	-	-	-	-

It has been estimated by an expert at the cement production plant that the CaO content of the clinker was 63% for all years from 1990 to 2006. From 2007 the CaO content is based on chemical analysis at the plant, as presented in Table 4.5. The cement factory was undergoing rough operating conditions, leading to the closing of the factory in 2011. The cement kiln

was only running for 8 weeks in 2010, while the cement grinder was active longer. This is the reason for the significant inter-annual change in the CO₂ IEF between 2010 and 2011.

4.2.1.2 Recalculations

No category-specific recalculations were done for this submission.

4.2.1.3 Planned Improvements

No improvements are currently planned for this category.

4.2.1.4 Uncertainties

The uncertainty on activity data is assumed 2.0% which is the higher value of range given for plant reported production data (Table 2.3, Volume 3, Chapter 2, IPCC Guidelines). The uncertainty of emission factor is 30% which is the median value of the default uncertainty for CKD (Table 2.3, Volume 3, Chapter 2, IPCC Guidelines). The combined uncertainty is 30%. The complete uncertainty analysis is shown in Annex 2.

4.2.2 Lime Production (CRT 2A2)

This activity does not occur in Iceland.

4.2.3 Glass Production (CRT 2A3)

This activity does not occur in Iceland.

4.2.4 Other Process Uses of Carbonates (CRT 2A4)

4.2.4.1 Ceramics (CRT 2A4a)

This activity does not occur in Iceland.

4.2.4.2 Other Uses of Soda Ash (CRT 2A4b)

Other use of soda ash was in diatomite production for the period 1990-2004. The emissions associated with the use of soda ash are marked as Included Elsewhere under 2A4b Other uses of soda ash and are included in the emissions reported under 2B10 Diatomite Production. Methodological description of calculations of emissions related to soda ash use can be found under 4.3.10.1 Diatomite Production (CRT 2B10a).

4.2.4.3 Non-Metallurgical Magnesium Production (CRT 2A4c)

This activity does not occur in Iceland.

4.2.4.4 Other (CRT 2A4d) Mineral Wool Production, Limestone Use in Ferrosilicon Production

Two emission sources fall under this category, on one hand a mineral wool production plant and on the other hand limestone used in a ferroalloy production plant. Emissions from mineral wool production are reported here, whereas the emissions associated with limestone use in ferroalloy production are reported under 2C2 Ferroalloys Production, as noted as "node comment" in CRT reporter. Methodology for mineral wool production is described here, whereas the methodology used for determining greenhouse gas emissions from limestone use in ferroalloy production are described under Ferroalloys Production (CRT 2C2).

All imported goods are registered by the Directorate of Customs and subsequently by Statistics Iceland (Hagstofa) (SI), which indicates that there is no other recorded use of carbonates. If carbonates are imported for manufacturing artistic ceramics, for example, the quantity is negligible.

Methodology

The mineral wool production plant has a production capacity requiring it to be a part of the EU Emission Trading Scheme (EU ETS - described in Directive 2003/87/EC ("The ETS Directive")). However, since its annual greenhouse gas emissions are low (typically ≤ 1 kt CO₂e/year), the plant is excluded from the EU scheme as per Article 27 of the ETS Directive (which applies to operations producing less than 25 kt CO₂e/year). According to Article 27 of the ETS Directive and Article 20 of Icelandic Act No 96/2023 on the EU Emissions Trading System, the plant is obligated to report annual emissions to the Environment and Energy Agency in a format similar to the EU ETS operators and pays an annual emission fee to the Icelandic State.

Activity data are provided by the plant (application for free allowances under the EU ETS for 2005-2010 and reporting under the EU ETS, or exemption thereof, after that). In particular, the plant provides data on electrode consumption, emission factor and NCV, as well as C-content of shell sand. Emissions of CO₂ are calculated from the carbon content and the amount of shell sand and electrodes used in the production process. Emissions of SO₂ are calculated from the S-content of electrodes and amount (in unit of mass) of electrodes used. Emissions of CO are based on measurements performed at the plant in 2009 and Mineral Wool Production.

Emissions from the mineral wool plant were 0.92 kt CO₂e in 2024. Fluctuations in greenhouse gas emissions reflect fluctuations in annual production.

Recalculations

No category-specific recalculations were done for this submission.

Planned Improvements

No improvements are currently planned for this category.

Uncertainties

The uncertainty on activity data was calculated to be 2.25% based on the combined uncertainty for two source stream types as reported in the ETS annual emission reports. CO₂ emission factor uncertainty was estimated to be 1.5% according to Chapter 2, subchapter 2.5.2.1, in 2006 IPCC guidelines. The combined uncertainty is 2.7%. The complete uncertainty analysis is shown in Annex 2.

4.3 Chemical Industry (CRT 2B)

The Chemical Industry Sector is insignificant in the Icelandic inventory, with no greenhouse gas emissions reported under this sector since 2005. In the past, there were two large contributors to this sector, a fertiliser production plant, which stopped production in 2001, and a diatomite production plant, which stopped production in 2004.

4.3.1 Ammonia Production (CRT 2B1)

Ammonia was produced amongst other fertilisers during the period 1990-2001. The associated emissions are marked as Included Elsewhere under 2B1 Ammonia Production and are included in the emissions reported under 2B10 Fertiliser Production. The methodology associated with ammonia Production is also described under Fertiliser Production (CRT 2B10b).

4.3.2 Nitric Acid Production (CRT 2B2)

This activity does not occur in Iceland.

4.3.3 Adipic Acid Production (CRT 2B3)

This activity does not occur in Iceland.

4.3.4 Caprolactam, Glyoxal and Glyoxalic Acid Production (CRT 2B4)

This activity does not occur in Iceland.

4.3.5 Carbide Production (CRT 2B5)

This activity does not occur in Iceland.

4.3.6 Titanium Dioxide Production (CRT 2B6)

This activity does not occur in Iceland.

4.3.7 Soda Ash Production (CRT 2B7)

This activity does not occur in Iceland.

4.3.8 Petrochemical and Carbon Black Production (CRT 2B8)

The only activity mentioned under this subsector is 2B8a Methanol Production which in Iceland started in 2012. However, methanol production in this case does not produce any greenhouse gases, since the plant is recycling CO₂ emitted from a geothermal power plant to convert it to methanol. All energy used in the plant comes from the Icelandic grid, which is generated from hydro and geothermal energy. The plant uses electricity to make hydrogen which is converted to methanol in a catalytic reaction with CO₂. The CO₂ is captured from gas released by a geothermal power plant located next to the facility (Carbon Recycling International, 2018); see also section 3.4.2 Geothermal Energy (CRT 1B2d).

4.3.9 Fluorochemical Production (CRT 2B9)

This activity does not occur in Iceland.

4.3.10 Other (CRT 2B10)

4.3.10.1 Diatomite Production

One company was producing diatomite (diatomaceous earth) by dredging diatom sand from the bottom of Lake Mývatn in the north of Iceland. The silica-rich sludge was burned to remove organic material, and soda ash was used as a fluxing agent. Production ceased in 2004.

Methodology

Emissions of CO₂ and NO_x were estimated on the basis of the C-content and N-content of the sludge, and of the stoichiometric carbonate content of the soda ash. All activity data was obtained from the plant directly. CO₂ emissions from the silicic sludge derive from organic carbon and therefore are not included in the totals. CO₂ emissions that occurred from the use of soda ash in the production process are reported here (in the CRT tables, IEEA uses the notation key "Included Elsewhere" (IE) under sector 2A4b Other use of soda ash). The annual CO₂ emissions ranged from 0.24 to 0.49 kt CO₂, and the annual NO_x emissions ranged from 0.31 to 0.48 kt NO_x.

Recalculations

No category-specific recalculations were done for this submission.

Planned Improvements

No improvements are currently planned for this category.

Uncertainties

The uncertainty on activity data was estimated to be 5% (higher end of the range suggested as general default AD uncertainty values suggested in vol. 3 chap 3 of the IPCC guidelines), and the CO₂ emission factor uncertainty was estimated to be 10%, leading to a combined uncertainty of 11%. The complete uncertainty analysis is shown in Annex 2.

4.3.10.2 Fertiliser Production

A fertiliser production plant was operational until 2001 when there was an explosion at the plant. In the early days of the factory, only one type of fertiliser was produced (a nitrogen fertiliser), whereas at the end of its production phase it was producing over 20 different types of fertilisers. CO₂ and CH₄ emissions are considered insignificant, as the fertiliser plant used H₂ produced on-site by electrolysis.

Methodology

NO_x and N₂O emissions were reported directly by the factory to the IEEA.

Recalculations

No category-specific recalculations were done for this submission.

Planned Improvements

No improvements are currently planned for this category.

Uncertainties

The uncertainty on activity data was estimated to be 5% (higher end of the range suggested as general default AD uncertainty values suggested in vol. 3 chap 3 of the IPCC guidelines), and the N₂O emission factor uncertainty was estimated to be 40%, leading to a combined uncertainty of 40%. The complete uncertainty analysis is shown in Annex 2.

4.4 Metal Production (CRT 2C)

4.4.1 Iron and Steel Production (CRT 2C1)

The only activity under Iron and Steel Production occurring in Iceland was Steel production (2C1a).

4.4.1.1 Steel (CRT 2C1a)

A secondary steelmaking facility was operating in the industrial area in Grundartangi, West-Iceland next to one ferroalloy plant and one aluminium smelter from 2014 to February 2017. Production stopped at the end of 2016 and no production is reported for 2017. The company produced steel from scrap iron and steel from the aluminium smelters, using an electric arc furnace. Carbonates and slags were added during the smelting process. The CO₂ emissions amounted between 0.34 and 0.83 kt CO₂ during the years of operation (2014-2016).

Methodology

CO₂ emissions are calculated using production data provided by the plant in their annual Green Accounting reports (now called Environmental information according to Icelandic regulation No 990/2008, formally called Green Accounting in accordance with Icelandic regulation No 851/2002 which is no longer in force), and the default Tier 1 emission factor for steel production in electric arc furnaces (Volume 3, Chapter 4, Table 4.1, 2006 IPCC Guidelines). Pollutants are calculated using the Tiers 2 emission factors for Electric Arc Furnaces in the 2023 EMEP/EEA Guidebook (EEA, 2023).

Recalculations

No category-specific recalculations were done for this submission.

Planned Improvements

No improvements are currently planned for this category.

Uncertainties

The uncertainty on activity data was estimated to be 10% (Default 2006 IPCC Guidelines), and the CO₂ emission factor uncertainty was estimated to be 25% (Default 2006 IPCC Guidelines), leading to a combined uncertainty of 27%. The complete uncertainty analysis is shown in Annex 2.

4.4.2 Ferroalloys Production (CRT 2C2)

Two factories were producing metals falling under the CRT category 2C2 Ferroalloys. One company has been producing FeSi75 since 1979 and another one started production of ≥98.5% pure silicon metal in 2018. A third company was operating between 2016-2017 producing silicon metal but stopped production in 2017. Both active operators are under the EU Emission Trading Scheme (as per Directive 2003/87/EC). In both factories, raw ore, carbon material and slag forming materials are mixed and heated to high temperatures for reduction and smelting.

One company is using a submerged, three phase electrical arc furnace with self-baking Söderberg electrodes. The furnaces are semi-covered. The other is using submerged arc furnaces using pre-baked graphite electrodes.

4.4.2.1 Methodology

CO₂ emissions are calculated according to the Tier 3 method from the 2006 IPCC Guidelines (Equation 4.17 Vol. 3) based on the consumption of fossil reducing agents and electrodes (Electrodes, electrode paste, carbon blocks, coal and coke) and plant specific carbon content. Information on the carbon content of electrodes and reducing agents is provided by the plants through annual emission reports submitted within the EU ETS. Emissions from limestone calcination are calculated based on the consumption of limestone, also reported through the EU ETS, and emission factors from the IPCC Guidelines for one operating factory while the other performs laboratory analysis. The emissions are included in this sector (marked as "included elsewhere" under CRT sector 2A4d: Other process use of carbonate). The emission factor is 440 kg CO₂ per tonne limestone, assuming the fractional purity of the limestone is 1.

CH₄ emissions are calculated using the Tier 2 defaults from the 2006 IPCC guidelines (Volume 3, Chapter 4, Table 4.8, 2006 IPCC Guidelines) using the appropriate emission factor for the different technologies used by the operators (batch-charging, sprinkle charging).

Activity data for raw materials, products and the resulting emissions are given in Table 4.6.

Table 4.6. Raw materials [kt], production [kt] and resulting greenhouse gas emissions [kt CO₂e] from the production of ferroalloys.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Electrodes, Casings, and Paste	3.83	3.88	5.73	6.00	4.79	4.86	4.82	4.66	4.66
Carbon Blocks	0	0	0	0	0	0.119	0.284	0.0307	0.0222
Anthracite/Coking Coal	45.1	52.4	73.2	86.9	96.1	115	129	128	173
Coke Oven Coke	24.9	30.1	46.6	42.6	30.3	30.9	23.5	19.8	22.7
Charcoal	0	0	0	2.08	0	0	1.67	14.0	14.4
Wood	16.7	7.73	16.2	15.6	11.3	27.2	59.9	72.0	101
Limestone	0	0	0.469	1.62	0.497	2.19	0.950	2.08	2.62
FeSi, Silicon Metal Production	62.8	71.4	109	111	102	118	116	128	154
Total Emissions [kt CO₂e]	211	246	366	380	373	404	419	408	527

Plant- and year specific emission factors for CO₂ are based on the carbon content of the reducing agents, the electrodes. For the FeSi75 plant, this information was taken from the company's application for free allowances under the EU ETS for 2005-2010. Upon request by the EAI, the company provided this information for 2000-2004 and 2011. Since 2013, this data has been obtained from the electronic reports submitted under the EU ETS and Environmental information (according to Icelandic regulation No 990/2008, formally called

Green Accounting in accordance with Icelandic regulation No 851/2002 which is no longer in force) reports for both factories.

Carbon content of electrode paste, graphite electrodes, coal, coke, charcoal, limestone, and wood have been obtained from the reports submitted under the EU ETS. Earlier in the timeline carbon content of coal (anthracite), coke-oven coke and charcoal are based on routine measurements of each lot at the FeSi75 plant. These measurements are available for the years 2000 to 2013. For the years 1990 to 1999 the average values for the years 2005 to 2010 were used. Carbon content of wood is taken from a Norwegian report (SINTEF. Data og informasjon om skogbruk og virke, Report OR 54.88). The carbon content of the electrodes is measured by the producer of the electrodes.

The emission factors for the major source streams coal and coke are plant and year specific. The implied emission factor differs from year to year based on different carbon content of inputs and outputs as well as different composition of the reducing agents used, from 3.2 tonne CO₂ per tonne Ferrosilicon in 1998, to 3.7 tonne CO₂ per tonne Ferrosilicon in 2018. The CH₄ emission factor is the default value for FeSi75 production in furnaces operating in sprinkle-charging mode (1 kg CH₄/t product - Volume 3, Chapter 4, Table 4.8, 2006 IPCC Guidelines) and for the silicon metal plant the default value for Si-metal production in furnaces operating in Batch-charging mode (1.5 kg CH₄/t product - Volume 3, Chapter 4, Table 4.8, 2006 IPCC Guidelines).

Figure 4.1 shows the evolution of total greenhouse gas emissions from Ferroalloy production since 1990. Since 2000 the production and associated emissions have been on somewhat steady level, with a clear dip in 2008 which is due to the major financial collapse Iceland experienced that year.

The main contributor to greenhouse gas emissions is CO₂, with CH₄ only contributing to less than 1% of the emissions from ferroalloy production.

The IEF fluctuates over the time series depending on the consumption of different reducing agents and electrodes (3.2-3.7 t CO₂/t FeSi), as well as expansions and changes in production capacity in existing facilities (1996-1999) and establishments of new facilities (2017, 2018).

4.4.2.2 Category-specific QA/QC and Verification

CO₂ emissions reported in this inventory are cross-checked with the annual emission reports verified by accredited EU ETS verifiers (according to Article 67 of Directive 2003/87/EC) since 2013.

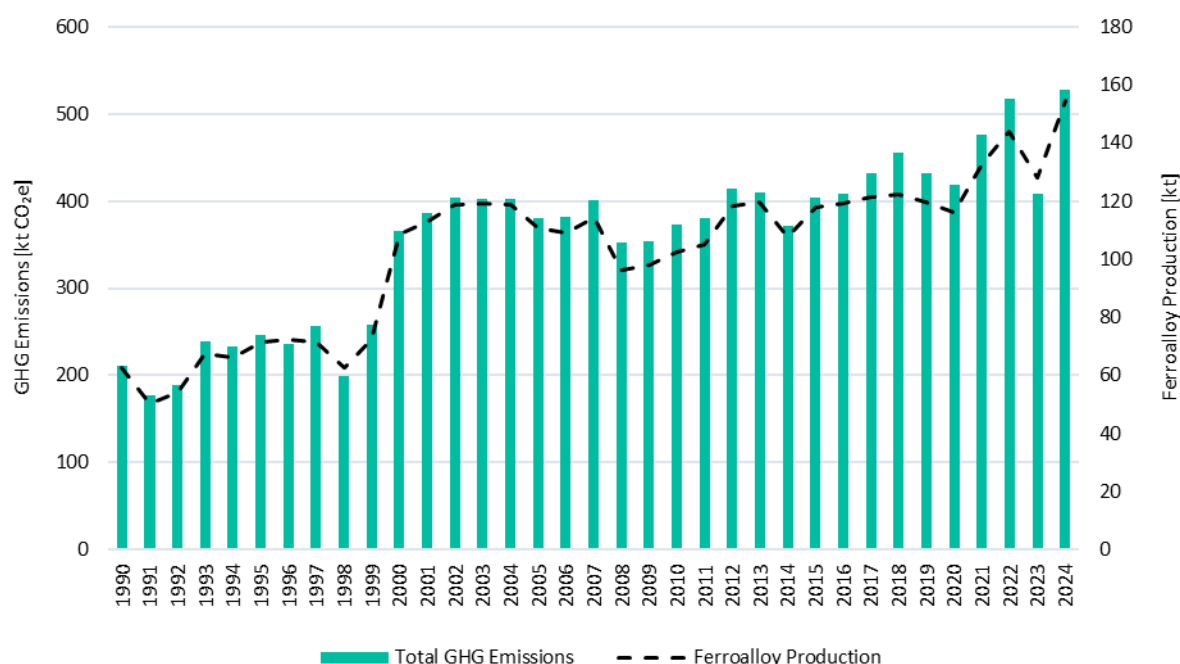


Figure 4.1. Total greenhouse gas emissions (CO₂ and CH₄) from the Ferroalloy production, and annual production.

4.4.2.3 Recalculations

No category-specific recalculations were done for this submission.

4.4.2.4 Planned Improvements

No improvements are currently planned for this category.

4.4.2.5 Uncertainties

The estimate of quantitative uncertainty has revealed that the uncertainty of CO₂ emissions from ferroalloys production is 2.1% (with an activity data uncertainty of 1.5% (as given in the ETS Annual Emission Report) and emission factor uncertainty of 1.5%). It is estimated that the uncertainty of the CH₄ emission factor is 10% as suggested in the 2006 IPCC Guidelines, uncertainties for Tier 2 emission factors. In combination with above mentioned activity data uncertainty this leads to a combined uncertainty of 10% for CH₄. The complete uncertainty analysis is shown in Annex 2.

4.4.3 Aluminium Production (CRT 2C3)

There are four aluminium factories in Iceland, three primary aluminium producers and one secondary aluminium producer. Primary aluminium production results in emissions of CO₂ and PFCs, whereas secondary aluminium production does not generate any significant amounts of greenhouse gases in the process itself. However, in both primary and secondary aluminium production there are greenhouse gas emissions associated with the combustion

of fossil fuels used as energy source, and these emissions are accounted for in the Energy chapter under sector 1A2.

4.4.3.1 Primary Aluminium Production

Primary aluminium production occurs in three smelters. All three primary aluminium producers use the Centre Worked Prebaked Technology. The emissions of CO₂ originate from the consumption of electrodes during the electrolysis process, whereas PFCs (CF₄ and C₂F₆) are produced during anode effects (AE) in the prebake cells, when the voltage of the cells increases from the normal 4 - 5 V to 25 - 40 V.

All three primary aluminium operators are under the EU-Emission Trading Scheme (as per Directive 2003/87/EC) and submit annual emission reports verified by accredited EU ETS verifiers (according to Article 67 of Directive 2003/87/EC).

Methodology

The IEAA collects annual process specific data from the aluminium plants, through electronic reporting forms in accordance with the EU ETS. Activity data and the resulting emissions can be found in Table 4.7 and are displayed in Figure 4.2.

Table 4.7. Aluminium Production, CO₂ and PFC emissions, IEF for CO₂ and PFC since 1990.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Primary Aluminium Production [kt]	87.8	100	226	272	819	857	831	866	851
CO ₂ emissions [kt]	139	154	353	417	1238	1300	1261	1335	1302
PFC emissions [kt CO ₂ e]	445	62.4	135	27.7	154	93.2	67.5	68.1	58.5
CO ₂ [t/t Al]	1.58	1.54	1.56	1.53	1.51	1.52	1.52	1.54	1.53
PFC [t CO ₂ e/t Al]	5.06	0.623	0.595	0.102	0.189	0.109	0.081	0.0786	0.0687
Total emissions [kt CO ₂ e]	584	216	488	445	1392	1393	1329	1403	1360

CO₂ Emissions

Emissions are calculated according to the Tier 3 method from the 2006 IPCC Guidelines, based on the quantity of electrodes used in the process and the plant and year specific carbon content of the electrodes. This information was taken from the aluminium plants' applications for free allowances under the EU ETS for 2005-2010. Upon request by the EAI, the aluminium plants also provided information on carbon content of the electrodes for all other years in which the corresponding aluminium plant was operating in the time period 1990-2012. Since 2013, the information comes from submitted data from the operators under the EU ETS. The weighted average carbon content of the electrodes ranges from 98%-99%.

PFC Emissions

PFCs (CF_4 and C_2F_6) are produced during anode effects (AE) in the prebake cells, when the voltage of the cells increases from the normal 4 - 5 V to 25 - 40 V. Emissions of PFCs are dependent on the number of anode effects and their intensity and duration. Anode effect characteristics vary from plant to plant. The PFCs emissions are either calculated according to the Tier 2 Slope Method, using equation 4.26 from the 2006 IPCC Guidelines (see below) with default coefficients taken from table 4.16 in the 2006 IPCC Guideline for Centre Worked Prebaked Technology, or using plant-specific emission factors for some of the operators in recent years (depending on the EU ETS requirements in this matter).

Equation 4.26

$$E_{\text{CF}_4} = S_{\text{CF}_4} \cdot AEM \cdot MP$$

and

$$E_{\text{C}_2\text{F}_6} = E_{\text{CF}_4} \cdot F_{\text{C}_2\text{F}_6/\text{CF}_4}$$

Where:

E_{CF_4} = emissions of CF_4 from aluminium production, kg CF_4

$E_{\text{C}_2\text{F}_6}$ = emissions of C_2F_6 from aluminium production, kg C_2F_6

S_{CF_4} = slope coefficient for CF_4 , (kg CF_4 /tonne Al)/(AE-Mins/cell-day)

AEM = anode effects per dell-day, AE-Mins/cell-day

MP = metal production, tonnes Al

$F_{\text{C}_2\text{F}_6/\text{CF}_4}$ = weight fraction of C_2F_6 / CF_4 , kg C_2F_6 / kg CF_4

Greenhouse gas emissions from primary Al production have been relatively stable since 2008 (Figure 4.2). The main contributor to greenhouse gas emissions gas is CO_2 , with various contributions from PFC. The PFC emissions rose significantly in 2006 due to an expansion of one facility and in 2008 which was the first full year of operations at a new facility. Total greenhouse gas emissions from the primary Aluminium sector have more than doubled since 1990 although a slight decrease in emissions has occurred in the last few years.

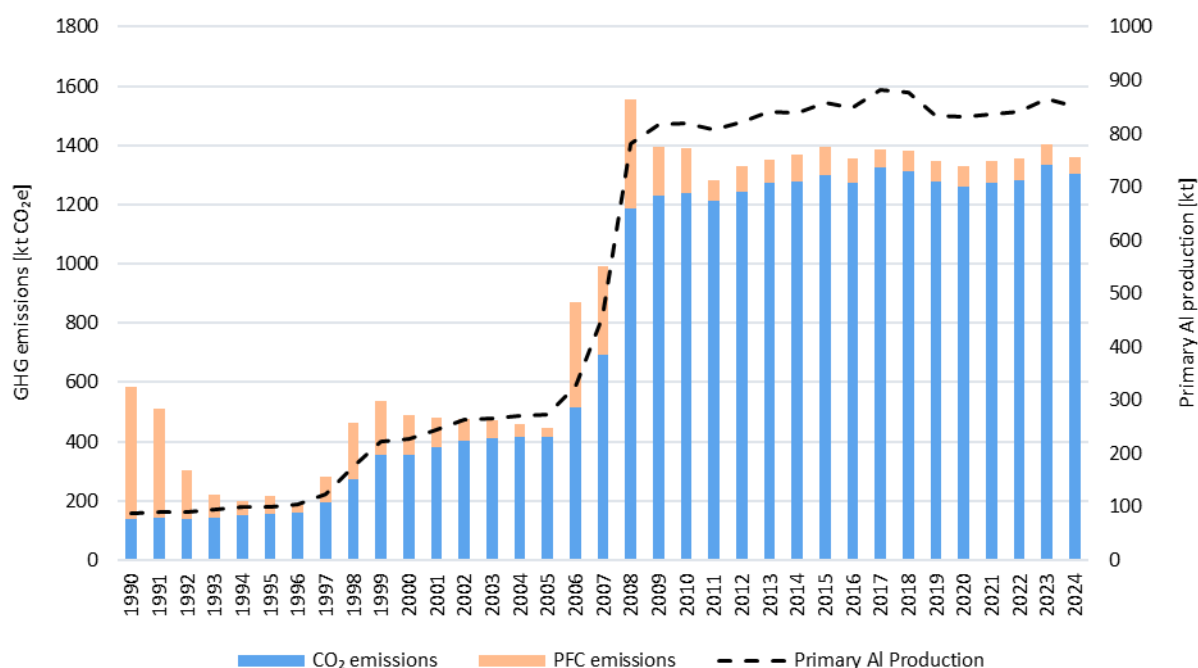


Figure 4.2. GHG emissions (CO₂ and PFC) from primary Al production [kt CO₂e], and annual production [kt].

Category-specific QA/QC and Verification

CO₂ and PFC emissions reported in this inventory are cross-checked with the annual emission reports verified by accredited EU ETS verifiers (according to Article 67 of Directive 2003/87/EC).

Recalculations

No category-specific recalculations were done for this submission.

Planned Improvements

No improvements are currently planned for this category.

Uncertainties

The uncertainty of CO₂ emissions is based on the ETS Annual Emission Reports and is 1.5% for activity data and 1.5% for the emission factors giving a combined uncertainty of 2.1%. For PFC the activity data has also 1.5% uncertainty and the emission factor uncertainty is 15%, following the suggestion of the 2006 IPCC Guidelines for Tier 3. This leads to a combined uncertainty of 15%. The complete uncertainty analysis is shown in Annex 2.

4.4.3.2 Secondary Aluminium Production

Secondary aluminium production started in 2004. In 2012, another facility opened in the industrial area of Grundartangi. At the end of 2014, the first company was acquired by the second moving the production to Grundartangi. Secondary aluminium production does not

lead to greenhouse gas emissions; however, it does lead to emissions of certain atmospheric pollutants which are reported under CLRTAP. Upon request during the 2019 UNFCCC desk review, the company was contacted for a clarification about the oxidation process. It is possible to affirm that the secondary aluminium industries work with two processes to prevent oxidation: one is salt-flux and in the other the slag acts as a cover for oxidation when the raw material melts. No cover gases are used for either process.

4.5 Non-Energy Products from Fuels and Solvent Use (CRT 2D)

4.5.1 Lubricant Use (CRT 2D1)

Lubricants are mostly used in industrial and transportation applications. Lubricants are produced either at refineries through separation from crude oil or at petrochemical facilities. They can be subdivided into (a) motor oils and industrial oils, and (b) greases, which differ in terms of physical characteristics (e.g., viscosity), commercial applications, and environmental fate (IPCC, 2006).

Only CO₂ emissions are reported here. There is no default methodology currently available to estimate NMVOC emissions. Currently available activity data does not allow to separate lubricants mixed in with other fuel in 2-stroke engines from lubricants used for their lubricating properties, however the amount of lubricant used as 2-stroke engine fuel is likely to be very small. Thus, we attribute all emissions from lubricants to this category (2D1), and none to combustion in the energy sector.

4.5.1.1 Methodology

Lubricant emissions are calculated using the Tier 1 method (Equation 5.2, 2006 IPCC Guidelines) and the IPCC default Oxidised During Use (ODU) factor used when the activity data does not allow to discriminate between lubricant oils and greases. Default NCV and C contents are used (from Table 1.2 and 1.3, respectively, Chapter 1 Volume 2 of the 2006 IPCC Guidelines).

Activity data for import and export of lubricants is obtained from Statistics Iceland. Lubricant use of a given year is assumed to be the difference between imports and exports of that year.

CO₂ emissions from lubricant use have generally been following a decreasing trend since 1990: From 4.06 kt CO₂e in 1990, the emissions decreased to 1.87 kt CO₂e in 2009. Since 2010, the emissions have been rather stable or 2.3 kt CO₂e on average.

4.5.1.2 Recalculations

No category-specific recalculations were done for the 2026 submission.

4.5.1.3 Planned Improvements

There are no improvements planned in this category.

4.5.1.4 Uncertainties

The activity data uncertainty is 5% (Volume 3, Chapter 5.2.3.2, 2006 IPCC Guidelines) and the emission factor uncertainty is 50.1% deriving from the combined uncertainty of the C-content (3%) and the ODU-content (50%); both uncertainty values are taken from the 2006 IPCC Guidelines, vol 3, chapter 5.2.3.1. The combined uncertainty for activity data and emission factors is 50.3%. The complete uncertainty analysis is shown in Annex 2.

4.5.2 Paraffin Wax Use (CRT 2D2)

Paraffin waxes are used in applications such as candles, corrugated boxes, paper coating, board sizing, food production, wax polishes, surfactants (as used in detergents) and many others. Emissions from the use of waxes derive primarily when the waxes or derivatives of paraffin are combusted during use (e.g., candles), and when they are incinerated with or without heat recovery or in wastewater treatment (for surfactants). In the cases of incineration and wastewater treatment the emissions should be reported in the Energy or Waste Sectors, respectively (IPCC, 2006).

According to 2006 IPCC guidelines, CH₄ and N₂O emissions are possible but no default methodology for estimating those is provided, therefore those emissions are marked as "NA" in the CRT tables.

Emissions from Paraffin Wax Use are estimated at 0.17 kt CO₂ in 1990 and 0.29 kt CO₂ in 2024, representing a 70% increase compared to 1990 levels.

4.5.2.1 Methodology

CO₂ emissions from paraffin wax use are calculated using equation 5.4 (Tier 1), Volume 3, in the IPCC 2006 guidelines.

Equation 5.4

$$\text{CO}_2 \text{ emissions} = PW \cdot CC_{\text{wax}} \cdot ODU_{\text{wax}} \cdot \frac{44}{12}$$

Where:

CO_2 emissions = emissions of CO_2 from paraffin waxes, kt CO_2

PW = Total paraffin wax consumption, TJ

CC_{wax} = Carbon content of paraffin wax, tonne C/TJ

ODU_{wax} = "Oxidised during use"-factor for paraffin wax, fraction

$44/12$ = mass ratio of CO_2/C

For calculating the total paraffin wax consumption, PW , in energy units, the activity data given in tons are multiplied by the Net Calorific Value of 40.2 TJ/kt given in table 1.2, Vol. 2 of the IPCC 2006 guidelines. The default CC_{wax} factor of 20.0 kg C/GJ (on a Lower Heating Value basis) and the default ODU_{wax} factor of 0.2 (Tier 1) given in the IPCC 2006 guidelines is applied.

Since the activity data is twofold, we have the emissions both from candles and other paraffin:

1. Emissions from paraffin from candles based on net consumption of candles (import - export + production where production is zero).
2. Emissions from paraffin (without candles) based on net consumption of paraffin (without candles) (import – export + production where production is zero).

To be able to add the two, the net consumption of candles is multiplied by the factor 0.66 since not all the candle activity data is made of paraffin:

$$PW = (m_{\text{candles}} * 0.66 + m_{\text{paraffin}}) \cdot NCV$$

where m_{candles} and m_{paraffin} is the mass (net consumption) of candles and paraffin (without candles), respectively. The proportion of paraffin candles used is assumed to be 66%, taken from the Norwegian Inventory Document for 2025 (chapter 4.5.2.4 on Paraffin wax use) as the activity data available in Iceland does not distinguish between paraffin candles and others.

There is no available data for the production of candles. Considering that most candles used in Iceland are imported (and therefore accounted for) only candles produced by very small local craft workshops might be missing from the estimates. According to expert judgement, the amount of candles produced within the country is insignificant. Activity data for paraffin production is missing but is considered insignificant based on expert judgement.

4.5.2.2 Recalculations

No category-specific recalculations were done for the 2026 submission.

4.5.2.3 Planned Improvements

There are no improvements planned in this category.

4.5.2.4 Uncertainties

The activity data uncertainty is 5% (Volume 3, Chapter 5.3.3.2, 2006 IPCC Guidelines,) and the emission factor uncertainty is combined 100.1%, deriving from a 5% uncertainty for the C-content and 100% uncertainty for the ODU-factor (Volume 3, Chapter 5.3.3.1, 2006 IPCC Guidelines). The combined uncertainty for both activity data and emission factors is therefore 100.2%. The complete uncertainty analysis is shown in Annex 2.

4.5.3 Other Non-Energy Products from Fuels and Solvent Use (CRT 2D3)

This section describes non-methane volatile organic compounds (NMVOC) emissions from asphalt production, fossil fuel-derived solvents use and urea-based additives for catalytic converters. The various subgroups within 2D3 are taken from the 2023 EMEP/EEA Guidebook.

NMVOCs are not considered direct greenhouse gases but once they are emitted, they will oxidise to CO₂ in the atmosphere over a period of time, and the associated CO₂ emissions are considered indirect. However, in order for these emissions to count towards national totals in the CRT reporter, we are including these CO₂ inputs from the atmospheric oxidation of NMVOC in CRT Tables 2(I) and 2(I).A-H, following recommendations from the Working Group 1 under the European Union Climate Change Committee.

An overview of the NMVOC emissions from the individual 2D3 subcategories is given in Table 4.8 and is shown in Figure 4.3.

4.5.3.1 Methodology

NMVOC emissions are estimated according to the 2023 EMEP/EEA Guidebook using activity data provided by Statistics Iceland unless otherwise noted in the specific subcategories below. The source category "Other Non-Energy Product and Solvent Use" is divided into subcategories in accordance with the EMEP/EEA Guidebook classification, as the nature of this source requires somewhat different approaches to calculate emissions than other emissions categories.

The conversion of NMVOC to CO₂ was done using the general formula provided in Box 7.2, Vol. 1 Chapter 7 of the 2006 IPCC Guidelines:

$$\text{Inputs (CO}_2\text{)} = \text{Emissions}_{\text{NMVOC}} * C * \frac{44}{12}$$

where C is the fraction carbon in NMVOC by mass. For the subcategory “Road paving with Asphalt,” C was set to 0.5, the upper range given in the 2006 IPCC guidelines for asphalt production and use for road paving (Volume 3, Chapter 5.4.4, 2006 IPCC Guidelines). For all other subcategories of 2D3, the default value of 0.6 was given (Volume 3, Chapter 5.5.4, 2006 IPCC Guidelines).

Domestic Solvent Use Including Fungicides (2D3a)

NMVOC emissions from domestic solvent use including fungicides (2D3a) are calculated using Tier 2b methodology according to Table 3-4 and Table 3-5 in the 2023 EMEP/EEA Guidebook. Table 3-4 presents default emission factors (g/kg product) with different product aggregation levels to account for the different levels of statistical data on consumption of products. Table 3-5 presents additional emission factors (g/person) and are used in specific cases, such as when the product statistics are not complete in terms of the product types.

NMVOC emissions from *cosmetic and toiletries, household products, car care products and pesticides* are estimated according to Table 3-4. *DIY/buildings* and *pharmaceutical products* are estimated according to Table 3-5.

Road Paving with Asphalt (2D3b)

Asphalt road surfaces are composed of compacted aggregate and asphalt binder. Gases are emitted from the asphalt plant itself, the road surfacing operations and subsequently from the road surface. Information on the amount of asphalt produced comes from Statistics Iceland for the period 1990 to 2011, and directly from the producers since 2012. The emission factors for NMVOC (0.016 kg/t asphalt) are taken from Table 3.1, in chapter 2D3b in the 2023 EMEP/EEA emission inventory Guidebook. Emissions of SO₂, NO_x and CO are expected to originate mainly from combustion and are therefore not estimated here but accounted for under sector 1A2.

Other – Coating Applications (2D3d)

The 2023 EMEP/EEA Guidebook provides emission factors based on amounts of paint applied. Data exists on imported paint since 1990 (Statistics Iceland, 2025) and on domestic production of paint since 1998, or written communication for the most recent reporting year. For the time before 1998 no data exists about the amount of solvent-based paint produced domestically. Therefore, the domestically produced paint amount of 1998, which happens to be the highest of the time period for which data exists, is used for the period from 1990-1997. The Tier 1 emission factor refers to all paints applied, e.g., waterborne, powder, high solid, and solvent based paints. The existing activity data on production and imported paints, however, makes it possible to narrow the activity data down to conventional solvent-based paints. Subsequently, Tier 2 emission factors for conventional solvent-based paints could be applied. The activity data does not permit a distinction between decorative coating application for construction of buildings and domestic use of paints. Their NMVOC emission

factors, however, are identical: 230 g/kg paint applied. It is assumed that all paint imported and produced domestically is applied domestically during the same year. Therefore, the total amount of solvent-based paint is multiplied with the emission factor.

Other – Degreasing (2D3d)

The 2023 EMEP/EEA Guidebook provides a Tier 1 emission factor for degreasing based on amounts of cleaning products used. Data on the amount of cleaning products imported is provided by Statistics Iceland. Activity data consisted of the chemicals listed by the EMEP/EEA Guidebook methylene chloride (MC), tetrachloroethylene (PER), trichloroethylene (TRI) and xylenes (XYL). In Iceland, though, PER is mainly used for dry cleaning (expert judgement). In order to estimate emissions from degreasing more correctly without underestimating them, only half of the imported PER was allocated to degreasing. Emissions from dry cleaning are estimated without using data on solvents used (see below). The use of PER in dry cleaning, though, is implicitly contained in the method. In Iceland, xylenes are mainly used in paint production (expert judgement). Following the same rationale, only half of the imported xylenes were allocated to degreasing. Emissions from paint production are estimated without using data on solvents used but xylene use is implicitly contained in the method.

In addition to the solvents mentioned above, 1,1,1-trichloroethane (TCA), now banned by the Montreal Protocol, is added for the time period during which it was imported and used. Another category included is paint and varnish removers as well as other composite organic solvents. The amount of imported solvents for degreasing was multiplied with the NMVOC Tier 1 emission factor for degreasing: 460 g/kg cleaning product.

Other – Dry Cleaning (2D3d)

Emissions from dry cleaning were calculated using the Tier 2 emission factor for conventional closed-circuit PER machines with abatement efficiency of $\eta_{\text{abatement}} = 89\%$ provided by the EMEP/EEA 2023 Guidebook. Activity data for calculation of NMVOC emissions is the amount of textile treated annually, which is assumed to be 0.3 kg/head (EEA, 2023) and calculated using demographic data. The unabated NMVOC emission factor is 177 g/kg textile treated.

Other – Chemical Products, Manufacturing, and Processing (2D3d)

The only activity identified for the subcategory chemical products, manufacture and processing is manufacture of paints. NMVOC emissions from the manufacture of paints were calculated using the EMEP/EEA 2023 Guidebook Tier 2 emission factor of 11 g/kg product (Table 3-11). The activity data consists of the amount of paint produced domestically, with data from the Icelandic Recycling Fund (2020), from yearly reports or written communication for the most recent reporting year. Data only exist from the year 1998, thus for the time before 1998 the domestically produced paint amount of 1998, which happens to be the highest of the time period for which data exists, is used for the period from 1990-1997.

Other – Printing (2D3d)

NMVOC emissions for printing were calculated using the 2023 EMEP/EEA Guidebook Tier 1 emission factor of 500 g/kg ink used. Import data on ink was received from Statistics Iceland (Statistics Iceland, 2025).

Other – Wood Preservation (2D3d)

Emissions from wood preservation were calculated using the 2023 EMEP/EEA Guidebook Tier 2 emission factors for creosote preservative type (105 g/kg creosote) and organic solvent borne preservative (945 g/kg preservative). Import data on both wood preservatives was received from Statistics Iceland. In Iceland, creosotes were used from 1990 to 2010 and have been banned since 2011.

Other – Aircraft De-Icing (2D3d)

Emissions from Aircraft de-icing was calculated using the 2023 EMEP/EEA Guidebook Tier 2 emission factors for de-icing (53 kg/ton de-icing fluid used). Data on de-icing fluid used was sent by e-mail from Icelandair/Jet Center and Airport Associates Keflavík.

Other – Urea-based Catalytic Converters (2D3d)

Emissions deriving from the use of urea-based additives for diesel vehicles are allocated to the subcategory 2D3. Urea imports are registered at Customs Iceland and data are provided by Statistics Iceland. However, urea used as fertiliser was registered in the same category until January 2020 (see also Agriculture sector, chapter 5.10.2.2). Customs Iceland has been contacted to correct the error in the registration which took place 2020. In order to gather the data of urea-based additives for SCR (selective catalytic reduction), the oil distributor companies in Iceland were contacted and the amount of urea-additives sold was requested. The so obtained activity data refers to the years 2008-2019. The emissions are then calculated following the 2006 IPCC guidelines, Volume 2, Chapter 3, Equation 3.2.2 as amount of urea-based additives used in catalytic converters multiplied by the purity (in this case 32.5%) and multiplied by 12/60 (stoichiometric conversion from urea ($\text{CO}(\text{NH}_2)_2$) to carbon) and 44/12 (conversion from carbon to CO_2). The obtained emissions were 0.012 kt CO_2e in 2008, the first year in which this activity is reported, and have increased since then but are still under 1.0 kt CO_2e .

4.5.3.2 Emissions of Sector 2D3

Table 4.8 and Figure 4.3 show the NMVOC emissions from the sector 2D3 from 1990.

Table 4.8. NMVOC emissions from all sub-categories, and total emissions from subsector 2D3 due to NMVOC.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
2D3a Domestic Solvent Use [t]	218	277	565	976	626	909	1216	1598	1756
2D3b Road Paving with Asphalt [t]	2.76	2.76	5.18	5.36	3.75	3.10	4.21	4.53	4.63
2D3d Coating Applications [t]	509	547	560	342	289	318	442	350	386
2D3d Degreasing [t]	76.2	56.8	85.3	57.6	38.0	46.3	43.1	55.9	49.2
2D3d Dry Cleaning [t]	1.48	1.56	1.63	1.71	1.86	1.89	2.07	2.19	2.24
2D3d Paint Manufacturing [t]	15.6	15.6	12.2	5.42	3.20	3.31	7.87	2.85	2.85
2D3d Printing [t]	77.5	109	198	305	189	207	78.4	44.6	27.8
2D3d Wood Preservation [t]	8.67	18.7	25.4	85.9	30.9	26.5	37.6	31.7	23.3
2D3d Aircraft De-Icing [t]	36.6	36.6	36.6	36.6	36.6	31.4	38.0	61.5	74.3
Total NMVOC [t]	946	1066	1489	1816	1218	1546	1869	2152	2326
Total NMVOC [t CO₂e]	2079	2344	3275	3994	2678	3400	4111	4732	5116

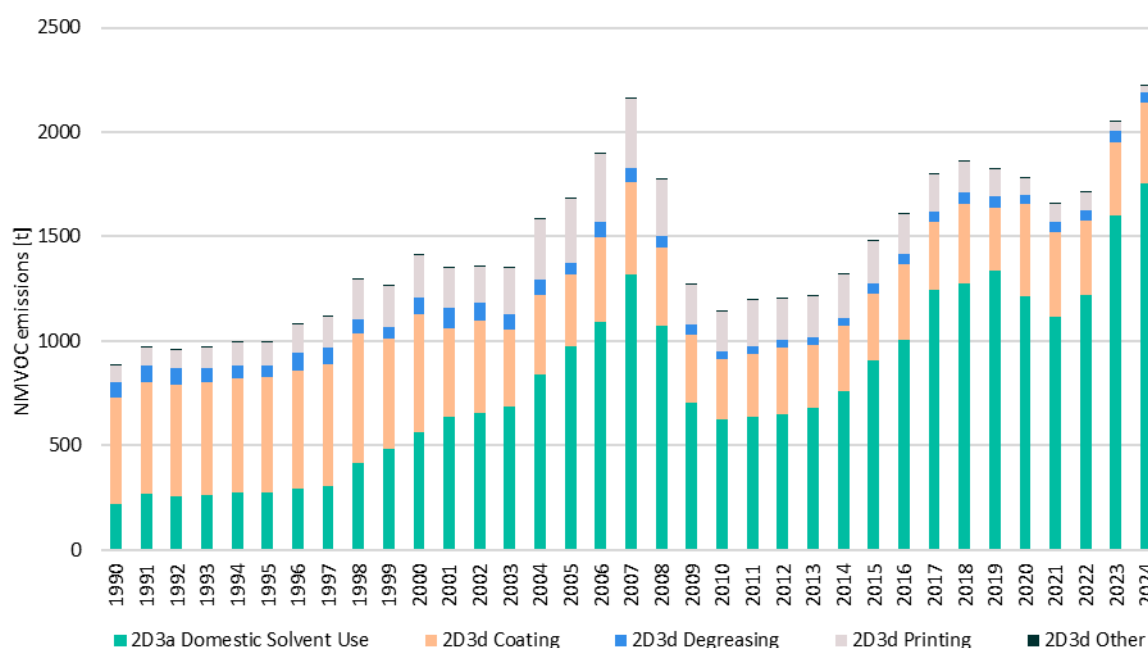


Figure 4.3. NMVOC emissions from all subgroups of Sector 2D3, Other Non-Energy Products from Fuels and Solvent use.

4.5.3.3 Recalculations

For the 2026 submission, there was a change in methodology used in 2D3a Domestic Solvent Use. The emissions in this sector were previously estimated using Tier 1 methodology which was population-based. The methodology has now been upgraded to Tier 2b which is based on the amount of product (population numbers are although still being used in specific

cases). The Tier upgrade led to major recalculations in 2D3a for the entire time series, see table below.

Table 4.9. Recalculations of emissions within 2D3a (Domestic Solvent Use Including Fungicides).

2D3a Domestic Solvent Use Including Fungicides	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂]	1.00	1.06	1.11	1.16	1.26	1.28	1.40	1.45	1.49
2026 submission [kt CO ₂]	0.591	0.610	1.24	2.15	1.38	2.00	2.68	2.68	3.52
Change relative to the 2025 submission [kt CO₂]	-0.41	-0.45	0.14	0.99	0.12	0.72	1.3	1.2	2.0
Change relative to the 2025 submission [%]	-41%	-42%	12%	85%	9.5%	56%	91%	85%	137%

Minor recalculations were made in 2D3d Coating Application for the years 2002, 2006, and 2010 due to updated activity data for imported solvent-based paint. This update resulted in increases of 6.1 kg, 2.5 kg, and 1.5 kg in CO₂ emissions for those years, respectively, which is less than 0.001%.

4.5.3.4 Planned Improvements

There are no improvements planned in this category.

4.5.3.5 Uncertainties

The uncertainties for this subcategory (2D3) were calculated for each subgroup and then aggregated. The activity data is retrieved from national statistics, and the uncertainty is therefore for each group 2% (except 30% for aircraft de-icing where data is retrieved from service companies) as proposed in table 2-1, chapter 5 of the General Guidance of the 2023 EMEP/EEA Guidebook. The emission factor uncertainties are derived from the upper and lower range of emission factors proposed in the 2023 EMEP/EEA Guidebook (except for urea based catalytic converters where the uncertainty of emission factor is 5% based on 2006 IPCC Guidelines default value for CO₂). The complete uncertainty analysis is shown in Annex 2.

4.6 Electronic Industry (CRT 2E)

This CRT sector is not occurring in Iceland and therefore subcategories 2E1-2E5 are reported as NO.

4.7 Product Uses as Substitutes for Ozone Depleting Substances (CRT 2F)

4.7.1 Overview

This chapter covers HFC and PFC emissions from product use in refrigeration and air conditioning as substitutes for Ozone Depleting Substances. In Iceland hydrofluorocarbons (HFCs) are also used in refrigerants and in metered dose inhalers. HFCs substitute ozone depleting substances like the chlorofluorocarbon (CFC) R-12 and the hydrochloro-fluorocarbons (HCFCs) R-22 and R-502, which are being phased out by the Montreal Protocol. PFCs are also used in some refrigeration applications, as part of HFC-containing blends, however emissions from PFCs in refrigeration applications are typically < 0.01% of the total emissions from refrigeration.

The structure of the source category 2F "Product Uses as Substitutes for Ozone Depleting Substances" is shown in Table 4.10 Use of HFCs and PFCs in other sub-source categories of sector 2F is not occurring. SF₆ is used only in electric switchgear and medical accelerators and is reported under 2G1 Electrical Equipment and 2G2 SF₆ and PFCs from Other Product Use (see chapter 4.8.1 and 4.8.2) while NF₃ has never been used or imported to Iceland.

In this chapter the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 34 is used to label HCFCs and HFCs (ASHRAE, 1992). It consists of the letter R and additional numbers and letters. HFC and PFC notations are used later on when the R-blends have been disaggregated into their components. In the written text, HFCs and PFCs are referred to as F-gases.

Table 4.10. Source category structure of product uses as substitutes for ozone depleting substances.

GHG Source Category	GHG Sub-source Category	Further Specification	HFCs	PFCs
2F1 Refrigeration and Air Conditioning	Refrigeration	2F1a Commercial Refrigeration Combination of stand-alone and medium & large commercial refrigeration	✓	✓
		2F1b Domestic Refrigeration Household fridges and freezers	✓	
		2F1c Industrial Refrigeration Food industries (fish farming, meat processing, vegetable production, etc.)	✓	✓
		2F1d Transport Refrigeration Reefers Fishing vessels	✓	✓
	2F1e Mobile Air-Conditioning (MAC)	Passenger cars		
		Trucks Coaches	✓	
	2F1f Stationary Air-Conditioning	Residential and Commercial AC, including heat pumps	✓	
2F4 Aerosols	2F4a Metered Dose Inhalers (MDI)		✓	

4.7.1.1 Legislation

HFCs in bulk were first imported to Iceland in 1993. The use of fluorinated gases was regulated in 1998 with the implementation of Icelandic regulation No 230/1998 (Regulation on substances contributing to greenhouse effect) banning the import, production, and sale of HFCs for other uses than in refrigeration systems, air conditioning and in drugs (metered dose inhalers). This regulation was later repealed by Icelandic regulation No 834/2010 (Regulation on fluorinated greenhouse gases). Regulation No 834/2010 is to a large extent an implementation of regulation (EC) No 842/2006 as dictated by the EEA agreement. However, in accordance with article 9 in the EU regulation, states that had adopted stricter national measures were allowed to maintain those measures until 31 December 2012. In light of this, Regulation No 834/2010 banned production, import and sale of HFCs or products containing HFCs with the exception of HFCs used in refrigerants, air conditioning equipment and in metered dose inhalers (MDIs). The regulation thus implied a ban of HFC use as foam blowing agent and HFC contained in hard cell foams imported (2F2), its use in fire protection (2F3), as aerosols (2F4) (with the exception of metered dose inhalers), and as solvents (2F5).

As per the transitional provisions described above the bans of production, import and sale of HFCs were only allowed to reach to the year 2013 and have not been re-established. From 2013, article 9 (and Annex II) of regulation (EC) 842/2006 states which products and equipment are prohibited. Instead of import and sale ban with exceptions, there was now a list of those products and equipment prohibited. Icelandic regulation 1279/2018 amends 834/2010 by implementing import quotas according to the Kigali amendment for the phasing out of the use of F-gases, taking effect in 2019.

All previous regulations were repealed with regulation 1066/2019 (Regulation about fluorinated greenhouse gases) which combines regulations 834/2010, 1279/2018 and institutes the European F-gas regulation (EU) No 517/2014 into the Icelandic system. Article 11 (and Annex III) of regulation (EU) 517/2014 states which products and equipment are prohibited to place on the market (incl. foams with HFC with high GWP, use in fire protection, aerosols for entertainment and decorative purposes). A stricter quota was twice adopted through amendments (Regulation 1425/2020 and Regulation 1446/2023) to Regulation 1066/2019 on F-gases which took effect in January 2021 and January 2024, further accelerating the decrease in F-gas emissions in Iceland. In 2019 a tax scheme was established with act No. 135 from 18 December 2019 (Act on amendments to various laws regarding the budget for 2020), chapter 18, putting a tax on the import of F-gases (blends and species) according to their global warming potential.

4.7.2 Refrigeration and Air Conditioning (CRT 2F1)

HFCs are used either as single compounds, or in blends. The most used HFCs are HFC-125, HFC-134a, and HFC-143a. They are imported in bulk, as part of blends and in equipment such as domestic refrigerators, vehicle air conditionings and reefers. All other HFCs are imported in

bulk only, either as single compounds or as parts of blends. In the case where HFC blends are used, the individual components are calculated using the blend ratios shown in Table 7.8, Volume 3, Chapter 7 of the 2006 IPCC guidelines. Since 2001, two blends containing PFCs (R412A and R508B) have been used in Iceland.

Refrigeration and Air Conditioning is a significant sector in Iceland, as it is by far the largest source of emissions in the IPPU sector when considering the sources outside of the EU ETS.

4.7.2.1 Methodology

Emissions for the refrigeration and air conditioning sector are estimated using the Tier 2a methodology from the 2006 IPCC Guidelines, using Emission Factors (EF) and other calculation factors from the default range (Volume 3, Chapter 7, Table 7.9, 2006 IPCC Guidelines). For the 2020 submission the Icelandic estimation model was reworked completely based on the information provided in the 2019 IPCC Refinements of the guidelines.

The calculation method applies a mixed model between defined amount of imported F-gases which are yearly reported and registered by IEEA and other data from which the use of F-gases is only inferred, that is (a) number of cars with MACs, b) number of imported domestic refrigeration appliances, c) units of reefers charged with a defined amount. This leads to imbalances between the actual imported amount and the calculated use which requires some data modelling to even out imported and used amounts. The total imported amounts of R134a over the whole timeline is also compared to what is calculated to be filled due to emissions from MAC and reefers. If the total times series import is lower, then the data is adjusted in a way that the usage is capped at the total import. See below. That could lead to a change in the IEF (Product life factor) within 2F1d and 2F1e.

The main equations used in the Icelandic estimation model are the following, the equation numbers refer to the equations in Chapter 7, Volume 3 of the 2006 IPCC Guidelines:

Equation 7.4

$$\text{Total emissions} = \text{Assembly/manufacture emissions} + \\ \text{Operation emissions} + \text{Disposal emissions}$$

Where:

Assembly/manufacture emissions include the emissions associated with product manufacturing or when new equipment is filled with chemical for the first time.

Operation emissions include annual leakage or diffusion from equipment stock in use as well as servicing emissions.

Disposal emissions occur when the product or equipment reaches its end-of-life and is decommissioned and disposed of.

Equation 7.12

Sources of Emissions when charging new equipment

$$E_{\text{charge},t} = M_t \cdot \frac{k}{100}$$

Where:

 $E_{\text{charge},t}$ = emissions during system manufacture/assembly, in year t, kg M_t = amount of HFC charged into new equipment per year t, kg k = emission factor of assembly losses of HFC charged into new equipment, percent

Equation 7.13

Sources of Emissions during equipment lifetime

$$E_{\text{lifetime},t} = B_t \cdot \frac{x}{100}$$

Where:

 $E_{\text{lifetime},t}$ = emissions during system operation, in year t, kg B_t = amount of HFC banked in existing systems in year t, kg x = emission factor of each bank during operation, percent

Equation 7.14

Emissions at end-of-life

$$E_{\text{end-of-life},t} = M_{t-d} \cdot \frac{p}{100} \cdot \left(1 - \frac{\eta_{\text{rec},d}}{100}\right)$$

Where:

 $E_{\text{end-of-life},t}$ = emissions at system disposal, in year t, kg M_{t-d} = amount of HFC initially charged into new system installed in year (t-d), kg p = residual charge of HFC in equipment being disposed, percentage of full charge $\eta_{\text{rec},d}$ = recovery efficiency at disposal, ratio of recovered HFC referred to the HFC contained in the system, percent

The annual refrigeration bank of year y is calculated following the example from the 2019 IPCC Refinements (Box 7.2B) as $\text{Bank}_y = \text{Bank}_{y-1} + \text{Addition}_y - \text{Removal}_y$. These equations are applied for each subcategory with exception of the Mobile Air Conditioning, which follows the calculation procedure from Chapter 7.5.2.4 of the 2019 IPCC Refinements (Vol. 3, Chapter 7).

Recovery is calculated as the difference between the amount remaining in products at decommissioning minus disposal emissions. In the case of mobile A/C no recovery is calculated as there is no data on recovery upon disposal of cars, coaches, and trucks.

Activity Data

Input data comes from different sources:

- Environment and Energy Agency (IEEA), Chemicals Unit, providing yearly bulk import data of F-gases as declared by the industry.
- Two logistic companies using reefers, providing the yearly amount of reefers using F-gases (for 2F1d Transport).
- The Transport Authority (Samgöngustofa) which provides numbers of first registrations of cars (for 2F1e Mobile ACs) and country of previous registration for used cars imported.
- Statistics Iceland provides the amounts of imported domestic appliances (fridges, freezers) registered at the Directorate of Customs (2F1b Domestic Refrigeration).

In order to allocate the blends/species to the subcategories the following assumptions are made:

- All R-407C and R-410A goes to 2F1f Stationary AC as suggested by the 2006 IPCC Guidelines
- HFC-134a and R404A from reefers (2F1d Transport) are calculated from the information provided from the logistics company (either data about yearly refill or number of reefers in their use with refill rate)
- HFC-134a from MAC (2F1e) is calculated (applying the calculation procedure from the 2006/2019 IPCC Guidelines, Chapter 7, Vol. 3)
- The calculated amounts of HFC-134a and R404A from Reefers and MACs are subtracted from the total imported amount of that species/blends. If the import of R404A is none, the calculated amount is manually adjusted to zero for consistency. This adjustment is made to avoid negative values when distributing the unallocated blends based on import data. However, emissions reported are not set to zero.
- Using all assumptions above and the bulk import amount as communicated from the Environment and Energy Agency, Chemicals Unit, the remaining blends are distributed over the categories by applying the following percentages of use for the years 1990-2012:
 - 15% Commercial Refrigeration
 - 20% Industrial Refrigeration
 - 65% Transport minus Reefers

After 2012 the percentages are species specific. For the year 2020 they are presented in Table 4.11. For the years between 2012 and 2020 they change linearly from the 2012 to the 2020

values. Additionally, for the year 2022 they are presented in Table 4.12 and an average of 2020 and 2022 was used for the year 2021. For years since 2022, the 2022 values are used.

Table 4.11. Distribution of unallocated blends, the share in 2020.

Distribution of Unallocated Blends, 2020 share	2F1a	2F1c	2F1d
HFC-125	32%	52%	16%
HFC-143a	40%	44%	16%
HFC-134a	23%	55%	22%
HFC-32	6%	77%	17%
HFC-23	0%	100%	0%
HFC-227ea	0%	100%	0%
C ₂ F ₆	0%	100%	0%

Table 4.12. Distribution of unallocated blends, the share in 2022.

Distribution of Unallocated Blends, 2022 share	2F1a	2F1c	2F1d
HFC-125	25%	57%	19%
HFC-143a	40%	40%	21%
HFC-134a	13%	61%	26%
HFC-32	7%	77%	16%
HFC-23	0%	100%	0%
HFC-227ea	0%	0%	0%
C ₂ F ₆	0%	100%	0%

The percentages of use derive from surveys carried out among service providers and importers of F-gases. For the newest survey (2023) all importers returned a spreadsheet to the EAI with information about the distribution of each blend between these sectors. The distribution is based on sale numbers. Since parts of the sales were to service providers of F-gases, the EAI has also managed to get information from some of the service providers. After analysing the data, the IEEA now has a distribution of the F-gas usage for by each blend and therefore species. There were no sales of blends with HFC-152a and C3F8, and HFC-227ea in 2022 which is consistent with import data that show that the last import took place in 2009 for HFC-152a and C3F8 and 2021 for HFC-227ea.

Figure 4.4 gives an overview of the imported bulk amounts of F-gases since 1990 as registered by the Chemicals Unit of the Environment and Energy Agency. The drop in import between 2019 and 2022 can partly be explained by stricter measures to decrease the use of F-gases (tax and import quota) and partly due to the possibility that companies did stock up in 2018 before the new import quota took place. The sharp peak in the import amounts of

2018 can be explained by the onset of the import quota from the year 2019 (see Legislation section in Reference list, Chapter 4.7.1.1).

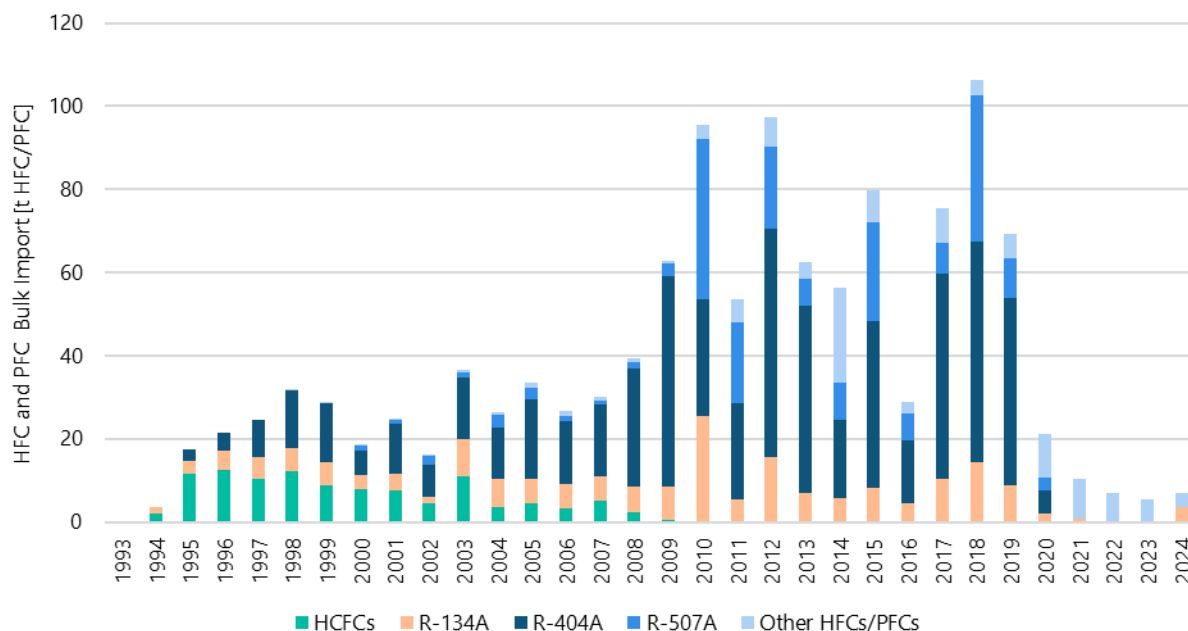


Figure 4.4. Quantity of F-gases imported in bulk to Iceland since 1993.

Pre-charged equipment is not included in this data, but separate surveys about the type and number of equipment sold were carried out by contacting the biggest service providers in Iceland. Pre-charged equipment is included in Commercial refrigeration (2F1a) and consists of commercially used refrigeration and freezing units used in industrial kitchens and supermarkets for example.

Domestic Refrigeration 2F1b

Based on expert judgement it is assumed that all domestic refrigerators imported to Iceland from the US since 1993 contain R-134A as refrigerant whereas refrigerators from elsewhere contain non-HFC refrigerants. Data about the import amounts are collected from Statistics Iceland based on the imports registered by the Directorate of Customs. The average charge per refrigerator is estimated at 0.25 kg. This estimation is in line with the range given by the 2006 IPCC Guidelines, or 0.05-0.5 kg (Volume 3, Chapter 7, Table 7.9, 2006 IPCC Guidelines). It is also assumed that all equipment is coming pre-charged to the country, resulting in "NO" for assembly emissions.

Transport Refrigeration 2F1d

Transport refrigeration is calculated on a disaggregated level. On the one side, the emissions from the use of reefers, which are only using R-134A and R-404A are accounted for. Reefers come to Iceland already prefilled, therefore emissions arise only from the yearly servicing operations and assembly/first filling emissions are "NO." Information on the number of

reefers in stock along with information on the sort of refrigerants contained in them was obtained from major stakeholders. During the 1990s R-12 in reefers was replaced by R-134A. Today reefers contain either R-134A or R-404A. The average refrigerant charge per reefer is 6 kg for R134A and 4 kg for R404A refrigerant. No information about recovery or disposal emissions are available, therefore these emissions are "NE."

Refrigeration systems on-board fishing ships are fundamentally different from systems on land regarding their susceptibility to leakage. Therefore, they are allocated to transport refrigeration. The lifetime of systems on-board fishing ships does, however, resemble the equipment in industry and is therefore longer than for usual transport refrigeration. Two experts from the fishing industry were contacted and confirmed that the lifetime of refrigeration systems on-board fishing ships is more similar to equipment in industry. The commercial fishing industry is one of Iceland's most important industry sectors, yielding total annual catches between one and two million tonnes since 1990. Directly after catch and processing, fish is either cooled or frozen and shipped to the market. A substantial part of the Icelandic fleet replaced refrigeration systems that used CFCs and HCFCs as refrigerants with systems that use ammonia. Some ships, especially smaller ones, retrofitted their systems with HFCs because the additional space requirements of ammonia-based systems exceeded available space. The phase of retrofitting and replacing refrigerant systems in the fishing industry is still on-going. A ban of importing new R-22 became effective in 2010 and a total ban on R-22 import has been in effect since 1 January 2015. Therefore, R-22 refrigerant systems are obsolete as the refrigerant is no longer available and its use for repairs and servicing is prohibited.

Mobile Air Conditioning 2F1e

To derive activity data pertaining to mobile air-conditioning (MAC), information on the first registration of vehicles was obtained from the Iceland Transport Authority. This data consisted of annual information dating back to 1995 on the number of registered vehicles subdivided by vehicle classes and their first registration year. Vehicle classes were aggregated based on estimated refrigerant charges:

- EU classes M1, M2, and N1: default value of 0.8 kg for passenger cars
- EU classes N2 and N3 (trucks): default value of 1.2 kg for trucks
- EU class M3 (coaches): country specific value of 10 kg (expert judgement)

The information on vehicles' first registration years was used to estimate the number of vehicles equipped with (R-134A containing) MACs. Based on a study by the EU (Schwarz, et al., 2012) it is assumed that 80% of all vehicles manufactured (since 2010) contain MACs. This value was reduced linearly to 5% in 1995, the first year in which the automobile industry used R-134A in new vehicles.

According to data obtained from the largest car importers in Iceland in 2020, all vehicles imported by them in 2019 had R-1234yf as a coolant. This development started in 2014 in

response to the European Directive on MACs (Directive 2006/40/EC) which introduces a gradual ban of F-gases in passenger cars. Data from the Transport Authority shows that 3% of newly registered vehicles in Iceland in 2019 were imported from outside of Europe by individuals, mostly from North America, where R134a is still in use. Therefore, we assume a linear decrease of newly registered vehicles containing R134a from 80% in 2013 to 3% to 2019. The same percentage is used onwards after 2019.

Vehicles come to Iceland already pre-charged and therefore no emissions occur from manufacturing/assembly.

At decommissioning of vehicles, the remaining F-gases in the system are not collected, therefore recovery is reported as "NO."

Emission Factors

All emission factors applied in the different subcategories are shown in Table 4.13. They are taken from the 2006 IPCC Guidelines (Volume 3, Chapter 7, Table 7.9, 2006 IPCC Guidelines), taking into consideration Icelandic conditions and variations over the time series (such as the operation emission factor in transport refrigeration-fishing vessels and MAC). Stand-alone and medium & large commercial refrigeration are combined into one sub-source.

Table 4.13. Values used for charge, lifetime and emission factors for stationary and transport refrigeration equipment and mobile air conditioning.

Application	HFC Charge [kg/unit]	Lifetime [years]	Initial EF [% of initial charge]	EF Equipment in Use	End-of-life EF [% recovery efficiency]
Domestic Refrigeration	0.25	12	NO	0.3%	70%
Commercial Refrigeration ¹	NE	8	2%	10%	70%
Transport ref.: Reefers	4 (404a) & 6 (134a)	NE	NO	15% until 2015 and 10% since 2016	NE
Transport ref.: Fishing Vessels	NE	15 ²	2% ²	Linear decrease from 50% in 1993 to 20% in 2012; 20% since 2012	70%
Industrial Refrigeration	NE	15	2%	10%	90%
Residential AC	NE	12	1%	3%	80%
MAC: Passenger Cars	0.8	14	NO	10% from 1990 and 7% from 2008 ³	0%
MAC: Trucks	1.2	14	NO	10% from 1990 and 7% from 2008 ³	0%
MAC: Coaches	10	14	NO	10% from 1990 and 7% from 2008 ³	0%

¹ Stand-alone and medium & large commercial refrigeration are combined in Commercial Refrigeration.

² The lifetime and initial EF of transport refrigeration equipment on fishing vessels is outside the range in the guidelines for transport. Expert judgements from some of the major fishing companies led to revaluation of the

lifetime. The lifetime is the lower value of the range in the 2019 Refinements for Industrial Refrigeration (for developed countries). The main reason is that the nature of the equipment on fishing vessels resembles the equipment in industry.

³ The lifetime EF for MAC is outside the range in the guidelines for MAC. This is based on expert judgement that lifetime EF is 5-7%. This is mainly due to Icelandic climate conditions and reflected in the minimal import of R-134a for the past several years.

Lifetime

The lifetime for domestic refrigerators is at the lower end of the range given by the 2006 IPCC Guidelines, the lifetime emission factor and the efficiency of recovery at end of life are also 2006 IPCC Guidelines default values. Initial emissions are not occurring as domestic refrigeration equipment's are assembled prior to import. The same applies for MACs and reefers until 2015. The lifetime of transport refrigeration equipment on fishing vessels is 15 years which is outside the range in the guidelines for transport. Expert judgements from some of the major fishing companies led to revaluation of the lifetime. That is the lower value of the range in the 2019 Refinements for Industrial Refrigeration (for developed countries). The lifetime of equipment on fishing vessels is now the same as the lifetime of industrial refrigeration in the inventory. The main reason is that the nature of the equipment on fishing vessels resembles the equipment in industry.

Initial emission factors

Transport refrigeration equipment on fishing vessels, commercial and industrial refrigeration equipment as well as residential ACs are assembled on site and are therefore attributed with initial emission factors. These initial emission factors as well as lifetimes for other sub-source categories are taken from the ranges given in the 2006 IPCC Guidelines default values (Volume 3, Chapter 7, Table 7.9, 2006 IPCC Guidelines).

Emission factor, equipment in use

Both commercial and industrial refrigeration lifetime emission factors are estimated at 10%. Thus, they are in the lower half of the ranges given by the 2006 IPCC Guidelines (both commercial applications together have a lifetime emission factor range from 1-35%). The value was chosen based on information from the poll of the Icelandic refrigeration sector mentioned previously.

Since data logistics companies imply a lower leakage proportion for recent years, the emission factor for reefers is assumed to be 10% since 2016. Since 2021 there was no bulk import of R-404A. R-404A was therefore not used to refill reefers. The calculated R-404A emissions, based on the number of reefers, is therefore set to zero from 2021 and onwards.

Leakage on shipping vessels has decreased considerably in the last decades. This is mainly a consequence of the higher prices of HFC refrigerants compared to the prices of their predecessors. Higher refrigerant prices make leakage detection and reduction more feasible. The employments of leak detectors and routine leakage searches have become common

practice on fishing vessels. Therefore, it can be assumed that the lifetime emission factor of shipping vessels has decreased since the introduction of HFCs. The lifetime emission factor of shipping vessels for the beginning of the period is assumed to be at the upper end of the range for transport refrigeration (50%). This emission factor is lowered linearly to 20% in 2012, which equals 1.6% decrease each year. The latter value was determined after evaluation of information from the previously mentioned poll and has been kept constant for all years since 2012.

Values for residential AC in the subcategory Stationary AC are default values given by the 2006 IPCC Guidelines.

The lifetime of vehicles is based on information collected by the Icelandic recycling fund. The average age of vehicles at end-of-life is 14 years. The lifetime emission factor is at the lower end of the range given in the 2006 IPCC Guideline until 2008 where it is changed to 7%. This is based on expert judgement. Several experts were contacted and agreed that leakage rate for R-134a is less than 10%, or closer to 5-7%, even in cars older than 15 years old. To be conservative we choose 7% starting 15 years ago. This is justified by the prevailing cold temperate climate which limits AC use and reflected in the limited import of R-134a for the past several years. We also assume no illegal trade or cross border transport due to geographical location of Iceland. The low import for the past years resulted in the emissions in a year from vehicles to be more than the import over the whole times series (leading to negative stock) when assuming a 10% emission factor. The recovery efficiency is set to zero since no refrigerant recovery takes place when vehicles are prepared for destruction.

End-of-life emission factors

According to law, decommissioning must be done by certified companies and there is a monetary incentive for them to do so. We have data on the amount of F-gases being sent for decommissioning but not which blends or what kind of application it was extracted from. Therefore, the assumption leads to a high recovery rate. Additional research would be necessary into the blends and the types of application the HFC was extracted from, before going outside the guideline range. Therefore, we select the highest value of recovery efficiency given in the 2006 IPCC Guideline range for Domestic, Commercial, Industrial, and Residential sub-applications.

No HFC charge amounts are given for commercial refrigeration, fishing vessels, industrial refrigeration, and residential AC. No information is available on the average charge and the number of units for these sub-source categories. Therefore, the bottom-up approach was modified. Instead of estimating sub-source specific HFC amounts by multiplying units with their average charge, imported HFC bulk amounts were divided between sub-sources using fractions (cf. previous explanations). The bulk import, divided between sub-sources, is attributed with a sub-source specific lifetime n . After n years the part of initially imported HFC not yet emitted is disposed of or recovered.

For MACs the residual charge being disposed (%) (p value from Eq. 7.14) is estimated in the following way: assuming that the MAC is serviced the year before it is disposed and that the annual emission rate is estimated, p is calculated as $p = 1 - x$. In the case of MACs, the recovery efficiency is set to zero since no refrigerant recovery takes place when vehicles are prepared for destruction. Since there is no recovery at disposal, the recovery efficiency at disposal (%), or the $\eta_{(rec,d)}$ value from Eq 7.14 is 0%. Calculating the recovery as charge contained at disposal multiplied with recovery efficiency, we obtain 0 and therefore "NO."

Emissions

Emitted refrigerants are separated into constituent HFCs and PFCs (information on blend compositions from Volume 3, Chapter 7, Table 7.8, 2006 IPCC guidelines). HFC and PFC emissions are aggregated by multiplying individual compounds with respective GWPs leading to totals in kt CO₂e. All values and fractions below relating to aggregated emissions are expressed in CO₂e.

Total HFC and PFC emissions from all refrigeration and air conditioning equipment disaggregated to constituents are shown in Table 4.14.

Table 4.14. HFC and PFC emissions for all individual compounds, calculated into CO₂e.

[t CO ₂ e]	1990	1995	2000	2005	2010	2015	2020	2023	2024
HFC-23	NO	NO	NO	29.0	11.4	11.4	43.4	63.4	55.8
HFC-32	NO	NO	5.13	15.7	56.8	102	411	724	645
HFC-125	NO	725	17071	20090	37014	54077	65866	43381	36701
HFC-134a	NO	1574	5087	9114	11146	16608	26447	13253	13843
HFC-143a	NO	183	20041	27023	57551	84899	104318	65914	55367
HFC-152a	NO	9.33	74.20	52.11	44.52	1.84	NO	NO	NO
HFC-227ea	NO	NO	NO	112	23.6	324	196	153	134
Total HFC	NO	2490	42279	56436	105847	156024	197281	123489	106745
C ₂ F ₆ (PFC-116)	NO	NO	NO	2.92	1.12	7.28	60.9	76.2	66.5
C ₂ F ₈ (PFC-218)	NO	NO	NO	NO	0.631	0.207	0.0684	0.0402	0.765
Total PFC	NO	NO	NO	2.92	1.75	7.48	60.9	76.2	67.2
Total HFC+PFC	NO	2490	42279	56439	105849	156031	197342	123565	106812

Figure 4.5 shows the total emissions (assembly emissions, lifetime emissions and disposal emissions) expressed as kt CO₂e from Refrigeration and Air Conditioning (2F1). The largest emissions arise from the transport refrigeration which is explained by the importance of the Icelandic fishing fleet and the high emission factors applied due to the nature of this category. Stationary AC and domestic refrigeration are minor emission sources considering the cold climate of Iceland and the fact that most domestic appliances are imported from mainland Europe and do not use F-gases for refrigeration but rather natural refrigerants.

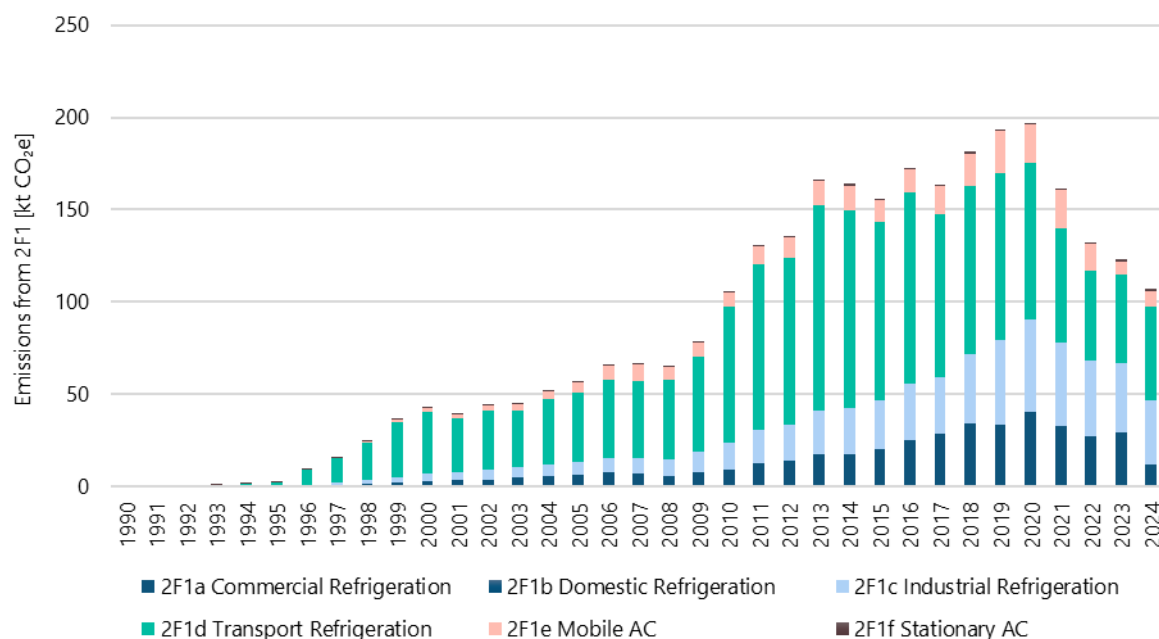


Figure 4.5. Total F-gas emissions from Refrigeration and Air Conditioning, split by subcategories.

4.7.2.2 Recalculations

For the 2026 submission, the categories of imported household fridges and freezers used in the emissions calculations were re-evaluated. The re-evaluation focused on whether the categories were or were not specifically marked for household use. Several categories were removed and other added, resulting in recalculations across the time series for Domestic Refrigeration (CRT 2F1b). As a result, total emissions from 2F1b decreased significantly (see Table 4.15).

Table 4.15. Recalculations of emissions within 2F1b (Domestic Refrigeration).

2F1b Domestic Refrigeration	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [t CO ₂ e]	0	0.871	3.12	34.6	58.9	31.7	24.7	28.3	31.2
2026 submission [t CO ₂ e]	0	0.368	1.62	8.02	35.7	21.6	2.93	4.22	0.895
Change relative to the 2025 submission [t CO₂e]	—	-0.50	-1.5	-27	-23	-10	-22	-24	-30
Change relative to the 2025 submission [%]	—	-58%	-48%	-77%	-39%	-32%	-88%	-85%	-97%

4.7.2.3 Planned Improvements

It is planned to investigate usage of heat pumps in Iceland. Recovery efficiency of Reefers will be investigated and if R-134a is still being used in imported domestic refrigeration.

4.7.2.4 Uncertainties

The emission factor uncertainty of each subsector was calculated for the lifetime emission factor ranges, initial emission ranges, operation emission ranges, and recovery efficiency ranges given in the 2006 IPCC Guidelines to the respective values used. Using equation 3.1 (Volume 1, Chapter 3, 2006 IPCC guidelines) the emission uncertainty was calculated for each application in every subsector by combining the emission factor uncertainty and the activity data uncertainty. The emission uncertainty for all subsectors of sector 2F1 was derived by combining the uncertainty of each subsector to one value using equation 3.2 (Volume 1, Chapter 3, 2006 IPCC guidelines). The combined emission uncertainty for the sector was calculated as per equation 3.2 (Volume 1, Chapter 3, 2006 IPCC guidelines). The combined emission uncertainty was calculated to be 55.2%.

Details about the retrieval of the uncertainty factors are summarised in Table 4.16. Overview of the uncertainties can be found in Annex 2.

Table 4.16. Emission factors used along with emission factor ranges given in the 2006 IPCC Guidelines; calculated combined emission factor uncertainties and estimated AD uncertainties.

Sector		EF Used	Lower Bound	Upper Bound	EF Uncertainty	AD uncertainty
2F1a Commercial ref.	Lifetime EF	8	7	15	50%	100%
	Initial Em.	2	0.5	3	63%	100%
	Operation Em.	10	10	35	125%	100%
	Recovery Effic.	70	0	70	50%	100%
2F1b Domestic ref.	Lifetime EF	12	12	20	33%	50%
	Initial Em.	No first fills in Iceland				
	Operation Em.	0.3	0.1	0.5	67%	50%
	Recovery Effic.	70	0	70	50%	50%
2F1c Industrial ref.	Lifetime EF	15	15	30	50%	100%
	Initial Em.	2	0.5	3	63%	100%
	Operation Em.	10	7	25	90%	100%
	Recovery Effic.	90	0	90	50%	100%
2F1d Transport fishing	Lifetime EF	15	15	30	50%	100%
	Initial Em.	2	0.5	3	63%	100%
	Operation Em.	20	15	50	88%	100%
	Recovery Effic.	70	0	70	50%	100%
2F1d Transport reefers	Lifetime EF	NA				
	Initial Em.	No first fills in Iceland				
	Operation Em.	20	15	50	88%	100%
	Recovery Effic.	NA				
2F1e Mobile air-con.	Lifetime EF	14	9	16	25%	70%
	Initial Em.	No first fills in Iceland				

Sector		EF Used	Lower Bound	Upper Bound	EF Uncertainty	AD uncertainty
2F1f Stationary air-condition.	Operation Em.	7 ¹	7 ¹	20	93%	70%
	Recovery Effic.			NA		
	Lifetime EF	12	10	20	42%	50%
	Initial Em.	1.0	0.2	1.0	40%	50%
	Operation Em.	3.0	1.0	10	150%	50%
	Recovery Effic.	80	0	80	50%	50%

¹ Leakage rate in MAC was changed according to expert judgment as explained in section 4.7.2.

4.7.3 Foam Blowing Agents (CRT 2F2)

This activity does not occur in Iceland. During the in-country review of the 2011 submission the expert review team remarked that emissions from foam blowing were declared as not occurring although Iceland reported the import of hard foams in containers for fish export since 2001. During the preparation of the 2012 submission information on the nature of imported fish containers were gathered in order to estimate emissions more exactly. The Icelandic Directorate of Customs supplied the EAI with a list of all companies importing goods under the customs number denoting fish boxes to Iceland. The five biggest importers, which comprise more than 99% of fish container imports, were contacted. The biggest importer buys foam boxes from a manufacturer in the UK. The manufacturer produces the boxes from HFC free polypropylene. Another company buys its boxes from a manufacturer in Slovakia. The manufacturer was contacted and explained that it does not use HFC in the production of foam boxes. One company buys HFC free containers in Spain. The same company also imports polyurethane boards from The Netherlands to insulate fish tanks they manufacture. The manufacturer of the polyurethane boards was contacted and declared that it did not use HFC in the production of its boards. The remaining two companies importing fish containers import exclusively cardboard containers. Therefore, emissions from foam blowing in Iceland are reported as not occurring.

4.7.4 Fire Protection (CRT 2F3)

This activity does not occur in Iceland.

4.7.5 Aerosols (CRT 2F4)

Emissions from metered dose inhalers (MDI) use are reported under CRT 2F4a. R-134A and R-227ea are used in MDI's imported to Iceland. No other emissions are attributed to CRT sector 2F4.

4.7.5.1 Methodology

The annual emissions from the MDI stock are estimated by using the default Tier 1a emission factor of 50% of the initial charge per year (Volume 3, Chapter 7, 2006 IPCC Guidelines), meaning that half of the chemical charge escapes within the first year and the remainder in the second.

4.7.5.2 Activity Data

The Icelandic Medicines Agency has recorded imports of MDIs containing R-134A since 2002 and R-227ea since 2014. The amount of HFCs in MDIs imported has been oscillating between 500 kg and 700 kg since 2002.

As no import data exist for 1990–2001, activity data for these years were estimated by calculating the average per-capita MDI import for 2002–2015 and applying this value to the population in each year from 1989 to 2001.

4.7.5.3 Emissions

Emissions from MDIs in 2024 were approx. 0.97 kt CO₂e.

4.7.5.4 Recalculation

For the 2026 submission, recalculation was made within subsector 2F4a Metered Dose Inhalers for the year 1990 due to a calculation error. As described in methodological chapter above, half of the chemical charge escaped within the first year and the remainder in the second. This means that the estimation of emissions for each years relies not only on import data for that particular year but also from the year before. Previously, the estimated import number only reached back to 1990, leaving the emission estimation for 1990 incomplete or roughly half of what is should have been reported. The corrected value aligns with the emissions reported for the following years (see table below).

Table 4.17. Recalculations of emissions within 2F4a (Metered Dose Inhalers).

2F4a Metered Dose Inhalers	1990	1991	1992	1993	1994
2025 submission [t CO ₂ e]	316	634	642	650	657
2026 submission [t CO ₂ e]	629				
Change relative to the 2025 submission [t CO ₂ e]	314				
Change relative to the 2025 submission [%]	99%				

4.7.5.5 Planned Improvements

There are no category-specific improvements planned for future submissions.

4.7.5.6 Uncertainties

The combined uncertainty of HFC emissions from MDIs are assumed to be 7%, with an activity data uncertainty of 5% and an emission factor uncertainty of 5%. The complete uncertainty analysis is shown in Annex 2.

4.8 Other Product Manufacture and Use (CRT 2G)

This sector covers emissions from other product manufacture and use. In Iceland the relevant subsectors are 2G1 (SF₆ emissions from use of electrical equipment), 2G3 (N₂O from product use, mostly in medical applications) and 2G4 where we report CH₄, N₂O, NO_x, CO and NMVOC emissions from tobacco consumption and CO₂, CH₄, N₂O, NO_x, CO and SO₂ emissions from fireworks use.

4.8.1 Electrical Equipment (CRT 2G1)

4.8.1.1 Use of Electrical Equipment (2G1b)

Sulphur hexafluoride (SF₆) is used as insulation gas in gas insulated switchgear (GIS) and circuit breakers. The number of SF₆ users in Iceland is small. The bulk of SF₆ used in Iceland is used by Landsnet LLC which operates Iceland's electricity transmission system. Additionally, a number of energy intensive plants, like aluminium smelters and an aluminium foil producer have their own high voltage gear using SF₆.

Methodology

SF₆ nameplate capacity development data as well as SF₆ quantities lost due to leakage were obtained from the above-mentioned stakeholders. The data regarding leakage consisted of measured quantities as well as calculated ones. Measurements consisted mainly of weighing amounts used to refill or replace equipment after incidents. Quantities were calculated either by allocating periodical refilling amounts to the number of years since the last refilling or by assuming leakage percentages. The Icelandic calculating method takes into account that when circuit breakers (CB) are imported to Iceland they have normally been filled with SF₆ at the factory. Combined CB cabinets come also to Iceland already prefilled. Nevertheless, this equipment could need a top up upon installation, as well as GIS (gas insulated switchgear) substations. In absence of detailed data about the installation of new equipment per year which is assembled or topped up with SF₆ in Iceland, the approach is based on the yearly amount of SF₆ which has been refilled by each power distribution/generation company and industry with its own gas insulated switchgear. Therefore "Filled into new manufactured products" is reported as "NO" in the Icelandic Inventory and no emissions are occurring from manufacturing. The emissions from stocks on the other hand comprises the total refill or use of SF₆ carried out in one year and reported by the stakeholders; it is comprised of the first top-up, the first filling, and the refill in case of annual servicing. The amount refilled reflects

the amount leaked obtaining therefore the yearly emissions (as reported "from stocks"). Stakeholders also report the total amount of SF₆ within the electrical equipment in order to obtain the yearly stock of SF₆ in the country.

Iceland acquired its first SF₆ equipment (220 V) in 1981, used at one power station. At the same time some 66 kV equipment was imported. These installations are still in use which explains why there are no disposal emissions. The lifetime reported in the IPCC 2006 guidelines is > 35 years (vol. 3, table 8.2). In addition, circuit breakers (CB) have an expected lifetime of 40-50 years, which is supported by the fact that none of the early installed equipment has been decommissioned yet. This information was obtained from an expert at a consulting company working amongst other things on assisting in design of power plants, transmission, and distribution³⁰. Based on this information the amount "Remaining in products at decommissioning" and the resulting emissions "from disposal" and the "recovery" is reported as "NO."

Emissions

Figure 4.6 shows the evolution of SF₆ in switchgear and the associated emissions due to leakage. The increase in emissions is less than proportional compared to the net increase in SF₆ nameplate capacity since 1990. The spike in 2010 is caused by two unrelated incidents during which switchgear was destroyed and SF₆ emitted. The spike in 2012 is caused by an increase of emissions from Landsnet LLC.

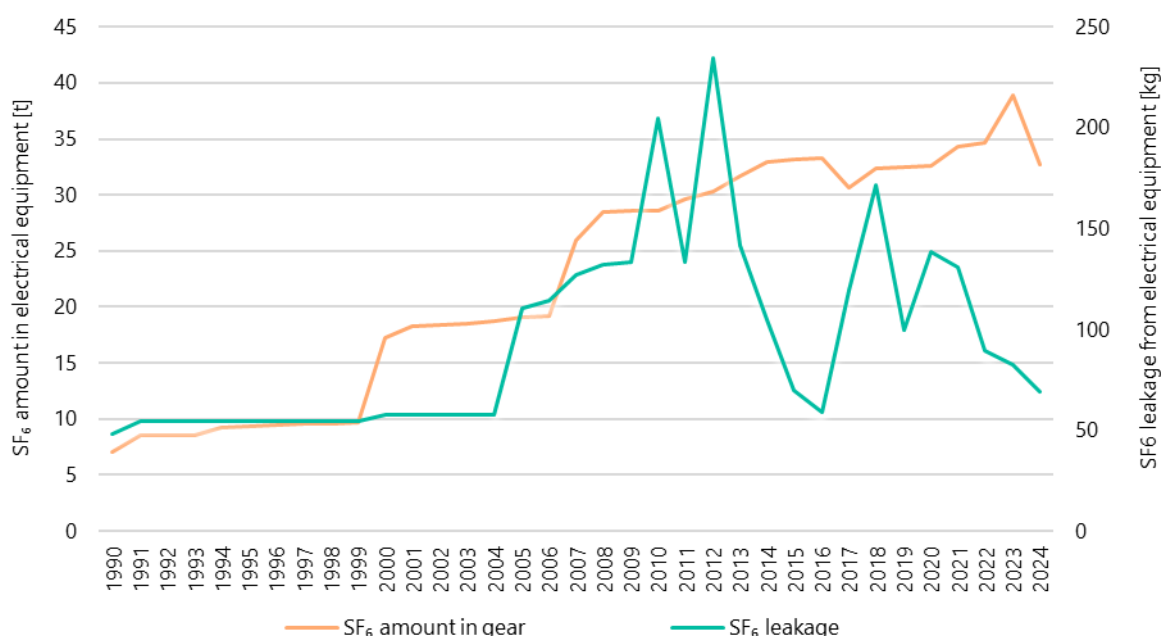


Figure 4.6. Total SF₆ amounts contained in and SF₆ leakage from electrical equipment.

³⁰ <https://www.lota.is/power-and-energy/?lang=en>

Recalculations

No category-specific recalculations were done for the 2026 submission.

Planned Improvements

There are no category-specific improvements planned for future submissions.

Uncertainties

The uncertainty of the activity data is assumed to be 30% following expert judgement while the emission factor uncertainty is derived from Table 8.5, chapter 8, volume 3 of the 2006 IPCC Guidelines and is 30%. The combined uncertainty is therefore 42%. The complete uncertainty analysis is shown in Annex 2.

4.8.2 SF₆ and PFCs from Other Product Use (CRT 2G2)

Medical particle accelerators are used in Iceland which use SF₆ as insulating gas.

4.8.2.1 Methodology

Amount in bank and leakage rate are obtained from the manufacturer.

4.8.2.2 Emissions

No new medical particle accelerators have been commissioned since 1995. Therefore, emissions have remained constant at 11.4 g of SF₆ per year (0.0002679 kt CO₂e) since then. From 1990 – 1995 the emissions were 5.7 g of SF₆ per year.

4.8.2.3 Recalculations

No category-specific recalculations were done for the 2026 submission.

4.8.2.4 Planned Improvements

There are no category-specific improvements planned for future submissions.

4.8.2.5 Uncertainties

The activity data is assumed to have high accuracy since it comes from the manufacturer (Volume 3, Chapter 8.3.3, 2006 IPCC Guidelines) and 2% is selected as it is a common uncertainty factor for highly accurate activity data. The emission factor uncertainty is taken from the closest subsector, 2G1, which is 30% until an uncertainty assessment from the manufacturer is available. The combined uncertainty is therefore 30%. The complete uncertainty analysis is shown in Annex 2.

4.8.3 N₂O from Product Use (CRT 2G3)

N₂O in Iceland is almost exclusively used as anaesthetic and analgesic in medical applications (CRT subsector 2G3a). Minor uses of N₂O in Iceland comprise its use as fuel oxidant in auto racing, in fire extinguishers and from the use of aerosol cans of cream (CRT subsector 2G3b).

4.8.3.1 Methodology

N₂O emissions from product uses (2G3a and 2G3b) were calculated using the 2006 IPCC guidelines. Activity data stems from import and sales statistics from the main importers of N₂O to Iceland and is therefore confidential. It is assumed that all N₂O is used within 12 months from import/sale. Therefore, emissions were calculated using equation 8.24 of the 2006 IPCC guideline, which assumes that half of the N₂O sold in year *t* is emitted in the same year and half of it in the year afterwards. The available activity data since 2015 does not allow to determine whether the end use of the imported N₂O is for medical applications or other applications. The average distribution ratio (medical vs. other uses) of the years 2010-2014 was used for the years since 2015, and the ratio used (95% vs 5%) was confirmed by expert judgment.

The Directorate of Customs does not register the number of aerosol cans of cream or whipped cream cartridges imported to Iceland. In order to estimate the amount of N₂O that could be emitted from whipped cream containers, Iceland follows the Finnish example of applying an average of the emission factors used in Central Europe, that is, 3.3 g N₂O/inhabitant/year.

Equation 8.24

$$E_{\text{N}_2\text{O}}(t) = \sum_i \{ [0.5 \cdot A_i(t) + 0.5 \cdot A_i(t-1)] \cdot EF_i \}$$

Where:

$E_{\text{N}_2\text{O}}(t)$ = emissions of N₂O in year *t*, tonnes

$A_i(t)$ = total quantity of N₂O supplied in year *t* for application type *i*, tonnes

$A_i(t-1)$ = total quantity of N₂O supplied in year *t*-1 for application type *i*, tonnes

EF_i = emission factor for application type *i*, fraction

Emissions from Medical Applications (2G3a)

The 2006 IPCC Guideline recommends an emission factor of 1 for medical use of N₂O. This emission factor is also used for other N₂O uses. Total emissions from medical use of N₂O decreased from 17.8 t N₂O in 1990 (4.7 kt CO₂e) to about 4-5 t in recent years (1.2-1.3 kt CO₂e). Because the Icelandic market is relatively small there can be large fluctuations in

imports year-to-year, and sometimes whether a shipment is recorded at the end of a calendar year or at the begin of the next one can have a large impact on the yearly totals. The significant interannual change in the IEF between 2016 and 2017 arises from the amount of N₂O imported in those years, especially the imported amount in 2016 which is half of the year 2015 and a third less than in 2017. Combining half of the emissions of the current year with the previous year leads to the deviation of the IEF from 1.

Emissions from Other Product Use (2G3b)

Emissions from other use of N₂O comprise the emissions from aerosol cans of cream and whipped cream cartridges for the whole time series. In 1990, emissions from the use of N₂O from other product use including fuel oxidants for motorsport, fire extinguishers and whipped cream applications were 2.4 t N₂O (0.64 kt CO₂e) and around 1.5 t N₂O (0.40 kt CO₂e) in recent years.

4.8.3.2 Recalculations

No category-specific recalculations were done for the 2026 submission.

4.8.3.3 Planned Improvements

There are no category-specific improvements planned for future submissions.

4.8.3.4 Uncertainties

The activity data uncertainty was calculated to be 6% as the data is based on national statistics, but some uncertainty lies in the completeness and allocation of the data. The emission factor uncertainty is 5% giving a combined uncertainty factor of 8%. The complete uncertainty analysis is shown in Annex 2.

4.8.4 Other: Tobacco Combustion and Fireworks Use (CRT 2G4)

4.8.4.1 Tobacco

All tobacco used in Iceland is imported. Emissions for CH₄, N₂O, NO_x, CO, and NMVOC are reported here.

Methodology

Activity data for tobacco consumption is based on import data collected by Statistics Iceland and includes all imports of tobacco (including loose tobacco, cigarettes, cigars, and all other tobacco products). CH₄ and N₂O emissions are calculated using the Danish country-specific approach (Danish Centre for Environment and Energy, 2018) with emission factors of 3.187 t CH₄/kt tobacco used and 0.064 t N₂O/kt tobacco used. These emission factors are based on calorific data and energy content for wood. NO_x, CO and NMVOC emissions are calculated

using the Tier 2 emission factors in the EMEP/EEA 2023 Guidebook. CO₂ emissions from tobacco are biogenic and therefore not applicable.

Emissions

As can be seen in Figure 4.7, Tobacco consumption in Iceland has been steadily decreasing since 1990, with the imports in the most recent inventory year less than half of the 1990 imports. Accordingly, the greenhouse gas emissions have decreased significantly, as shown in the same figure.

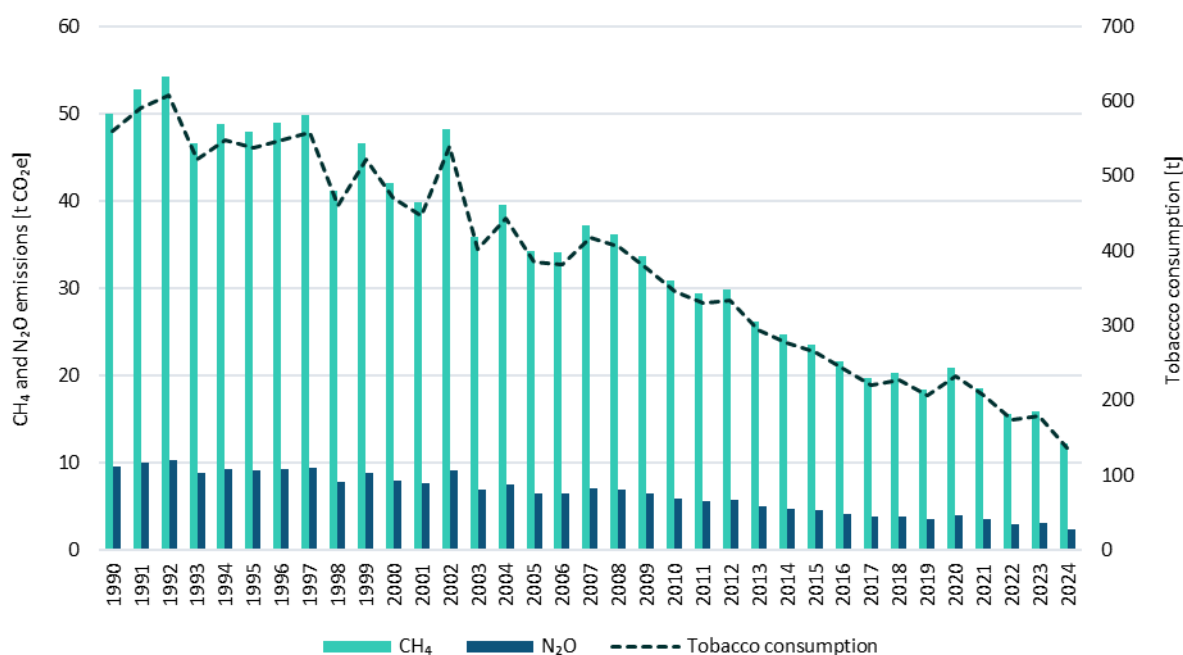


Figure 4.7. Tobacco imports and greenhouse gas emissions [t CO₂e] from tobacco use.

Recalculations

For the 2026 submission, waterpipe tobacco (customs code 24031109) was removed from the activity data as its consumption does not involve combustion. The removal led to recalculations and lowered emissions for the years 2012 onwards, see the table below. For 2023, however, the reduction resulting from removing waterpipe tobacco was outweighed by the effect of updated import data from Statistics Iceland, as an additional 26 tonnes of other cigars imported for personal use (customs code 24021019) were added to the inventory.

Table 4.18. Recalculations of emissions within 2G4 (Other: Tobacco).

2G4 Other: Tobacco	2012	2015	2020	2022	2023
2025 submission [t CO ₂ e]	36.1	29.4	25.8	19.3	17.0
2026 submission [t CO ₂ e]	35.5	28.1	24.8	18.5	18.9
Change relative to the 2025 submission [t CO₂e]	-0.61	-1.3	-1.0	-0.80	1.9

2G4 Other: Tobacco	2012	2015	2020	2022	2023
Change relative to the 2025 submission [%]	-1.7%	-4.4%	-4.0%	-4.1%	11%

Planned Improvements

There are no category-specific improvements planned for future submissions.

Uncertainties

The activity data uncertainty is 2% as proposed in table 2-1, chapter 5 of the General Guidance of the 2023 EMEP/EEA Guidebook. The emission factor uncertainties are 50% for CH₄ and 50% for N₂O and are chosen in analogy to the Danish NIR 2021. The combined uncertainty for each greenhouse gas is 50%. The complete uncertainty analysis is shown in Annex 2.

4.8.4.2 Fireworks

All fireworks used in Iceland are imported. Here we are reporting emission data for CO₂, CH₄, N₂O, NO_x, CO and SO₂ emissions.

Methodology

Activity data for fireworks use was collected from Statistics Iceland and is based on yearly imports. CO₂, CH₄ and N₂O emissions were calculated using emission factors from the Netherland National Water Board (2008). Emissions of SO₂, CO and NO_x were calculated using default Tier 2 emission factors from the 2023 EMEP/EEA Guidebook.

Emissions

Total fireworks use has been gradually increasing since the early 1990's, with associated increase in emissions (Figure 4.8). The large spike in fireworks import in 2007 was due to a strong economic upturn, which was then followed by a financial collapse in 2008 which is reflected in the fireworks activity data and associated emissions. The main contributor to greenhouse gas emissions from fireworks is N₂O, with about 90% of total emissions (when calculated in CO₂e).

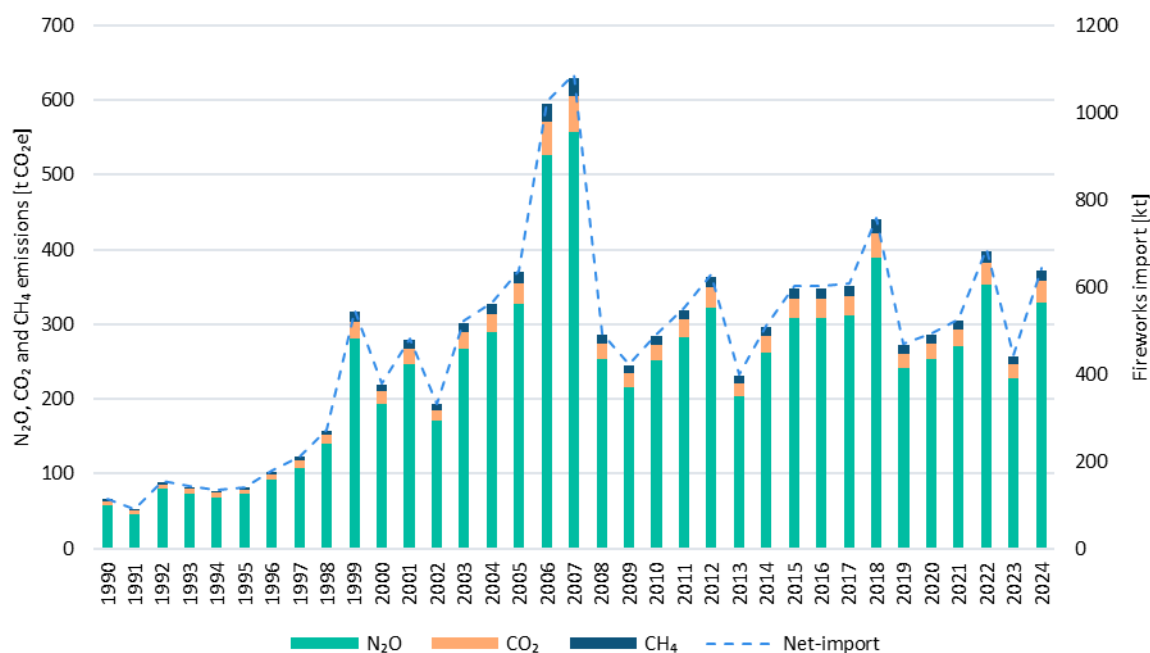


Figure 4.8. Fireworks import and greenhouse gas emissions [kt CO₂e] from firework use.

Recalculations

No category-specific recalculations were done for the 2026 submission.

Planned Improvements

There are no category-specific improvements planned for future submissions.

Uncertainties

The activity data uncertainty is 2% as proposed in table 2-1, chapter 5 of the General Guidance of the 2023 EMEP/EEA Guidebook. The emission factor uncertainties are 50% for CO₂, 50% for CH₄ and 50% for N₂O and are chosen in analogy to the Danish NIR 2021. The combined uncertainty for each greenhouse gas is 50%. The complete uncertainty analysis is shown in Annex 2.

4.9 Other (CRT 2H)

In this sector emissions are reported from the Food and Beverages industry (CRT sector 2H2).

Emissions from imported CO₂ in canisters, such as those used in soft drinks, are not included. It is assumed that these emissions are allocated to the sector generating the CO₂ in the exporting country, in accordance with the 2006 IPCC Guidelines (Ch. 5, Vol. 2) which states that "where CO₂ emissions are captured from industrial processes or large combustion sources, emissions should be allocated to the sector generating the CO₂".

4.9.1 Food and Beverages Industry (CRT 2H2)

The only pollutant emitted in this industry is NMVOC. The emission calculations include production of fish, meat, poultry, animal feed, coffee, bread and other breadstuff, beer and other malted beverages and spirits.

4.9.1.1 Methodology

Animal Feed: Production statistics for animal feed are available for 2005-2013. The statistics were extrapolated using GDP as proxy for earlier and later years in the times series.

Beer and Pilsner: Production data of beer and malt/pilsner is obtained from the main producers. These were the only producers until 2006 when other breweries started. Based on expert judgement the main producers produce at least 90% of the total production since 2006. This factor is used as a conservative estimate of the total production since 2006.

Baked goods, meat, fish and spirits: Production of bread, cakes/biscuits, meat, fish, poultry, and spirits was estimated as follows. The total consumption within the country was estimated by using results of the survey The Diet of Icelanders (Embætti landlæknis, 2022; 2011; 2002; 1990). The results give average consumption figures per person for the years 1990, 2002, 2011 and 2020. The consumption figures were interpolated for the years in between. The total consumption was calculated by using the population (or adult population in the case of spirits). A waste factor of 33% was also used when produced amounts were calculated from consumption figures (FAO, 2011). In the case of bread, cakes/biscuits, meat, fish, and poultry, it is assumed that the total production in Iceland is for the domestic market. There are exports of fish and meat, but they are almost exclusively fresh or frozen and therefore not cooked in Iceland. In the case of spirits, the import and export statistics were available from Statistics Iceland. The net import (import minus export) was subtracted from the calculated consumption to estimate the domestic production.

Coffee: The estimation assumes that all coffee roasted domestically is entirely derived from imported raw beans. The import data for raw coffee beans are obtained from Statistics Iceland.

There is no distinction made between industry and household emissions in these calculations. All NMVOC emission from bread and cake baking and fish/meat/poultry cooking is therefore estimated.

Emission factors for NMVOC were taken from the 2023 EMEP/EEA Guidebook and are presented in Table 4.19

Table 4.19. NMVOC emission factors for the production of various food and beverage products.

	NMVOC
Meat, fish, and poultry	0.30 kg/t
Cakes, biscuits, and breakfast cereals	1.0 kg/t
Beer and malt	0.035 kg/hl
Bread (European)	4.5 kg/t
Coffee roasting	0.55 kg/t
Animal feed	1.0 kg/t

4.9.1.2 Emissions

NMVOC emissions have increased since 1990. Figure 4.9 shows the various subcategories contributing to the emissions from the food and beverage production industry. Production of spirit has increased in recent years leading to an increase of NMVOC emissions. Iceland's inventory does not include CO₂ emission from NMVOC emission oxidation from this subsector.

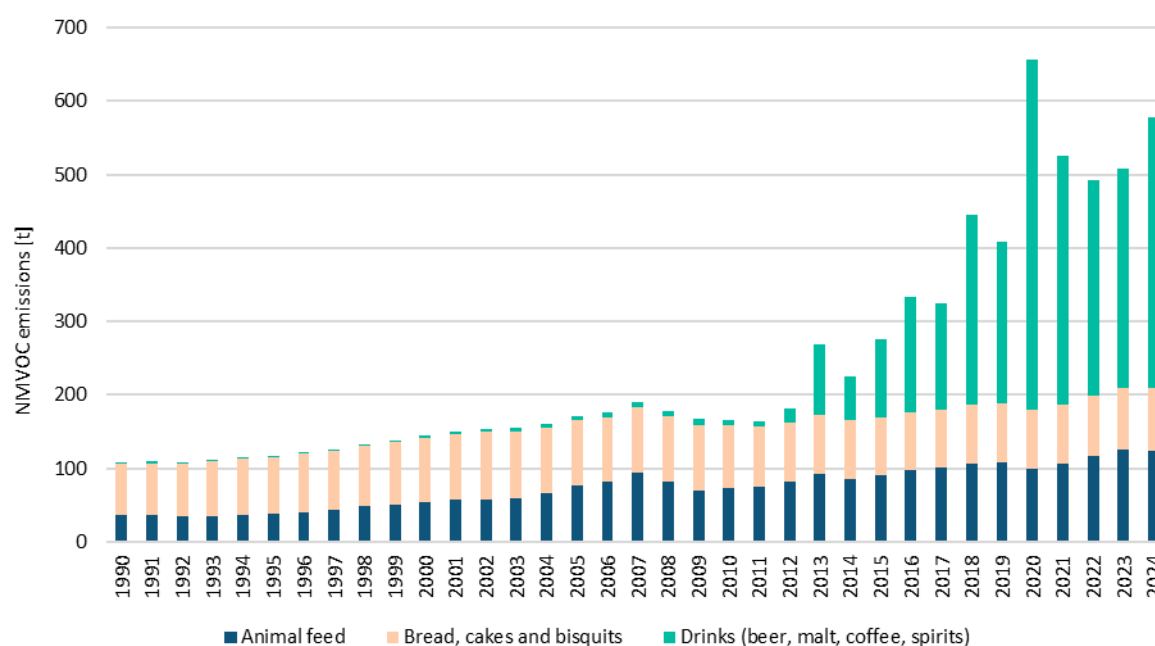


Figure 4.9. NMVOC emissions for various food and beverage processing.

4.9.1.3 Recalculations

In previous submission, historical years with unknown animal feed production were estimated based on years with known production data using linear regression. Since the projections of animal feed production are based on projected GDP trends, the known historical production data were revisited and compared with historical GDP. The comparison showed that those

known historical production follows the GDP trend reasonably well. Therefore, the estimation of unknown historical years now also takes into account the GDP historical trend.

Improvements were also made to the activity data used to estimate the emissions from coffee roasting. The estimation had previously been based on average coffee consumption per capita and average amount of coffee beans per brewed coffee. This approach did not distinguish between coffee roasted domestically and coffee roasted abroad. In 2024, imported unroasted coffee beans accounted for 32% of total coffee imports (in all forms), clearly indicating that most coffee consumed in Iceland is roasted abroad and that emissions had therefore been overestimated. Consequently, a new approach was introduced in which a quantity of imported unroasted beans is used as the activity data. This led to the average 71% reduction in the estimated amount of domestically roasted coffee and, accordingly, lower emissions for the entire time series.

Finally, changes were made to the activity data used to estimate the emissions from spirit production. The activity data consist of 1) average spirit consumption (g/adult/day) and 2) net import data. For the 2026 submission, the custom categories for spirits were revised, with some new categories added and some obsolete ones removed. This revision led to changes in net import figures, resulting in an average decrease of 200 tonnes and relatively large recalculations through the entire time series. The change in net import data is the main driver behind the recalculations in 2H2.

The combined impact of improvements and changes described above on the total NMVOC emissions from the subsector 2H2 Food and Beverages Industry is shown in table below.

Table 4.20. Recalculations of emissions within 2H2 (Food and Beverages Industry) between submissions.

2H2 Food and Beverages Industry	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission NMVOC [t]	153	163	174	180	176	284	403	402	414
2026 submission NMVOC [t]	115	125	152	179	175	289	668	503	521
Change relative to the 2025 submission [NMVOC [t]]	-37	-37	-22	-1.0	-0.83	4.3	266	102	107
Change relative to the 2025 submission [%]	-24%	-23%	-13%	-0.53%	-0.47%	1.5%	66%	25%	26%

4.9.1.4 Planned Improvements

For the future emissions, it is planned to improve the estimation of emissions from spirit production through actual production data from distilleries.

5 Agriculture (CRT sector 3)

5.1 Overview

Iceland is self-sufficient in all major livestock products, such as meat, milk, and eggs. Traditional livestock production is grassland based, and most farm animals are native breeds of an ancient Nordic origin, e.g., dairy cattle, sheep, horses, and goats. These animals are generally smaller than the breeds common elsewhere in Europe. Beef production, however, is partly through imported breeds, as is most poultry and all pork production. There is not much arable crop production in Iceland, due to the cold climate and short growing season. Cropland in Iceland consists mainly of cultivated hayfields, although potatoes, barley, root crops and brassicas are grown on limited acreage.

An overview of emissions from the Agriculture sector is in Table 5.1. The decrease of greenhouse gas emissions since 1990 is mainly due to a decrease in sheep livestock population, reducing methane (CH₄) emissions from enteric fermentation and manure management. Enteric fermentation is the source of most of the CH₄ emissions from agriculture and fertiliser use and cultivation of organic soils stand behind most of the nitrous oxide (N₂O) emissions.

Table 5.1. Emissions of greenhouse gases in the Agriculture sector in Iceland since 1990 (kt CO₂e).

	1990	1995	2000	2005	2010	2015	2020	2023	2024
CH ₄	416	371	367	350	376	386	356	344	338
N ₂ O	297	305	325	323	334	337	324	308	318
CO ₂	0.02	2.44	2.76	4.53	3.92	3.19	6.99	8.08	5.68
Total	712	679	695	678	714	726	687	660	662
Emission change compared to 1990 emissions.		-4.7%	-2.4%	-4.8%	0.2%	1.9%	-3.5%	-7.3%	-7.1%

5.1.1 Methodology

The methodology for the Agriculture sector has mostly been updated from the 2006 IPCC Guidelines to the 2019 Refinements, in those cases where an update is provided.

CH₄ emissions from enteric fermentation and manure management build upon livestock characterisation and are mostly calculated by applying the 2019 Refinements. N₂O emissions from manure management are however estimated using a comprehensive nitrogen flow model, as described in the 2019 EMEP/EEA Guidebook (EEA, 2019). The nitrogen flow model integrates factors from the IPCC Guidelines and as for the CH₄ emissions, the factors from the 2019 Refinements are used for all animal categories except cattle and sheep, where country specific factors are mainly used. Applying the nitrogen flow methodology allows for full consistency with the methodologies presented in the IPCC Guidelines and allows for a more

detailed assessment of N₂O emissions and other nitrogen species and consistency with the reporting under CLTRAP. The 2019 Refinements and output from the nitrogen flow model are used to calculate N₂O emissions from agricultural soils, except for emissions from fertiliser use where EFs from the 2006 IPCC Guidelines are applied. Carbon dioxide (CO₂) emissions from liming, urea application and other carbon containing fertilisers are calculated by applying the default emission factors and methodology as presented in the 2006 IPCC Guidelines.

The following Table 5.2 gives an overview of the reported emissions, calculation methods and type of EFs for the sector Agriculture. The methodologies are described in more detail under each of the CRT categories in the respective chapters.

Table 5.2. Reported emissions, calculated methods and type of emission factors used in the Icelandic inventory.

CRT Source		Reported Emissions	Method	Emission Factor
3A	Enteric Fermentation	CH ₄	T1a, T2	CS, D
3B	Manure Management	CH ₄ , N ₂ O	T1a, T2	CS, D
3C	Rice Cultivation	CH ₄	NA	NA
3D	Agricultural Soils	N ₂ O	T1, T2	CS, D
3E	Prescribed Burning of Savannas	CH ₄ , N ₂ O	NA	NA
3F	Field Burning of Agricultural Residues	CH ₄ , N ₂ O	NA	NA
3G	Liming	CO ₂	T1	D
3H	Urea	CO ₂	T1	D
3I	Other Carbon-containing Fertilisers	CO ₂	T1	D

CS: country specific, D: default

5.1.2 Key Category Analysis

The key sources for the first and latest inventory years and the timeline trend in the Agriculture sector are shown in Table 5.3 (compared to total emissions without LULUCF) and Table 5.4 (compared to total emissions with LULUCF).

Table 5.3. Key categories for Agriculture (excluding LULUCF).

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
3A1	Enteric Fermentation - Cattle	CH ₄	✓	✓	✓
3A2	Enteric Fermentation - Sheep	CH ₄	✓	✓	✓
3A4	Enteric Fermentation - Other	CH ₄	✓		
3B1	Manure Management - Cattle	CH ₄	✓	✓	
3D1	Direct N ₂ O Emissions from Managed Soils	N ₂ O	✓	✓	✓
3D2	Indirect N ₂ O Emissions from Managed Soils	N ₂ O	✓	✓	

Table 5.4. Key categories for Agriculture (including LULUCF).

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
3A1	Enteric Fermentation - Cattle	CH ₄	✓	✓	
3A2	Enteric Fermentation - Sheep	CH ₄	✓	✓	✓
3D1	Direct N ₂ O Emissions from Managed Soils	N ₂ O	✓	✓	

5.1.3 Completeness

Table 5.5 gives an overview of the IPCC source categories included in this chapter and presents the status of emission estimates from all sub-sources in the agricultural sector.

Table 5.5. Agriculture – completeness.

Sources		CO ₂	CH ₄	N ₂ O
3A	Enteric Fermentation	NA	E	NA
3B	Manure Management	NA	E	E
3C	Rice Cultivation	NOT OCCURRING		
3D	Agricultural Soils	NA	NA	E
3E	Prescribed burning of Savannas	NOT OCCURRING		
3F	Field burning of Agricultural Residues	NOT OCCURRING		
3G	Liming	E	NA	NA
3H	Urea application	E	NA	NA
3I	Other Carbon-containing fertilisers	E	NA	NA

E: estimated, NA: not applicable, NE: not estimated

5.1.4 Source Specific QA/QC Procedures

General QA/QC activities, as listed in Chapter 1.5, are performed for the Agriculture sector. Further sector-specific activities include the following:

- For the category mature dairy cows, the correlation between milk yield and feed digestibility is observed.
- Data reported under CRT 3B and 3D is checked to assure consistency between nitrogen deposited on pasture, range and paddock and urine and dung deposited by grazing animals.
- To ensure that no double counting or omissions occur during the nitrogen calculations in the N flow tool, a nitrogen balance is carried out, where the total input of nitrogen (animal excretion plus addition through bedding minus loss in the manure management system) should match the output of nitrogen (total nitrogen inputs to soil).
- A comparison between the Icelandic country-specific data on synthetic fertiliser consumption and fertiliser usage data from the International Fertiliser Association

(IFA) and synthetic fertiliser consumption estimates from the Food and Agriculture Organization of the United Nations (FAO).

These checks are performed after completion of the emission estimates. More details on some of the sector-specific activities are provided in the following sections.

5.1.4.1 Mature Dairy Cows: Correlation Between Milk Yield and Feed Digestibility

This check for the livestock category mature dairy cows is conducted because the parameters milk yield and feed digestibility (DE) are inherently connected. The correlation between milk yield and feed digestibility is studied as higher productivity, resulting in increased milk production, requires a higher feed intake and higher quality feed with a higher digestibility. The correlation between milk yield and feed digestibility is 0.96 and can be seen in Figure 5.1.

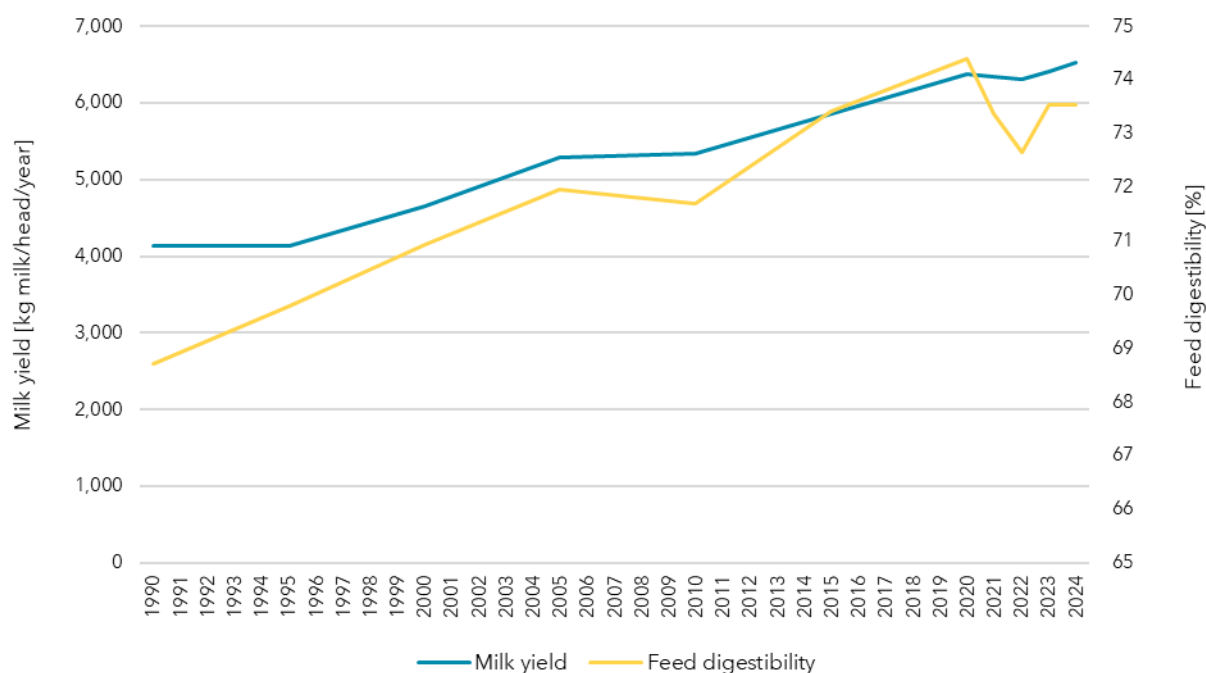


Figure 5.1. Correlation between milk yield and feed digestibility.

5.1.4.2 Data Comparison on Synthetic Fertiliser Consumption

During the 2019 UNFCCC desk review it was noted (Question 2019ISLQA216) that there were sharp peaks in nitrogen fertilisers use in 2009 and 2014. It was recommended that Iceland conducts a comparison between the Icelandic country-specific data on synthetic fertiliser consumption and fertiliser usage data from the IFA and synthetic fertiliser consumption estimates from the FAO.

As can be seen in Figure 5.2 there are various peaks and dips in all three datasets³¹. The country-specific dataset appears to coincide better with the FAO dataset. The overall trend of the country-specific dataset is higher, however. The main conclusions are that:

- All datasets correspond well in the first decade (1990-2000), after which they diverge further.
- The country-specific dataset and the FAO dataset continue to correspond quite well until 2009. For the years 2009-2014 the FAO dataset is on average lower than the country-specific data. After that the datasets come together again and correspond nearly perfectly.
- There are bigger differences when the country-specific dataset is compared with the IFA dataset. The IFA data is up to 43% higher than the country-specific data in 2005. After 2012 the IFA data is consistently lower, and the two datasets diverge steadily.

Synthetic fertiliser data for the inventory is obtained from Statistics Iceland (Hagstofa Íslands) (SI) for the years 1990-2011 and from the Icelandic Food and Veterinary Association (Matvælastofnun) (IFVA) after that. IFVA must be notified about every import or manufacture of fertilisers in the country according to Icelandic laws 22/1994, 630/2007, 398/1995, 499/1996, 25/1993, 87/1995 and regulation 479/1995 regarding the inspection of food, fertilisers and seeds, animal diseases and prevention of them and relative changes.

According to information provided by IFVA, the peak in import of fertilisers occurred during the financial boom in Iceland, after which the financial crisis and fall of the currency is expected to have caused the drop in imports, in line with a sharp increase in the price of imported goods. The numbers refer to import data in a calendar year; in November 2014 a company imported more than 2,000 tonnes of fertilisers which were then sold over the following spring 2015; this can distort the overall picture and lead to "artificial" peaks. The peaks are though not all artificial according to a fertiliser expert at the Agricultural University of Iceland. Farmers try to reduce fertiliser use when the price is at its highest and then increase it when the price drops. Difficult seasons with frost damage and/or crop failure also affect the purchase of fertilisers.

³¹ 2024 data is not yet available in the FAO and IFA dataset at the time of this writing.

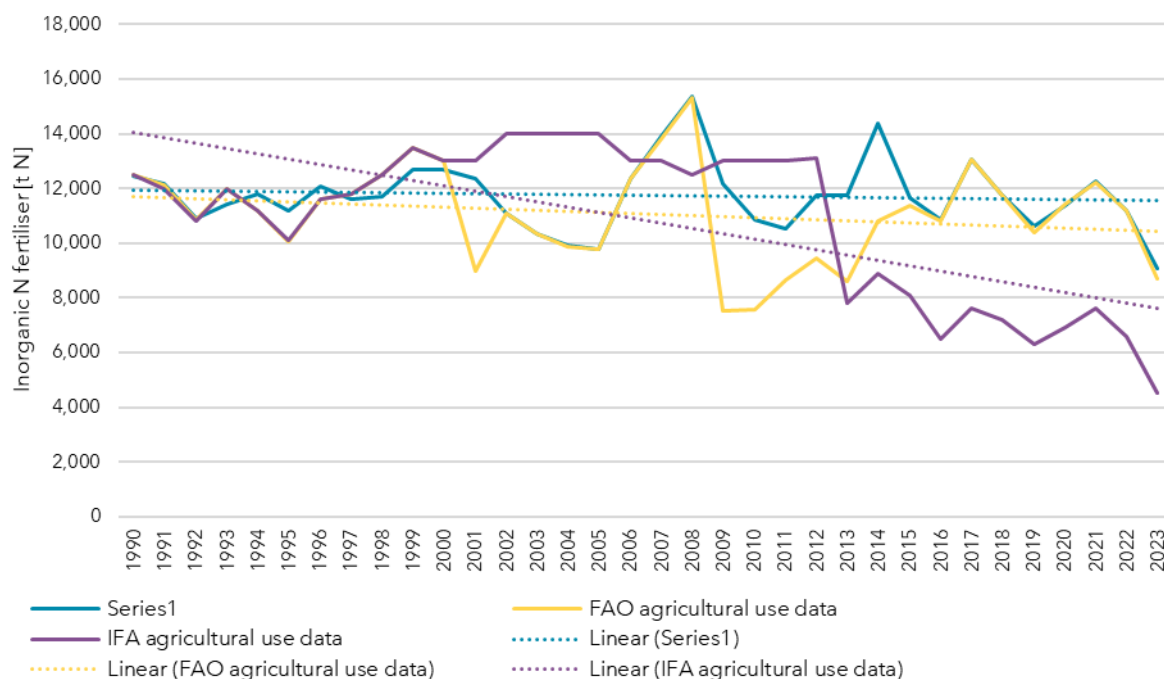


Figure 5.2. Comparison of different datasets on synthetic fertiliser use in Agriculture.

Based on this comparison, the conclusion is that the country-specific data is currently the best available data. This is supported by the relative soundness of the domestic data flow and the big inconsistencies between the FAO and IFA datasets. They diverge too much, both from each other and from the domestic data, for either of them to be the better choice conclusively.

5.1.5 Planned Improvements

Country-specific emission factors are being developed at the Agricultural University of Iceland for methane emissions from enteric fermentation of dairy cows. When available, they will be incorporated into the inventory.

Research has been launched with the aim to establish country specific methane production capacity (B0) and methane conversion factors (MCFs) from slurry and pit storage in cattle and sheep farming. Results, expected in 2027, will be incorporated in the 2028 submission.

5.2 Data Sources

Activity data and emission factors are collected from different institutions and processed at the Icelandic Environment and Energy Agency (Umhverfis- og orkustofnun) (IEEA). The main data providers are listed in Table 5.6. In addition, data can be requested from private companies and farmers or breeding associations if needed. When published data is lacking information that is needed for the compilation of the emission inventory, expert judgement is requested.

Table 5.6. Main data providers for the Agricultural sector.

Data Provider	Icelandic Name	Website	Data/Information
Ministry of Food, Agriculture and Fisheries (MFAF)	Matvælaráðuneytið	https://www.stjornarradid.is/verkefni/atvinnuvegir/landbunadur/maelabord-landbunadarins-/#Tab4bustofn.is	Annual livestock census Meat production
Icelandic Food and Veterinary Authority (IFVA)	Matvælastofnun (MAST)	mast.is	Slaughtering data Inorganic fertiliser import data
Icelandic Agricultural Advisory Centre (IAAC)	Ráðgjafarmiðstöð landbúnaðarins (RML)	rml.is	Data required for the Tier 2 methodology for cattle and sheep ¹ Expert judgements
Land and Forest Iceland (LFI)	Land og skógur	https://island.is/s/land-og-skogur	Areas of drained organic soils Use of sewage sludge and other organic fertilisers for land reclamation
Statistics Iceland (SI)	Hagstofa	hagstofa.is	Crop production and annual area of crops harvested Inorganic fertiliser import data and livestock numbers for comparison
Agricultural University of Iceland (AUI)	Landbúnaðarháskóli Íslands (LBHÍ)	lbhi.is	Specific studies about Icelandic agricultural practices Emission factor for drained organic soils Expert judgements

¹ Including dry matter intake, protein and ash content in feed, animal weights, time spent in various feeding situations, fractions of manure going to different manure storage pathways, pregnancy rates, wool production, and the ratios for how many lambs each ewe and young sheep carried with her in pasture over the summer (IAAC, 2022).

An extensive effort to update livestock parameters for all cattle and sheep subcategories was undertaken for the 2023 submission. The EAI collaborated with the Icelandic Agricultural Advisory Centre (Ráðgjafamiðstöð landbúnaðarins) (IAAC) on updating the livestock parameters needed for a Tier 2 methodology for enteric fermentation and manure management emission calculations (IAAC, 2022). Information for the years 1990, 1999, 2005, and 2010 were also updated simultaneously to improve the backwards trend. Updated feed digestibility data was obtained from the IAAC for the 2026 submission and the methodology used to estimate digestible energy was also updated. The plan is to update feed digestibility data every three to four years. Data about milk yield is collected annually and published by IAAC (and other entities in the past).

5.3 Data covering various agricultural subsectors

5.3.1 Animal Population Data

The Ministry of Food, Agriculture, and Fisheries (Matvælaráðuneytið) (MFAF) conducts an annual livestock census, formerly conducted by the Icelandic Food and Veterinary Authority

(Matvælastofnun) (IFVA). Farmers count their livestock once a year in November and send the numbers to MFAF through the online application bustofn.is. Consultants from local municipalities visit each farm during March of the following year and correct the numbers from the farmers in case of discrepancies. The IEAA has access to the online application bustofn.is and downloads the livestock numbers directly from there. From 2025 onwards the poultry slaughter data will be retrieved the same way.

SI also publishes livestock population data on their website and comparison to their data can be seen in Table 5.7. In the SI data, cattle for meat production or Other Mature Cattle were not reported until 1998. From 1993, Other Mature Cattle numbers are available through MFAF, even though they are not reported on the website of SI. The annual livestock census is the basis for government subsidies in the raising of cattle, sheep and goats and can be considered accurate. There are not government subsidies for swine, poultry and fur-animal farmers but due to regular monitoring the data can be considered accurate as well. Livestock numbers for horses are explained in the next section.

The Icelandic Agricultural Advisory Centre (IAAC) keeps a more detailed data base on cattle population in Iceland, called Huppa, than the autumn census. The data from Huppa, have been used alongside the autumn census since the 2026 submission to get a more accurate split into cattle subcategories.

Table 5.7. Comparison between animal numbers, in 1000s, as used for the calculation of greenhouse gas emissions and as reported on the website of SI.

Animal category	Source	1990	1995	2000	2005	2010	2015	2020	2023	2024
Mature Dairy Cattle	Statistics Iceland	32.2	30.4	27.1	24.5	25.7	27.4	25.8	25.9	25.2
	NIR	31.6	30.4	27.1	24.5	25.4	27.4	25.9	25.7	25.5
Other Mature Cattle	Statistics Iceland	[*]	[*]	0.95	1.4	1.7	2.0	3.3	3.7	3.7
	NIR	0.64	0.74	1.0	1.4	1.6	2.0	3.3	3.8	3.7
Sheep	Statistics Iceland	548.5	458.3	465.8	455.0	479.8	480.7	401.0	355.0	345.4
	NIR	548.7	458.4	465.6	454.7	477.3	473.6	401.8	356.9	348.8
Goats	Statistics Iceland	0.35	0.35	0.42	0.44	0.73	1.0	1.6	1.8	1.9
	NIR	0.33	0.35	0.38	0.45	0.70	1.0	1.7	1.9	1.9
Swine	Statistics Iceland	3.1	3.7	3.9	4.0	3.6	3.6	3.1	3.0	[*]
	NIR	3.1	3.7	3.9	4.0	3.4	3.5	3.1	3.0	2.9
Laying hens	Statistics Iceland	214.9	164.4	193.1	166.1	173.4	238.0	203.6	194.2	[*]
	NIR	215.0	164.4	193.1	152.2	144.4	119.8	203.6	194.2	194.2
Mink	Statistics Iceland	42.0	29.9	36.6	35.9	37.4	47.7	15.8	5.2	[*]
	NIR	42.8	30.5	36.6	36.0	39.7	47.7	15.8	5.2	4.8
Foxes	Statistics Iceland	4.8	7.3	4.1	0.77	5.0.E-03	0	[*]	0	[*]
	NIR	5.0	7.3	4.1	0.83	5.0.E-03	2.0.E-03	4.0.E-03	0	0
Rabbits	Statistics Iceland	1.8	0.08	0.71	0.24	0.11	0.34	0.081	0.062	[*]
	NIR	1.8	0.08	0.71	0.27	0.17	0.34	0.081	0.060	0.044

[*] Data not available from Statistics Iceland. In the SI data, Other Mature Cattle were not reported until 1998.

Horses

Since changing the yearly livestock count methodology in 2013, there have been issues with the number of horses which could result in an under- or overestimation (double counting). There is no legal obligation for horse owners to report the number of horses, as they do not receive any support payments as for cattle and sheep. This could still lead to an underestimation of the actual number of horses present in the country (Lorange, written communication, 2019).

For this submission it was decided to maintain the estimation method established for the past submissions by modelling the total number of horses as the sum of two thirds of animals registered at MFAF (bustofn.is) and one third registered in the studbook of origin for the Icelandic horse³² after consulting with Jón Baldur Lorange, advisor at the office for agricultural affairs at MFAF and manager of the studbook Worldfengur (Table 5.8). The calculated total number of horses is assumed to include all horses, mares, young horses, and live foals, but excludes the number of foals that are slaughtered annually. This methodology has been re-confirmed by expert judgment (Lorange, written communication, 2022). At a certain point, no calculations should be necessary, and the horse numbers should derive directly from the studbook, linked to the autumnal census of livestock. Until then, the abovementioned expert judgment is used to have the most realistic livestock population numbers as possible.

Table 5.8. Comparison of registered horses, in 1000s, in the autumn census of IFVA and the studbook Worldfengur since 2015 and calculated horse numbers to be used in this submission.³³

Source	1990	1995	2000	2005	2010	2015	2020	2023	2024
MFAF (bustofn.is) [1000s]	72	78	74	75	56	67	59	50	46
Studbook (worldfengur.com) [1000s]	NA	NA	NA	NA	NA	98	92	92	93
Calculated for NIR [1000s]	72	78	74	75	77	78	72	67	65

5.3.1.1 Animals with a Lifespan Shorter than One Year

The fact that young animals that live less than one year and have been slaughtered by autumn, means that they are unaccounted for in the annual census data. This issue has been resolved by calculating these animal populations based on the parameters and methods listed below.

³² <https://www.worldfengur.com/>

³³ This table contains the number of horses which are alive for more than one year (horses, mares, young horses, and live foals). The AAP of foals which are slaughtered is not included in this number, because they have never been a part of the census. Therefore, the total number of horses calculated for NIR in this table is a little lower than the total number of horses reported in CRT.

To adjust for the fact that the animals have a lifespan shorter than one year, annual average populations (AAP) were calculated, according to equation 10.1 in the 2006 IPCC Guidelines, using estimates of total production of animals and average lifespan.

More details on how the numbers of each relevant animal category are calculated can be found in the sections below.

Lambs

The population of lambs was calculated with information on birth rates, derived from data on infertility rates, single, double, and triple birth fractions for both mature ewes and young sheep, e.g., one-year-old ewes, early mortality rate and average age at slaughter, as shown in Table 5.9 (IAAC, 2022). The number of lambs produced annually (NLPA) is consequently estimated with the following equation:

Equation

Number of lambs produced annually

$$NLPA = (1 - Rate_{Mortality}) \cdot (Frac_{ewes} \cdot N_{ewes} + Frac_{afr} \cdot N_{afr})$$

Where:

$NLPA$ = Number of lambs produced annually

$Rate_{Mortality}$ = Early mortality rate

$Frac_{ewes}$ = Birth rate fraction for ewes

$Frac_{afr}$ = Birth rate fraction for animals for replacement

N_{ewes} = Number of ewes

N_{afr} = Number of animals for replacement

When the NLPA has been established, the AAP of lambs is calculated based on data on the age of lambs at slaughter. The parameters and resulting calculated AAP of lambs can be seen in Table 5.9.

Table 5.9. Parameters used to calculate the AAP of lambs and the resulting calculated AAP of lambs.

Lambs	Unit	1990	1995	2000	2005	2010	2015	2020	2023	2024
Mature ewes	1000s	446	372	373	360	373	373	316	278	268
Lambs born per mature ewe	Fracti on	1.81	1.81	1.82	1.82	1.83	1.83	1.83	1.81	1.82
Female young sheep	1000s	79.7	64.7	71.1	74.2	83.3	79.8	67.1	61.4	63.2
Lambs born per female young sheep	Fracti on	0.83	0.85	0.87	0.88	0.90	0.92	0.94	0.92	0.96
Lambs born	1000s	871	729	739	721	755	757	642	559	549
Early mortality	%	7.5%	7.2%	6.9%	6.6%	6.4%	6.1%	6.2%	6.2%	6.6%
Number of lambs produced annually (NLPA)	1000s	805	676	688	673	707	711	602	524	513

Lambs	Unit	1990	1995	2000	2005	2010	2015	2020	2023	2024
Age at slaughter	Days	137	137	137	137	139	140	138	140	142
AAP of lambs	1000s	302	254	258	252	269	273	228	202	199

Piglets

The number of piglets was calculated with data on the number of piglets born to each sow per year³⁴. The parameters and resulting calculated AAP of piglets can be seen in Table 5.10.

Table 5.10. Parameters used to calculate the AAP of piglets and the resulting calculated AAP of piglets.

Piglets	Unit	1990	1995	2000	2005	2010	2015	2020	2023	2024
Sows	1000s	2.96	3.52	3.69	3.91	3.33	3.45	3.02	2.93	2.93
Piglets born per sow	Fraction	15.0	17.0	17.0	20.0	23.0	25.0	26.5	26.5	26.5
Piglets born (NAPA)	1000s	44.5	59.8	62.8	78.2	76.6	86.3	80.1	77.8	77.8
Age at slaughter	Days	215	165	165	165	165	165	165	165	165
AAP of piglets	1000s	26.2	27.0	28.4	35.3	34.6	39.0	36.2	35.1	35.1

Kids

The number of kids was calculated with information on the fraction of female goats of the total mature goat population, birth fractions and the age at slaughter received from Iceland's biggest goat farmer (Þorvaldsdóttir, oral information, 2012). The parameters and resulting calculated AAP of kids can be seen in Table 5.11.

Table 5.11. Parameters used to calculate the AAP of kids and the resulting calculated AAP of kids.

Kids	Unit	1990	1995	2000	2005	2010	2015	2020	2023	2024
Goats (female)	1000s	0.29	0.31	0.33	0.40	0.61	0.89	1.45	1.65	1.70
Kids per doe	Fraction	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Kids born (NAPA)	1000s	0.44	0.46	0.50	0.59	0.92	1.33	2.18	2.48	2.54
Age at slaughter	Months	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
AAP of kids	1000s	0.20	0.21	0.23	0.27	0.42	0.61	1.00	1.14	1.17

Foals

Due to a lack of registration of foals, their number is estimated as a share of the total calculated number of horses. These numbers are based on data received from the IFVA and

³⁴ The Farmer's Association of Iceland, sections for each livestock category:
<https://www.bondi.is/bugreinadeildir>

on expert judgment from the MFAF. Data on the number of foals, both live and slaughtered, was received from the IFVA between 1990-2012. From then on, the average share of live- and slaughtered foals between 2007-2011 of the total number of horses in Iceland was used to calculate the number of live- and slaughtered foals.

A key difference between live and slaughtered foals, is that the live foals are calculated as a share of the total calculated horse population, because they are alive for more than one year, while the slaughtered foals are added to the total, i.e., it is assumed that horses, mares, young horses, and live foals add up to 100% of the total calculated number of horses. The 6% of slaughtered foals is added on top of that. The parameters and resulting calculated AAP of foals can be seen in Table 5.12.

Table 5.12. Parameters used to calculate the AAP of foals and the resulting calculated AAP of foals.

Foals	Unit	1990	1995	2000	2005	2010	2015	2020	2023	2024
Total horses	1000s	72.0	78.2	73.7	74.8	77.2	77.6	71.8	67.0	64.7
Live foals, share of total horses	%	9%	9%	9%	9%	9%	9%	9%	9%	9%
Slaughtered foals, share of total horses	%	6%	6%	6%	6%	6%	6%	6%	6%	6%
Live foals	1000s	6.8	7.1	4.8	5.7	6.9	6.7	6.2	5.8	5.6
Slaughtered foals	1000s	4.4	4.9	4.7	4.3	4.0	4.3	4.0	3.7	3.6
Age at slaughter	Months	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
AAP of foals	1000s	8.6	9.2	6.8	7.5	8.6	8.5	7.9	7.3	7.1

Poultry

Animal numbers for mature poultry are derived from the yearly census data on bustofn.is. This is used for the more mature animals, including hens and pullets. For pullets, the average number of animals in house at each time is registered in the census, i.e. the average annual population. For 1990-1991, data on the number of mature turkeys was missing. This was gap filled by estimating the number of mature turkeys to be the average of the first five known years (1992-1996).

The number of younger poultry is derived from data on slaughtered poultry. Information on age at slaughter was reviewed in collaboration with a poultry expert at the IFVA in 2021 and updated in 2024.

For some of the poultry categories, data on slaughtered animals was missing for 1990-1994. For the chicks categories of chicken, ducks, and turkeys, the same AAP was assumed for 1990-1994 as were estimated for 1995.

The parameters used for these calculations and resulting annual average and total populations of chicken, ducks and turkeys can be seen in Table 5.13.

National Inventory Document, Iceland 2026

Table 5.13. Parameters used to calculate the AAP of poultry (chicken, ducks, and turkeys) and the resulting calculated AAP of poultry.

Poultry Category	Description	Unit	1990	1995	2000	2005	2010	2015	2020	2023	2024
Chicken	Total hens	1000s	506	186	285	213	164	171	241	242	106
Chicken	Total pullets	1000s	24.0	27.8	63.0	205.4	73.2	75.8	66.0	68.7	46.0
Chicken	Total chicks	1000s	1,517	1,517	2,009	3,793	4,284	5,008	5,401	5,547	5,697
Chicken	Age of chicks at slaughter	Days	33	33	33	33	33	33	35	34	34
Chicken	AAP of chicks	1000s	137	137	182	343	387	453	513	517	531
Chicken	Total population	1000s	667	351	529	761	625	700	820	828	683
Ducks	Total hens	1000s	3.62	3.13	0.88	1.24	1.08	0.79	0.52	0.42	0.44
Ducks	Total chicks	1000s	11.9	11.9	8.9	1.6	0	0.79	0	0	0
Ducks	Age of chicks at slaughter	Days	50	50	50	50	50	50	50	50	50
Ducks	AAP of chicks	1000s	1.64	1.64	1.22	0.22	0	0.11	0	0	0
Ducks	Total population	1000s	5.25	4.77	2.11	1.46	1.08	0.90	0.52	0.42	0.44
Turkeys	Total hens	1000s	0.85	0.36	4.51	0.53	0.96	1.10	1.20	1.20	1.20
Turkeys	Total chicks	1000s	12.6	12.6	29.9	35.6	38.3	50.1	48.8	57.4	58.4
Turkeys	Age of turkeys at slaughter	Months	77	77	77	77	77	77	83	84	84
Turkeys	AAP of chicks	1000s	2.65	2.65	6.32	7.51	8.08	10.56	11.05	13.21	13.45
Turkeys	Total population	1000s	3.50	3.01	10.82	8.04	9.04	11.66	12.25	14.41	14.65

5.3.2 Livestock Characterisation

Emissions from enteric fermentation and manure management are reported for the categories Mature Dairy Cattle, Other Mature Cattle and Growing Cattle. Growing Cattle summarises calculations which were performed separately for the following three subcategories: 1) Heifers older than 12 months, 2) Young bulls older than 12 months, and 3) Calves up to 12 months of age.

The livestock category Sheep comprises Mature Ewes, Young sheep, Rams and Lambs. Young sheep match the category of female and male yearlings in the autumn census. The annual average lamb population is obtained as explained in Section 0.

Table 5.14 shows national parameters for cattle in the latest inventory year. Not all parameters have been constant over the last three decades. The ones that have changed are days on stall, days on pasture, kg milk per day, fat and protein content of milk, the pregnancy rate. For cattle, the number of calves is taken directly from the autumn census of the IFVA because calves have a lifespan longer than one year.

Table 5.14. Animal performance data used in emission calculations for cattle for 2024.

	Mature Dairy Cattle	Other Mature Cattle	Heifers	Young bulls	Calves
Weight [kg]	517	525	344	413	145
Mature body weight [kg]	NA	NA	550	766	647
Daily weight gain [kg]	NO	NO	0.51	0.67	0.61
Days in stall	309	30	245	365	283
Days on pasture	56	335	120	0	82
Milk per day [kg]	17.9	5.5	NA	NA	NA
Fat content of milk [%]	4.2	4.2	NA	NA	NA
Protein content of milk [%]	3.4	3.4	NA	NA	NA
Pregnancy rate [%]	93%	80%	50%	NA	NA
CF _i ²	0.375	0.343	0.322	0.370	0.322

NA: Not applicable, NO: Not occurring

² The parameter CF_i is taken from Table 10.4 in the 2006 IPCC Guidelines. For Mature Dairy Cattle and Other Mature Cattle the default value is adjusted to the lactating period, 305 and 120 days, respectively.

Icelandic Cattle

The Icelandic cow breed is probably one of the very few breeds in the world that has remained little or unmixed with other breeds since the age of settlement in Iceland (874-930 AD). Research shows that the Icelandic breed is very similar to old breeds still found in Norway nowadays. While all the dairy cattle are of the old Icelandic breed, the beef cattle are Aberdeen Angus, Galloway, and Limousin, all imported from Great Britain and France. The import of these breeds started in the early 20th century and is limited.

The Icelandic dairy cattle are small, and adults weigh only about 500 kg. The cows are multicoloured and show more diverse colours than any other cattle breed in Europe.

The table below shows a comparison in weight between the Icelandic breed (ISL) and four other Nordic breeds.



	NH	NRF	NR	DJ	ISL
Adult body weight [kg]	640	560	600	470	500
Milk production [kg ECM]	11,500	9,650	10,730	10,080	6,400

NH: Nordic Holstein, NRF: Norwegian Red, NR: Nordic Red, DJ: Danish Jersey, ISL: Icelandic breed.

ECM: Energy-Corrected Milk is a standardized way to compare milk yield across different cows or breeds by adjusting for the energy content of the milk, which depends on its fat and protein content.

Information and pictures from naut.is (Icelandic), Comparison between breeds from (Kristofersson, Eythorsdottir, Harðarson, & Jonsson, 2007)

Icelandic Sheep

The Icelandic sheep breed has been a part of the Icelandic landscape since the age of settlement (874-930). The breed was brought over from Norway and belongs to the Northern European short-tailed sheep.

Selective breeding of the Icelandic sheep began in the 19th century, but it led to diseases that the Icelandic sheep was very sensitive to and therefore it was stopped. Today it is forbidden to import sheep to Iceland. The size of the sheep is average. The ewes weigh around 65kg and the rams around 93kg. The sheep are generally short legged with face and legs free of wool. Both ewe and ram can be horned or polled, but most sheep are horned.

After lambing in May, Icelandic farmers turn their flocks loose into the hills, valleys, and highlands, where they graze freely on grass, berries, and herbs over the summer. The sheep roundup takes place in the autumn, where the sheep are brought in, sorted, and go back to their respective owners. This method has been used ever since settlement. Every summer, the sheep roam around the highlands.



Table 5.15 shows national parameters used for emission calculations for sheep for 2024.

Table 5.15. Animal performance data used for emission calculations for sheep for 2024. NA: Not applicable, NO: Not occurring.

	Mature Ewes	Rams	Young sheep	Lambs
Weight [kg]	65	93	51	23
Body weight at weaning [kg]	NA	NA	NA	20
Body weight final [kg] ¹	NA	NA	60	41
Birth weight [kg]	3.9	3.9	3.9	3.9
Days in stall	200	200	200	0
Days on flat pasture	60	60	60	32
Days on hilly pasture	105	105	105	105
Single birth fraction ²	0.16	NA	0.08	NA
Double birth fraction	0.68	NA	0.13	NA
Triple birth fraction	0.10	NA	NO	NA
Annual wool production [kg]	2.0	2.5	1.5	1.5

¹ Weight at 16.5 months for young sheep and 4.5 months for lambs (slaughter).

² Difference between sum of birth fractions and one is due to infertility rates of mature ewes and young sheep.

For the Tier 1 methodology in the 2019 Refinements for emission calculations from enteric fermentation and manure management, information on animal weight and productivity system is often needed. The values used are shown in Table 5.16. For poultry and pigs the 2019 Refinements values from Table 10A.5 for Western Europe are used and for fur-animals the values from Table 10A-9. For horses and goats, country-specific values are used (Stefánsdóttir, 2015), (Sveinsdóttir & Dýrmundsson, 1994).

Table 5.16. Animal Weight and Productivity System for Tier 1 calculations.

Animal	Body Weight [kg]	Productivity System
Swine	190	High productivity
Piglets	61	
Hens	2	
Pullets	2	
Broilers	1	
Turkeys	7	
Fur-animals	2	
Ducks/Geese	3	Low productivity
Goats	46	
Adult horses	360	
Young horses	318	
Foals	136	

5.3.3 Feed Characteristics and Gross Energy Intake

As well as providing data on cattle and sheep livestock characteristics, data on feed characteristics and digestible energy calculations are obtained from the IAAC, as discussed in Section 5.2.

Feed ash content (instead of manure ash content) was used in all calculations in accordance with Dämmgen et al. (2011). Organic matter digestibility and feed ash content were weighted with the respective daily feed amounts in order to calculate average annual values. This method included seasonal variations in feed, e.g., stall feeding versus grazing on pasture, lactation versus non-lactation period etc. Organic matter digestibility was transformed into digestibility of gross energy intake using a formula from (Ministry of Agriculture, Fisheries and Food, 1975), updated by the IAAC in 2025 in such a way that the calculations are now based on organic matter digestibility instead of dry matter digestibility.

The gross energy (GE) requirement is derived based on the summed net energy requirements and the energy availability characteristics of the feed, i.e. using equations, 10.3 – 10.16, from the 2019 Refinements, except equations 10.9 and 10.11, which do not apply for Iceland.

Table 5.17 shows organic matter digestibility, digestible energy, ash content of feed, and gross energy in the latest inventory year, for all cattle and sheep categories. All values and calculations used to estimate the digestible energy of cattle and sheep feed are reported Annex 5: Values used in Calculation of Digestible Energy of Cattle and Sheep Feed. Animal characteristics data used is shown in Section 5.3.2.

Table 5.17. Organic matter digestibility, digestible energy, ash content and gross energy intake of cattle and sheep feed in 2024.

	OMD [%]	DE [%]	Ash in feed [%]	GE [MJ/day]
Mature Dairy Cattle	79.8	73.5	8.1	258.3
Other Mature Cattle	77.1	71.9	7.1	166.1
Heifers	77.1	71.5	7.3	110.9
Young bulls	76.9	71.7	7.1	120.6
Calves	78.5	72.7	7.7	52.6
Mature Ewes	75.8	70.4	7.5	22.3
Rams	75.8	70.4	7.5	24.3
Young sheep	75.8	70.4	7.5	22.0
Lambs	81.6	70.4	7.1	16.1

Figure 5.3 shows the variation of gross energy intake (GE) in MJ per animal per day for all cattle and sheep subcategories since 1990. Feed digestibility has been increasing, which has led to slightly lowered gross energy intake for all categories except Mature Dairy Cattle and Lambs. Over the decades, mature dairy cattle have been producing increasingly much milk

and lambs have been growing in average body weight. These elements mainly explain their increased gross energy intake.

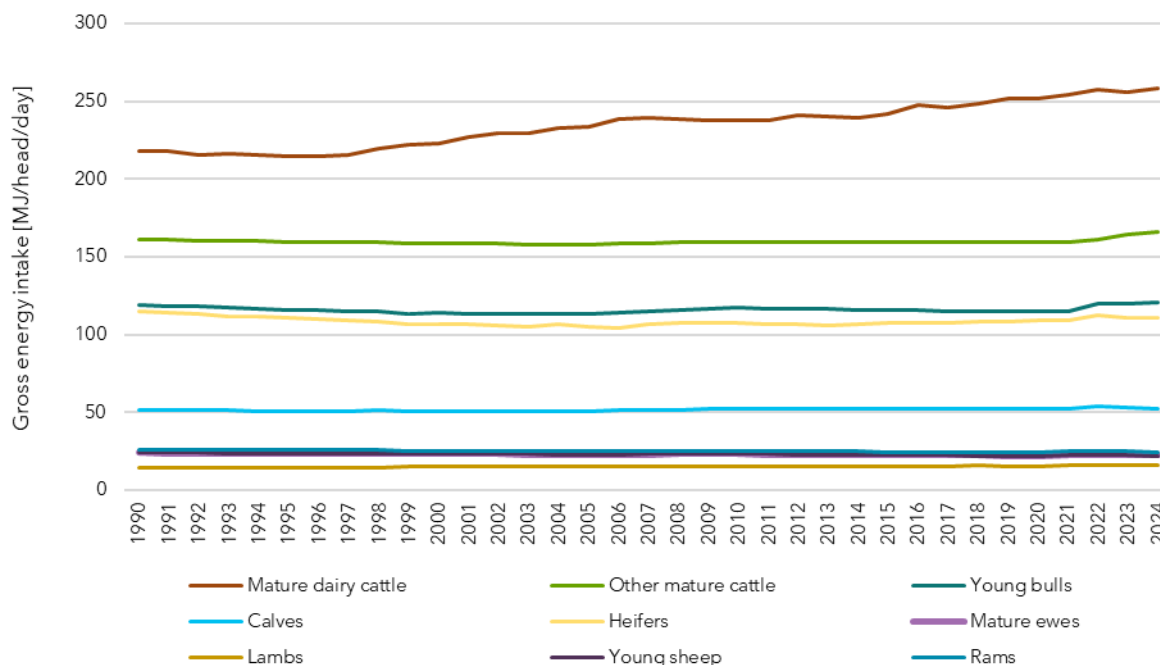


Figure 5.3. Gross energy intake [MJ/animal/day] for cattle and sheep subcategories since 1990.

The livestock category Growing Cattle comprises the categories Heifers, Young bulls, and Calves. Emissions are calculated separately for each category, as shown in Table 5.18, but uploaded in CRT as a sum. Manure management system fractions for Growing Cattle can be seen in Table 5.33.

Table 5.18. Weighted averages of parameters necessary to calculate emissions from the category Growing Cattle as reported in CRT.

Growing cattle	1990	1995	2000	2005	2010	2015	2020	2023	2024
Population Heifers [1000s]	12.4	14.1	15.0	13.3	14.8	15.7	15.8	15.5	15.8
Population Young bulls [1000s]	10.2	8.7	11.2	8.6	10.7	11.2	13.4	12.0	11.4
Population Calves [1000s]	20.1	20.0	17.9	18.1	20.0	22.4	22.8	21.7	21.6
Weighted average Body weight (BW) [kg]	246	248	266	257	264	264	272	273	272
Weighted average digestible energy (DE) [%]	68.4	69.6	70.4	71.3	70.6	71.5	72.4	72.0	72.1
Weighted average gross energy (GE) [MJ/day]	85.8	83.9	86.0	82.4	85.5	84.3	85.6	87.3	87.3
Weighted average Volatile solid excretion (VS) [kg VS/day]	1.6	1.5	1.5	1.4	1.5	1.4	1.4	1.4	1.4

Growing cattle	1990	1995	2000	2005	2010	2015	2020	2023	2024
Weighted average Nex [kg N/head/year]	35.1	35.4	37.4	36.7	37.3	36.0	35.9	36.1	36.1

5.3.4 Recalculations

The cattle categories behind the category Growing Cattle were changed to increase the transparency of calculations. The category Young bulls and non-inseminated heifers has been split up by gender, and the non-inseminated heifers have been put in the same group as bred heifers forming the category Heifers. These changes only slightly affect the emissions.

Updated animal weights and manure storage fractions were obtained for all cattle categories, affecting 3A, 3B and 3D emissions. An error was also found and fixed for the Mature Dairy Cattle, the days in different systems didn't add up to 365.

The methodology used to estimate feed digestibility for cattle and sheep was updated. Instead of basing the calculations on data on dry matter digestibility they are now based on data on organic matter digestibility. The ash content of feed was also updated for cattle and sheep. This change increased the digestibility and therefore decreased 3A, 3B and 3D emissions due to cattle and sheep farming, see relevant recalculation sections.

The mortality rate of lambs was increased by around 2.5% for the whole timeline, affecting the sheep population size, and hence, emissions due to sheep farming, see Table 5.19.

Table 5.19 Recalculations of the sheep population size due to updated lamb mortality rate.

3B2 Sheep, population	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [1000s]	859	719	730	713	753	753	636	587	565
2026 submission [1000s]	851	712	724	707	747	746	629	578	557
Change relative to the 2025 submission [1000s]	-7.89	-6.65	-6.56	-6.23	-6.43	-6.30	-6.46	-8.41	-7.37
Change relative to the 2025 submission [%]	-0.92%	-0.93%	-0.90%	-0.87%	-0.85%	-0.84%	-1.02%	-1.43%	-1.30%

For goats updated gender fractions were received (12% adult males instead of 15%), updated number of kids per doe (1.5 instead of 1.3) and updated slaughter age (5.5 months instead of 5 months), affecting the population size of goats, see Table 5.20.

Table 5.20 Recalculations of the goat population size due to updated livestock characterisation.

3B2 Sheep, population	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [1000s]	859	719	730	713	753	753	636	587	565
2026 submission [1000s]	851	712	724	707	747	746	629	578	557
Change relative to the 2025 submission [1000s]	-7.89	-6.65	-6.56	-6.23	-6.43	-6.30	-6.46	-8.41	-7.37

3B2 Sheep, population	1990	1995	2000	2005	2010	2015	2020	2022	2023
Change relative to the 2025 submission [%]	-0.92%	-0.93%	-0.90%	-0.87%	-0.85%	-0.84%	-1.02%	-1.43%	-1.30%

Updated weights were received for foals (136 kg instead of 60 kg) and 1–3-year-old horses (318 kg instead of 175 kg), and those weights are now used to adjust the 3A Emission factor for horses, while in the 2025 submission the weight of an adult horse was used to adjust the 3A EF used for all horse age groups. The weight change also effects the amount of volatile solids and nitrogen excreted. These changes led to recalculations in 3A, 3B and 3D, see recalculation tables in the respective sections on recalculations.

5.3.5 Planned Improvements

There are no planned improvements regarding animal population data, livestock or feed characteristics.

5.4 CH₄ Emissions from Enteric Fermentation (CRT 3A)

The amount of enteric methane emitted by livestock is driven primarily by the number of animals, the type of digestive system and the type and amount of feed consumed. Cattle and Sheep are the largest sources of enteric CH₄ emissions in Iceland and therefore Tier 2 methodology is applied for those livestock categories while Tier 1 methodology is applied for all other livestock categories. The methodologies and parameters in the 2019 Refinements are applied for all livestock categories other than Cattle, for which the 2006 IPCC Guideline's Y_m factor is still applied³⁵.

5.4.1 Emission Factors

Tier 1

The CH₄ emissions from Swine, Horses and Goats are calculated using emission factors from Table 10.10 in the 2019 Refinements. The emission factors for both Horses and Goats are adjusted using the average Icelandic animal weight in each category as suggested in footnote 7 to Table 10.10. Both species are Icelandic breeds and especially horses differ in size from the reference weight in Table 10.10 (see Table 5.16). The adjustment is done as follows:

$$\text{Approximate } EF_{\text{Group}} = \left[\frac{\text{Weight Icelandic horse}_{\text{Group}}}{\text{Liveweight in Table 10.10}} \right]^{0.75} \cdot \text{Tier 1 } EF$$

³⁵ A country specific Y_m factor for Icelandic dairy cows is expected in early 2026 and hence the Cattle Y_m factor was not updated alongside the others.

For Poultry and Fur-bearing animals, emission factors reported in the Norwegian Emission Inventory are used, as agricultural practices and the climate in the two countries are similar. Further information can be found in the Norwegian NIR (Statistics Norway, 2019).

Table 5.21. Emission factors used for Tier 1 calculations.

Livestock Category	EF [kg CH ₄ /head/year]	Source
Swine	1.5	IPCC 2019 RF, Table 10.10, high productivity system
Horses	13	
Young horses	12	IPCC 2019 RF, Table 10.10, weight adjusted
Foals	6.3	
Goats	7.3	IPCC 2019 RF, Table 10.10, low productivity system, weight adjusted
Minks, Foxes, Rabbits	0.1	
Poultry	0.02	2019 Norwegian NIR

Tier 2

Livestock population characterisation was used to calculate gross energy intake of Cattle and Sheep as shown in Section 5.3.3. For cattle, the default values of the CH₄ conversion rates (Y_m) from the 2006 IPCC Guidelines are used since research has been ongoing at the Agricultural University of Iceland (AUI) which will soon provide country-specific factors for enteric fermentation emissions from dairy cows. The Y_m value used for Sheep, other than Lambs, is 6.5%, since the average feed intake is above 0.8 kg/day, following the recommendation in the bottom paragraph of p. 46 in Ch. 10, Vol. 4 of the 2019 Refinements. The Lamb category contains lambs that are less than 4,5 month old. The Y_m value for this category is adjusted to account for the lower methane emissions pre-weaning in such a way: $Y_m = 0\%$ is applied the first 60 days and afterwards $Y_m = 6.5\%$ is applied. This approach gives slightly lower emissions pre-weaning than reality but higher emissions post-weaning but balances out for the Lamb category as a whole, see Table 5.22

The gross energy intake and the CH₄ conversion rates were used to calculate emission factors for CH₄ emissions from Enteric Fermentation by applying Equation 10.21 from the IPCC Guidelines. Table 5.23 shows the country specific emission factors for Cattle and Sheep and the respective subcategories. Feed digestibility has been increasing for all subcategories which has a lowering effect on the emission factor, however, increased body weight since 1990, as well as increased milk production of dairy cows counteracts the decrease, leading to a higher emission factor for some subcategories.

Table 5.22. Methane conversion rates for cattle from Table 10.12 from the 2006 IPCC Guidelines and for sheep from the 2019 Refinements, Table 10.13 and the paragraph above that table.

Category/Subcategory	Cattle	Sheep ¹	Lambs ²
Y _m	6.5%	6.5%	3.7%

¹ A value of 6.5% is most appropriate since the average feed intake is above 0.8 kg/day, see bottom paragraph of p. 46 in Ch. 10, Vol. 4 of the 2019 Refinements.

² This category contains less than 4,5-month-old lambs. The Y_m value is adjusted to account for the lower methane emission pre-weaning. Y_m = 0% is applied the first 60 days and afterwards Y_m = 6.5% is applied.

Table 5.23. Country-specific emission factors [kg CH₄/head/year] for cattle and sheep.

Livestock Category	2024	Relative change 1990-2024
Mature Dairy Cattle	110.1	18.5%
Other Mature Cattle	70.8	3.1%
Heifers	47.3	-3.4%
Young bulls	51.4	1.3%
Calves	22.4	2.6%
Mature Ewes	9.5	-6.8%
Rams	10.3	-7.4%
Young sheep	9.4	-8.7%
Lambs	4.0	14.9%

5.4.2 Emissions

CH₄ emissions from Enteric Fermentation in domestic livestock are calculated by multiplying the emission factors from Section 5.4.1 with the respective population sizes of each livestock category and subsequent aggregation of emissions of all categories. The results are shown in Table 5.24.

The livestock category Growing Cattle comprises the categories Heifers, Young bulls and Calves. CH₄ emissions are calculated separately for each category, as shown in Table 5.24, but are reported in the CRT as a total sum. In the CRT, all relevant parameters are expressed as a weighted average (see Table 5.21), leading to shifts in the implied emission factor (IEF) in case of population composition changes in this category.

Due to a decrease in population size, emissions from Sheep have decreased by almost substantially since 1990, driving the decrease in emissions from Icelandic agriculture. Cattle have superseded Sheep as the livestock category with highest emissions from enteric fermentation. The only non-ruminant livestock category with substantial methane emissions is Horses. The population size of Horses has been rather stable from 1990, and therefore, the CH₄ emissions are fairly constant.

Table 5.24. CH₄ emissions from Enteric Fermentation [t CH₄].

Livestock category	1990	1995	2000	2005	2010	2015	2020	2023	2024
Mature Dairy Cattle	2,937	2,781	2,571	2,440	2,570	2,832	2,782	2,803	2,810
Other Mature Cattle	44	50	64	91	109	139	224	262	265
Heifers	604	666	682	599	679	720	732	731	746
Young Bulls	517	431	546	418	535	552	656	614	586
Calves	440	436	389	393	446	500	507	488	485
Ewes	4,539	3,728	3,690	3,514	3,676	3,585	2,935	2,683	2,547
Rams	148	136	131	120	130	124	113	107	96
Young Sheep	924	743	797	816	917	850	707	658	668
Lambs	1,040	888	919	915	997	1,026	829	805	787
Swine	44	46	48	59	57	64	59	57	57
Horses	890	964	924	936	955	963	891	832	803
Goats	3.9	4.1	4.4	5.3	8.1	11.8	19.3	21.9	22.5
Fur Animals	5.0	3.8	4.1	3.7	4.0	4.8	1.6	0.5	0.5
Poultry	13.5	7.2	10.9	15.4	12.7	14.2	16.7	16.8	17.1
Total CH ₄ emissions [t]	12,150	10,884	10,781	10,325	11,095	11,387	10,473	10,081	9,890
Emission change compared to 1990		-10.4%	-11.3%	-15.0%	-8.7%	-6.3%	-13.8%	-17.0%	-18.6%

5.4.3 Recalculations

There are recalculations for the whole timeline 1990-2023 due to updated digestibility of feed for cattle and sheep, cattle weights and updated lamb population, see Section 5.3.4.

The Y_m values for sheep was updated from the one in the 2006 IPCC Guidelines to the one from the 2019 Refinements. Simultaneously, the methodology for calculating methane emission from enteric fermentation of lambs was changed to follow the example of Norway. The Lamb category contains lambs that are less than 4.5 months old. The Y_m value for this category is adjusted to account for the lower methane emissions pre-weaning in such a way: Y_m = 0% is applied the first 60 days and afterwards Y_m = 6.5% is applied. This approach gives slightly lower emissions pre-weaning than reality but higher emissions post-weaning but balances out for the Lamb category as a whole.

The resulting changes can be seen in Table 5.25 for cattle and Table 5.26 for sheep.

Table 5.25. Recalculations in 3A1 between submissions.

3A1 Cattle, CH ₄ emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	140.2	138.7	128.7	118.2	128.8	138.5	140.7	140.4	138.7
2026 submission [kt CO ₂ e]	127.2	122.2	119.1	110.3	121.5	132.8	137.2	140.1	137.2
Change relative to the 2025 submission [kt CO ₂ e]	-13.0	-16.5	-9.7	-7.9	-7.3	-5.7	-3.4	-0.27	-1.5
Change relative to the 2025 submission [%]	-9.3%	-11.9%	-7.5%	-6.6%	-5.7%	-4.1%	-2.5%	-0.20%	-1.1%

Table 5.26. Recalculations in 3A2 between submissions.

3A2 Sheep, CH ₄ emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	209.4	172.4	173.2	167.4	178.2	173.3	141.9	135.2	130.0
2026 submission [kt CO ₂ e]	186.2	153.9	155.0	150.2	160.1	156.4	128.4	121.8	119.1
Change relative to the 2025 submission [kt CO ₂ e]	-23.2	-18.6	-18.2	-17.2	-18.1	-16.9	-13.5	-13.4	-11.0
Change relative to the 2025 submission [%]	-11.1%	-10.8%	-10.5%	-10.3%	-10.1%	-9.8%	-9.5%	-9.9%	-8.4%

Recalculations for goats are due to updated information on gender fractions, the number of kids per doe, and on slaughter age, all of which affect the population size of goats, see Table 5.27.

Table 5.27 Recalculations in 3A4d between submissions.

3A4d Goats, CH ₄ emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	0.10	0.10	0.11	0.13	0.21	0.30	0.49	0.56	0.55
2026 submission [kt CO ₂ e]	0.11	0.11	0.12	0.15	0.23	0.33	0.54	0.63	0.61
Change relative to the 2025 submission [kt CO ₂ e]	0.010	0.010	0.011	0.013	0.020	0.030	0.049	0.070	0.068
Change relative to the 2025 submission [%]	9.9%	9.9%	9.9%	9.9%	9.9%	9.9%	9.9%	12.5%	12.4%

Updated weights were received for foals (136 kg instead of 60 kg) and 1–3-year-old horses (318 kg instead of 175 kg), and those weights are now used to adjust the 3A Emission factor for horses, while in the 2025 submission the weight of an adult horse was used to adjust the 3A EF used for all age groups, see Table 5.28.

Table 5.28 Recalculations in 3A4e between submissions.

3A4e Horses, CH ₄ emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	27.1	29.4	27.7	28.1	28.9	29.1	26.9	25.7	25.1
2026 submission [kt CO ₂ e]	24.9	27.0	25.9	26.2	26.7	27.0	24.9	23.8	23.3
Change relative to the 2025 submission [kt CO ₂ e]	-2.2	-2.4	-1.9	-1.9	-2.2	-2.2	-2.0	-1.9	-1.9
Change relative to the 2025 submission [%]	-8.0%	-8.3%	-6.7%	-6.8%	-7.5%	-7.4%	-7.4%	-7.4%	-7.4%

5.4.4 Uncertainties

Annual livestock data are based on a national census, and it is possible to assign an activity data uncertainty of 5% for all animal categories except Horses, which are assigned 10% due to the shifting in the registration system over the past few years. These uncertainties were assigned based on expert judgement. The uncertainty of the CH₄ emission factors are estimated to be 40% based on the indications of the 2006 IPCC Guidelines for Tier 1 calculations. It was decided to also apply this uncertainty to the animal classes for which a Tier 2 calculation is performed. The combined activity data and emission factor uncertainty for CRT categories 3A1 (Cattle), 3A2 (Sheep) and 3A3 (Swine) is 40%, and for 3A4 (Other livestock) it is 39%. The complete uncertainty analysis is shown in Annex 2.

5.4.5 Planned improvements

Country-specific emission factors are being developed at the Agricultural University of Iceland for methane emissions from enteric fermentation of dairy cows. When available, they will be incorporated into the inventory.

5.5 Emissions from Manure Management (CRT 3B)

The relevant greenhouse gases emitted from this source category are CH₄ (CRT 3Ba) and N₂O (CRT 3Bb).

The emissions from manure depend on several factors: animal type, feeding, manure management system, duration of storage, and climate. Organic material in manure is transformed to CH₄ in an anaerobic environment by microbiological processes and during storage and handling of manure, some nitrogen is converted to N₂O. Indirect N₂O emissions from deposition are also estimated from NH₃ and NO_x volatilisation from the manure. Emissions occurring due application of manure to soils or deposition during grazing are reported under 3D Agricultural Soils (Section 5.7).

5.5.1 Methodology

5.5.1.1 Methane (CH₄)

For all livestock categories other than cattle and sheep, the Tier 1 methodology from the 2019 Refinements is applied, using Tables 10.13A and 10.14 and Equations 10.22A and 10.22 (Volume 4, AFOLU, chapter 10).

For the livestock categories Cattle and Sheep, Tier 2 methodology from the 2019 Refinements is applied. Based on the livestock characterisation described in 5.3.2, the volatile solid excretion rate is calculated using Equation 10.24. Subsequently, Equation 10.23 and Tables 10.16A and 10.17 are used to calculate the CH₄ emission factor from manure management.

5.5.1.2 Nitrous Oxide (N₂O)

A nitrogen mass-flow approach, as presented in the 2019 version of the EMEP/EEA Guidebook is used for the N₂O calculations. This approach has been designed to be fully consistent with the IPCC Guidelines on estimating emissions from manure management and provides a methodology that is considered to be a “higher Tier” methodology. For Cattle and Sheep, Tier 2 methodology from the 2019 Refinements for nitrogen excretion is incorporated into the N-flow model, Eq. 10.31 and 10.32, as well as Equation 10.33 for cattle and Table 10.20 for sheep. For the other animal categories Equation 10.30 and default nitrogen excretion rate values from Table 10.19 in the 2019 Refinements are used to calculate the nitrogen excretion.

The N-flow approach considers the flow of both total nitrogen and total ammoniacal nitrogen (TAN) through the entire manure management system, in contrast to only using the total amount of nitrogen as used by the IPCC. The N-flow is modelled by a series of equations that consider the amount of nitrogen and TAN at each management stage and corresponding losses as different nitrogen compounds. The methodology provided in the EMEP/EEA Guidebook (EEA, 2023) is applied to the disaggregated livestock category level described in Section 5.3.2. The resulting emissions are then aggregated to the respective CRT reporting categories. N₂O emissions from grazing animals are part of this N-flow approach, as is the calculation of the organic nitrogen in management systems that is available for application to land as organic fertiliser. Consequently, the approach provides a methodology that is used for estimating emissions from both 3B Manure Management and selected sources that are reported under 3D Managed Soils.

Based on TAN, a more accurate estimate of gaseous nitrogen emissions such as NH₃ and NO_x is possible. This calculation method allows consistency of the nitrogen emissions from the Agricultural sector between the greenhouse gas inventory, and the air pollutant inventory compiled under the LTRAP convention.

A brief outline of the stepwise procedure, in which manure is either managed as slurry/liquid or solid is given here:

- Calculation of the amount of the annual nitrogen excreted, which is deposited in different areas (housed, yards, grazing), depending on the time period in which animals are for example housed inside or outside.
- Multiplication with the default proportions of TAN that can be found in table 3.9 of the 2023 EMEP/EEA Guidebook.
- Calculation of the amount of TAN and total nitrogen deposited in buildings as liquid/slurry or as solid.
- NH₃-N losses from buildings and yards for both liquid and solid are calculated by multiplying with an emission factor, which is also given in table 3.9 of the 2023 EMEP/EEA Guidebook.

- Addition of straw to the bedding of housed animals (only solid).
- Calculation of the total-N and TAN leaving housing (only solid).
- Calculation of the total-N and TAN entering storage (slurry and solid).
- Calculation of TAN from which slurry storage emissions will occur (only slurry).
- Calculation of the storage emissions of all nitrogen species (NH₃-N, N₂O-N, NO-N).
- Calculation of organic nitrogen and TAN applied to the field.
- Calculation of emissions during and immediately following application to field.
- Calculation of total-N and TAN returned to soil.

Indirect emissions from housing are calculated by multiplying the nitrogen volatilised as NH₃-N and NO-N, deriving from the above-described N-flow methodology with the default emission factor, EF4 = 0.01 kg N₂O-N, from the 2019 Refinements.

Figure 5.4 shows the N-flow methodology with the data for the newest historical year and the relationship in the reporting between the different nitrogen species (NH₃-N, NO_x-N, N₂O-N) and the different chapters, 3B Manure Management and 3D Agricultural Soils. The diagram also includes 5B2 Biological Treatment of waste, but biodigesters are not occurring in Iceland.

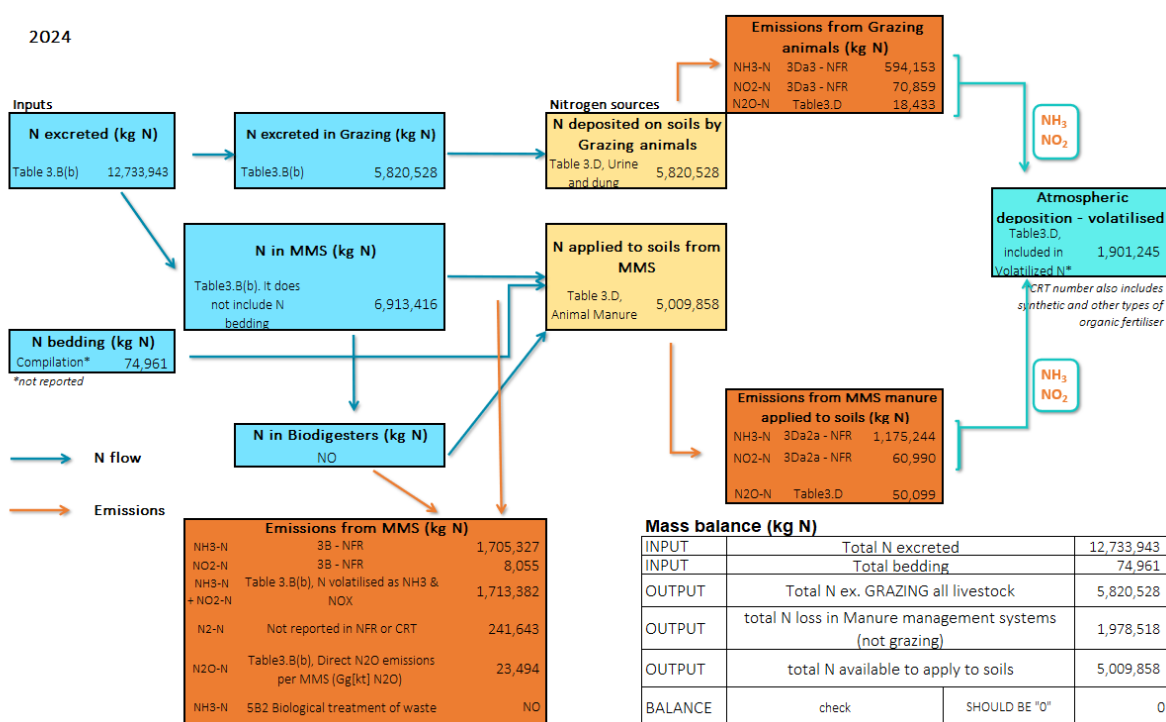


Figure 5.4. Complete Nitrogen flow applied to the categories 3B Manure Management and 3D Agricultural soils for 2024. Biodigesters are not occurring in Iceland. In Atmospheric Deposition – volatilised CRT includes also synthetic and other types of organic fertilisers. NFR refers to the reporting of air pollutants under CLTRAP (NH₃ and NO_x).

5.5.2 Activity data

Activity data needed for the Tier 1 methodology is animal numbers (shown in Table 5.7 to Table 5.13), weight and productivity system, Table 5.16, and manure management system

fractions, Table 5.30. Additionally, for the Tier 2 methodology the volatile solid excretion rate, nitrogen input through feeding, nitrogen retention, and nitrogen input through bedding are needed, which in turn require information on feed digestibility, gross energy intake, ash content in feed, lactation and protein and fat content of the milk etc., see Table 5.14, Table 5.15 and Table 5.17. The volatile solid excretion (VS) and nitrogen excretion (Nex) rates can be seen in Table 5.29. For most livestock categories the animal parameters are not changing over the time series and the VS and Nex rates are also constant. Exceptions are Cattle and Sheep categories, calculated using the Tier 2 approach and Horses and Poultry, for which the Nex rate has been calculated on a more disaggregated level and reported as a weighted average in relation to the population data.

Table 5.29. Volatile solids (VS) and nitrogen excretion (Nex) rates for the newest historical inventory year for all animal categories.

Livestock Category	VS excretion [kg VS/head/day]	Nex [kg N/head/year]
Mature Dairy Cattle	3.92	95.3
Other Mature Cattle	2.69	66.9
Heifers	1.81	48.8
Young bulls	1.96	47.6
Calves	0.82	20.0
Growing Cattle	1.41	35.9
Mature Ewes	0.38	9.6
Rams	0.41	10.7
Young sheep	0.37	9.7
Lambs	0.23	7.1
Swine	0.46	26.4
Piglets	0.32	16.9
Horses (weighted average)	1.85	31.1
Goats	0.42	7.8
Minks	NE	7.3
Foxes	NE	19.3
Rabbits	NE	13.0
Poultry	0.018	0.54

NE: Not estimated

The fractions of total manure, managed in the different manure management systems (MMS), impact both CH₄ and N₂O emissions from manure management and consequently N₂O emissions from agricultural soils. The fractions used for all Cattle subcategories were updated for the entire time series for the 2023 submission (IAAC, 2022) and again in 2025 (IAAC, 2025). The type of MMS used, time in each system and amount of straw used as bedding were all updated. The fractions used for other livestock categories are based on expert judgement (Sveinsson, oral communication; Sveinbjörnsson, oral communication;

Dýrmundsson, oral communication) and are assumed to be constant since 1990, see Table 5.30.

The average amount of time Mature Dairy Cattle spend on pasture has decreased from 90 to 56 days since 1990. Heifers spend 4 months per year on pasture whereas young bulls are housed all year round. Most cattle manure is managed as slurry without a natural crust cover. The use of solid storage for Calves has increased from 2% to 12% since 1990. Sheep spend five and half months on pasture, range, and paddock (PRP); this includes the whole life span of lambs. Around 19% of the manure from adult sheep is assumed to be kept as slurry, which has a much higher MCF (21%) than PRP (0.47%) or solid storage (2%). Therefore, the emission factor from sheep in the Icelandic inventory is much higher than the Tier 1 emission factor from the 2019 Refinements, which assumes that all manure is managed in a solid system. In addition, two thirds of Icelandic horses are on pasture all year round. The remaining third spends around five months in stables, where manure is managed in solid storage.

Table 5.30. Current manure management system fractions for all livestock categories.

	Slurry w/ Natural Crust Cover	Slurry w/o Natural Crust Cover	Solid Storage	Pasture/Range/ Paddock
Mature Dairy Cattle	9.3%	75%		15%
Other Mature Cattle		8.2%		92%
Heifers	7%	60%		33%
Young bulls	11%	89%		0%
Calves		65%	13%	23%
Mature Ewes		19%	36%	45%
Rams		19%	36%	45%
Young sheep		19%	36%	45%
Lambs				100%
Goats			55%	45%
Horses			14%	86%
Young horses			14%	86%
Foals				100%
Sows		100%		
Piglets		100%		
Poultry, fur animals			100%	

In 2022, the IAAC interviewed farmers about their use of straw for bedding for calves and estimated it at 350 kg straw/animal/year in recent years. In the Cattle subcategory, straw is otherwise used only for calving cows in Iceland, with an estimated use of 3 kg/animal/year. Similarly, in 2025, the IAAC interviewed sheep farmers about their use of straw for sheep and estimated it at 40 kg straw per sheep in dry storage per year. The straw value for sheep is applied for goats as well. For horses, the default straw value from the 2023 EMEP/EEA Guidebook (Table 3.7) is adjusted for the different housing period.

5.5.3 Emission Factors

5.5.3.1 Methane (CH₄)

Tier 1

Default CH₄ emission factors are used for all livestock categories except Cattle and Sheep, shown in Table 5.31. These emission factors are sourced from Tables 10.14, 10.15 and 10.16A from the 2019 Refinements, using the volatile solid excretion rate (VS rate) from Table 10.13A and animal weights and productivity system from Table 5.16. For the livestock categories Horses and Poultry, the emissions are calculated in a disaggregated level to reflect the different emission factors and then summed.

Table 5.31. Tier 1 default emission factors used for methane emissions from manure management, excluding pasture, range and paddock.

Livestock Category	Emission factor [g CH ₄ /kg VS]
Swine	63
Piglets	63
Horses	3.5
Young horses	3.5
Foals	3.5
Goats	1.7
Hens ¹	5.2
Pullets	5.2
Broilers	5.2
Turkeys	5.2
Ducks	2.4
Mink, Foxes ²	0.7
Rabbits ²	0.1

¹ Calculated using dry/wet storage fractions.

² The emission factors for fur-animals are in kg CH₄/head/year.

Tier 2

Methane conversion factors (MCF) and maximum CH₄-producing capacity of manure (B₀) values for both livestock categories, Cattle and Sheep, are taken from the 2019 Refinements, see Table 5.32.

Table 5.32. CH₄ conversion factor (MCF) and CH₄-producing capacity (B₀) from the 2019 Refinements used for the calculations of CH₄ emissions from manure management (MM).

Source	Cattle	Cattle	Cattle	Sheep
Cool climate	Pasture/range	Solid storage	Liquid/slurry	All MM systems
MCF	Table 10.17, 0.47%	2%	13% ¹	Same as for cattle

	Source	Cattle	Cattle	Cattle	Sheep
	2019 RF			21% ²	
		Mature Dairy Cattle	Other Cattle		Sheep and PRP
B ₀	Table 10.16A, 2019 RF	0.24	0.18		0.19

¹ With natural crust cover. ² Without natural crust cover.

The emission factors are calculated using VS rates, MCFs, and manure management fractions for Cattle and Sheep, and are shown in Table 5.33. Mature Dairy Cattle have the highest emission factors for CH₄ from manure management. The emission factors for Cattle subcategories vary due to changes in feed digestibility and gross energy intake over the timeline, as well as changes in feeding situation and manure management systems. For Sheep subcategories, there is a lack of activity data for manure management systems and hence, the emission factor variability stems entirely from change in feed digestibility and gross energy intake.

Table 5.33. Emission factors values and range for the Tier 2 calculations of CH₄ emissions from manure management.

Livestock Category	Emission factor [kg CH ₄ /head/year]	Emission factors range 1990-2024 [kg CH ₄ /head/year]
Mature Dairy Cattle	39.20	34.78 - 47.21
Other Mature Cattle	2.58	2.46 - 2.65
Heifers	10.86	10.54 - 13.14
Young bulls	17.32	16.31 - 20.44
Calves	5.08	4.96 - 6.14
Mature Ewes	0.86	0.84 - 1.03
Rams	0.94	0.93 - 1.13
Young sheep	0.85	0.85 - 1.05
Lambs	0.049	0.044 - 0.050

5.5.3.2 Nitrous Oxide (N₂O)

The parameters and emission factors for the different nitrogen species used in the N-flow methodology are taken from the 2023 EMEP/EEA Guidebook (Tables 3.8, 3.9 and 3.10) (EEA, 2023) and an extract is given in Table 5.34.

Table 5.34. Proportion of total ammoniacal nitrogen (TAN), fraction slurry/solid housing periods and emission factor (EF) for nitrogen species used in the N-flow methodology, non-exhaustive list. All the EFs are given as a proportion of TAN.

Livestock Category	Prop. TAN (of N)	Fraction Slurry	Fraction Solid	Housing Period [days]	MMS	EF NH ₃ -N Housing	EF NH ₃ -N Storage	EF N ₂ O-N Storage ^{1,2}	EF NO-N Storage
Mature Dairy Cattle	0.6	1	0	309	Slurry	0.24	0.25	0/0.01	0.0001
					Solid	0.08	0.32	0.04	0.01
All Other Cattle ³	0.6	0.93	0.07	271	Slurry	0.24	0.25	0/0.01	0.0001
					Solid	0.08	0.32	0.04	0.01
Sheep ⁴	0.5	0.35	0.65	200	Slurry	0.24	0.25	0.01	0.0001
					Solid	0.22	0.32	0.03	0.01
Swine - Piglets	0.7	1	0	365	Slurry	0.27	0.11	0	0.0001
					Solid	0.23	0.29	0.03	0.01
Swine - Sows	0.7	1	0	365	Slurry	0.35	0.11	0	0.0001
					Solid	0.24	0.29	0.03	0.01
Goats	0.5	0	1	200	Solid	0.22	0.28	0.03	0.01
Horses	0.6	0	1	51	Solid	0.22	0.35	0.04	0.01
Hens (laying and breeding)	0.7	0	1	365	Slurry	0.41	0.14	0	0.0001
					Solid	0.2	0.08	0.002	0.01
Turkeys	0.7	0	1	365	Solid	0.35	0.24	0.002	0.01
Other Poultry (ducks)	0.7	0	1	365	Solid	0.24	0.24	0.002	0.01
Fur animals ⁵	0.6	0	1	365	Solid	0.27	0.09	0.04	0.01

¹ 0/0.01 means "0" for slurry without a natural crust cover and "0.01" for slurry with a natural crust cover. Most cattle manure is stored in slurry without a natural crust cover.

² The N₂O-N EFs from storage are adjusted from those in the 2023 EMEP/EEA Guidebook. The factors in Table 3.8 in the 2023 EMEP/EEA Guidebook are based on the N₂O-N EFs from storage in the 2006 IPCC Guidelines. However, in the 2019 Refinements changes have been made to the EFs from solid storage. Hence, Table A1.8 in the 2023 EMEP/EEA Guidebook is used to incorporate those changes into the factors used.

³ All Other Cattle consists of Other Mature Cattle, Heifers, Young bulls and Calves. A weighted average is used for fraction slurry/solid and housing period for these subcategories.

⁴ No EFs exist for NH₃ emissions from slurry for Sheep in the 2019 EMEP/EEA Guidebook. Hence, the EFs for Cattle are applied.

⁵ There are no default N₂O-N EFs from storage for fur animals and hence an average of cattle and sheep EFs are used.

The emission factor for indirect emissions due to volatilised NH₃-N and NO-N is taken from the 2019 Refinements (Volume 4, chapter 11), EF4, and corresponds to 0.01 kg N₂O-N/(kg NH₃-N + NO-N volatilised). Indirect emissions from leaching and runoff from storage are not estimated, further information on this can be found in Section 5.5.4.3.

5.5.4 Emissions

5.5.4.1 CH₄ Emissions

CH₄ emissions from manure management can be seen in Table 5.35. Cattle farming is the largest source of these emissions.

Table 5.35. CH₄ emissions from manure [kt CO₂e].

CH ₄ emissions [kt CO ₂ e]	1990	1995	2000	2005	2010	2015	2020	2023	2024
Mature dairy cattle	32	30	27	25	27	28	27	28	28
Other mature cattle	0.048	0.053	0.067	0.093	0.114	0.144	0.230	0.268	0.270
Growing cattle	13.8	12.7	13.2	10.9	13.1	13.4	14.0	13.7	13.4
Sheep	16.3	13.1	13.0	12.3	13.2	12.3	9.8	9.3	8.7
Swine	6.4	6.8	7.1	8.6	8.2	9.2	8.5	8.2	8.2
Horses	1.4	1.5	1.4	1.5	1.5	1.5	1.4	1.3	1.3
Goats	2.7E-03	2.9E-03	3.1E-03	3.7E-03	5.7E-03	8.3E-03	1.4E-02	1.5E-02	1.6E-02
Fur animals (minks and foxes)	0.91	0.72	0.78	0.70	0.76	0.91	0.30	0.10	0.09
Rabbits	4.1E-03	1.9E-04	1.6E-03	6.0E-04	3.7E-04	7.7E-04	1.8E-04	1.3E-04	9.9E-05
Poultry	4.60	1.76	2.63	2.20	1.66	1.46	1.38	1.00	0.84
Total CH₄ from manure [kt CO₂e]	75	66	65	61	66	67	63	62	61
Emission reduction 1990- 2024		-12%	-14%	-19%	-13%	-11%	-17%	-18%	-19%

5.5.4.2 N₂O Emissions

N₂O emissions from manure management can be seen in Table 5.36, including indirect emission from manure management as atmospheric deposition of nitrogen on soils and water surfaces, due to volatilisation of nitrogen.

Table 5.36. N₂O emissions from manure management [kt CO₂e].

N ₂ O emissions [kt CO ₂ e]	1990	1995	2000	2005	2010	2015	2020	2023	2024
Liquid systems	2.0	1.8	2.0	2.0	2.2	2.3	2.1	2.0	1.9
Solid storage	13.7	12.0	12.2	11.6	12.2	12.3	9.2	8.1	7.8
Indirect N ₂ O emissions: atmospheric deposition	8.2	7.4	7.8	7.6	8.0	8.3	7.7	7.4	7.3
Total N₂O from manure management [kt CO₂e]	23.8	21.2	22.0	21.1	22.3	22.9	19.0	17.5	17.0
Emission change 1990-2024		-11%	-7.8%	-11%	-6.3%	-3.9%	-20%	-27%	-29%

Emissions from liquid systems make up only a small part of total emissions from manure management systems. This is because the emission factor is 20-times lower for liquid systems than for solid storage. Solid storage of sheep manure is the single largest source of N₂O emissions from manure management.

Figure 5.5 shows N₂O emissions from slurry and solid storage. It also includes emissions from manure deposited directly onto soils from farm animals (Pasture). Although they are reported under emissions from Agricultural Soils in national totals, they are included here to show their magnitude in comparison to other emissions.

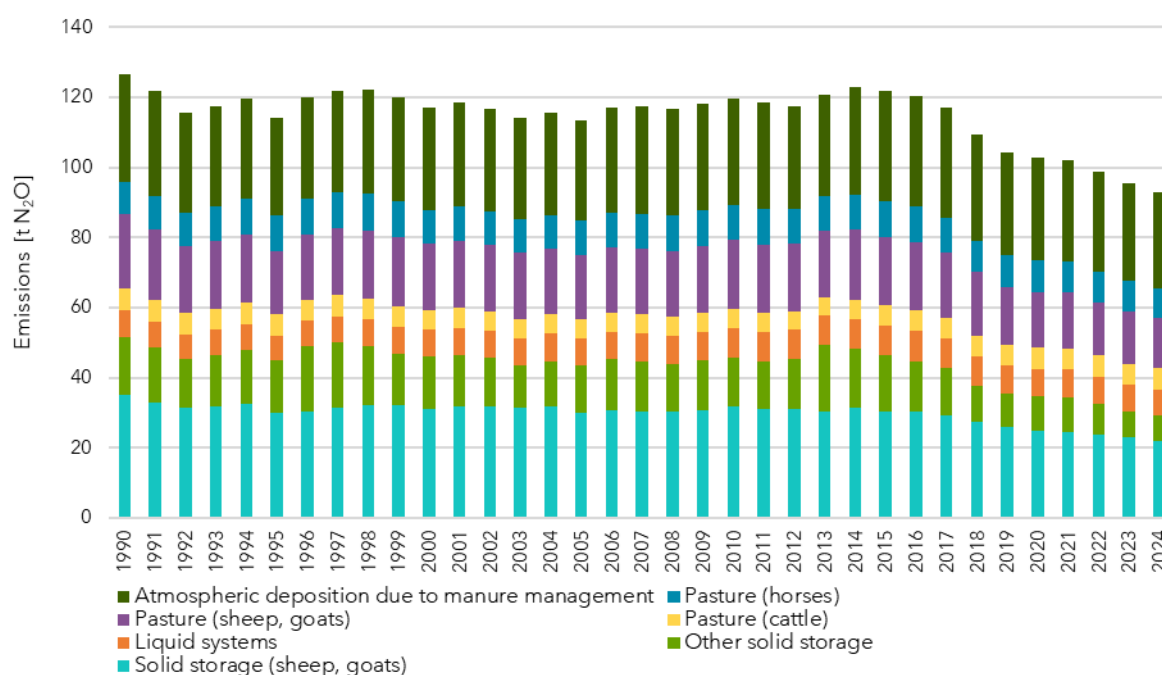


Figure 5.5. N₂O emissions from manure management and from urine and dung from grazing animals, including indirect emissions due to volatilisation from manure management, [t N₂O].

5.5.4.3 Indirect Emissions from Leaching and Run-Off from Storage

Default values for nitrogen loss fractions due to leaching of nitrogen from manure management were not available in the 2006 IPCC Guidelines and came first with the 2019 Refinements. The default values are zero for all manure management systems in Iceland other than solid storage, where the default fraction is generally 2%. This has yet to be added into the N-flow model used.

The approach used assumes that there is no nitrogen loss to leaching and run-off from stored manure. This approach is expected to result in similar N₂O emissions from the Agriculture sector. This is because instead of assigning nitrogen to leaching and run-off, the nitrogen is retained in the stored nitrogen and subsequently applied to land, leading to emissions of N₂O.

Leaching and run-off that may arise from nitrogen inputs to agricultural soils are considered in 3D Managed soils.

5.5.5 Recalculations

There are recalculations for the whole timeline 1990-2023 due to updated digestibility of feed and ash content of feed for cattle and sheep, weights of cattle, updated manure management system (MMS) fractions, and updated early mortality percentage for lambs. The change in MMS fraction was largest for Calves where the fraction of solid storage was decreased while the slurry fraction increased, and days on pasture were introduced as well, all based on better data from the IAAC. An error was also found and fixed for the Mature Dairy Cattle, the days in different systems didn't add up to 365. These changes affect both CH₄ and N₂O emissions from Cattle and Sheep. The recalculations for CH₄ emissions for 3B1 Cattle and 3B2 Sheep due to the above-mentioned changes can be seen in Table 5.37 and Table 5.39.

Updated weights were received for foals (136 kg instead of 60 kg) and 1–3-year-old horses (318 kg instead of 175 kg), and those weights affect the amount of volatile solids excreted.

For goats updated gender fractions were received (12% adult males instead of 15%), updated number of kids per doe (1.5 instead of 1.3) and updated slaughter age (5.5 months instead of 5 months), affecting the population size of goats.

Combined effects of the changes for horses and goats on CH₄ emissions can be seen in Table 5.41.

N₂O emission factors for solid manure storage were also updated in accordance with the updates in the 2019 Refinements, doubling the factors, and a decimal point error was fixed for the N₂O emission factors for solid manure storage for fur animals, which together with the 2019 RF update increased the factors almost 200-fold. No default EF is available for N₂O emissions from slurry for sheep, however, a ten times smaller factor had been in use for sheep than for cattle, without sufficient documentation of why. Hence, a decision was taken to use the cattle N₂O emission factor for sheep as well, increasing those emissions ten-fold. These changes are the main drivers behind the increase in N₂O emissions from 3B2 Sheep, see Table 5.42, and from 3B4 Other, due to the change in factors for fur-animals, see Table 5.42.

Information on the use of straw in solid storage for sheep and calves was also updated with new data from the IAAC, causing recalculation for direct and indirect N₂O emissions from manure management, although not as much as the updates and fixes to the direct N₂O emission factors from manure management. This change affects the year 1990-2007 for calves, up to 49% higher values for straw usage, and the whole timeline 1990-2023 for sheep, 70% lower values for straw usage.

The recalculations for N₂O emissions from 3B1 Cattle are the result of a combination of the changes listed in the first paragraph of this section and the update to the 2019 Refinements of the N₂O emissions factors, see Table 5.38.

The indirect emissions are affected by all the changes mentioned above, other than the updates and fixes of direct N₂O emission factors, and the recalculations for CRT 3B5 are shown in Table 5.43.

Table 5.37 Recalculations in 3B1 Cattle between submissions, CH₄ emissions.

3B1 Cattle, CH₄ emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	47.3	44.8	39.9	35.4	38.1	39.1	38.0	38.5	38.2
2026 submission [kt CO ₂ e]	45.8	42.5	40.1	36.0	40.1	41.8	41.3	44.2	41.9
Change relative to the 2025 submission [kt CO ₂ e]	-1.50	-2.26	0.16	0.63	2.03	2.66	3.27	5.67	3.70
Change relative to the 2025 submission [%]	-3.2%	-5.0%	0.40%	1.8%	5.3%	6.8%	8.6%	14.7%	9.7%

Table 5.38 Recalculations in 3B1 Cattle between submissions, N₂O emissions.

3B1 Cattle, N₂O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	0.32	0.46	0.89	1.06	1.61	1.79	1.82	1.78	1.76
2026 submission [kt CO ₂ e]	0.17	0.32	0.48	0.57	0.78	1.00	1.12	1.09	1.09
Change relative to the 2025 submission [kt CO ₂ e]	-0.15	-0.14	-0.41	-0.49	-0.83	-0.79	-0.70	-0.69	-0.67
Change relative to the 2025 submission [%]	-46%	-31%	-46%	-46%	-51%	-44%	-38%	-39%	-38%

Table 5.39. Recalculations in 3B2 Sheep between submissions, CH₄ emissions.

3B2 Sheep, CH₄ emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	18.7	14.9	14.7	13.9	15.1	13.9	11.0	10.7	10.3
2026 submission [kt CO ₂ e]	16.3	13.1	13.0	12.3	13.2	12.3	9.8	9.6	9.3
Change relative to the 2025 submission [kt CO ₂ e]	-2.32	-1.80	-1.76	-1.66	-1.84	-1.63	-1.21	-1.15	-1.02
Change relative to the 2025 submission [%]	-12.4%	-12.0%	-11.9%	-11.9%	-12.2%	-11.7%	-10.9%	-10.7%	-9.9%

Table 5.40. Recalculations in 3B2 Sheep between submissions, N₂O emissions.

3B2 Sheep, N₂O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	4.6	3.9	4.0	3.9	4.1	3.8	3.0	2.9	2.8
2026 submission [kt CO ₂ e]	11.2	9.5	9.9	9.6	10.1	9.6	7.8	7.5	7.2
Change relative to the 2025 submission [kt CO ₂ e]	6.7	5.7	5.9	5.7	6.0	5.8	4.8	4.5	4.4
Change relative to the 2025 submission [%]	145%	146%	146%	146%	145%	154%	161%	156%	158%

Table 5.41. Recalculations in 3B4 Other livestock between submissions, CH₄ emissions.

3B4 Other, CH ₄ emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	6.7	3.8	4.7	4.2	3.7	3.7	2.9	2.7	2.3
2026 submission [kt CO ₂ e]	6.9	4.0	4.9	4.4	3.9	3.9	3.1	2.8	2.4
Change relative to the 2025 submission [kt CO ₂ e]	0.17	0.21	0.17	0.15	0.18	0.17	0.16	0.15	0.15
Change relative to the 2025 submission [%]	2.5%	5.6%	3.7%	3.6%	4.7%	4.6%	5.5%	5.7%	6.6%

Table 5.42. Recalculations in 3B4 Other livestock between submissions, N₂O emissions.

3B4 Other, N ₂ O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	0.75	0.74	0.77	0.83	0.82	0.88	0.80	0.78	0.75
2026 submission [kt CO ₂ e]	4.27	3.92	3.85	3.42	3.50	3.96	2.31	2.13	1.72
Change relative to the 2025 submission [kt CO ₂ e]	3.52	3.18	3.08	2.59	2.68	3.07	1.52	1.35	0.97
Change relative to the 2025 submission [%]	468%	430%	399%	312%	327%	348%	190%	172%	130%

Table 5.43. Recalculations for 3B5 Indirect N₂O Emissions.

3B5 Indirect N ₂ O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	8.27	7.65	7.75	7.52	7.83	8.08	7.36	7.22	7.03
2026 submission [kt CO ₂ e]	8.16	7.44	7.76	7.57	7.96	8.33	7.68	7.55	7.40
Change relative to the 2025 submission [kt CO ₂ e]	-0.11	-0.21	0.01	0.06	0.13	0.25	0.32	0.32	0.36
Change relative to the 2025 submission [%]	-1.4%	-2.7%	0.1%	0.8%	1.7%	3.1%	4.3%	4.5%	5.2%

5.5.6 Uncertainties

The complete uncertainty analysis is shown in Annex 2: Assessment of Uncertainty.

The activity data uncertainties, affecting both CH₄ and N₂O emissions from manure management, are the livestock number uncertainty (5% for each animal class except Horses, which are assigned an uncertainty of 10% due to the nature of the registration system) and the uncertainty related to the manure management system distribution (50% for Sheep, 10% for all other animal classes).

5.5.6.1 Methane (CH₄)

Animal mass and VS excretion uncertainty are considered 30% and 50%, respectively for the Tier 1 animal categories, i.e. the default IPCC uncertainties from Table 10A-9, even for the country specific weights due to lack of other uncertainty measures. For cattle and sheep, more thorough weight and VS data is obtained from the IAAC for each age group, hence 5%

and 20% uncertainties are used, respectively. Combined activity data uncertainty ranges from 23% for Cattle to 60% for Horses.

The emission factor uncertainties are chosen on the basis of the indication of the 2006 IPCC Guidelines, that is, 20% for Tier 2 calculations (Cattle, Sheep) and 30% for Tier 1 calculations (all other animal categories). The combined uncertainties, activity data and emission factors are the following: 3B1 (Cattle) 31%, 3B2 (Sheep) 58%, 3B3 (Swine) 67%, 3B4 (Other livestock) 46%.

5.5.6.2 Nitrous Oxide (N₂O)

The additional N₂O activity data uncertainty is the amount, and uncertainty of nitrogen excreted, and the amount and uncertainty of nitrogen volatilised. All these activity data uncertainties are calculated and aggregated using both Equation 3.1 and Equation 3.2 of the 2006 IPCC Guidelines and differ for each animal category ranging from 40% for Cattle to 60% for Poultry. The emission factor uncertainty is assigned to be 100% for all animal categories as it is based on Table 10.21, chapter 10, vol. 4 of the 2006 IPCC Guidelines. The combination of activity data and emission factor uncertainty produces the following uncertainties for each CRT subcategory: 3B1 (Cattle) 108%, 3B2 (Sheep) 115%, and 3B4 (Other livestock) 83%.

Indirect emissions from manure management have a combined uncertainty of 223%, with 208% uncertainty for activity data and 80% uncertainty for the emission factor following the indications of Table 11.3, chapter 11, vol. 4 of the 2006 IPCC Guidelines.

5.5.7 Planned Improvements

Research was launched in the end of 2024 with the aim to establish country specific B0 and MCFs from slurry and pit storage in cattle and sheep farming. Results, expected in 2027, will be incorporated in the 2028 submission.

During the 2021 UNFCCC review Iceland was encouraged to take steps to define an appropriate $Frac_{leachMS}$ value for Iceland and include estimates for indirect nitrogen emissions from leaching and run-off in the inventory, along with a justification of the methodology and assumptions used in the calculations (Question 2021ISLQA73). Such research requires resources and time, which are at the moment not available. In the meantime, a temporary solution is described in Section 5.5.4.3.

5.6 Rice Cultivation (CRT 3C)

This activity is not occurring in Iceland.

5.7 Direct and Indirect N₂O Emissions from Managed Soils (CRT 3D)

The largest sources of emissions are cultivated and uncultivated drained organic soils, causing over half of the total emissions from Agricultural Soils (CRT 3D). The overall emissions from Agricultural Soils have increased since 1990.

N₂O is produced naturally in soils through the microbial processes of nitrification and denitrification. The following agricultural activities lead to N₂O emissions and are described in this chapter:

- Application of inorganic nitrogen fertiliser.
- Application of organic nitrogen fertiliser (animal manure, sewage sludge, other organic fertilisers).
- Urine and dung deposited by grazing animals.
- Crop residues.
- Mineralisation/ immobilisation associated with loss/gain of soil organic matter (not occurring in Iceland).
- Cultivation of organic soils.

These activities add nitrogen to soils, increasing the amount of nitrogen available for nitrification and denitrification, and ultimately the amount of N₂O emitted. The emissions of N₂O that result from anthropogenic nitrogen inputs also occur through two indirect pathways:

- Volatilisation of nitrogen as NH₃ and NO_x from agricultural fertilisers and manure and subsequent atmospheric deposition.
- Leaching and runoff from applied organic and inorganic fertilisers, crop residues and urine and dung deposition.

5.7.1 Methodology

Direct N₂O emissions from Agricultural Soils are calculated applying the Tier 1 methodology from the 2019 IPCC Refinements using Equation 11.1. There are hints that the 2006 IPCC emission factor for N₂O emissions from application of inorganic fertilisers fits better than the disaggregated emission factor from the 2019 Refinements and, therefore, a decision was taken to use the aggregated emission factor values from the 2019 Refinements, i.e. those that do not take climate into account, since they equal the 2006 values until more data is available.

Tier 2 methodology from the 2023 EMEP/EEA Guidebook is applied to calculate the amount of NH₃ volatilised of the nitrogen applied in synthetic fertilisers, applying emission factors for normal pH in Table 3-2, chapter 3.D of the guidebook.

The NH_3 emissions from animal manure applied to soils and urine and dung from grazing animals are calculated in the N-flow tool, described in Section 5.5.1.2, and applying the $\text{EF}_{\text{application}}$ factors in Table 3-9, chapter 3.B of the 2023 EMEP/EEA Guidebook.

Tier 1 methodology from the 2023 EMEP/EEA Guidebook is applied to calculate the amount of NH_3 volatilised of the nitrogen applied in sewage sludge and other organic fertilisers, and to calculate the NO_2 emissions from all relevant sources. Emission factors are taken from Table 3-1, Chapter 3.D. To calculate the amount of N_2O -N deposited of the nitrogen volatilised from managed soils, the amount of NH_3 -N and NO_2 -N volatilised from relevant sources is summed together and multiplied with the default emission factor of 0.01 (kg N_2O -N per kg of NH_3 -N & NO -N) from the 2019 IPCC Refinements (Table 11.3, EF4).

A comparison of the 2023 EMEP/EEA Guidebook methodology applied with the 2019 IPCC Refinements' Tier 1 methodology, using $\text{Frac}_{\text{GASF}}$ and $\text{Frac}_{\text{GASM}}$, was carried out. On average, the EMEP/EEA Guidebook methodology applied showed lower volatilisation of NH_3 as a fraction of N applied than the IPCC methodology, especially for synthetic fertiliser where the volatilisation fraction was less than half the $\text{Frac}_{\text{GASF}}$ value. Considering, however, that not much urea is used in Iceland, combined with the cool climate and normal pH soils, and the higher tier of the NH_3 calculations used, this difference is considered to be realistic.

A large proportion of nitrogen added to/mineralised in agricultural soils can be lost through leaching and runoff. This nitrogen enters groundwater, wetlands, rivers, and eventually the ocean, where it enhances biogenic production of N_2O . The amount of nitrogen input lost through leaching and run-off is calculated by summing all the agricultural nitrogen inputs and then by assuming that 24% is leached or runs-off (default $\text{Frac}_{\text{LEACH-(H)}}$ from the 2019 IPCC Refinements). Indirect N_2O emissions from leaching and run-off are then calculated by multiplying the resulting nitrogen amount with the emission factor from the 2019 IPCC Refinements, 0.011 kg N_2O -N/kg N lost through leaching/runoff (see Equation 11.10).

5.7.2 Activity data

Table 5.44 shows the main activity data used for emissions calculations from Agricultural Soils. Further description is in the following subsections.

Table 5.44. Nitrogen applied to soils in fertilisers and in urine and dung from grazing animals, as well as areas with organic soils.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Inorganic fertilizers [t N]	12,471	11,193	12,665	9,757	10,852	11,652	11,395	8,695	10,674
Manure applied to soils [t N]	5,661	5,197	5,378	5,226	5,519	5,762	5,267	5,057	4,976
Sewage sludge [t N]	NO	NO	NO	NO	NO	1.7	14	43	33

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Other organic fertilisers [t N]	NO	NO	NO	21	100	157	185	271	303
Urine and dung from grazing animals [t N]	7,492	6,953	6,953	6,842	7,168	7,181	6,293	5,985	5,821
Organic soils - cropland [kha]	70	69	68	67	64	58	53	51	51
Organic soils - grasslands [kha]	157	202	223	254	259	262	268	273	274

5.7.2.1 Inorganic N Fertiliser (F_{SN})

In Iceland, all fertilisers imported into the country must be registered by customs, and the Icelandic Food and Veterinary Association (IFVA) must be notified of every import or domestic manufacture of fertilisers, in accordance with the Icelandic laws No 22/1994, 543/2024, 87/1995, regulation 398/1995 and relative changes. The IEEA receives a detailed list of the inorganic fertilisers from the IFVA and use this information to calculate the amount of nitrogen applied to soils. A less detailed list is also available at the website of Statistics Iceland (SI)³⁶.

Information on the inorganic fertiliser use in forestry is received from Land and Forest Iceland (LFI) and subtracted from the overall national fertiliser use, since it is accounted for in the Land Use, Land-use Change and Forestry sector.

Due to lack of data on the amount of inorganic fertilisers applied, the amount imported, and previously also manufactured domestically, is used instead. Expert judgement from the Agricultural University of Iceland supports the assumption that the fluctuations in import are related to fluctuations in the amounts applied, i.e. farmers fertilise less when the price is high, rather than import companies stockpiling fertilisers when the price is low to sell over a few years. The import system in Iceland allows for the possibility of stockpiling fertilisers due to the timing of imports, which can explain irregular trends such as periodic peaks in fertiliser imports. For example, fertilisers imported late in the autumn may not be used until the following year (Figure 5.6). In addition, the peak in import of fertilisers occurred around the financial boom in Iceland (2007-2008) is followed by a noticeable decline after the 2009 financial crisis, which coincided with a significant drop in the currency and a corresponding increase in the price of imported goods.

³⁶ <https://hagstofa.is/talnaefni/atvinnuvegir/landbunadur/aburdur/>

5.7.2.2 Organic N Fertiliser (F_{ON})

Animal Manure Applied to Soils

The amount of manure available for application is determined in the N-flow model, which is explained in Section 5.5.1.2. The amount of manure applied is assumed to be the same as the amount of manure that is available for application to land. Since inorganic fertiliser is expensive in Iceland, manure is considered a valuable commodity. Fluctuations in the emissions are due to fluctuations in yearly livestock numbers (Table 5.44).

Sewage Sludge Applied to Soils

Regulation 799/1999, about handling of sewage sludge, defines the type and modalities of the application of sewage sludge, which can occur only after applying for a permit and after treatment of the sewage sludge. Strict rules apply for the use in agriculture, such as for fertiliser for areas to produce feed and forage for animals. Currently in Iceland, a few municipalities are using sewage sludge as an organic fertiliser for land reclamation purposes in collaboration with LFI. A pilot project was carried out between 2012-2014 in the Hrunamanna-district and a report (only in Icelandic) is available (Jónsdóttir & Jóhannsson, 2016). The amount of sewage sludge applied since 2012 is obtained through written communication with specialists at LFI and for the first time, for the year 2024, also through a waste data portal at the IEEA. The nitrogen content of sewage sludge is obtained from a 2022 report from the Soil Conservation Service (Jóhannsson & Valdimarsdóttir, 2022). Before 2012 no application of sewage sludge on agricultural soils or for land reclamation purposes is known. As can be seen from Figure 5.6 the emissions from the application of sewage sludge are low.

Other Organic Fertilisers Applied to Soils

This category reports other organic fertilisers used by LFI for land-reclamation purposes: bone meal, chyme, hay and fish sludge. These fertilisers are applied only on land reclamation sites, where grazing of domestic animals is excluded for the next 20-50 years. In addition, compost is included this subcategory. Figure 5.6 shows the N_2O emissions from this category.

Information on type and quantity of other organic fertilisers applied to soils is received from LFI and the information on compost is obtained from the inter-municipal waste management company SORPA and the holding company Molta Ltd. No application of these types of fertilisers is known from before the year 2002.

5.7.2.3 Urine and Dung Deposited by Grazing Animals (F_{PRP})

Nitrogen deposited from animals at pasture, range and paddock is determined by the N-flow approach described in Section 5.5. The number of days animals spend outside are collected for the livestock characterisation and are reported in chapter 5.3.2.

5.7.2.4 Nitrogen in Crop Residues Returned to Soils (F_{CR})

The main types of nitrogen fixing crops cultivated in Iceland are potatoes, cereals, mainly barley, root crops (turnips and carrots), and brassicas (cabbage, cauliflower and broccoli). After harvest, crop residues are returned to soils. The amount of residue returned to soils is derived from crop production and area data. The crop yield data, retrieved from SI, is reported in harvested fresh yield. It is estimated that 80% of barley residue is used as fodder and bedding.

Data on the total annual areas harvested of each crop were obtained from SI and the IAAC for the years 2020-2024 and extrapolated back to 1990 by using area data from the FAO database as proxy, except for cereals, where annual production data is used as proxy.

5.7.2.5 Mineralisation/Immobilisation Associated with Loss/Gain of Soil Organic Matter

This category does not occur in Iceland. As can be seen in CRT table 4B (LULUCF sector), in mineral soil there is a carbon stock gain (+) reported in 4B1 Cropland remaining Cropland, hence, there are no associated N_2O emissions.

5.7.2.6 Cultivation of Organic Soils

In this category, N_2O emissions from cultivated drained histosols, comprising mostly hayfields, and from drained organic soils, falling in the Grasslands category, are calculated. The areas are calculated by the LULUCF team at LFI and communicated to the IEEA. The areas and associated N_2O emissions are reported in Table 5.44 and Figure 5.6.

5.7.2.7 Activity Data for Indirect Emissions

All previously mentioned data on the application of inorganic and organic N-fertiliser, urine and dung deposited during grazing and crop residues is used to calculate indirect N_2O emissions from atmospheric deposition and nitrogen leaching and run-off.

5.7.3 Emission Factors

Most emission factors applied in emissions calculations from Agricultural Soils are from the 2019 Refinements, Vol. 4, chapter 11 and are reported in Table 5.45 and Table 5.46.

Table 5.45. Emission factors used for the estimation of direct N_2O emissions from agricultural soils.

		N_2O emission factor [kg N_2O-N per kg N]	Source
Inorganic N fertilisers	EF ₁	0.01	Table 11.1 IPCC 2019 RF
Animal manure applied to soils	EF ₁	0.01	Table 11.1 IPCC 2019 RF
Sewage sludge applied to soils	EF ₁	0.01	Table 11.1 IPCC 2019 RF

		N₂O emission factor [kg N₂O-N per kg N]	Source
Urine and Dung deposited by grazing animals	EF _{PRP}	0.004 cattle, poultry, pigs	Table 11.1 IPCC 2019 RF
	EF _{PRP}	0.003 sheep and other	
Crop residues	EF ₁	0.01	Table 11.1 IPCC 2019 RF
Cultivation of organic soils	EF _{OS}	2.24/1.26 [kg N ₂ O-N/ha/yr] ¹	Country Specific

¹ The higher value is for cultivated drained land (cropland) and the lower one for uncultivated drained land (grassland).

Table 5.46. Emission factors used for the estimation of indirect N₂O emissions from agricultural soils.

		N₂O Emission Factor	Source
N Volatilisation and redeposition	EF4	0.010 [kg N ₂ O-N / (kg NH ₃ -N + NO _x -N volatilised)]	Table 11.3 IPCC 2006
Leaching and runoff	EF5	0.011 [kg N ₂ O-N / (kg N leaching/runoff)]	Table 11.3 IPCC 2006
Fra _{CLEACH-(H)}		0.24 [kg N (kg N additions or deposition by grazing animals)]	Table 11.3 IPCC 2006

The two cases where default IPCC factors are not used are described below.

5.7.3.1 Crop Residues

For the residue to crop ratio, dry matter fraction and nitrogen fraction, the 2019 IPCC RF values from Tables 11.1A and 11.2 are used. However, the 2019 RF does not provide all the necessary factors for root crops and brassicas, hence, expert judgement was used to choose which factors to use instead. All factors used are shown in Table 5.47.

Table 5.47 Factors, from Tables 11.1A and 11.2, 2019 IPCC RF, used to estimate the amount of nitrogen in crop residues returned to soils.

	Potatoes	Cereals	Root crops	Brassicas
Dry matter fraction [kg d.m./kg fresh weight]	0.22	0.89	0.22	0.22
Slope - to calculate above-ground residue dry matter	0.10	0.98	0.10	1.07
Intercept - to calculate above-ground residue dry matter	1.06	0.59	1.06	1.54
NAG - N content of above-ground residues [kg N/kg d.m.]	0.019	0.007	0.019	0.019
NBG - N content of below-ground residues [kg N/kg d.m.]	0.014	0.014	0.014	0.014
RS - Ratio of below-ground biomass to above-ground biomass	0.20	0.22	0.20	0.20

5.7.3.2 Cultivation of Organic Soils

Iceland uses two country specific emission factors to calculate the emissions from organic soils; 2.24 kg N₂O-N/ha/yr for the emissions from cultivated drained land (cropland), comprising mostly hay fields, and 1.26 kg N₂O-N/ha/yr for uncultivated drained land within the Grassland category. These emission factors are 72% and 84% lower than the default emission factor proposed by the 2006 IPCC Guidelines, respectively.

These organic soils emission factors derive from measurements of N_2O fluxes in Iceland, carried out by Jón Guðmundsson from the Agricultural University of Iceland (AUI) over the years 2006-2009, comprising nine measurement sites with three different land management types of organic soils: undrained land, drained but not cultivated land and drained, cultivated, and fertilised (hayfield land). In addition to these sites, some measurements were performed in freshly tilled drained land. In total, 861 measurements on plots with different land use were carried out (Guðmundsson J. , et al., 2024). The measurements were carried out using a static chamber and a gas chromatograph measuring the gas flux from the gas concentration in the headspace of the chamber with time.

5.7.4 Emissions

Emissions from agricultural soils have increased on average since 1990, due to higher emissions from subsector 3D1f Cultivation of Organic Soils, which in turn are caused by increased cropland and grassland areas used in agriculture, as shown in Figure 5.6.

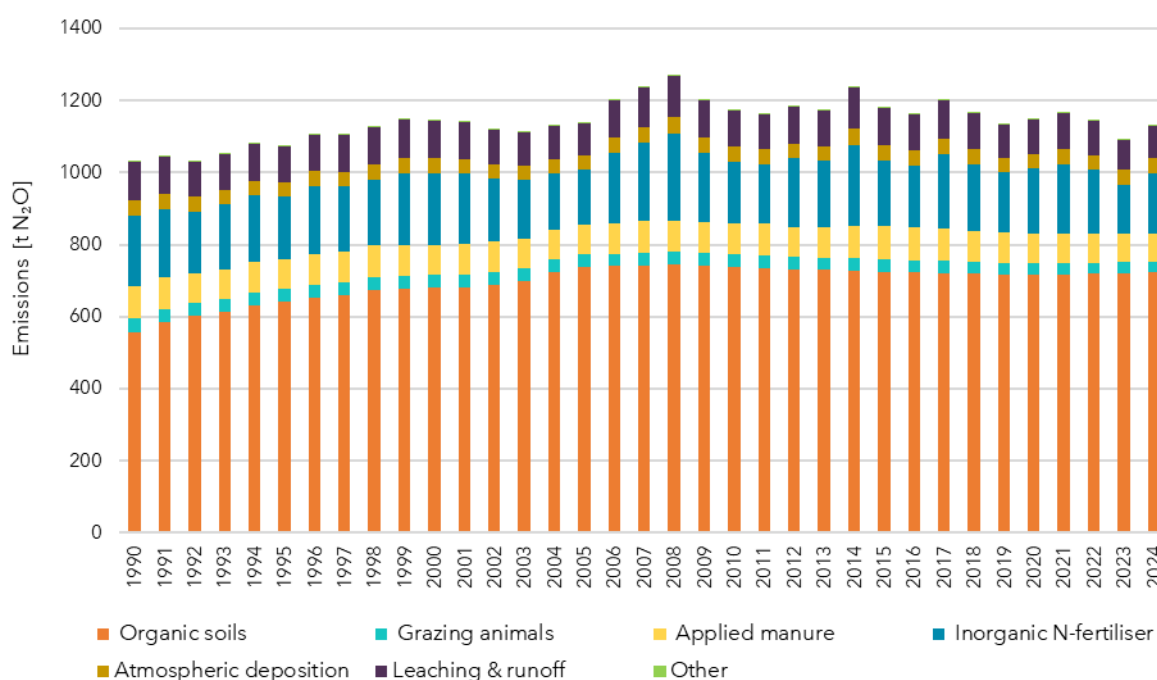


Figure 5.6. Direct N_2O emissions from Agricultural Soils [t N_2O].

5.7.4.1 Emissions due to crop residues

The amount of nitrogen from residues returned to soils is subsequently calculated using Equation 11.6 from the 2019 Refinements. Crop production and associated N_2O emissions are shown in Figure 5.7.

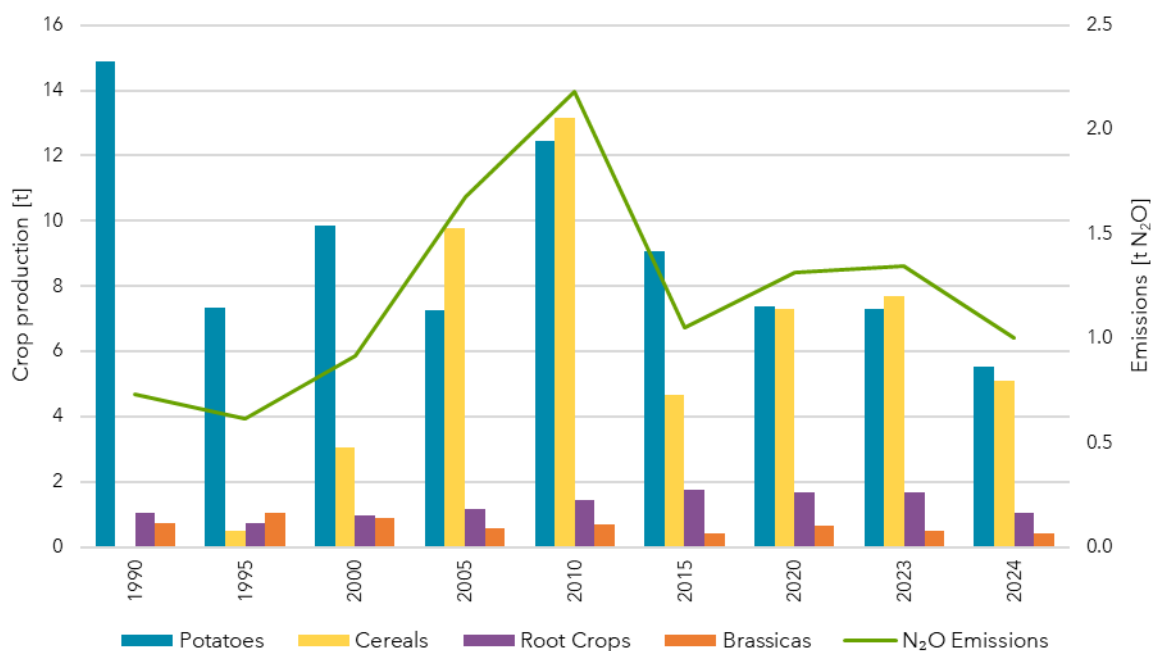


Figure 5.7. Crop production and associated N₂O emissions since 1990.

5.7.5 Recalculations

The types of inorganic fertilisers used were reevaluated causing recalculations for NH₃ emissions from fertiliser use. This did not affect the N₂O emissions from 3D1a Inorganic N Fertilizers but lead to recalculations of emissions form 3D2a Atmospheric Deposition, see Table 5.48.

Table 5.48 Recalculations in 3D2a between submissions.

3D2a Atmospheric Deposition, N ₂ O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	10.8	10.2	10.4	9.7	10.3	10.1	10.4	9.9	9.3
2026 submission [kt CO ₂ e]	11.3	10.5	11.0	10.2	11.0	11.6	11.0	10.9	10.5
Change relative to the 2025 submission [kt CO ₂ e]	0.46	0.369	0.60	0.52	0.75	1.44	0.60	1.02	1.18
Change relative to the 2025 submission [%]	4.2%	3.63%	5.7%	5.4%	7.3%	14.2%	5.8%	10.3%	12.6%

Errors were fixed in the fertiliser calculation sheets for the years 2012 and 2023 causing recalculations of N₂O emissions for those years. The amount of inorganic fertiliser used in forestry was also updated causing small recalculations for N₂O emissions for the years 2009-2023. However, due to how small those changes were the effect on emissions is less than 0.5% for all years, only the changes for the years 2012 and 2023 are shown in Table 5.49.

Table 5.49 Recalculations in 3D1a between submissions.

3D1a Inorganic N Fertiliser, N ₂ O emissions	2012	2023
2025 submission [kt CO ₂ e]	49.0	37.6
2026 submission [kt CO ₂ e]	50.4	36.2
Change relative to the 2025 submission [kt CO ₂ e]	1.4	-1.4
Change relative to the 2025 submission [%]	2.9%	-3.8%

Updated feed digestibility, ash content of feed, animal mass, manure management system fractions for calves, early mortality of lambs and goat population size, as well as an error fixed in the calculations of the digestibility of feed for dairy cattle, all affect the amount of manure available for application. Emission factor updates to 2019 IPCC Refinements for N₂O emissions from manure management, error fixes to how these emission factors are applied for sheep, mink, foxes and rabbits, and new information from the IAAC on the use of straw in solid storage for sheep and calves, caused recalculations for category 3D1bi Animal Manure Applied to Soils by affecting the amount of manure available for application, see Table 5.50.

Table 5.50 Recalculations in 3D1bi between submissions.

3D1bi Animal Manure Applied to Soils, N ₂ O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	27	25	25	24	26	26	24	23	22
2026 submission [kt CO ₂ e]	24	22	22	22	23	24	22	21	21
Change relative to the 2025 submission [kt CO ₂ e]	-3.3	-3.1	-2.7	-2.6	-2.7	-2.3	-1.7	-1.5	-1.3
Change relative to the 2025 submission [%]	-12%	-13%	-11%	-10.6%	-10.4%	-8.7%	-7.2%	-6.5%	-5.9%

The amount of organic fertiliser used in forestry was updated causing recalculations for N₂O emissions from 3D1biii Other Organic Fertilisers Applied to Soils for the years 2009-2023, Table 5.51.

Table 5.51 Recalculations in 3D1biii between submissions.

3D1biii Other Organic Fertilisers Applied to Soils, N ₂ O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	NO	NO	NO	0.09	0.45	0.74	0.87	1.35	1.26
2026 submission [kt CO ₂ e]	NO	NO	NO	0.09	0.41	0.65	0.77	1.24	1.13
Change relative to the 2025 submission [kt CO ₂ e]	-	-	-	0	-0.039	-0.091	-0.10	-0.11	-0.13
Change relative to the 2025 submission [%]	-	-	-	0%	-8.7%	-12%	-12%	-7.9%	-11%

Recalculations are due to the transition of emission factors from 2006 IPCC Guidelines to the 2019 Refinements for categories 3D1c Urine and Dung Deposited by Grazing Animals, see

Table 5.52, and 3D2b Nitrogen Leaching and Run-off, see Table 5.53. The factors in the 2019 Refinements were generally considered better researched and more appropriate than those in the 2006 IPCC Guidelines, hence it was decided to use the 2019 Refinements for the entire Agriculture sector.

Table 5.52 Recalculations in 3D1c between submissions.

3D1c Urine and Dung Deposited by Grazing Animals, N₂O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	36	34	33	33	34	34	30	29	28
2026 submission [kt CO ₂ e]	10	9.1	9.1	8.9	9.3	9.4	8.3	8.0	7.9
Change relative to the 2025 submission [kt CO ₂ e]	-27	-25	-24	-24	-25	-24	-22	-21	-20
Change relative to the 2025 submission [%]	-73%	-73%	-73%	-73%	-73%	-72%	-72%	-73%	-72%

Table 5.53 Recalculations in 3D2b between submissions.

3D2b Nitrogen Leaching and Run-off, N₂O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	25	23	24	21	23	24	22	22	19
2026 submission [kt CO ₂ e]	28	26	28	24	26	27	26	25	22
Change relative to the 2025 submission [kt CO ₂ e]	3.2	2.9	3.3	2.8	3.1	3.4	3.4	3.3	2.7
Change relative to the 2025 submission [%]	13%	13%	14%	13%	13%	14%	15%	15%	14%

The methodology applied for category 3D1d Crop Residues was updated to the 2019 IPCC Refinements and emissions from residues from the cultivation of brassicas were added to the inventory, see Table 5.54.

Table 5.54 Recalculations in 3D1d between submissions.

3D1d Crop Residues, N₂O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	0.26	0.19	0.29	0.52	0.67	0.40	0.44	0.52	0.47
2026 submission [kt CO ₂ e]	0.19	0.16	0.24	0.44	0.58	0.28	0.35	0.40	0.36
Change relative to the 2025 submission [kt CO ₂ e]	-0.065	-0.029	-0.051	-0.072	-0.087	-0.12	-0.094	-0.11	-0.12
Change relative to the 2025 submission [%]	-25%	-15%	-17%	-14%	-13%	-31%	-21%	-22%	-25%

Recalculations were made to the activity data for 4B Cropland, 4C1 Cropland abandoned for more than 20 years and 4C2b Cropland converted to grassland throughout the timeseries. The changes were mostly driven by two factors: correction of artificial rise in IGLUD map data and subsequent reinterpretation of a key reference (Snæbjörnsson, o.fl., 2010), see Table 5.55. Further information can be found in Sections 6.4.7 and 6.5.7.

Table 5.55 Recalculations in 3D1f between submissions.

3D1f Cultivation of Organic Soils, N ₂ O emissions	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 submission [kt CO ₂ e]	134	159	172	186	188	191	195	197	198
2026 submission [kt CO ₂ e]	148	170	180	196	196	192	190	191	191
Change relative to the 2025 submission [kt CO ₂ e]	14	11	8.3	10	7.9	1.5	-4.7	-6.0	-6.6
Change relative to the 2025 submission [%]	10%	7.0%	4.8%	5.4%	4.2%	0.80%	-2.4%	-3.0%	-3.3%

5.7.6 Uncertainties

5.7.6.1 Direct N₂O Emissions

The variability in activity data uncertainties is great. For 3D1a Inorganic N Fertilisers the uncertainty is 5% based on expert judgement and based on the fact that the amount of imported N-fertilisers are part of national statistics. The activity data uncertainty for 3D1bi Animal Manure Applied to Soils is derived from the maximum uncertainty of the activity data in 3B and is 61%, while for Sewage Sludge and Other Organic Fertilisers this uncertainty is 10% and 20%, respectively, in light of the uncertainty of completeness. For subcategory 3D1c, Urine and Dung Deposited by Grazing Animals the activity data uncertainty is derived from the maximum uncertainty values used in 3B (livestock uncertainty, distribution of manure management systems and nitrogen excretion) and is 71%. The activity data uncertainty for Crop Residues 3D1d derives mainly from completeness issues and is estimated to be 200%. For the subcategory Cultivation of Organic Soils 3D1f, the activity data uncertainty is estimated to be 17%, based on expert judgement for the uncertainty of each land category and the size of the relevant categories.

The emission factor uncertainties for N additions from synthetic fertilisers, organic amendments and crop residues are calculated using the lower and upper range values of the default emission factors from the 2019 IPCC Refinements, Volume 4, Chapter 11, Table 11.1, and amount to 80%. The same table is used to estimate the EF uncertainty for 3D1c Urine and Dung by grazing animals and a combined uncertainty of 175% obtained. The 3D1f combined emission factor uncertainty is 44% and is based on the uncertainty for the EFs for cultivated and uncultivated drained land, 66% and 51% respectively, taking into account the size of each land group.

The combined uncertainties of activity data and emission factors are the following: 3D1a Inorganic Fertilisers 80%, 3D1b Organic Fertilisers 95%, 3D1c Urine and Dung Deposited by Grazing Animals 189%, 3D1d Crop Residues 215%, and 3D1f Cultivation of Organic Soils 47%. The complete uncertainty analysis is shown in Annex 2.

5.7.6.2 Indirect N₂O Emissions

Activity data uncertainty is 200% for atmospheric deposition and 19% for nitrogen leaching and run-off. The emission factor uncertainty for both subsectors is calculated based on the upper and lower ranges for the EFs in Table 11.3, Chapter 11, Volume 4 of the 2019 IPCC Refinements as well as for $Frac_{LEACH-(H)}$, resulting in 80% emission factor uncertainty for atmospheric deposition and 201% for nitrogen leaching and run-off. Combined uncertainty is 215% and 202% for atmospheric deposition and nitrogen leaching and run-off, respectively.

5.7.7 Planned improvements

The aggregated emission factors from the 2019 Refinements are now being used in the calculations for Agricultural Soils.

The 2006 IPCC Guidelines, which forms the basis for the estimation of the emissions, were updated in 2019 (2019 Refinements). Plans are underway to collect the necessary data and information to evaluate how to incorporate these updates into the calculations for Agricultural Soils.

5.8 Prescribed Burning of Savannas (CRT 3E)

This activity is not occurring in Iceland.

5.9 Field Burning of Agricultural Residues (CRT 3F)

No field burning occurs on fields actively used in Iceland, as explained in the following sections. Hence, the notation key for this category is NO (not occurring).

Crop residues in Iceland are considered a valuable agricultural resource (Þóroddur Sveinsson, written information, 2022). Straw is utilised for bedding while hay for feeding livestock, as animals must be kept indoors for a large part of the year in Iceland. Many livestock categories (incl. horses and sheep) rely entirely on hay harvested during the summertime to sustain them through the winter months.

Old fields in Iceland that have been unused for a considerable amount of time often develop dense vegetation in the form of straws, over a few years. In such cases, farmers may occasionally burn these fields if they plan to reuse them for agricultural purposes. However, this activity is not considered as the burning of agricultural residues.

The practice of burning old fields in Iceland was effectively banned with strict laws in 1992 under Act No 61/1992 (Law on the burning of straws and use of fire in open areas). These restrictions were further tightened with Act No 40/2015 (Law on the treatment of fire and fire prevention) and Regulation No 325/2016 (Regulation on the treatment of fire and fire prevention). These laws significantly reduced the ability to obtain permits for burning fields,

with permits requiring approval from the District Commissioner in Iceland becoming almost unattainable.

Even if a landowner gains a permit for field burning, strict regulations still limit its feasibility. Permits can only be issued between April 1 and May 1, provided the purpose is justified. Even then, the activity is subject to numerous constraints: weather conditions must be ideal, and the fire marshal must be notified at least six hours in advance, and they can cancel the field burning if the weather conditions change. Illegal burning of land is estimated to be extremely rare. According to the District Commissioner's office there are serious consequences for not getting a licence.

To confirm even further that no oversight of this activity has occurred in Iceland's inventory, a review was performed of countries where field burning is known to occur, which crops are known to be most commonly burned, as well as how the other Scandinavian countries are reporting field burning of agricultural residues. Globally, field burning is most common for cereals, fibres, oilseeds, pulses, and sugarcane. Of these, only cereals are grown in Iceland. In Norway and Denmark, field burning is only reported in very little amounts for cereals and hay. Hay is, as mentioned above, too valuable a resource for bedding and feeding to be burned in Iceland. The main crops grown in Iceland have traditionally been tubers – potatoes – and root crops. The first cereals (barley) were grown in Iceland in 1992, and this crop has been grown steadily more and more since then. Iceland, however, only has one short outdoor growing season during the year, which is over the summer months (May-September) and, therefore, farmers have no need to burn crop residue fast in order to be able to get the fields ready for a winter growing season. Residues from barley crops are also considered valuable as bedding for calves. Farming has been modernised in Iceland for many years and every farm has a tractor and ploughing machinery, which has been the main method for getting fields ready for the next growing season. Hence, it is most appropriate to report this activity as not occurring in Iceland.

5.10 CO₂ Emissions from Liming, Urea Application, and Other Carbon-containing Fertilisers (CRT 3G, 3H, 3I)

Combined CO₂ emissions from liming (3G), urea application (3H) and other carbon containing fertilisers (3I) generally account for around 1% of the total greenhouse gas emissions from the Agricultural sector.

5.10.1 Methodology

Tier 1 methodology from the 2006 IPCC Guidelines, Volume 4, Chapter 11 is applied for all three subsectors. No update was provided for these sectors in the 2019 Refinements.

Annual CO₂ emissions from 3G Liming, i.e., emissions from the application of limestone, shellsand (~90% CaCO₃), and dolomite, are estimated by using Eq. 11.12 from the 2006 IPCC Guidelines. Since shellsand is about 90% limestone, the total limestone amount is obtained by adding 90% of the shellsand weight to the other limestone data.

Annual CO₂ emissions from 3H Urea Application are estimated using Equation 11.13 from the 2006 IPCC Guidelines.

Calcium ammonium nitrate (CAN) exists usually in a fertiliser mixture, where other nutrients, such as phosphorus and potassium, are included in the mixture. The proportion of potassium and phosphate compounds in CAN fertilisers has remained relatively stable over the time series. To estimate the weight of pure CAN, 20% of the total fertiliser weight is subtracted, assuming it is potassium and phosphate compounds. Pure CAN contains approximately 23% limestone and dolomite. Therefore, the limestone/dolomite weight in CAN is calculated as 23% of 80% of the original CAN fertiliser weight.

CO₂ emissions are estimated using Eq. 11.12 from the 2006 IPCC Guidelines, based on the limestone/dolomite weight of CAN fertiliser. This is the same equation as is used for emissions from 3G Liming. However, the slightly higher emission factor for dolomite is used due to lack of specific information on whether CAN fertilisers contain calcium carbonate or dolomite.

This process is described in the following equation:

Equation

Annual CO₂ emissions from CAN application (Tier 1)

$$\text{CO}_2 - \text{C emission} = M_{\text{CAN fertiliser}} \cdot 0.8 \cdot 0.23 \cdot EF_{\text{Dolomite}}$$

Where:

CO₂ – C emission = emission of C from CAN application, t C/yr

$M_{\text{CAN fertiliser}}$ = annual amount of CAN fertiliser, t/yr

EF_{Dolomite} = emission factor, tonne of C (tonne of dolomite)⁻¹

5.10.2 Activity Data

The amount of limestone, dolomite, Urea and CAN imported and shellsand sold since 1990 can be seen in Figure 5.8.

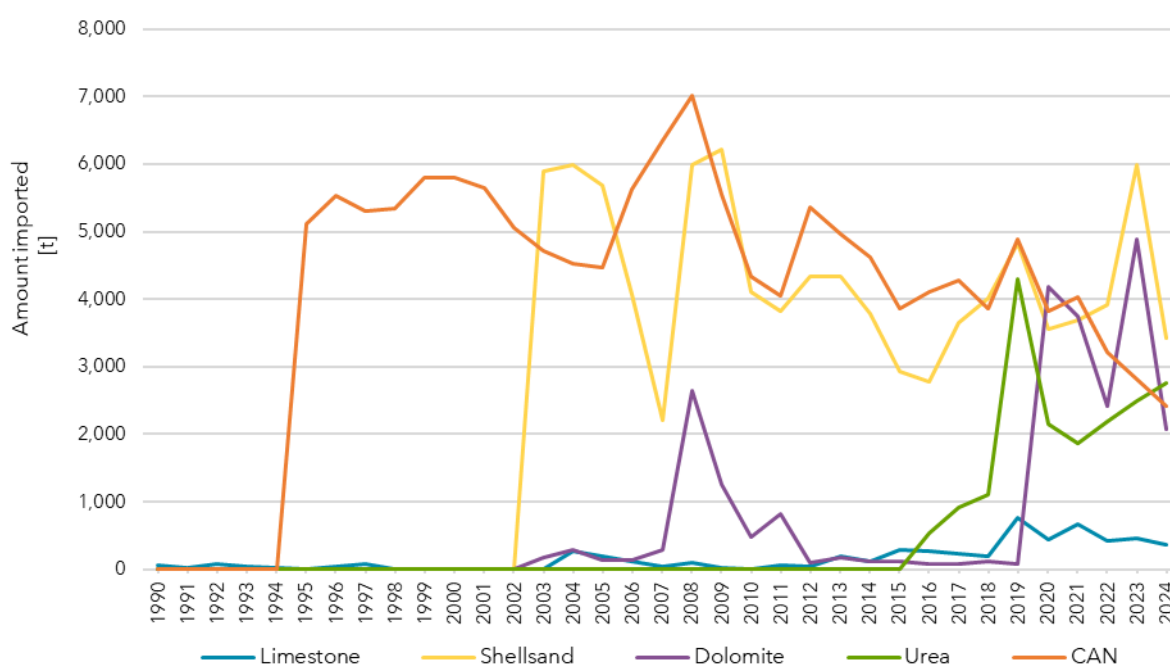


Figure 5.8. The amount of limestone, dolomite, urea and calcium ammonium nitrate (CAN) imported and shellsand sold since 1990.

5.10.2.1 Liming

Data on liming is based on imported pure limestone and dolomite, as well as sold shellsand. Activity data about imported limestone and dolomite are registered through the customs system and obtained either from SI or from IFVA. Data on the use of shellsand is derived from distributor sales numbers. Shellsand, which is naturally available from Icelandic seashores, contains 90% of calcium carbonate (CaCO_3). However, there is no system in place to track the amount of shellsand used by farmers.

The time series 1990–2003 for limestone has been completed following an update in data collection from SI. Data for dolomite and shellsand are unavailable before 2002. However, based on expert judgement from specialists at AUI and IAAC in 2021, it was assumed that dolomite and shellsand used during 1990–2002 were negligible or non-existent. As a result, they are now estimated as not occurring during 1990–2002. Figure 5.8 shows the imported amounts of limestone, dolomite, urea and CAN, along with the sold amounts of shellsand.

It is assumed that all liming occurs on cropland and that the bulk occurs on organic soil as the pH of mineral soils is generally so high that liming is unnecessary.

The peak in imports of dolomite in 2020 is due to a significant increase in imports by one distributor according to information received from IFVA. The distributor intends to encourage a significant calcification effort by Icelandic farmers which is taking place from 2021–2022. Calcification improves the uptake of nutrients from fertilisers in soils significantly and,

therefore, soils at the optimum pH level (5.5 pH to 6.0 pH for cropland) require much less fertilisation than soils at sub-optimum pH levels.³⁷

5.10.2.2 Urea Application

Activity data for imported urea fertilisers are registered through the customs system and obtained by the IFVA. Urea data from the IFVA is used from 2012. Based on expert judgment (Valgeir Bjarnason, written communication, 2022) and supported by data from the IFVA for 2012 and 2013, no urea was used as fertiliser in Icelandic agriculture until 2014. Urea use is, therefore, marked as not occurring for the period 1990-2013. Urea import data is presented in Figure 5.8.

5.10.2.3 Other Carbon-containing Fertilisers

Data on which imported nitrogen fertilisers qualify as calcium ammonium nitrate (CAN) fertilisers is based on expert judgement of the fertiliser expert at the IFVA (Valgeir Bjarnason, meetings and phone calls, 2022-2024). Although the ratio of calcifying materials is low in these fertilisers, the amount of fertilisers applied make this source relatively large in comparison to other CO₂ emissions from the Agriculture sector.

Until 1995, a single fertiliser factory in Iceland had exclusive rights to import and manufacture fertilisers, manufacturing ammonium nitrate-based fertilisers. Therefore, it is considered certain that no CAN fertiliser was used in Iceland before 1995 when the factory's exclusive rights were revoked.

Expert judgement indicates that nearly 100% of imported nitrogen fertilisers from 1995 to 2009 were CAN, except for granular fertilisers, which proportion has remained relatively steady over time. During this period, granular fertilisers are estimated to have been about one-third of nitrogen fertilisers, and the rest is assumed to be CAN. The proportion of CAN of all inorganic nitrogen fertilisers has fluctuated considerably since then but is on average around 45% of inorganic fertilisers imported. The amount of CAN fertilisers used in 2010 and 2011 are estimated based on extrapolation from later years.

5.10.3 Emission factors

Default emission factors from the 2006 IPCC Guidelines, Vol. 4, Chapter 11 for limestone, 0.12 t CO₂-C/t applied, and dolomite, 0.13 t CO₂-C/t applied, are used. The emission factor for the application of urea fertilisers is 0.2 t CO₂-C/t applied.

³⁷ <https://www.yara.is/kolkun-er-grundvallaratridi-thegar-kemur-ad-godri-upptoku-naeringarefna/>

The activity data available for CAN does not fully annotate whether magnesium or calcium or both is used in the fertiliser. The emission factor for dolomite is slightly higher than for limestone and is used for all CAN fertilisers to not underestimate the emissions.

5.10.4 Emissions

CO₂ emissions due to liming of cropland and use of urea and CAN fertilisers are shown in Table 5.56 and Figure 5.9. Due to the exclusive rights of a single fertiliser factory, to import and manufacture fertilisers, until 1995, there are no emissions from CAN before 1995.

Table 5.56. CO₂ emissions from liming (limestone, shellsand and dolomite), urea application and other carbon containing fertilisers (CAN).

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Limestone + shellsand	23	3.1E-03	2.2	2,341	1,633	1,288	1,599	2,577	1,518
Dolomite	NO	NO	NO	65	225	58	1,997	2,331	988
Urea	NO	NO	NO	NO	NO	6.6	1,574	1,826	2,018
CAN	NO	2,437	2,760	2,127	2,066	1,836	1,821	1,342	1,149
Total CO ₂ Emissions [t]	23	2,437	2,762	4,533	3,925	3,188	6,991	8,076	5,672
Relative change since 1990		10450%	11857%	19522%	16890%	13701%	30166%	34862%	24454%

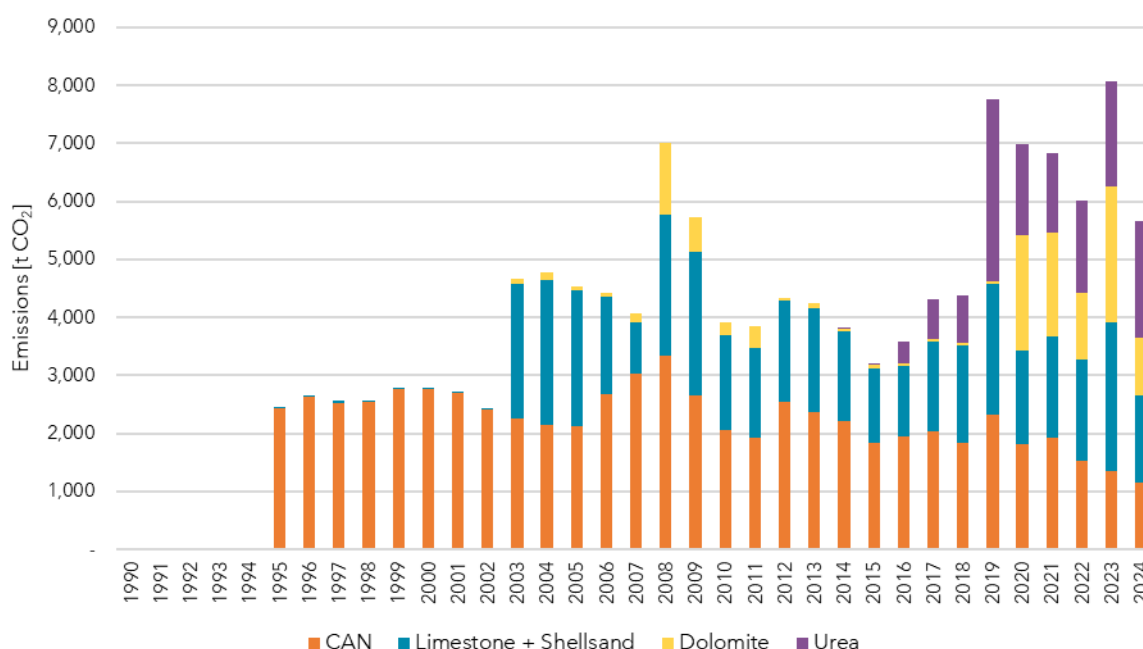


Figure 5.9. CO₂ emissions from liming (limestone, shellsand and dolomite), urea application and other carbon containing fertilisers (CAN).

5.10.5 Recalculations

Activity data on fertiliser types was revisited resulting in recalculations for urea for the year 2020, decreasing the urea emissions by 1.5 kt CO₂ or 49% that year, and recalculations for CAN for the years 2010-2023, see Table 5.57. The change for 3G was miniscule, 0.6% increase in CO₂ emissions in one year, 2020.

Table 5.57. Recalculation for 3I Other Carbon-containing Fertilizers due to updated activity data.

CRT 3I, Other Carbon-containing Fertilizers	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 Submission [kt CO ₂]	NO	2.44	2.76	2.13	2.05	1.79	1.47	1.50	1.14
2026 Submission [kt CO ₂]	NO	2.44	2.76	2.13	2.07	1.84	1.82	1.53	1.34
Change relative to the 2025 submission [kt CO ₂]	-	0	0	0	0.021	0.049	0.35	0.033	0.20
Change relative to the 2025 Submission [%]	-	0%	0%	0%	1.0%	2.8%	24%	2.2%	17%

5.10.6 Uncertainties

For liming and other carbon containing fertilisers the activity data uncertainty is 50% and 20% for urea application, based on expert judgement in light of completeness and data retrieval issues. The emission factor uncertainty for CO₂ is 50% based on approximations suggesting emissions may be less than half of the maximum value, which is the current factor value, according to page 11.27, Chapter 11, Volume 4, in the 2006 IPCC Guidelines. The combined uncertainties of activity data and emission factors are the following: 3G Liming 71%, 3H Urea Application 54%, and 3I Other Carbon-containing Fertilisers 71%. The complete uncertainty analysis is shown in Annex 2.

5.10.7 Planned Improvements

The activity data on CAN fertilisers is expected to improve over the next few years, as more detailed data recording is planned.

6 Land Use, Land-use Change, and Forestry (CRT sector 4)

6.1 Overview

The sector includes emissions and removals resulting from carbon stock changes across five key carbon pools: aboveground biomass, belowground biomass, dead wood, litter, and soil, as well as Harvested Wood Products (HWP). The changes are tracked within defined land-use categories, including

- Forest land (4.A)
- Cropland (4.B)
- Grassland (4.C)
- Wetlands (4.D)
- Settlements (4.E)
- Other land (4.F)

The sector also accounts for:

- Direct and indirect N₂O emissions from nitrogen inputs to managed soils (Table 4(I))
- Emissions and removals from the drainage and rewetting and other management of organic and mineral soils (Table 4(II))
- Direct and indirect N₂O emissions from nitrogen mineralization associated with loss of SOM resulting from changes in land use or management of mineral soils (Table 4(III))
- Emissions from biomass burning (Table 4(IV))

All emissions and removals are reported in accordance with the guidelines provided in Volume 4: Agriculture, Forestry, and Other Land Use of the 2006 Guidelines (IPCC, 2006), and the 2013 Supplement to the 2006 Guidelines: Wetlands (IPCC, 2014), hereafter named 2013 Wetlands Supplement.

The greenhouse gas inventory is compiled by Land and Forest Iceland (LFI).

6.1.1 Emission trends

Almost 90% of the total area of Iceland falls under two land-use categories: Grassland and Other land. The relative distribution of Iceland's area among the six land-use categories is presented in Figure 6.1.

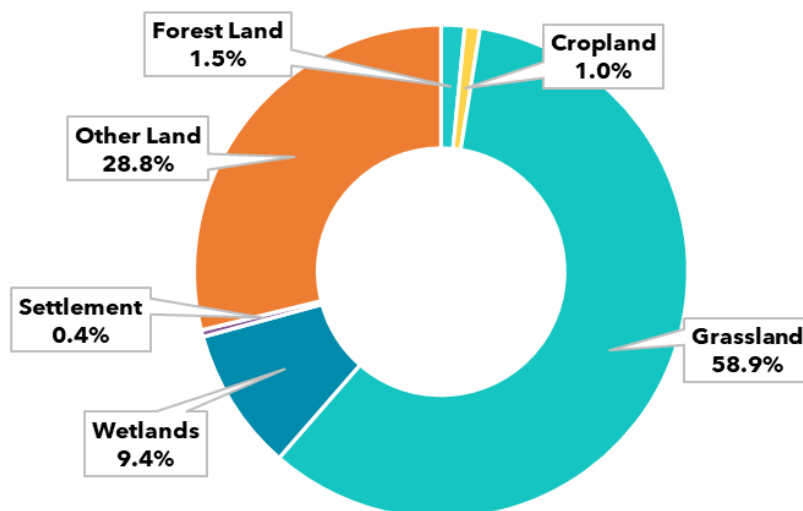


Figure 6.1 Relative size of land-use categories in Iceland as reported for 2024, %.

Total gross emissions for 2024 were estimated at 8,798.5 kt CO₂e. Emissions associated with the drainage of organic soils contributed 8,653.8 kt CO₂e, accounting for slightly more than 98% of total gross emissions. These emissions occur predominantly within the Grassland and Cropland categories, with a much smaller contribution reported under Forest land.

CO₂ was the dominant GHG in the sector, accounting for 64% of total net gross emissions (5,593.5 kt CO₂). CH₄ was the second-largest contributor, representing 7% of emissions (614.7 kt CO₂e). Direct and indirect N₂O emissions made up only a minor fraction of the total, contributing less than 0.1% (7.7 kt CO₂e).

Both emissions from sources and removals by sinks are reported for this sector. The net contribution of each land use category for the 2026 submission is summarised in Figure 6.2.

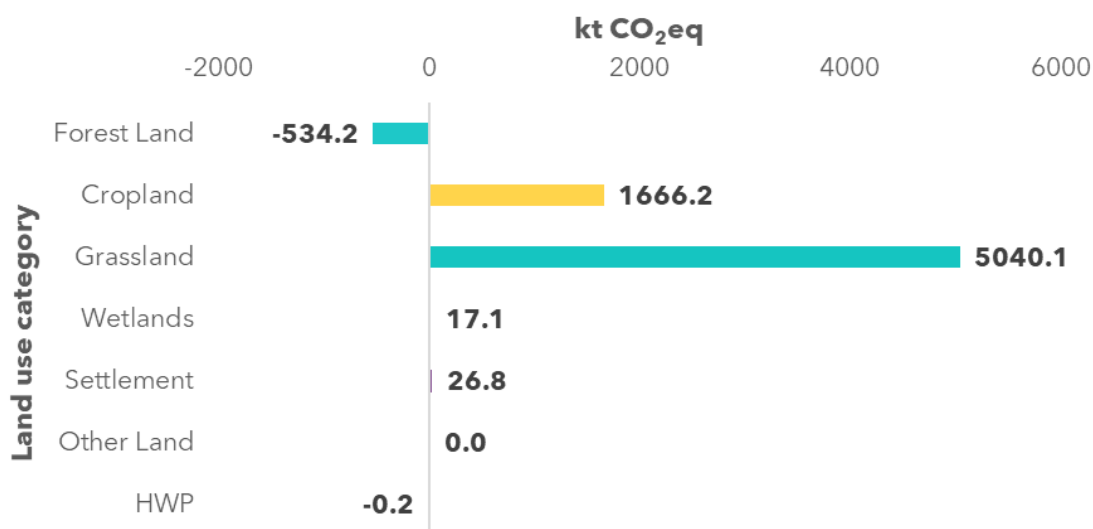


Figure 6.2 The net emissions/removals [kt CO₂e] of land-use categories and HWP in 2024

The largest sink was due to sequestration of CO₂ by biomass and mineral SOC pools of Grassland (22.8% or 2,006.3 kt CO₂), by biomass and SOC of mineral soils in forest (6.2% or 546.8 kt CO₂; Figure 6.2). More detailed information is reported in a land use category-specific section of the LULUCF chapter.

Hence, the LULUCF sector in Iceland has acted as a net source in 2024 and over the whole reporting period, with all the land use categories except Forest land act as a net source of emissions. The net emissions from the LULUCF sector were equal to 6,215.9 kt CO₂ in 2024, contributing to 57% of the total emissions in the country. Between 1990 and 2024, there is a net decrease of 7.04% in LULUCF emissions, corresponding to 470.5 kt CO₂e. Fluctuations in geographically explicit data for active and inactive cropland and coincident conversion of Grassland and Wetland to Cropland drive the fluctuations in emissions for the last four years of the timeline (2021-2024).

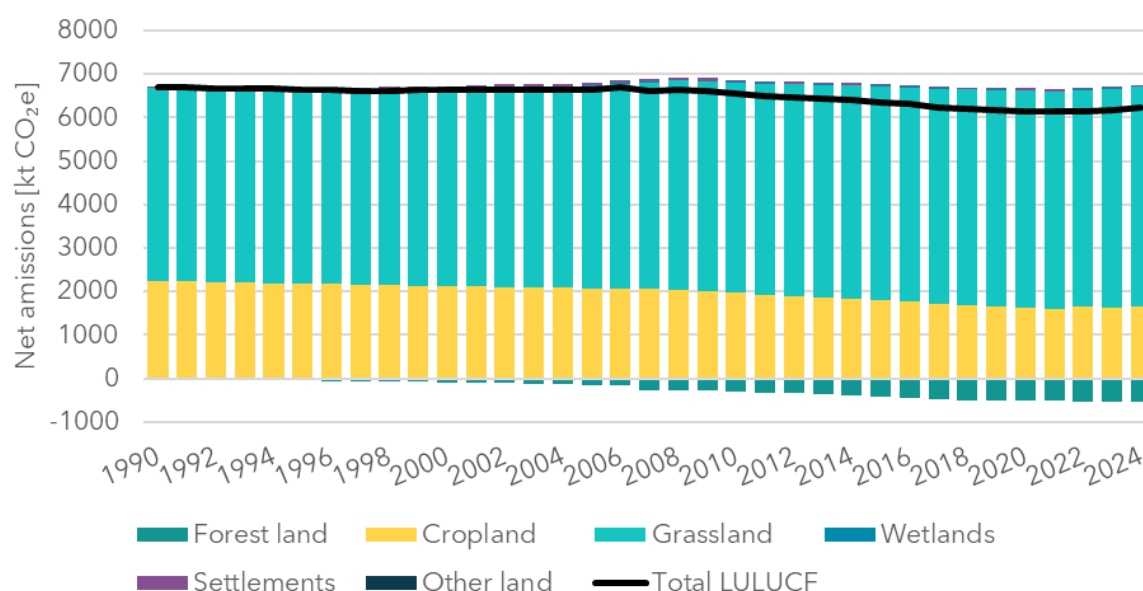


Figure 6.3 Emissions trends [kt CO₂e] for all land use categories from 1990. Note that these trends include non-CO₂ gases.

Overall, the carbon pools living biomass, mineral soil organic carbon (SOC) and dead organic matter (DOM) remain net sinks across the time series, with cumulative increases of 452.7 kt CO₂e, 424.6 kt CO₂e and 44.6 kt CO₂e, respectively, since 1990. Organic soil organic carbon (SOC) emissions constitute a major increasing source of emissions for Iceland with an increase of 378.2 kt CO₂e between 1990 and 2024 (see Figure 6.4).

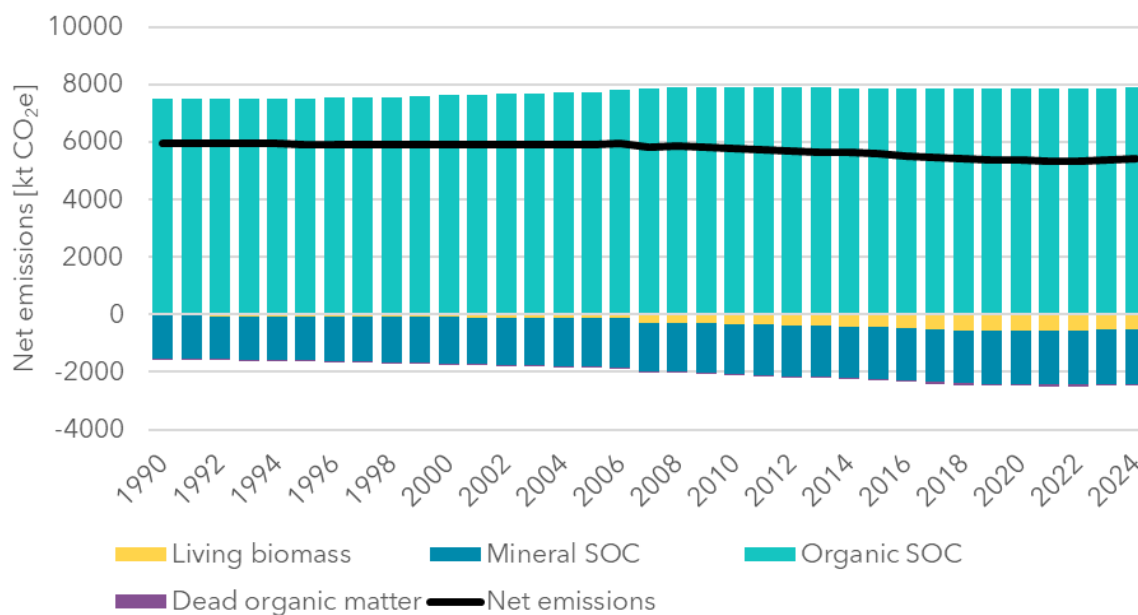


Figure 6.4 Emissions trends (kt CO₂) for carbon pools living biomass, mineral soil organic carbon (SOC), organic soil organic carbon (SOC) and dead organic matter from 1990. Note that these trends do not include non-CO₂ gases.

Table 6.1 Emissions trends (kt CO₂e) broken down by pollutant from 1990.

Pollutant	Units	1990	1995	2000	2005	2010	2015	2020	2023	2024
Carbon dioxide (CO ₂)	kt CO ₂ e	6,125	6,070	6,048	6,057	5,947	5,746	5,539	5,541	5,594
Methane (CH ₄)	kt CO ₂ e	554	563	574	586	602	605	610	614	615
Nitrous oxide (N ₂ O)	kt CO ₂ e	7	6	6	6	7	7	6	8	8
Total	kt CO₂e	6,686	6,639	6,627	6,649	6,556	6,357	6,154	6,163	6,216
Emissions increases/ reductions (year-base year)/base year	%	-	-0.7%	-0.9%	-0.6%	-2.0%	-4.9%	-8.0%	-7.8%	-7.0%

6.1.2 Key Category Analysis

Analysis of key categories was performed collectively for all sectors using Approach 1. The results of the analysis are presented in Chapter 1.4 and Annex 1. In addition, a list of key categories identified through Level Assessment (LA) and Trend Assessment (TA) is provided in Table 6.2.

Table 6.2 Key categories identified for the LULUCF sector.

IPCC Source Category	Gas	Level 1990	Level 2024	Trend
4A1 Forest Land Remaining Forest Land	CO ₂		✓	✓
4A2 Land Converted to Forest land	CO ₂		✓	✓
4B1 Cropland Remaining Cropland	CO ₂	✓	✓	✓
4B2 Land Converted to Cropland	CO ₂	✓	✓	✓

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
4C1	Grassland Remaining Grassland	CO ₂	✓	✓	✓
4C2	Land Converted to Grassland	CO ₂	✓	✓	✓
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils -Grasslands	CO ₂	✓	✓	
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils - Wetlands	CH ₄	✓	✓	

6.1.3 Completeness

The emissions and removals of most sources and sinks are estimated in the 2026 submission. Beginning with this submission, estimates for BGB and DOM have also been included. For further details, refer to the land-use-specific sections of the LULUCF chapter. Direct and indirect N₂O emissions from nitrogen mineralization and immobilization for the subcategory Grassland converted to Wetlands are reported as NE.

6.1.4 Sector-specific QA/QC and Verification

In accordance with Chapter 6 of the 2006 IPCC Guidelines, Iceland has developed and implemented the following LULUCF sector-specific QC/QA procedures and activities:

- Check those assumptions and criteria for the selection of activity data, emission factors, and other estimation parameters are documented.
- Check for transcription errors in data input and references.
- Check that emissions and removals are calculated correctly.
- Check of notation keys and the associated assumption to ensure they are correct. Specially NO or NA when tier 1 equilibrium assumption is used or when emissions are not reported because the AD (area) is NO.
- Check of CSC used and their consistency between land use categories.
- Review the appropriate use of the Gain-Loss method in non-Forest land use categories.
- Check that parameters and units are correctly recorded and that appropriate conversion factors are used.
- Check the integrity of database files.
- Check for consistency in data between categories.
- Check that the movement of inventory data among processing steps is correct.
- Check that uncertainties in emissions and removals are estimated and calculated correctly.
- Check time series consistency.
- Check completeness.
- Trend checks.

As part of a collaborative project with Aether in 2023 (for the 2024 submission), a comprehensive checklist with guiding questions for QA/QC personnel was developed and implemented for the first time. As part of a collaborative project with Aether in 2023 for the 2024 submission, a comprehensive QA/QC checklist with guiding questions was developed and implemented for the first time. This checklist was applied by the LFI internal team for the 2026 submission, and an additional external QC review was carried out by experts from Aether. Moreover, Iceland will continue to implement this checklist in future submissions to ensure that the reporting of the greenhouse gas inventory for the LULUCF sector aligns with the TACCC quality principles established by the 2006 IPCC Guidelines.

6.2 Land-use Definitions and Classification Systems Used

6.2.1 Definitions

Definitions of the six main land-use categories are presented in Table 6.3. Further information on the subcategory's definitions is provided in the respective category-specific chapters³⁸. In Iceland, all land is considered managed except Other land and the Wetland's subcategories Lakes and rivers, and Intact mires – no grazing.

Table 6.3 Definitions of the main land-use categories.

LU category	Definition
4A Forest land	Includes all land not included under Settlements, covered with trees or woody vegetation that is on average more than 2 m high, with a crown cover minimum of 10%, covering at least 0.5 ha in continuous area and has a minimum width of 20 m. Land which currently falls below these thresholds but is expected to reach them in situ at mature state, is also included. Roads, power lines and other linear gaps within Forest Land are also included if the actual gap zone does not reach 20 m, the minimum width of Forest Land.
4B Cropland	Includes all cultivated land not included under Settlements or Forest Land that is at least 0.5 ha in continuous area and has a minimum width of 20 m. This category includes annual and bi-annual crops and harvested hayfields with perennial grasses.
4C Grassland	The Grassland category covers all land with more than 20% vascular plant cover that doesn't fall under Forest Land, Cropland, Wetlands, or Settlements—following the definitions in the 2006 IPCC Guidelines (Vol. 4, Ch. 3, Table 3.1) and Article 2(1) of Regulation (EU) 2018/841. We exclude grazing areas that are reported under Other Land. We also include land that's being revegetated but hasn't been assigned to another category (IPCC Vol. 4, Ch. 3.3.2.6), and drained organic soils that don't fit elsewhere consistent with the 2013 Wetlands Supplement and Annex V of the EU LULUCF Regulation. This applies to CRF subcategories 4(C)1 and 4(C)2.
4D Wetlands	Includes all land that is covered or saturated by water for at least part of the year and does not fall under the Settlements, Forest Land, or Cropland categories. It includes reservoirs and Intact mires – grazing areas as managed subdivisions (although all emissions and removals from this subcategory are reported as Not Applicable from the 2026 submission onward; see section 6.6.3.1). Natural rivers, lakes, and Intact mires – no grazing are classified as unmanaged land.
4E Settlements	Includes populated area with at least 200 inhabitants and: (a) a clear street system; or (b) name; or

³⁸ It should be noted that, through significant improvements in the transparency of land representation reporting, Iceland has addressed the recommendation made by the ERT during the 2022 review cycle (FCCC/ARR/2022/ISL/L.5 and FCCC/ARR/2022/ISL/L.15)

LU category	Definition
	(c) a maximum of 200 m between houses. However, there may be exceptions due to industrial and commercial areas, recreational areas, bridged rivers, parking and other transport infrastructure, cemeteries, hazardous areas due to natural hazards, etc. Urban centers with fewer than 200 inhabitants are therefore not considered as settlements.
4F Other land	Includes bare soil, rock, glaciers, lands with vascular plant cover <20%, and all land that does not fall into any of the other categories. All land in this category is unmanaged.

6.2.2 Description of activity data

The Icelandic Geographic Land Use Database (IGLUD) integrates 109 distinct geographical data layers from multiple authoritative sources in Iceland. This database has been designed to support land-use classification and carbon accounting requirements under the LULUCF reporting. The primary foundation consists of 70 layers derived from Iceland's national habitat mapping program, which provides ecological and environmental classification across the country's diverse landscape. These habitat layers capture essential information about natural ecosystems, vegetation patterns, and land cover characteristics, offering a baseline for land-use assessment.

Complementing the habitat mapping foundation, 39 specialized layers have been sourced from various partner organizations, each contributing unique and detailed information about specific land-use aspects. These partner organizations include government agencies, research institutions, and environmental monitoring bodies, each providing data within their respective areas of expertise. These layers include a map of Grassland on drained (organic) soils, a map of reservoirs, a map of revegetated land (with its subcategories), a map of Forest land (with subcategories), a map of Cropland (with subcategories), a map of birch woodland, and a map of Settlements. These specialized layers often contain more detailed or focused information about particular land-use types.

The integration process produced IGLUD map areas for the inventory years 2018–2024. However, there are still some discrepancies between these layers that will be addressed in future submissions as an effort to improve the overall quality and accuracy of land representation and to comply with current guidelines. The specialized layers often contain more detailed or focused information about particular land-use types. For data quality and consistency, IGLUD implements a hierarchical grading system ranging from grade A (high-precision GPS data) to grade H (broad-scale remote sensing) (Table 6.4). Supporting layers, including ArcticDEM and OpenStreetMap data, provide additional context for refining LULUCF classifications.

Table 6.4 Core LULUCF Data Layers graded (A-H) based on their quality and direct applicability in LULUCF mapping.

Grade	Format	Method and Technology	Scale	Resolution	Data input year	IGLUD
A	Vector	Direct GPS-based measurements	1:500 1:2000	± 10 m	2018 to 2025	Precise land boundary delineation in high-resolution areas
B	Vector	Data with ± 10 m accuracy per regulatory standards (e.g., Regulation No. 918/2009)	1:500 1:2000	± 10 m	2020 to 2025	Suitable for administrative boundaries and medium-accuracy land use mapping
C	Vector	GPS-tracked field boundaries (e.g., for fertilizer application)	1:1000 1:2000	Precise GPS location tracking	2002-2025	Applied in agriculture and precise land use mapping
D	Vector	Interpretation of aerial and high-resolution satellite imagery	1:1000 1:3000	High resolution	1950 to 2025	General land classification and boundary delineation
E	Vector	GPS-based measurements, and georeferenced data			1844-2025	Requires refinement due to inconsistencies with physical features
F	Raster	Derived data from vector and remote sensing analyses and other supporting data	1:25.000 1:50.000	± 10 m	1999-2006	Supports integrated land use mapping through analysis-derived layers
G	Raster	Remote sensing using RapidEye, SPOT, LANDSAT, and aerial imagery	1:50.000	15 m (225 m ²)	1999-2016	Essential for general land cover mapping with field verification for accuracy
H	Raster	Remote sensing with LANDSAT and SPOT	1:50.000	15m (225 m ²)	1999-2006	Suitable for broad land cover mapping with medium resolution

IGLUD map was first developed in 2010 with the objective to compile available geographical data into a new land use map compliant to the requirements of the IPCC Guidelines (IPCC 2006). The IGLUD database includes also geographically referenced datasets and analysis obtained through IGLUD fieldwork, photographs taken at sampling sites, geographical data related to surveys on specific map layers or topics related to the database, and metadata describing the above datasets. Until 2019 the Icelandic Farmland Database (IFD) was the most extensive data source from the compilation of different geographical data, serving as a base map for IGLUD map with 18 layers (Table 6.5).

Table 6.5 Summary table for all sources used for the preparation of the IGLUD land – use map.

Land use category	Type	SOURCE
4A1 Forest land remaining forest land	Cultivated forest	Land and Forest Iceland (LFI)
4A2 Land converted to forest land	Natural birch forest Natural birch shrubland	Land and Forest Iceland (LFI)
4B1 Cropland remaining cropland		IGLUD - AUI, RI, IAAC, NSII Snæbjörnsson A., et al.
4B2 Land converted to cropland		
	Cropland converted to grassland	IGLUD, AUI
4C1 Grassland remaining grassland	Natural birch forest/shrubland converted to grassland	Land and Forest Iceland
4C2 Land converted to grassland	Revegetation	NIRA database
	Wetland converted to grassland	Ditches map AUI/NSII
	Grazing on other land	IGLUD, AUI
4D1b Flooded land remaining flooded land		Agricultural research institute (Rannsóknastofnun landbúnaðarins)
4D2b Land converted to flooded land		
4D1c Other wetlands remaining other wetlands	Lakes and rivers	The National Power Company of Iceland (Landsvirkjun)
4D2c Land converted to other wetlands	Intact mires	
	Rewetted land and refilled lakes and ponds	Land and Forest Iceland (LFI)
4E1 Settlements remaining settlements		
4E2a Forest land converted to settlements		
4E2c Grassland converted to settlements		Land and Forest Iceland (LFI)
4F1 Other land remaining other land		

Since 2019 the Habitat Type Map (HMI), prepared by the Natural Science Institute of Iceland (NSII) (Ottósson, Sveinsdóttir, & Harðardóttir, 2016), was adopted as a base map of IGLUD. The HMI is a comprehensive description and overview of habitat types in Iceland and their distribution, size, and conservation value. The HMI then included a total of 105 habitat types of which 64 are terrestrial, 17 freshwater, and 24 coastal habitat types. This change in IGLUD introduced many advantages. For example, providing data at smaller mapping unit (5 x 5 m) for more detailed stratification of land cover with 64 terrestrial land cover types, instead of 6 or 12 classes in IFD (with 15 x 15 m mapping unit). Beside this, in the IFD, the classification method was supervised classification adjusted to ground truth sampling points to reach reasonable certainty, whereas in the HMI the classification is automatic ISODATA (Lillesand, Kiefer, & Chipmann, 2004) and classes correlated to on ground classification. When defining

and classifying habitats in Iceland, the EUNIS classification system (European Environment Agency 2012) was used as a reference.

The 2026 submission consists of 3rd edition of HMI and accounts for 90.93% of the total mapped area³⁹. LFI contributes both independently (3.91%) and through collaboration with the AUI (2.73%), by providing detailed mapping of ditch network resulting in derived spatial data for grassland on drained soils. The remaining 2.43% comprises data from various sources including the Icelandic Agricultural Advisory Center (IAAC), the NSII, and Registers Iceland (RI).

Moreover, the process of describing and mapping habitat types in Iceland has been the most extensive project undertaken by the NSII to date in collaboration with numerous individuals and institutes. Project findings are the product of wide-ranging field observations and data analysis, and the databases developed in the process will continue to serve well in the future. Concise descriptions of each habitat type with their attributes, distribution and conservation values are provided (Ottósson, Sveinsdóttir, & Harðardóttir, 2016). Further investigations regarding HMI are being assessed by GróLind (the National Soil and Vegetation Monitoring Program: <https://grolind.is/>; an independent research program coordinated by the LFI).

Development of land-use areas for the time series 1990–2024 is carried out through multiple approaches: comparison with official datasets from Land and Forest, analysis of aerial and satellite imagery, including SPOT, Landsat, MAXAR, and historical aerial photographs dating back to 1945 (Fanney Ó. Gísladóttir et al., 2024); cross-referencing with historical maps and field survey data; and error matrix validation using confusion matrices and user/producer accuracy assessments, as recommended by Olofsson et al. (2014) and Stehman & Foody (2019). These procedures conform to IPCC Approach 2 expectations, emphasizing geospatial traceability and accuracy (IPCC, 2006). Detailed information on time series development can be found in each chapter.

6.2.2.1 Conversion periods

To inform the land use changes across the timeseries, and to account for Iceland's deviation from the IPCC's default 20-year transition period, historical land-use change data were reconstructed using long-term records. Forest land was traced back to 1941 through historical establishment and planting records from the LFI, validated against aerial photographs and land reclamation documentation from the 1940s onward. Revegetation process, i.e. land conversion to Grassland, was reconstructed back to 1931 using detailed project-level records and land treatment plans from LFI. These reconstructions were further validated with georeferenced historical imagery from 1945 onwards (Gísladóttir et al., 2024). Where direct data were unavailable prior to 1990, land-use history was reconstructed using a

³⁹ Uncertainties for the 3rd edition of the habitat type classification was evaluated in the 2025 submission (in response to the recommendation FCCC/ARR/2022/ISL/L.7. The uncertainty rates are provided in Annex 6, Table A6.8).

combination of methods: interpretation of historical aerial photographs (1945–1980); expert judgment supported by proxy variables such as road networks, topography, and land tenure records; interpolation and backward extrapolation of documented transitions and policy-driven land-use changes; and scenario modelling based on observed post-1990 trends, validated by stakeholder input. The combination of broad habitat mapping with specialized thematic layers creates a framework that supports both general land-use classification and a more detailed analysis of specific areas of interest.

The conversion period for land-use changes to Forest land is defined as 50 years. The 50 years conversion period is in line with Article 1 in the Decision of the EEA Joint Committee No 269/2019 of 25th October 2019. In a chronosequence study (named ICEWOODS research project) where afforestation sites of the four most commonly used tree species of different age were compared in eastern and western Iceland, the results showed a significant increase in the SOC on fully vegetated sites with well-developed, deep mineral soil profiles (Bjarnadóttir, 2009). The age of the oldest afforestation sites examined were 50 years so an increase of carbon in mineral soil can be confirmed up to that age. These results did govern the choice of conversion period of 50 years for Land converted to forest land.

Iceland applies a 60-year conversion period for the land-use category 4C2e Other land converted to grassland. This extended period is necessary because much of Iceland's grassland establishment is not a simple land-use change but involves large-scale restoration and reclamation of severely degraded land, resulting from centuries of soil erosion, deforestation, and overgrazing. The affected soils are predominantly volcanic Andosols, which, after prolonged degradation, are characterized by extremely low organic carbon content and poor fertility.

The cold sub-Arctic climate further slows biological processes, including plant growth, litter decomposition, and soil organic matter stabilization. As a result, both vegetation recovery and soil carbon accumulation occur at a markedly slower rate compared with temperate regions. Long-term ecological studies and monitoring programs in Iceland have demonstrated that soil organic carbon stocks and stable grassland ecosystems may require several decades to develop, far exceeding the default 20-year transition period suggested by the IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Furthermore, the 2006 IPCC Guidelines specifically indicate that the commencement time for the historical data required is based on the amount of time needed for dead organic matter and soil carbon stocks to reach equilibrium following land-use conversion, for which 20 years is recommended as a default, but can be longer, particularly in temperate and boreal systems. By adopting a 60-year conversion period for areas undergoing revegetation activities, Iceland ensures that emission and removal estimate for areas converted from Other Land to Grassland better reflect the gradual trajectory of carbon sequestration in AGB, BGB, and mineral soils. This approach prevents the premature classification of restored lands as Grassland remaining grassland, thereby providing a more accurate representation of long-term carbon dynamics under Icelandic conditions.

6.2.3 Organic soils

Icelandic wetland soils are unusual on a global scale due to their volcanic origin and the distinctive environmental conditions that shape their development. Unlike peat-dominated wetlands elsewhere, they rarely show hydric soil properties typical of highly organic peat soils. Instead, their characteristics are shaped by volcanic parent materials, frequent aeolian and tephra deposition, and variable hydrological regimes. Surface horizons show a wide range of organic carbon contents, generally <25%, which is considerably lower than northern peatland averages. Soil classification separates Gleyic Andosols (<12% C), Histic Andosols (12–20% C), and Histosols (>20% C) (Table 6.6), with carbon accumulation rates from ~4 g m⁻² yr⁻¹ in Gleyic Andosols up to ~25 g m⁻² yr⁻¹ in Histosols—comparable to northern peatlands (Arnalds Ó., 2004).

A key feature is the gradient in organic matter: within the volcanic belt, Gleyic Andosols with low organic contents (2–6% C) dominate due to continual dust and ash inputs. With increasing distance from volcanic and dust sources, soils become progressively more organic, culminating in Histosols rich in poorly decomposed organic matter in western, northwestern, and northern Iceland.

Other distinguishing traits include relatively high pH (often >5), moderate C/N ratios (13–25), and the presence of organo-mineral complexes characteristic of volcanic soils. These properties, combined with unusual shrinkage behaviour and high water retention, sets Icelandic wetland soils apart from the highly acidic, Sphagnum-dominated peatlands of the Arctic and boreal regions, as in Arnalds et al. (2016).

Table 6.6 Typical ranges of selected soil properties for diagnostic horizons at 0–50-cm depth (Arnalds Ó., 2004).

Type	BD ^a (g cm ⁻³)	C (%)	pH H ₂ O	pH NaF	Al _o ^b (%)	Fe _o ^b (%)	Si _o ^b (%)	N ^c
Histosol (H)	0.15–0.4	20–40	4–5.5	9–10.5	0.7–1.6	0.5–1.2	0.2	2
Histic Andosol (HA)	0.2–0.4	13–18	4.5–5.5	9–10.5	1–3	1–5	0.4	5
Gleyic Andosol (WA)	0.3–0.8	1–12	4.5–7.2	10–11	1.3–4	1–7	1–1.7	7
Brown Andosol (BA)	0.5–0.8	2–7	5.5–7.5	9–11.5	1–7	1–8	0.4–4.2	22
Vitrisol (V)	0.8–1.2	<1	7–7.9	9	0.4–2	0.4–3	0.4–2.8	19

^a Bulk density.

^b Extracted with ammonium oxalate.

^c Number of pedons used in the study.

6.2.4 Drained organic soils

Drained organic soils represent a significant source of emissions in the Icelandic GHG inventory. Wetland drainage accelerates organic matter oxidation and nutrient release, boosting biomass production in the short term. This potential drove interest among farmers in the early 20th century, leading to a 1923 law that subsidized drainage. Initially, ditches were dug by hand, but large-scale drainage expanded rapidly after World War II with mechanized excavation and continued government support (Magnusson, 1998). This activity

peaked in 1968, when 1,633 km of ditches were dug. After subsidies were cut in 1987, drainage declined, as most easily accessible farmland had already been affected (Snæbjörnsson A, 2010).

Today, about 15% of drained wetlands are used for hay production, with additional areas grazed. Some drained land, however, remains unused and has never been cultivated.

A substantial proportion of Icelandic inland wetlands has been disturbed by drainage, with nearly half of all wetlands affected. The results indicate that about 70% of lowland wetlands have experienced some degree of impact. Drainage often leads to a vegetation shift from wetland to grassland communities, characterized by more graminoids, varying amounts of *Salix* species, and herbaceous plants. The extent of this shift depends on land use, particularly grazing and fertilizer application, which favour grass dominance (Magnusson, 1998). It is assumed that drainage influence extends on average ~200 m from ditches, though this range varies locally. In south Iceland, areas fully enclosed by ditches are likely affected due to altered water and nutrient flows. While only about 15% of drained land is used for hay production, high-density drainage is common there. Highland ecosystems remain largely unaffected, though some wetlands have been disturbed by hydropower projects, such as those at Blanda and Kárahnjúkar.

The map layer Grassland on drained soils was prepared by LFI using the updated 2025 ditch map. For this submission, the previous map layer was revised based on new HMI data and the Arctic Digital Elevation Model (ADEM).

As in earlier versions, the first step was to apply a 200 m buffer around each ditch. Areas where the slope exceeded 10° in the new ADEM or extended below the seashore line were then excluded. From the remaining area, overlaps with map layers classified as not potentially drained soils were removed; this includes HMI habitat type classes L1, L2, L3, L4, L6, L12, L13, V1 and V2 (Table 6.7). The excluded HMI classes are all described as not containing organic soils (Ottósson J. S., 2016). After these exclusions, polygons without a ditch were formed (e.g., where buffers crossed rivers). These polygons were removed, and the dataset was converted back to raster grid format. Next, overlaps with remaining HMI habitat types not stated to include organic soils were analysed using GIS overlap analysis (OA). Based on this analysis, habitat descriptions, and expert judgment, additional exclusions were made. Through this process, 13 more habitat types (L5.1, L5.2, L5.3, L7.1, L7.2, L7.3, L7.7, L10.1, L10.2, L10.5, L10.7, L10.8, and L14.4) were removed from the buffer. Further exclusions were applied using OpenStreetMap (houses) and IS50V (lakes and rivers), resulting in a more accurate spatial area. The new layer "Grassland on drained soils before 2009 and after 2009" is used in the IGLUD compilation process and in NID, Iceland 2026, and is limited by higher-ranking map layers in the compilation order. The grassland subcategory "Drained Grassland" in IGLUD is identified based on these processes. The 200 m threshold reflects extensive work by Land and forest using AUI ditch mapping in defining the extent of drainage impacts, as in Arnalds et al. (2016).

Table 6.7 Habitat types excluded from grassland on drained soils. The table shows type HMI number, the EUNIS number and the name of the type.

Types	Habitat types HMI3rd edition, classes excluded from grassland on drained soils	EUNIS
L1.1	Sparsely or unvegetated habitats on mineral substrates not resulting from recent ice activity	H5.3
L1.2	Sparsely or unvegetated habitats on mineral substrates not resulting from recent ice activity	H5.3
L1.3	Oroboreal <i>Carex bigelowii</i> - <i>Racomitrium</i> moss-heaths	E4.21
L1.4	Glacial moraines with very sparse or no vegetation	H5.2
L1.5	Volcanic ash and lapilli fields	H6.25
L1.6	Icelandic inland dunes	H5.341
L2.1	Icelandic exposed andic soils	H5.7
L3.3	Icelandic <i>Achemilla</i> screes	H2.11
L3.1	Icelandic talus slopes	H2.13
L3.2	Icelandic <i>Salix herbacea</i> screes	H2.12
L4.2	Icelandic braided river plains	H5.351
L4.1	Unvegetated or sparsely vegetated shores	C3.6
L5.1	Boreal moss snowbed communities	E4.115
L5.2	Icelandic <i>Racomitrium ericoides</i> heaths	E4.26
L5.3	Moss and lichen fjell fields	E4.25
L6.2	Icelandic lava field lichen heaths	E4.241
L6.1	Barren Icelandic lava fields	H6.241
L6.4	Icelandic lava field shrub heaths	E4.243
L6.3	Icelandic lava field moss heaths	E4.242
L7.1	Icelandic sand beach perennial communities	B1.234
L7.2	Upper shingle beaches with open vegetation	B2.3
L7.3	Atlantic embryonic dunes	B1.311
L7.7	Atlantic sea-cliff communities	B3.31
L10.1	Icelandic <i>Racomitrium</i> grass heaths	E4.28
L10.2	Arctic <i>Dryas</i> heaths	F2.294
L10.5	Icelandic lichen <i>Racomitrium</i> heaths	E4.27
L10.7	Oroboreal moss-dwarf willow snowbed communities	F2.112
L10.8	North Atlantic <i>Vaccinium</i> - <i>Empetrum</i> - <i>Racomitrium</i> heaths	F4.211
L12.1	Geothermal wetlands	C2.1431
L12.2	Geothermal heathlands	H6.152
L12.3	Geothermal alpine habitats	C2.1432
L12.4	Icelandic solfatars/Geothermal bare grounds	H6.151
L13.1	Glaciers, rock glaciers and unvegetated ice-dominated moraines	H4.2 & H4.3
L14.4	Land reclamation forb fields	L14.4
V1	Standing waters	C1 & C3
V2	Running waters	C2

6.2.5 Approaches used to represent land areas and time-series consistency

Information on land use is mostly in line with Approach 2 as described in Chapter 3.3.1 of the 2006 AFOLU Guidelines (IPCC, 2006). However, in the case of cultivated forests category Approach 3 qualifications with spatially explicit observations as systematic sample plot inventory is adopted, whereas for land converted to reservoirs and the Settlements category Approach 3 qualifications is by direct mapping.

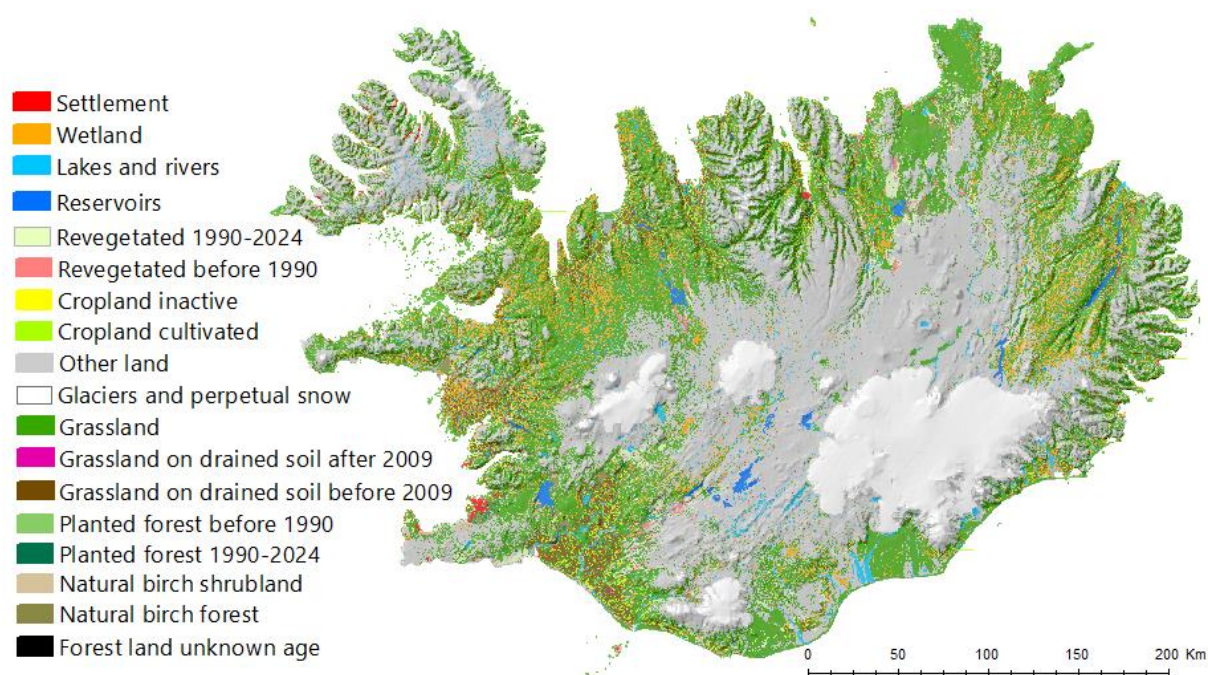


Figure 6.5 The land-use map of IGLUD prepared for 2024 reporting year.

A sample of land-use map for 2024, showing Grassland on drained soils Figure 6.6 and Revegetated areas and NBF in Figure 6.7.

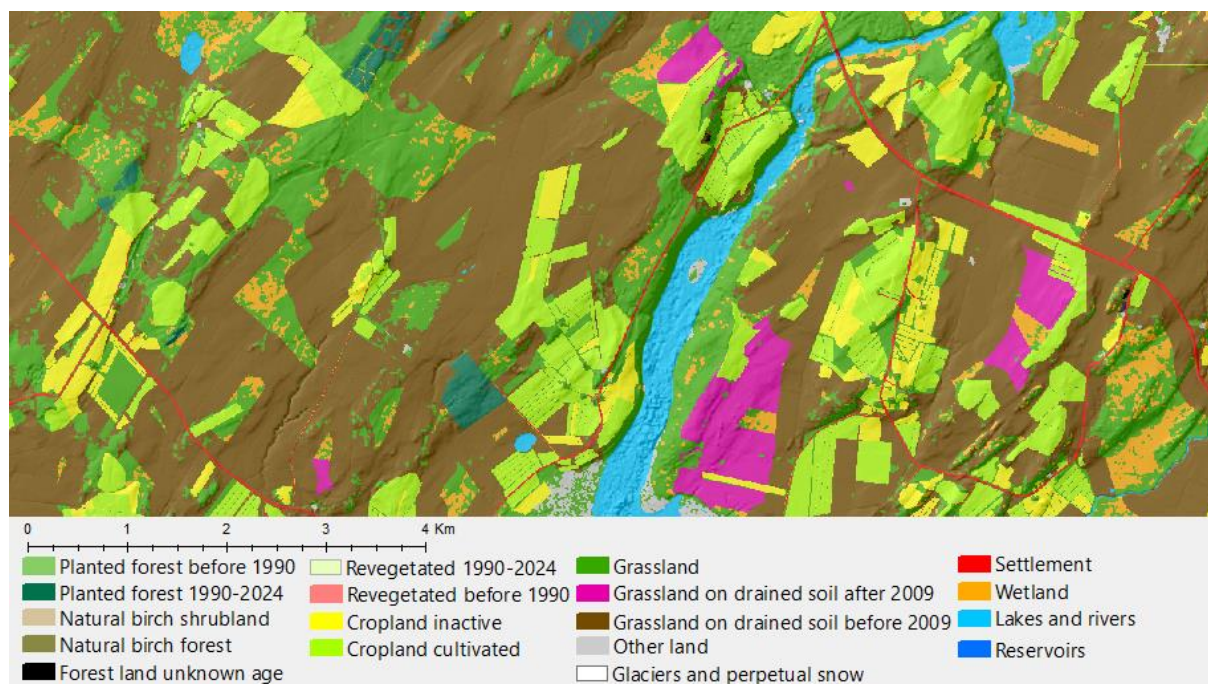


Figure 6.6 Sample of land-use map for 2024, showing Grassland on drained soils before and after 2009.

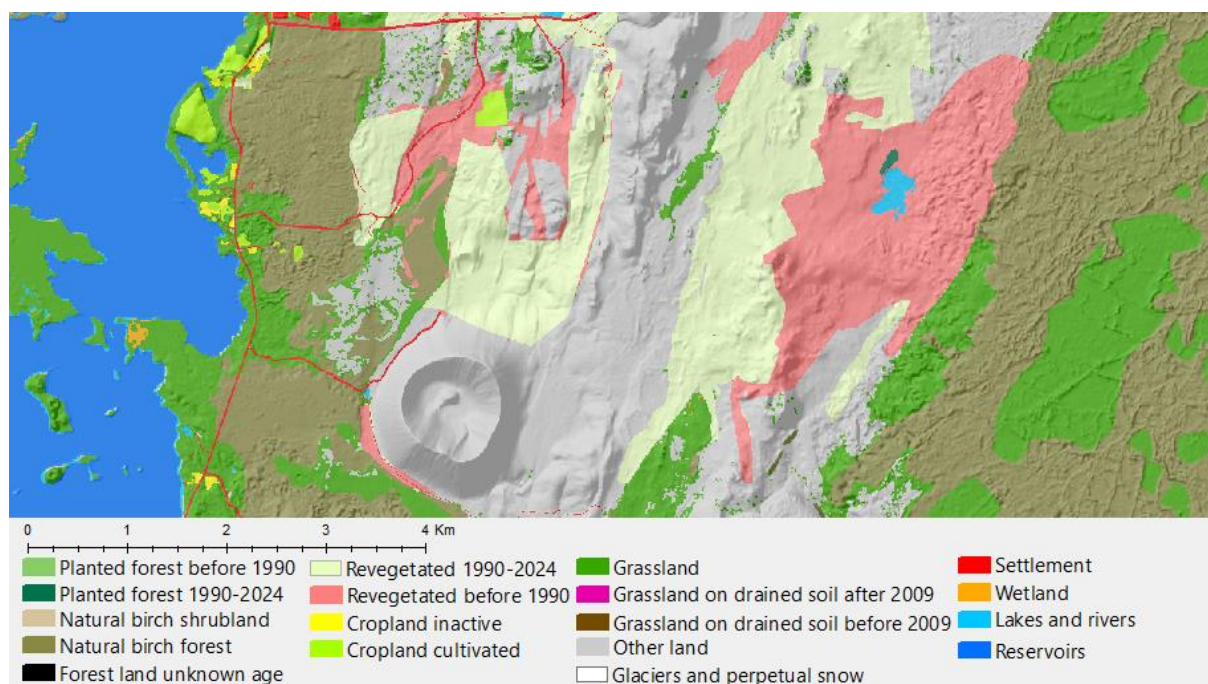


Figure 6.7 Sample of land-use map for 2024, showing Revegetated areas and NBF.

The estimation of areas converted from one land category to another land category reported in the current Icelandic inventory is as of now only based geographically for Settlement and Cropland categories.

Annual land use transition matrices were introduced in the 2025 submission to build the time series and track annual changes between land use subcategories. These matrices ensure no

discrepancies in CRT table 4.1 as the final land-use areas for a given year align with the initial areas of the following year⁴⁰. The CRT table 4.1 for the latest two inventory years are reported below (Quality Assurance & Quality Control (QA/QC) and Figure 6.9) to demonstrate that the issue was resolved in the 2025 submission. Additionally, the method ensures that the areas of organic and mineral soils remain constant across the time series.

Table 4.1 LAND TRANSITION MATRIX

2023

Areas and changes in areas between the previous and the current inventory year ⁽¹⁾

ISL-CRT-2026-V0.2

Iceland

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TO:	Forest land (managed)	Forest land (unmanaged)	Cropland	Grassland (managed)	Grassland (unmanaged)	Wetlands (managed)	Wetlands (unmanaged)	Settlements	Other land	Total unmanaged land	Initial area
FROM:	(kha)										
Forest land (managed) ⁽²⁾	154.47	NO	NO	NO	NO	NO	NO	NO	NO	NO	154.47
Forest land (unmanaged) ⁽²⁾	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Cropland ⁽²⁾	NO	NO	100.88	1.54	NO	NO	NO	IE	NO	NO	102.43
Grassland (managed) ⁽²⁾	1.62	NO	0.42	6,019.92	NO	0.01	NO	0.09	NO	NO	6,022.06
Grassland (unmanaged) ⁽²⁾	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Wetlands (managed) ⁽²⁾	NO	NO	0.45	0.34	NO	322.67	NO	IE	NO	NO	323.46
Wetlands (unmanaged) ⁽²⁾	NO	NO	NO	NO	NO	NO	635.96	NO	NO	NO	635.96
Settlements ⁽²⁾	NO	NO	NO	NO	NO	NO	NO	45.13	NO	NO	45.13
Other land ⁽²⁾	0.29	NO	NO	2.18	NO	NO	NO	IE	2,952.08	NO	2,954.54
Total unmanaged land ⁽³⁾	IE	NO	NO	IE	NO	IE	NO	IE	NO	IE	IE,NO
Final area	156.38	NO	101.76	6,023.98	NO	322.68	635.96	45.23	2,952.08	IE,NO	10,238.06
Net change ⁽⁴⁾	1.91	NO	-0.67	1.93	NO	-0.78	0.00	0.09	-2.47	IE,NO	0.00

Figure 6.8 Table 4.1 Land Transition Matrix for the inventory year 2023.

Table 4.1 LAND TRANSITION MATRIX

2024

Areas and changes in areas between the previous and the current inventory year ⁽¹⁾

ISL-CRT-2026-V0.2

Iceland

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TO:	Forest land (managed)	Forest land (unmanaged)	Cropland	Grassland (managed)	Grassland (unmanaged)	Wetlands (managed)	Wetlands (unmanaged)	Settlements	Other land	Total unmanaged land	Initial area
FROM:	(kha)										
Forest land (managed) ⁽²⁾	156.38	NO	NO	NO	NO	NO	NO	0.00	NO	NO	156.38
Forest land (unmanaged) ⁽²⁾	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Cropland ⁽²⁾	NO	NO	100.42	1.34	NO	NO	NO	IE	NO	NO	101.76
Grassland (managed) ⁽²⁾	0.21	NO	0.65	6,022.97	NO	NO	NO	0.15	NO	NO	6,023.98
Grassland (unmanaged) ⁽²⁾	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Wetlands (managed) ⁽²⁾	NO	NO	0.70	0.34	NO	321.64	NO	IE	NO	NO	322.68
Wetlands (unmanaged) ⁽²⁾	NO	NO	NO	NO	NO	NO	635.96	NO	NO	NO	635.96
Settlements ⁽²⁾	NO	NO	NO	NO	NO	NO	NO	45.23	NO	NO	45.23
Other land ⁽²⁾	0.72	NO	NO	1.84	NO	NO	NO	IE	2,949.52	NO	2,952.08
Total unmanaged land ⁽³⁾	IE	NO	NO	IE	NO	IE	NO	IE	NO	IE	IE,NO
Final area	157.30	NO	101.76	6,026.50	NO	321.64	635.96	45.38	2,949.52	IE,NO	10,238.06
Net change ⁽⁴⁾	0.92	NO	0.00	2.52	NO	-1.04	0.00	0.16	-2.56	IE,NO	0.00

Figure 6.9 Table 4.1 Land Transition Matrix for the inventory year 2024.

⁴⁰ Iceland addressed FCCC/ARR/2022/ISL/L.6 recommendation provided by the ERT in 2017

6.3 Forest land (CRT 4A)

6.3.1 Category description

Between 1990 and 2024, the total forest area increased by approximately 63%, from 96,3 kha 1990 to 157,3 kha 2024 (Figure 6.10). In particular, during the 1990–1994 period, the area grew from 96.3 kha to 102.1 kha, demonstrating gradual but consistent growth. The growth rate appears slightly faster between 1995 and 2010, increasing from 105.2 kha in 1995 to 138.1 kha in 2010. During the 2011–2024 period, the upward trajectory remained steady, with the area expanding from 139.7 kha in 2011 to 157.3 kha in 2024.

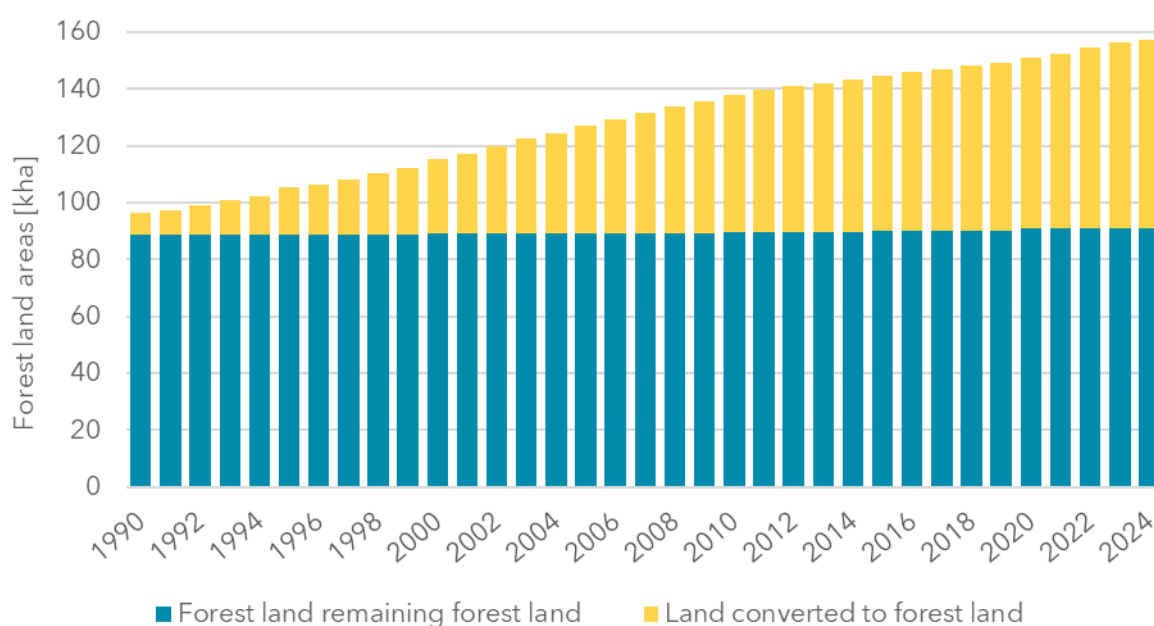


Figure 6.10 4A Forest land area by category in Iceland in 1990 – 2024 [kha].

In accordance with the Good Practise Guidance arising from the Kyoto Protocol, a country-specific (CS) definition of forest has been adopted:

- The minimum crown cover and the minimum height of forest at maturity is 10% and 2 m respectively.
- The minimum area of forest is 0.5 ha and minimum width 20 m. This definition is also used in the National Forest Inventory (NFI) as a classification definition to distinguish between forest, shrubland, and other land categories. All forests, both naturally regenerated and planted, are defined as managed, as they are all directly affected by human activity.

6.3.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Forest land category includes five subcategories (below), their definitions are presented in the Table 6.9.

4A1 Forest land remaining forest:

- Natural birch forest older than 50 years
- Afforestation older than 50 years
- Plantations in natural birch forest

4A2 Land converted to Forest Land:

- Afforestation natural birch forest 1-50 years old
- Afforestation cultivated forest 1-50 years old

Table 6.8 gives an overview of methods used for land identification of the Forest land categories in different time periods.

Table 6.8 Methodology and data sources for constructing the time series of 4A Forest land category.

Land use category	1989	1990	-	2000	-	2008	-	2010	-	2012	-	2019	-	2023	2024
Forest land remaining forest land	Sample plots (n=1080, ±4%, 95% confidence interval)														
Land converted to Forest land	1987-1991 map	Linear interpolation								2010-2014 map	Linear extrapolation				
Legend															
Samples or known areas	Maps	Expert judgement	Interpolation extrapolation		Assumptions										

Table 6.9 Definitions of Forest land use subcategories.

LU category	Definition	LU subcategory	Definition	Abbreviation	Conversion period
4A Forest land	Includes all land not included under Settlements that is covered with trees or woody vegetation that is on average more than 2 m high, with a crown cover minimum of 10%, that covers at least 0.5 ha in continuous area and has a minimum width of 20 m. Land which currently falls below these thresholds but is expected to reach them in situ at mature state, is also included. Roads and other linear tree-less areas within 4A Forest Land are also included if their actual zones do not reach	4A1 NBF older than 50 years	NBF existing for more than 50 years. Includes all NBF that were mapped in the 1987-1991 survey.	FLrFL	-
		4A1 Afforestation older than 50 years	Afforested area of CF that was afforested more than 50 years ago. CF consist of tree plantation, direct seeding, or natural regeneration originating from CF	FLrFL	-
		4A1 Plantations in NBF	NBF that has been converted to CF by plantation.	FLrFL	-

LU category	Definition	LU subcategory	Definition	Abbreviation	Conversion period
	20 m, the minimum width of 4A Forest Land.	4A2 Afforestation natural birch 1-50 y.o.	This subcategory includes a natural expansion of NBF on Grassland and Other land that is 1-50 years old. Land use conversions from Grassland to Afforestation natural birch 1-50 y.o. are assumed to come proportionally from all Grassland categories other than BS.	LUC to FL	50 years
		4A2 CF 1-50 y.o.	This subcategory refers to mostly active afforestation with plantation on Grassland and Other land. Land use conversions from Grassland to CF 1-50 y.o. In rare cases natural expansion of CF.	LUC to FL	50 years

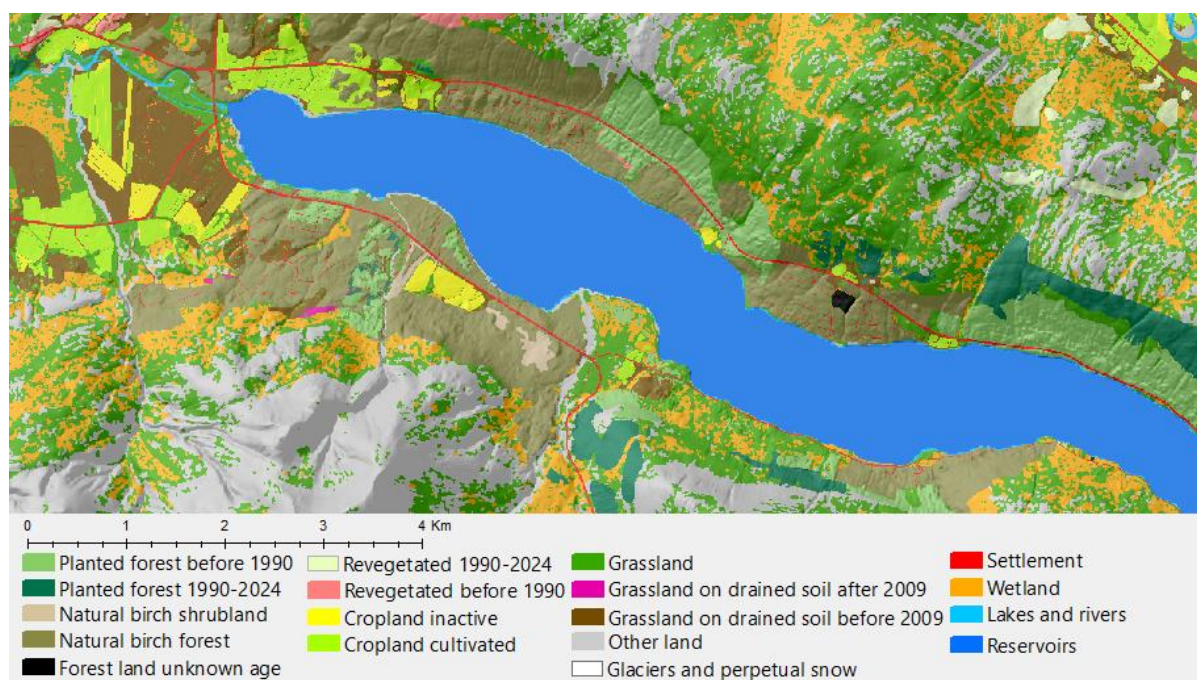


Figure 6.11 Forest land in Skorradalur area in West Iceland. Natural birch woodland and planted forests are dominant land classes around the lake.

National Forest Inventory

The main source of data for Forest land is the Icelandic National Forest Inventory (INFI). In the INFI, there are two strata to be sampled: Natural Birch Woodland (NBW) and Cultivated Forest (CF). All plots in the INFI are permanent and sampled on an intersection of systematic sampling grid.

Cultivated forest

CF consist of tree plantation, direct seeding, or natural regeneration originating from CF. Since the start of the INFI in 2005 to 2024, the sampling grid in the CF was 0.5×1.0 km (Snorrason A., 2010) but in 2025 the grid was changed to 1.0×1.0 km. The reason for this change was to reduce the cost of measurements as well as to decrease the scope of fieldwork in order to allow the inclusion of new components in the survey, such as enhanced soil monitoring within the sample plots as well as increased biodiversity monitoring. CF plots are visited in five-year intervals. This change did not have a significant effect on the results. The sample population of CF is an aggregation of maps of forest management reports from stakeholders in forestry in Iceland. In some cases, the INFI staff does mapping in the field of private CF. The forest map has turned out to be inaccurate and overestimates the area of CF by approximately 10%.

The forest map was used to select CF sample plots for the SSPP-INFI. To ensure that CF sample plots are not outside the mapped area, the population for CF and NBW is increased with a 24m buffer of the mapped border. The mapped area of CF was 60.84 kha in year 2024 and the area of the sampling population (with 24m buffer) was 89.71 kha in this year submission.

The land classification results on the SSPP-INFI are used to estimate the area of CF and the area is calculated by proportions as described in Annex 3 A.3 in Chapter 3 of the 2006 IPCC Guidelines (IPCC, 2006).

The biomass stock change estimates of the C-stock of CF are for each year built on five-year sample plot measurements, seen in Table 6.10. The estimates for 2007-2023, are built on growth measurements of the two nearest years before, the two nearest years after, and of the year of interest (here named mid-value estimates). In these cases, biomass growth rates are equally calculated forward and backward in time. For 2024, the estimate is forwarded one year respectively, compared to the mid-value for 2023. The forward value for 2024 was calibrated by the average difference between mid-values and forward values of 2008-2023, which was 0.84. Estimates for 2005 and 2006 are backward values for two years and one year, respectively, from the mid-value for the field measurements of the period 2005-2009. They are calibrated with the relative difference between the backward value and the mid-value from 2008, which was 1.21. For earlier years (1990-2004), a species-specific growth model that is calibrated towards the inventory results is used to estimate annual stock changes. In the next submission, a mid-value estimate for 2024 build on measurement years 2022-2026 will be used instead of the forward calibrated estimate. This is the reason for regular update of the biomass gain CSC of the second last year of the inventory.

Table 6.10 Measurement years used to estimate different annual estimates of biomass stock change in CF.

Mid-value Estimates	Forward Estimates	Backward Estimates	Built on Measurement Years
	2024		2020-2024
2023			2020-2024
2022			2020-2024
2021			2019-2023
2020			2018-2022
2019			2017-2021
2018			2016-2020
2017			2015-2019
2016			2014-2018
2015			2013-2017
2014			2012-2016
2013			2011-2015
2012			2010-2014
2011			2009-2013
2010			2008-2012
2009			2007-2011
2008			2006-2010
2007			2005-2009
		2006	2005-2009
		2005	2005-2009

Conversion factors from biomass to dry mass and from dry mass to carbon is referenced in AFOLU 4.2.1.1. The EF are described in Table 6.11. Conversion factor for dry mass to carbon is same for all species 0.5.

Four inventory cycles of CF have been completed, the last one in 2024. The fifth cycle was started in 2025 and will continue until 2029.

Table 6.11 Conversion factors for biomass to dry mass.

Conversion factors	Black cottonwood	Downy birch	Scots pine	Siberian larch	Sitka spruce	Other species
Biomass to dry mass, ratio	0.35	0.51	0.4	0.46	0.4	0.4

Natural birch woodland

Natural Birch Woodland (NBW) consists of Natural Birch Forest (NBF), with a mature height exceeding 2 m, and Natural Birch Shrubland (NBS), which does not reach 2 m at maturity and is classified as part of the Grassland category.

In the NBW, the sampling fraction for each 200 m² plot is placed on the intersection of 1.5 x 3.0 km grid. The sample population for NBW is based on the intersection of the grid over the newest mapped area of NBW. The NBW plots are visited in ten-year intervals. Two cycles have been completed in the inventory for the NBW, and the third cycle was started in the year of 2025. The part of NBW defined as forest (reaching 2 m or greater in height at maturity) is estimated on basis of map of NBW mapped in 2010-2014 (Snorrason, et al., 2016).

The NBW has been under continuous usage for many centuries. Until the middle of last century, it was the main source for fuel wood for house heating and cooking in Iceland (Ministry for the Environment (Umhverfissráðuneytið), 2007). Most of the woodland was used for grazing and still is, although some areas have been protected.

In the mapping of NBW from 2010 to 2014 (mid-year 2012), the age of the woodland was estimated, and the age classes 0–15 and 16–30 years were used as the basis for assessing natural regeneration of birch from earlier analysis from 1987-1991 (mid-year 1989). The NBW that existed prior to the 1989 inventory was classified as older forest, whereas woodland established after 1989 and up to 2012 was classified as natural regeneration, corresponding to the 0–15 year age class and half of the 16–30 year age class (23 years).

The difference from 1989 to 2012 was 12.95 kha (Table 6.12) as an estimate of natural expansion of the NBW. The area was estimated to be 137.69 kha at the time of the initial survey in 1987-1991. The area of NBW was estimated 150.65 kha in the 2010-2014 mapping survey (Snorrason, et al., 2016).

Table 6.12 Area results from NBW mapping 1989 and 2012.

NBW classes – mapping results	Area kha
NBW mapping area 1989	137.69
NBW mapping area 2012	150.65
Difference 1989 – 2012 – natural expansion	12.95
NBF mapping area 1989	87.72
NBF mapping area 2012	95.97

In the map of 2012, the ratio of NBW that can reach 2 m height in the mature state and is defined as a forest was 64% of the total area. NBF was accordingly estimated as 87.72 kha in 1989 and 95.97 kha in 2012, with the former figure categorising NBF classified as Forest remaining forest and the difference between the two figures (8.25 kha) as NBF classified as 4A2b Grassland converted to forest land or 4A2e Other land converted to forest land with a mean annual increase of 0.36 kha. The 2012 map of NBW is used to classify soils into mineral and organic soils as these soils attributes were sampled when mapping was done.

Deforestation

For the estimate of Forest land converted to other land uses, a register on planned activity that can lead to deforestation is used. In accordance with the forest law (Alþingi, 2019), LFI and the National Planning Agency (NPA) hold a register on planned activity that can lead to deforestation (Skógræktin & Skipulagsstofnun, 2017). Planned activities leading to deforestation must be announced by the municipalities to LFI and NPA. LFI samples activity data of the affected areas and data about the forest and NBS that is removed. This data is used to estimate emissions from lost biomass and C- stock in dead wood, litter, and soils. Deforestation in this year's submission is reported for the inventory years 2004-2007, 2011, 2013, 2015, 2017, 2020, 2021 and 2024. Three different types of deforestation occurred in these years.

- The first and most common type is road building, house building, and construction of snow avalanche defences. In these cases, not only were the trees removed, but also the litter together with the uppermost soil layer.
- The second type are two events in 2006 and 2020 in which trees in an afforested area were cut down for new power lines. Bigger trees were removed. In this case, dead wood, litter, and soil were not removed, so only the biomass of the trees was supposed to cause instant emissions in the year of the action taken and reported as such. These two types of deforestation are both reported as 4E2a Forest land converted to settlements.
- The third type reported was an afforested area on drained organic soil that was converted to cropland and reported as such in 2015. Further description on C-stock changes regarding deforestation can be found in the Cropland and Settlements chapters.

Dead wood

The dead wood components of biomass losses due to harvest (Sign H in Table 6.14, section 6.3.3.2) are moved to the dead wood C-stock pool. Half-life of the decay of dead wood is set to 30 years with annual decay rate of 0.023 (Hararuk, Kurz, & Didion, 2020) for annual mean temperature of 5°C and annual precipitation under 1837 mm. CSC caused by harvest (biomass losses and change in the dead wood pool) are reported for the third time both in Forest land remaining forest land and Land converted to forest land subcategories of cultivated forest. 79% are reported in Forest land remaining forest land categories and 21% in

Land converted to forest land categories of cultivated forest according to results of analyses of harvests in the reference period of the Forest Reference Level (Snorrason, Kjartansson, & Traustason, 2020). Split between subcategories are done by weighting on area. These estimates are further described in section 6.3.4.2.

6.3.3 Forest land remaining forest land (CRT 4A1)

6.3.3.1 Category Description

Three categories are defined as 4A1 Forest land remaining forest land:

- Afforestation older than 50 years
- Plantations in NBF
- NBF older than 50 years

whereas NBF older than 50 years remained the most significant throughout the entire reporting period (Figure 6.12).

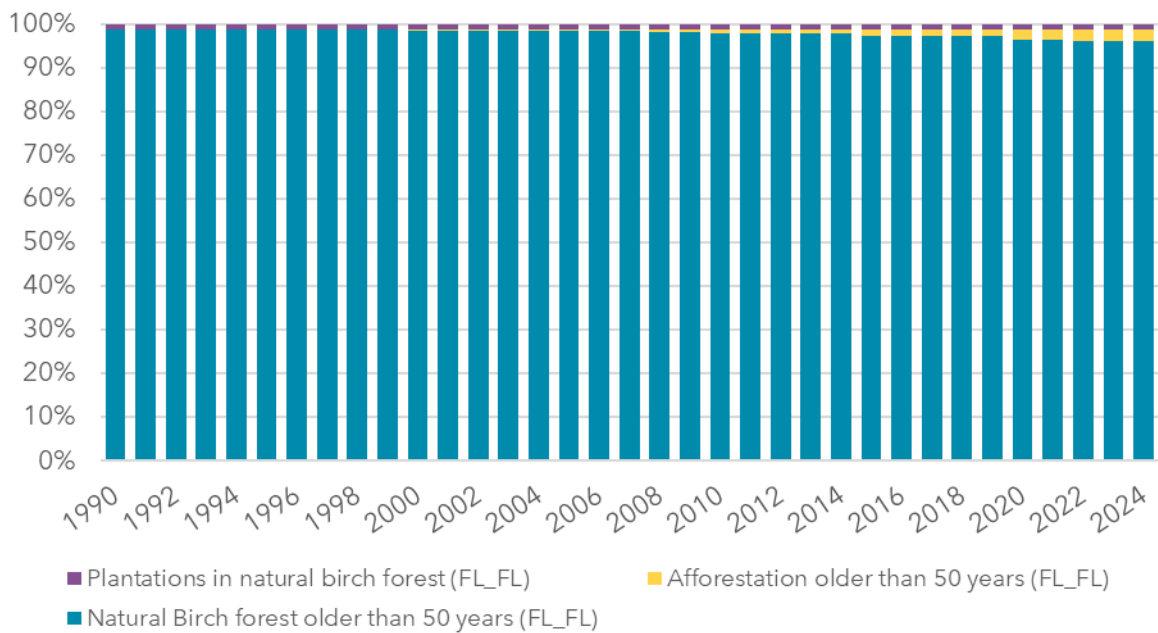


Figure 6.12 Relative shares of Forest land remaining forest land by subcategories in Iceland in 1990 – 2024, %.

As for the most significant pools contributing to CO₂ removals/emissions, living biomass remains the most prominent throughout the entire reporting period, followed by mineral soils. Organic soils acted as a source, but their contribution were not significant (Figure 6.13).

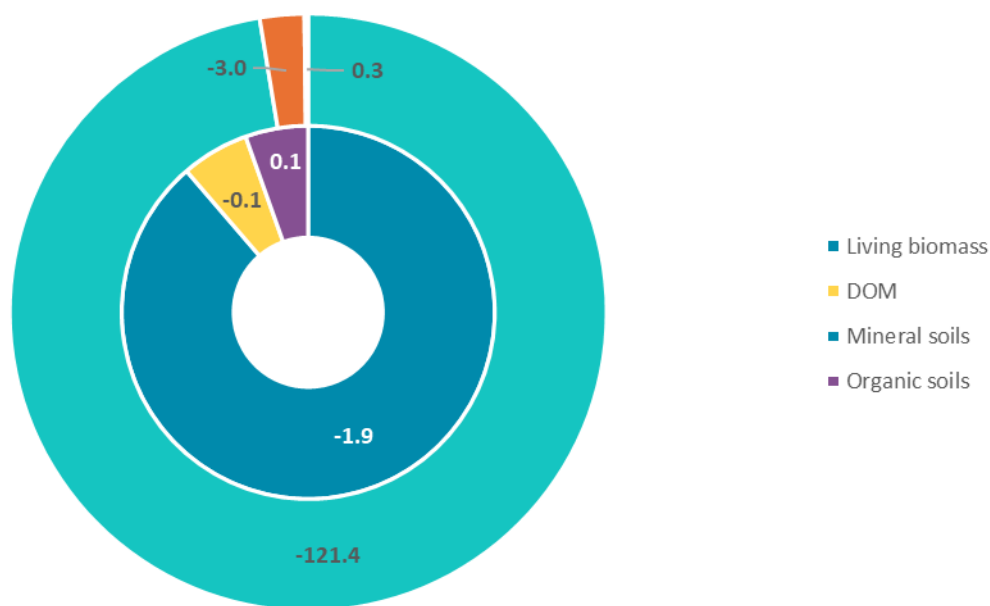


Figure 6.13 CO₂ emissions resulting from Forest land remaining forest land by pool in 1990 (inner circle) and 2024 (outer circle) in Iceland [kt].

Activity data sources

The AD for Afforestation older than 50 years and Plantations in NBF subcategories are extracted from the Systematic Sampling of Permanent Plots (SSP) of the NFI of CF. The conversion period for land-use changes to Forest land is defined as 50 years and as plantations measured on plots are of known age, they move to Forest land remaining forest land when they reach an age of 50 years; see Section 6.2.2.1. The soil on each plot is described and further classified into mineral or drained organic soil.

The AD for NBF older than 50 years category is extracted from the SSPP-NFI of NBW and the 2010-2014 mapping survey of the NBW. All NBFs that existed before the 1987-1991 survey are assumed to have existed more than 50 years ago. The majority are pristine NBF. Area changes reported in the NBF older than 50 years are either deforestation or plantations. In the case of plantations, the area is moved from NBF to the category Plantations in natural birch forest. The area of NBF older than 50 years, is estimated directly from the newest mapping survey of the NBW (Snorrason, et al., 2016).

6.3.3.2 Methodology

Table 6.13 summarizes tier-level approaches, notation keys [in square brackets], and emission factors (in parentheses) used to estimate changes in relevant carbon stocks in the Land converted to forest land category and to report information in the relevant CRT table. More detail information is presented in the text below.

Table 6.13 Tier-level approaches, notation keys, and emission factors used for the Forest land remaining forest land category.

Land-Use Category	LB		Dead wood	Litter	Soils	
	Gains	Losses			Min	Org
Natural birch forest older than 50 years	T3 (OTH)	IE ¹	NO	T1 [NA]	T1 [NA]	T1 (D)
Afforestation older than 50 years	T3 (OTH)	T3 (OTH)	T3 (OTH)	T1 [NA]	T1 [NA]	T1 (D)
Plantations in natural birch forest	T3 (OTH)	T3 (OTH)	T3 (OTH)	T1 [NA]	T1 [NA]	NO

¹ Net biomass gain/losses estimated by the Stock-difference method described in Chapter 2.3.1.1, with Equation 2.8 in the 2006 IPCC Guidelines (IPCC, 2006). Biomass losses caused by mortality and harvest are therefore included in the net annual removal and reported as included elsewhere (IE) in the CRT reporting table

Living biomass: Natural birch forest

The net C-stock change of the biomass of the NBW is estimated by the Stock-Difference Method described in Chapter 2.3.1.1, with Equation 2.8 in the 2006 AFOLU Guidelines (IPCC, 2006).

Biomass losses caused by mortality and harvest are therefore included in the net annual removal and reported as Included Elsewhere (IE) in the CRT reporting table 4.A.1.

Net C-stock changes in biomass of the NBW for the period 2007-2021 are estimated with data of the above ground biomass from the second INFI of NBW conducted in 2015-2021 compared to biomass estimates from the first INFI of NBW conducted in 2005-2011. Paired plot estimates on 196 plots were compared and resulted in average net gain of 0.34 t C ha⁻¹yr⁻¹ for the 10-year period from 2007 to 2017 with significant changes in stock in the period (P= <0.001). (Snorrason et al. in prep). These plots were located as inside the NBW that existed before the 1987-1991. Increases in the biomass stock in this ten-year period can be partially explained by skewed age distribution as shown in Figure 6.14 for median age class 21-40 years. Biomass stock per hectare is increasing with age, meaning NBW will likely become a sink of carbon as long as mean age increases.

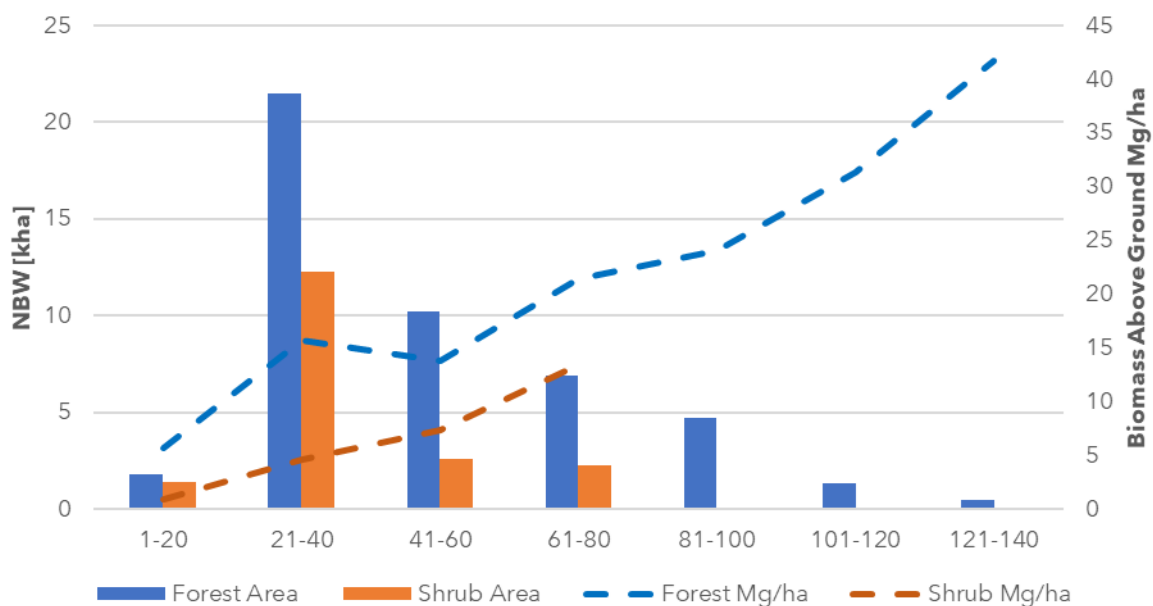


Figure 6.14 Age distribution and the mean stock of biomass aboveground of the natural birch woodland as estimated in the 2015-2021 inventory. The forest area is reported in Forest land but the Shrub area as in Grassland.

An older analysis of the comparison of the 1987-1988 tree data sampling (Jónsson T. H., 2004) with the data from the 2005-2011 SSPP of NBW was used to estimate the woody above ground biomass of the NBW in 1987 and 2007 (mid-year of 2005-2011 first NBW-INFI), and compare these estimates (Snorrason, Jónsson, & Eggertsson, 2019). These estimates were built on the same newly made allometric biomass equations as used to estimate C-stocks in 2005-2011 (Jónsson & Snorrason, 2018) and the 2015-2021 NBW-INFI's. The biomass of NBW was estimated in two separate inventories, 1987-1988 and 2005-2011. There was no statistically significant difference of the biomass in these two inventories (Snorrason, Jónsson, & Eggertsson, 2019). Consequently, the net CSC in tree biomass is reported as not occurring in the period 1990-2006 for the categories of NBF older than 50 years and NBS older than 50 years, which is in subcategory of Grassland remaining grassland.

Living biomass: Cultivated Forest

Carbon stock gain of the living biomass of trees in CF is based on data from a direct sample plot field measurement of the INFI, subcategories 4A1 Afforestation older than 50 years, 4A1 Plantation in natural birch forest and Land converted to forest land, is based on data from a direct sample plot field measurement of the NFI. The figures provided by LFI are based on the INFI data from 2005-2025. Plots with CF older than 50 years did not exist until 2005 in the sampling of the subcategory 4A1 Afforestation older than 50 years so CSC is reported as not occurring (NO) or not applicable (NA) for the period 1990-2004 respectively. In 2010, the second inventory round of CF started with remeasurement of plots measured in 2005 and of new plots since 2005 on new afforested areas. The fifth inventory cycle started in the spring of 2025, where the oldest plots are measured for the fifth time. In each year, the internal annual growth rate of each living tree is estimated by the differences between current

biomass and the biomass five years ago. Trees that died or were cut and removed in the five-year period are not included, so the C-stock gain estimated is not entirely a gross gain. This will result in slight underestimation of the biomass gain and the CO₂ removal by sink. Further information on the calculation of living biomass is in Section 6.3.2.

Biomass losses

Annual wood removal is the source of the reporting of C-stock losses using data on activity statistics of commercial round-wood and wood-products production from domestic cuttings in forest (Gunnarsson E., 2010; 2011; 2012; 2013) (Gunnarsson E., 2014; 2015; 2016; Gunnarsson & Brynleifsdóttir, 2017; Gunnarsson & Brynleifsdóttir 2019; Elefsen & Brynleifsdóttir, 2020; Jóhannsdóttir P., 2020; Brynleifsdóttir & Jóhannsdóttir, 2021, Snorrason et al. 2022 (Jóhannsdóttir, Jóhannesdóttir, & Snorrason, 2023)). Most of the cultivated forests in Iceland are relatively young; area weighted average age was only 22 years at the end of 2021, and clear cutting is very rare. As an example, in 2022 only 4 ha of forest were clear cut, 115 ha were commercially thinned, and 167 ha were pre-commercially thinned (Jóhannsdóttir, Jóhannesdóttir, & Snorrason, 2023).

Commercial cutting is taking place in some of the older forests and is accounted for as losses in C-stock in living biomass. A very restricted traditional selective cutting is practiced in a few natural birch forests and is managed by LFI. As the NBF C-stock change is done by the Stock-Difference Method, its wood removal should not be accounted as losses in C-stock, but because the volume of the birch wood from the NBF cannot be distinguished from reported annual birch volume from cultivated forest, the birch volume is accounted as C-stock losses in the cultivated forest.

Estimation of the C-stock losses of biomass are done in accordance with the biomass losses estimates and calculation done in the Iceland National forestry accounting plan of the Forest reference level 2021-2025 (Snorrason, Kjartansson, & Traustason, 2020). To calculate the stem C-stock from commercial reported roundwood C-stock a left over stem residues ratio of 30% is used. The ratio between the C-stock of the stem and total C-stock aboveground was calculated from biomass functions of the stem biomass and the total biomass above ground (Snorrason & Einarsson, 2006) for dimensions 22 cm in dbh and 14 m in height of the four main introduced species and 15 cm in d0.5 and height 8 m of the native birch, resulting in factor of 0.71.

The ratio of the belowground biomass/total biomass used (0.2) is identical to the results of excavation of root systems in Iceland (Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002). Total expansion factor of the commercial roundwood C-stock to the total C-stock of harvested trees is then 2.5 (See calculation steps in Table 616).

Table 6.14 Calculation of the expansion of commercial roundwood C stock to tree total C-stock.

C-stocks of Various Tree Components	Equation	Sign	Expansion Ratios	% of Total C Stock
Commercial roundwood = 1		A	1.00	40%
Harvested stems and associated stumps above ground	$A/(1-0.3)$	B	1.43	57%
Leftover of harvested stems including top and stump: 30% of harvested stems	B-A	C	0.43	17%
Above ground stock: Stem/total abg = 0.71	$C/0.71$	D	2.00	80%
Crown stock	D-C	E	0.57	23%
Below ground 25% of aboveground stock	$D*0.25$	F	0.50	20%
Root stock and coarse roots > 3 cm 68% of below ground stock	$F*0.68$	G	0.34	14%
Input to deadwood pool: root stock, stem leftovers	C+G	H	0.77	31%
Crown and other coarse roots combusted or moved into litter pool	$E+F-G$	J	0.73	29%
Sum all parts			2.50	100%

Litter: All Forest land remaining forest land subcategories

No evidence from research literature exists for Forest land remaining forest land in Iceland, but models and model modifications used in other Nordic countries show an increase in litter and mineral soil pools overall in Forest in general (Dalsgaard, et al., 2016). Changes in the litter C-stock in the categories of Forest land remaining forest land are likely to be sinks rather than a source and is therefore reported as NA. As in the Tier 1 approach, they are assumed to be zero as recommended in 2006 IPCC Guidelines (see page 2.21).

Mineral soils: All Forest land remaining forest land subcategories

C-stock changes in mineral soil are reported in the same manner as for litter. They are reported as NA and assumed in a Tier 1 approach to be zero, as recommended in the 2006 IPCC Guidelines (see page 2.29) (IPCC, 2006).

Organic soils

Direct CO₂-emissions from drained organic soil are estimated by default EF of 0.37 t CO₂-C ha⁻¹ yr⁻¹ for "Forest land, drained, including shrubland and drained land that may not be classified as forest".

The EFs used to estimate carbon stock changes for Forest land remaining forest land subcategories are summarised in Table 6.15.

Table 6.15 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of Forest land remaining forest land, by land-use subcategory.

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
4A1 NBF older than 50 years	Biomass Gains	OTH	0.34	Paired plot estimates on 135 plots were compared and resulted in average net gain of 0.34 t C ha ⁻¹ yr ⁻¹ for the 10-year period from 2007 to 2017 with significant changes in stock in the period (P= <0.001). (Snorrason et al. in prep.).
	Organic Soils	D	-0.37	Table 2.1 in the 2013 Wetlands Supplement
4A1 Afforestation older than 50 years	Biomass Gains	OTH	3.3	Estimated each year from data of the INFI of the CF (this year data from 958 plots measured in 2020-2024)
	Biomass Losses	OTH	-1.25	Jóhannsdóttir P., Jóhannesdóttir H., & Snorrason A. Skógræktarárið 2023. [Forest year 2023] Skógræktarritið, Skógræktarfélag Íslands. Nr. 2 2024. [Journal of the Icelandic Forestry Association issue nr. 2 2024] 78-90.
	Dead Wood	OTH	0.33	Estimated on the basis of biomass losses – see Section 6.3.3.2
	Organic Soils	D	-0.37	Table 2.1 in the 2013 Wetlands Supplement
4A1 Plantations in NBF	Biomass Gains	OTH	2.46	Estimated each year from data of the INFI of the CF (this year data from 958 plots measured in 2020-2024)
	Biomass Losses	OTH	-1.25	Jóhannsdóttir P., Jóhannesdóttir H., & Snorrason A. Skógræktarárið 2023. [Forest year 2023] Skógræktarritið, Skógræktarfélag Íslands. Nr. 2 2024. [Journal of the Icelandic Forestry Association issue nr. 2 2024] 78-90.
	Dead Wood	OTH	0.33	Estimated on the basis of biomass losses – see Section 6.3.3.2.

Dead Wood pool: Cultivated Forest

Dead Wood (DW) is calculated in the same way for Forest land remaining forest land and Land converted to forest land, see Section 6.3.2, based on dead wood inputs from roundwood and dead wood stock decay (Table 6.16). Biomass losses are described in Section 6.3.3.1.

Table 6.16 Net CSC in DW. Values in afforestation, plantation in NBF and DW input and stock decay used as parameters to calculate Net CSC in DW. EF for CSC losses in LB is 0.79. [kt CO₂e].

Category	1990	1995	2000	2005	2010	2015	2020	2023	2024
Net CSC in DW	NO	NO	0.01	0.02	0.18	0.24	0.20	0.09	0.53
Afforest. older than 50 years - Area of mineral soil	NO	NO	0.23	0.23	0.66	1.10	2.03	2.14	2.14
Afforest. older than 50 years - Area of organic soil	NO	NO	NO	NO	0.05	0.05	0.10	0.10	0.10
Plantations in natural birch forest - Area of mineral soil	1.13	1.13	1.13	1.21	1.21	1.21	1.21	1.21	1.21
Dead wood input from roundwood	0.04	0.06	0.06	0.19	0.67	0.76	0.57	0.41	1.27

Category	1990	1995	2000	2005	2010	2015	2020	2023	2024
Dead wood	NO	-0.01	-0.01	-0.02	-0.04	-0.12	-0.18	-0.22	-0.23

6.3.4 Land converted to forest land (CRT 4A2)

6.3.4.1 Category Description

Two subcategories are defined as Land converted to forest land:

4A2b Grassland converted to forest land

- 4A2b Afforestation cultivated forest 1-50 years old
- 4A2b Afforestation natural birch forest 1-50 years old –
- 4A2e Other land converted to forest land
- 4A2e Afforestation cultivated forest 1-50 years old
- 4A2e Afforestation natural birch forest 1-50 years old

Conversion from other land-use classes does not occur. Old hayfields are sometimes used for afforestation but are converted from Cropland to Grassland before afforestation.

The total area of Land converted to forest land increased from 7.4 kha in 1990 to 66.2 kha in 2024 (Figure 6.15). All subcategories demonstrated a consistent upward trend. Afforestation natural birch forest 1-50 years old (4A2b) increased steadily from 0.2 kha in 1990 to 7.3 kha in 2024, with gradual increments each year. Similarly, 4A2b Afforestation cultivated forest 1-50 years old years demonstrated a growth, starting at 6.3 kha in 1990 and reaching 41.9 kha in 2024. In the 4A2e Other land converted to forest land subcategories, both 4A2e Afforestation natural birch forest 1-50 years old and 4A2e Afforestation cultivated forest 1-50 years old areas showed consistent increase rising from 0.2 kha to 5.3 kha and 0.8 kha to 11.8 kha respectively over the same period.

The changes in land use resulted in a consistent increase in carbon removals across most pools between 1990 and 2024, contributing significantly to CO₂ sequestration (Figure 6.16). The changes in Living biomass pool demonstrated the largest removals, starting at -18.6 kt CO₂ in 1990 and reaching -411,1 kt CO₂ in 2024. The DOM pool and removals, respectively, also increased steadily, from -4,0 kt CO₂ in 1990 to -38,1 kt CO₂ in 2024. The carbon pool of mineral soils (SOCmin) followed a similar pattern, with removals rising from -9.7 kt CO₂ in 1990 to -97.6 kt CO₂ in 2024. However, organic soils (SOCorg) were a source and showed only slight increases, contributing minor removals from 0.8 kt CO₂ in 1990 to 6.1 kt CO₂ in 2024.

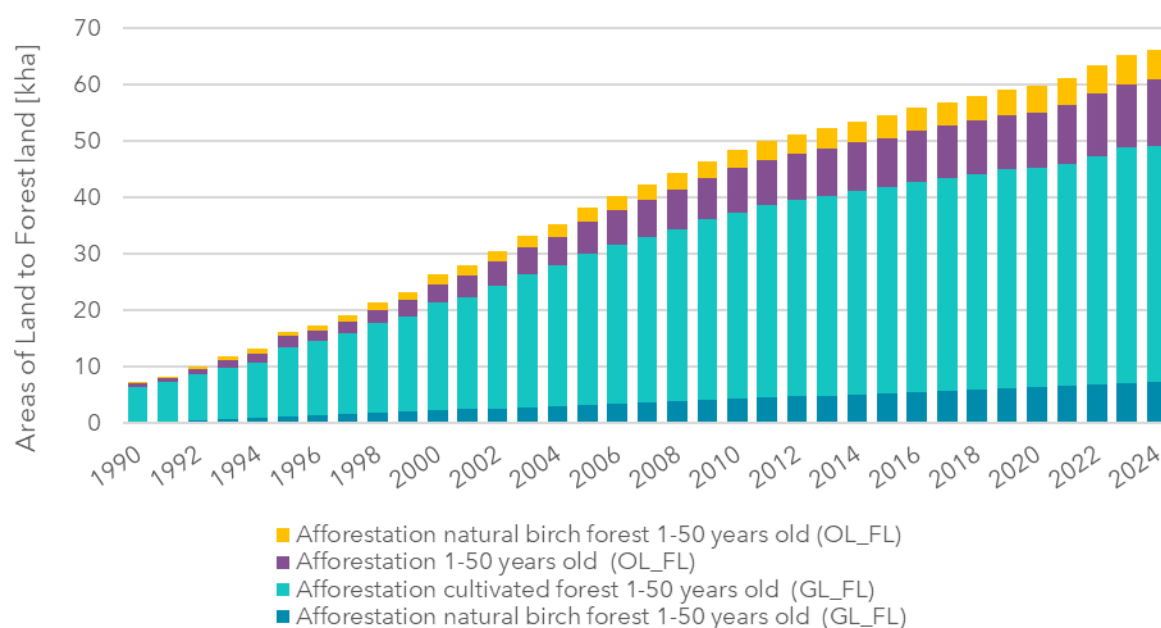


Figure 6.15 4A2 Land converted to forest land by land-use subcategory [kha].

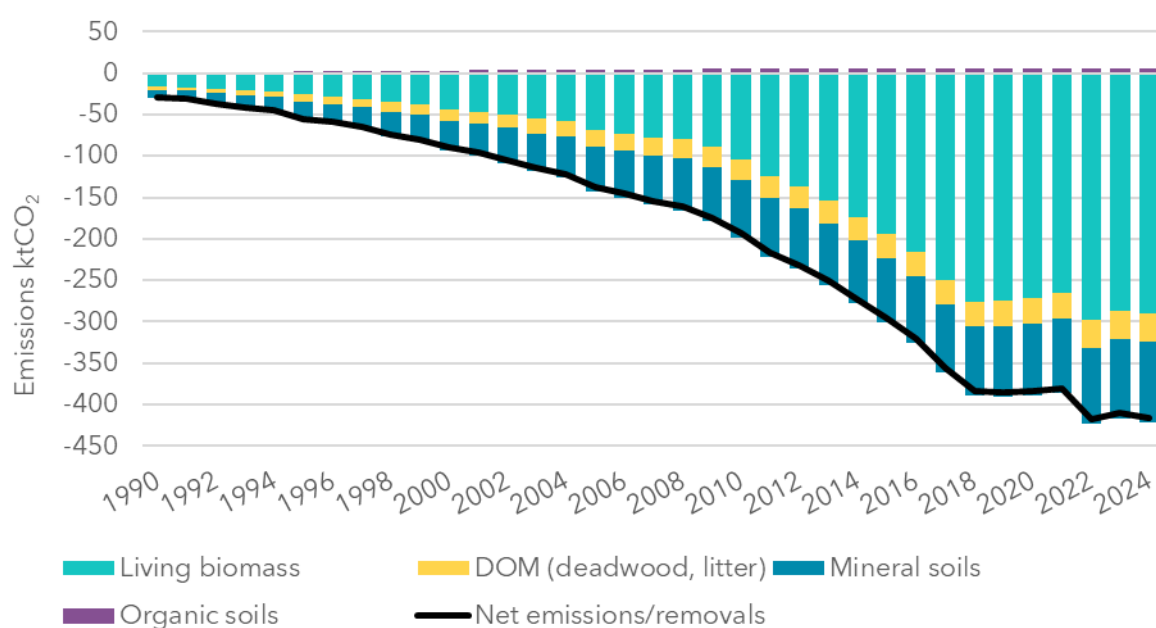


Figure 6.16 Emissions (+) and removals (-) due to conversion of Land to forest land by carbon pool, kt CO₂.

Activity data sources

Forest land remaining forest land and Land converted to forest land of cultivated forests are extracted from the SSPP of the INFI of CF. The conversion period for land-use changes to Forest land is defined as 50 years. As plantations measured on plots are of known age, they move from Land converted to forest land when they reach age over 50 years. Accordingly, the areas of these categories changes between reporting years. They, too, are updated annually when new plot data are merged into the INFI SSPP database.

The categories of NBF are extracted from the mapping survey of the NBW. A mean annual area increases of 0.36 kha is interpolated over the 1989-2012 period and extrapolated for 2013-2023. Area estimation for categories in Land converted to forest land is identical to Forest land remaining forest land. Former land-use classification and soil classification is for the CF assessed on the measurement plots in field. In the inventory 2010-2014, previous land on which natural regeneration of birch occurred was assessed and the mapping ratio between the two former land-use classes and soil classification (Grassland and Other land) is used.

6.3.4.2 Methodology

Table 6.17 summarizes tier-level approaches, notation keys, and emission factors (in parentheses) are used to estimate changes in relevant carbon stocks in the Land converted to forest land category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Table 6.17 Tier-level approaches, notation keys, and emission factors used for the Land converted to forest land category.

Land-Use Category	LB		Dead wood	Litter	Soils	
	Gains	Losses			Min	Org
4A2a Cropland converted to forest land	NO	NO	NO	NO	NO	NO
4A2b Grassland converted to forest land						
<i>Afforestation NBF 1-50 years old</i>	T3 (OTH)	IE1	NO	T2 (CS)	T2 (CS)	T1 (D)
<i>Afforestation 1-50 years old – CF</i>	T2 (CS)	T3(OTH)	T3(OTH)	T2 (CS)	T2 (CS)	T1 (D)
4A2c Wetlands converted to forest land	NO	NO	NO	NO	NO	NO
4A2d Settlements converted to forest land	NO	NO	NO	NO	NO	NO
4A2e Other land converted to forest land						
<i>Afforestation 1-50 years old</i>	T3 (OTH)	T3 (OTH)	T3 (OTH)	T2 (CS)	T2 (CS)	NO
<i>Afforestation NBF 1-50 years old</i>	T2 (CS)	IE	NO	T2 (CS)	T2 (CS)	NO

¹ Net biomass gain/losses estimated by the Stock-Difference Method described in Chapter 2.3.1.1, with Equation 2.8 in the 2006 IPCC Guidelines (IPCC, 2006). Biomass losses caused by mortality and harvest are therefore included in the net annual removal and reported as Included Elsewhere (IE) in the CRT reporting table.

Biomass gains

Estimation of C-stock changes in biomass for the CF categories are the same as for CF categories in Forest land remaining forest land. C-stock changes are gradually increasing with annual additions of afforestation area every year and the increasing age of the CF. Skewed

age distributions with high ratios of young age classes are accelerating the annual increase of CSC in tree biomass, as can be seen in Figure 6.17.

For the NBF expansion since 1989, a linear regression between biomass per area unit in trees and age on measurement plots in NBW that belongs to the area expansion from 1989 ($n=28$, $P = 0.0002$) is used to measure net annual CSC (Snorrason et al. in prep.).

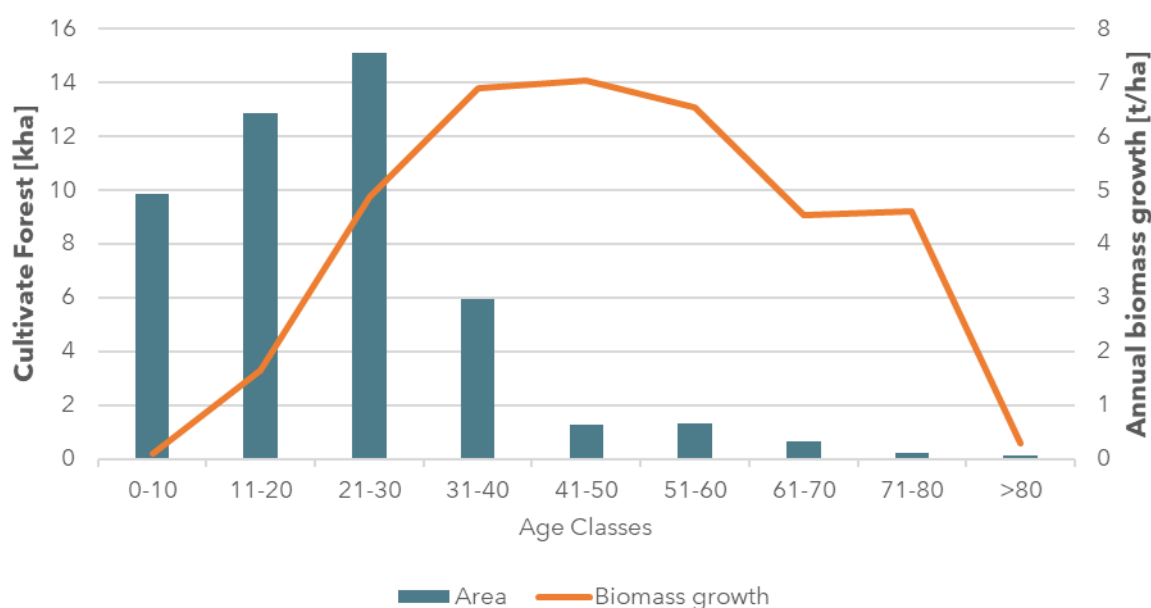


Figure 6.17 Age distribution of CF in 2023 showing area and current annual biomass growth per hectare of each 10 years age class.

In the already mentioned ICEWOODS research project, the carbon stock in vegetation other than trees showed very low increase 50 years after afforestation by the most used tree species, Siberian larch, although the variation inside this period was considerable (Sigurðsson, Magnússon, Elmarsdóttir, & Bjarnadóttir, 2005).

Biomass losses

Biomass losses are calculated in the same way for Land converted to forest land as for Forest land remaining forest land; see Section 6.3.3.2.

Dead wood

Dead wood is calculated in the same way for Land converted to forest land as for Forest land remaining forest land; see Section 6.3.3.2.

Litter

For CSC in litter and mineral soil for Land converted to forest land, country-specific removal factors are used. Carbon stock samples of litter are collected on field plots under the field measurement in the INFI. Estimates of CSC in dead organic matter, as for vegetation other

than trees, are available from the INFI data when sampling plots have been revisited and samples analysed.

The results from two separate research projects of CSC are used to estimate CSC in litter (Snorrason A. , Jónsson, Svavarsdóttir, Guðbergsson, & Traustason, 2000; Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Magnússon, Elmarsdóttir, & Bjarnadóttir, 2005).

In the ICEWOOD research project, carbon removal in the form of woody debris and dead twigs was estimated to be $0.083 \text{ t C ha}^{-1} \text{ yr}^{-1}$. The ICEWOOD project contained chronosequence measurements of Siberian larch, Lodgepole pine, Sitka spruce, and Natural birch woodland compared with treeless grazed heathland which is defined as Grassland in IGLUD (Bjarnadóttir, 2009). Snorrason et al. (2000; 2002) found a significant increase in carbon stock of the whole litter layer (woody debris, twigs, and fine litter) for afforestation of plantations and direct seeding of various species (Siberian larch, Downy birch, and Sitka spruce) and ages ranging from 32 to 54 years compared to treeless grazed heathland which is defined as Grassland. The range of the increase was $0.087\text{--}1.213 \text{ t C ha}^{-1} \text{ yr}^{-1}$, with the maximum value in the only thinned forest measured resulting in a rapid increase of the carbon stock of the forest floor. A weighted average for these measurements was $0.199 \text{ t C ha}^{-1} \text{ yr}^{-1}$. An arithmetic average of the results from these two research projects is used as a factor of annual increase of C-stock in litter, $0.141 \text{ t C ha}^{-1} \text{ yr}^{-1}$. New research from Southwest Iceland shows higher C accumulation in conifer plantations ($0.22 \text{ t C ha}^{-1} \text{ yr}^{-1}$) compared to native birch plantations ($0.049 \text{ t C ha}^{-1} \text{ yr}^{-1}$) (Owona, 2019), but on average they were at a similar level as the factor used in this submission.

Minerals soils

The same research results as mentioned above showed an increase of carbon of soil organic matter (C-SOM) in mineral soils ($0.3\text{--}0.9 \text{ t C ha}^{-1} \text{ yr}^{-1}$) due to afforestation (Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008). In the ICEWOODS study, a significant increase in SOC was found in the uppermost 10 cm layer of the soil (Bjarnadóttir, 2009). The average increase in soil carbon detected was $134 \text{ g CO}_2 \text{ m}^{-2} \text{ yr}^{-1}$ for the three most used tree species. This rate of C-sequestration to soil was applied to estimate changes in soil carbon stocks in mineral soils for Grassland converted to forest land. New research results from Southwest Iceland showed much higher C-stock accumulation in SOC than the factor applied or $309 \text{ g CO}_2 \text{ m}^{-2} \text{ yr}^{-1}$ for conifer plantations, and $235 \text{ g CO}_2 \text{ m}^{-2} \text{ yr}^{-1}$ for native birch plantation indicating underestimation of C-stock accumulation in Southwestern Iceland (Owona, 2019).

Research results of carbon stock changes in soil on revegetated and afforested areas show a mean annual increase of soil C-stock between 0.4 to $0.9 \text{ t C ha}^{-1} \text{ yr}^{-1}$ up to 65 years after afforestation. A comparison of a 16-year-old plantation on a poorly vegetated area to a similar open land gave an annual increase of C-SOM of 0.9 t C ha^{-1} (Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002). Newer experimental research results showed

removals of 0.4 to 0.65 t C ha⁻¹ yr⁻¹ of soil seven years after revegetation and afforestation on poorly vegetated land (Arnalds, Orradottir, & Aradottir, 2013). Another chronosequence research project focused on native birch showed a mean annual removal of 0.466 t C ha⁻¹ to soil up to 65 years after afforestation in desert areas (Kolka-Jónsson, 2011). A new chronosequence research in NBW mineral soil (Sanchez, Arnalds, Thorsson, Dahlgren, & Aradottir, 2025) showed a mean annual removal of 0.73 t C ha⁻¹ to soil in old woodlands (30-60 years old) and 0.53 ha⁻¹ to soil in young woodlands (0-30 years old). These new results are used for the first time in the calculation of Net carbon stock change in mineral soil in the land-use categories Grassland converted to forest land, and 4A2e Other land converted to forest land, Afforestation – natural birch forest 1–50 years old, and 4C1 Natural birch shrubland – recently expanded into other grassland and 4C2e Other Land converted to natural birch shrubland.

Table 6.18 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of 4A2 Land converted to forest land, by land-use subcategory.

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
4A2b Grassland converted to forest land	Biomass gains	OTH	1.63	Estimated each year from data of the NFI of the CF (this year data from 958 plots measured in 2020-2024)
	Biomass losses	OTH	-0.02	Jóhannsdóttir P., Jóhannsdóttir H., & Snorrason A. Skógræktarárið 2023. [Forest year 2023] Skógræktarritið, Skógræktarfélag Íslands. Nr. 2 2024. [Journal of the Icelandic Forestry Association issue nr. 2 2024] 78-90.
	Dead wood	OTH	0.01	Estimated on the basis of biomass losses – see description above in this Section
	Litter	CS	0.14	Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008
	Mineral soils	CS	0.37	Bjarnadóttir, 2009
	Organic soils	D	-0.37	Table 2.1 in the 2013 Wetlands Supplement
Afforestation 1-50 years old – cultivated forest	Biomass gains	CS	0.19	Linear regression between biomass per area unit and age in trees on measurement plots in Natural Birch Woodland that belongs to the area expansion from 1989 (n=28, P = 0.0002) is used to measure net annual C-stock change (Snorrason et al. in prep.).
	Litter	CS	0.14	Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008
	Mineral soils – 0-30 years old forest	CS	0.53	Sanchez, Arnalds, Thorsson, Dahlgren & Aradottir 2025
	Mineral soils – 30-60 years old forest	CS	0.74	Sanchez, Arnalds, Thorsson, Dahlgren & Aradottir 2025
Afforestation natural birch forest 1-50 years old	Biomass gains	CS	0.19	Linear regression between biomass per area unit and age in trees on measurement plots in Natural Birch Woodland that belongs to the area expansion from 1989 (n=28, P = 0.0002) is used to measure net annual C-stock change (Snorrason et al. in prep.).
	Litter	CS	0.14	Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008
	Mineral soils – 0-30 years old forest	CS	0.53	Sanchez, Arnalds, Thorsson, Dahlgren & Aradottir 2025
	Mineral soils – 30-60 years old forest	CS	0.74	Sanchez, Arnalds, Thorsson, Dahlgren & Aradottir 2025

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
	Organic soils	D	-0.37	Table 2.1 in the 2013 Wetlands Supplement
4A2e Other land converted to forest land				
Afforestation 1-50 years old	Biomass gains	OTH	1.10	Estimated each year from data of the NFI of the CF (this year data from 958 plots measured in 2020-2024)
	Biomass losses	OTH	-0.02	Jóhannsdóttir P., Jóhannsdóttir H., & Snorrason A. Skógræktarárið 2023. [Forest year 2023] Skógræktarfélag Íslands. Nr. 2 2024. [Journal of the Icelandic Forestry Association issue nr. 2 2024] 78-90.
	Dead wood	OTH	0.01	Estimated on the basis of biomass losses – see description above in this Section
	Litter	CS	0.14	Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008
	Mineral soils	CS	0.51	Estimated by LFI (expert Jóhann Þórsson)
Afforestation natural birch forest 1-50 years old	Biomass gains	CS	0.19	Linear regression between biomass per area unit and age in trees on measurement plots in Natural Birch Woodland that belongs to the area expansion from 1989 (n=28, P = 0.0002) is used to measure net annual C-stock change (Snorrason et al. in prep.).
	Litter	CS	0.14	Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008
	Mineral soils – 0-30 years old forest	CS	0.53	Sanchez, Arnalds, Thorsson, Dahlgren & Aradóttir 2025
	Mineral soils – 30-60 years old forest	CS	0.74	Sanchez, Arnalds, Thorsson, Dahlgren & Aradóttir 2025

6.3.5 Uncertainty Assessment and Time-Series Consistency

The uncertainty assessment for Forest land use category for the period 1990–2024 has been carried out using Approach 1 of the 2006 IPCC Guidelines (IPCC, 2006). Detailed information on uncertainty rates associated with the AD and the EFs is presented in Annex 6. It should be noted that Iceland applied a conservative approach for some country-specific EFs where uncertainty rates were not evaluated in relevant studies. Specifically, the IPCC default uncertainty rates (developed for the relevant and appropriate LU category and carbon pool) were used alongside these country-specific data, which allowed for an underestimation of the uncertainty assessment. For carbon pools where a Tier 1 approach was applied (that assumes that the carbon pool is in equilibrium), the uncertainty rates were not reported in the table nor used in the overall assessment. The overall uncertainty analysis is reported in Annex 2.

6.3.6 Category-specific QA/QC and verification

Please consult Chapter 1.5 and Section 0 for more information.

6.3.7 Category-specific recalculations

New CFC EF are now used for mineral soil in Natural Birch Woodland (NBW). A new study on natural birch (reference) identified differences in soil carbon sequestration by age, whereby NBW was divided into two age classes: 0–30 years and 30–60 years. According to the results of the study the EF 0.53 is used for the 0–30-year age class and 0.74 for the 30–60-year age class. These factors are applied in the following land-use categories:

- 4A2b Afforestation cultivated forest 1-50 years old
- 4A2e Afforestation cultivated forest 1-50 years old
- 4A2b Afforestation natural birch forest 1-50 years old
- 4C2e Afforestation natural birch forest 1-50 years old

With the new grid for Cultivated Forest (CF) of 1 km × 1 km introduced in 2025, replacing the 0.5 km × 1 km grid used for 2005–2024, some sample plots that were previously part of the inventory are omitted, which may affect smaller land-use categories, but does not have a significant effect on the total area of the Forest land categories (Figure 6.18, Table 6.19). The same applies to removals and emissions within the Forest land categories; the change does not have a significant effect (Figure 6.19).

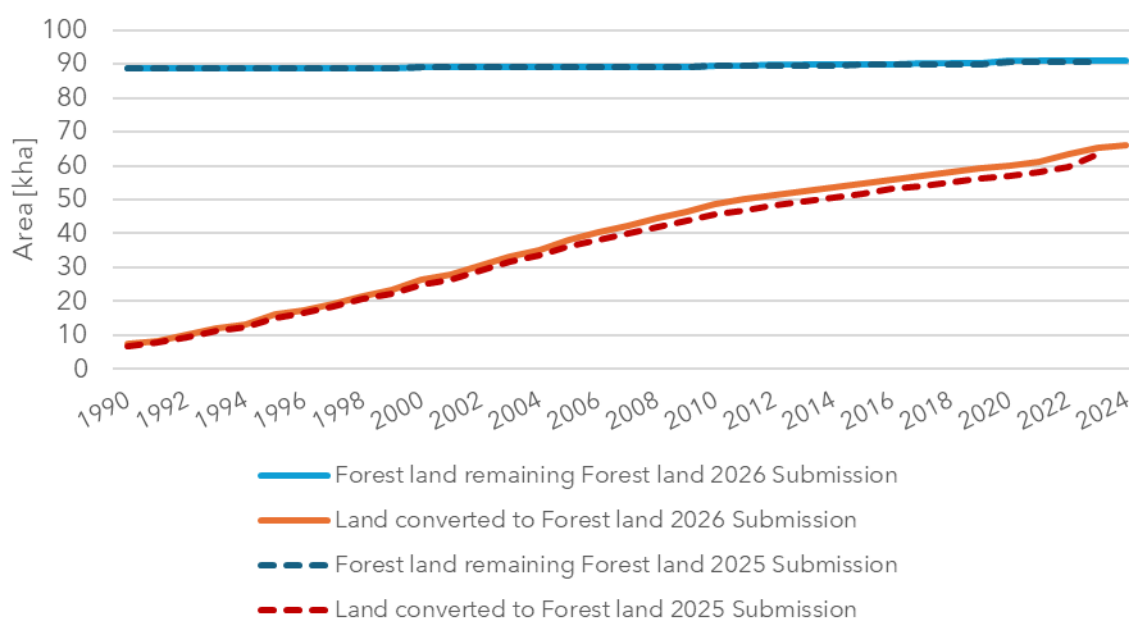


Figure 6.18 Recalculations to the activity data between the current (2026) and previous (2025) submission for Forest land.

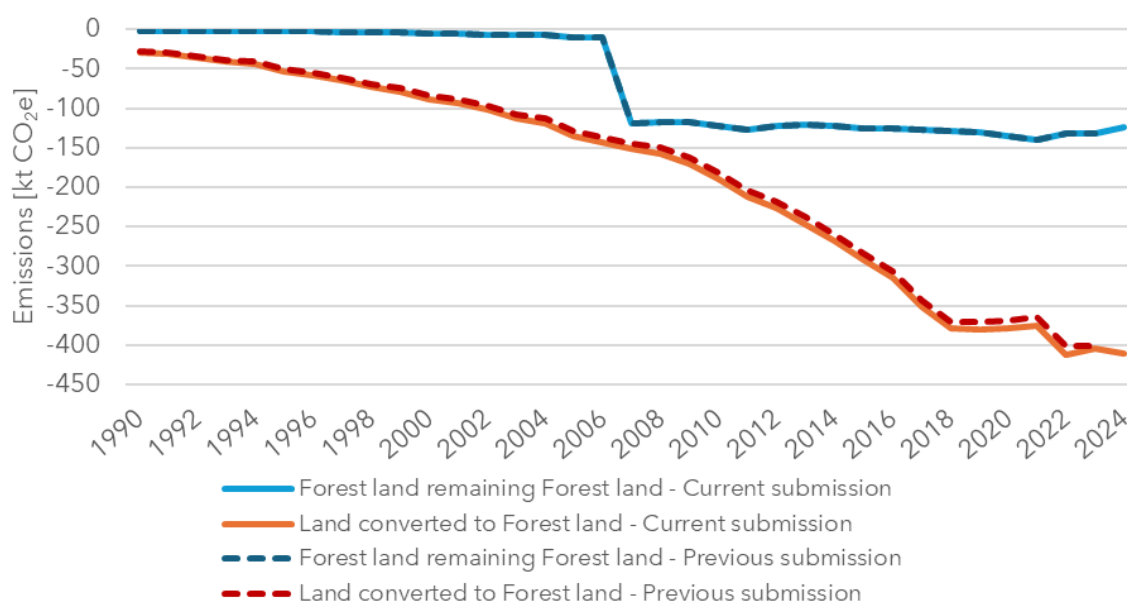


Figure 6.19 Recalculations to the emissions between the current (2026) and previous (2025) submission for Forest land.

Table 6.19 Comparison of area data [kha] in the key category Forest land, as reported in the current submission versus the previous year's submission.

Area [kha]	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
Forest land	2025	94.1	101.2	111.0	122.5	132.9	140.2	146.0	148.6	150.4
	2026	95.0	102.1	112.2	124.3	135.7	143.2	149.3	152.3	154.5
	Difference	0.9	0.9	1.2	1.8	2.8	3.0	3.3	3.7	4.1
	In %	101.0	100.9	101.1	101.5	102.1	102.1	102.3	102.5	102.7

6.3.8 Category-specific planned improvements

Forest land remaining forest land: Sampling of soil, litter, and vegetation other than trees, is included as part of NFI. Higher tier estimates of changes in the carbon stock in soil, litter, and other vegetation than trees are expected in future reporting when data from remeasurement of the permanent sample plot will be available and analysed for C-content.

One can therefore expect gradually improved estimates of carbon stock and carbon stock changes regarding forest and forestry in Iceland. Moreover, improvements in forest inventories will also improve uncertainty estimates both on area and stock changes.

Land converted to forest land: Carbon stock samples of vegetation other than trees are collected on field plots under the field measurement in NFI together with samples of litter and soil. Estimates of carbon stock changes in vegetation other than trees, litter and soil are

planned to be available from NFI when sampling plots have been revisited and the samples analysed for C-content.

6.4 Cropland (CRT 4B)

6.4.1 Category description

The total Cropland area shows a steady decline from 135.7 kha in 1990 to 128.0 kha in 2008. This downward trend becomes more pronounced from 125.9 kha in 2009 to 101.3 kha in 2021. From 2021 to 2024, year-to-year fluctuations are mainly associated with the implementation of HMI, the adoption of updated methodological approaches for land-use identification, and the integration of high-precision GPS measurement data from IAAC (see Section 0) (Figure 6.20).

Overall, emissions from Cropland follow the same overall trend as the associated Cropland area. The long-term decrease in Cropland area is reflected in a corresponding decline in emissions, while short-term variations between 2021 and 2024 are primarily driven by changes in AD for active and inactive cropland.

Emissions show a consistent decreasing trend over the period 1990–2008, declining from 2,123.8 kt CO₂ in 1990 to 1,938.6 kt CO₂ in 2008. From 2009 to 2021, the decline in emissions becomes more pronounced, decreasing from 1,888.7 kt CO₂ to 1,497.3 kt CO₂. The increases observed in 2022 (1,563.2 kt CO₂) and 2024 (1,581.6 kt CO₂) are mainly associated with fluctuations in activity data over the same period as describe in section 6.1.1 (Figure 6.21).

Emissions from the cultivation of organic soils were the primary source of emissions for 4B2b Grassland converted to cropland and 4B2c Wetlands converted to cropland.

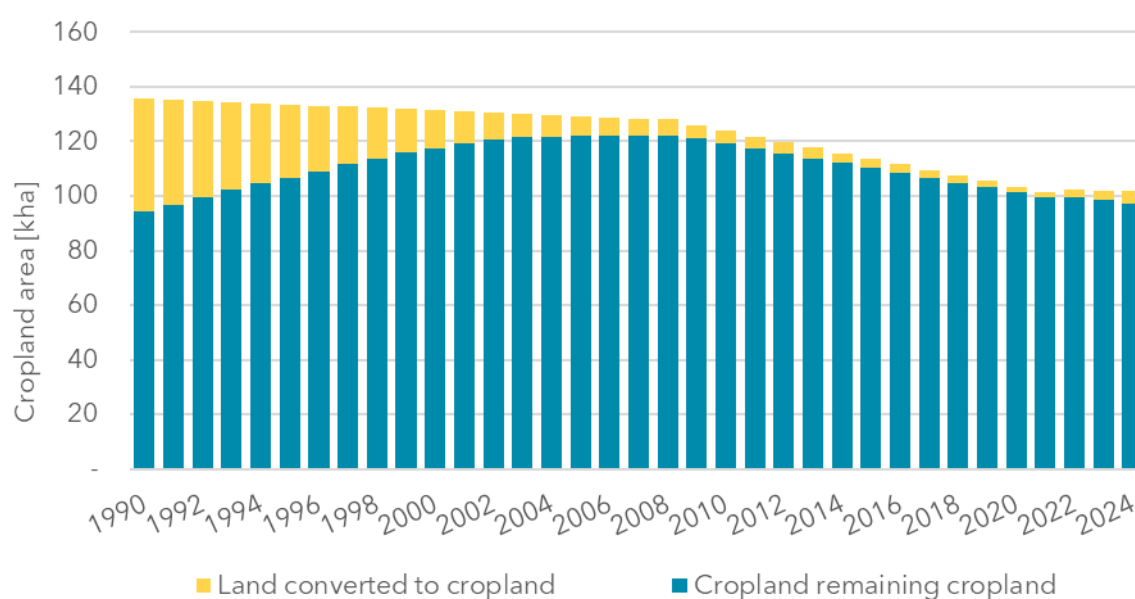


Figure 6.20 Cropland area (by category) in Iceland in 1990 – 2024 [kha].

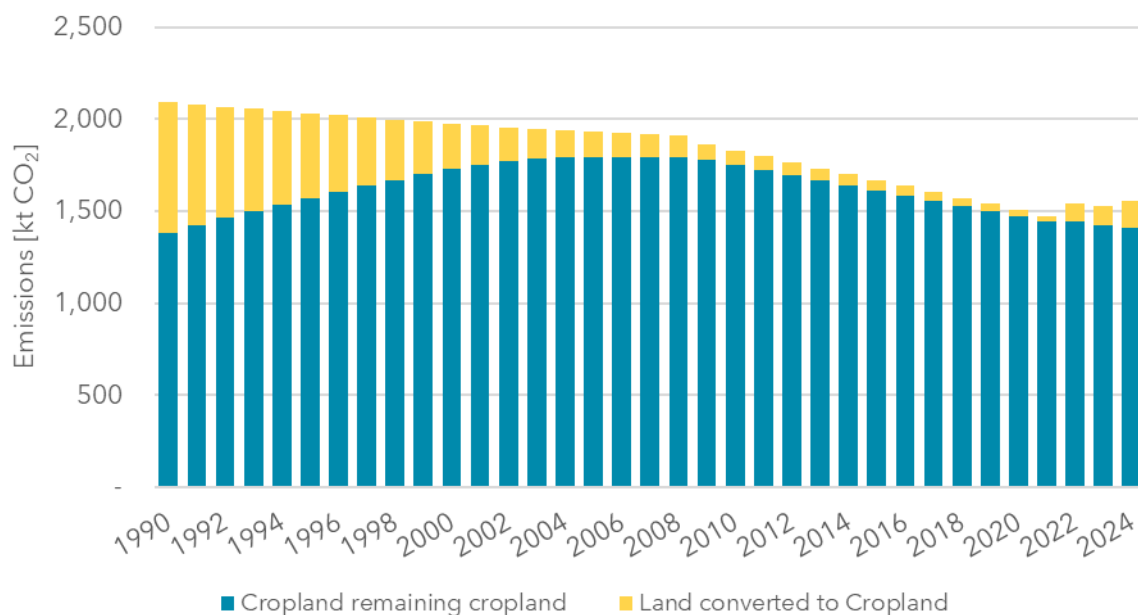


Figure 6.21 Emissions (+) and removals (-) from Cropland remaining cropland and Land converted to cropland [kt CO₂].

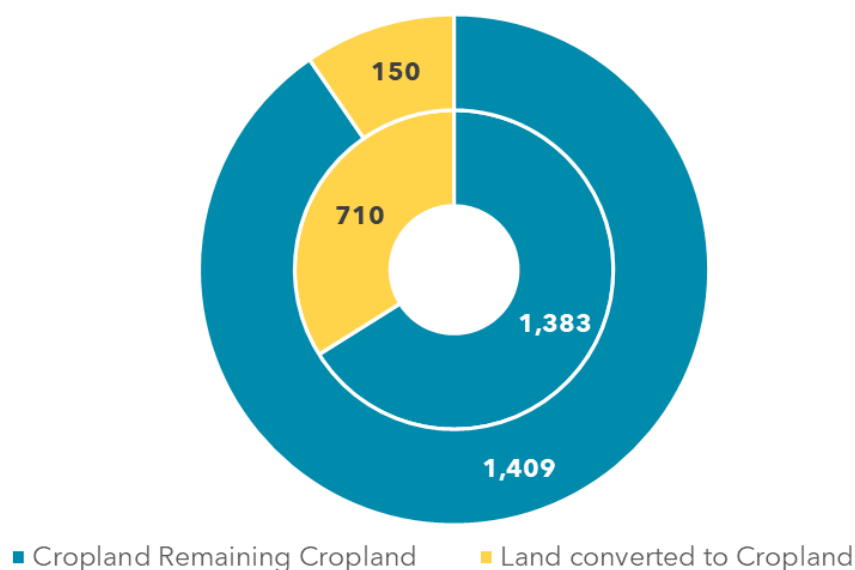


Figure 6.22 Emissions (+) resulting from Cropland remaining cropland and Land converted to cropland in Iceland in 1990 (inner cycle) and in 2024 (outer cycle) [kt CO₂].

6.4.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Cropland (4B) includes all land used for the cultivation of crops and hay production, as well as land that has been converted to crop production from other land-use categories such as forest land, grassland, or wetlands, see Table 6.20.

Table 6.20 Definitions of Cropland subcategories.

LU category	Definition	LU subcategory	Definition	Allocation	Conversion period
4B Cropland	This category includes: - annual and bi-annual crops and harvested hayfields with perennial grasses cultivated within the last three years. - all cultivated land not included under Settlements or Forest Land that is at least 0.5 ha in continuous area and has a minimum width of 20 m.	4B1 Cropland active	Hayfields or arable land where hay or crops have been cultivated or soil worked within the last three years.	CLrCL	
		4B2a Forest land converted to cropland	Forest cut down and converted to cropland*.	LUC to CL	20 years
		4B2b Grassland converted to cropland	Cultivation of hay or crops on grassland that was previously not actively cultivated. Currently, this is only on mineral soil**.	LUC to CL	20 years
		4B2c Wetlands converted to cropland	Wetland drained with ditches to generate cropland for cultivation of hay or crops.	LUC to CL	20 years

* This conversion is very rare and only took place in 2015.

** Currently there is no flow in the model for grassland on organic soil converted to Cropland. The plan is to add this flow to represent better current conditions, see planned improvements in chapter 6.4.8.

Cropland consists mainly of mowed hayfields, many of which are located on drained organic soils, as well as arable land used for cultivation of barley, potatoes and vegetables.

Only hayfields that are mowed and harvested (cultivated) for hay within the last three years are reported under Cropland active (4B1). The three-year period is used to distinguish actively managed from unused or converted to Grassland. The classification is based on subsidy data, as farmers get harvest subsidies (ísl. landgreiðslur) for fields that they are actively harvested. To qualify for these subsidies, farmers must map out and register their harvested fields, thus identifying active cropland.

If a hayfield is neglected for more than three years, it is assumed to have converted to Grassland and is reported as 4C2b Cropland converted to grassland, see Table 6.34 in section 6.5.2. As due to frequent freeze-thaw cycles in Iceland, soil conditions and grass species, hayfields that are mowed one year and then left unmowed for several years go tussocky (ísl. þýfð), i.e. the grass starts to grow in clumps, hummocks or tufts and becomes hard to mow. The time it takes for a neglected hayfield to go tussocky depends on the soil (organic, mineral) and grass species but it generally takes around three years for an unmowed field to go tussocky according to an agriculture expert judgement (Borgar Páll Bragason, personal communication, 18.2.2026). It is therefore assumed that hayfields that have been mowed within the last three years are in the active cropland category.

Farmers also get subsidies for working the soil, i.e. tilling, ploughing or harrowing the soil, and these areas are also reported under Cropland active (4B1). Such soil working subsidies (ísl. jarðræktarstyrkir) are given when the soil is worked to cultivate a new hayfield; when recultivating an old hayfield that has gone tussocky (the grass grows in clumps or tufts); or

for the annual tillage of arable land for crop cultivation (e.g. potatoes or barley). Farmers must map out and register the land where they work the soil in order to get the soil working subsidies.

As for hayfields, it is assumed that if arable land is left unused for more than three years, it has converted to Grassland and is reported as 4C2b Cropland converted to grassland.

If cropland that has been converted to grassland continues to be uncultivated for more than 20 years, then it is reported under Grassland remaining grassland, 4C1 Cropland abandoned for more than 20 years, see Table 6.34 in section 6.5.2. Moreover, as pastures used exclusively for grazing do not qualify for subsidies and no harvest is produced, they are classified under 4C Grassland rather than 4B Cropland.

Methodology and data sources for constructing the time series of Cropland category

For the time period before 2018, Cropland in Iceland was identified using aggregated statistical data, historical reports and lower-resolution spatial datasets. Since 2018, Cropland has been identified using spatially explicit land-use data integrated into the IGLUD map. The consistency across Cropland definition across the entire timeseries and with the land-use definitions and reporting framework of the 2006 IPCC Guidelines was ensured.

Table 6.21 Methodology and data sources for constructing the time series of Cropland category.

Land use category	Subcategory	1950	...	1983	...	1989	1990	...	2008	...	2015	...	2021	...	2024
Cropland remaining cropland	Cropland active	Snæbjörns-son (2010)	Annual areas of new crops	Linear interpolation	Snæbjörns-son (2010)	Linear interpolation	Snæbjörns-son (2010)	Linear interpolation	2015 estimate	3-year running total from IGLUD maps					
Land converted to Cropland	Forest land to cropland											Cropland active timeseries			
	Grassland to cropland														
	Wetlands to cropland														
Cropland conversion	Cropland to grassland*	Assumed to be zero	Linear interpolation						Snæbjörns-son (2010)	Linear interpolation	3-year running total from IGLUD maps				
Legend															
Samples or known areas	Maps	Expert judgement	Interpolation			Assumptions									

* Please note that Cropland converted to grassland is a Grassland category and is only shown here for illustrative purposes.

Primary data source: Jord.is Agricultural Reporting System

The primary data source for Cropland remaining cropland (4B1) is the agricultural reporting system Jord.is, operated by the IAAC. Jord.is is a georeferenced, plot level system that records land use activity data related to crop cultivation and land management, including information on:

- Cultivation status
- Crop type
- Fertilization,
- Harvest practices

Activity data are reported at the level of individual land parcels, primary entered by farmers and verified through advisory and inspection procedures. This provides spatially explicit areas with high accuracy. Spatial delineation of cropland parcels in Jord.is is conducted by IAAC consultants using high-resolution aerial photography from Loftmyndir ehf, with a spatial resolution of approximately 0.5 m. Where parcel boundaries cannot be reliably identified from aerial imagery most commonly where cultivation postdates image acquisition geometries are supplemented using Global Navigation Satellite System (GNSS/GPS) data collected by consultants, inspectors, or land managers.

Digitization is typically performed at mapping scales between 1:500 and 1:2000, allowing accurate representation of parcel boundaries. This spatial resolution and mapping scale exceed the minimum requirements for land-use identification under IPCC good practice guidance and supports consistent time-series tracking of land-use status.

The IGLUD maps

The Jord.is areas were first incorporated into IGLUD in 2020 based on mapping conducted by Registers Iceland. The mapping employed a combination of:

- Sentinel satellite imagery
- Maxar high-resolution satellite imagery
- Aerial photography from Loftmyndir ehf

Mapping scales ranging from 1:2000 to 1:6000. The dataset from 2020 represents a comprehensive national delineation of arable land for cadastral and land use classification purposes. This reflects both land-use change and improvements in land-use identification and reporting.

The transition from medium resolution satellite imagery (e.g. Landsat, SPOT) to high-resolution aerial photography ensures improvement of spatial resolution and land-use certainty over time, thereby reducing uncertainty in activity data.

Overall, cropland activity data provided by IAAC represent the most spatially precise and methodologically robust source currently available for IGLUD and form the primary basis for Cropland area reporting. The dataset provides a strong basis for accurate Cropland reporting within the national LULUCF inventory.

The key activity used for identifying active cropland includes:

- Spatial records of a three-year running total for the areas of mowed or harvested hayfields receiving subsidies (available for years 2017-2024)
- Spatial records of a three-year running total for the areas of ploughed land receiving soil working subsidies (available for 2019-2024)

Identification of organic soils

The geographical identification of the organic soils of cropland as they appear on the IGLUD maps is based on analysis of the density of the ditch network.

Historical cropland area and time-series development

For the earlier years (Table 6.21), the cropland area estimates are based on the *Committee Report on land use: Assessment of use and conservation of cultivated areas* by Snæbjörnsson et al. (2010). The report estimates cumulative cropland expansion using:

- Land development permits
- Drainage records
- Other administrative data

The report provides the following estimates of the total Cropland area:

- 1950: 45 kha
- 1989: 163 kha
- 2008: 168 kha
 - Active cropland: 128 kha
 - Inactive cropland: 40 kha

It is assumed that there was no inactive cropland in 1950 and that there was a linear increase in inactive cropland between 1950 and 2008.

To improve accuracy, areas that were drained but never cultivated or have remained uncultivated for more than 20 years are identified using historical data and removed from the IGLUD Cropland time series.

The total Cropland area time series is constructed by combining:

- Historical estimates from Snæbjörnsson et al. (2010), and
- Spatially explicit IGLUD map data for recent years

Land-use conversions to Cropland

Information on land use conversions is limited. Only one type of conversion from Forest land to Cropland has been identified, occurring in 2015, see Table 6.21.

Other conversions are assumed to originate from Wetlands and Grassland. The analysis of IGLUD map data indicates that some land classified as Grassland on organic soils (e.g. inactive or abandoned cropland) has been converted back to Cropland. The development of detailed information on conversion is planned as an improvement in the next submissions, see category-specific planned improvements in chapter 6.4.8. All conversions of organic soils to Cropland are currently assumed to come from Wetlands.

In the current submissions, the conversions are defined as follows:

Organic soils: Land use conversions to Cropland are assumed to come from Wetlands, subcategory 4D1c Intact mires – grazing areas. It was assumed that these areas originate from these low-lying intact organic soils located below 200 meters in altitude (see Chapter 6.6 - Wetlands (CRT 4D)).

Mineral soils: All conversions to Cropland on mineral soils are assumed to come from all mineral Grassland categories. These conversions are assumed to occur proportionally based on the total areas in different mineral Grassland categories. The conversions from Settlements and Other land are considered unlikely and thus reported as Not Occurring (NO).

6.4.3 Cropland remaining cropland (CRT 4B1)

6.4.3.1 Category Description

The total area of Cropland remaining cropland (i.e. 4B1, Cropland active) shows a consistent trend over the period 1990–2008, increasing from 94.1 kha in 1990 to 122.2 kha in 2008. From 2009 onwards, the trend reverses, with the area decreasing from 120.9 kha to 97.4 kha in 2024 (Figure 6.20).

While cultivation of organic soils generates emissions, the management practices applied to mineral soils lead to carbon sequestration. However, despite this partial offset from mineral soils, the 4B1 Cropland active subcategory remains a consistent net source throughout the entire reporting period (Figure 6.23).

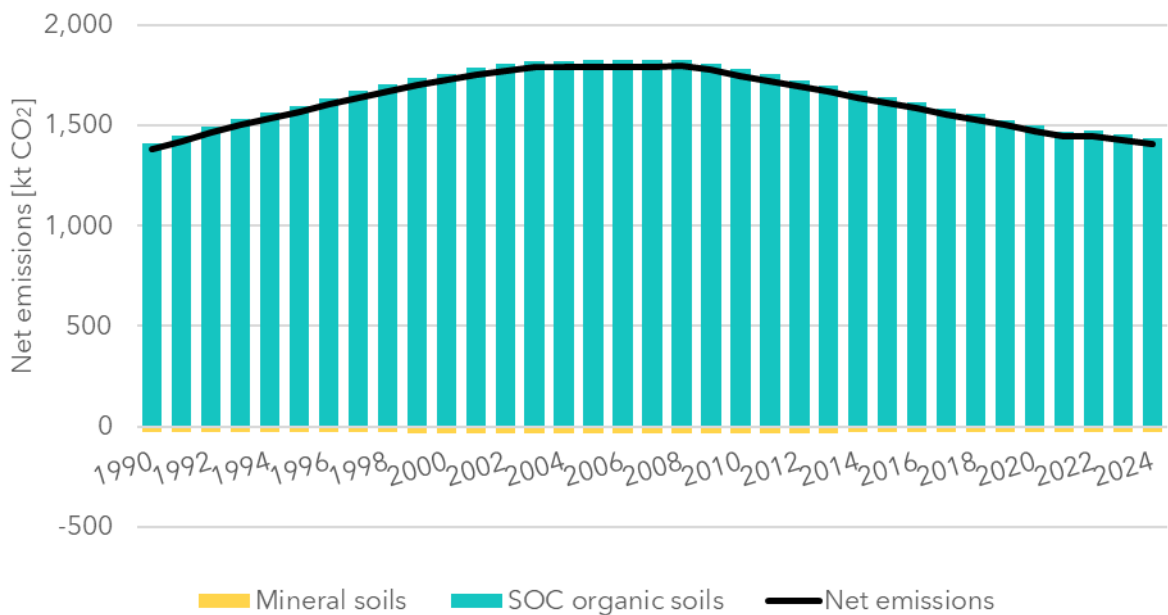


Figure 6.23 Emissions (+) and removals (-) from Cropland remaining cropland by pools in Iceland in 1990 – 2024, kt CO₂.

6.4.3.2 Methodology

Figure 6.22 summarizes the tier-level approaches, notation keys [in square brackets], and emission factors (in parentheses) used to estimate changes in relevant carbon stocks in the Cropland remaining cropland category and to report information in the corresponding CRT table.

Table 6.22 Tier-level approaches, notation keys, and emission factors used for the Cropland remaining cropland category.

Land-Use Category	LB		DOM	Soils	
	Gains	Losses		Min	Org
4B1 Cropland active	NA	NA	T1 (NA)	T2 (CS)	T1 (D)

Living biomass

No perennial woody crops are cultivated in Iceland, and accordingly no changes in living biomass are reported for this category.

DOM

No detailed data are available to estimate changes in DOM within Cropland remaining cropland. In Iceland, most of the land classified as Cropland is covered by hayfields with perennial grasses, which are ploughed or harrowed at decade-long intervals. This practice forms a turf layer, that, depending on the soil horizon definition, may partially be considered as DOM. Consequently, it could be recognized as a potentially negligible sink or source. Therefore, a Tier 1 approach was applied, assuming no or insignificant changes in DOM within Cropland remaining cropland.

Mineral soils

The EF (reported in

Table 6.23) was evaluated based on a study of Helgason (1975) that aimed to investigate the changes in base status and SOM content resulting from long-term use of three different nitrogen fertilisers (over 28 years). The experiment was conducted at four different locations; the one used here is in Sámstaðir in Southern Iceland. The site is located on freely drained, gently sloping soils, and the experiment was conducted from 1945 to 1973. The study detected that SOC content increased from 7.92% in 1945 to 9.14% in 1973. Additionally, the measured data on soil bulk density (BD) and cation exchange capacity (CEC) were applied to calculate the carbon sequestration rate (in t C/ha)⁴¹. The EF applied to estimate emissions due to cultivation of mineral soils is reported in Table 6.23.

⁴¹ Response to the recommendation FCCC/ARR/2022/ISL/L.14

Organic soils

Detailed information on drained organic soils is provided in Section 6.2.3. Changes in SOC of organic soils are calculated applying equation 2.3 of the 2013 Wetlands supplement. The EF applied to estimate emissions due to cultivation of organic soils is reported in Table 6.23.

Table 6.23 EFs used to estimate emissions (-) and removals (+) due to cultivation of mineral and organic soils in the Cropland remaining cropland category for the entire reporting period.

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
4B1 Cropland active	Mineral soils	CS	0.15	Helgason (1975)
	Organic soils	D	-7.9	Table 2.1 of the 2013 Wetlands Supplement

6.4.4 Land converted to cropland (CRT 4B2)

6.4.4.1 Category Description

The total land area converted to Cropland declined from 41.5 kha in 1990 to 1.9 kha in 2021. From 2021 onwards, an increase in land converted to Cropland is observed, rising from 2.7 kha in 2021 to 4.4 kha in 2024. This increase is mainly driven by annual conversions of Wetland and Grassland areas to Cropland, reflecting fluctuations in activity data (AD) over the same period, as described in Section 6.4.1 (Figure 6.24).

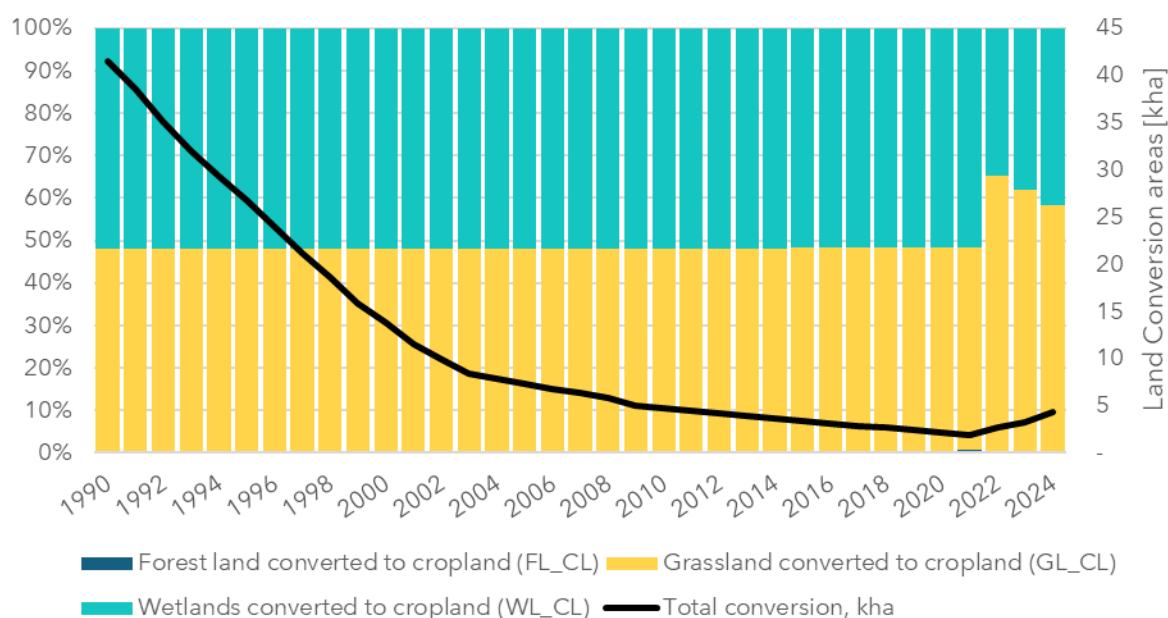


Figure 6.24 Relative shares of land conversion areas to Cropland (by subcategory), and the total area converted to Cropland (kha) in Iceland in 1990 – 2024.

The primary categories of land converted to cropland were grasslands and wetlands. The forest land was first converted in 2015, and the total area remained unchanged in the following years of the reporting period (Figure 6.24). Conversion of land to Cropland is a source of emissions for the entire reporting period. Emissions from organic soils remain the largest component as reflected in the data for 1990 and 2024 (Figure 6.25).

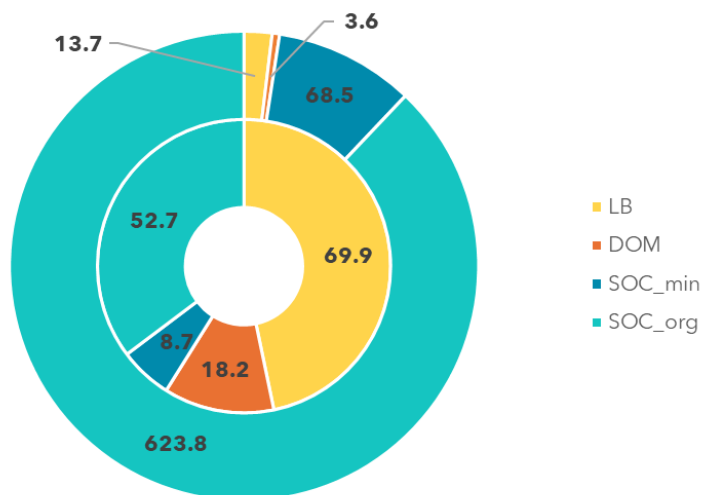


Figure 6.25 CO₂ emissions resulting from land conversion to cropland by pools in 1990 (inner circle) and 2024 (outer circle) in Iceland [kt].

6.4.4.2 Methodology

Table 6.24 summarizes tier-level approaches, notation keys, and emission factors (in parentheses) used to estimate changes in relevant carbon stocks in the Land converted to cropland category and to report information in the relevant CRT table. More detailed information is presented in textual format below.

Table 6.24 Tier-level approaches, notation keys, and emission factors used for the Land converted to Cropland category.

Land-Use Category	LB		DOM	Soils	
	Gains	Losses		Min	Org
4B2a Forest Land Converted to Cropland	NO (2015, T1) ³	NO (2015, T3) ³	NO	NO	T1(D)
4B2b Grassland Converted to Cropland	T1 (D)	T2 (CS)	T2(CS)	T2 (CS)	IE ²
4B2c Wetlands Converted to Cropland	T1 (D)	T2 (CS)	T2(CS)	NO ¹	T1(D)
4B2d Settlements Converted to Cropland	NO	NO	NO	NO	NO
4B2e Other Land Converted to Cropland	NO	NO	NO	NO	NO

¹ It is assumed that all wetlands that are converted to croplands are on organic soils.

² Reported as aggregated number under organic soil in 4B2c Wetlands converted to cropland.

³ The conversion of Forest Land to Cropland occurred in 2015.

Living biomass

Net carbon stock changes in living biomass associated with the conversion of land to Cropland were estimated using a combined approach:

- a Tier 1 to calculate carbon stock changes due to biomass gains and
- a Tier 2 – due to biomass losses: the changes occur only at the year of conversion as all biomass is cleared and assumed to be zero immediately after conversion.

Biomass gains for the area of 4B2b Grassland converted to cropland and 4B2c Wetlands converted to cropland equal the biomass after one year of growth, using a default EF (Table 6.27).

Losses are estimated based on the living biomass of the previous land use (Grassland or Wetlands). In particular, CS CSC data was obtained IGLUD field sampling (Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010). Based on that sampling, the average AGB for Grassland and Wetlands below 200 m height above sea level, including litter and standing dead, was estimated as 1.27 kg C m^{-2} , equivalent to $12.68^{42} \text{ t C ha}^{-1} \text{ yr}^{-1}$, and for Wetlands 1.80 kg C m^{-2} , equivalent to $17.96^{43} \text{ t C ha}^{-1} \text{ yr}^{-1}$. These estimates represent the carbon stocks prior to conversion and exclude components. However, in the 2026 submission, the changes of carbon in the DOM pool were reported separately to ensure comparability in the reporting⁴⁴. In particular, the annual CSC factors were calculated at $-3.04 \text{ t C ha}^{-1} \text{ yr}^{-1}$ and $-4.31 \text{ t C ha}^{-1} \text{ yr}^{-1}$, respectively. These factors were derived by applying a CS DOM-to-AGB ratio (0.24), obtained from data presented in

Table 6.25 of Aradóttir et al. (2000), to the carbon stocks present prior to conversion. Hence, the annual CSC were updated, accordingly: the updated carbon stock values at the value of $13.40 \text{ t C ha}^{-1}$ and $18.97 \text{ t C ha}^{-1}$ were used in the estimates (

Table 6.25), respectively.

Table 6.25 Calculation annual CSCs for DOM and living biomass losses, including BG biomass (as it was introduced in the 2026 submission)

Land use category	CSC (including litter and standing dead) tC/ha	CSC DOM tC/ha/yr	CSC AGB tC/ha/yr	Ratio	Annual CSCF tC/ha/yr
4B2b Grassland converted to cropland - DOM	-12.68	-	-	0.24*	-3.04
4B2b Grassland converted to cropland - LB losses	-12.68	-3.04	-9.64	0.39**	-13.40

⁴² Note that for Grassland the value of 12.68 t C/ha represents the stock of the above-ground biomass, including the litter and standing dead. It excludes the below-ground biomass.

⁴³ Note that for Wetlands, the value of $17.96 \text{ t C ha}^{-1}$ represents the carbon stock of the above-ground biomass, including litter and standing dead material. It does not include below-ground biomass.

⁴⁴ Until the 2025 submission, carbon stock changes in DOM resulting from the conversion of Grassland and Wetland areas to Cropland were reported as aggregate values under living biomass losses.

Land use category	CSC (including litter and standing dead) tC/ha	CSC DOM tC/ha/yr	CSC AGB tC/ha/yr	Ratio	Annual CSCF tC/ha/yr
4B2c Wetlands converted to cropland - DOM	-17.96	-	-	0.24*	-4.31
4B2c Wetlands converted to cropland - LB losses	-17.96	-4.31	-13.65	0.39**	-18.97

* CS DOM:AGB ratio derived from data in Aradóttir et al. (2000) (see Table 2 in that study). See explanation in section Dead organic matter above.

**CS ratio BGB:AGB derived from data in Aradóttir et al. (2000) (see Table 3 in that study). See explanation in section BGB above.

To estimate losses due to carbon stock changes in living biomass due to conversion from 4B2a Forest land converted to cropland (only for 2015), the data from a measurement plot of the SSPP-NFI of CF situated in this area was used to estimate C-stock removed and instantly oxidised. To estimate C-stock losses of litter, the Tier 2 approach was used (as for 4E2a Forest land converted to settlement).

Below ground biomass

The CSC in BGB were calculated for the first time in the 2026 submission for the subcategories 4B2b Grassland converted to cropland and 4B2c Wetlands converted to cropland, the values for CSC in BGB were estimated by multiplying the annual carbon stock change from living biomass losses by a CS BG to AB biomass ratio (R 0.39; taken from Aradóttir et al. (2000)). See

Table 6.25.

Dead organic matter

As it was mentioned under Living biomass section of the current Section (6.4.4.2), the CSCs in DOM due to conversion were calculated for the first time in the 2026 submission. For more details see Living biomass section and

Table 6.25. The impact of the recalculation may be observed in Section 6.4.7.

Mineral soils

The comprehensive review conducted by the EEA between May and June 2025, the review concluded that Iceland's method for calculating carbon stock changes in mineral soils for the subcategories 4B2b Grassland converted to cropland and 4C2b Cropland converted to grassland is not fully consistent with the 2006 IPCC Guidelines⁴⁵. In the 2026 submission, SOC

⁴⁵ The TERT noted that Iceland applied a SOC_{ref} of 90.5 t C/ha based on field measurements but also used this value as SOC₍₀₎ and SOC_(0-T) for managed grassland in land-use conversions. According to the Guidelines, SOC_{ref} should serve as the basis for deriving SOC₍₀₎/SOC_(0-T), adjusted for historical management effects (e.g. using default factors from Tables 5.5 or 6.2). Using SOC_{ref} directly assumes native conditions, which is inconsistent with managed grassland.

stock in Grassland has been updated applying updated values for the management parameters (Table 6.26 and Section 6.4.7.).

The calculation of the CS EF for C-stock change in mineral soils for 4B2b Grassland converted to cropland is based on Equation 2.25 (Chapter 2 of the 2006 IPCC Guidelines) using a CS SOC_{REF} evaluated in (Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010) and the IPCC default stock change factors (Table 6.26). Applying the default 20 years conversion period results in an annual carbon stock change of -0.93 tC/ha.

Table 6.26 Calculation of the country country-specific EF for C-stock change in mineral soils for 4B2b Grassland converted to cropland.

Land use category	SOCref tC/ha	FLU	FMG	FI	Reference for factors	CSC tC/ha/yr
4B2b Grassland converted to cropland	90.5	1	1	1		
		[All]	[Nominally managed (non- degraded)]	[Medium]	Table 6.2, IPCC 2006	90.5
	90.5	0.69	1.15	1		
		[Long-term cultivated, Temperate/ Boreal moist]	No till, Temperate/Boreal moist	Medium	Table 5.5, IPCC 2006	71.8
	Annual CSCs					-0.93

Organic soils

Detailed information on drained organic soils can be found in Section 6.2.3. For the estimation of emissions from organic soils across all categories, the default EF for drained organic soils in Boreal and Temperate climate zones from the 2013 Wetlands Supplement was applied (Table 6.27).

Table 6.27 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of 4B2 Land converted to Cropland, by land-use subcategory for the entire reporting period.

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
4B2a Forest Land converted to cropland	Organic Soils	D	-7.9	Table 2.1 of the 2013 Wetlands Supplement
4B2b Grassland converted to cropland	Mineral Soils	CS	-0.93	See the text above
	Biomass Gains	D	2.1 (perennial) 0.11 (ICSCEF* for 2024)	Table 5.9 (Temperate (all moisture regimes)) of the 2006 IPCC Guidelines
	Biomass Losses	CS	-13.4	Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010 &

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
4B2c Wetland Converted to Cropland	DOM	CS	-0.72 (ICSCEF* for 2024)	Aradóttir et.al., (2000) (see Section 6.4.4.2)
			-3.04	Estimated by Land and Forest Iceland (see Section Dead organic matter in Section 6.4.4.2)
			-0.16 (ICSCEF* for 2024)	
	Organic Soils	D	-7.9	Table 2.1 in the 2013 Wetlands Supplement
	Biomass Gains	D	2.1 (perennial)	Table 5.9 (Temperate (all moisture regimes)) of the 2006 IPCC Guidelines
			0.11 (ICSCEF* for 2024)	
	Biomass Losses	CS	-18.97	Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010 & Aradóttir et.al., (2000) (see Section 6.4.4.2)
			-1.02 (ICSCEF* for 2024)	
	DOM	CS	-4.31	Estimated by Land and Forest Iceland (see Section Dead organic matter in Section 6.4.4.2)
			-0.23 (ICSCEF* for 2024)	

* Implied CSC EF (ICSCEF) for 2023 reporting year was reported in the CRT.

6.4.5 Uncertainty Assessment and Time-series Consistency

The uncertainty assessment for Cropland land use category for the period 1990–2024 have been assessed following Approach 1 of the 2006 IPCC Guidelines (IPCC, 2006). Detailed information on the uncertainty rates associated with the AD and the EFs are presented in Annex 2: Assessment of Uncertainty.

Iceland applied a conservative approach in cases where uncertainty rates for CS EFs were not available from relevant studies. In these cases, the IPCC default uncertainty values (corresponding to the applicable land-use category and carbon pool) were used together with the CS data, ensuring that the uncertainty assessment was not underestimated. For carbon pools where a Tier 1 approach was applied (that assumes that the carbon pool is in equilibrium), the uncertainty rates were not reported in the table nor used in the overall uncertainty assessment. The overall uncertainty assessment is presented in Annex 2.

6.4.6 Category-specific QA/QC and verification

Please consult Chapter 1.5 and Section 0 for more information.

6.4.7 Category-specific recalculations

Cropland area timeseries revisions

Recalculations were made to the Cropland activity data throughout the timeseries. The changes were mostly driven by two factors: correction of artificial rise in IGLUD map data and subsequent reinterpretation of a key reference (Snæbjörnsson, o.fl., 2010).

Correction of artificial rise in IGLUD map data

Geographically explicit IGLUD map data has been used in recent submissions for the area of active cropland and inactive cropland (Cropland converted to grassland) in years 2018-2024. With the previous method of processing of the map data, the size of active cropland each year appeared to be larger than the year before. This apparent rise in active cropland was a driving factor in previous construction of the Cropland time series. Upon thorough review of the processing method, it became clear that the increase was artificial, an artifact of the processing method. The active cropland map data is based on charting of mowed hayfields (for harvest subsidies) and charting of ploughed land (for soil working subsidies), see more details in chapter 6.4.2. The map data was processed in a way that each year's area that got subsidies was added to the areas that received a subsidy the year before. The active cropland of a single year was therefore a cumulative of active cropland for all the previous years where data was available, a cumulative running total.

An agricultural expert was consulted on how long hayfields can be considered in active cultivation after they have been mowed. According to his expert judgement, if a hayfield is left unmowed for more than three years, earth hummocks, tufts or tussocks start to form, rendering the field unsuitable for mowing (Borgar Páll Bragason, personal communication, 18.2.2026). See more details in chapter 6.4.2.

The IGLUD map data has now been processed with a different method, where land stays in the 4B1 Cropland active for three years after it was mowed or ploughed. If a hayfield or arable land is left unused for more than three years, it moves to subcategory 4C2 Cropland converted to grassland. 4B1 Cropland active is therefore a three-year running total instead of a continuous cumulative running total.

After this change of processing method of the IGLUD map data, there is no clear increase in Cropland active area over the years where geographically explicit map data is available (2018-2024).

Reinterpretation of a key reference (Snæbjörnsson, o.fl., 2010)

The previous map data processing method gave rise to an artificial rise in active cropland in the last years of the timeline (2018-2024), as explained above. This apparent rise in active cropland was a narrow constraint that was a driving factor in the construction of the rest of the Cropland active timeline. A continuous rise in active cropland had to be assumed for the

rest of the timeline to fit it with the apparent steep rise in active cropland in the last years in the timeline.

The forced rise in active cropland over the timeline (1990-2024) was in contradiction with various supplementary indicators. Country-wide hay harvest and the number of sheep in the country were at maximum around 1975-1985 and have been decreasing after 1990, see Figure 6.26 and Figure 6.27 (Statistics Iceland (Hagstofa Íslands), 2021; 2024). The number of dug ditches annually to drain wetlands also decreased drastically after 1990.

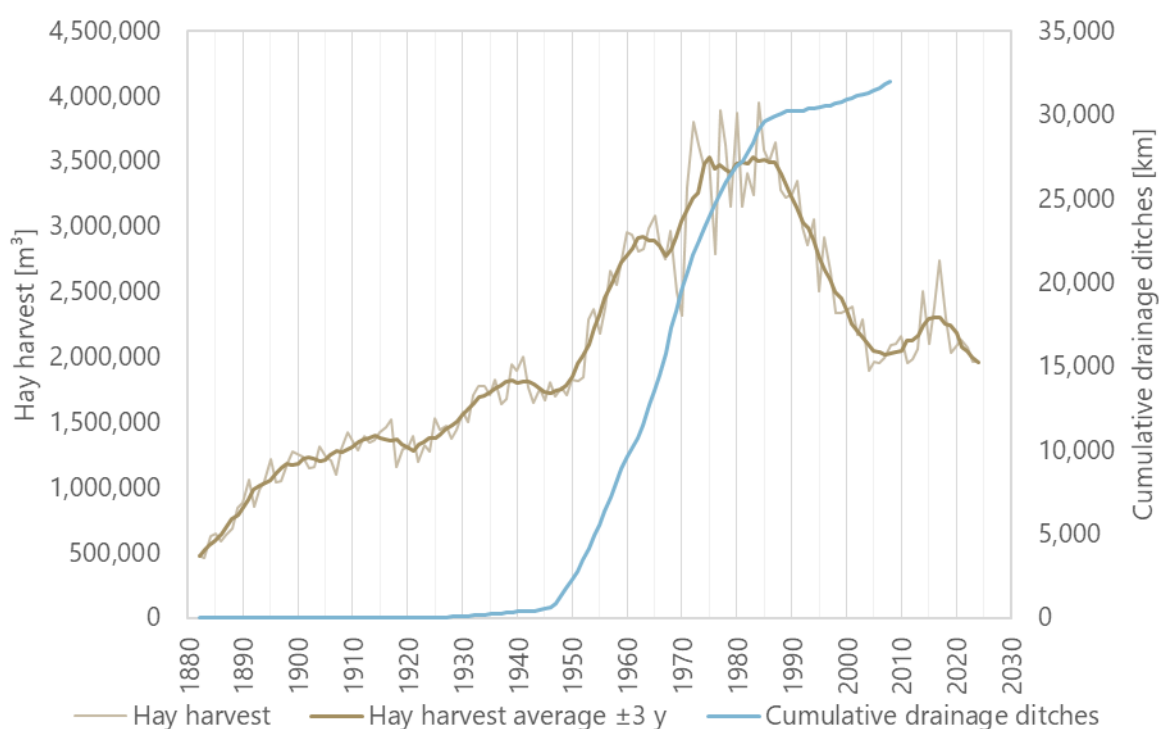


Figure 6.26. Hay harvest and cumulative drainage ditches in Iceland from 1882 to 2024 (Statistics Iceland (Hagstofa Íslands), 2021).

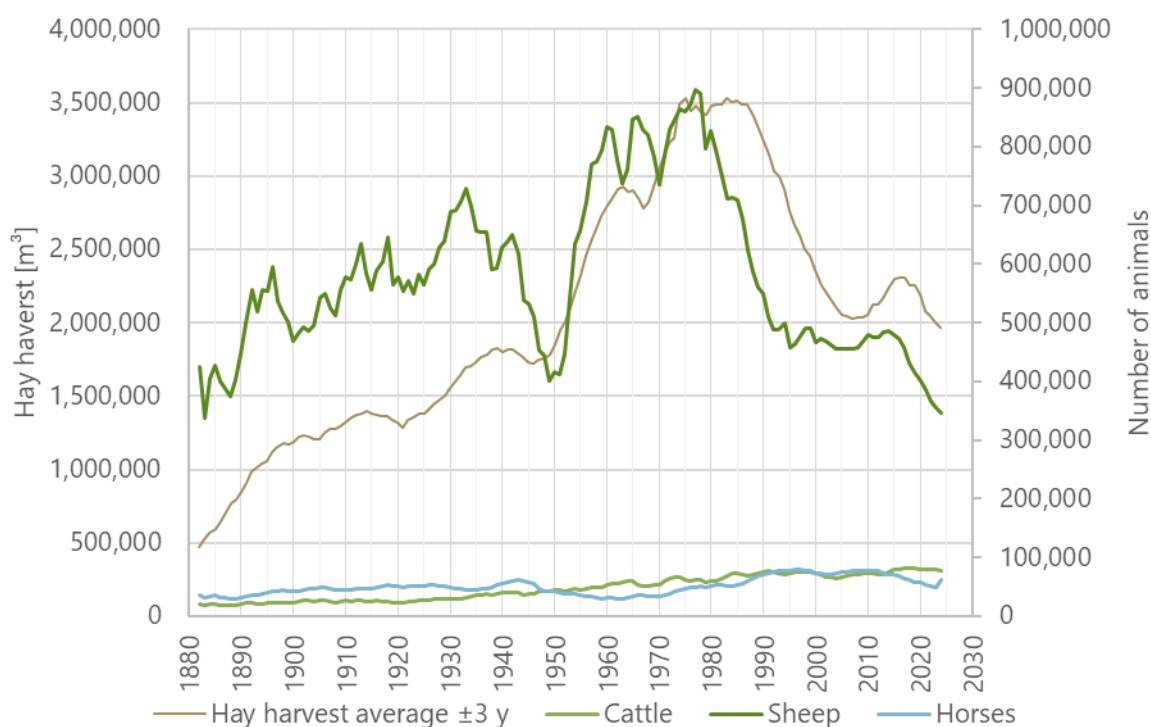


Figure 6.27. Hay harvest and number of farm animals in Iceland from 1882 to 2024 (Statistics Iceland (Hagstofa Íslands), 2024).

A key reference in the Cropland timeline construction is the *Committee Report on land use: Assessment of use and conservation of cultivated areas* by Snæbjörnsson et al. (2010). Due to the narrow constraints set by the apparent rise in active cropland towards the end of the timeline, not all the results from Snæbjörnsson et al. (2010) report could be used previously. Now, however, as the apparent rise turned out to be a processing artifact, the results from the Snæbjörnsson et al. (2010) report can be reinterpreted and fully implemented in the timeline. Previously, the results of the report were interpreted in a way that the total cropland area (including inactive, uncultivated cropland) was 128 kha in 2008. Upon detailed reassessment of the report's results, it is now clear that only active cropland was 128 kha in 2008 but total cropland was 168 kha and thereof were 40 kha inactive cropland. Data points for years 1950 and 1989 in the cropland timeline could also be extracted from the report's results. This reinterpretation of the Snæbjörnsson et al. (2010) report shifts the shape of the 1990-2024 timeline in a way that now the active cropland area is decreasing from 1990-2021. Active cropland area is stable and changes little over the years 2021-2024.

Table 6.28, Figure 6.26 and Figure 6.27 show the total Cropland area reported in the 2026 submission compared with the values from the 2025 submission.

Table 6.28 Comparison of total area data [kha] for the Cropland category as reported in the current submission and in the previous year's submission

Area [kha]	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
4.B Cropland	2025	92.2	93.1	94.1	95.1	97.7	102.6	107.5	109.5	110.5
	2026	135.7	133.5	131.4	129.3	123.9	113.7	103.4	102.4	101.8
	Difference	43.5	40.4	37.3	34.2	26.2	11.1	-4.1	-7.0	-8.7
	in%	47%	43%	40%	36%	27%	11%	-4%	-6%	-8%

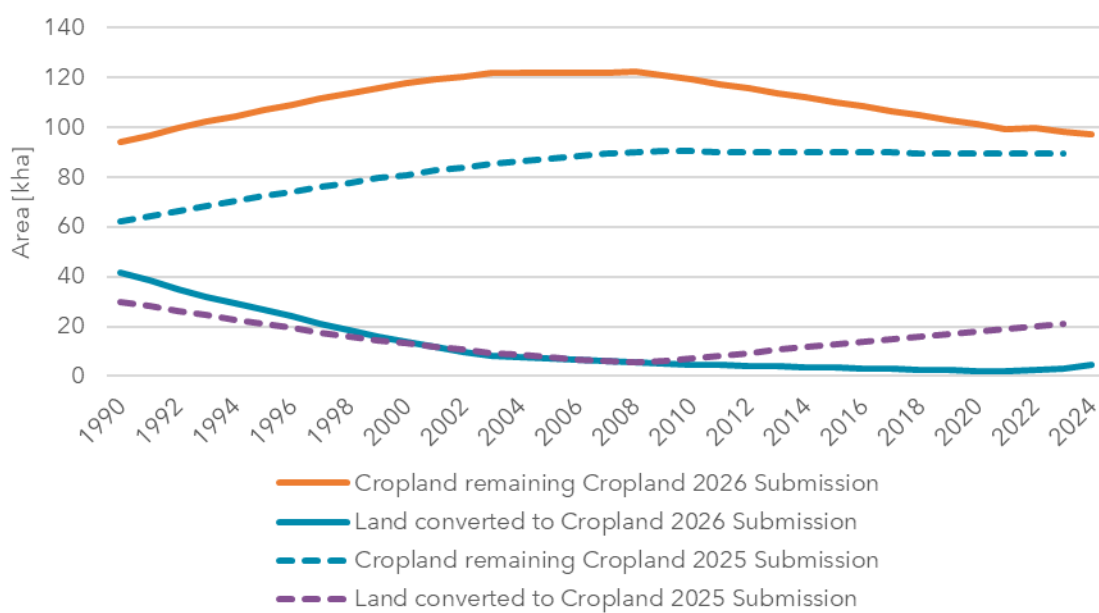


Figure 6.28 Recalculations to the activity data between the current (2026) and previous (2025) submission for Cropland.

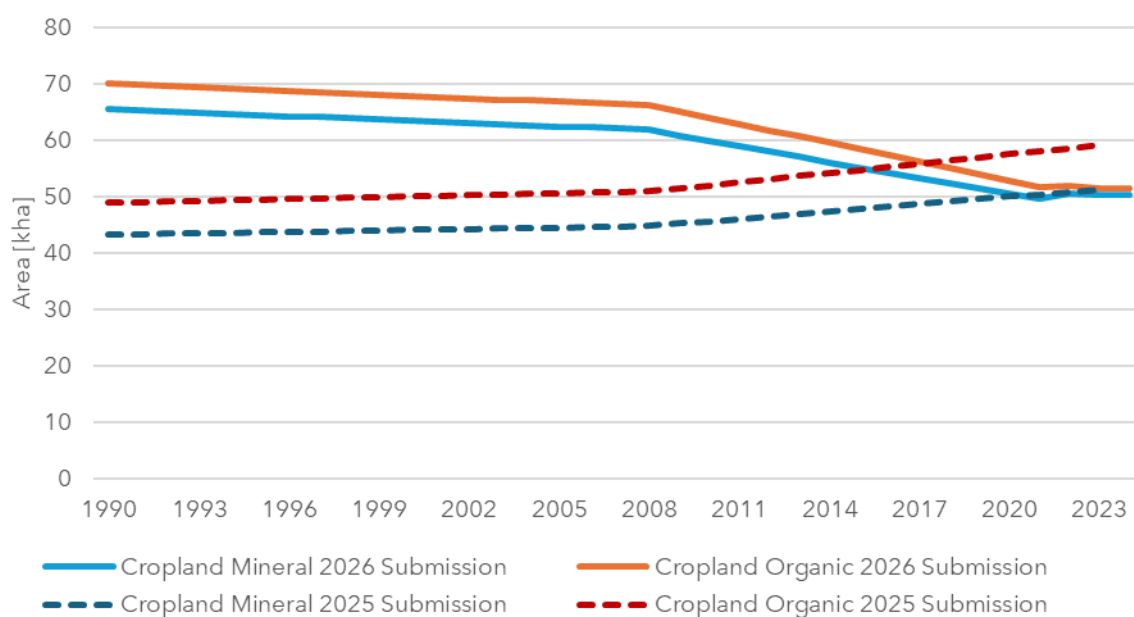


Figure 6.29 Recalculations to the activity data between the current and previous submission for Cropland mineral and organic soils.

Carbon stock change revisions

The following recalculations were conducted in the 2026 submission for the subcategories 4B2b Grassland converted to cropland and 4B2c Wetlands converted to cropland:

1. the inclusion of annual carbon stock changes in BGB, accounted for as part of living biomass losses for the subcategories 4B2b Grassland converted to cropland;
2. the inclusion of carbon stock changes in DOM for these above-mentioned subcategories;
3. the recalculation of annual CSC per hectare in mineral soils for the subcategory Grassland converted to cropland.

A comparison of emissions reported in the 2025 and 2026 submissions is presented in Table 6.29, while the impact of the recalculations on Grassland remaining grassland and Land converted to grassland between the current and previous submissions is shown Figure 6.28.

CSC EF for mineral soils for Grassland converted to cropland

Recalculations of CSCs in mineral soils for 4B2b Grassland converted to cropland are based on updated IPCC default factors for both Grassland and Cropland. See also section Mineral soils in Chapter 6.4.4.2. Values used in the previous submission and 2026 submission are presented in Table 6.29.

Table 6.29 Comparison of calculations for the country-specific EF for C-stock change in mineral soils for the subcategory 4B2b Grassland converted to cropland between the 2025 and 2026 submissions

Land use category	SOCref tC/ha	FLU	FMG	FI	Transition period [years]	CSC tC/ha/yr
4B2b Grassland converted to Cropland [Calculation for the 2025 submission]	90.05	1.00*	1.00*	1.00*	20	90.05
	90.05	1.00**	0.82**	1.15**	20	84.92
	Annual carbon stock changes					-0.26
4B2b Grassland converted to Cropland [Recalculation for the 2026 submission]	90.5	1.00*	1.00*	1.00*	20	90.50
	90.5	0.69***	1.15***	1.00***	20	71.81
	Annual carbon stock changes					-0.93
Differences between previous annual carbon stock change (CSC) estimates and those reported in the 2026 submission in tC/ha/yr						-0.68
Differences between previous annual carbon stock change (CSC) estimates and those reported in the 2026 submission in %						264%

Default stock change factors taken from:

* Table 6.2 from Chapter 6 – 2006 IPCC Guidelines: $F_{LU(0-T)}$ – All – All; $F_{MG(0-T)}$ – Nominally managed (non – degraded) Management (non-degraded) – All; $F_{I(0-T)}$ – Medium – All

** Table 5.5 from Chapter 5 – 2006 IPCC Guidelines: $F_{LU(0)}$ – Long-term cultivated – Temperate/Boreal and Tropical – Moist/Wet; $F_{MG(0)}$ – No-till – Moist; $F_{I(0)}$ – Medium – All – Dry and Moist/Wet.

*** Table 5.5 from Chapter 5 – 2006 IPCC Guidelines: $F_{LU(0)}$ – Long-term cultivated – Boreal – Moist; $F_{MG(0)}$ – No-till – Boreal – Moist; $F_{I(0)}$ – Medium – All – Moist/Wet.

This recalculation has led to a substantial increase in estimated carbon stock losses from mineral soils in this subcategory (See Table 6.30 and Table 6.31).

Table 6.30 Comparison of area data [kha] for mineral soils in the subcategory Grassland converted to Cropland, as reported in the current submission versus the previous year's submission.

Area [kha]	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
4B2b Grassland converted to cropland - mineral soils	2025	14.4	10.0	6.3	3.6	3.5	6.1	8.6	9.6	10.1
	2026	20.0	12.9	6.7	3.5	2.3	1.6	1.0	1.7	2.0
	Difference	5.6	2.8	0.4	0.0	-1.3	-4.4	-7.6	-7.9	-8.1
	in%	39%	28%	6%	-1%	-36%	-73%	-88%	-82%	-80%

Table 6.31 Comparison of net carbon stock changes [kt C] for mineral soils in the subcategory Grassland converted to Cropland, as reported in the current submission and in the previous year's submission.

Land use category	Subm.	ktC/ha/yr	1990	1995	2000	2005	2010	2015	2020	2022	2023
4B2b Grassland converted to cropland - mineral soils	2025	-0.26	-3.7	-2.6	-1.6	-0.9	-0.9	-1.6	-2.2	-2.2	-2.5
	2026	-0.93	-18.7	-12.0	-6.2	-3.3	-2.1	-1.5	-0.9	-1.6	-1.9
	Difference	0.67	15.0	9.4	4.6	2.4	1.2	0.0	1.3	0.6	0.6
	in%	258%	402%	365%	283%	259%	133%	-2%	-57%	-27%	-24%

Summary of emissions comparisons between the 2025 and 2026 submissions due to Recalculations

Table 6.32 provides comparison of emissions reported in the 2025 and 2026 submissions. Figure 6.28 illustrates the comparison of emission trends for Cropland remaining cropland and Land converted to Cropland between the current (2026) submission and the previous (2025) submission.

Table 6.32 Comparison of greenhouse-gas emissions [kt CO₂e] for the Cropland category as reported in the current submission and in the previous year's submission.

GHG kt CO ₂ e	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
CO ₂	2025	1448.9	1458.3	1468.8	1480.6	1573.5	1656.8	1740.1	1773.4	1790.0
	2026	2123.8	2063.1	2005.9	1961.1	1856.9	1696.8	1530.8	1563.2	1550.1
	Difference	674.9	604.7	537.2	480.4	283.4	40.0	-209.3	-210.1	-239.8
	in%	47%	41%	37%	32%	18%	2%	-12%	-12%	-13%
CH ₄	2025	2.9	2.9	2.9	3.0	3.0	3.2	3.4	3.4	3.5
	2026	4.1	4.0	4.0	3.9	3.7	3.4	3.1	3.0	3.0
	Difference	1.2	1.1	1.0	0.9	0.7	0.2	-0.3	-0.4	-0.5
	in%	43%	40%	36%	32%	23%	7%	-8%	-11%	-13%
N ₂ O	2025	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Difference	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	in%	402%	365%	283%	259%	133%	-2%	-56%	-35%	-28%

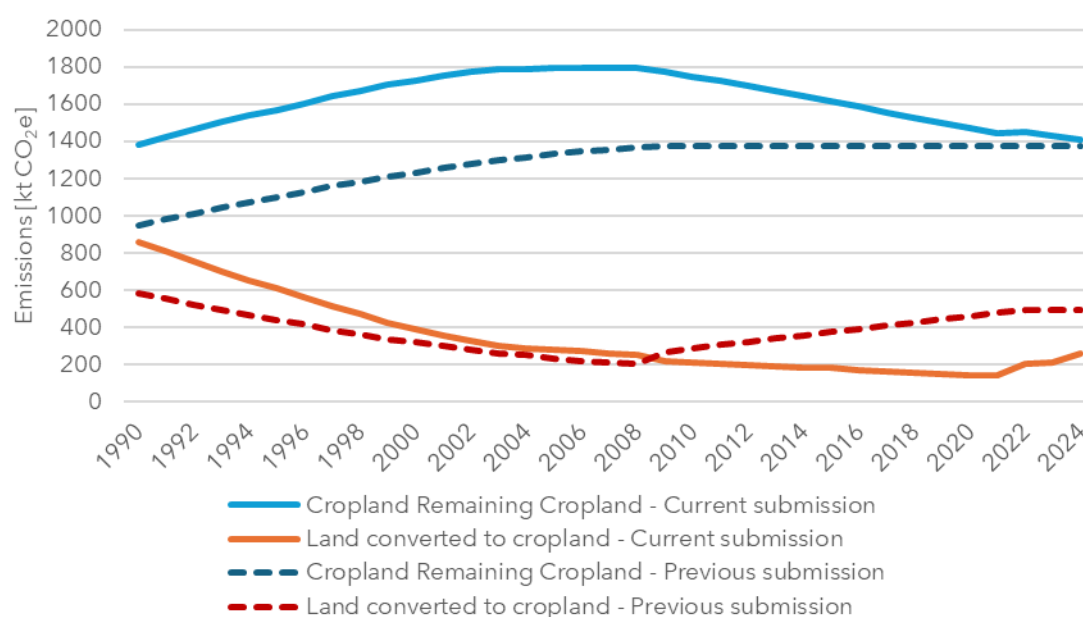


Figure 6.30 Recalculations to the emissions between the current and previous submission for Cropland.

6.4.8 Category-specific Planned Improvements

Cropland remaining cropland

In 2024, a project was launched focusing on the Cropland remaining cropland category. Soil samples, both mineral and organic, were collected during the summers of 2024 and 2025. The project is expected to conclude in 2026, at which point there will be sufficient data to advance this category to Tier 2.

For the most recent years of the timeline, it may be possible to extract land transition data from the geographically explicit IGLUD map data. The IGLUD map data indicates that farmers periodically start cultivating old, abandoned hayfields on organic soil. Conversion of Grassland on organic soils to Cropland is thus a key flow but it is currently missing in the LULUCF model. Revision of the model requires some data processing, but the aim is to complete this work before 2027 submission.

As a high-resolution soil map is not available for Iceland, the plan is to do a geographical analysis to estimate areas where organic soils are located with much more detail than has previously been done. The analysis would take into account drainage ditches density, coupled with data on landscape conditions, inclination and connection to water bodies.

Currently, there is only a single Cropland remaining cropland subcategory, 4B1 Cropland active. This subcategory consists of lands that have received hay harvest (mowing) subsidies and lands that have received soil working (tillage) subsidies. The soil emissions are surely higher from tilling a field, compared to just mowing a field. It is suspected that the current IPCC default emissions factor for organic Cropland soils could be an overestimate for mowed fields. The aim is to make a distinction between the two in the coming years, by creating two separate subcategories. This will be done in conjunction with development of country-specific emission factors for these categories.

Land converted to cropland

This category is currently under revision, with the initial improvements included in this submission. The work is expected to be completed by the 2027 submission. The project initiated for mineral and organic soils under Cropland remaining cropland, as described above, also covers mineral and organic soils within this category.

6.5 Grassland (CRT 4C)

6.5.1 Category description

The total Grassland area shows a stable, gradual upward trend over the reporting period, increasing from 5,868.3 kha in 1990 to 6,026.5 kha in 2024 (Figure 6.29).

The Grassland land use category was a source of CO₂ emissions throughout the entire reporting period. Total CO₂ emissions fluctuated from 4,439.5 kt CO₂ in 1990 to 5,040.14 kt CO₂ in 2024. The increasing emission trend from Grassland remaining grassland over the inventory period is partly offset by removals from Land converted to grassland during the periods 2005–2008 and 2018–2024 (Figure 6.30).

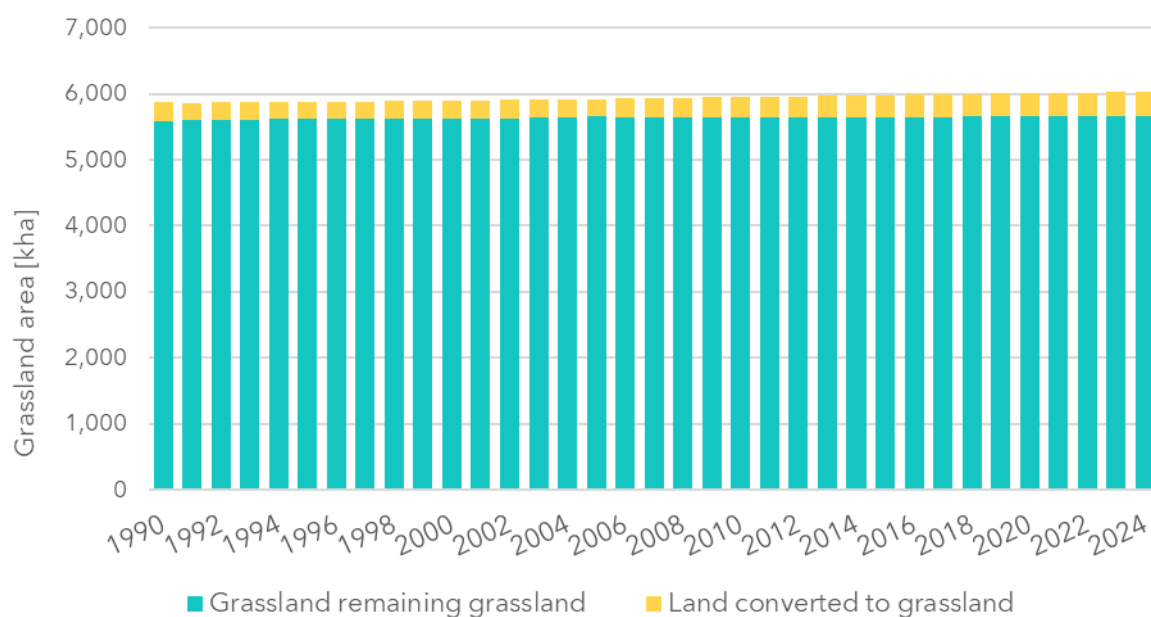


Figure 6.31 Grassland area (by category) in Iceland in 1990 – 2024 [kha].

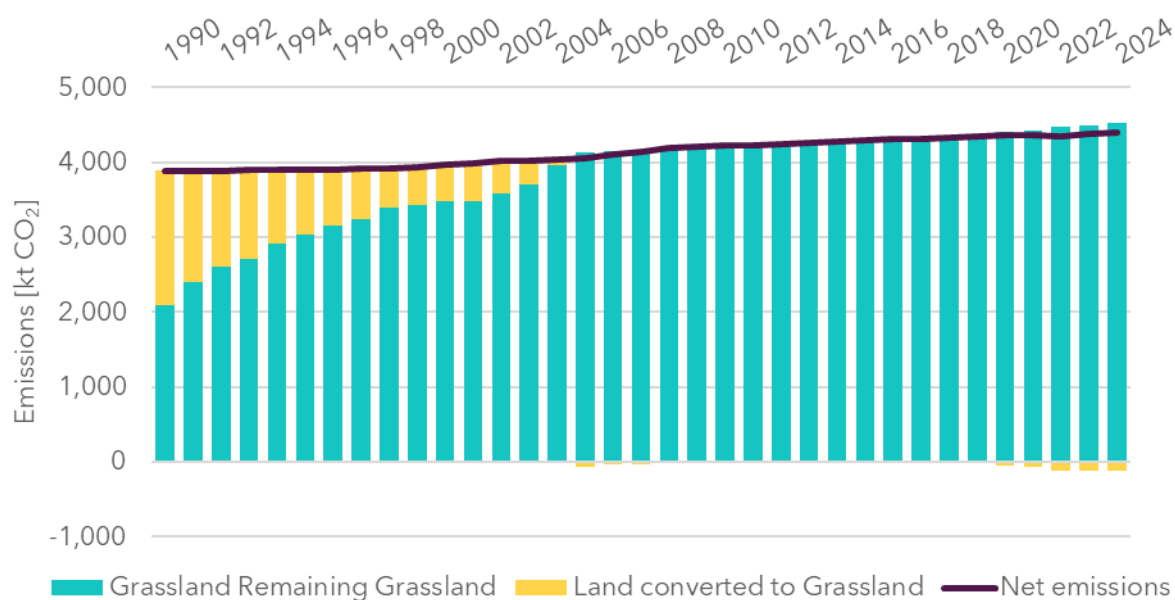


Figure 6.32 Emissions (+) and removals (-) from Grassland remaining grassland and Land converted to grassland [in kt CO₂].

6.5.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Grassland is a diverse land-use category characterized by vegetation communities with vascular plant cover exceeding 20%, encompassing a variety of soil types, erosion forms, and management practices. The Grassland category is divided into 16 subcategories. However, it is assumed that no conversion from Forest Land or Settlements to Grassland occurs. Therefore, definitions for these two subcategories are not *included in* Table 6.34. The 2026 submission incorporates data from 45 map layers compiled within the IGLUD land-use map, of which 30 layers originate from the Habitat Map of Iceland (HMI).

The total Grassland area has an increasing trend over the time series. However, there is limited information about where the conversions come from. The land representation across the time series have been constructed mostly according to three primary time series of Cropland converted to grassland, Revegetation records, Wetlands converted to grassland. In addition, two independent time series are used: one describing the expansion of Birch Shrubland into Other Grassland, and a separate time series for Other Land (Table 6.33). The layers used vary in scale, age and accuracy (Table 6.4).

The identification of mineral and organic soils in the Grassland subcategories is based on information from kernel density calculations from ditch maps, the denser the ditches are, the more change of them being on organic soils, that together with available soil data, assumptions are made.

All the conversions from the Cropland category to Grassland assumed a proportional split of mineral and organic soils to this category. The allocation of the mineral and organic soils of the Natural Birch Shrublands subcategory is based on sampling data from the NFI (LFI). For Natural birch shrubland – recently expanded into other grassland, a mean annual area increases of 0.2 kha is interpolated over the 1989-2012 period and extrapolated for 2013-2023. All conversions from Wetlands to Grassland are assumed to come from Intact mires <200 m a.s.l. and are therefore reported under organic soils. All the revegetation activities are reported on 4C2e Other land converted to Grassland and thus reporting as activities on mineral soils.

Table 6.33 Methodology and data sources for constructing the time series of Grassland category.

Land use category		1989	1990	-	2000	-	2008	-		2018	...	2024
Grassland remaining grassland	Cropland abandoned more > 20 years	Cropland to grassland timeseries										
	Natural birch shrublands	Natural birch forest timeseries										
	Organic soils drained >20 years	Records of excavated ditches		Linear interpolation		2008 Ditches map		Linear interpolation		Annual IGLUD maps		
	Revegetation	Recorded revegetation activities - NIRA database										
	Grazing on Other land	Other land timeseries										
Land converted to Grassland	Cropland to grassland	Linear interpolation from zero in 1950				Snæbjörns-son (2010)		Linear interpolation		3-year running total from IGLUD maps		
	Revegetation (Other land to grassland)	Recorded revegetation activities - NIRA database										
	Wetlands to grassland	Records of excavated ditches		Linear interpolation		2008 Ditches map		Linear interpolation		Annual IGLUD maps		
Legend												
Samples or known areas	Maps	Expert judgement	Interpolation		Assumptions							

Table 6.34 Definitions of Grassland subcategories.

LU category	Definition	LU subcategory	Definition	Allocation	Conversion period
Grassland	Includes all land where vascular plant cover is >20% and is not included under the Settlements, Forest Land, Cropland, or Wetlands categories, with the exception of Grazing areas on Other land. The Grassland category also includes land that is being revegetated and meets the definition of the activity but does not fall into the other categories. Drained organic soils, not falling into other categories, are also included in this category.	Revegetated land older than 60 years	This category refers to a small area of revegetated land (4C2e Other land converted to Grassland) older than 60 years.	GLrGL	-
		Cropland, abandoned for more than 20 years	This subcategory includes all previous Cropland abandoned for more than 20 years that is remaining under the Grassland land-use category.	GLrGL	-
		Natural birch shrubland – recently expanded into grassland areas	This subcategory represents grassland areas converted to natural birch shrubland. As this change in vegetation cover does not shift the land between categories, this land remains as Grassland.	GLrGL	-
		Natural birch shrubland – old	Natural birch shrubland is the part of the Natural Birch Woodland that does not meet the thresholds to be accounted for as Forest Land but is covered with birch (<i>Betula pubescens</i>) to a minimum of 10% in vertical cover and at least 0.5 ha in continuous area.	GLrGL	-
		Organic soils drained for more than 20 years	This subcategory includes areas of Histosols drained for more than 20 years because of time series and	GLrGL	-

LU category	Definition	LU subcategory	Definition	Allocation	Conversion period
			application of default 20 years conversion period of the subcategory 4C2c Wetland converted to Grassland.		
		Grazing areas	Land dominated by grasses, land with grasses and mosses in variable combinations (respecting the 20% minimum vascular plant cover), vegetated lava fields, river plains and coastal land, heathlands with dwarf shrubs, shrubs other than birch (<i>Betula pubescens</i>), lichens, and mosses.	GLrGL	-
		Grassland without grazing	Same as Grazing areas but without grazing activities	GLrGL	-
		Grazing areas on Other land	Areas with vascular vegetation cover <20%, which do not meet the definition of Grassland, but are subject to light grazing activities and are therefore treated as managed land.	GLrGL	-
		4C2b Cropland converted to grassland	The area is derived from Cropland time series using the default 20-year conversion period. It is not a distinct mapping unit but is included under both mineral and organic soils within the Cropland category.	LUC to GL	20
		4C2c Wetlands converted to grassland	This subcategory includes areas drained within 20 years before the inventory year, based on revised time series reflecting updated estimates of total drained grassland soils.	LUC to GL	20
		Revegetation before 1990	This is a subcategory of Other land converted to Grassland. It reports on revegetation activity where no afforestation is included. The revegetation activities started before 1990	LUC to GL	60*
		Revegetation since 1990 – limited grazing allowed	This is a subcategory of Other land converted to Grassland. It reports on revegetation activity where no afforestation is included. The revegetation activities started after	LUC to GL	60*

LU category	Definition	LU subcategory	Definition	Allocation	Conversion period
			1990. Grazing activities are allowed.	LUC to GL	60*
		Revegetation since 1990 – protected from grazing	This is a subcategory of Other land converted to Grassland. It reports on revegetation activity where no afforestation is included. The revegetation activities started after 1990. Grazing activities are not allowed.		
		Other land converted to natural birch shrubland	Originates from the ongoing expansion of Birch Shrubland noted in the NFI		

* Detailed information on the 60-year conversion period is provided in Section 6.2.2.1.

6.5.3 Grassland remaining grassland (CRT 4C1)

6.5.3.1 Category Description

Overall, the total area of Grassland remaining grassland demonstrated a slight increase (around 74 kha) throughout the period, rising from 5,588.9 kha in 1990 to 5,663.3 kha in 2024. The main subcategory contributing to the total area remains (4C1 Grazing areas) the largest throughout the entire period, although it shows a moderate decline, decreasing from 2,686.5 kha in 1990 to 2,651.5 kha in 2024. The second most significant subcategory has been and remains 4C1 Grazing areas on Other land, which exhibits a steady decrease from 2,356.4 kha in 1990 to 2,326.2 kha in 2024 (Figure 6.33).

Grassland remaining grassland was a source of emissions throughout the entire reporting period, with emissions increasing from 2,093.5 kt CO₂ in 1990 to 4,521.9 kt CO₂ in 2024. The primary source of emissions was the management of organic soils. These emissions were partially offset by sequestration occurring in mineral soils (Figure 6.32).

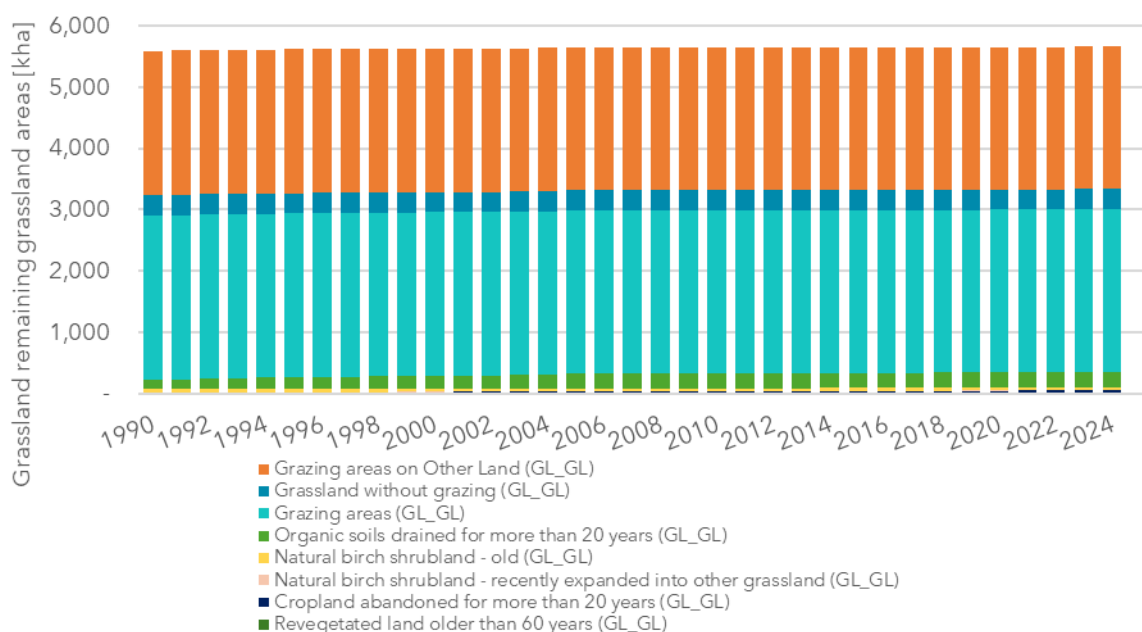


Figure 6.33 Area of Grassland remaining grassland by subcategory in Iceland in 1990 – 2024 [kha].

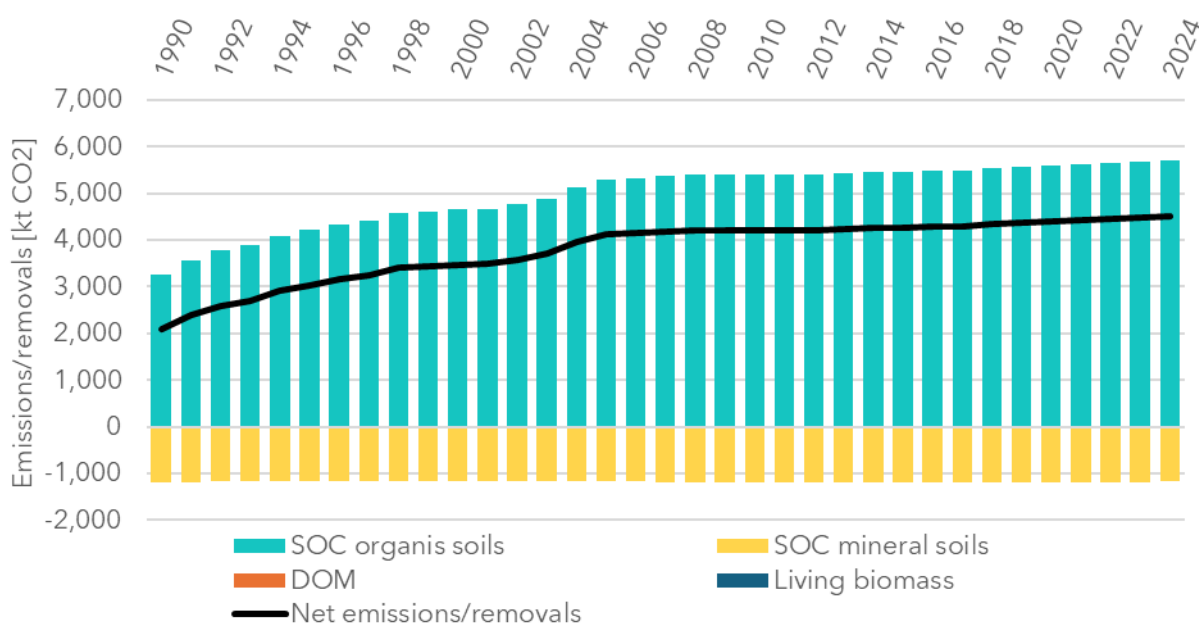


Figure 6.34 Emissions (+) and removals (-) from Land converted grassland by pools in Iceland in 1990 – 2024 [kt CO₂].

6.5.3.2 Methodology

Table 6.35 summarizes tier-level approaches, notation keys [in square brackets], and emission factors (in parentheses) are used to estimate changes in relevant carbon stocks in the Grassland remaining grassland category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Table 6.35 Tier-level approaches, notation keys, and emission factors used for the 4C1 Grassland remaining grassland category.

Land-Use Category	Living Biomass		DOM	Soils	
	Gains	Losses		Min	Org
4C1 Revegetated land older than 60 years	NA [T1]	NA [T1]	NA [T1]	NA[T1]	NO
4C1 Cropland abandoned for more than 20 years	NA [T1]	NA [T1]	NA [T1]	NA[T1]	T1 (D)
4C1 Natural Birch Shrubland – recently expanded into other grassland	T2 (CS)	IE ¹	T2 (CS)	T2 (CS)	T1 (D)
4C1 Natural Birch Shrubland – old	T3 (OTH)	IE ¹	NA [T1]	NA [T1]	T1 (D)
4C1 Organic soils drained for more than 20 years	NA [T1]	NA [T1]	NA [T1]	NO ²	T1 (D)
4C1 Grazing areas	NA [T1]	NA [T1]	NA [T1]	T2 (CS)	IE ³
4C1 Grassland without grazing	NA [T1]	NA [T1]	NA [T1]	T2 (CS)	IE ³
4C1 Grazing areas on Other land	NA [T1]	NA [T1]	NA [T1]	NA [T1]	NO

¹ Net biomass gain/losses estimated by the “The Stock-Difference Method” described in Chapter 2.3.1.1, with Equation 2.8 in the 2006 AFOLU Guidelines (IPCC, 2006). Biomass losses caused by mortality and harvest are therefore included in the net annual removal and reported as Included Elsewhere (IE) in the CRT reporting table.

² Mineral soils were reported as IE as aggregated numbers in Grassland remaining grassland - Grazing areas and Grassland without grazing up to and including the 2025 submission. However, as it is assumed that mineral soils are not included under ‘Organic soils drained,’ the notation key has been revised from NK to NO.

³ Estimation of CSC in organic soils are reported as aggregated number under organic soils in Organic soils drained for more than 20 years

Living biomass

A tier 1 approach was applied to report changes in carbon stock in living biomass for all land-use subcategories, except 4C1 Natural Birch Shrubland – recently expanded into other grassland and 4C1 Natural Birch Shrubland – old, for which a Tier 2 and Tier 3 were applied, respectively. The changes in carbon stock of the subcategories 4C1 Natural Birch Shrubland – old and 4C1 Natural Birch Shrubland – recently expanded into other grassland are estimated by LFI based on NFI data and estimated in same manner as 4C1 Natural Birch Forest – old and Grassland converted to Natural Birch Forest respectively (See Sections 6.3.3.2 and 6.3.4.2).

DOM

For all subcategories (except Natural Birch Shrubland – recently expanded into other grassland) of the remaining 4C1 Grassland remaining grassland subcategories, DOM is assumed to be in equilibrium and is therefore reported as NA (Tier 1) (Table 6.35). The CSC in

DOM for 4C1 Natural Birch Shrubland – recently expanded into other grassland are estimated by the same CS EFs as used for 4A2b Grassland converted to forest land (Table 6.35).

Mineral soils

The CSC in SOC of mineral soils under 4C1 Natural Birch Shrubland – recently expanded to other grassland was estimated using CS EFs as used for 4A2b Afforestation natural birch forest 1-50 years old and 4A2e Afforestation natural birch forest 1-50 years old (Table 6.37).

The calculation of the CS EF for C-stock change in mineral soils for the subcategories 4C1 Grazing areas and 4C1 Grassland without grazing was calculated for the first time in the 2026 submission (please see also Section 6.5.7 Category-specific recalculations):

1. The proportion of grassland areas for these two subcategories that are severely degraded, degraded, not degraded, and improved grassland (Marteinsdóttir B, 2020);
2. CS SOC_{ref} 90.5 t C/ha (Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010);
3. Equation 2.25 (Volume 4, Chapter 2 of the 2006 IPCC Guidelines);
4. IPCC default stock change factors from Table 6.2 (Volume 4, Chapter 6 of the 2006 IPCC Guidelines (Table 6.36). The annual CSC for the mineral soil pool was calculated to be 0.107 kt C/ha/year.

In Table 6.36 country-specific and default values used for the calculation of the annual carbon stock change in mineral soils pool for these two subcategories.

Table 6.36 Calculation of the country-specific EF for C-stock change in mineral soils for 4C1 Grazing areas and 4C1 Grassland without grazing (calculations were performed in hectares and tonnes, but values are reported in kha and in kt in this table due to cell size limitations).

Land use categ.	Subcat. of unique climate, soil, and managem	Area for 2024 kha	Area for 1990 kha	SOC _{ref} [CS] t C/ha	FLU *	FMG *	FI *	Carbon stock in last year of inv. period [SOC] kt	Carbon stock at begin. of inv. Period [SOC-T] kt	Transition period [yr] D	Ann. ch. in carbon stocks mineral soils, kt C/yr	Ann. t C/ha
4C1 Grazing areas/ 4C1 Grassl. without grazing	Not-degraded	1310	2019	90.5	1	1	1	118,580	185,829	60	-1,069	
4C1 Grazing areas/ 4C1 Grassl. without grazing	Moderately degraded	584	615	90.5	1	0.95	1	50,243	56,624	60	-44	

Land use categ.	Subcat. of unique climate, soil, and managem	Area for 2024 kha	Area for 1990 kha	SOC _{ref} [CS] t C/ha	FLU *	FMG *	FI *	Carbon stock in last year of inv. period [SOC0] kt	Carbon stock at begin. of inv. Period [SOC0-T] kt	Transition period [yr] D	Ann. ch. in carbon stocks mineral soils, kt C/yr	Ann. t C/ha
4C1 Grazing areas/ 4C1 Grassl. without grazing	Severely degraded	252	280	90.5	1	0.7	1	15,942	25,738	60	-30	
4C1 Grazing areas/ 4C1 Grassl. without grazing	Improved grassland	874	106	90.5	1	1.14	1.11	100,034	9,780	60	1,464	
Total		3020	3020					284,799	277,971	60	322	0.107

Moderately F_{MG} for Moderately degraded areas – Level: Moderately degraded grassland; Climate regime:

Temperate/Boreal; F_{MG} for Severely degraded areas – Level: Severely degraded; Climate regime: All

F_{MG} for Improved grassland areas – Level Improved grassland; Climate regime Temperate/Boreal

F_I for Not-degraded, Moderately degraded, Severely degraded areas: Level: Medium; Climate regime: All

F_I for Improved grassland areas: Level: High; Climate regime: All

Due to the lack of available information on carbon stock changes in the mineral soil pool, a Tier 1 approach was applied for all other subcategories under Grassland remaining grassland, assuming this pool to be in equilibrium.

Organic soils

Detailed information on drained organic soils can be found in Section 6.2.3. A tier 1 approach along with the IPCC default values (Table 6.37) were used to estimate emissions due to management of organic soils.

Table 6.37 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of Grassland remaining grassland, by land-use subcategory.

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
4C1 Cropland Abandoned for more than 20 Years	Organic Soils	D	-5.7	Table 2.1 in the 2013 IPCC Wetlands supplement (Grassland, Drained in Boreal Zone)
4C1 Natural Birch Shrubland – Recently Expanded into Other Grassland	Mineral Soils	CS	0.53: 0-30 yrs 0.74: 31-60 yrs	Sanchez, 2025
	Organic Soils	D	-0.37	Table 2.1 in the 2013 Wetlands Supplement (Forest Land, Drained, Including Shrubland and Drained Land that may not be Classified as Forest)

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
	Biomass Gains	CS	0.19	Linear regression between biomass per area unit and age in trees on measurement plots in Natural Birch Woodland that belongs to the area expansion from 1989 (n=28, P = 0.0002) is used to measure net annual C-stock change (Snorrason et al. in prep.).
	DOM	CS	0.14	Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008
4C1 Natural Birch Shrubland – Old	Organic Soils	D	-0.37	Table 2.1 in the 2013 Wetlands Supplement (Forest Land, Drained, Including Shrubland and Drained Land that may not be Classified as Forest)
	Biomass Gains	OTH	0.12	Paired plot estimates on 58 plots were compared and resulted in average net gain of 0.12 t C ha ⁻¹ yr ⁻¹ for the 10-year period from 2007 to 2017 with significant changes in stock in the period (P=<0.001). (Snorrason et al. in prep.).
4C1 Grazing areas	Mineral soils	CS	0.11	Technical Expert Review Team and Land and Forest Iceland (refer to the calculations provided in the Table 6.36)
4C1 Grassland without grazing	Mineral soils	CS	0.11	Technical Expert Review Team and Land and Forest Iceland (refer to the calculations provided in the Table 6.36)
4C1 Organic soils drained for more than 50 years	Organic Soils	D	-5.7	Table 2.1 in the 2013 IPCC Wetlands supplement (Grassland, Drained in Boreal Zone)

6.5.4 Land converted to grassland (CRT 4C2)

6.5.4.1 Category Description

The total area of Land converted to grassland increased from 279.5 kha in 1990 to 363.2 kha in 2024 over the entire reporting period. The 4C2e Revegetation before 1990 (OL - GL) subcategory consistently represented the largest area throughout the period. Starting at 164.9 kha in 1990, it declined slightly to 152.2 kha in 2024, with a total decrease of 12.7 kha. The 4C2c Wetlands converted to grassland subcategory was the second most significant category in terms of initial area. However, it shows a substantial decline from 98.4 kha in 1990 to 15.1 kha in 2024, a total decrease of 83.3 kha. The 4C2e Revegetation since 1990 - protected from grazing subcategory demonstrated the most substantial growth, starting at

1.7 kha in 1990 and increasing to 119.8 kha in 2024, a total increase of 118.1 kha. (Figure 6.33).

Land converted to Grassland alternated between a source and a sink over the reporting period. It acted as a source during 1990–2004, with emissions declining markedly from 1,793.1 kt CO₂ in 1990 to 74.0 kt CO₂ in 2004. The category became a net sink during 2005–2008, with removals decreasing in magnitude from –70.4 kt CO₂ to –6.4 kt CO₂. It reverted to a source during 2009–2017, with emissions ranging from 13.2 kt CO₂ to 10.1 kt CO₂ and became a net sink again from 2019 to 2024, with removals increasing from –3.3 kt CO₂ to –128.0 kt CO₂.

Emissions due to the management of organic soils were the only source of emissions. However, this pool demonstrated a decline in emissions, from + 2,206.7 kt CO₂ in 1990 to +681.4 kt CO₂ in 2024. All other pools were sinks, with the management of mineral soils becoming the largest sink and showing a steady increase in carbon sequestration, from –331.9 kt CO₂ in 1990 to –633.2 kt CO₂ in 2024. The living biomass pool also shows an increasing sequestration trend, from –65.6 kt CO₂ in 1990 to –140.6 kt CO₂ in 2024. A similar trend is observed in the DOM pool, where sequestration increased from –16.1 kt CO₂ in 1990 to –35.6 kt CO₂ in 2024 (Figure 6.34).

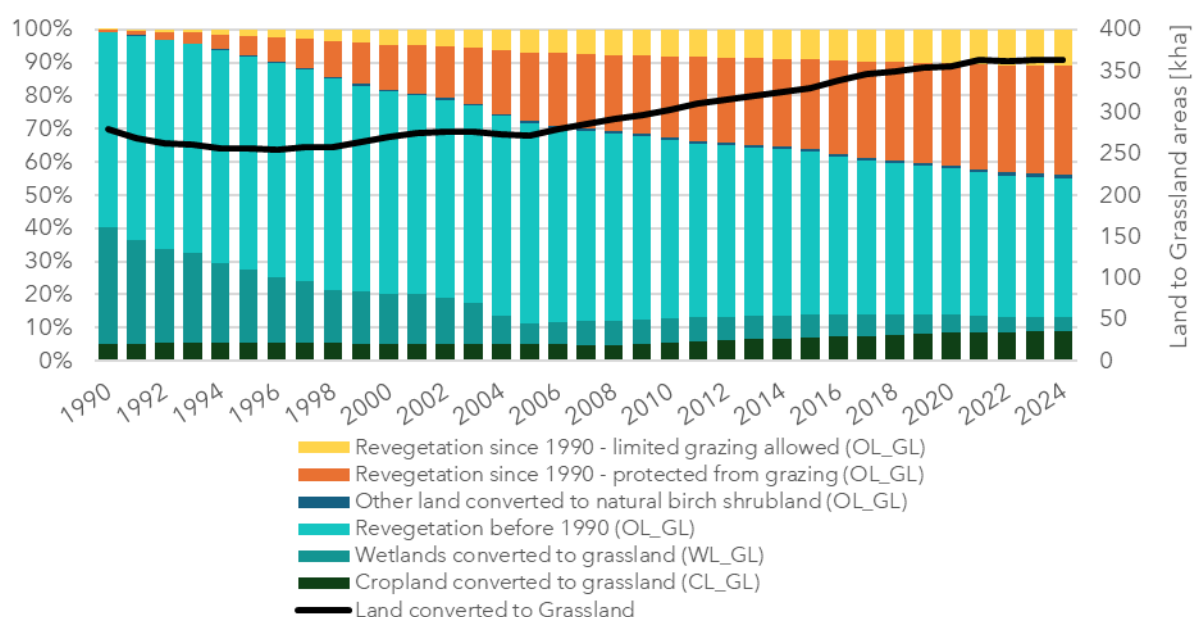


Figure 6.35 Relative shares of Land converted to grassland (by subcategory), and the total area converted to Grassland (kha) in Iceland in 1990 – 2024.

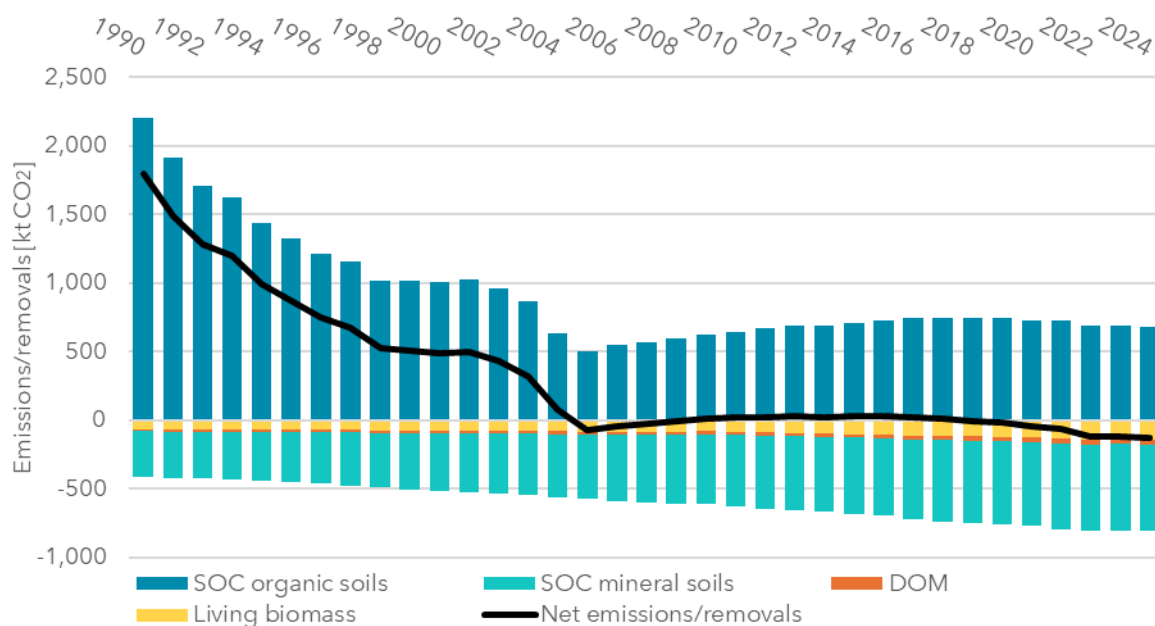


Figure 6.36 CO₂ emissions resulting from land conversion to Grassland by pools in Iceland in 1990 – 2024 [kt].

6.5.4.2 Methodology

Table 6.38 summarizes tier-level approaches, notation keys [in square brackets], and emission factors (in parentheses) used to estimate changes in relevant carbon stocks in the Land converted to grassland category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Table 6.38 Tier-level approaches, notation keys, and EFs used for 4C2 Land converted to grassland category.

Land-Use Category		Living Biomass		DOM	Soils	
		Gains	Losses		Min	Org
4C2a Forest land converted to grassland		NO	NO	NO	NO	NO
4C2b Cropland converted to grassland		T2 (CS)	T1 (D)	T2 (CS)	T2 (CS)	T1 (D)
4C2c Wetlands converted to grassland		NA ³ [T1]	NA ³ [T1]	NA ³ [T1]	NO	T1 (D)
4C2d Settlements Converted to Grassland		NO	NO	NO	NO	NO
4C2e Other land converted to grassland	Revegetation before 1990	T2 (CS)	IE ¹	T2 (CS)	T2 (CS)	NO
	Other Land Converted to Natural Birch Shrubland	T2 (CS)	IE ²	T2 (CS)	T2 (CS)	NO
	Revegetation since 1990 – Protected from Grazing	T2 (CS)	IE ¹	T2 (CS)	T2 (CS)	NO
	Revegetation since 1990 – Limited Grazing Allowed	T2 (CS)	IE ¹	T2 (CS)	T2 (CS)	NO

¹ Reported as aggregate number under CSC in living biomass - Gains.

² Net biomass gain/losses estimated by the “The Stock-Difference Method” using Equation 2.8 in the 2006 IPCC Guidelines. Biomass losses caused by mortality and harvest are therefore included in the net annual removal and reported as Included Elsewhere (IE) in the CRT reporting table.

³ It is assumed that changes in C-stock in this C pool is in equilibrium based on a Tier 1 approach as the vegetation remains largely undisturbed due to the absence of ploughing or harrowing.

Living biomass

The CSCs in living biomass including BGB were estimated for 4C2b Cropland converted to grassland and all subcategories within 4C2e Other land converted to grassland (Table 6.39). Further information on the calculations is provided in Section 6.5.7.

For 4C2e Other Land converted to grassland, stock changes in living biomass represent revegetation activities reflecting increases in vegetation cover and biomass. These biomass changes are estimated as a relative contribution (10%) of the total carbon stock increase, as in Aradóttir et al (2000).

Carbon stock changes in living biomass for 4C2c Wetlands converted to grassland are reported as NA assuming that changes in C-stock in this C pool is in equilibrium based on a Tier 1 approach, as the vegetation remains largely undisturbed due to the absence of ploughing or harrowing.

Below ground biomass

The approach was implemented for the first time in the 2026 submission: The estimates for BGB for were calculated by multiplying the annual carbon stock change from living biomass losses using a CS BGB to AGB ratio ($R = 0.39$). This ratio was derived from data presented in Aradóttir et al. (2000). The same ratio was also applied to the annual carbon stock change from living biomass gains used for the subcategories 4C2e Revegetation before 1990 and 4C2e Revegetation since 1990.

The value for BGB was then added to the annual carbon stock change associated with AGB gains, from which DOM had already been subtracted, under the subcategories 4C2b Cropland converted to grassland, 4C2e Revegetation before 1990, 4C2e Revegetation since 1990 – protected from grazing, and 4C2e Revegetation since 1990 – limited grazing allowed.

Table 6.39 presents the annual CSCs for LB gains, including BGB, including BGB, as introduced in the 2026 submission. See also Section 6.5.7 on Category-specific recalculations.

Dead organic matter

Emissions and removals from DOM pool for the 4C2b Cropland converted to grassland and 4C2e Other land converted to grassland (all subcategories except for 4C2e Other land converted to natural birch shrubland) are accounted using CS annual carbon stock change factors of $0.15 \text{ t C ha}^{-1} \text{ yr}^{-1}$ and $0.01 \text{ t C ha}^{-1} \text{ yr}^{-1}$, respectively. These factors were derived by applying a CS DOM-to-AGB ratio of 0.24, based on data presented in Table 2 of Aradóttir et

al. (2000), to the previously estimated annual carbon stock changes for living biomass gains. Table 6.39 presents the annual carbon stock changes for living biomass gains, including BGB (2026). For further details, see section 6.5.7. Category-specific recalculations.

Table 6.39 Annual carbon stock change for living biomass gains used up to the 2025 submission (CSC including litter and standing dead); and calculation annual CSCs for DOM and living biomass gains, including BGB, introduced in the 2026 submission.

Land use category	CSC (including litter and standing dead), t C/ha	CSC DOM tC/ha/yr	CSC AGB tC/ha/yr	Ratio	Annual CSCF tC/ha/yr
4C2b Cropland converted to grassland - DOM	0.634			0.24*	0.152
4C2b Cropland converted to grassland - LB Gains	0.634x	0.152	0.482	0.39**	0.670
4C2e Other land converted to grassland: Revegetation before 1990; Revegetation since 1990 -protected from grazing & limited grazing allowed - DOM	0.057			0.24*	0.014
4C2e Other land converted to Grassland: Revegetation before 1990; Revegetation since 1990 -protected from grazing & limited grazing allowed - LB Gains	0.057	0.014	0.043	0.39**	0.060

*Country-specific DOM:AGB ratio derived from data in Aradóttir et al. (2000) (see Table 2 in that study). See explanation in section Dead organic matter above.

**Country-specific ratio BGB:AGB derived from data in Aradóttir et al. (2000) (see Table 3 in that study). See explanation in section BGB above.

The conversion period for Other Land converted to Natural Birch Shrubland is set to 50 years, as it is for Other land Converted to Natural Birch Forest, and with the same in-country removal factors for biomass, DOM, and mineral soil (see Section 0).

Mineral soils

Cropland converted to Grassland

The CSC EF for mineral soils in Cropland converted to grassland has been recalculated and is now 0.71 t C ha⁻¹ compared with the CSC EF 0.26 t C ha⁻¹ applied up to the 2025 submission. This change is due to the use of different default factors in Equation 2.25. (see

Table 6.40). For further details, see Section 6.5.7 Category-specific Recalculation.

Table 6.40 Comparison of calculations for the country-specific EF for C-stock change in mineral soils for the subcategory 4C2b Cropland converted to Grassland between the 2025 and 2026 submissions.

Land use category	SOCref tC/ha	FLU	FMG	FI	Transition period [years]	CSC tC/ha/yr
4C2b Cropland converted to Grassland [Recalculation for the 2026 submission]	90.5	0.69*	1.15*	1.00*	20	71.81
	90.5	1.00**	0.95**	1.00**	20	85.98
	Annual carbon stock changes					0.71

* Table 5.5 2006 IPCC Guidelines: FLU – Long-term cultivated – Temperate/Boreal – Moist/Wet; FMG – No-till – Moist; FI – Medium – All – Dry and Moist/Wet.

** Table 6.2 2006 IPCC Guidelines: FLU – Level: All – Climate regime: All; FMG – Level: Moderately degraded grassland – Climate regime: Temperate/Boreal; FI – Level: Improved grassland – Climate regime: All.

Other land converted to grassland

For mineral soils in the subcategories 4C2e Revegetation before 1990, 4C2e Revegetation since 1990 – protected from grazing, and 4C2e Revegetation since 1990 – limited controlled grazing allowed a CS EF of $0.51 \text{ t C ha}^{-1} \text{ yr}^{-1}$ and a 60-year transition period are applied. The EF is derived from paired soil carbon measurements (0–30 cm) collected at representative sites during 2007–2011 and 2018–2022, yielding an average annual increase of $0.51 \text{ t C ha}^{-1} \text{ yr}^{-1}$.

This value is consistent with findings from Aradóttir et al. (2000), which reported AGB carbon accumulation of $0.01\text{--}0.5 \text{ t C ha}^{-1} \text{ yr}^{-1}$ and demonstrated that soils account for the major share (61–87 %) of total carbon stored in revegetated ecosystems.

A single EF is currently used for three 4.C.2.e. subcategories (Revegetation before 1990; Revegetation since 1990 – protected; Revegetation since 1990 – limited grazing) as no statistically significant differences have yet been found.

The 60-year transition period reflects the slow approach to equilibrium of Icelandic mineral soils under cool, tephra-rich conditions and the sustained carbon accumulation observed in long-term studies (Further information is provided in Section 6.2.2.1. No mineral soils are included in 4C2c Wetland converted to grassland.

Organic soils

Detailed information on drained organic soils can be found in Section 6.2.3 A tier 1 approach together with the IPCC default EF was used to estimate emissions from the use of organic soils (Table 6.41).

Table 6.41 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of 4C2 Land converted to Grassland, by land-use subcategory for the entire reporting period.

Land Category	Pool	EF	$\text{t C ha}^{-1} \text{ yr}^{-1}$	Reference
4C2b Cropland converted to grassland	Mineral Soils	CS	0.71	Calculated based on $\text{SOC}_{\text{ref}} = 90.5 \text{ tC/ha}$ (Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010), $F_{\text{LU}} = 0.93$ (set aside); $F_{\text{MG}} = 1.10$ (no tillage); $F_{\text{I}} = 1.0$ (medium input) from Table 5.5 the 2006 IPCC Guidelines.
	Organic Soils	D	-5.70	Table 2.1 in the 2013 IPCC Wetlands supplement (Grassland, Drained in Boreal Zone)
	Biomass Gains	CS	0.67	Annual increase in above- and BGB is calculated based on the average sampled biomass from grassland below 200 m a.s.l. ($12.68 \text{ t C ha}^{-1}$), divided over

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
				a 20-year conversion period, and adjusted using country-specific BGB:AGB -Aradóttir et.al., (2000) (see Section 6.5.4.2)
	Biomass Losses	D	-2.1 [ICSC in 2024 = -0.08]	Table 5.9 (Temperate (all moisture regimes)) of the 2006 IPCC Guidelines
	DOM	CS	0.15	Estimated by LFI (see Section Dead organic matter in Section Section 6.5.4.2)
4C2c Wetlands converted to grassland	Organic Soils	D	-5.70	Table 2.1 in the 2013 IPCC Wetlands supplement (Grassland, Drained in Boreal Zone)
4C2e Other land converted to grassland				
	Mineral Soils	CS	0.51	Estimated by LFI (expert Jóhann Þórsson)
<i>Revegetation before 1990</i>	Biomass Gains	CS	0.06	Estimated by LFI (expert Jóhann Þórsson) adjusted using country-specific BGB:AGB -Aradóttir et.al., (2000) (see Section Section 6.5.4.2)
	DOM	CS	0.01	Estimated by Land and Forest Iceland (see Section Dead organic matter in Section Section 6.5.4.2)
	Mineral Soils	CS	0.53 0-30 yrs 0.74 31-60 yrs	Sanchez, 2025
<i>Other land converted to Natural Birch Shrubland</i>	Biomass Gains	CS	0.19	Linear regression between biomass per area unit and age in trees on measurement plots in Natural Birch Woodland that belongs to the area expansion from 1989 (n=28, P = 0.0002) is used to measure net annual C-stock change (Snorrason et al. in prep.).
	DOM	CS	0.14	Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008
	Mineral Soils	CS	0.51	Estimated by LFI (expert Jóhann Þórsson)
<i>Revegetation since 1990 – protected from grazing</i>	Biomass Gains	CS	0.06	Estimated by LFI (expert Jóhann Þórsson) adjusted using country-specific BGB:AGB -Aradóttir et.al., (2000) (see Section 6.5.4.2)
	DOM	CS	0.01	Estimated by LFI (see Section Dead organic matter in Section Section 6.5.4.2)
	Mineral Soils	CS	0.51	Estimated by LFI (expert Jóhann Þórsson)
<i>Revegetation since 1990 – limited controlled grazing allowed</i>	Biomass Gains	CS	0.06	Estimated by LFI (expert Jóhann Þórsson) adjusted using country-specific BGB:AGB -Aradóttir et.al., (2000) (see Section 6.5.4.2)
	DOM	CS	0.01	Estimated by LFI Iceland (see Section Dead organic matter in Section Section 6.5.4.2)

6.5.5 Uncertainty Assessment and Time-series Consistency

The uncertainty assessment for Grassland land use category for the period 1990–2024 have been assessed following Approach 1 of the 2006 IPCC Guidelines (IPCC, 2006). Detailed information on the uncertainty rates associated with the AD and the EFs is presented in Annex 2: Assessment of Uncertainty.

It should be noted that Iceland applied a conservative approach for some CS EFs where uncertainty rates were not evaluated in relevant studies. Specifically, the IPCC default uncertainty rates (developed for the relevant and appropriate LU category and carbon pool) were used alongside these CS data, which allowed for an underestimation of the uncertainty assessment. For carbon pools where a Tier 1 approach was applied (that assumes that the carbon pool is in equilibrium), the uncertainty rates were not reported in the table nor used in the overall assessment. The overall uncertainty analysis is reported in Annex 2.

It should also be noted that the data for uncultivated abandoned Cropland are uncertain, particularly regarding whether these areas have ever actually been cultivated. This is because until 1989 wetland drainage was subsidised by the government, giving farmers incentives to drain wetlands. However, a portion of these drained areas have never been used for cultivation, which further supports their allocation to the Grassland category. Due to the lack of reliable information on if the duration for which cropland areas remain uncultivated and whether such land is temporarily out of production or permanently abandoned, all uncultivated cropland areas are reported under Grassland. These areas are, therefore, included in the subcategory 4C1 Cropland abandoned for more than 20 years.

6.5.6 Category-specific QA/QC and verification

Please consult Chapter 1.5 and Section 0 for more information.

6.5.7 Category-specific recalculations

Grassland area timeseries revisions

Recalculations were made throughout the timeseries for subcategories 4C2b Cropland converted to grassland and 4C1 Cropland abandoned for more than 20 years. The changes were driven by updates in the processing of Cropland areas in IGLUD map data and reinterpretation of a key reference for Cropland the earlier part of the timeseries.

An artificial rise in the IGLUD map data for cropland was identified and corrected, see section 6.4.7 for more details. Previously, cultivated areas were added to the cultivated areas of the year before, creating a cumulative running total. The revised processing method uses a three-year running total to assess the area of active cropland, based on the expert judgement that hayfields become tussocky if they are left unused for more than three years.

A key reference for the earlier part of cropland timeseries was revisited (Snæbjörnsson, o.fl., 2010), see section 6.4.7 for details. Reinterpretation of the report resulted in a higher estimate of total cropland in 2008 (168 kha), which consists of active cropland (128 kha) and inactive cropland (40 kha). The report also estimates total cropland to have been 163 kha in 1989.

The recalculations described above primarily affect the area of inactive cropland over the timeseries, i.e. subcategory 4C2b Cropland converted to grassland. As a consequence, subcategory 4C1 Cropland abandoned for more than 20 years is also affected.

The recalculations to the areas of Cropland converted to grassland based on the uncultivated (inactive) cropland timeseries also impacts the ditches area estimates outside of cropland which are used to estimate drained organic soils in Grassland, resulting in a decrease in emissions reported under the category 4C1 Organic soils drained for more than 20 years in the 2026 submission compared to the 2025 submission.

There are also recalculations to the areas of Other grassland from the processed IGLUD data which impacts the grassland subcategories 4C1 Grazing areas, 4C1 Grassland without grazing, and 4C1 Grazing areas on Other Land.

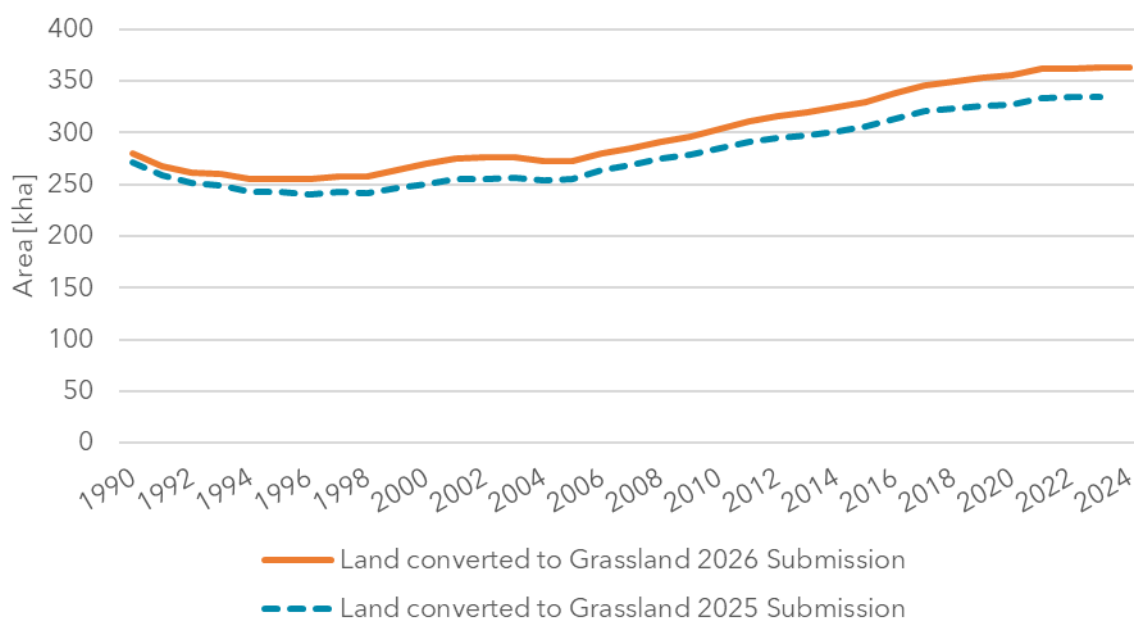


Figure 6.37 Recalculations to the activity data between the current (2026) and previous (2025) submission for Land converted to grassland.

Carbon stock change revisions

Recalculations to emissions and removals for the Grassland category were mainly driven by the following:

1. Estimation of carbon stock changes in the mineral soil pool in 4C1 Grazing areas and 4C1 Grassland without grazing under Grassland remaining grassland;

2. Recalculation of annual carbon stock changes in living biomass gains, including BGB, for the subcategories 4C2b Cropland converted to grassland, 4C2e Revegetation before 1990, 4C2e Revegetation since 1990 – protected from grazing, and 4C2e Revegetation since 1990 – limited grazing allowed;
3. Calculation of carbon stock changes in the dead organic matter (DOM) pool for the subcategories 4C2b Cropland converted to grassland, 4C2e Revegetation before 1990, 4C2e Revegetation since 1990 – protected from grazing, and 4C2e Revegetation since 1990 – limited grazing allowed; and
4. Recalculation of carbon stock change emission factors (CSC EFs) for mineral soils in the subcategory 4C2b Cropland converted to grassland.

A comparison of emissions reported in the 2025 and 2026 submissions is presented in

Table 6.46, while the impact of the recalculations on Grassland remaining grassland and Land converted to grassland between the current and previous submissions is shown in Figure 6.36.

CSC EF for mineral soils in 4C1 Grazing areas and 4C1 Grassland without grazing

Until the 2025 submission, the carbon pool for mineral soils in the subcategory 4C1 Grazing areas, which represents almost 50% of the total area of mineral soils in 4C1 Grassland remaining grassland, was reported as being in equilibrium and consequently as NA. During the comprehensive review conducted by the EEA between May and June 2025, the TERT requested estimates of emissions/removals from this subcategory, assuming that the application of the equilibrium assumption was very likely leading to an underestimation of emissions from mineral soils.

The subcategory 4C1 Grassland without grazing is assumed to exhibit similar characteristics to 4C1 Grazing areas, with the key distinction being the absence of grazing activity (see Table 6.34 for details). Based on this assumption, the same annual carbon stock change factor calculated for 4C1 Grazing areas has been applied to the mineral soil pool of the 4C1 Grassland without grazing subcategory. The recalculation methodology is presented in Table 6.36 in Section 6.5.3.2.

Living biomass

For the 2026 submission, the estimates for LB in the subcategories 4C2b Cropland converted to grassland, 4C2e Revegetation before 1990 and since 1990 have been disaggregated into DOM and AGB (see the DOM section below). Additionally, the living biomass pool for 4C2b Cropland converted to grassland, 4C2e Revegetation before 1990 and 4C2e Revegetation since 1990 now includes BGB (see the BGB section below). The calculation methodology is presented in Table 6.39 in Section 6.5.4.2.

Below ground biomass

Following the comprehensive review conducted by the European Environment Agency (EEA) between May and June 2025, the 2026 submission includes estimates for the BGB pool within the living biomass estimates for the subcategory 4C2b Cropland converted to grassland. The same method was then also applied to 4C2e Revegetation before 1990, 4C2e Revegetation since 1990 – protected from grazing, and 4C2e Revegetation since 1990 – limited grazing allowed (Table 6.39). See also Section Section 6.5.4.2.

Dead organic matter

Until the 2025 submission, carbon stock changes in DOM resulting from the conversion of Cropland to Grassland and Other land to Grassland (all subcategories except for 4C2e Other land converted to Natural Birch Shrubland) were reported as aggregate values under living biomass gains (AGB).

Beginning with the 2026 submission, emissions and removals from DOM pool for the subcategories listed above are accounted using country-specific annual carbon stock change factors of $0.15 \text{ t C ha}^{-1} \text{ yr}^{-1}$ and $0.01 \text{ t C ha}^{-1} \text{ yr}^{-1}$, respectively. These factors were derived by applying a country-specific DOM-to-AGB ratio of 0.24, based on data presented in Table 2 of Aradóttir et al. (2000), to the previously estimated annual CSCs for LB gains. The calculation methodology is presented in Table 6.39 in Section Section 6.5.4.2.

CSC EF for mineral soils in Cropland converted to grassland

Until 2025, carbon stock changes in mineral soils of 4C2b Cropland converted to grassland were assumed to be the reverse of the changes estimated for 4B2b Grassland converted to cropland.

Following the comprehensive review conducted by the European Environment Agency (EEA) between May and June 2025, it was noted that Iceland's method for calculating carbon stock changes in mineral soils for the subcategories 4B2b Grassland converted to cropland and 4C2b Cropland converted to grassland is not fully consistent with the 2006 IPCC Guidelines. The TERT observed that Iceland applied a SOC_{ref} of 90.5 t C/ha based on field measurements but also used this value as SOC₍₀₎ and SOC_(0-T) for managed grassland in land-use conversions. According to the Guidelines, SOC_{ref} should serve as the basis for deriving SOC₍₀₎/SOC_(0-T), adjusted for historical management effects (e.g. using default factors from Tables 5.5 or 6.2). Using SOC_{ref} directly assumes native conditions, which is inconsistent with managed grassland.

Consequently, for the 2026 submission, the CSC EF for mineral soils in 4C2b Cropland converted to grassland has been recalculated and is now 0.71 t C/ha, compared with 0.26 t C/ha used up to the 2025 submission (see Table 6.42).

Table 6.42 Comparison of calculations for the country-specific EF for C-stock change in mineral soils for the subcategory 4C2b Cropland converted to grassland between the 2025 and 2026 submissions.

Land use category	SOCref tC/ha	FLU	FMG	FI	Transition period [years]	CSC tC/ha/yr
4C2b Cropland converted to grassland [Calculation for the 2025 submission]	90.05	0.82*	1.15*	1.00*	20	84.92
	90.05	1.00**	1.00**	1.00**	20	90.05
	Annual carbon stock changes					0.26
4C2b Cropland converted to grassland [Recalculation for the 2026 submission]	90.5	0.69***	1.15***	1.00***	20	71.81
	90.5	1.00****	0.95****	1.00****	20	85.98
	Annual carbon stock changes					0.71
Differences between previous annual carbon stock change (CSC) estimates and those reported in the 2026 submission in tC/ha/yr						0.45
Differences between previous annual carbon stock change (CSC) estimates and those reported in the 2026 submission in %						176%

* Table 5.5 2006 IPCC Guidelines: FLU – Set aside (<20 yrs) – Temperate/Boreal and Tropical – Moist/Wet; FMG – No-till – Temperate/Boreal – Moist; FI – Medium – All – Dry and Moist/Wet.

** Table 6.2 2006 IPCC Guidelines: FLU – Level: All – Climate regime: All; FMG – Level: Nominally managed (non-degraded) – Climate regime: All; FI – Level: Medium – Climate regime: All.

*** Table 5.5 2006 IPCC Guidelines: FLU – Long-term cultivated – Temperate/Boreal – Moist/Wet; FMG – No-till – Moist; FI – Medium – All – Dry and Moist/Wet.

**** Table 6.2 2006 IPCC Guidelines: FLU – Level: All – Climate regime: All; FMG – Level: Moderately degraded grassland – Climate regime: Temperate/Boreal; FI – Level: Improved grassland – Climate regime: All.

The recalculation of the CSC EF has resulted in a significant increase in carbon stock gains in mineral soils in this subcategory (See Table 6.43 and Figure 6.36).

Table 6.43 Comparison of area data [kha] for mineral soils in the subcategory 4C2b Cropland converted to grassland, as reported in the current submission versus the previous year's submission.

Area [kha]	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
4C2b Cropland converted to grassland - mineral soils	2025	4.12	3.26	2.39	1.51	1.13	1.93	2.71	3.03	3.18
	2026	6.62	6.62	6.62	6.62	7.87	10.99	13.98	14.23	14.59
	Difference	2.50	3.36	4.24	5.10	6.74	9.06	11.27	11.20	11.41
	%	60.8%	103.3%	177.4%	337.6%	595.9%	470.8%	415.2%	370.2%	358.3%

Table 6.44 Comparison of net carbon stock changes [kt C] for mineral soils in the subcategory 4C2b Cropland converted to grassland, as reported in the current submission and in the previous year's submission.

Land use category	Subm.	ktC/ ha/yr	1990 Net CSC ktC	1995 Net CSC ktC	2000 Net CSC ktC	2005 Net CSC ktC	2010 Net CSC ktC	2015 Net CSC ktC	2020 Net CSC ktC	2022 Net CSC ktC	2023 Net CSC ktC
4C2b Cropland converted to	2025	0.26	1.06	0.84	0.62	0.39	0.29	0.50	0.70	0.78	0.82
	2026	0.71	4.69	4.69	4.69	4.69	5.57	7.78	9.90	10.08	10.33

Land use category	Subm.	ktC/ha/yr	1990 Net CSC ktC	1995 Net CSC ktC	2000 Net CSC ktC	2005 Net CSC ktC	2010 Net CSC ktC	2015 Net CSC ktC	2020 Net CSC ktC	2022 Net CSC ktC	2023 Net CSC ktC
Grassland - mineral soils	Difference	0.45	3.62	3.85	4.07	4.30	5.28	7.28	9.20	9.30	9.51
	in%	172%	341%	458%	662%	1101%	1811%	1467%	1315%	1191%	1158%

Summary of emissions comparisons between the 2025 and 2026 submissions due to Recalculations

Table 6.46 provides comparison of emissions reported in the 2025 and 2026 submissions. Figure 6.36 illustrates the comparison of emission trends for Grassland remaining grassland and Land converted to grassland between the current (2026) submission and the previous (2025) submission

Table 6.45 Comparison of area data [kha] for the Grassland category as reported in the current submission and in the previous year's submission.

Area [kha]	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
4C Grassland	2025	5954	5959	5980	6000	6021	6036	6058	6066	6065
	2026	5868	5877	5902	5926	5953	5980	6013	6022	6024
	Difference	-85.92	-82.52	-78.51	-74.34	-67.73	-56.63	-45.27	-43.58	-40.54
	%	-1.4%	-1.4%	-1.3%	-1.2%	-1.1%	-0.9%	-0.7%	-0.7%	-0.7%

Table 6.46 Comparison of greenhouse-gas emissions [kt CO₂e] for the Grassland category as reported in the current submission and in the previous year's submission.

GHG kt CO ₂ e	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
CO ₂	2025	5361	5325	5334	5372	5466	5463	5444	5430	5437
	2026	4002	4018	4083	4183	4351	4427	4490	4481	4512
	Difference	-1359	-1307	-1251	-11895	-1116	-1035	-954	-950	-925
	in%	-25.3%	-24.6%	-23.5%	-22.1%	-20.4%	-18.9%	-17.5%	-17.5%	-17.0%
CH ₄	2025	16.00	16.00	16.19	16.44	16.90	17.02	17.11	17.12	17.18
	2026	15.63	15.78	16.14	16.57	17.24	17.66	18.04	18.12	18.21
	Difference	-0.37	-0.22	-0.06	0.13	0.34	0.64	0.93	0.99	1.04
	in%	-2.3%	-1.4%	-0.3%	0.8%	2.0%	3.7%	5.5%	5.8%	6.0%
N ₂ O	2025	-	-	-	-	0.00	0.00	0.00	-	0.00
	2026	-	-	-	-	0.00	0.00	0.00	-	0.00
	Difference	-	-	-	-	0.00	0.00	0.00	-	0.00
	in%	-	-	-	-	0.00%	0.00%	0.00%	-	0.00%

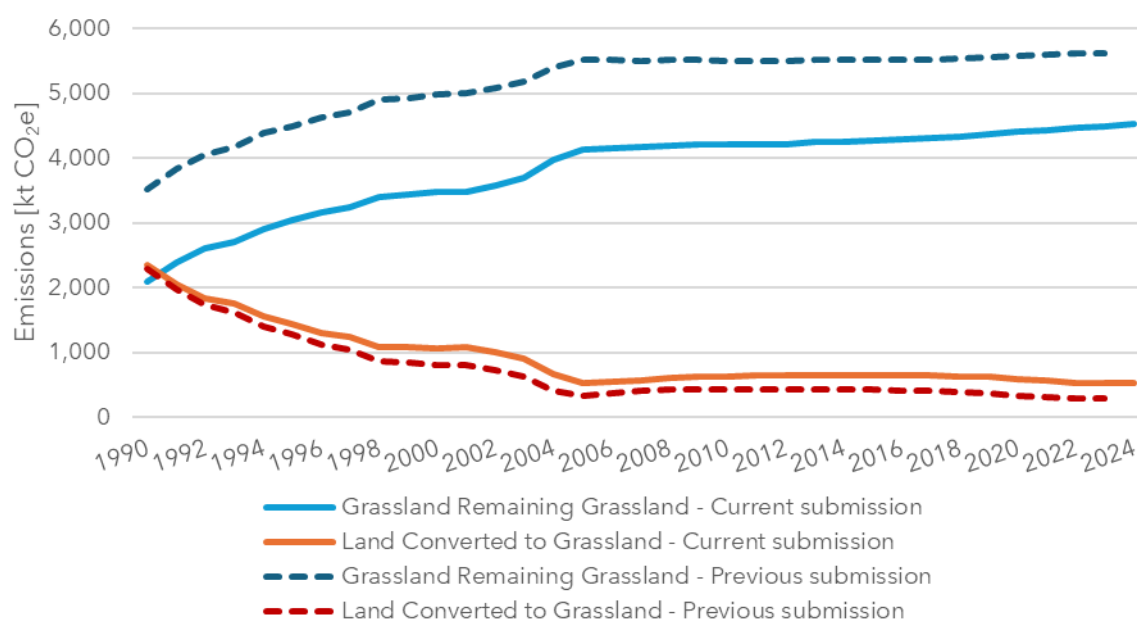


Figure 6.38 Recalculations to the emissions between the current and previous submission for Grassland.

6.5.8 Category-specific planned Improvements

Grassland remaining grassland

The total emissions related to drained Grassland soils are a principal component in the net emissions reported for the land-use category. The estimation of this component is still based on T1 methodology and basically no disaggregation of the drainage area (Table 6.35 and Table 6.37). In 2023, Land and Forest Iceland initiated a project to systematically collect soil samples and perform in situ measurements of greenhouse gas fluxes from drained organic soils using portable flux chambers and analysers. The objective is to enhance emissions and removals estimates by upgrading the methodology to higher Tiers for this carbon pool. Preliminary data are being assessed and will be incorporated into the national inventory submission.

A scientific article *Regional Estimates of CO₂ Fluxes and Stock Losses from Drained Uncultivated Peatlands in West Iceland* was published on 16th of February 2026 (Guðmundsson J. , Óskarsson, Pagneux, & Þórðarson, 2026). The article measured chamber CO₂ fluxes, Photosynthetically Active Radiation (PAR), soil and air temperature at five sites in Borgarfjörður in West Iceland. Measurements were made in 2001-2004 and model verification was based on further measurements in 2007-2009. The results were coupled with remote sensing measurement of greenness as Normalized Difference Vegetation Index (NDVI) to extend the results to the extended area around the measurement sites. Net Ecosystem Exchange (NEE) for the extended area was 2.07 t C ha⁻¹, 4.90 t C ha⁻¹ and 2.12 t C ha⁻¹ for years 2002, 2003 and 2007, respectively, and average for the years was 3.03 t C ha⁻¹. The annual average soil temperature was 3.76°C, 6.11°C and 3.97°C, for years 2002, 2003 and

2007, respectively. “The annual average soil temperature in 2003 was much higher than that in the other years [and] the average NEE of all the measurement sites in 2003 consequently more than doubled” (Guðmundsson J. , Óskarsson, Pagneux, & Þórðarson, 2026). Since the article was only published a month before the final March 2026 submission, it was not possible to integrate these results properly into the GHG inventory in such a short timeframe. It is planned to integrate these results into the emissions inventory in 2027 submission.

New map of ditches was released in 2025 and provide new estimates of changes in ditch network. Mapping of ditches is ongoing, now with emphasis on improving the timeseries. This work is ongoing.

The largest subcategory of Grassland, Other Grassland, is reported as two units: 4C1 Grazing areas and 4C1 Grassland without grazing. The importance of mineral soil pools must be emphasised, as Icelandic mineral grassland soils are almost always Andosols with a high capacity for carbon storage. (Arnalds, Óskarsson, Gísladóttir, & Grétarsson, 2009; Arnalds & Óskarsson, 2009). Subdivision of those categories according to vegetation coverage and soil erosion was done for the first time in response to the 2025 TERT review. However, improvement on this subdivision is ongoing in relation to new data on ecosystem conditions and soil erosion.

In 2023, Land and Forest Iceland initiated a project to systematically collect soil samples and perform in situ measurements of greenhouse gas fluxes from Grassland remaining grassland on mineral soils using portable flux chambers and analysers. The objective is to enhance emissions and removals estimates by upgrading the methodology to higher Tiers for this carbon pool. Preliminary data are being assessed and will be incorporated into the national inventory submission.

Improvements in the Cropland category will influence Grassland subcategories 4C2b Cropland converted to grassland and 4C1 Cropland abandoned for more than 20 years. See more details in section 6.4.7.

Iceland is currently reviewing available national datasets to assess the presence and extent of organic soils within the subcategories 4.C.1 Grazing areas and 4.C.1 Grassland without grazing.

Land converted to grassland

The planned improvements described above for drained organic soils of Grassland remaining grassland also apply to the drained organic soils for the subcategories 4C2c Wetlands converted to grassland and 4C2b Cropland converted to grassland. Maps of Cropland in use have been improved, along with reformation of agricultural support payments. These improvements enable better tracking of abandoned Cropland, such as 4C2b Cropland Converted to grassland or other categories.

Improvements in sequestration rate estimates and recordings for other revegetation areas are aimed at establishing a transparent, verifiable inventory of carbon stock changes. The corresponding emissions and removal factors, based on the ongoing national inventory on revegetation area (NIRA) update, have been delayed and are now expected to be included in the 2027 submission. When implemented, these improvements will provide more accurate area and removal factor estimates for revegetation, subdivided according to management regime, regions, and age.

6.6 Wetlands (CRT 4D)

6.6.1 Category description

The total area of managed wetlands, combining both existing wetlands and those converted to wetlands, increased from 323.9 kha in 1990 to a peak of 338.3 kha in 1998. After 1998, the total area began to decline slightly and by 2024, the total area was 321.6 kha, reflecting a general decline over the long term (Figure 6.39).

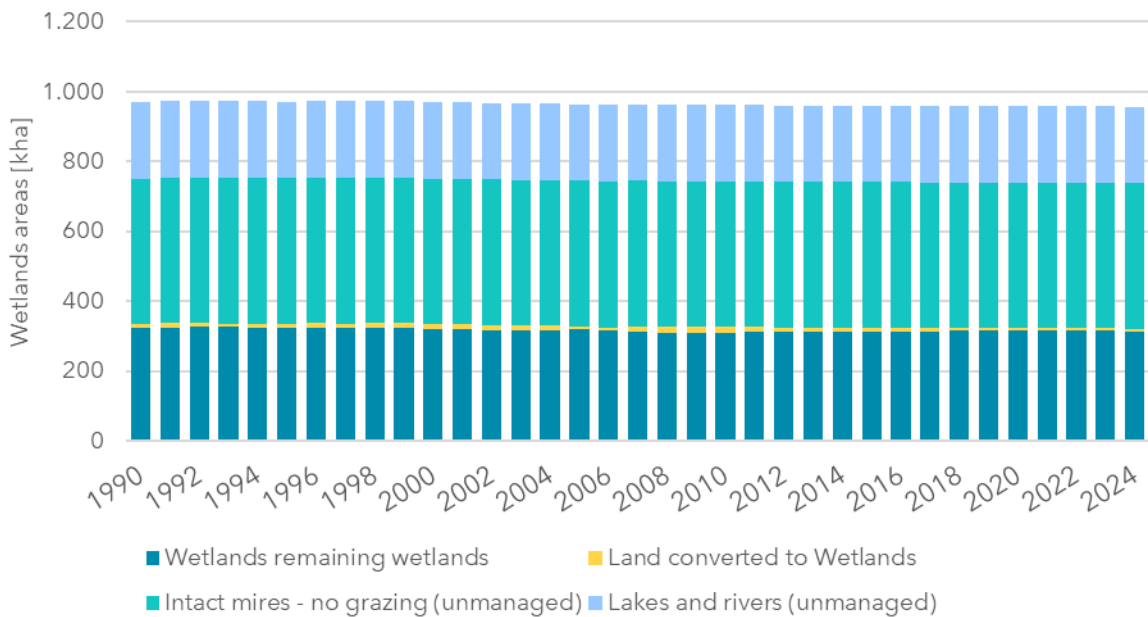


Figure 6.39 Area of Wetlands by category in Iceland in 1990 – 2024 [kha] (The areas of unmanaged Wetlands areas are shown for transparency. The data were not used in the estimates).

Wetlands remaining wetlands is a CO₂ source between 1991 and 2010, with steady emissions of 1.39 kt CO₂. From 2016 to 2024, however, this category becomes a sink, showing an increasing trend in removals from -0.07 kt CO₂ to -0.53 kt CO₂ in 2024 (Figure 6.40).

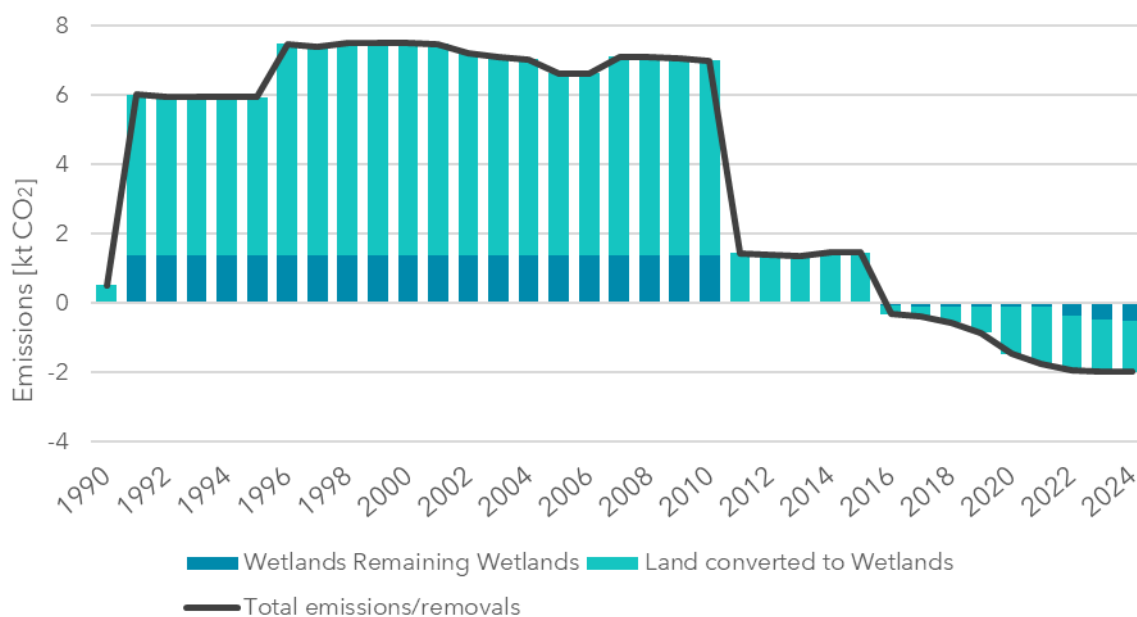


Figure 6.40 CO₂ emissions resulting from Wetlands (by category) in Iceland in 1990 – 2024 [kt].

6.6.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Wetlands represent the third largest land-use category in the country. The category includes both managed and unmanaged areas. According to the 2006 IPCC Guidelines, wetlands areas are classified as "managed" when the water table is artificially altered. Unmanaged wetlands encompass lakes, rivers, and mires or fens located at elevations above 200 meters, where grazing activities are minimal or absent. Managed wetlands comprise reservoirs, intact mires with grazing activity, and rewetted mires. The category consists of 10 subcategories summarized in Table 6.47 below.

Table 6.47 Definitions of Wetlands subcategories

LU category	Definition	LU subcategory	Definition	Allocation	Conversion period
4D Wetlands	Includes all land that is covered or saturated by water for at least part of the year and does not fall into the Settlements, Forest Land, or Cropland categories. It includes intact mires and reservoirs as managed subdivisions, and natural rivers and lakes as unmanaged subcategories.	Flooded land			
		4D1b Intact mires converted to reservoirs	This subcategory includes land areas with high organic carbon content (>50 kgC/m ²) that have been inundated, changing their natural state. Due to the altered ecosystem function from flooding, these areas are now classified as "4D1b Flooded land remaining flooded land" instead of being reported as mires. These areas come from "Intact mires – unmanaged" as the reservoirs are known to be built at higher elevation (>200m)	WLRWL	-
		4D1b Intact mires converted to reservoirs more than 20 years	This subcategory includes land areas that were initially classified as "Mires converted to reservoirs" and have completed a 20-year conversion period. CO ₂ emissions are reported as NA (Table 6.49) for this category as CO ₂ emissions from conversion are no longer expected after 20 years (IPCC 2019, Vol 4, Chap. 7, p. 7.11).	WLRWL	-
		4D1b Medium SOC to reservoirs older than 20 years	This subcategory includes flooded grassland areas having a vegetation cover in the range of 20-50% and therefore classified as medium soil organic carbon content. This subcategory is assumed to be converted from all mineral Grassland categories proportionally to their size. This subcategory is reported in WLRWL when the area has transitioned from the subcategory "Grassland converted to flooded land (Medium SOC)" after a 20-year conversion period.	WLRWL/LUC to WL	20 years
		4D1b Low SOC to reservoirs older than 20 years	This subcategory includes flooded Other land areas having a vegetation cover less than 20% and therefore classified as low soil organic carbon content. This subcategory is reported in WLRWL when the area has transitioned from the subcategory "Other land converted to flooded land (Low SOC)" after a 20-year conversion period.	WLRWL/LUC to WL	20 years
		Other wetlands			
		4D1c Lakes and rivers	This subcategory includes areas of unmanaged land reported as Lakes and rivers.	WLRWL	-
		4D1c Lakes and rivers converted to reservoirs	This subcategory represents areas of unmanaged lakes or rivers which were turned into reservoirs by building a dam in their outlet without changing the water level.	WLRWL	-

LU category	Definition	LU subcategory	Definition	Allocation	Conversion period
		4D1c Intact Mires - no grazing	This subcategory encompasses wetland areas situated above 200 m elevation that have remained ecologically intact and free from significant human disturbance.	WLRWL	
		4D1c Intact Mires – grazing areas	This subcategory includes intact mires below 200 m where livestock grazing is known to occur as a land-use activity ⁴⁶ .	WLRWL	-
		4D1c Rewetted mires	Rewetted mires are wetland areas that have undergone restoration after previous disturbance, transitioning into this subcategory 20 years after rewetting. They are reported under Grassland converted to Other wetlands subcategory. Areas of organic soils are assumed to be converted from the organic Grassland category 4C1 Organic soils drained for more than 20 years and areas of mineral soils are assumed to be converted from the mineral Grassland category 4C1 Cropland abandoned for more than 20 years as these areas are known to be drained and historically intensively managed respectively.	WLRWL/LUC to WL	20 years
		4D1c Refilled lakes and ponds	This subcategory includes refilled lakes and ponds areas previously disturbed. They are reported under Grassland converted to Other wetlands subcategory. Areas are assumed to be converted mineral Grassland category 4C1 Cropland abandoned for more than 20 years as these areas are known to be historically intensively managed.	WLRWL/LUC to WL	20 years

⁴⁶ Although intact mires – grazing areas constitute the largest subcategory within managed wetlands, the soils in this subcategory are not drained but are only subject to grazing. In line with the 2006 IPCC Guidelines (Chapter 7.1, p. 7.5), which state that “managed wetlands will be restricted to wetlands where the water table is artificially changed (e.g., drained or raised) or those created through human activity (e.g., damming a river),” the comprehensive review conducted by the EEA between May and June 2025 highlighted that the previously applied methodology was inappropriate. Therefore, intact mires – grazing areas continue to be classified as managed land due to grazing activities; however, emissions and removals for this subcategory are now reported as NA.

The data for the Wetlands category is derived from various sources, including:

- Land and Forest Iceland (LFI)
- The Icelandic Geodatabase for Land Use and Land Cover (IGLUD).
- Agricultural University of Iceland
- Data from The National Power Company of Iceland.
- Cropland active time series and ditches time series.

The time series for the Wetlands category is developed using historical records, assumptions and current data coming out from IGLUD map (Table 6.48).

Information on the mires converted to reservoirs is based on reservoir mapping and data on inundated land. The subcategory includes inundated land with high soil organic carbon (SOC) content (over 50 kg C m⁻²). Reservoir mapping provides also information on reservoirs over medium or low SOC older than 20 years.

Intact mires, previously classified as managed and unmanaged wetlands, were reclassified for the 2026 submission into 4D1c Intact mires - grazing areas and 4D1c Intact mires – no grazing (unmanaged) subcategories. The revised series assumes that no drainage of histosols occurs within these two subcategories, resulting in all areas remaining undrained for every year except 1991. In that year, 500 hectares were flooded and reclassified as 4D1b Intact mires converted to reservoirs. The time series of land representation on intact mires is based on data from IGLUD maps since 2019 and assumptions considering information from active cropland time series and ditches maps before that.

Information on the time series of lakes and rivers come from The National Power Company until 2019 after which data from IGLUD is used.

Data on other land-uses converted to reservoirs was sourced from hydropower companies, covering 27 reservoirs. These areas were further classified based on soil organic carbon (SOC) content into low, medium, and high SOC categories to provide a more detailed representation.

Table 6.48 Methodology and data sources for constructing the time series of Wetlands category.

Land use category		Subcategories	1989	1990	-	2019	-		2023	2024
Wetlands remaining wetlands	Flooded land remaining flooded land	<i>Intact mires to reservoirs</i>	Agriculture Research Institute							
		<i>Intact mires to reservoirs > 20 years</i>								
		<i>Medium SOC to reservoirs > 20 years</i>								
		<i>Low SOC to reservoirs > 20 years</i>								
	Other wetlands remaining other wetlands	<i>Lakes and river</i>	The National Power Company of Iceland		Annual IGLUD maps					
		<i>Lakes and rivers to reservoirs</i>								
		<i>Intact mires - no grazing</i>	Cropland active timeseries and diches timeseries							
		<i>Intact mires - grazing areas</i>								
		<i>Rewetted mires</i>	Recorded areas converted							
		<i>Rifilled lakes and ponds > 20 years</i>								
Land converted to Wetlands	Grassland to flooded land	<i>Medium SOC to reservoirs</i>	Agriculture Research Institute							
	Other land to flooded land	<i>Low SOC to reservoirs</i>								
	Grassland to Other wetlands	<i>Rewetted wetland soils</i>	Recorded areas converted							
		<i>Rifilled lakes and ponds</i>								
Legend										
Samples or known areas	Maps	Expert judgement	Interpolation / extrapolation		Assumptions					

6.6.3 Wetlands remaining wetlands (CRT 4D1)

6.6.3.1 Category Description

The area of 4D1 Wetlands remaining wetlands showed a consistent decrease over the period, declining from 323.9 kha in 1990 to 313.3 kha in 2024.

The area of Lakes and rivers converted to reservoirs subcategory represented the second most significant subcategory in terms of the area. It remained stable at 31.8 kha from 1990 to 2007, then showed a slight increase, reaching 32.3 kha by 2024 (Figure 6.41).

Regarding the magnitude of emissions/removals, 4D1 Wetlands remaining wetlands is a CO₂ source between 1991 and 2010, with steady emissions of 1.39 kt CO₂. From 2016 to 2024, however, this category becomes a sink, showing an increasing trend in removals from -0.07 kt CO₂ to -0.53 kt CO₂ in 2024. Organic soils were the sole contributor to emissions during the period 1991 to 2010 and the sole contributor to removals during the period 2016 to 2024 (Figure 6.42).

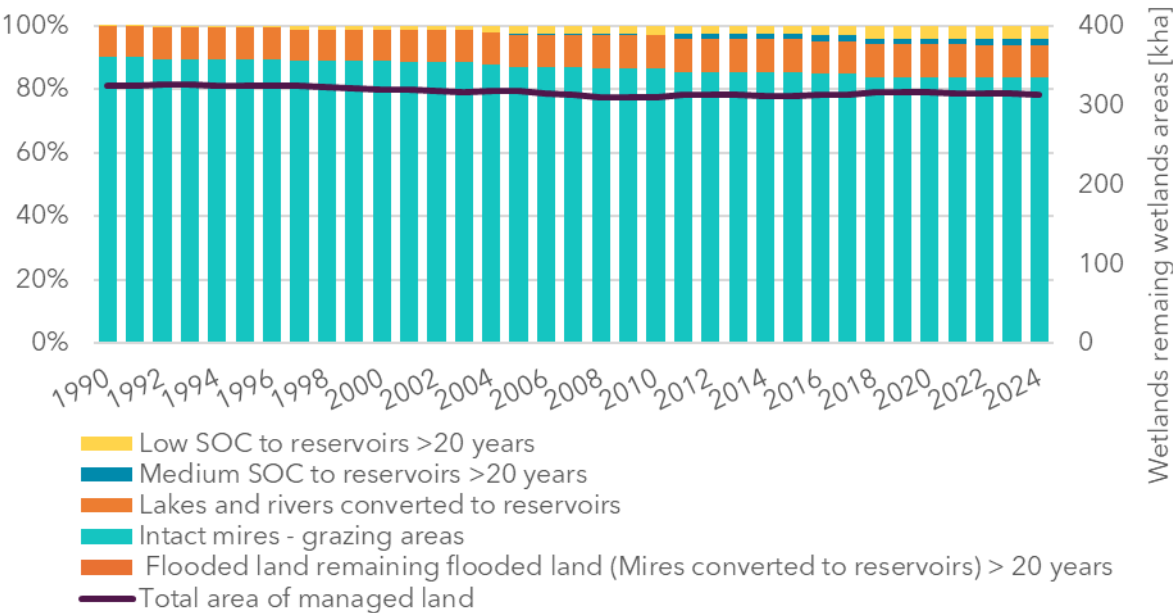


Figure 6.41 The total area [kha] and relative shares [%] of Wetlands remaining Wetlands (by subcategory) in Iceland in 1990 – 2024.

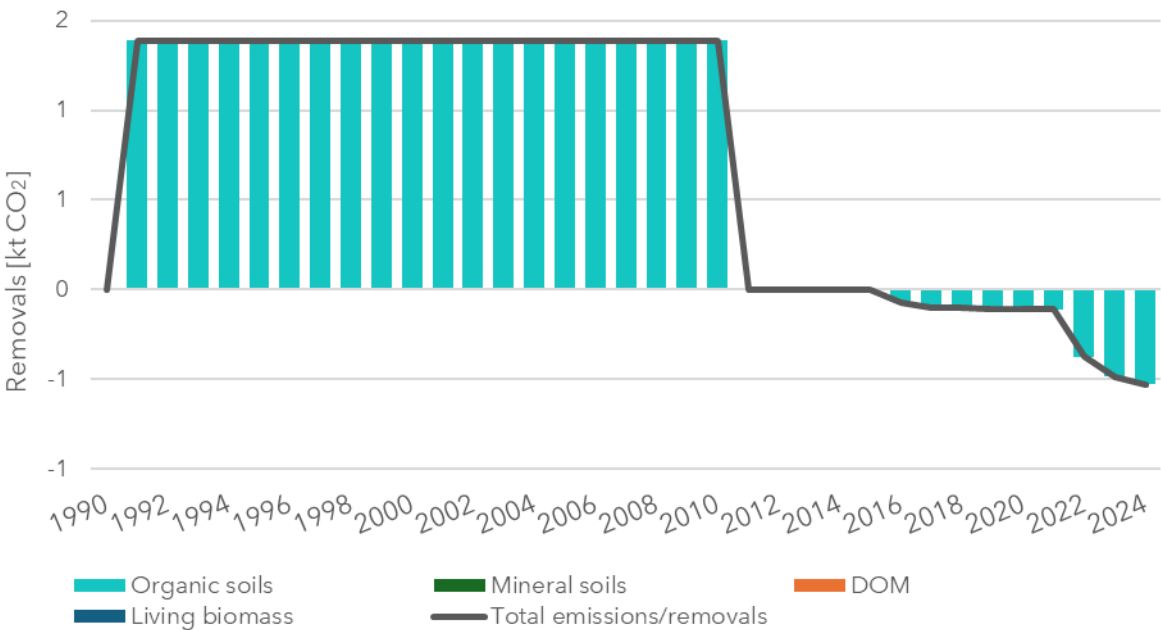


Figure 6.42 Emissions (+) and removals (-) from Wetlands remaining wetlands by pools in Iceland in 1990 – 2024, [kt CO₂].

6.6.3.2 Methodology

Table 6.49 summarizes tier-level approaches, and notation keys are used to estimate changes in relevant carbon stocks in the Wetlands remaining wetlands category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Significant updates were implemented in this category following the comprehensive review carried out by the European Environment Agency (EEA) between May and June 2025. In particular, substantial revisions and recalculations were made for the 4D1c Intact mires – grazing areas subcategory (formerly Intact mires – managed). Further details are provided in Section 6.7.7 on category-specific recalculations.

Table 6.49 Tier-level approaches, notation keys, and emission factors used for the Wetlands remaining wetlands category.

Land-Use Category	LB		DOM	Soils	
	Gains	Losses		Min	Org
4D1a Peat Extraction Remaining Peat Extraction	NO	NO	NO	NO	NO
4D1b Flooded Land Remaining Flooded Land					
Intact mires converted to Reservoirs	NO	NO	NO	NO	NO
Intact mires converted to reservoirs more than 20 years	NA ¹	NA ¹	NA ¹	NO	NA ¹
Medium SOC to reservoirs older than 20 years	NA ¹	NA ¹	NA ¹	NA ¹	NO ⁴
Low SOC to reservoirs older than 20 years	NA ¹	NA ¹	NA ¹	NA ¹	NO ⁴
4D1c Other Wetlands Remaining Other Wetlands					
Intact Mires – grazing areas	NA ⁶	NA ⁶	NA ⁶	NO	NA
Lakes and Rivers Converted to Reservoirs	NA ²	NA ²	NA ²	NA ²	NO
Refilled lakes and ponds older than 20 years	NA ²	NA ²	NA ²	NO	IE ⁵
Rewetted mires	IE ³	IE ³	IE ³	NO	T1(D)

¹ According to the 2019 Refinement to the 2006 IPCC Guidelines, no CO₂ emissions are reported for Land converted to Flooded land for more than 20 years.

² LB and DOM are reported as NA because no vegetation removal occurred before flooding the area.

³ CSCs in living biomass for gains and losses and DOM are included as aggregated values in organic soils under this subcategory. In section 3.2.1 in the 2013 WL supplement to the IPCC 2006 GL it is stated the following: "Since the default CO₂-C EFs in this chapter are all derived from flux measurements (see Annex 3A.1), the CO₂-composite results from the net flux, emissions or removals, from the soil and non-tree vegetation taken together." It is assumed no trees-vegetation cover over areas of intact mires.

⁴ No organic soils areas occur under Medium SOC to reservoirs older than 20 years and Low SOC to reservoirs older than 20 years land-use subcategories, therefore NO was used.

⁵ Reported as aggregate values under organic soils in "Rewetted mires"

⁶ Following the EEA comprehensive review between May and June 2025, significant updates and recalculations were made to the category Intact mires – grazing areas. Please see Section 6.6.7 Category-specific recalculations

Living biomass, Mineral soils and DOM: All subcategories

The information regarding notation keys and the approaches used to estimate or report emissions and/or removals due to changes in the stock of living biomass, mineral soils and DOM is provided in the footnote of Table 6.49 for each relevant category.

Organic soils:

CO₂ emissions from organic soils were estimated for 4D1b Intact mires converted to reservoirs up to the 2010 reporting year. Starting with the 2011 reporting year, however, CO₂ emissions for this category are no longer estimated and are reported as NO, as these areas are no longer classified as 4D1b intact mires converted to reservoirs but as 4D1b Intact mires converted to reservoirs for more than 20 years.

Organic soils: Other wetlands remaining other wetlands

The CSCs in organic soils of the category 4D1c Rewetted mires were estimated according to a Tier 1 by applying Equation 3.4 and the IPCC default EF (Table 6.50). Other information on notation keys and the approaches used to estimate or report emissions and/or removals from organic soils is provided in Table 6.49 for each relevant category.

Table 6.50 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of Wetlands remaining wetlands, by land-use subcategory for the entire reporting period.

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
4D1b Rewetted mires	Organic soils	D	0.55	Table 3.1 in the 2013 Wetlands Supplement (Boreal Nutrient Rich Soils)

6.6.4 Land converted to wetlands (CRT 4D2)

6.6.4.1 Category Description

The Land converted to wetlands category exhibited notable fluctuations in area over the reporting period, beginning at 9.0 kha in 1990, peaking at 16.9 kha in 2010, and then declining to 8.3 kha in 2024. Meanwhile, the Other Land converted to flooded land (4D2bv Low SOC to reservoirs) subcategory remained the largest throughout the period, starting at 8.4 kha in 1990 and decreasing to 6.3 kha in 2024. The Grassland converted to flooded land (4D2biii Medium SOC to reservoirs) subcategory showed a moderate increase, beginning at 0.5 kha in 1990 and reaching a peak of 6.4 kha in 2009, followed by a decrease to 1.0 kha in 2024 (Figure 6.43).

Land converted to wetlands shifted from being a net source to a net sink over the reporting period. The total value of emissions changed from 0.5 kt CO₂ in 1990 to 6.1 kt CO₂ in 1996 and moved to net removals in 2016, reaching -1.5 kt CO₂ in 2024. Management of mineral soils consistently showed emissions throughout the reporting period. The management of organic soils was a net source (Figure 6.44).

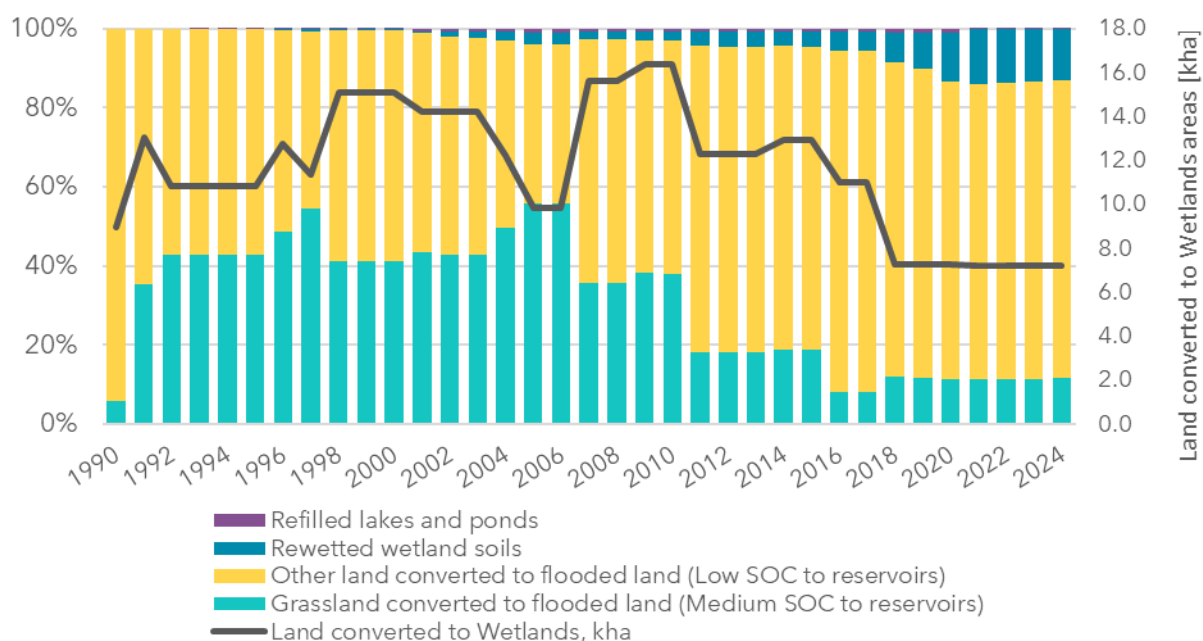


Figure 6.43 The total area (kha) and relative shares (%) of subcategories within Land converted to wetlands in Iceland in 1990 – 2024.

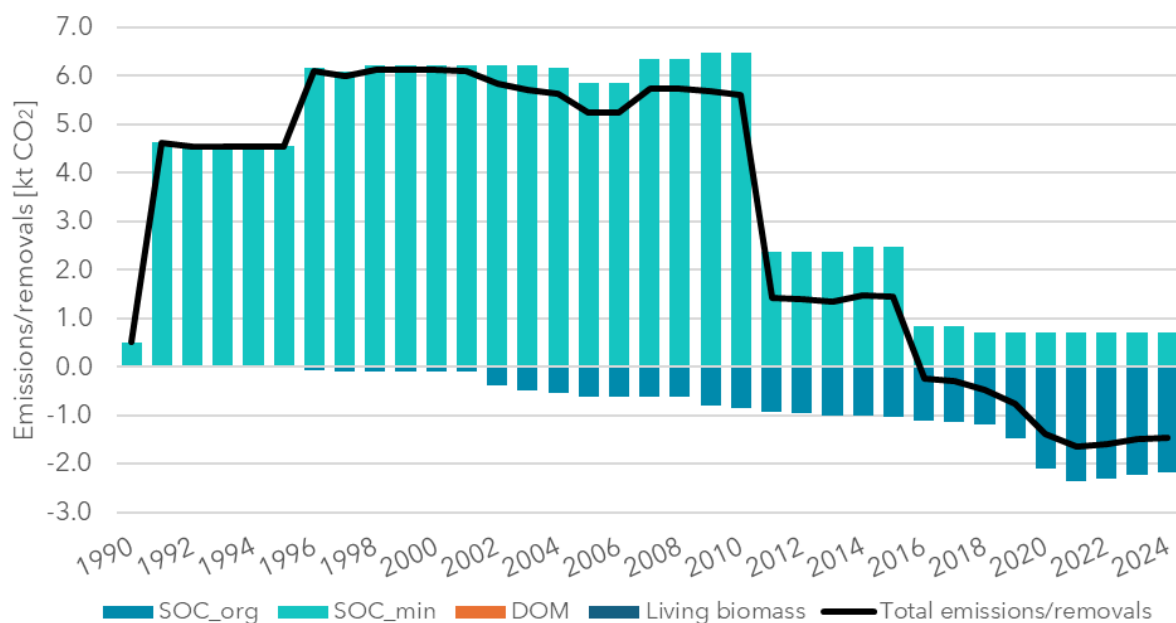


Figure 6.44 Emissions (+) and removals (-) by pools from Land converted to wetlands in Iceland in 1990 – 2024, [kt CO₂].

6.6.4.2 Methodology

Table 6.51 summarizes tier-level approaches, notation keys, and EFs (in parentheses) are used to estimate changes in relevant carbon pools in the Land converted wetlands category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Table 6.51 Tier-level approaches, notation keys, and EFs used for the Land converted to wetlands category.

Land-Use Category	LB		DOM	Soils	
	Gains	Losses		Min	Org
4D2a Land Converted to peat extraction	NO	NO	NO	NO	NO
4D2biii Grassland Converted to flooded land					
Medium SOC to reservoirs	NA ¹	NA ¹	NA ¹	T2 (CS)	NO
4D2bv Other Land converted to flooded land					
Low SOC to reservoirs	NA ¹	NA ¹	NA ¹	T2 (CS)	NO
4D2ciii Grassland converted to other wetlands					
Rewetted Wetland Soils	IE ²	IE ²	IE ²	T1(D)	T1(D)
Refilled Lakes and Ponds	NA ³	NA ³	NA ³	NA ⁴	IE ⁵

¹ According to the WL Supplement, LB and DOM are reported as NA because no vegetation removal occurred before flooding the area.

² Living biomass for gains and losses and DOM are included as aggregated values in organic soils under this subcategory. In section 3.2.1 in the 2013 WL supplement to the IPCC 2006 GL it is stated the following: "Since the default CO₂-C EFs in this chapter are all derived from flux measurements (see Annex 3A.1), the CO₂-composite results from the net flux, emissions or removals, from the soil and non-tree vegetation taken together." It is assumed no trees-vegetation cover over areas of intact mires.

³ LB and DOM are reported as NA because no vegetation removal occurred before flooding the area.

⁴ C-stock changes in mineral soils are reported as "NA," as 2006 IPCC Guidelines (Vol 4, chap. 7, p. 7.20) do not provide any methodology for estimating C-stock changes in soils due to land conversion to Flooded Land.

⁵ Reported as aggregate values under organic soils in "Rewetted wetland soils".

Mineral soils: Medium SOC and Low SOC to Reservoirs

The data on reservoir areas (i.e., land converted to reservoirs) were obtained from the hydro-power companies. In total, the data areas were obtained for 27 reservoirs. Furthermore, the reservoirs were classified according to SOC content: low, medium and high.

The CS EFs were developed by taking into consideration the study results on inundated carbon evaluated by Óskarsson and Guðmundsson (2001) and (Óskarsson & Guðmundsson, 2008). Reservoir EFs include seasonal diffusion from the surface and degassing through spillways for both CO₂ and CH₄, and bubble emissions. In total, 10 reservoirs were examined in the studies for which EFs were evaluated (Table 6.52): 6 reservoirs classified as Low SOC, 3 as Medium SOC, and 1 as High SOC. For those reservoirs where no specific EFs evaluated, the average of EF for the relevant category (i.e., low SOC, medium SOC or high SOC) was applied. The EF of High SOC are applied for the land-use category Mires Converted to Reservoirs (Section 6.6.3.1). The IEFs for Low SOC and Medium SOC to Reservoirs is reported in Table 6.52.

Table 6.52 EFs applied to estimate emissions from Flooded Land (Óskarsson and Guðmundsson 2001, Óskarsson and Guðmundsson, 2008).

Reservoir name	Emission factor [kg GHG ha ⁻¹ d ⁻¹]			
	CO ₂ ice-free	CO ₂ ice cover	CH ₄ ice-free	CH ₄ ice cover
Low SOC				
R9_Krókslón	0.23	0	0.0092	0
R10_Hrauneyjalón	0.106	0	0.0042	0
R6_Bjarnalón	0.076	0	0.003	0
R11_Sultartangalón	0.083	0	0.0033	0
R22_Háslón	0.392	0	0.0157	0
R23_Grjótárlón	0.2472	0	0.0099	0
Average	0.162	0	0.0065	0
Medium SOC				
R16_Blöndulón	4.67	0	0.187	0.004
R25_Ufsarlón	0.902	0	0.036	0.0008
R24_Kelduárlón	0.770	0	0.031	0.0007
Average	2.114	0	0.085	0.0018
High SOC				
R17_Gilsárlón	12.9	0	0.524	0.012

Mineral and Organic Soils: Rewetted Wetland Soils

The C-stock changes in organic soils were estimated using a Tier 1 and the IPCC default EF (Table 6.53).

However, the mineral soils were rewetted only once in 2016 during the entire reporting period, specifically affecting 8.3 hectares. Hence, due to the insignificance of the area and since this practice occurred only once and will not be repeated, a CS EF was not evaluated. Instead, the IPCC default (Table 6.53), developed for estimating emissions from organic soils, was used to calculate emissions from mineral soils.

Table 6.53 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of Land converted to wetlands, by land-use subcategory for the entire reporting period.

Land Category	Pool	E F	t C ha ⁻¹ yr ⁻¹	Reference
4D2biii Grassland converted to flooded land Medium SOC to reservoirs	Mineral soils	C S	-0.06	Reported as IEF, the CS EFs and the calculation approach is reported in the text above
4D2bv Other Land converted to flooded Land Low SOC to reservoirs	Mineral soils	C S	-0.02	Reported as IEF, the CS EFs and the calculation approach is reported in the text above
4D2ciii Grassland converted to other wetlands	Mineral soils	D	0.55	See explanation in the text above
Rewetted wetland soils	Organic soils	D	0.55	Table 3.1 in the 2013 Wetland Supplement (Boreal Nutrient Rich Soils)

6.6.5 Uncertainty Assessment and Time-series Consistency

The uncertainty assessment for Wetlands land use category for the period 1990–2024 have been assessed following Approach 1 of the 2006 IPCC Guidelines (IPCC, 2006). Detailed information on the uncertainty rates associated with the AD and the EFs is presented in Annex 6. It should be noted that Iceland applied a conservative approach for some country-specific EFs where uncertainty rates were not evaluated in relevant studies. Specifically, the IPCC default uncertainty rates (developed for the relevant and appropriate LU category and carbon pool) were used alongside these country-specific data, which allowed for an underestimation of the uncertainty assessment. For carbon pools where a Tier 1 approach was applied (that assumes that the carbon pool is in equilibrium), the uncertainty rates were not reported in the table nor used in the overall assessment. The overall uncertainty analysis is reported in Annex 2.

6.6.6 Category-specific QA/QC and verification

Please consult Chapter 1.5 and section 0 for more information.

6.6.7 Category-specific recalculations

Following the EEA comprehensive review between May and June 2025, significant updates and recalculations were made to the category Intact mires – grazing areas. Since the organic soils in this category are not drained but are only subject to grazing activities, and given that the 2006 IPCC Guidelines (Chapter 7.1, p. 7.5) state that “managed wetlands will be restricted to wetlands where the water table is artificially changed (e.g., drained or raised) or those created through human activity (e.g., damming a river),” the TERT strongly emphasized during the review that the methodology applied to estimate removals and emissions was not appropriate, as it was based on the 2013 Supplement to the 2006 IPCC Guidelines, which provides methods specifically for drained organic soils. Accordingly, in consultation with the TERT, it was decided to report all carbon stock changes and the corresponding emissions and

removals from this category as NA, due to the lack of an appropriate methodological approach provided under the current IPCC Guidelines. The impact of this update on the emissions and removals from this category is presented in Table 6.55 and Figure 6.45.

Table 6.54 Comparison of area data [kha] for the Wetlands category (managed) as reported in the current submission and in the previous year's submission.

Area [kha]	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
Wetlands	2025	278.55	281.63	282.68	277.15	274.42	270.15	265.62	263.81	262.80
	2026	332.89	335.22	334.98	328.17	326.04	325.15	324.02	323.46	322.68
	Difference	54.33	53.58	52.30	51.02	51.61	55.00	58.40	59.65	59.88
	in%	19.5%	19.0%	18.5%	18.4%	18.8%	20.4%	22.0%	22.6%	22.8%

Table 6.55 Comparison of greenhouse-gas emissions [kt CO₂e] for the Wetlands category as reported in the current submission and in the previous year's submission

GHG kt CO ₂ e	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
CO ₂	2025	-408.24	-400.04	-390.38	-380.96	-363.67	-360.53	-354.48	-351.39	-349.64
	2026	0.51	6.08	7.68	6.89	7.31	1.64	-1.13	-1.57	-1.59
	Difference	408.75	406.12	398.05	387.86	370.97	362.17	353.35	349.82	348.05
	in%	-100.1%	-101.5%	-102.0%	-101.8%	-102.0%	-100.5%	-99.7%	-99.6%	-99.5%
CH ₄	2025	43.40	43.35	42.58	41.56	39.82	38.91	38.08	37.75	37.56
	2026	0.08	0.30	0.39	0.45	0.49	0.52	0.62	0.67	0.67
	Difference	-43.33	-43.05	-42.19	-41.11	-39.32	-38.39	-37.45	-37.08	-36.89
	in%	-99.8%	-99.3%	-99.1%	-98.9%	-98.8%	-98.7%	-98.4%	-98.2%	-98.2%
N ₂ O	2025	-	-	-	-	0.0000	0.0001	0.0001	-	-
	2026	-	-	-	-	0.0000	0.0001	0.0001	-	-
	Difference	-	-	-	-	0.0000	0.0000	0.0000	-	-
	in%	-	-	-	-	0.0%	0.0%	0.0%	-	-

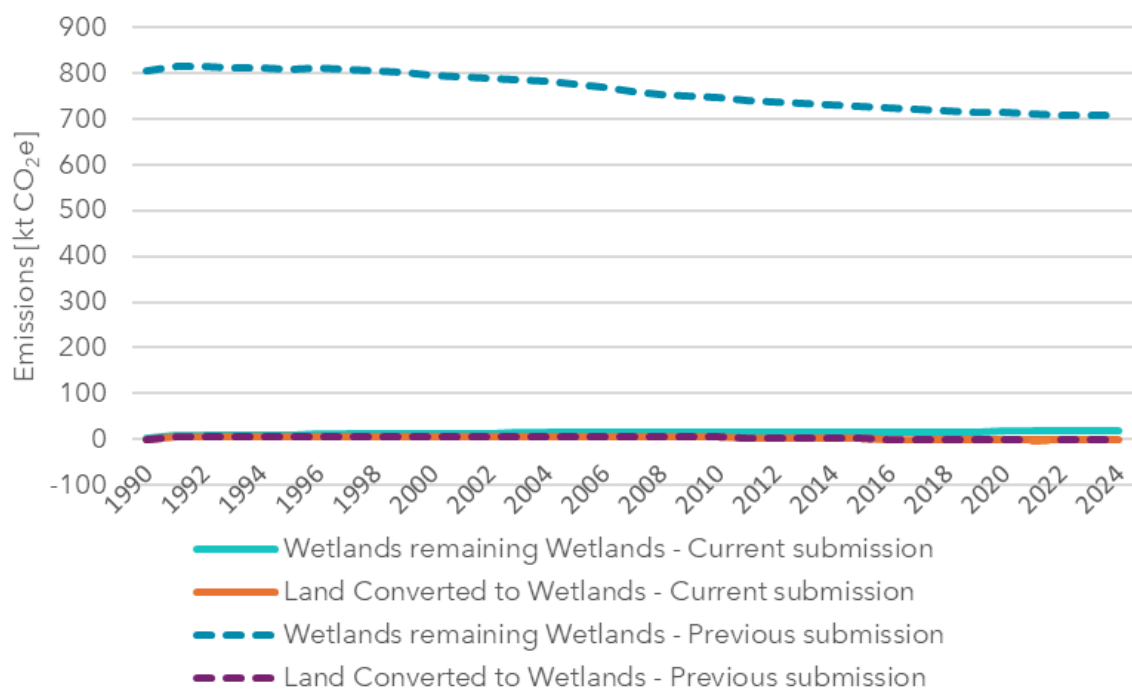


Figure 6.45 Recalculations to the emissions between the current and previous submission for Wetlands.

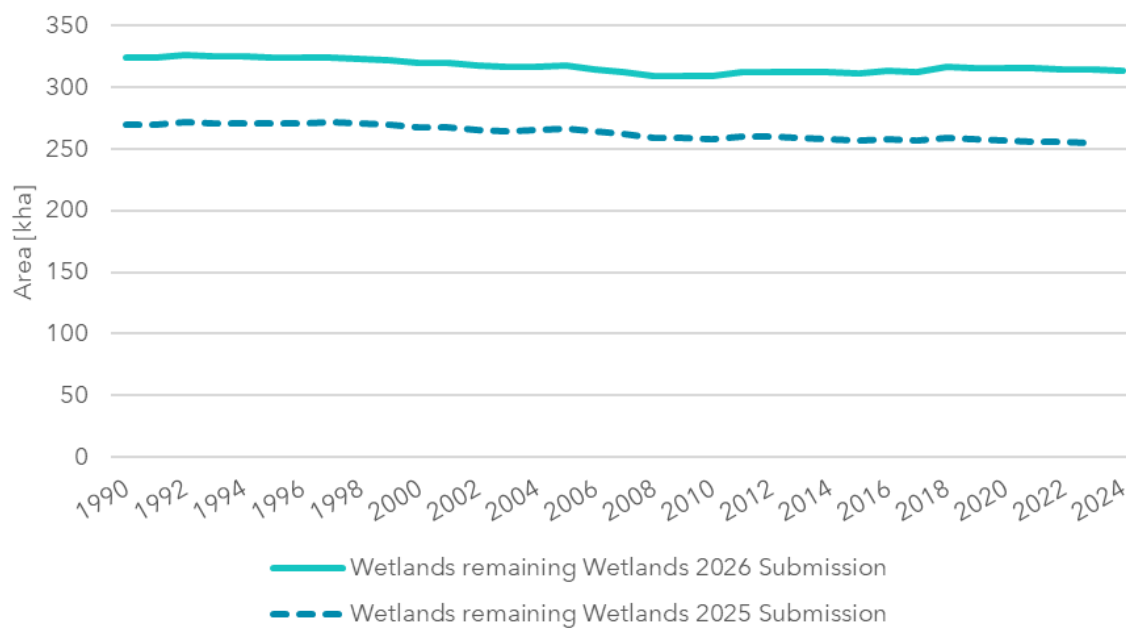


Figure 6.46 Recalculations to the activity data between the current (2026) and previous submission for Wetlands remaining wetlands. Note this graph does not include unmanaged wetlands.

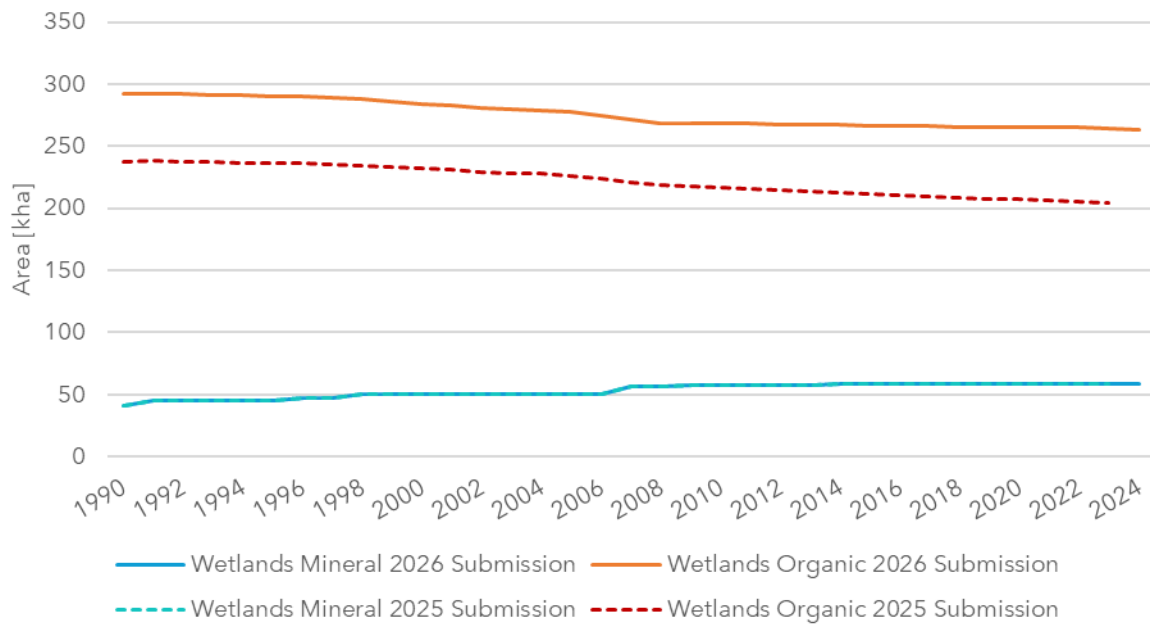


Figure 6.47 Recalculations to the activity data between the current and previous submission for Wetlands mineral and organic soils.

There are no revisions to 4D2 Land converted to Wetlands (see Figure 6.48).

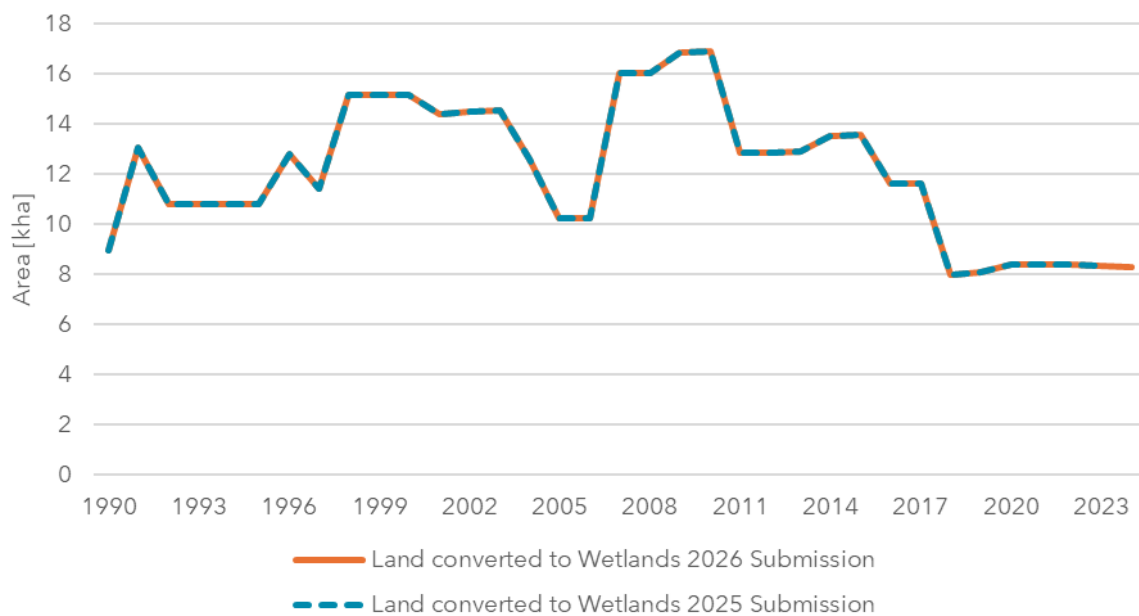


Figure 6.48 Recalculations to the activity data between the current and previous submission for Land converted to Wetlands.

6.6.8 Category-specific planned improvements

In 2023, Land and Forest Iceland initiated a project to systematically collect soil samples and perform in situ measurements of greenhouse gas fluxes from Rewetted wetland soils, intact mires and drained organic soils (see Section 6.5.8), using portable flux chambers and analysers. The objective is to enhance emissions and removals estimates by upgrading the methodology to higher Tiers for this carbon pool. Preliminary data are being assessed and will be incorporated into the national inventory submission.

6.7 Settlements (CRT 4E)

6.7.1 Category description

The total area under settlements (including Settlements remaining settlements and Land converted to Settlements) increased steadily from 30.7 kha in 1990 to 45.4 kha in 2024. The share of the Settlements remaining settlements category dominated the overall Settlements area throughout the entire reporting period (Figure 6.49). Settlements were a source throughout the entire reporting period, with living biomass and management of mineral soils being the main pools contributing to emissions (more information see in Land converted to settlements section).

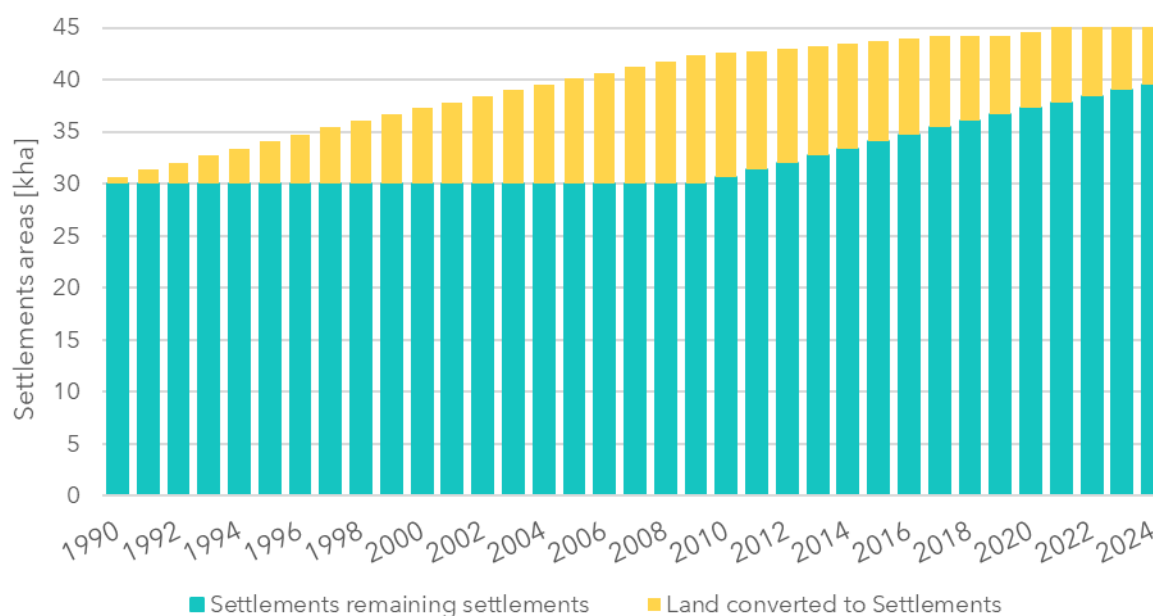


Figure 6.49 Settlements area (by category) in Iceland in 1990 – 2024, [kha].

6.7.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Settlement in Iceland is precisely defined as a continuously built area with specific characteristics. The primary criterion is a minimum population of 200 inhabitants, but this alone is insufficient for classification. The area must also demonstrate clear urban infrastructure patterns through at least one of three key indicators:

- **Road Network:** The settlement must possess a structured road network that indicates organized development. This network should demonstrate intentional planning rather than merely connecting isolated structures.
- **Recognized Name:** Alternatively, the area may have an established, recognized name that indicates its status as a cohesive community.
- **Building Density:** The third criterion allows for classification based on building density, requiring no more than 200 meters between structures.

Exceptions to the building density rule exist for functional urban spaces, such as industrial zones, recreational areas, bridged rivers, parking facilities, transportation infrastructure, cemeteries, and areas designated as natural hazard zones.

Settlement boundaries extend beyond the actual built environment. A 25-meter buffer zone is established from the outermost structures, creating a transitional area that accounts for immediate urban influence. When these buffer zones overlap between settlements connected by roads, they are considered contiguous and merged into a single settlement unit. These boundaries transcend municipal borders, focusing on the physical and functional aspects of urban areas rather than administrative divisions.

The estimation of the area of settlements is based on spatially explicit data according to Approach 3, which uses land use maps and conversions. Land and Forest Iceland (LFI) has compiled new urban area maps for 1990, 2000, 2010 and since 2020. Since the year 2021 settlement is digitized every year for the IGLUD database. These maps were developed using Maxar satellite imagery and aerial photographs from NSII and Loftmyndir ehf⁴⁷. The current mapping effort utilizes high-resolution imagery from multiple sources, with a strong preference for 0.5-meter resolution data. This precision allows for accurate delineation of urban boundaries and identification of new development areas. The 2024 dataset represents significant improvements in coverage and accuracy.

⁴⁷ <https://loftmyndir.is>

Table 6.56 Definitions of Settlements subcategories.

LU category	Definition	LU subcategory	Allocation	Conversion period
4E Settlements	Settlement/locality is a continuously populated area with at least 200 inhabitants and: (a) a clear street system; or (b) name; or (c) a maximum of 200 meters between houses. However, there may be exceptions due to industrial and commercial areas, recreational areas, bridged rivers, parking and other transport infrastructure, cemeteries, hazardous areas due to natural hazards, etc. Urban centers with fewer than 200 inhabitants are therefore not considered urban/settlement.	Settlements	SMrSM/LUC to SM	20 years

For UNFCCC reporting purposes, settlement mapping requires historical analysis at specific time points. The total Settlements area across the time series is estimated by combining spatial data from LFI maps and interpolation. The time series for Towns and Villages and Other Settlements (Roads) are constructed using interpolation between LFI map areas for 1990, 2000, 2010, and the most recent maps since 2018 (Table 6.57). The total area of Settlements remaining settlements is calculated by subtracting recorded land conversions from Forest land and Natural Birch Shrubland in the previous year.

Table 6.57 Methodology and data sources for constructing the time series of Settlements category.

Land use category	1989	1990	1991	-	1999	2000	2001	-	2009	2010	2011	2012	-	2018	-	2024
Settlement remaining settlements		LFI urban map	Linear interpolation			LFI urban map	Linear interpolation			LFI urban map	Linear interpolation			LFI urban map		
Land converted to settlements																
Forest land to settlements	Deforestation reported to LFI															
Natural birch shrublands to settlements	1987-1991 map	Linear interpolation										2019-2014 map	Linear extrapolation			
All other grassland subcategories to settlements	Other grassland timeseries															
Legend																
Samples or known areas	Maps	Expert judgement	Interpolation / extrapolation	Assumptions												

The total area of Settlements shows an increasing trend over the time series. The conversions from Forest and Natural Birch Shrubland to settlements are mapped and reported with high spatial accuracy by the LFI deforestation records, although they represent only a small part of the increase in settlement area. The remaining expansion is currently assumed to be from the Grassland category and is reported as such, although no maps are available for this component. Due to a lack of data, it has not yet been possible to quantify the areas converted from Grassland to Settlements for the specific subcategories of Grassland. Therefore, all the conversions are reported under the subcategory 4E2c All other Grassland

converted to settlements. These conversions are assumed to occur proportionally from all mineral Grassland subcategories other than Natural Birch Shrubland. Conversions from other land uses to Settlements, such as from Cropland, Wetlands and Other land, are considered theoretically possible and are therefore reported as including elsewhere (IE) assuming that they are included in the aggregated value of the subcategory 4E2c All other Grassland subcategories converted to settlements.

6.7.3 Settlements remaining settlements (CRT 4E1)

6.7.3.1 Category Description

The total area of Settlements remaining settlements is reported in Figure 6.49. A Tier 1 approach was used to estimate the changes in carbon stock of living biomass, DOM, and mineral soils, assuming that the carbon stock is in equilibrium. Therefore, the notation key "NA" was used to report the emissions/removals in the CRT.

6.7.3.2 Methodology

Table 6.58 summarizes tier-level approaches, notation keys [in square brackets], and emission factors (in parentheses) are used to estimate changes in relevant carbon stocks in the Settlements remaining settlements category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Organic soils

Carbon stock changes in the organic soils pool under Settlements remaining settlements are reported as "IE" (Table 6.58). Iceland does not currently have data on the extent of organic soils within this land-use category, as the existing national soil map does not enable differentiation between organic and mineral soils at the required resolution. The government recognizes this limitation and is actively exploring approaches to improve the availability and quality of soil data.

In any case, all organic soils that have been drained due to anthropogenic activities for construction purposes are reported under Grassland remaining grassland, specifically within the subcategory 4C1Organic soils drained for more than 20 years. For example, some wetland areas in Reykjavík were drained as early as the early 1900s. Additionally, the area of organic soils classified under Settlements remaining settlements is considered to be minimal.

Table 6.58 Tier-level approaches, notation keys, and EFs used for the Settlements remaining settlements category

Land-Use Category	Living Biomass		DOM	Soils	
	Gains	Losses		Min	Org
4E1 Settlements remaining Settlements	T1 [NA]	T1 [NA]	T1 [NA]	T1 [NA]	IE ¹

¹ Emissions from organic soils are reported as IE and reported as aggregated values under organic soils in 4.C Grassland. Refer to Section 6.7.3.2 for detailed information.

6.7.4 Land converted to settlements (CRT 4E2)

6.7.4.1 Category description

The trend for Land converted to settlements shows a consistent increase in area from 0.7 kha in 1990 to a peak of 12.3 kha in 2009. However, from 2009 onward, the trend reverses, with the area gradually decreasing to 5.8 kha by 2024. The dominant subcategory converted to Settlements was 4C1All other Grassland subcategories converted to Settlements, while the conversion of other land-use categories remained insignificant throughout the reporting period (Figure 6.50). As for emissions and/or removals due to the conversion of lands to Settlements, the primary source of emissions was the changes in the carbon pool of living biomass, DOM and mineral soils (Figure 6.51). Additional information is available in Table 6.59.



Figure 6.50 The total area [kha] and relative shares (%) of Land converted to settlements (by subcategory) in Iceland in 1990 – 2024.

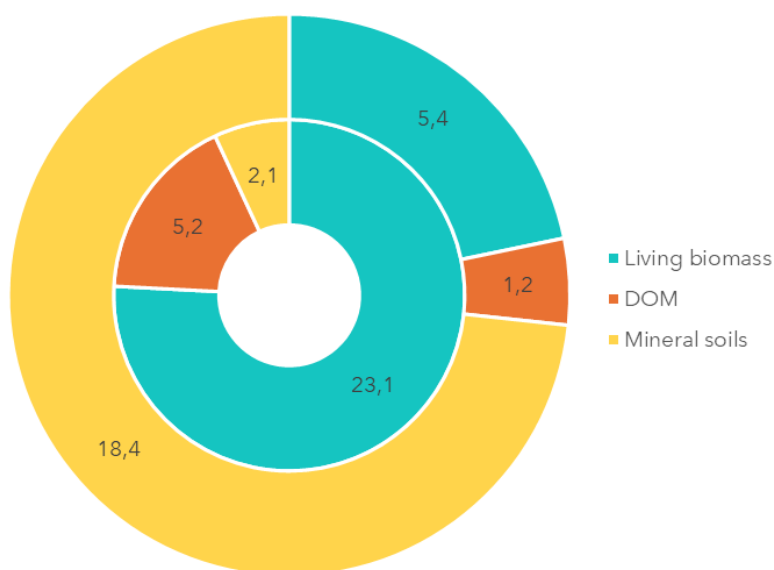


Figure 6.51 CO₂ emissions resulting from Land converted to settlements by pool in 1990 (inner circle) and 2024 (outer circle) in Iceland, [kt].

6.7.4.2 Methodology

Table 6.59 summarizes tier-level approaches, notation keys [in square brackets], and emission factors (in parentheses) are used to estimate changes in relevant carbon stocks in the Land converted to settlements category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Table 6.59 Tier-level approaches, notation keys, and EFs used for the Land converted to settlements category in 2024.

Land-Use Category	Living Biomass		DOM	Soils	
	Gains	Losses		Min	Org
4E2a Forest Land converted to settlements	NO	NO [T3 (CS) ⁴]	NO [T2 (CS) ⁴]	T2 (CS)	NO
4E2b Cropland converted to settlements	IE ¹	IE ¹	IE ¹	IE ¹	IE ²
4E2c Grassland converted to settlements					
4E2c Natural Birch Shrubland converted to settlements	NO	NO [T3 (CS) ³]	NO [T2 (CS) ³]	T2 (CS)	NO
4E2c All Other Grassland sub-categories converted to settlements	NA	T2(CS)	T2 (CS)	T2 (CS)	IE ²
4E2d Wetlands converted to settlements	IE ¹	IE ¹	IE ¹	IE ¹	IE ²
4E2e Other Land converted to settlements	IE ¹	IE ¹	IE ¹	IE ¹	NO

¹ Reported as aggregated value under Living biomass gains, losses, mineral soils, and DOM in 4E2c All Other Grassland subcategories converted to settlements.

² Reported as aggregated value under organic soils in 4.C Grassland.

³ The changes in Living biomass-losses and DOM pool were estimated for 2014, 2015, 2019, 2021.

⁴ The changes in Living biomass-losses and DOM pool were estimated for 2004 - 2007, 2011, 2013, 2015, 2017, 2020, 2021 and 2024

Living biomass

For 4E2a Forest land converted to settlement, biomass is either measured on the site prior to deforestation or built on measurement plots in the neighbourhood of the deforestation site. In few cases with deforestation of Natural Birch Woodland country specific value for biomass C-stock was used. According to Tier 1 methodology (the 2006 IPCC Guidelines), biomass is reported as instant oxidation in the year of deforestation.

The carbon stock changes in AGB for the 4E2c All other Grassland subcategories converted to settlements subcategory were estimated using the average carbon stock derived from IGLUD field sampling points located below 200 m.a.s.l. and classifies as Grassland (-). It was assumed that 70% of the original vegetation cover is removed during conversion, an estimated based on correspondence with planning authorities in several Icelandic municipalities. The carbon stock changes in BGB for the 4E2c All other Grassland subcategories converted to settlement subcategory were estimated by applying the CS BGB-to-AGB ratio (0.39; see also Section 6.4.4.2).

The annual CSC EF for LB losses introduced in the 2026 submission is -9.38 t /ha. See also Section 6.7.7 on Category-specific recalculations.

DOM and mineral soils, Forest land converted to settlements

Carbon stock in litter has been measured outside of forest areas on after 10-year afforestation period areas, as this type of land was mostly converted to settlements. The value varies depending on the condition of the vegetation cover, which were adjusted for every reporting year: specifically, on treeless or medium-to-fertile sites, a mean litter C-stock of 1.04 t ha^{-1} was measured ($n=40$, $SE=0.15$; Snorrason et al., (2002)). An annual increase in the litter C-stock was estimated to be $0.141 \text{ t C ha}^{-1}$ resulting in an estimated litter C-stock of 2.45 t C ha^{-1} for 10 years post-afforested medium-to-fertile land.

In contrast, treeless or poorly vegetated land has a much sparser litter layer. The referenced research indicated a C-stock of 0.10 t ha^{-1} ($n=5$, $SE: 0.03$). Afforestation activities on this type of land, 10-year-post-establishment, were estimated to result in a C-stock of 1.51 t C ha^{-1} . Using a year-specific proportional distribution between poorly and fully vegetated land, the weighted C-stock values for a 10-year-old afforestation sites were calculated and used in the estimates.

According to the 2006 IPCC Guidelines, a Tier 1 approach to estimate changes in DOM pool for 4E2a Forest Land converted to settlements assumes that all carbon contained in litter is assumed to be lost during conversion process, and subsequent accumulation is not accounted for.

As with carbon in litter, mineral soils SOC has been measured in this research project. SOC in the same research plots mentioned above for poorly vegetated areas was 14.9 t C ha^{-1} , while for fully vegetated areas with thick developed andosol layers it was 72.9 t C ha^{-1} ($n=40$; down

to 30 cm soil depth). The annual increase in SOC on afforested land, according to this year's submission, was 0.513 t C ha⁻¹ yr⁻¹ for poorly vegetated sites, and 0.365 t C ha⁻¹ yr⁻¹ for fully vegetated sites. Accordingly, 10-year-old forests have a C-stock of 20 t ha⁻¹ and 76.6 t ha⁻¹ on poorly and fully vegetated sites, respectively. The weighted C-stock of treeless land was 66.9 t ha⁻¹. Hence, according to a Tier 1 method (the 2006 IPCC guidelines) for mineral soil stock change of Land converted to settlements that is paved over (with a coefficient 0.8). Using a 20-year conversion period, this results in an estimated carbon stock loss of 1% during the year of conversion; the annual emissions from SOC to be 0.67 t C ha⁻¹.

Dead organic matter for 4E2c All other Grassland subcategories converted to settlement

Emissions and removals from the DOM pool for the subcategory 4E2c All other Grassland subcategories converted to settlement are reported using a country-specific annual carbon stock change factor of -2.13 tC/ha/yr. This factor was derived by applying a CS DOM-to-AGB ratio of 0.24, obtained from data presented in Table 2 of Aradóttir et al. (2000), to the previously estimated annual carbon stock changes for living biomass gains. For further details, see Section 6.7.7, Category-specific recalculations.

Mineral soils

The annual changes in mineral soil SOC was calculated using the country-specific SOC stock value (85.98 t C/ha) applied in the calculation of SOC stock for 4B2b Grassland converted to cropland (see Table 6.42 in Section 6.5.7). Furthermore, SOC stock change was derived by applying the relevant soil stock change factors to the SOC stock and multiplying by the default coefficient of 0.8 specified in Section 8.3.3.2 of the 2006 IPCC Guidelines. Using a 20-year conversion period, the annual SOC emissions are estimated to be -0.86 t C ha⁻¹ yr⁻¹ (Table 6.60). For more detailed information, refer to Section 6.7.7

Table 6.60 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of Land converted to settlements for the entire reporting period

Land Category	Pool	EF	t C ha ⁻¹ yr ⁻¹	Reference
4E2a Forest land converted to settlement	Mineral Soils	CS/D	-0.67	Snorrason et al. 2002
4E2c All Other Grassland subcategories converted to settlements	Biomass losses	CS	-9.38	Study compiled by the Land and Forest Iceland Institute
	Mineral Soils	CS	-0.86	Described above
4E2c NBS converted to settlements	Mineral Soils	CS	-0.67	Snorrason et al. 2002
	DOM	CS	-0.14	Snorrason et al. 2002

6.7.5 Uncertainty Assessment and Time-series Consistency

The uncertainty assessment for Land converted to settlements land use category for the period 1990–2023 have been assessed following Approach 1 of the 2006 IPCC Guidelines (IPCC, 2006). Detailed information on the uncertainty rates associated with the AD and the EFs is reported in Annex 6. It should be noted that Iceland applied a conservative approach for some country-specific EFs where uncertainty rates were not evaluated in relevant studies. Specifically, the IPCC default uncertainty rates (developed for the relevant and appropriate LU category and carbon pool) were used alongside these country-specific data, which allowed for an underestimation of the uncertainty assessment. For carbon pools where a Tier 1 approach was applied (that assumes that the carbon pool is in equilibrium), the uncertainty rates were not reported in the table nor used in the overall assessment. The overall uncertainty analysis is reported in Annex 2.

The Settlements remaining settlements category is neither a source nor a sink, and no estimates were completed. Therefore, an uncertainty assessment was not performed.

6.7.6 Category-specific QA/QC and verification

Please consult Chapter 1.5 and section 0 for more information.

6.7.7 Category-specific recalculations

Recalculations of emissions for Settlements are mainly driven by the inclusion of annual carbon stock changes in BGB within living biomass losses, and the inclusion of annual carbon stock changes in dead organic matter for the subcategory 4E2c All other Grassland subcategories converted to settlements.

Below ground biomass

Following the comprehensive review conducted by the European Environment Agency (EEA) between May and June 2025, the 2026 submission includes estimates for the BGB pool within the living biomass estimates for the subcategory 4E2c All other Grassland subcategories converted to settlement. The estimates for BGB were calculated by multiplying the annual carbon stock change from living biomass gains by the country-specific below-ground to AGB ratio ($R = 0.39$). This ratio was derived from data presented in Aradóttir et al. (2000). The resulting value was then added to the existing annual carbon stock change for living biomass losses under the subcategory 4E2c All other Grassland converted to settlements. Calculations of annual carbon stock change factors for the LB including below ground biomass are presented in Table 6.61

Dead organic matter

Until the 2025 submission, carbon stock changes in DOM resulting from the conversion of the subcategory 4E2c All other Grassland subcategories converted to settlement were reported as IE and included as aggregate values under living biomass losses (AGB). Losses were estimated for the area converted in a given year based on the living biomass of the previous land use, Grassland, in this case.

Starting with the 2026 submission, emissions and removals from the DOM pool for the subcategory 4E2c All other Grassland subcategories converted to settlement are reported using a country-specific annual carbon stock change factor of -2.13 tC/ha/yr . This factor was derived by applying a CS DOM-to-AGB ratio of 0.24, obtained from data presented in Table 2 of Aradóttir et al. (2000), to the previously estimated annual carbon stock changes for living biomass gains. Calculations of annual carbon stock change factors for the DOM pool for these subcategories are presented in Table 6.61.

Table 6.61 Annual carbon stock change for living biomass losses used up to the 2025 submission; and calculation annual CSCs for DOM and living biomass gains, including BGB, introduced in the 2026 submission.

Land use category	CSC used in submission 2025 tC/ha	CSC DOM tC/ha/yr	Ratio	Annual CSCF tC/ha/yr
4E2c All other Grassland subcategories converted to Settlements - DOM	-8.88		0.24*	-2.13
4E2c All other Grassland subcategories converted to Settlements - LB losses	-8.88	-2.13	0.39**	-9.38

*Country-specific DOM:AGB ratio derived from data in Aradóttir et al. (2000) (see Table 2 in that study). See explanation in section Dead organic matter above.

**Country-specific ratio BGB:AGB derived from data in Aradóttir et al. (2000) (see Table 3 in that study). See explanation in section BGB above.

Mineral soils

The carbon stock changes in mineral soils for 4E2c All other grassland subcategories converted to settlements have been recalculated. Updates to the annual changes in mineral soil SOC were made using the country-specific SOC stock value (85.98 t C/ha) that is also applied in the estimation of SOC stocks for 4B2b Grassland converted to cropland (Table 6.42 in Section 6.5.7). The resulting SOC stock change was then derived by multiplying the SOC stock by the relevant soil stock change factors and by a coefficient of 0.8. Based on a 20-year conversion period, the estimated annual SOC emissions amount to $-0.86 \text{ t C ha}^{-1} \text{ yr}^{-1}$ (see Table 6.62).

Table 6.62 Summary of the annual CSC factor calculation for mineral soils in All other Grassland subcategories converted to Settlements.

CS SOC _{ref} (t C/ha)	Paved Settlements soil stock change	SOCstock in SL (tC/ha)			20-year conversion period			Annual CSC factor All other GL to SL (tC/ha year)		
85.98*	0.8	68.48			20			-0.86		
Area [kha]	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
Settlements	2025	28,38	31,74	34,98	37,77	40,12	40,67	41,54	42,39	42,72
	2026	30,72	34,07	37,31	40,11	42,57	43,74	44,56	45,13	45,23
	Difference	2,33	2,33	2,33	2,33	2,46	3,07	3,02	2,75	2,50
	in%	8,2%	7,4%	6,7%	6,2%	6,1%	7,5%	7,3%	6,5%	5,9%

Area [kha]	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
Settlements	2025	28,38	31,74	34,98	37,77	40,12	40,67	41,54	42,39	42,72
	2026	30,72	34,07	37,31	40,11	42,57	43,74	44,56	45,13	45,23
	Difference	2,33	2,33	2,33	2,33	2,46	3,07	3,02	2,75	2,50
	in%	8,2%	7,4%	6,7%	6,2%	6,1%	7,5%	7,3%	6,5%	5,9%

Table 6.64 present the comparison of areas and greenhouse gas emissions [kt CO₂e] for the Settlements category, as reported in the current submission and in the previous year's submission.

Table 6.63 Comparison of area data [kha] for the Settlements category as reported in the current submission and in the previous year's submission

Area [kha]	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
Settlements	2025	28,38	31,74	34,98	37,77	40,12	40,67	41,54	42,39	42,72
	2026	30,72	34,07	37,31	40,11	42,57	43,74	44,56	45,13	45,23
	Difference	2,33	2,33	2,33	2,33	2,46	3,07	3,02	2,75	2,50
	in%	8,2%	7,4%	6,7%	6,2%	6,1%	7,5%	7,3%	6,5%	5,9%

Table 6.64 Comparison of greenhouse-gas emissions [kt CO₂e] for the Settlements category as reported in the current submission and in the previous year's submission

GHG kt CO ₂ e	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
CO ₂	2025	26,28	37,40	44,53	53,67	42,50	33,20	35,61	34,59	31,05
	2026	30,41	40,98	46,50	55,09	47,19	40,26	37,66	21,07	23,41
	Difference	4,13	3,58	1,96	1,43	4,69	7,06	2,05	-13,52	-7,64
	in%	15,7%	9,6%	4,4%	2,7%	11,0%	21,3%	5,7%	-39,1%	-24,6%
N ₂ O	2025	-	-	-	0,00	0,00	0,00	0,00	0,00	0,00
	2026	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01
	Difference	-	-	-	0,01	0,01	0,01	0,01	0,01	0,01

GHG kt CO ₂ e	Subm.	1990	1995	2000	2005	2010	2015	2020	2022	2023
	in%	-	-	-	79644%	46874%	25679%	18458%	11508%	10694%

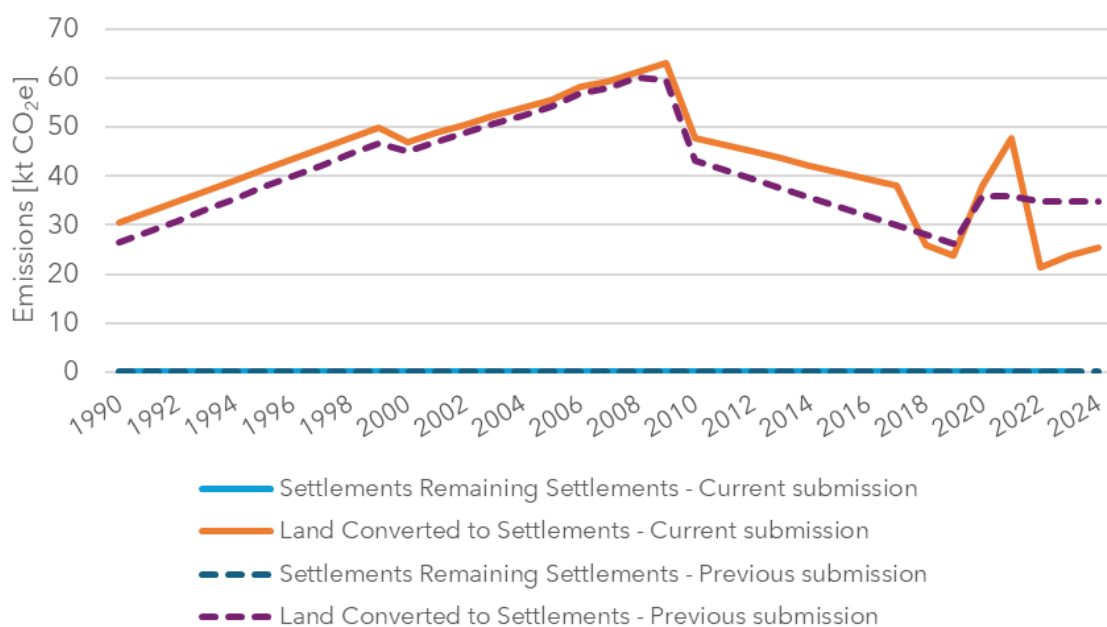


Figure 6.52 Recalculations to the emissions between the current and previous submission for Settlements.

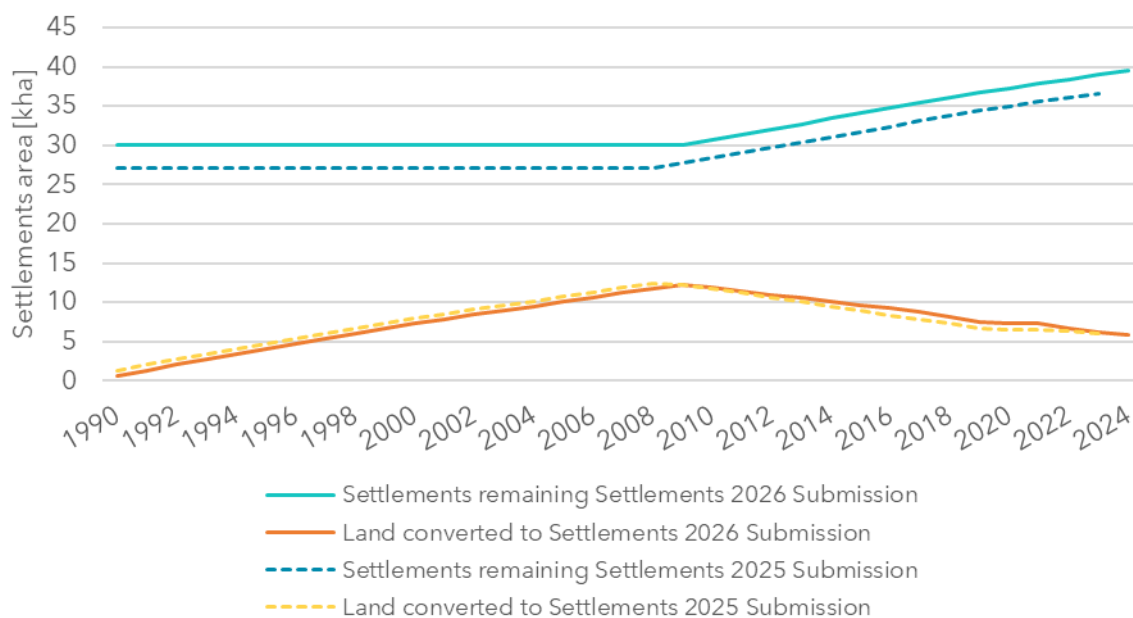


Figure 6.53 Recalculations to the activity data between the current and previous submission for Settlements.

6.7.8 Category-specific Planned Improvements

Iceland is currently reviewing available national datasets to assess the presence and extent of organic soils within 4.E.1 Settlements remaining settlements.

6.8 Other Land (CRT 4F)

6.8.1 Other land remaining other cand (CRT 4F1) and Land
Converted to other land (CRT 4F2)

6.8.1.1 Category Description

Other Land is defined as the area of the map layer remaining within this category after the compilation process in IGLUD.

The total area of Other land is reported in Figure 6.54 The total area of Other Land has slightly declined over the reporting period: from 3.137,3 kha in 1990 to 2.949,5 kha in 2024 (Figure 6.54).

Areas classified under the Other Land category are characterized by less than 20% vascular vegetation cover.

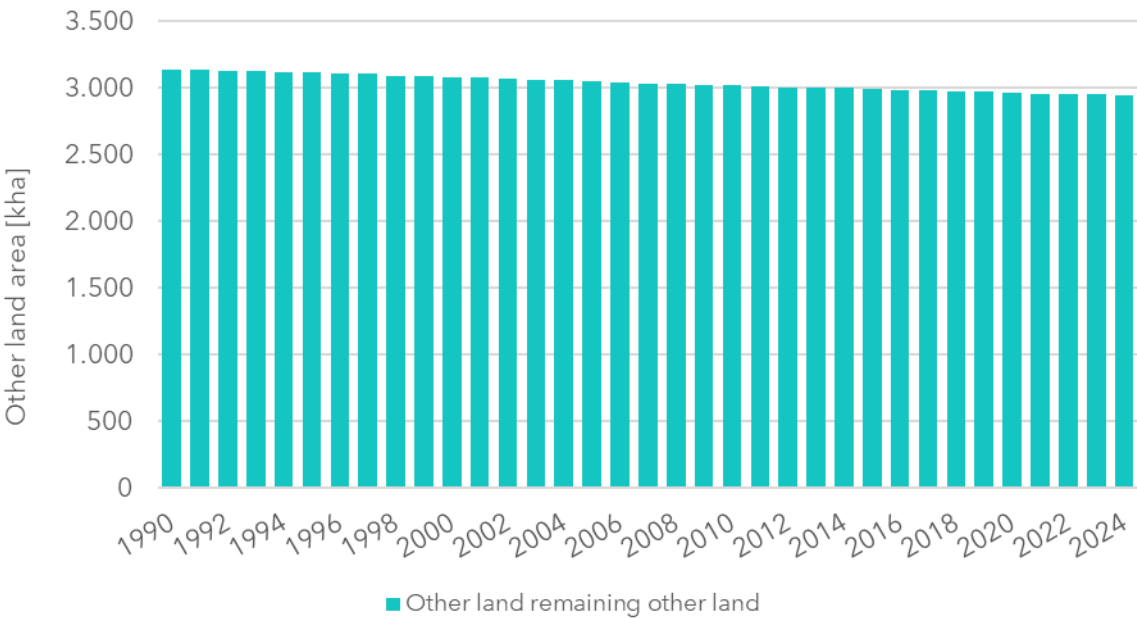


Figure 6.54 The total area of Other land [kha].

6.8.1.2 Methodology

No emissions are estimated or reported from this land-use category.

Table 6.65 summarizes notation keys used to report emissions from the Other land category.

Table 6.65 Notation keys used for the Other Land category in 2023.

Land-Use Category	Living Biomass		DOM	Soils	
	Gains	Losses		Min	Org
4F1 Other Land remaining Other Land	NO	NO	NO	NO	NO
4F2a Forest Land Converted to Other Land	NO	NO	NO	NO	NO
4F2b Cropland Converted to Other Land	NO	NO	NO	NO	NO
4F2c Grassland Converted to Other Land	NO	NO	NO	NO	NO
4F2d Wetlands Converted to Other Land	NO	NO	NO	NO	NO
4F2e Settlements Converted to Other Land	NO	NO	NO	NO	NO

6.8.2 Uncertainty Assessment and Time-series Consistency

Time series of Other Land derive from changes in conversion to other categories.

6.8.3 Category-specific QA/QC and verification

Please consult Chapter 1.5 and section 0 for more information.

6.8.4 Category-specific Recalculations

No recalculation was carried out for this category for the 2026 submission.

6.8.4.1 Category-specific Planned Improvements

There are no category-specific planned improvements for this category.

6.9 Harvested wood products (CRT 4G)

6.9.1 Category Description

The production approach was applied to estimate emissions and removals associated with Harvested Wood Products (HWP). Data on domestic wood utilisation and production of wood products from domestic wood are not official and the official statistical agency in Iceland (Statistics Iceland) has fragmented, unverified, and incomplete reporting of these data⁴⁸, the

⁴⁸ <http://faostat3.fao.org/download/F/FO/E>

annual unofficial report of the Iceland Forest Association contains data about sawn wood production from domestic harvested wood for 1996 to 2024 (see Table 6.66); (Gunnarsson E. , 2010; 2011; 2012; 2013) (Gunnarsson E. , 2014; 2015; 2016; Gunnarsson & Brynleifsdóttir, 2017; Gunnarsson & Brynleifsdóttir, Skógræktarárið 2017, 2019) (Elefsen & Brynleifsdóttir, 2020; Jóhannsdóttir Þ., 2020; Brynleifsdóttir & Jóhannsdóttir, 2021) (Snorrason, Brynleifsdóttir, & Jóhannsdóttir, 2022) (Jóhannsdóttir, Jóhannesdóttir, & Snorrason, 2023) (Jóhannsdóttir, Jóhannesdóttir, & Snorrason, 2024).

Table 6.66 Annual wood production (in m³ on bark) and sawn wood production (in m³) in 1996 to 2024.

Year	Wood	Sawnwood
1996	403	9
1997	314	18
1998	308	5
1999	309	9
2000	326	6
2001	286	7
2002	458	11
2003	620	9
2004	537	10
2005	961	6
2006	884	6
2007	642	27
2008	1,444	21
2009	1,528	46
2010	4,185	50
2011	3,845	112
2012	3,459	93
2013	5,511	93
2014	5,923	165
2015	4,744	64
2016	4,182	133
2017	4,333	202
2018	3,131	118
2019	2,702	76
2020	3,537	77
2021	2,726	46
2022	8,167	149

Year	Wood	Sawnwood
2023	2,451	296
2024	7,725	271

These data were used to estimate C-stock changes in HWP. Sawn wood is only a small fragment of commercial wood removal. Other HWP than sawn wood is not produced from domestic wood. To convert sawn wood volume (m³) to C-stock, a conversion factor of 0.229 from Table 2.8.1 in 2013 Revised Supplementary Methods and GPG Arising from the KP (IPCC, 2014) is used. Equation 2.8.5 with a default half-life of 35 years for sawn wood given in Table 2.8.2 are used to estimate CSC of the HWP pool. Methods and activity data of HWP are unchanged from last year submission. Uncertainty is assumed to be 5%. Other (CRT 4H).

6.10 Direct and indirect N₂O emissions from N inputs to managed soils (CRT 4(I))

6.10.1 Category description and methodology

Direct: N₂O emissions from fertilisers used for agricultural purposes are reported under agricultural soil (Chapter 5.7). However, forest land is also fertilized in Iceland. Nonetheless, the amounts of organic and inorganic fertilisers applied to Forest land are negligible.

Activity data for organic and inorganic fertilizers applied to Forest land are obtained from annual unofficial report of the Iceland Forest Association. (Gunnarsson E. , 2010; 2011; 2012; 2013) (Gunnarsson E. , 2014; 2015; 2016; Gunnarsson & Brynleifsdóttir, 2017; Gunnarsson & Brynleifsdóttir, Skógræktarárið 2017, 2019) (Elefsen & Brynleifsdóttir, 2020; Jóhannsdóttir P., 2020; Brynleifsdóttir & Jóhannsdóttir, 2021) (Snorrason, Brynleifsdóttir, & Jóhannsdóttir, 2022) (Jóhannsdóttir, Jóhannesdóttir, & Snorrason, 2023) (Jóhannsdóttir, Jóhannesdóttir, & Snorrason, 2024).

The IPCC default EFs were used to estimate direct and indirect N₂O emissions from N input (organic and inorganic fertilizers) to Forest land.

6.10.2 Uncertainty assessment and Time-series consistency

The uncertainty assessment for CRT 4(I) category for the period 1990–2023 have been assessed following Approach 1 of the 2006 IPCC Guidelines (IPCC, 2006). Detailed information on the uncertainty rates associated with the AD and the EFs is presented in Annex 6. The overall uncertainty analysis is reported in Annex 2.

6.10.3 Category-specific QA/QC and verification

Please consult Chapter 1.5 and section 0 for more information.

6.10.4 Category-specific recalculations

Recalculation of nitrogen (N) in organic and inorganic fertilisers used in forestry for the period 2009–2024. The reason is that previously all fertiliser was reported as inorganic, whereas it is now separated into these two categories.

6.10.4.1 Category-specific Planned Improvements

There are no category-specific planned improvements for this category.

6.11 Emissions and removals from drainage and rewetting and other management of organic and mineral soils (CRT 4(II))

6.11.1 Category Description

The total area of organic soils by land-use category is shown in Figure 6.55, with Wetlands (managed and unmanaged land) representing the largest share. The area of ditches within each land-use category is presented in Figure 6.56, with Grassland category having the largest area among all land-use categories.

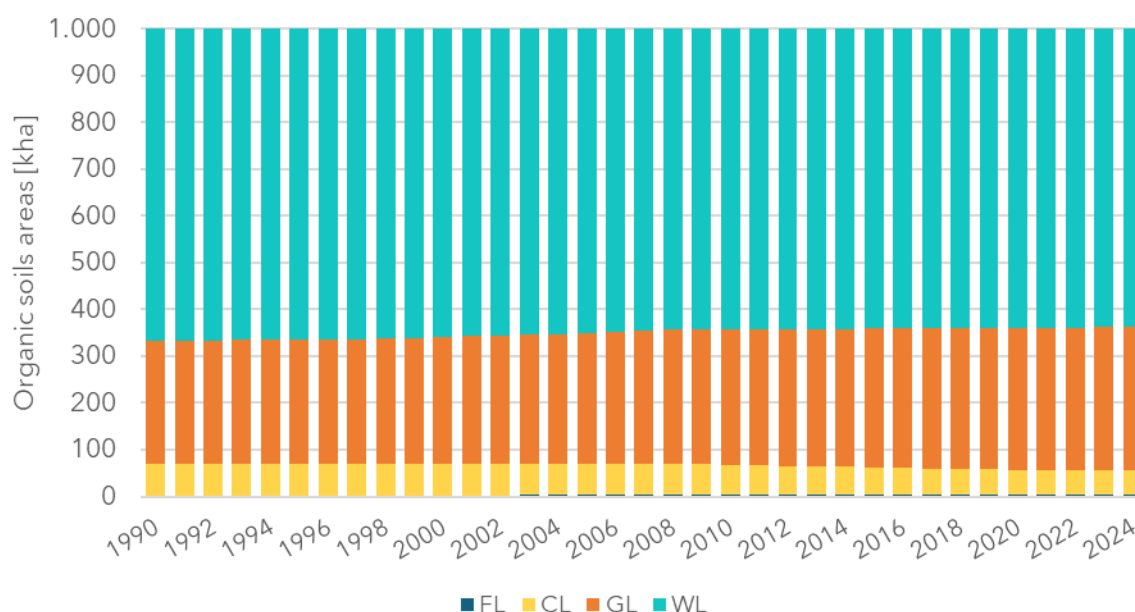


Figure 6.55 Area of organic soils by land-use category in Iceland in 1990 – 2024, [kha].

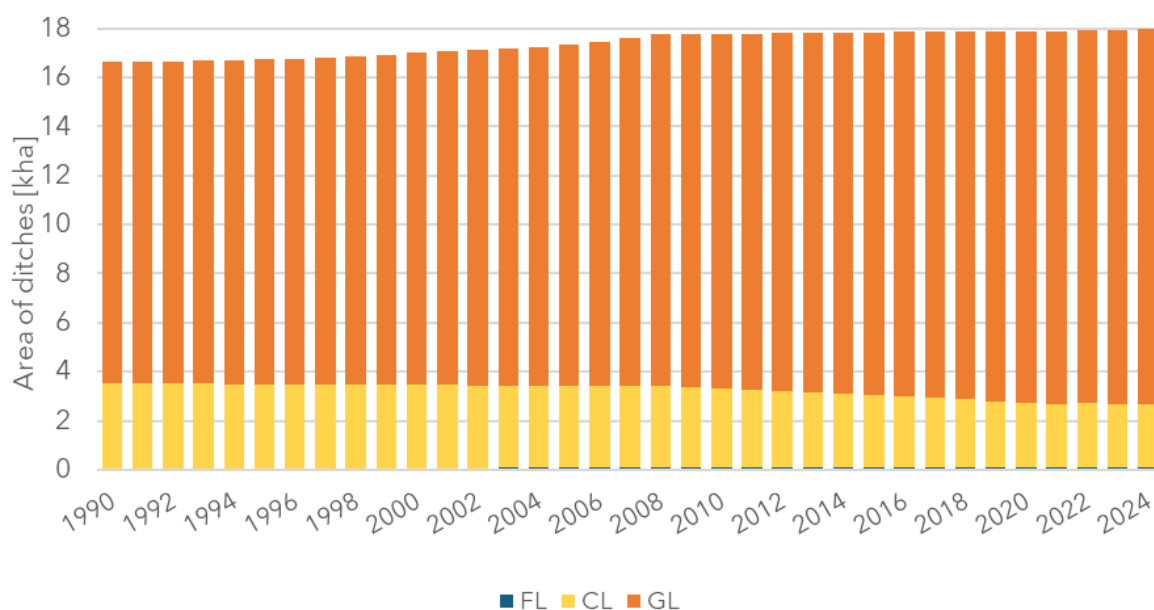


Figure 6.56 Areas of ditches within land-use categories in Iceland in 1990 – 2024, [kha].

The emissions from organic soils and ditches show a stable trend over the reporting period, whereas emissions from Grassland contribute the most significant share (Figure 6.57).

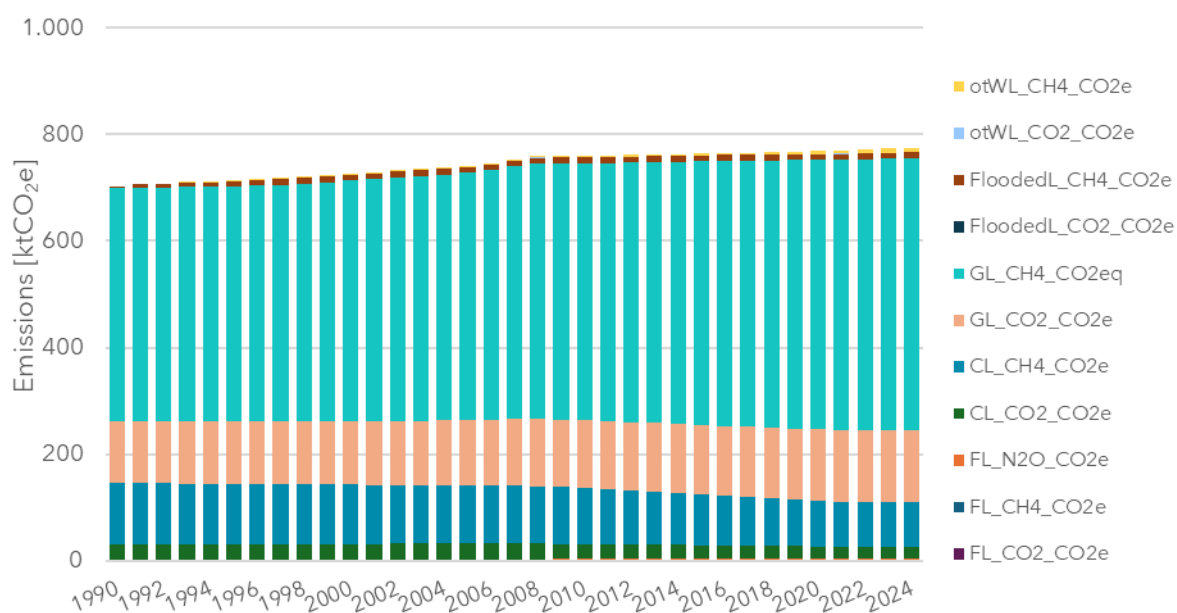


Figure 6.57 Non-CO₂ emissions from the organic soils and ditch areas in Iceland in 1990 – 2024, [kt CO₂e].

6.11.2 Methodology

An approach used to estimate greenhouse gas emissions, along with the AD and EFs employed, is described in the respective subsection below.

Forest land

Areas of ditches are reported in Figure 6.58 and areas of organic soils in Forest land in Figure 6.59. The EFs used to estimate the emissions and tier-level approaches applied are briefly described below and reported in Table 6.67.

Table 6.67 Tier-level approaches, notation keys, and emission factors used for the Forest land category.

Land-use category	CO ₂	N ₂ O	CH ₄
4(II)A1 Forest land remaining forest land			
Total organic soils			
Drained organic soils	T2 (CS)	T2 (CS)	T1 (D)
Total mineral soils	NA	NA	NA
4(II)A2 Land converted to forest land			
Total organic soils			
Drained organic soils	T2 (CS)	T2 (CS)	T1 (D)
Total mineral soils	NA	NA	NA

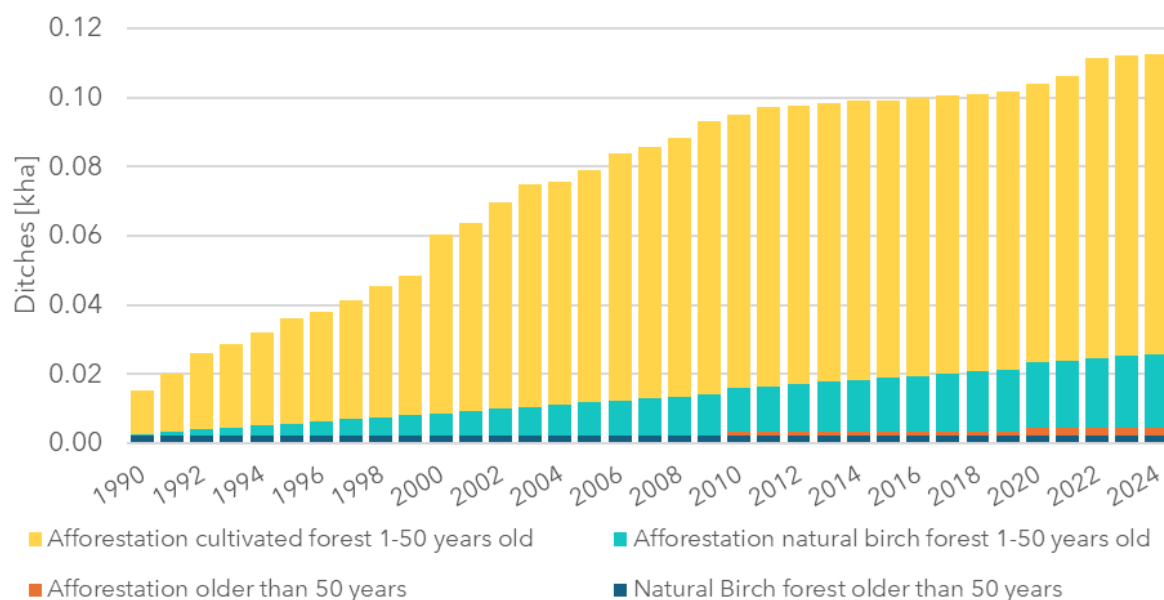


Figure 6.58 Ditches areas, total for Forest land remaining forest land and Land converted to forest land in Iceland in 1990 – 2024, [kha].

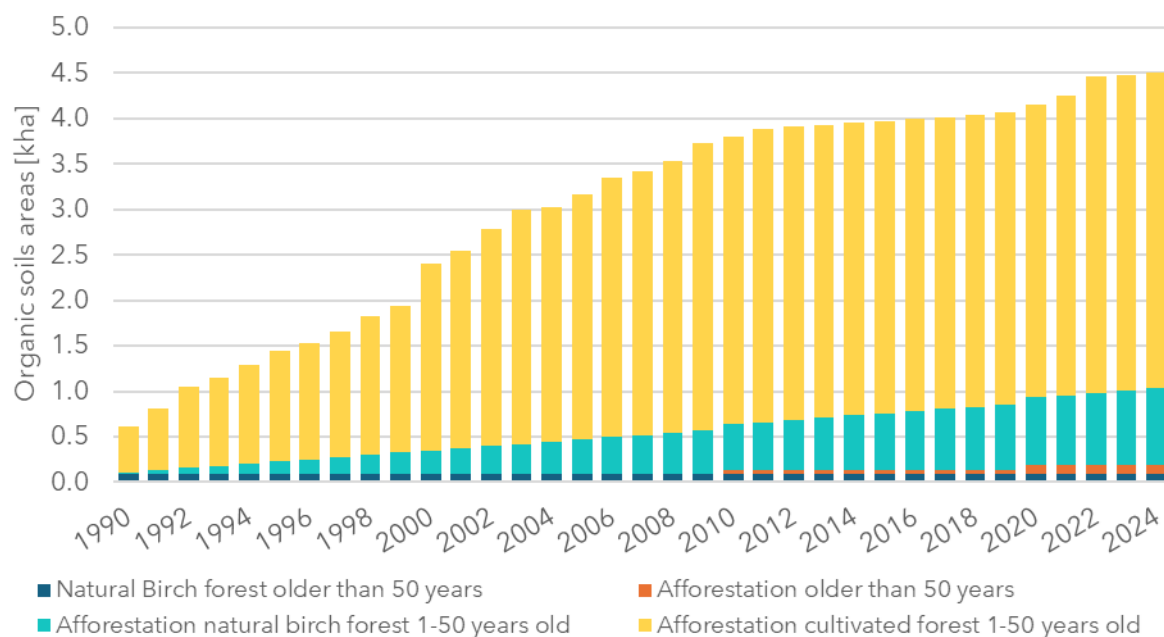


Figure 6.59 Areas of organic soils in Forest land remaining forest land and Land converted to forest land in Iceland in 1990 – 2024, [kha].

Indirect CO₂ emissions from drained organic soils (off-site emissions via waterborne carbon losses) were estimated using CS EF for the first time in the 2025 submission. In newly published research, the Eddy Covariance technic was used to estimate CO₂ fluxes in 23-25-year-old Black Cottonwood plantation on drained peatland in South Iceland, offsite CO₂ was measured simultaneously (Bjarnadóttir B., 2021). Waterborne carbon losses were measured at 0.04 t C ha⁻¹ yr⁻¹ or 147 kg CO₂/ha⁻¹ yr⁻¹ (Table 6.68), which represents 1/3 of the default value stated in the 2013 Wetlands Supplement.

CH₄ emissions from drained organic soil were estimated using the default EFs and Equation 2.6 from the 2013 Wetlands Supplement. The calculation assumes an average ditch width of 2.5 m and average distance between ditches of 100 m. The drained area is thus divided between ditches (2.5%) and drained land (97.5%). The IPCC default CH₄ EFs was applied for drained land categorised as "Forest Land, Drained, Nutrient-rich, Boreal" (Table 2.3) and for ditches under "Boreal/Temperate-Drained Forest Land/Drained Wetlands" from Table 2.4 in the 2013 Wetlands Supplement (Table 6.68).

N₂O emissions from drained organic soils were estimated using CS EFs (Jón Guðmundsson, 2024). The same EF value was used for drained organic soils in Grassland, which is 1.26 kg N₂O-N ha⁻¹ yr⁻¹ (or 1.98 N₂O/ha/yr; see Table 6.68), see further description in Chapter 5.7.3.2).

Table 6.68 EFs applied to estimate emissions from ditches and organic soils in Forest land

Category/Subcategory	EF CO ₂ per area [kg CO ₂ /ha]	EF Land [kg CH ₄ /ha/yr]	EF Ditches [kg CH ₄ /ha/yr]	EF Land ([kg N ₂ O/ha/yr]
4(II)A1 Forest land remaining forest land				
4(II)A1 Afforestation more than 50 years old	147	2	217	1.98
4(II)A1 Forest land remaining Forest land – Natural Birch Forest older than 50 Years	147	2	217	1.98
4(II)A2 Land converted to forest land				
4(II)A2 Grassland Converted to Forest Land – Natural Birch Forest 1 to 50 Years Old	147	2	217	1.98
4(II)A2 Grassland Converted to Forest Land – Afforestation 1 to 50 Years Old	147	2	217	1.98

Cropland

Areas of ditches are reported in Figure 6.60, areas of organic soils in Cropland in Figure 6.61. The EFs used to estimate the emissions and tier-level approaches applied are briefly described below and reported in Table 6.69 and Table 6.70.

Table 6.69 Tier-level approaches, notation keys, and emission factors used for the Cropland category.

Land-use category	CO ₂	N ₂ O	CH ₄
4(II)B1 Cropland remaining cropland			
Total organic soils			
Drained organic soils	T1 (D)	-	T1 (D)
Total mineral soils	NA	-	NA
4(II)B2 Forest land converted to cropland			
Total organic soils			
Drained organic soils	T1 (D)	IE*	T1 (D)
Total mineral soils	NA	NA	NA
4(II)B2 Wetlands converted to cropland			
Total organic soils			
Drained organic soils	T1 (D)	IE*	T1 (D)
Total mineral soils	NA	NA	NA

*IE – Direct and indirect emissions are reported under the Agriculture sector.



Figure 6.60 Ditches areas, total for 4(II)B1 Cropland remaining cropland and 4(II)B2 Land converted to cropland in Iceland in 1990 – 2024, [kha].

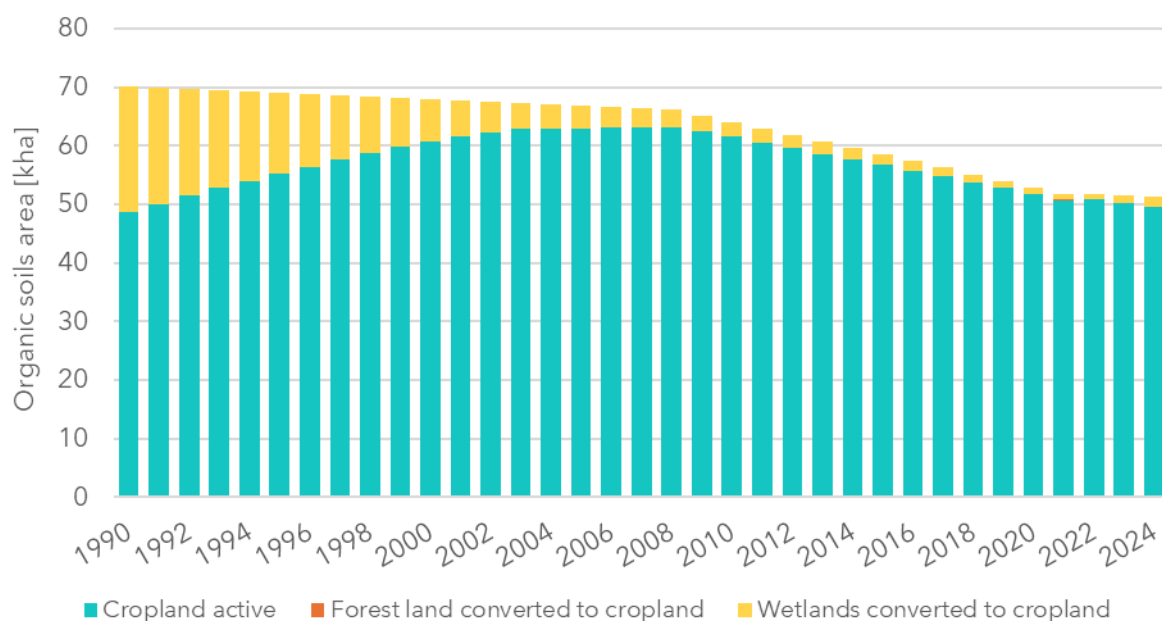


Figure 6.61 Areas of organic soils in 4(II)B1 Cropland remaining cropland and 4(II)B2 Land converted to cropland in Iceland in 1990 – 2024, [kha].

Off-site CO₂ emissions via waterborne losses in drained inland soils for Cropland were calculated using a Tier 1 and applying Equation 2.4 in the 2013 Wetlands Supplement. The default EF from table 2.2 (Boreal climate zone) was applied (Table 6-66).

CH₄ emission from drained land is calculated according to a Tier 1 by applying Equation 2.6 (for two components: drained land and ditches) in 2013 Wetlands supplement. The CH₄ EFs

were used from the 2013 Wetlands Supplement (from Tables 2.3 and 2.4 in, respectively) (Table 6-66).

Table 6.70 EFs applied to estimate emissions from ditches and organic soils in Cropland category

Category/Subcategory	EF CO ₂ per area [kg CO ₂ /ha]	EF Land [kg CH ₄ /ha/yr]	EF Ditches [kg CH ₄ /ha/yr]
4(II)B1 Cropland Remaining Cropland			
4(II)B1 Cropland Active	440	0	1,165
4(II)B2 Land Converted to Cropland			
4(II)B2 Wetlands Converted to Cropland	440	0	1,165
4(II)B2 Forest Land Converted to Cropland	440	0	1,165

Grassland

Areas of ditches and organic soils in Grassland are reported in Figure 6.62 and Figure 6.63. The EFs used to estimate the emissions and tier-level approaches applied are briefly described below and reported in Table 6.71 and Table 6.72.

Table 6.71 Tier-level approaches, notation keys, and emission factors used for the Grassland category.

Land-use category	CO ₂	N ₂ O	CH ₄
4(II)C1 Grassland remaining grassland			
Total organic soils			
Drained organic soils	T1 (D) – T2 (CS)	-	T1 (D)
Total mineral soils	NA	-	NA
4(II)C2 Cropland converted to grassland			
Total organic soils			
Drained organic soils	T1 (D)	IE*	T1 (D)
Total mineral soils	NA	NA	NA
4(II)C2 Wetlands converted to grassland			
Total organic soils			
Drained organic soils	T1 (D)	IE*	T1 (D)
Total mineral soils	NA	NA	NA

*IE – Direct and indirect emissions are reported under the Agriculture sector



Figure 6.62 Ditches areas, total for 4(II)C1 Grassland remaining grassland and 4(II)C2 Land converted to grassland in Iceland in 1990 – 2024 [kha].

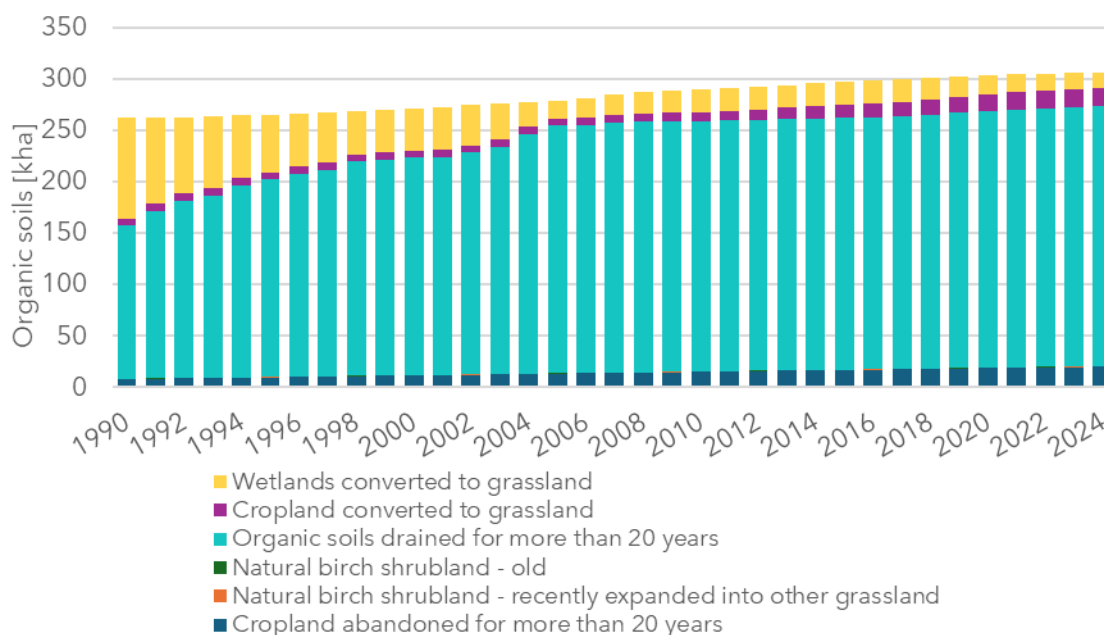


Figure 6.63 Areas of organic soils in 4(II)C1 Grassland remaining grassland and 4(II)C2 Land converted to grassland in Iceland in 1990 – 2024 [kha].

Two sources of emissions are reported for Grassland: off-site CO₂ emissions via waterborne losses from drained inland soils, and CH₄ emissions from drained inland soils and ditches.

The off-site emissions of CO₂ waterborne organic matters from drained soils were estimated according to equation 2.4 in 2013 Wetlands Supplement, applying a tier 1 with the IPCC default EFs (Table 2.2 in 2013 Wetlands Supplement) almost for all sub-categories. An

exception was made for Natural Birch Shrubland subcategory, where a tier 2 and CS EF was applied (see Forest land chapter above).

CH₄ emissions from drained land and ditches were calculated according to Tier 1 by applying Equation 2.6 from the 2013 Wetlands Supplement. No CS data on the fraction of area covered by ditches is available, therefore the default values reported in Table 2.4 in the 2013 Wetlands Supplement were applied. Drainage ditches in Iceland are deep (1.5-4.0 m), therefore the EF for Grassland ditches were selected. CH₄ emissions from drained Grassland were calculated according to Tier 1 by applying the default EFs from Tables 2.3 and 2.4 in the 2013 Wetlands Supplement, respectively.

Table 6.72 EFs applied to estimate emissions from ditches and organic soils in Grassland category.

Category/Subcategory	EF CO ₂ per area [kg CO ₂ /ha]	EF Land [kg CH ₄ /ha/yr]	EF Ditches [kg CH ₄ /ha/yr]
4(II)C1 Grassland remaining grassland			
4(II)C1 Cropland Abandoned for more than 20 Years	440	1.4	1,165
4(II)C1 Natural Birch Shrubland (NBS) – Old	147	2	217
4(II)C1 NBS – Recently Expanded into other grassland	147	2	217
4(II)C1 Organic soils drained for more than 20 Years	440	1.4	1,165
4(II)C2 Land converted to grassland			
4(II)C2 Cropland converted to grassland	440	1.4	1,165
4(II)C2 Wetlands converted to grassland	440	1.4	1,165

Wetlands

Areas of organic soils in Wetlands are reported in Figure 6.64. The EFs used to estimate the emissions and tier-level approaches applied are briefly described below and reported in Table 6.73 and Table 6.74.

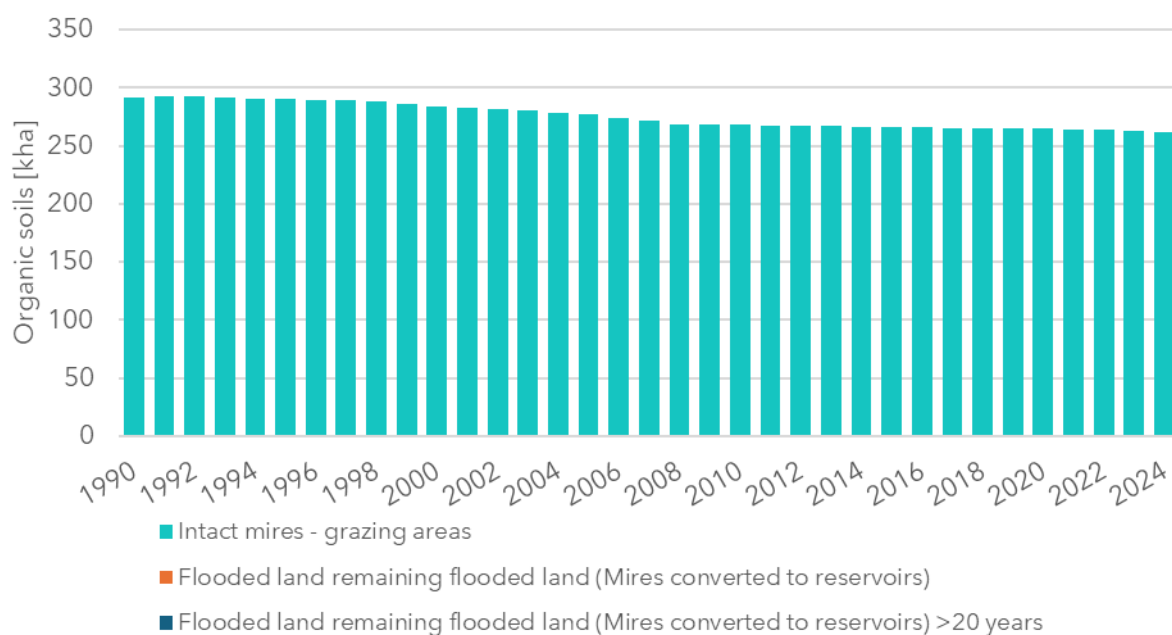


Figure 6.64 Areas of organic soils in 4(II)D1 Wetlands remaining wetlands and 4(II)D2 Land converted to wetlands in Iceland in 1990 – 2024 [kha].

Table 6.73 Tier-level approaches, notation keys, and emission factors used for the Wetlands category

Land-use category	CO ₂	N ₂ O	CH ₄
4(II)D1 Wetlands remaining wetlands			
4(II)D1a Peat extraction remaining peat extraction			
Total organic soils	NO	NO	NO
Total mineral soils	NO	NO	NO
4(II)D1b Flooded land remaining flooded land			
Total organic soils			
4(II)D1b Intact mires converted to reservoirs - High SOC to reservoirs	NO	NO	NO
4(II)D1b Intact mires converted to reservoirs - High SOC to reservoirs older than 20 years	NA	NO	T1 (D) ¹
Total mineral soils			
4(II)D1b Grassland converted to flooded land - Medium SOC to reservoirs older than 20 years	NA	NO	T2 (CS)
4(II)D1b Other land converted to flooded land - Low SOC to reservoirs older than 20 years	NA	NO	T2 (CS)
4(II)D1c Other wetlands remaining other wetlands			
Total organic soils			
4(II)D1b Rewetted mires	T1 (D)	NO	T1 (D)
4(II)D1b Intact mires – grazing areas	NA	NO	NA
Total mineral soils			
4(II)D1b Refilled lakes and ponds older than 20 years	NA	NA	T1 (D)
4(II)D2b Grassland converted to flooded land			
Total organic soils	NA	NA	NA
Total mineral soils			
4(II)D2b Medium SOC to reservoirs	NA	NO	T2 (CS)
4(II)D2b Other land converted to flooded land			
Total organic soils	NA	NA	NA

Land-use category	CO ₂	N ₂ O	CH ₄
Total mineral soils			
4(II)D2b Low SOC to reservoirs	NA	NO	T2 (CS)
4(II)D2c Grassland converted to other wetlands			
Total organic soils			
4(II)D2c Rewetted wetland soils	T1 (D)	NO	T1 (D)
Total mineral soils			
4(II)D2c Refilled lakes and ponds	T1 (D)	NA	T1 (D)

¹ To estimate CH₄ emissions from Intact mires converted to reservoirs (High SOC to reservoirs older than 20 years).

The rewetting of organic soils in the Grassland land-use category is reported as Grassland Converted to Wetlands. No other source or sink of greenhouse gases related to drainage or rewetting of Grassland soils is recognised, and the relevant categories of 4(II) reported with notation key NO.

Off-site CO₂ emissions via waterborne losses from wet organic soils are reported for three wetland subcategories:

- Rewetted mires (of 4(II)D1b Wetlands remaining wetlands),
- 4(II)D2c Refilled lakes and ponds, and
- 4(II)D2c Rewetted wetland soils (of 4(II)D2 Land converted to wetlands).

In all cases, the emissions are estimated according to Tier 1 by applying Equation 3.5 in the 2013 Wetlands Supplement.

The off-site CO₂ emissions via waterborne losses from 4(II)D1b Mires converted to reservoirs, 4(II)D2c Refilled lakes and ponds, and 4(II)D2c Rewetted wetlands soils are calculated according to Tier 1 using EF = 0.08 t CO₂-C ha⁻¹ yr⁻¹ from Table 3.2 in the 2013 Wetlands Supplement.

Emissions of CH₄ from reservoirs were estimated by applying a comparative method for CO₂ emissions using either reservoir classification or a reservoir-specific EF (Óskarsson & Guðmundsson, 2008). In cases where information was available, the emissions were calculated from inundated carbon.

CH₄ emissions from wet soils in the 4(II)D2c Refilled lakes and ponds, and 4(II)D2c Rewetted wetlands soils categories are estimated according to Tier 1 by applying Equation 3.8 in the 2013 Wetlands Supplement using the IPCC default EFs from Table 3.3 in 2013 Wetlands Supplement.

N₂O emissions from reservoirs are considered as not occurring.

Zero emissions were measured in an Icelandic study on which the emission estimates of CO₂ and CH₄ for reservoirs were based (Óskarsson & Guðmundsson, 2008).

The Tier 1 approach of the 2013 Wetlands Supplement for emissions of N₂O is considered negligible for Rewetted Wetland Soils.

Table 6.74 EFs applied to estimate emissions from ditches and organic soils in Wetlands category.

Category/Subcategory	EF CO ₂ per area [kg CO ₂ /ha]	EF Land
		CH ₄ per Area [kg CH ₄ /h]
4(II)D1 Wetlands remaining wetlands		
4(II)D1 Refilled lakes and ponds older than 20 years	-	183
4(II)D1 Rewetted mires	293	183
4(II)D2 Land converted to wetlands		
4(II)D2 Rewetted wetland Soils	293	183
4(II)D2 Refilled lakes and ponds	293	183

Settlements and Other Land

Settlements: No drainage or rewetting is occurring.

Other Land: by definition, this category is unmanaged, and no drainage or rewetting is occurring.

6.11.3 Uncertainty Assessment and Time-series Consistency

The uncertainty assessment for CRT 4(II) category for the period 1990–2024 have been assessed following Approach 1 of the 2006 IPCC Guidelines (IPCC, 2006). Detailed information on the uncertainty rates associated with the AD and the EFs is presented in Annex 6. The overall uncertainty analysis is reported in Annex 2.

6.11.4 Category-specific QA/QC and Verification

Please consult Chapter 1.5 and section 0 for more information.

6.11.5 Category-specific Recalculations

The recalculations for this category are based on the comprehensive review conducted by the EEA between May and June 2025. Following this review, substantial updates and recalculations were made to the subcategory Intact mires -grazing areas subcategory. Since the organic soils in this category are not drained and are only subject to grazing activities, the methodology previously applied was found to be inconsistent with the 2006 IPCC Guidelines (Chapter 7.1, p. 7.5), which state that “managed wetlands will be restricted to wetlands where the water table is artificially changed (e.g. drained or raised) or those created through human activity (e.g. damming a river).” During the review, the TERT highlighted that the previously used method, which is based on the 2013 Supplement to the 2006 IPCC Guidelines and specifically addresses drained organic soils, does not apply to this subcategory. As a result,

emissions of CO₂ and CH₄ from this subcategory are now reported as NA. Further details are provided in Section 6.6.7

6.11.6 Category-specific Planned Improvements

There are no specific improvements planned for this category.

6.12 Direct and indirect N₂O Emissions from N mineralisation and immobilisation (CRT 4(III))

6.12.1 Category Description and methodology

Direct N₂O emissions from N mineralisation and immobilisation are reported for 4(III)B2b Grassland converted to cropland, 4(III)E2a Forest land converted to settlements and starting with the 2026 submission also from 4(III)E2c Grassland converted to settlements. A Tier 1 and a Tier 2 approach, respectively, was used to estimate direct N₂O emissions.

Conversion of Cropland on mineral soils to Grassland, Forest land converted to settlements and Grassland converted to Settlements result in loss of SOC. Emissions of associated mineralisation of N are calculated by Equation 11.8 by assuming IPCC default C:N ratio of 15 and the emission factor of 0.01 N₂O (kg N₂O-N per kg N) according to Table 11.1 (IPCC 2006).

The notation key NE was used to report direct and indirect emissions due to mineralization associated with carbon losses from the conversion of 4(III)D2c Grassland converted to wetlands.

Direct and indirect N₂O emissions due to mineralization associated with carbon losses from the conversion of 4(III)D2e Other Land converted to wetlands were reported as NA, as the 2006 IPCC Guidelines do not provide default values.

Indirect N₂O emissions were estimated using Tier 1 approach given in Equation 11.10 and by emission factor of 0.075 and fraction factor of 0.30 given in Table 11.3. in 2006 IPCC Guidelines.

6.12.2 Uncertainty Assessment and Time-series Consistency

The uncertainty assessment for CRT 4(III) category for the period 1990–2023 have been assessed following Approach 1 of the 2006 IPCC Guidelines (IPCC, 2006). Detailed information on the uncertainty rates associated with the AD and the EFs is presented in Annex 6. The overall uncertainty analysis is reported in Annex 2.

6.12.3 Category-specific QA/QC and Verification

Please consult Chapter 1.5 and section 0 for more information.

6.12.4 Category-specific Recalculations

During the comprehensive review conducted by the EEA between May and June 2025, the TERT requested estimates for direct and indirect nitrous oxide (N₂O) emissions from nitrogen (N) mineralization/immobilization associated with the loss or gain of soil organic matter are estimated for 4(III)E2c Grassland converted to settlements. Emissions of associated mineralisation of N are calculated by Equation 11.8 by assuming IPCC default C:N ratio of 15 and the emission factor of 0.01 N₂O (kg N₂O-N per kg N) according to Table 11.1 (IPCC 2006). Table 6.75 and

Table 6.76 present examples of calculations for direct and indirect N₂O emissions from nitrogen (N) mineralization and immobilization associated with the loss or gain of soil organic matter for the inventory year 2024. To assess the impact of this recalculation on total emissions from Settlements, refer to Table 6.64 and Figure 6.52 in Section 6.7.7.

Table 6.75 Example of direct N₂O emission calculation from N mineralization/immobilization (4(III)E2c Grassland converted to settlements), inventory year 2024.

Inventory year	ktC	Default C:N Chapter 11	kt N	Default EF Table 11.1	44/24	kt N ₂ O
2024	-4.922	15	-0.328	0.010	-1.571	0.005

Table 6.76 Example of indirect N₂O emission calculation from N mineralization/immobilization (4(III)E2c Grassland converted to settlements), inventory year 2024.

Inventory year	kt N	Default Table 11.3	Default Table 11.3	44/24	kt N ₂ O
2024	-0.328	0.0075	0.3	-1.571	0.001

6.12.5 Category-specific Planned Improvements

No category specific improvements are planned for this category.

6.13 Biomass burning (CRT 4(IV))

6.13.1 Category description

Accounting for biomass burning in all land-use categories is addressed commonly in this section. The NSII has, in cooperation with regional natural history institutes, started recently

to record incidences of biomass burning categorised as wildfire. This recording includes mapping the area burned. These maps are used to classify the burned area according to IGLUD land-use map. The area affected by wildfires in Iceland across various land uses between 2006 and 2024 is shown in Figure 6.65. No wildfires were recorded for the period between 1990 and 2005.

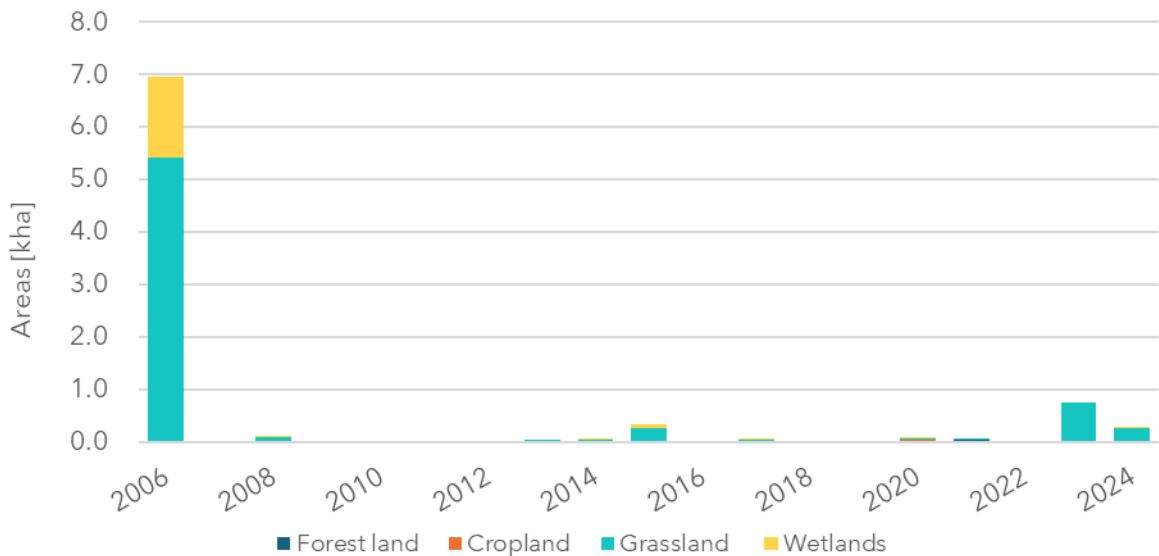


Figure 6.65 Areas affected by wildfires (by category) in Iceland in 2006 – 2024 [kha].

One forest fire was reported in 2021, which burned on 4 May 2021 in Southwest Iceland. According to an expert knowledge from NSII, who mapped and examined the burned area, the fire affected 4 ha of Natural Birch Forest, 40 ha of cultivated forest, and 12.5 ha of a *Lupinus nootkatensis* field within land categorized as Grassland remaining grassland (and was reported within Grassland category). Only some of the trees died, and most of the biomass of trees that died was converted into necromass (litter or deadwood). No forest fire was reported in 2024.

Biomass burning due to wildfires on areas categorised as Other land remaining other land has occurred since the eruption of Fagradalsfjall volcano (in the Reykjanes peninsula), which began on March 19, 2021 (not shown on Figure 6.65). Since March 19, 2021, 12 eruption events have occurred in the same area. Non-CO₂ emissions from this eruption event were estimated in accordance with the 2006 IPCC Guidelines (Volume 4, Chapter 9), which states that Other land is often unmanaged, and in that case changes in carbon stocks and non-CO₂ emissions and removals are not estimated.

6.13.2 Methodology

Emissions of CH₄ and N₂O are calculated according to Equation 2.27 from the 2006 IPCC Guidelines.

$$L_{fire} = A \times M_B \times C_f \times G_{ef} \times 10^{-3}$$

L_{fire} = tons of GHG emitted, A = area burned [ha], M_B = mass of fuel available [tons/ha], C_f = combustion factor, G_{ef} = emission factor [g GHG/kg DM].

No CO₂ emissions were reported because biomass is assumed to recover its pre-burning values within a few years of the burning.

Data on biomass burned were used from in the IGLUD project from the relevant land-use category as identified in land-use map.

Forest, which reach 2-5 m height at maturity, with average AGB of 11.9 Mgha⁻¹ (Snorrason et. al. 2019) was used to conduct the estimates for the forest fire in South West Iceland in 2021. EFs given for Extra tropical forest were selected along with combustion factor of All boreal forest.

The available biomass for other land-use categories was calculated from the average of IGLUD biomass samples of each mapping category, weighted against the area of the relevant mapping category (Table 6.77).

Table 6.77 Mass of fuel available by land category / soil type.

Land use category		Soil type / Land-use subcategory	kg FM / m ²
Cropland	Cropland remaining Cropland	Mineral	2.47
Cropland	Cropland remaining Cropland	Organic	2.61
Grassland	Grassland remaining Grassland	Cultivated forest-before 1990	2.73
Grassland	Grassland remaining Grassland	Organic	1.98
Grassland	Grassland remaining Grassland	Other	2.99
Grassland	Grassland remaining Grassland	Cultivated forest-Since 1990	2.62
Grassland	Grassland remaining Grassland	Settlement-Other	6.43
Grassland	Land converted to Grassland	Revegetated-Since 1990	12.36
Grassland	Grassland remaining Grassland	Uncategorized	2.99
Wetlands	Wetlands remaining Wetlands	Other	2.32

The value of the C_f constant was assumed to be 0.5 for all land-use categories, as no applicable constants are found in Table 2.6 of 2006 IPCC Guidelines. The default value of G_{ef} for Savanna and Grassland were taken from Table 2.5 in 2006 IPCC Guidelines.

Controlled burning has been heavily restricted since 1992 when Law 61/1992 on fires and fire management (Lög um sinubrennur og meðferð elds á víðavangi number 61, 1992) came into force. Controlled burning for all land-use categories is reported as NO for the entire reporting period. As for the 1990–1991 reporting years, it was assumed that these practices have been already followed. No wildfires occurred during 1990–1991.

6.13.3 Uncertainty Assessment and Time-series consistency

The uncertainty assessment for CRT 4(IV) category for the period 1990–2023 have been assessed following Approach 1 of the 2006 IPCC Guidelines (IPCC, 2006). Detailed information on the uncertainty rates associated with the AD and the EFs is presented in Annex 6. The overall uncertainty analysis is reported in Annex 2.

6.13.4 Category-specific QA/QC and Verification

Please consult chapter 1.5 and section 0 for more information.

6.13.5 Category-specific Recalculations

No recalculations have been conducted for this category.

6.13.6 Category-specific planned improvements

Recording of the area where controlled biomass burning is licensed is still not practiced. General awareness on the risk of controlled burning getting out of hand is presently rising and concerns are frequently expressed by municipal fire departments regarding this matter. Prohibition or stricter licenses on controlled burning can be expected in near future. This development might involve better recordkeeping on biomass burning.

Planned special sample plot measurements of forest fire areas is considered in the future.

7 Waste (CRT sector 5)

7.1 Overview

This sector includes emissions from Solid Waste Disposal (5A), Biological Treatment of Solid Waste (5B), Incineration and Open Burning of Waste (5C), and Wastewater Treatment and Discharge (5D). The category Other (5E) is currently reported as NO.

Table 7.1 shows an overview of the emissions from the Waste sector. The main contributor to the waste sector is CH₄ emissions from Solid Waste Disposal (5A). Composting (5B1) started in Iceland in 1995 and was the only category reported under Biological Treatment of Solid Waste until the first anaerobic gas and composting plant (Gas- og jarðgerðarstöð, GAJA) which has been operational since 2020. As the waste is first anaerobically digested and then composted, emissions from the plant are reported under both Anaerobic Digestion at Biogas Facilities (5B2) and composting (5B1).

Incineration and Open Burning of Waste (5C) has decreased since 1990. Under Waste Incineration (5C1), the only active incinerator in the country (Kalka), active since 2004, is reported. Open Burning of Waste (5C2) includes combustion in nature, on dumpsites and in open containers as well as in uncontrolled incinerators which were installed in Iceland during the period 1990-2010. Once the main pathway in the subcategory 5C, nowadays, only New Year's Eve and Twelfth Night bonfires are reported within the Open Burning of Waste category. In 2020 and 2021, there were only a handful of bonfires due to the COVID-19 pandemic and, consequently, 5C2 emissions are significantly lower those years.

The category Wastewater Handling and Discharge (5D) has increased since 1990.

Table 7.1. Emissions from the waste sector [kt CO₂e].

CRT			1990	1995	2000	2005	2010	2015	2020	2023	2024
5A	Solid Waste Disposal	CH ₄	173	225	261	284	280	234	230	216	203
5B	Biological Treatment of Solid Waste	CH ₄	NO	0.22	0.22	0.56	1.7	2.4	3.6	5.6	4.4
		N ₂ O	NO	0.13	0.13	0.32	1.0	1.4	2.0	2.7	2.0
5C	Incineration and Open Burning	CH ₄	6.8	4.7	2.9	0.50	0.39	0.39	0.12	0.39	0.39
		N ₂ O	1.5	1.0	0.63	0.27	0.22	0.29	0.23	0.33	0.46
		CO ₂	7.3	4.9	2.7	4.8	6.1	6.9	6.4	6.1	6.6
5D	Wastewater Treatment and Discharge	CH ₄	9.8	10.1	11.5	10.1	8.8	10.4	9.7	10.6	11.4
		N ₂ O	14.2	14.3	16.6	13.5	10.2	13.3	11.7	12.8	14.2
5E	Other		NO	NO	NO	NO	NO	NO	NO	NO	NO
5	Waste	Total	212	260	296	314	309	269	263	254	243

7.1.1 Waste Management in Iceland

The following paragraphs describe the evolution of waste management in Iceland. Characteristic and relevant for Iceland's early waste management practices are its remote location in the middle of the North Atlantic Ocean, the low population density (ranging from 2.0 to 3.7 people per square kilometres in 1970 and 2020 respectively)⁴⁹, and the rather difficult road transportation network, especially during the first half of the 20th century. Further information can be found in the National Plan on Waste Treatment 2004-2016 (2004)⁵⁰, the National Plan on Waste Treatment 2013-2024 (2013)⁵¹ and Towards a Circular Economy (2021)⁵², all in Icelandic. Figure 7.1 shows a summary of the most important developments since 1970.

From 1970 to 1990, little or no waste management practices were common in Iceland. The waste was disposed in landfills, which did not have to meet specific requirements regarding location, management, and aftercare before 1990 and were often just holes in the ground. Another practice involved the open burning of waste which mostly occurred at the same sites as the landfills, in the vicinity of settlements. Transport ways were short, and the waste was disposed of where it was produced. To prevent that the waste was blown away by the Icelandic weather, open concrete containers were used to burn the waste at relatively low temperature and in an uncontrolled way. In Reykjavík, the capital of Iceland and the area with the highest population, a landfill site (Gufunes) was established in 1967 and remained operational until 1990. Akureyri and Selfoss, two of the biggest municipalities outside the capital area, established municipal solid waste disposal sites (SWDSs) in the 1970s and 1980s.

⁴⁹ The Worldbank, population density, accessed 22/11/2024

<https://data.worldbank.org/indicator/EN.POP.DNST?end=2021&locations=IS&start=1970>

⁵⁰ The National Plan on Waste Treatment 2004-2016, available at

https://ust.is/library/Skrar/Atvinnulif/urgangur/Landsaatlun_2004-2016_VEF.pdf

⁵¹ The National Plan on Waste Treatment 2013-2024, available at

[https://www.stjornarradid.is/media/umhverfisraduneyti-media/media/PDF_skrar/Landsaaetlun-2013-2024-\(utgafa\).pdf](https://www.stjornarradid.is/media/umhverfisraduneyti-media/media/PDF_skrar/Landsaaetlun-2013-2024-(utgafa).pdf)

⁵² Towards a Circular Economy, available at https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/UAR_stefnal_att_ad_hringrasarhagkerfi.pdf

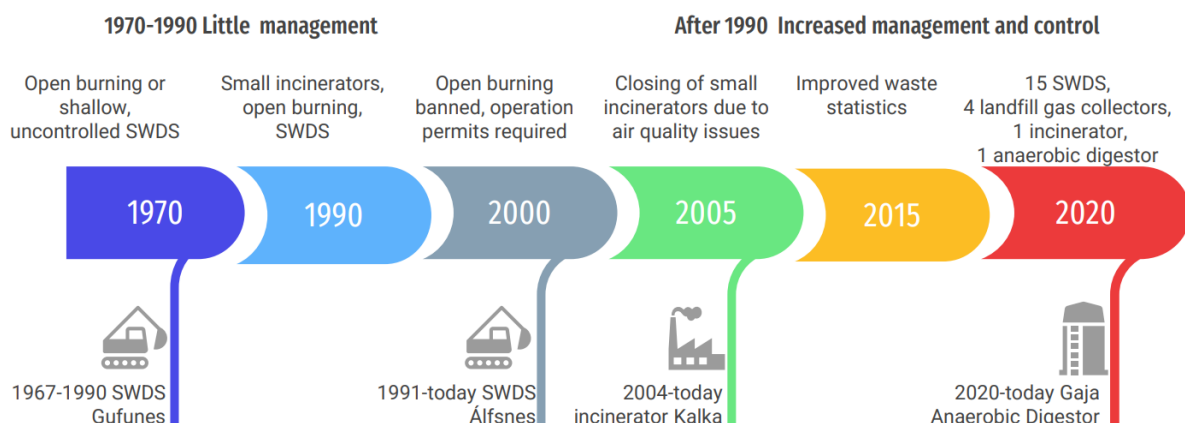


Figure 7.1. Timeline of the most important developments in waste management in Iceland since 1970.

From 1990 onwards, the number of landfills in the country increased, the practise of open burning decreased, and incinerators were built which, however, did not comply with modern air quality regulations. In 1991 a new SWDS site (Álfsnes), was established in the capital area, which is still in use today. From 1993 onwards, a number of municipalities established regional associations for waste treatment to achieve operational efficiency, creating fewer, but larger disposal sites. Composting, as a waste management practise, began in 1995, although the amounts composted were small in the beginning. During the period 1990-2010 several smaller incinerators were built, but soon after closed due to air quality and dioxin pollution issues. The only incinerator operative today in Iceland is Kalka, which has been operational since 2004. Open burning of waste was banned in 1999 and is non-existent today. The last place to burn waste openly was the rather remote island of Grímsey, which stopped doing so in 2010. Only traditional New Year's Eve and Twelfth Night bonfires are regarded as open burning of waste nowadays and reported as such.

Reliable data about waste composition does not exist until recent years. In 1991 the waste management company Sorpa Ltd. started serving the capital area and has gathered data on waste composition of landfilled waste since 1999. Since 2014, all waste operators in Iceland are required to report data on the amount of waste landfilled, incinerated, and recycled. Furthermore, obligations and criteria in waste matters are stipulated in detail in Act No 55/2003, on waste treatment, more specifically on regulated waste management practices, landfilling⁵³ and waste incineration.

Icelandic legislation on management of solid waste is at large based on and in accordance with EU legislation. As stipulated in the abovementioned Act on waste treatment, which was issued in 2003, from then on, all activities connected to waste management are subject to environmental permits and special requirements are required for waste operators regarding the collection, handling, and disposal of waste. The Icelandic Environment and Energy Agency (Umhverfis- og orkustofnun) (IEEA) is responsible for issuing operating permits and

⁵³ Regulation No 738/2003 on landfilling of waste.

supervising them, as well as checking that the permits are fulfilled and collecting waste statistics. Since Act No 55/2003 required all SWDS in Iceland to be managed and follow operation permits, as well as having a permeable cover layer, small SWDS, previously classified as 5A2 Unmanaged – Shallow, are classified as 5A1b Managed Well – Semi-Aerobic from 2004 onwards.

7.1.2 Methodology

The emission estimates of greenhouse gases from landfilling are based on the methodologies in the 2019 Refinements to the 2006 IPCC Guidelines. The methodologies suggested by the 2006 IPCC Guidelines are used in the other waste subsectors. Table 7.2 gives an overview of the reported emissions, calculation methods and type of emissions factors for the sector waste. The methodologies are described under each of the CRT categories in the respective chapters.

Table 7.2. Reported emissions, calculation methods and type of emission factors used in the Icelandic inventory (CS: country specific, PS: plant specific, D: default).

CRT	Reported Emissions	Method	Emission Factor
5A Solid Waste Disposal			
5A1 Managed Waste Disposal Sites	CH ₄	Tier 2	CS, D
5A2 Unmanaged Waste Disposal Sites	CH ₄	Tier 2	CS, D
5B Biological Treatment of Solid Waste			
5B1 Composting	CH ₄	Tier 1	D
5B1 Composting	N ₂ O	Tier 1	D
5B2 Anaerobic Digestion at Biogas Facilities	CH ₄	Tier 3	PS
5C Incineration and Open Burning of Waste			
5C1 Waste Incineration	CH ₄	Tier 1	D
5C1 Waste Incineration	N ₂ O	Tier 1	D
5C1 Waste Incineration	CO ₂	Tier 2a	D
5C2 Open Burning of Waste	CH ₄	Tier 1	D
5C2 Open Burning of Waste	N ₂ O	Tier 1	D
5C2 Open Burning of Waste	CO ₂	Tier 2	D
5D Wastewater Treatment and Discharge			
5D1 Domestic Wastewater	CH ₄	Tier 1, Tier 2 ¹	CS, D
5D1 Domestic Wastewater	N ₂ O	Tier 1	D
5D2 Industrial Wastewater	CH ₄	Tier 1	CS, D
5D2 Industrial Wastewater	N ₂ O	Tier 1	CS, D
5E Other	/	/	/

¹ Tier 1 for wastewater treatment emissions and Tier 2 for discharge emissions.

7.1.3 Key Category Analysis

The key sources for the first and latest inventory years and the time series trend in the Waste sector are shown in Table 7.3 (compared to total emissions without LULUCF) and Table 7.4 (compared to total emissions with LULUCF).

Table 7.3. Key source categories for Waste (excluding LULUCF).

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH ₄	✓	✓	✓
5A2	Unmanaged Waste Disposal Sites	CH ₄	✓		✓

Table 7.4. Key source categories for Waste (including LULUCF).

IPCC Source Category		Gas	Level 1990	Level 2024	Trend
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH ₄		✓	✓
5A2	Unmanaged Waste Disposal Sites	CH ₄	✓		✓

7.1.4 Completeness

Table 7.5 gives an overview of the IPCC source categories included in this chapter and presents the status of emission estimates from all greenhouse gas emission sources in the Waste sector.

Table 7.5. Completeness in Waste (NA: not applicable, E: estimated, NE: not estimated, NO: not occurring, IE: included elsewhere).

CRT		Direct GHG			Indirect GHG		
		CO ₂	CH ₄	N ₂ O	NO _x	CO	NM VOC
5A	Solid Waste Disposal						
5A1	Managed Waste Disposal Sites	NA	E	NA	NA	NA	E
5A2	Unmanaged Waste Disposal Sites	NA	E	NA	NA	NA	E
5A3	Uncategorised Waste Disposal Sites			NOT OCCURRING			
5B	Biological Treatment of Solid Waste						
5B1	Composting ¹	NA	E	E	NA	E	NA
5B2	Anaerobic Digestion at Biogas Facilities ³	NA	E	NA	NA, NO	NA, NO	NA, NO
5C	Waste Incineration and Open Burning of Waste						
5C1	Waste Incineration ³	E	E	E	E	E	E
5C2	Open Burning	E	E	E	E	E	E
5D	Wastewater Treatment and Discharge						
5D1	Domestic Wastewater	NA	E	E	NA	NA	NE
5D2	Industrial Wastewater	NA	E	E	NA	NA	NE
5E	Other			NOT OCCURRING			

¹ These notation keys apply to Composting of Municipal Solid Waste (CRT 5B1a) from 1995. Composting of Municipal Solid Waste was NO in Iceland between 1990-1994. Composting of Other (CRT5B1b) is NO in Iceland.

² These notation keys apply to Anaerobic Digestion at Biogas Facilities of Municipal Waste (CRT 5B2a) from 2020. Anaerobic Digestion at Biogas Facilities of Municipal Waste was NO in Iceland between 1990-2019. Anaerobic Digestion of Other (CRT 5B2b) is NO in Iceland.

³ These notation keys apply to Waste Incineration from 2001. Waste Incineration was NO in Iceland between 1990-2000.

N₂O emissions from Solid Waste Disposal Sites (5A1 and 5A2) are not applicable since the 2006 IPCC Guidelines consider N₂O emissions to be insignificant and the 2019 Refinements do not provide clear guidelines on how to estimate these emissions. CO₂ emissions from the same categories are also not applicable, because CO₂ emissions from the decomposition of organic material, derived from biomass sources, are of biogenic origin and, therefore, accounted for under the AFOLU sector. CO₂ emissions from Composting (5B1) are also not applicable since they are biogenic and the 2006 IPCC Guidelines do not require their reporting. For the category Wastewater Treatment and Discharge (5D), both for Domestic and Industrial Wastewater, the calculation of NO_x and CO is not applicable (NA), as there is no emission factor (EF) available in the 2023 EMEP/EEA Guidebook. There is, however, an emission factor to calculate NMVOCs, but the activity data needed is different from that used to calculate the greenhouse gases (Tier 1). The activity data required to calculate NMVOCs, mg/m³ of wastewater handled, has not been accessible and, therefore, these emissions are not estimated (NE).

7.1.5 Source-Specific QA/QC Procedures

The quality control (QC) activities include general methods such as accuracy checks on data acquisition and calculations as well as the use of approved standardised procedures for emission calculations, estimating uncertainties, archiving information and reporting. The data collection and emission estimation are carried out by one inventory compiler, and a second one performs the quality checks on activity data, EFs and emission calculations. Further information can be found in Chapter 1.5 on Quality Assurance and Quality Control.

Further sector-specific activities include the following:

- The Waste sector emissions are presented to the interdisciplinary waste expert group at the IEEA each year for comments.
- For the subsector 5B2 Anaerobic Digestion at Biogas Facilities, CH₄ production data is obtained directly from the only such plant in Iceland. This data is combined with the default 5% CH₄ leakage from the IPCC Guidelines to estimate the emissions. The implied emission factor (IEF) is then compared with the IPCC default emission factors.
- Data on CH₄ recovery and flaring from waste operators is compared to data on fuel statistics (previously from the National Energy Authority (Orkustofnun) (NEA)).

7.1.6 Activity Data

In recent years data has been received from waste operators with weighted waste amounts landfilled, incinerated, composted, or recycled. For some CRT categories, there can be a time lag between reassessment of waste generation data and its publication and, therefore, inconsistencies between older published data and newer data used in the greenhouse gas inventory are possible. When surrogate data is used, especially for the first half of the reporting period, explanations can be found in the respective chapters.

The data is collected by the IEEA, and the waste operators use the categories of the European Waste Statistics Regulation (WStatR) to communicate the waste amounts. The communicated waste amounts are then transposed to the waste categories as outlined in the 2019 Refinements. Data about the recovery of CH₄ is collected from the operators running CH₄ collection systems at the landfills and from the anaerobic gas and composting plant (GAJA). For the calculation of the emissions deriving from domestic wastewater treatment the population data (including overnight stays of foreign visitors) is retrieved from Statistics Iceland (Hagstofa Íslands) (SI), protein consumption is periodically collected from the Icelandic Directorate of Health (Embætti landlæknis), which conducts semi-regular surveys, and the treatment systems utilisation is collected by the IEEA. For industrial wastewater, the amount of domestically processed fish is also retrieved from Statistics Iceland.

7.2 Solid Waste Disposal (CRT 5A)

7.2.1 Methodology

The calculation of CH₄ emissions deriving from solid waste disposal on land follows the Tier 2 method of the 2019 Refinements to the 2006 IPCC Guidelines, and Iceland uses the First Order Decay (FOD) model provided by the IPCC for these estimates. The method assumes that the degradable organic carbon (DOC) in waste decays slowly throughout the years or decades following its deposition, thus producing CH₄ and (biogenic) CO₂ emissions.

No methodology is given in the 2019 Refinements for the estimation of N₂O emissions from Solid Waste Disposal Sites and these have not been estimated. CO₂ emissions from this category are not applicable, because CO₂ emissions from the decomposition of organic material derived from biomass sources are of biogenic origin and, therefore, accounted for under the AFOLU sector.

7.2.2 Activity Data

7.2.2.1 Waste Generation

The IEEA compiles data on total amounts of waste generated since 1995. This data is published by Statistics Iceland.

- 1950-1995: Estimated using gross domestic product (GDP) as surrogate data.
- 1995-2004: Relies on assumptions and estimation and is less reliable than the data generated since 2005.
- 2005-2014: Received from the biggest operators according to the European Waste Catalogue (EWC) categorisation. Smaller operators did not submit data on waste amounts during that period, so some gap-filling estimations were performed by experts at the EAI.
- From 2014: EAI has received data according to the WStatR categorisation from all waste operators in Iceland.

Data on CH₄ recovery and flaring is based on data provided by operators to the European Pollutant Release and Transfer Register (E-PRTR).

As a precise data set is not available prior to 1995 in Iceland, the indications from the 2006 IPCC Guidelines, Volume 5 Chapter 3, section 3.2.2 Choice of Activity Data, especially regarding the activity data from 1950-1990 were followed: "When production data are not available, historical disposal of industrial waste can be estimated proportional to GDP or other economic indicators [...] For those years data are not available interpolation or extrapolation can be used."

Waste generation before 1995 was therefore estimated using gross domestic product (GDP) as surrogate data. A polynomial regression of the 3rd order was chosen as its explanation power was $R^2 = 0.94$ and it predicted waste for GDPs close to the reference period (1990-1994) realistically (Figure 7.2). Information on GDP dates to 1945 and is reported relative to the 2000 GDP. It was used to estimate waste generation since 1950. The formula the regression analysis provided is:

$$\begin{aligned} \text{Waste amount generated (t)} \\ = 0.0003 \times GDP\ index^3 - 0.0443 \times GDP\ index^2 + 6.6191 \times GDP\ index \end{aligned}$$

The combination of these different datasets was carried out with the help of an external consultant company, Aether Ltd. The waste amount generated was calculated for total waste and not separately for municipal and industrial waste. The reason behind this is that the existing data on waste amounts does not support this distinction. Waste amounts are reported to the IEEA as either mixed or separated waste. Though the questionnaires sent to the waste industry contain the two categories mixed household and mixed production waste, the differentiation between the two on site is often neglected. Therefore, they can be assumed to have similar content. The fact that all other household and production waste is reported in separate categories makes the use of the umbrella category industrial waste obsolete.

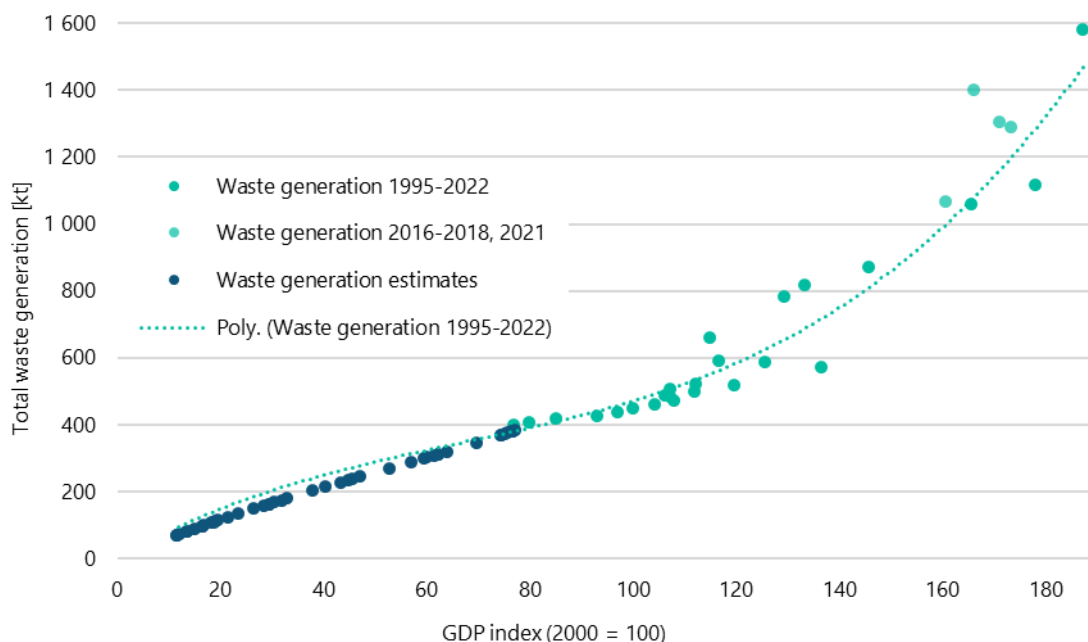


Figure 7.2. Correlation between waste generation and GDP index in Iceland used for waste generation estimates before 1995. Three years were not used for the prediction because of unusually much soil of total waste amount those years.

7.2.2.2 Waste Allocation

The data since 1995, as described above, allocates fractions of waste generated to SWDS, incineration, recycling, and composting. Recycling and composting began in 1995. Before 1995, the generated waste has to be allocated to either SWDS or incineration/open burning of waste. In a second step, the waste landfilled has to be allocated to SWDS types and the waste incinerated to incineration forms. To this end, population was used as surrogate data. It was determined that all waste from the Capital Area (Reykjavík and surrounding municipalities) was landfilled since at least 1950 (expert judgement), whereas only 50% of the waste generated in the rest of the country was landfilled and the remaining 50% were burned in open pits. Calculated annual waste generation was multiplied with the respective population fractions. It is not improbable that more than half of the waste generated in the countryside was burned openly. Nevertheless, to avoid underestimating the emissions from SWDS, this assumption was applied until 1972. In that year, the SWDS near Akureyri, started operating and all waste generated in Akureyri, Iceland's second largest town was landfilled there. From 1990, waste from Akureyri's neighbouring countryside was also landfilled at the SWDS. In response to this, the fraction of the population burning its waste was reduced accordingly, i.e., the 50% of waste that was burned in Akureyri before the opening of the new landfill were instead allocated to SWDS. The same was done in response to the opening of another big SWDS in Selfoss, in South Iceland, in 1981. The waste management system fractions from 1950-1989 and 1990 to the current reporting year are shown in Figure 7.3 and Figure 7.4.

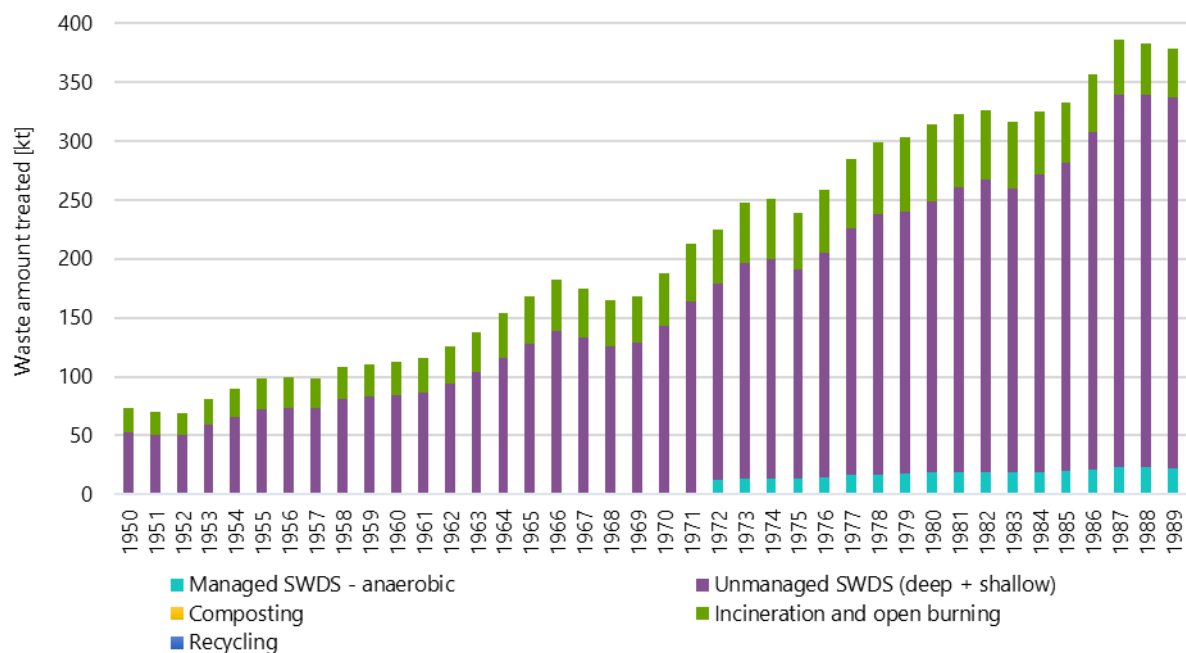


Figure 7.3. Waste amount and allocation to incineration/open burning, solid waste disposal, recycling, and composting 1950-1989.

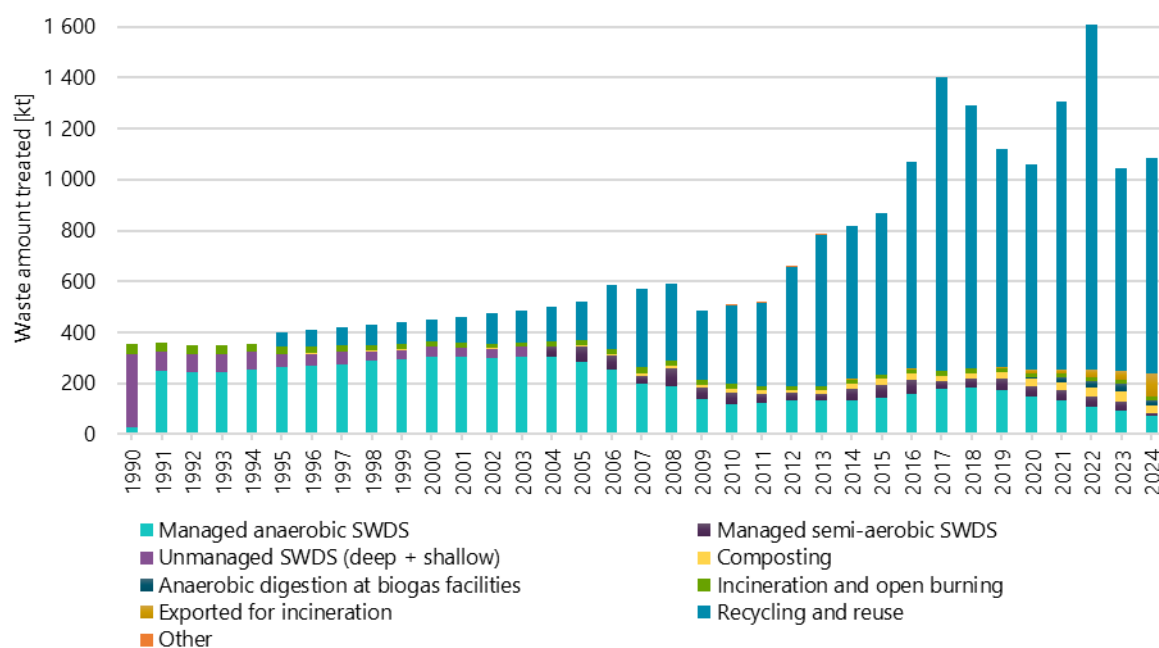


Figure 7.4. Waste amount and allocation to incineration/open burning, solid waste disposal, recycling, and composting, since 1990.

In accordance with the 2019 Refinements, the amount of waste landfilled was allocated to one of four SWDS types:

- Managed – anaerobic

- Managed well – semi-aerobic (the unmanaged – shallow sites after they become managed)
- Unmanaged – deep (>5 m waste)
- Unmanaged – shallow (<5 m waste)

Waste allocation to the different SWDS types is mainly based on the following events. The geographical location of the cited sites is shown in Figure 7.5:

- From 1950 to 1966, all waste landfilled went to unmanaged - shallow sites.
- In 1967, the SWDS Gufunes, classified as an unmanaged - deep SWDS, was commissioned to serve Reykjavík.
- In 1972, the SWDS in Akureyri started operating. Based on two landfill gas formation studies conducted there (Kamsma & Meyles, 2003; Júlíusson, 2011) it was classified as a managed - anaerobic SWDS.
- In 1981, a SWDS in Selfoss was commissioned and was classified as an unmanaged - deep SWDS.
- In 1991, Gufunes closed and in its place the SWDS Álfarnes started serving the capital and all surrounding municipalities. Álfarnes is the biggest SWDS in Iceland today and was classified as a managed – anaerobic SWDS (thus reducing both shallow and deep SWDS fractions).
- All SWDS that have opened since the Álfarnes site are classified as managed – anaerobic sites either based solely on 2019 Refinements criteria or also considering landfill gas measurements (Kamsma & Meyles, 2003; Júlíusson, 2011).
- Act No 55/2003 required all SWDS in Iceland to be managed and follow the rules states in the operation permits. Hence, in the inventory the previously Unmanaged – Shallow SWDS are classified as Managed Well – Semi-Aerobic from 2004 and onwards based on the criteria in the 2019 Refinements to the 2006 IPCC Guidelines.

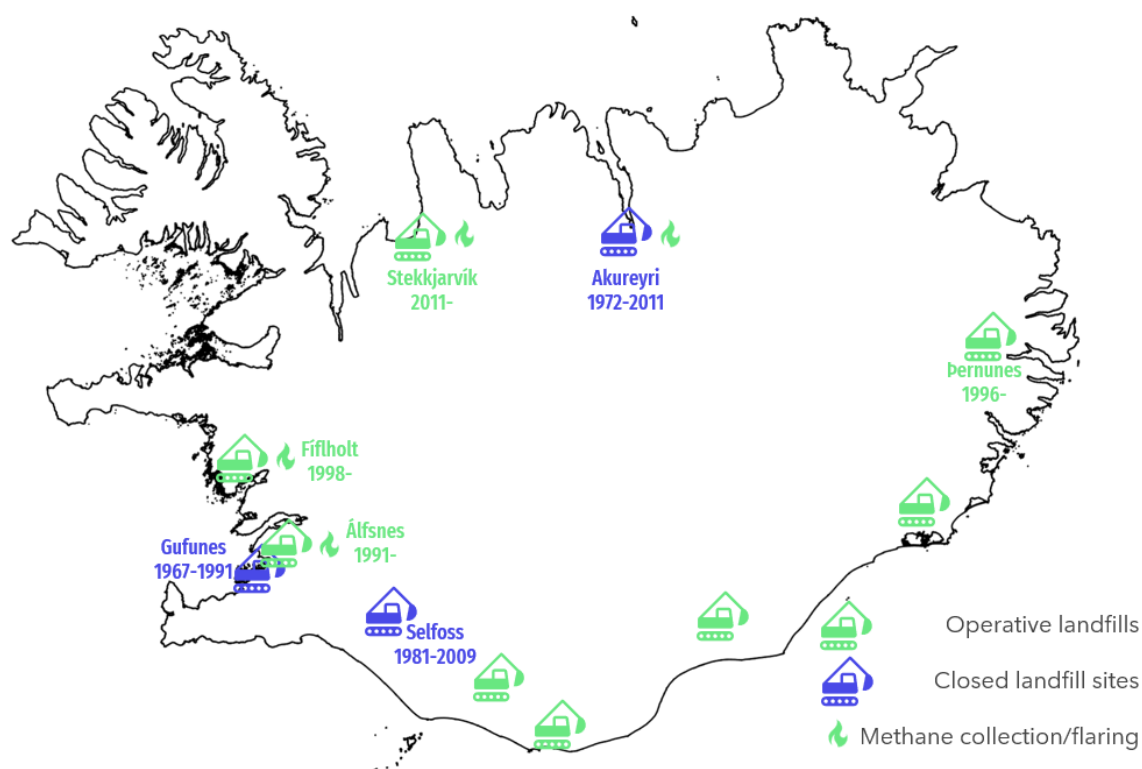


Figure 7.5. Main SWD sites in Iceland, operative (green) and closed sites (blue). There are several other smaller sites which are still operative or dismissed.

Figure 7.6 shows the development of landfill waste management practice shares since 1950. In 1990, before the Álfsnes SWDS opened, 91% of landfilled waste was landfilled in unmanaged SWDS. However, from 1991 to 2003, that fraction was on average 16%, and after Act No 55/2003 came into force, all SWDS in Iceland are considered managed.

Until 2004, the fractions of waste allocated to different SWDS types, managed and unmanaged, are based on surrogate data, e.g., population. Between 2005 and 2007, the actual waste amounts sent to the six landfill sites classified as managed - aerobic (Álfsnes, Akureyri, Selfoss, Fíflholt, Þernunes, Tjarnarland) were reported to the EAI. The waste amount going to managed well – semi-aerobic landfills is estimated by subtraction from the total amount of landfilled waste, which is estimated using population data. Since 2008, all SWDS data has been based on actual reported data from each SWDS and not on surrogate data.

The classification into SWDS types was updated alongside the 5A transition to the 2019 Refinements. Before the transition, the smaller managed sites were still classified as 5A2 Unmanaged – Shallow after they became managed, because no classification matched these sites. They were managed, but too small for fully anaerobic conditions to form and did not fulfil all the criteria for 5A1b Managed Well - Semi-Aerobic SWDS as they were defined in the 2006 IPCC Guidelines. However, since they all had a permeable cover layer, they did fit the definition of 5A1b Managed Well – Semi-Aerobic sites as they are defined in the 2019 Refinements. Since Act No 55/2003 required all SWDS in Iceland to be managed and follow the rules stated in the operation permits, it was decided for this submission to reclassify the

small SWDS from 5A2 to 5A1b from the year 2004 and onwards. The apparent jump in share of unmanaged SWDS in 2024 is due to export of MSW that was previously landfilled at the largest managed semi-aerobic SWDS in Álfsnes.

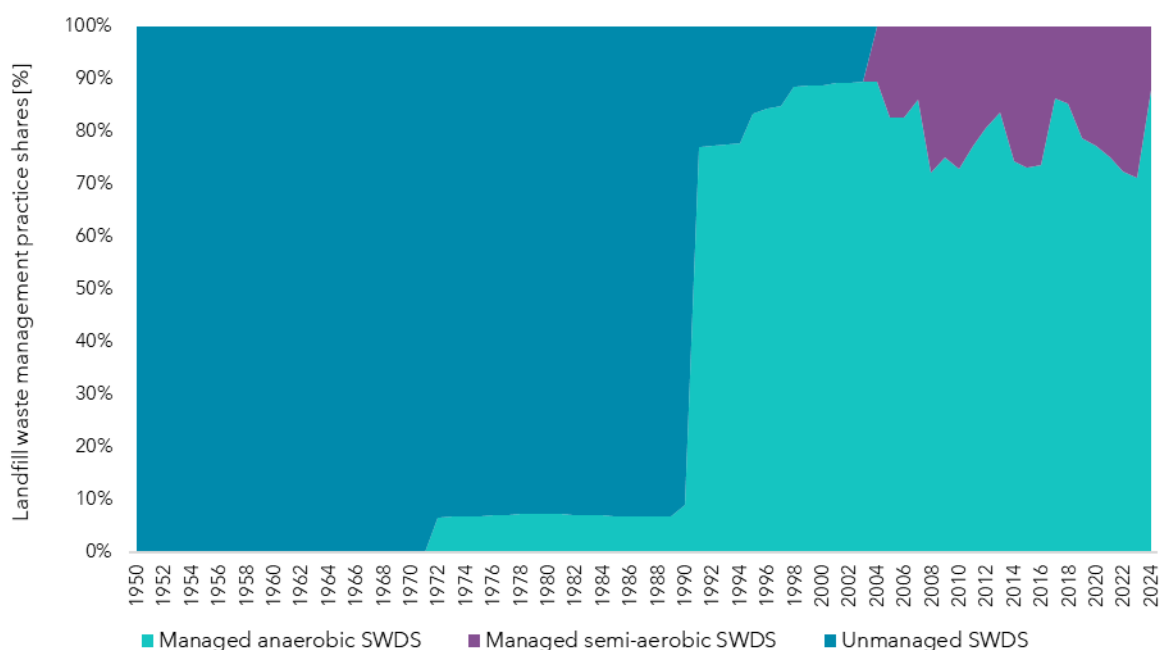


Figure 7.6. Waste management practice shares of total waste disposed of in managed and unmanaged SWDS.

7.2.2.3 Waste Categories

From 2005, the EAI has gathered information on waste quantities and composition from waste operators. From 2005-2013, data was received from most operators according to the EWC categorisation. Smaller operators generally did not submit data during that period, so some estimations had to be done by experts at the EAI.

From 2014, the IEEA has received data according to the WStatR categorisation from all waste operators in Iceland. This information includes:

- Amount of waste composted
- Amount of waste recovered and recycled
- Amount of waste incinerated with energy recovery
- Amount of waste incinerated without energy recovery
- Amount of waste landfilled

Since this data is received on the WStatR categorisation level, the IEEA is required to transform the data so that it matches the IPCC categorisation.

Current waste composition used for the emission estimates (i.e., used in the IPCC FOD models) are shown in Annex 7: Input data for Solid Waste Disposal Sites for the IPCC First Order Decay Model (5A1a, 5A1b, 5A2) for managed anaerobic SWDS, managed well – semi-

aerobic SWDS and for unmanaged SWDS, together with the parameters used in the First Order Decay model. The composition amounts are regularly subject to updates as streamlining of the WStatR to IPCC categorisation is a continuous process that requires regular reviewing and improvement.

Assumptions and Explanations for Specific Waste Category Amount Estimates

Since 2005, the IEEA has gathered information about annual composition of waste landfilled, burned, composted, and recycled. This data consists of separated and mixed waste categories. The separated waste categories could be allocated to one of the following waste categories:

- Food waste
- Industrial waste
- Paper/cardboard
- Textiles
- Wood
- Garden and park waste
- Nappies (disposable diapers)
- Sludge
- Inert waste

The last category comprises plastics, metal, glass, and hazardous waste. The pooling of these waste categories is done in the context of CH₄ emissions from SWDS only. For purposes other than greenhouse gas emission estimation, the IEEA keeps these categories separated.

The mixed waste categories are allocated to the categories above with the help of a study conducted by Sorpa Ltd., the waste management company servicing the capital area and operating the SWDS Álfarnes. Annually, Sorpa Ltd. conducts comparative studies on the composition of mixed waste from households and from commercial operators. This data is used to attribute the mixed waste categories to the nine waste categories listed above. A third mixed category was used up until 2014, mixed waste from waste reception centres. There is no reason for people to bring food waste to these reception centres as it can be disposed of in the bin at home, and mixed waste from collection points located in summer house areas is put in the mixed household waste category. Hence, it is reasonable to assume that this third category does not contain food waste. Therefore, the studies' fractions without the food waste fractions were used to attribute this category to the waste categories from the list, up until 2014. Thus, all waste landfilled could be attributed to one of the nine waste categories listed above with changing fractions from 2005 to the current reporting year. The average fractions from 2005-2011 were used as starting point to estimate waste composition of the years and decades before.

Although the data gathered by Sorpa Ltd. dates back to 1999, the data from 1999-2004 could not be used to represent mixed waste categories. That is because the mixed waste categories

in the data gathered by the EAI underwent changes during the same time period: many categories that were recorded separately during the five-year period (1999-2004) had been included in the mixed waste category before 2005 as well, thus doubling the amount recorded as mixed waste. Also, for the period from 1995-2004, the EAI data did not permit the exact allocation of waste categories to waste management systems.

Therefore, the average waste composition from 1990-2004 is assumed to be the same as the average waste composition from 2005-2011. Before 1990, the waste composition fractions were adjusted based on expert judgement and a trend deductible from the Sorpa Ltd. study data, namely that the fraction of food waste is increasing back in time. The adjustments that were made are shown in Table 7.6.

Table 7.6. Manipulations of waste category fractions for the time-period 1950-1990.

Waste Category	Adjustment	Rationale
Nappies/ Disposable Diapers	Linear reduction by 100% between 1990 and 1980.	Disposable diapers were introduced to Iceland around 1980 and were not widely used until the 1990s.
Paper/Cardboard	Linear reduction by 50% between 1990 and 1950.	The fraction of paper in waste was assumed to be much smaller decades ago. Also, paper was rather burned than landfilled (expert judgement).
Inert Waste	Linear reduction by 25% between 1990 and 1980 and linear reduction by 25% between 1980 and 1950.	Plastic and glass comprise around 50% of inert waste. Glass was reused during the beginning of the period. Plastic was much rarer during the beginning of the period. The amount of plastic in circulation increased in the 1980s (data from Norway), therefore the steeper decrease during that decade.
Food Waste	Increase of fraction by the amount that other categories were reduced by.	Expert judgement and trend in data from study by <i>Sorpa Ltd.</i>

Waste Data Adjustments

The IEEA receives data from all Icelandic waste operators that have a permit to accept waste for treatment or treat their own waste. This data is the basis for the IEEA's waste datasets. Corrections that are made to the data are the following:

- Amounts of waste metals, paper, plastics, and rubber that have been exported for treatment by entities other than domestic waste operators are added.
- Data from the Icelandic Recycling Fund (Úrvinnslusjóður), which imposes a recycling fee on various goods (e.g., selected hazardous materials, plastic and paper packaging, tires, EEE, batteries and accumulators and vehicles), are added to the datasets and the datasets are corrected accordingly.
- Amount of waste wood that was burned on bonfires is estimated separately (not annually).

7.2.3 Emission Factors

CH₄ emissions from SWDS are calculated with Equation 3.1 in Volume 5 of the 2006 IPCC Guidelines.

According to Icelandic Regulation No 738/2003 on waste management practices, it is a requirement that managed landfills are covered to prevent air and smell pollution and access by birds and vermin. In Iceland, most landfills use a combination of soil and wood chips as cover material, apart from a few exceptions which use sand and gravel. Therefore, the value of 0.1 is chosen for the oxidation factor (OX) as suggested in Table 3.2 of the 2006 IPCC Guidelines (Volume 5).

The amount of CH₄ recovered is discussed in chapter 7.2.4.1. To calculate CH₄ generated, the FOD method uses the emission factors and parameters shown in Table 7.7.

Table 7.7. Emission factors and parameters used to calculate CH₄ generated.

Emission factors/parameters	Values
Degradable organic carbon in the year of deposition (DOC)	Table 7.8
Fraction of DOC that can decompose (DOC _f)	Table 7.8
CH ₄ correction factor for anaerobic decomposition (MCF)	Table 7.9
Oxidation factor (OX) for SWDS	0.1
Fraction of CH ₄ in generated landfill gas (F)	0.5
Molecular weight ratio CH ₄ /C	16/12 (=1.33)
CH ₄ generation rate (k)	Table 7.8
Half-life time of waste in years (t _{1/2})	Table 7.8
Delay time in months	6

DOC, k, and t_{1/2} (which is a function of k) are defined for individual waste categories. The values are from the 2006 IPCC guidelines and are shown in Table 7.8.

Table 7.8. Degradable organic carbon (fraction) (DOC), fraction of DOC dissimilated (DOC_f), CH₄ generation rate (k) and half-life time in years (t_{1/2}) for each waste category.

Waste Category	Food	Paper	Textile	Wood	Garden	Nappies	Industrial	Sludge	Inert
DOC	0.15	0.4	0.24	0.43	0.2	0.24	0.04	0.05	NA
DOC _f	0.7	0.5	0.5	0.1	0.7	0.5	0.1	0.7	NA
k	0.185	0.06	0.06	0.03	0.1	0.1	0.03	0.185	NA
t _{1/2}	3.7	11.6	11.6	23.1	6.9	6.9	23.1	3.7	NA

The default DOC_f value for industrial waste in the waste model in the 2019 Refinements was not considered representative for Iceland. The industrial waste category in Iceland mostly consists of WStatR subcategory 12.13 (mixed construction and demolition waste) as well as

subcategory 10.3 (residues from waste treatment), which has been classified as industrial waste at Álfnes SWDS since 2014. According to the environmental manager at Sorpa Ltd. (which owns and runs Álfnes), the waste in categories 10.3 and 12.13 is mostly inert and hence a DOC_f of 0.10 was chosen for industrial waste. For consistency, the methane generation rate (k) and half-life time ($t_{1/2}$) was changed accordingly to 0.03 and 23.1, respectively.

The multiplication of the mass of waste deposited annually (W), with DOC and the fraction of DOC that can decompose (DOC_f), as well as the CH_4 correction factor (MCF), results in the mass of organic carbon which decomposes annually ($DDOC_m$).

The default MCF s for types of SWDS account for the fact that unmanaged and semi-aerobic SWDS produce less CH_4 from a given amount of waste than managed, anaerobic SWDS. The default values suggested by the 2019 Refinements for the four SWDS types used are shown in Table 7.9. Based on two landfill gas studies (Kamsma & Meyles, 2003; Júlíusson, 2011), no CH_4 production was reported for several of the SWDS contained in the category 5A1b Managed Well – Semi-Aerobic, which were previously classified as 5A2 Unmanaged – Shallow. Therefore, their MCF was reduced from 0.5 and 0.4, respectively, to 0.2. These measurements were performed at SWDS which all contained cover layers at the time of measurement and would therefore fall under 5A1b. These same sites were, however, classified as unmanaged – shallow before Act No 55/2003 came into action. The MCF for the unmanaged – shallow sites might therefore be slightly lower than the MCF currently used. Multiplication of MCF with respective SWDS type fractions results in a fluctuating MCF for solid waste disposal.

Table 7.9. IPCC default MCF s and MCF s used in the emission estimates.

SWDS Type	Managed, Anaerobic	Managed Well – Semi-Aerobic	Unmanaged, Deep	Unmanaged, Shallow
MCF (IPCC default)	1	0.5	0.8	0.4
MCF used	1	0.2	0.8	0.2

The FOD method is then used to establish both the mass of decomposable DOC accumulated and decomposed at the end of each year. To this end the k values of waste categories are used. A delay time of six months takes into account that decomposition is aerobic at first and production of CH_4 does not start immediately after the waste deposition. Equations 3.4 and 3.5 in Volume 5 from the 2006 Guidelines, which are used to calculate $DDOC$ accumulated and decomposed, are shown below. Finally, generated CH_4 is calculated by multiplying decomposed $DDOC$ with the volume fraction of CH_4 in landfill gas ($= 0.5$) and the molecular weight ratio of CH_4 and carbon ($16/12=1.33$).

7.2.4 Emissions

7.2.4.1 Methane Recovery

Recovery of landfill gas occurs currently at four sites in Iceland: Álfsnes, the largest landfill in Iceland, serving the capital area since 1996, Glerárdalur (Akureyri), a SWDS situated in the north of Iceland, which is not used for landfilling anymore, Fíflholt and Stekkjarvík, SWDS serving the Western and Northern part of the country, respectively, both collecting CH₄ since 2019. Figure 7.5 shows the location of the SWDS with CH₄ collection.

Data on the amount of landfill gas recovered from Álfsnes stems from the operator Sorpa Ltd., either through e-mail request or through the environmental reporting obligations, such as for the E-PRTR. For the earlier time period, landfill gas recovery from Álfsnes is estimated using the known capability of the burner and the time it was in operation as proxies. For the later time period, measurements exist on the amount of landfill gas recovered and the amount of CH₄ sold. Recovery of landfill gas from Glerárdalur began in 2014 and data on the amount of gas recovered is directly collected from the operator, Norðurorka. CH₄ has been collected at Fíflholt and Stekkjarvík since 2019 and all the gas is burned in a burner on site. Information about the amount of CH₄ collected and burnt is retrieved from the companies, Sorpurðun Vesturlands and Norðurá, through their environmental reporting obligations.

Where the landfill gas volume is obtained instead of the CH₄ volume, a CH₄ fraction, based on regularly performed measurements, is used to estimate the CH₄ volume. CH₄ volume is converted to CH₄ mass assuming standard conditions (0.717 kg at 0°C and 101.325 kPa) and purity percentages obtained from the SWDS.

Between 1996 and 2001, recovered CH₄ was combusted only. The main use between 2002 and 2006 was electricity production (reported in CRT category 1A1a in chapter 3.2.1). The bulk of CH₄ recovered since 2007 is sold as fuel for vehicles, e.g., cars and urban buses (reported in CRT category 1A3b in chapter 3.3.3). Figure 7.7 gives an overview of the annual CH₄ amounts by utilisation. There is currently a discrepancy between the values reported under the Energy sector and the values reported within this sector, based on numbers reported from the waste management company. This was pointed out during the 2021 UNFCCC review. The process of harmonising the numbers has begun, and the discrepancy, which existed for the year 2002-2006, was fixed for the 2025 submission. The IEAA will continue to harmonise the data for the period 2011-2015.

As can be seen in Figure 7.7, CH₄ recovery peaked in 2019. This can be explained by an increased collection of landfill gas at the Álfsnes landfill, from the end of 2018 to the summer of 2019. Due to the increased collection the quality of the CH₄ decreased, and the collection amount was reduced again in 2020 (information from Sorpa Ltd., e-mail).

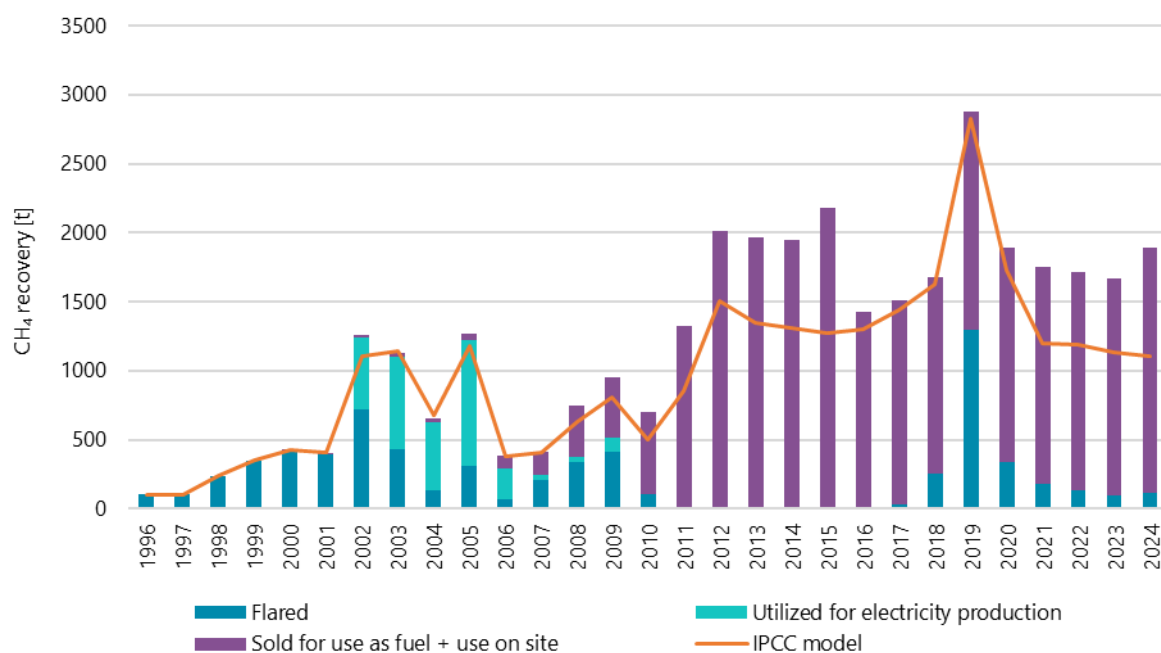


Figure 7.7. Methane recovery (5A1a) at Álfsnes, Glerárdalur, Stekkjarvík, and Fíflholt SWDSs (the last two started CH₄ recovery in 2019) [t CH₄].

7.2.4.2 Methane Emissions

CH₄ emissions from SWDS can be seen in Table 7.10. The highest emissions occurred in 2006. The main reason behind the increase until 2006 is a rather stable, high amount of waste disposed of in SWDS in connection with an increase of the MCF caused by the closing down of the unmanaged SWDS Gufunes, accompanied by the simultaneous opening of the managed SWDS Álfsnes, which services more than half the population of Iceland and receives a corresponding amount of waste. The shift in emissions from unmanaged to managed SWDS can be seen in Figure 7.8. In 1990, the CH₄ emissions from managed SWDS were only 11% of all SWDS emissions, while now most emissions originate from managed SWDS.

The reason for the decrease since 2006 is due to changes in waste management, where the amount of waste landfilled is rapidly decreasing and the amount of recycled waste is increasing. Because of the relatively high fraction of rapidly decreasing waste, the relatively new trend away from landfilling can already be seen in emissions. Increasing CH₄ recovery adds to this trend. The decrease of emissions in 2019 is due to the increased landfill gas collection at the Álfsnes site during that year, which had to be halted to ensure satisfactory quality of the collected CH₄.

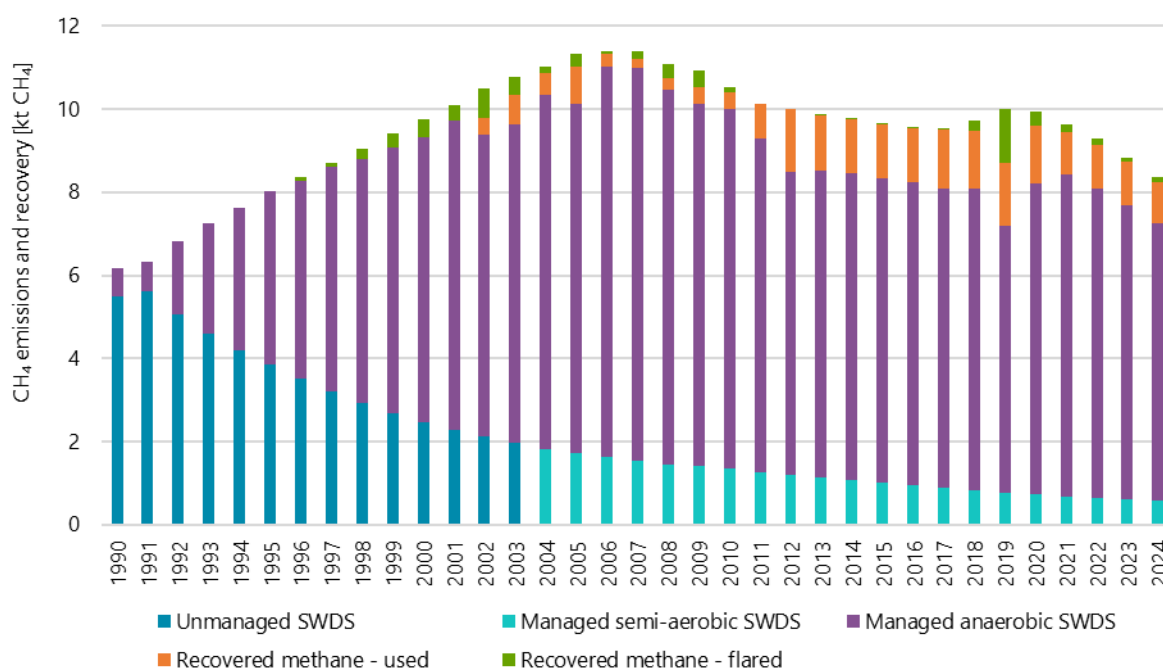


Figure 7.8. Methane generation estimates from SWDS since 1990.

Table 7.10. Methane emission estimates and recovery from SWDS since 1990.

CH ₄ emissions [kt CO ₂ e]	1990	1995	2000	2005	2010	2015	2020	2023	2024
Unmanaged SWDS	154	108	69	NO	NO	NO	NO	NO	NO
Managed Well – Semi-Aerobic SWDS	NO	NO	NO	48	37	28	20	17	16
Managed Anaerobic SWDS	19	116	192	236	243	205	209	199	187
Total CH ₄ emissions	173	225	261	284	280	234	230	216	203
Relative change from 1990		30%	51%	65%	63%	35%	33%	25%	18%
Recovered CH ₄ (flared and used)	NO	NO	12	33	14	36	49	32	31

7.2.5 Uncertainties

Activity data uncertainties are based on expert judgement within the IEAA on the uncertainty of total waste amount going to SWDS (10%) and composition uncertainty (20-25%, for 5A1a and 5A1b and 5A2 respectively). Emission factor uncertainties for Solid Waste Disposal are calculated based on Table 3.5, chapter 3, volume 5 of the 2019 Refinements to the IPCC Guidelines, using Equation 3.1 and 3.2 in volume 1 of the guidelines. The activity data uncertainty is 22% for managed, anaerobic SWDS and 27% for managed semi-aerobic SWDS and unmanaged SWDS. The emission factor uncertainty is 48% for managed anaerobic SWDS and 55% for managed semi-aerobic SWDS and unmanaged SWDS.

The combined uncertainty for activity data and emission factor is 53% for managed, anaerobic SWDS (5A1a) and 61% for managed, semi-aerobic SWDS and unmanaged SWDS

(5A1b and 5A2). The complete uncertainty analysis is shown in Annex 2: Assessment of Uncertainty.

7.2.6 Recalculations

Recalculations were made for anaerobic MWDS (5A1a) for years 1997-2003 and 2020-2023. CH₄ recovery at Álfnes landfill for years 1997-2003 was revised based on a summary document for these years from Sorpa. This increased the net CH₄ emissions in 1997 but reduced the emissions in years 1998-2003.

For years 2020-2023, CH₄ recovery at Álfnes landfill was previously overestimated because the amount of CH₄ collected from the landfill included the CH₄ produced at the GAJA biogas and composting plant, which opened in 2020. In the recalculations, the CH₄ produced at GAJA has been subtracted to derive the amount of CH₄ that was actually collected at the Álfnes landfill. This increased the net CH₄ emissions from the landfill, as less CH₄ was captured. The effect of revised CH₄ collection data at Álfnes landfill can be seen in Table 7.11.

Table 7.11. Recalculation in sector 5A1a due to revised CH₄ collection data at Álfnes landfill.

CRT 5A1a	1997	1999	2001	2003	2020	2021	2022	2023
2025 submission [kt CO ₂ e]	148.5	180.3	209.6	225.7	208.9	205.9	196.7	184.3
2026 submission [kt CO ₂ e]	151.1	178.4	208.0	214.9	209.5	217.1	208.6	198.6
Change relative to the 2025 submission [kt CO ₂ e]	2.5	-1.9	-1.6	-10.8	0.61	11.2	11.9	14.3
Change relative to the 2025 submission [%]	1.7%	-1.1%	-0.8%	-4.8%	0.29%	5.5%	6.1%	7.8%

7.2.7 Planned Improvements

There has been a discrepancy between the fuel sales data in the energy sector on landfill gas utilisation and the values reported within this sector, based on numbers reported from the waste management company. This was pointed out during the 2021 UNFCCC review. The process of harmonising the numbers has begun, and the discrepancy, which existed for the year 2002-2006, was fixed for the 2025 submission. The IEEA will continue to harmonise the data for the period 2011-2015.

7.3 Biological Treatment of Solid Waste: Composting and Anaerobic Digestion (CRT 5B)

Composting on a noteworthy scale has been practiced in Iceland since the mid-1990s. Composted waste mainly includes organic household waste, waste from slaughterhouses, garden and park waste, timber, and manure. Garden and park waste has been collected from

the capital area and composted using windrow composting, where grass, tree crush, and horse manure are mixed. In some municipalities, there is an active composting program where most organic waste is collected and composted. Increased emphasis is placed on composting as an option in waste treatment as opposed to landfilling this kind of waste.

The first anaerobic digestion and composting facility, GAJA, started operating at a small scale in the second half of 2020. It is the first plant of its kind in Iceland, and it processes waste from households from the entire capital area, which contains around two thirds of Iceland's population. For the first years, it processed mixed municipal solid waste (MSW) but the compost did not meet regulatory requirements and was therefore unusable. Separate collection of food waste at households started in 2023 and after that, GAJA processes mainly separately collected food waste, along with other organic waste and support materials (wood). It can process 30 to 40 kt of organic waste every year and produce 10 to 12 kt of compost and 3 million Nm³ of CH₄ each year, which has been utilised on vehicles, in industry or for internal purposes at Sorpa. After the introduction of separate collection of food waste at households, the amount of waste sent to the biogas facilities has decreased. This is both due to improved separation, resulting in less non-organic waste in the mix, and to the fact that not all organic waste is being correctly sorted at the household level, with some of it ending up in other waste categories. As a result, the quality of the compost has improved and is now considered good enough to be used as compost.

7.3.1 Methodology

Estimation of CH₄ and N₂O emissions from composting are calculated using the Tier 1 method of the 2006 IPCC Guidelines according to Equations 4.1 and 4.2 in volume 5. CO₂ emissions from composting are biogenic and do not need to be included in national totals according to the 2006 IPCC Guidelines.

Country specific data is used to quantify emissions from anaerobic digestion. Emissions estimated based on the country specific data were similar to the emissions estimated based on the Tier 1 method of the IPCC Guidelines, as described in Equation 4.1.

According to the 2006 IPCC Guidelines, emissions of CH₄ from biogas plants (anaerobic digestion) due to unintentional leakages during process disturbances or other unexpected events will generally be between 0 and 10% of the amount of CH₄ generated. In the absence of further information, the default value of 5% is used for the CH₄ emissions (IPCC, 2006). Based on this information, emissions from the anaerobic digestion facility were estimated based on the following equation:

Emissions from anaerobic digestion at biogas facilities

$$\text{CH}_{4,\text{leakage}} = \text{CH}_{4,\text{production}} \times C \times \text{FRAC}_{\text{leakage}}$$

Where:

$\text{CH}_{4,\text{leakage}}$: emissions from anaerobic digestion, [Nm^3]

$\text{CH}_{4,\text{production}}$: CH_4 production at the biogas plant, [Nm^3]

C : CH_4 density conversion factor, [0.716 kg/Nm^3]

$\text{FRAC}_{\text{leakage}}$: fraction of unintentional leakages, [5%]

7.3.2 Activity Data

Composting started in 1995 but activity data for the amount of waste composted has been reported only since 2005 to the IEEA. This includes waste composted in composting facilities and in combined biogas and composting facilities (GAJA). Since 2005, this amount has increased steadily, as can be seen in Table 7.12.

Table 7.12. Waste amounts composted since 1990 as dry matter weight.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Waste amount composted [kt DM]	NO	0.80	0.80	2.00	6.10	8.52	12.68	16.77	12.75

Anaerobic digestion at biogas and composting facilities (GAJA) started in the second half of 2020 in the capital region of Iceland. Biogas production in this sector covers emissions from the handling of biological waste including garden waste, household waste (prior to 2024), food waste (from 2024 onwards). Biogas production is received directly from facility data (Table 7.13).

Table 7.13. Activity data for anaerobic digestion of organic waste since 2020.

	2020	2021	2022	2023	2024
Waste amount sent to anaerobic digestion at biogas facilities [kt wet waste]	3.08	22.64	26.90	29.8	21.6
CH_4 production [Nm^3]	35,000	641,036	697,084	845,772	819,345

7.3.3 Emission Factors

Both CH_4 and N_2O emissions from composting are calculated by multiplying the mass of organic waste composted with the respective emission factors. The 2006 Guidelines default emission factors from Table 4.1 are used, shown in Table 7.14.

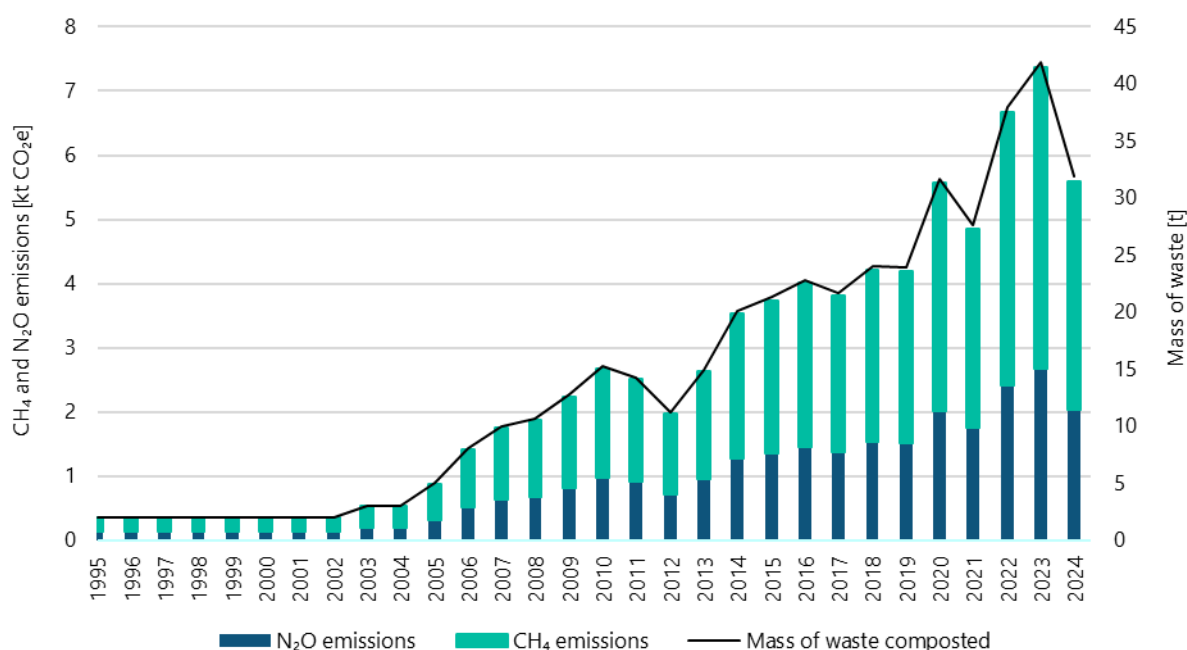
Table 7.14. Tier 1 emission factors for CH₄ and N₂O from composting from the 2006 IPCC Guidelines.

	Gas	Emission Factors [g/kg waste treated]
Emissions from composting (wet weight)	CH ₄	4
	N ₂ O	0.24

CH₄ emissions from anaerobic digestion at biogas facilities are calculated by multiplying the volume of CH₄ produced at the biogas facility with the CH₄ density conversion factor [0.716 kg/Nm³] and the fraction of leakage expected, which is 5% (IPCC, 2006), see the Equation above. The waste treated at the GAJA biogas and composting plant is first anaerobically digested and then composted, causing emissions in both 5B1 Composting and 5B2 Anaerobic Digestion.

7.3.4 Emissions

Emissions from Composting are shown in Figure 7.9 and Table 7.15, as well as the mass of waste composted.

Figure 7.9. Mass of waste composted and estimated CH₄ and N₂O emissions from composting.

CH₄ emissions from Anaerobic Digestion at Biogas Facilities can be seen in Figure 7.10 and Table 7.15. Emissions reported here are the estimated CH₄ leakage from the facility (FRAC_{leakage}). Any emissions, due to the use of the produced biogas for energy generation, are accounted for in the energy sector. In this sense, the biogas / CH₄ produced (Table 7.13) acts as activity data for the energy sector where it is utilised rather than being released directly.

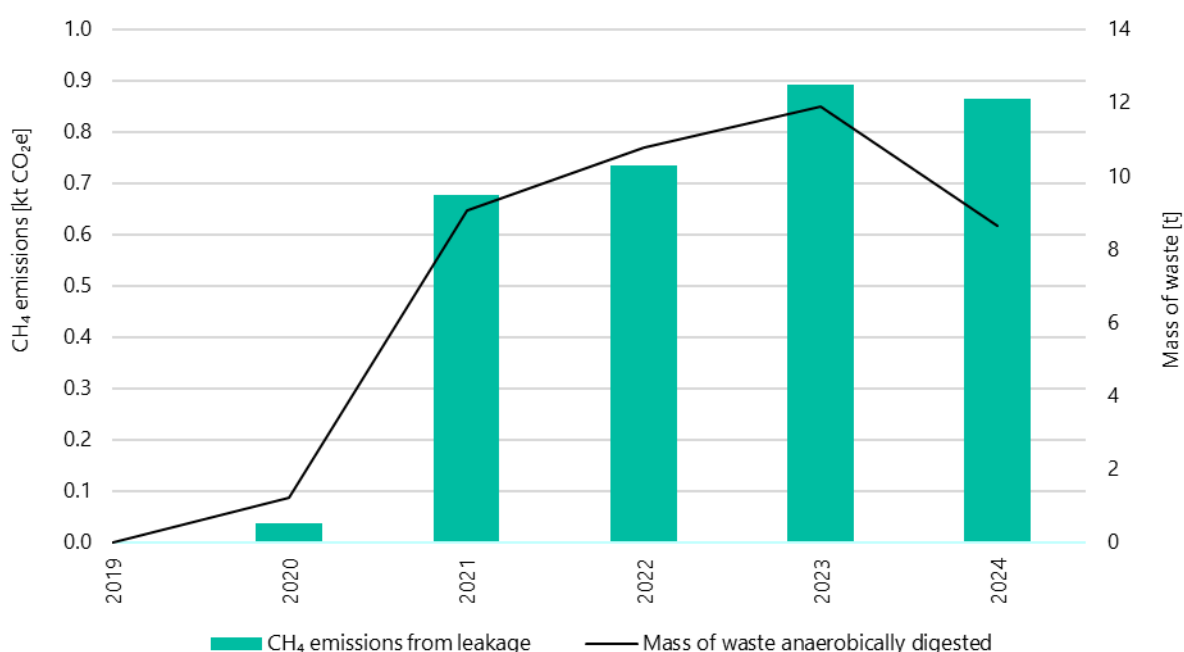


Figure 7.10. Mass of waste anaerobically digested and estimated CH₄ emissions from leakage (5%) from the anaerobic digestion facilities. Emissions from subsequent composting of the waste in the same facilities are not shown here, but as composting emissions in Figure 7.9.

Table 7.15. Emissions from composting and anaerobic digestion at biogas facilities since 1990.

Emissions [kt CO ₂ e]	1990	1995	2000	2005	2010	2015	2020	2023	2024
Composting CH ₄	NO	0.22	0.22	0.56	1.71	2.39	3.55	4.70	3.57
Composting N ₂ O	NO	0.13	0.13	0.32	0.97	1.35	2.02	2.67	2.03
Composting Total	NO	0.35	0.35	0.88	2.68	3.74	5.57	7.36	5.60
Anaerobic digestion CH ₄	NO	NO	NO	NO	NO	NO	0.037	0.892	0.865
Anaerobic digestion N ₂ O	NO	NO	NO	NO	NO	NO	NA	NA	NA
Anaerobic digestion Total	NO	NO	NO	NO	NO	NO	0.037	0.892	0.865

7.3.5 Uncertainties

Activity data uncertainties are based on expert judgement within the IEEA on the uncertainty of total waste amount going to composting and anaerobic digestion (15%) and composition uncertainty (5%). Combined activity data uncertainty is 16%. Emission factor uncertainty for composting was calculated using value ranges from Table 4 in the 2006 Guidelines and is 60% for the CH₄ emission factor and 113% for the N₂O EF. The CH₄ emission factor uncertainty for anaerobic digestion is based on data from the anaerobic digester GAJA and is estimated as 28%. N₂O emissions are considered negligible for anaerobic digestion. The uncertainty of CH₄ emissions from biological treatment of solid waste is estimated to be 62% and the N₂O uncertainty as 114%. The complete uncertainty analysis is shown in Annex 2: Assessment of Uncertainty.

7.3.6 Recalculations

Recalculations were made for years 2022 and 2023 to correct the amount of waste composted, which was previously underestimated for those years. When the biogas and composting plant GAJA opened in 2020, it originally treated MSW. In the waste data delivered to IEEA for years 2020 and 2021, the final treatment of MSW treated at GAJA was registered as composting. But the composted MSW did not meet regulatory requirements and had to be landfilled, so for years 2022 and 2023, the final treatment was registered as landfilling. The emissions from composting of this waste were therefore unintentionally neglected for years 2022 and 2023. This has now been corrected. For year 2024 and onwards, GAJA treats separately collected food waste and the resulting compost is usable and correctly registered as composting. The results of these recalculations can be seen in

Table 7.16.

Table 7.16. Recalculations in sector 5B1 Composting due to updated waste amount composted in 2022.

CRT 5B1	2022	2023
2025 Submission [kt CO ₂ e]	1.9	2.1
2026 Submission [kt CO ₂ e]	6.7	7.4
Change relative to the 2025 submission [kt CO ₂ e]	4.7	5.2
Change relative to the 2025 Submission [%]	243%	244%

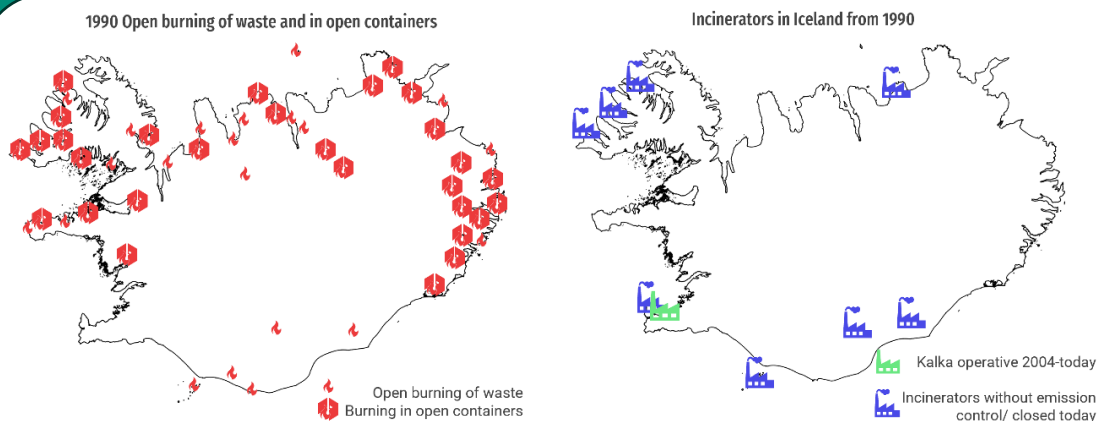
7.3.7 Planned Improvements

The estimate of 5% unintentional leakage according to the IPCC 2006 Guidelines approach is considered conservative, as the facility is new, and leakage might be expected to be negligible. Iceland intends to refine this estimate with the data provider and facility experts in the coming years.

From 1970 to 1990, there were no special laws or recommendations regarding handling of waste in Iceland. The waste was mostly openly burned in designated areas, or dumps, outside inhabited areas. It can be assumed that in 1970, 55 of these open burning sites were to be found around the country. From 1973 onwards, concrete containers (4-6m³-20m³) were installed with one open side for adding the waste to avoid its dispersal due to wind. The incineration occurred without controls and at slightly higher temperatures than at the previous open fires in the dumps, but still too low to allow for complete combustion.



Example of a concrete container, Patreksfjörður, 2000, archives EA



Maps of Iceland with the location of open burning of waste in Iceland in 1990 (left) and the incinerators built from 1990. Nowadays only one, Kalka, in the Southwest of the island is still operative.

In 1990, there were still 19 places around the country practising open burning of waste. From around 1990, incinerators were built around the country with higher combustion temperatures but still no satisfactory emission controls, especially regarding air pollutants such as dioxin. All these incinerators are considered as open burning due to the lack of emission controls. The incinerator Kalka was built in 2004 and is now the only incinerator still running in the country. It complies with air pollution control requirements.

7.4 Waste Incineration and Open Burning of Waste (CRT 5C)

This category calculates emissions from incineration and open burning of waste for CH₄, N₂O and CO₂. Consistent with the 2006 IPCC Guidelines, only CO₂ emissions deriving from the burning of waste from fossil origin are taken into consideration. Burning of biomass materials (paper, food, wood) leads to biogenic CO₂ emissions which should not be included in the national totals. Other waste categories such as textiles, diapers, and rubber contain both fossil and biogenic carbon and are therefore included in CO₂ emission totals proportionally to their fossil carbon content.

While open burning of waste was a widespread waste management option in Iceland in the past, it is banned nowadays and currently only the New Year's Eve and Twelfth Night bonfires are allocated to this subcategory (5C2). During these bonfires only wood can be burned, generating biogenic CO₂, which is not included in the national totals.

Incineration of waste is subdivided into incineration with energy recovery and incineration without energy recovery. Emissions from incineration with energy recovery are reported under the Energy sector (1A1a and 1A4a) whereas emissions from incineration without energy recovery are reported under the Waste sector (5C1). Despite having had several incinerators in Iceland, only one (Kalka) is currently operative and reported under the Subcategory 5C1, as no energy recovery is occurring.

7.4.1 Methodology

The methodology for calculating CO₂ emissions from waste incineration follows the Tier 2a method from the 2006 Guidelines. Country-specific data regarding waste generation, composition and management practices is used, while default data for other parameters for municipal solid waste is applied.

CH₄ and N₂O emissions are calculated using the Tier 1 method of the 2006 IPCC Guidelines.

NO_x, CO, NMVOC, and SO₂ emissions are estimated in accordance with the 2023 EMEP/EEA Guidebook (EEA, 2023).

Kalka conducts continuous measurements for NO_x, CO and SO₂ and these measurements represent the emissions of these three air pollutants in 5C1 from year 2004 (Kalka's opening) onwards.

7.4.2 Activity Data

7.4.2.1 Waste Incineration (5C1)

Currently, Kalka is the only active incinerator in Iceland, operative since 2004. The amount of waste incinerated there is reported yearly to the IEEA by the operator. The incineration occurs without energy recovery. In the past, several other incinerators were operative in Iceland, but due to their low combustion temperature or discontinuous usage, the burning was judged to be incomplete and better allocated in the category Open Burning of Waste (CRT 5C2). The exception is one incinerator operative from 2001-2004, included in this category. The amounts burned in that incinerator are based on expert judgement, as no reporting was required at that time. Therefore, from 1990-2000, the notation key "NO" is appropriate for this activity.

The amounts of waste incinerated in open pits and in incinerators with and without energy recovery, as well as the amount of wood incinerated at the yearly New Year's Eve and Twelfth Night bonfires, are shown in Figure 7.11.

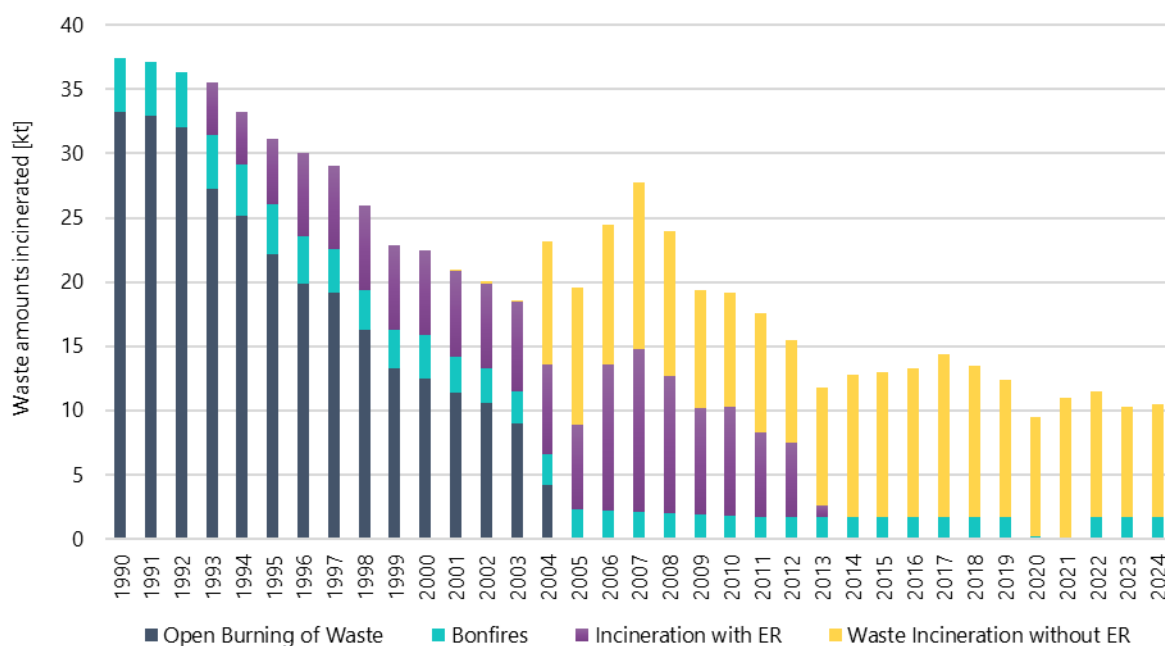


Figure 7.11. Amounts of MSW waste incinerated with and without energy recovery, burned openly and amount of wood burned in bonfires since 1990.

7.4.2.2 Open Burning of Waste (5C2)

The following types of incineration are accounted for under this category:

- Open Burning of Waste in open pits and concrete containers (see information box above)

- Waste burned in incinerators without satisfactory air pollution and temperature control
- New Year's Eve and Twelfth Night bonfires

The amount of waste burned openly is estimated using information on population in municipalities that were known to utilise open burning of waste and an assumed waste amount burned of 500 kg per head. The amount of waste burned in open pits decreased rapidly since the early 1990s, at which time more than 30 kt of waste were burned per year. Between 2005 and 2010, there was only one place still burning waste in open pits, on the remote island of Grímsey. It is assumed that around 45 t of waste were burned there annually. Incineration of waste in incineration plants without energy recovery started in 2001 and incinerated waste amounts have been oscillating between 9 and 15 kt since 2004.

The only emissions currently arising from 5C2 are from New Year's Eve and Twelfth Night bonfires which are celebrated all around the country. After stricter regulations and inspections of bonfires were adopted around 2000, their number has significantly decreased, the bonfires have become smaller, and only unpainted wood is allowed to be used. In 2010, the EAI estimated the amount and type of material burnt at these bonfires by accurately weighing the total amount of material going into one representative bonfire and measuring its volume. This resulted in an estimate of the density of such bonfires. Consequently, all the Public Health Authorities in Iceland, who give permits for such bonfires and are responsible for inspecting them, were contacted and asked to provide information on all the bonfires occurring in their region/operational area. They were asked to provide the number of bonfires as well as their diameter and height. With that information and using the density estimate made by the EAI, the total amount of material burnt in bonfires was estimated. There is not a significant correlation between bonfires and population, and strict regulations have been in place for some years requiring permits for bonfires. Therefore, this estimate is still expected to be accurate and has been used for the past years (see Figure 7.11).

7.4.2.3 Composition of Waste Incinerated

Data on the composition of waste incinerated has been available since 2005. The waste reported as mixed waste is divided into separate categories using the same studies carried out by Sorpa Ltd. used to define the mixed waste landfilled at the SWDS. The mixed share of waste incinerated is deemed to contain the same waste components as mixed waste landfilled, since incineration plants often took over the function of SWDS at their locations. In addition, the special function of incinerators, such as destruction of clinical and hazardous waste, is considered. From 2005 onwards, the incinerated waste is allocated to the following categories: paper, diapers, hazardous, industrial solid waste, textiles, food, clinical, wood, inert, rubber, garden, plastics, and sludge plus manure. The category inert waste is defined differently here than it is defined for the SWDS chapter. In this context it excludes plastics, rubber, and hazardous waste. As the data is only reliable from 2005 onwards, the weighted average fractions from 2005-2011 is applied to the period before 2005 to both incineration

and open burning of waste. Although the standard of living in Iceland has increased during the last two decades thus affecting waste composition, this method was deemed to yield better results than the Tier 1 method (with IPCC default waste composition).

The calculation of the amount of unpainted wood burned in the annual bonfires follows these steps: first the material that went into one of the country's largest bonfires was weighted and its mass correlated with the height and diameter of the timber pile. Then the height and diameter for most of the country's bonfires were used to calculate their weight. As a result, the amount of timber burned in bonfires was estimated at 1,700 t. The result was projected back in time using expert judgement. The amount of wood burnt has been kept constant at 1.7 kt since 2011 as there are no indications of a decrease and/or increase of these bonfires. In 2020 and 2021, the occurrence of bonfires was almost none, due to COVID-19 gathering restrictions.

7.4.3 Emission Factors

7.4.3.1 CO₂ Emission Factors

CO₂ emissions were calculated using Equation 5.2 in Volume 5 from the 2006 IPCC Guidelines. As described for SWDS, there is no distinction between municipal solid and industrial waste. Therefore, total waste incinerated was entered into the calculation instead of municipal solid waste.

As oxidation factors, the 2006 IPCC Guidelines' defaults of 1 for waste incineration (1 = complete oxidation) and 0.58 for open burning, were used. The equation first calculates the amount of fossil carbon incinerated and then converts it to CO₂. This is shown for this year's submission in Table 7.17.

Table 7.17. Calculation of non-biogenic CO₂ emissions from incineration in the latest inventory year (for all incineration subcategories under 5C1).

	Mass of Incinerated Waste [t]	Fraction of Incinerated Waste	(f) Dry Matter	(f) Carbon in Dry Matter	(f) Fossil Carbon in Total Carbon	Fossil Carbon [t]	CO ₂ Emissions [t/yr]
Paper	893	0.07	0.90	0.46	0.01	4	14
Textiles	423	0.03	0.80	0.50	0.20	34	124
Wood	62	0.00	0.85	0.50	0	0	0
Garden	88	0.01	0.40	0.49	0	0	0
Diapers	1,244	0.10	0.40	0.70	0.10	35	128
Food	3,394	0.27	0.40	0.38	0	0	0
Inert	1,141	0.09	0.90	0.03	1.00	31	113
Plastics	1,594	0.13	1.00	0.75	1.00	1,196	4,384
Hazardous	1,337	0.11	0.50	NA	0.275 ¹	368	1,348 ²
Clinical	556	0.04	0.65	NA	0.25 ¹	139	509 ²

	Mass of Incinerated Waste [t]	Fraction of Incinerated Waste	(f) Dry Matter	(f) Carbon in Dry Matter	(f) Fossil Carbon in Total Carbon	Fossil Carbon [t]	CO ₂ Emissions [t/yr]
Rubber	NO	NO	0.84	0.67	0.20	0	0
Sludge plus manure	754	0.06	0.40	0.45	0	0	0
Industrial solid waste	1,009	0.08	0.40	0.38	0	0	0
Total	12,496					1,805	6,620

¹ These numbers are the fraction of fossil carbon in wet waste produced, which for clinical and hazardous waste, is used instead of carbon in dry matter and fossil carbon in total carbon.

² These numbers are obtained by multiplying together the mass of waste and the fraction of fossil carbon in waste and converting from C to CO₂.

Between 1990 and 2004, the weighted average waste category fractions from 2005-2011 were combined with annual amounts incinerated. The same fractions were used for open burning of waste. In bonfires, only timber (packaging, pallets, etc.), which does not contain fossil carbon, is burned. Therefore, no CO₂ emissions from bonfires are reported.

7.4.3.2 CH₄, N₂O, NO_x, CO, NMVOC, and SO_x Emission Factors

In contrast to CO₂ emission factors, which are applied to the fossil carbon content of waste incinerated, the emission factors for CH₄, N₂O, NO_x, CO, NMVOC, and SO₂ are applied to the total waste amount incinerated. Emission factors for CH₄ and N₂O are taken from the 2006 IPCC Guidelines. They differ between incineration and open burning of waste. Since continuous measurements are performed for NO_x, CO and SO₂ at Kalka, those values are used directly in the Icelandic inventory. For NMVOC and emissions from the older incineration plants and open burning, emission factors are taken from the 2023 EMEP/EEA Guidebook (EEA, 2023), chapter 5C1a: Municipal Waste Incineration, 5C1b: Industrial Waste Incineration Including Hazardous Waste & Sewage Sludge, 5Cbiii: Clinical Waste Incineration and 5C2: Open Burning of Waste. The EFs used are shown in Table 7.18.

Table 7.18. Emission factors for Incineration and Open Burning of Waste. All values are in g/tonne wet waste except where indicated otherwise.

	CH ₄	N ₂ O		NO _x	CO	NMVOC	SO ₂
Incineration (MSW) EF	237	60	Kalka	/	/	5.9	/
			Little or no abatement	1,800	700	20	1,700
Incineration (Industrial) EF	237	100	Kalka	/	/	7,400	/
			Little or no abatement	NA	NA	NA	NA
Incineration (Hazardous) EF	237	100	Kalka	/	/	7,400	/
			Little or no abatement	NA	NA	NA	NA
Incineration (Clinical) EF	237	100	Kalka	/	/	700	/
			Little or no abatement	1,800	1,500	700	1,100
Open Burning EF	6,500	150	Little or no abatement	3,180	55,830	1,230	110

7.4.4 Emissions

Greenhouse gas emissions from Incineration (without energy recovery) and Open Burning of Waste are shown in Figure 7.12 and Table 7.19. Generally, the emission trend from Waste Incineration correlates with the waste amounts incinerated. From 2004, most waste is incinerated instead of open-burned, which has a higher oxidation factor, 100% instead of 58%, leading to an increase in CO₂ emission. CH₄ and N₂O emissions have been reduced significantly from 1990 due to a transition from open burning facilities towards waste incineration in waste incineration plants.

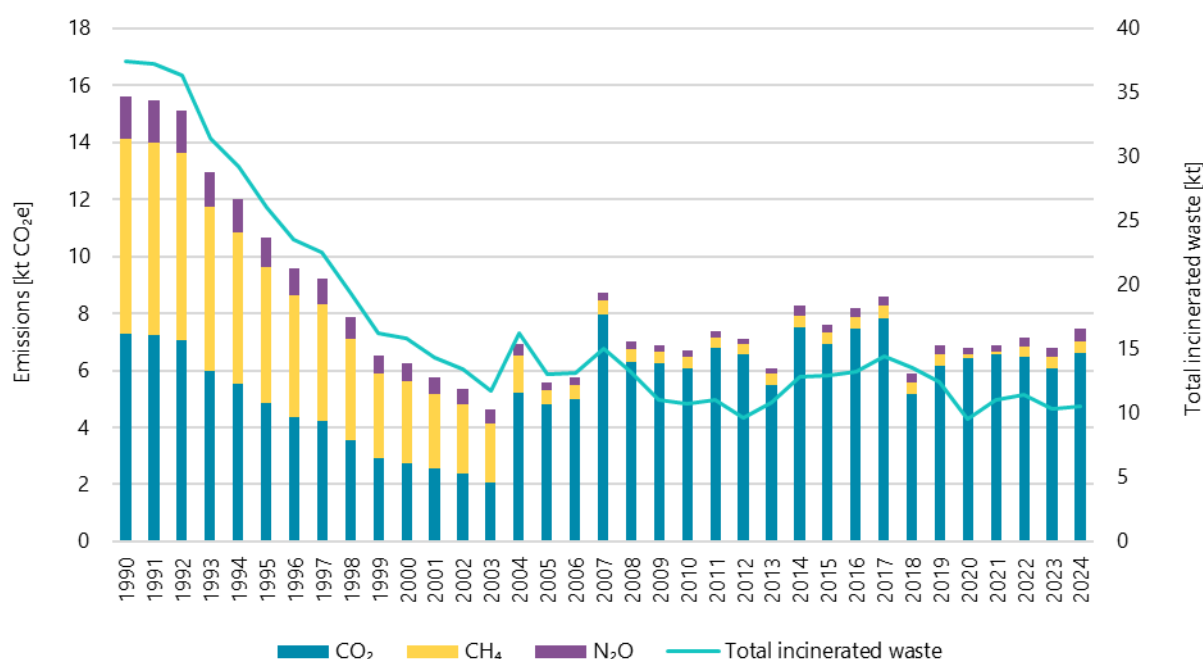


Figure 7.12. Emission estimates from incineration and open burning of waste since 1990.

Table 7.19. Emissions from Incineration and Open Burning of Waste (CRT 5C) since 1990.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
CO ₂ emissions [kt CO ₂ e]	7.3	4.9	2.7	4.8	6.1	6.9	6.4	6.1	6.6
CH ₄ emissions [kt CO ₂ e]	6.8	4.7	2.9	0.50	0.39	0.39	0.12	0.39	0.39
N ₂ O emissions [kt CO ₂ e]	1.5	1.0	0.63	0.27	0.22	0.29	0.23	0.33	0.46
Total	16	11	6.3	5.6	6.7	7.6	6.8	6.8	7.5
Relative change since 1990		-32%	-60%	-64%	-57%	-51%	-57%	-56%	-52%

7.4.5 Uncertainties

Activity data uncertainties are based on expert judgement from the IEEA regarding the uncertainty of the total waste amount sent incineration and open burning (15%) and the uncertainty in waste composition (20%). The uncertainty in the dry matter content of waste is

derived from Section 5.7.2 (Activity Data Uncertainties) in Chapter 5, Volume 5 of the 2006 IPCC Guidelines. In the Guidelines provide an uncertainty range, from which the average value of 30% is used. Combined activity data uncertainty is 39%.

Uncertainties associated with CO₂ emission factors for open burning depend on uncertainties related to fraction of dry matter in waste open-burned, fraction of carbon in the dry matter, fraction of fossil carbon in the total carbon, combustion efficiency, and fraction of carbon oxidised and emitted as CO₂. A default value of $\pm 40\%$ was used to estimate the emission factor uncertainty for CO₂ emissions from incineration and open burning of waste as proposed in the 2006 IPCC Guidelines (Volume 5, chapter 5, paragraph 5.7.1). This value is proposed for countries relying on default data on the composition in their calculations. The combined uncertainty for CO₂ emissions from incineration and open burning of waste is therefore 56%.

Default values were also used to estimate the uncertainties associated with N₂O and CH₄ emissions. The total combined uncertainty for N₂O and CH₄ emissions was estimated to be 107% (100% for the emission factors and 39% for the activity data). The complete uncertainty analysis is shown in Annex 2: Assessment of Uncertainty.

7.4.6 Recalculations

No recalculations were made for Incineration and Open Burning of Waste (5C) in the 2026 submission.

7.4.7 Planned Improvements

No specific improvements are planned for Incineration and Open Burning of Waste.

7.5 Wastewater Treatment and Discharge (CRT 5D)

In the 1990s, almost all wastewater was discharged directly into rivers or the sea. According to legacy data, only around 4% of people had wastewater treatment in 1990, which was collected in septic systems. The share of septic systems, which are mostly used in rural areas and smaller villages, has increased since then. Since 2002, the share of direct discharge of wastewater into rivers and the sea has diminished, mainly in favour of collection in closed underground sewers systems with basic pre-treatment. Pre-treatment includes at least filtering the wastewater through 3 mm wide grids. In the capital area, the wastewater is pumped and discharged 4 km away from the coastline after such pre-treatment, but in smaller municipalities the sewage outlets are not as far from the coast. Pre-treatment filters only negligible organic material from the wastewater in the form of grease flotation. Primary treatment of wastewater, e.g. settling of organics, is non-existent in Iceland, although some pre-treatment facilities are close to achieving the necessary biological oxygen demand (BOD) reduction to count as primary treatment. Since 2002, some smaller inland towns have

implemented secondary treatment of wastewater. This involves aerobic treatment, secondary settlement, and removal of sludge. The share of secondary treatment in Iceland is, however, still around 2%. A few municipalities in Iceland have started using sewage sludge as fertiliser for land reclamation purposes. Emissions from sludge, which is removed and used as fertiliser, are accounted for in the Agriculture sector.

The foremost industry producing organic loads in wastewater is fish processing. Other major industries contributing organic waste are the meat and dairy industries. Industrial wastewater from fish processing is either discharged directly into the sea or by means of closed underground sewers and basic treatment.

Several site factors reduce CH₄ emissions from wastewater in Iceland, such as:

- Cold climate with cold summers
- Steep terrain with fast running streams and rivers
- Open sea with strong currents surrounding the island
- Scarcity of population

Icelanders have a high protein intake which affects N₂O emissions from the wastewater.

7.5.1 Methodology

The calculation of CH₄ emissions from wastewater treatment in Iceland is based on the Tier 1 methodology for treatment emissions and the Tier 2 methodology for discharge emissions in the 2019 IPCC Guidelines. The calculation of N₂O emissions from wastewater treatment is based on the Tier 1 methodology in the 2006 IPCC Guidelines.

7.5.1.1 Domestic Wastewater (5D1)

CH₄ Emissions from Domestic Wastewater

Population data is used to estimate the annual amount of total organics in wastewater (*TOW*). *TOW* is calculated using Equation 6.3 from Ch. 6, Vol. 5 of the 2019 IPCC Guidelines. In the equation, the annual amount of *TOW* is a product of population, amount of biochemical oxygen demand (BOD) (in kg per person per year). Total organics in wastewater for each treatment and discharge pathway (*TOW_j*) is calculated with Equation 6.3A from CH. 6, Vol. 5 of the 2019 IPCC Guidelines. There are around 120 towns in Iceland and only one city. Wastewater treatment and recipient is considered for each town and city to assess the degree of utilisation of treatment and discharge pathways (*T_{ij}*). Since there is full partitioning by towns, a division by income groups is unnecessary (*U_i* = 1).

Equation 6.3A includes a correction factor *I_j* for additional industrial BOD discharged into sewers. *I_j* is set to 1.25 for all collected wastewater, treated and untreated, except for septic tanks, to account for industrial wastewater discharge such as commercial activities,

accommodation services, restaurants and shops, which are commonly discharged in the municipal sewer system. Septic tanks are not only used where wastewater is uncollected but also in small towns where there is a sewer system and possibly some small industry. The largest sludge collection company in Iceland, Hreinsistækni, estimates that around 45% of sewage sludge collected from septic tanks comes from larger septic tanks in municipalities (Svanur Lárússon, written communication, 2025). A correction factor $I_j = 1.25 \cdot 45\% + 1 \cdot 55\% = 1.11$ is therefore applied to septic tanks, to account for industrial and commercial co-discharge in smaller towns. Denmark and Sweden are the most comparable countries in Table 6.4 in Ch. 6, Vol. 5 of the 2019 IPCC Guidelines and thus the BOD_5 per person is derived by taking an average of the values for these two countries, 68.5 g BOD per person per day.

Equations 6.1 and 6.3B from Ch. 6, Vol. 5 of the IPCC 2019 Refinements were used to estimate CH_4 emissions from treatment. Equation 6.1 takes into account the BOD removed in sludge from in biological wastewater treatment plants ($S_{aerobic}$) and septic tanks (S_{septic}). Equation 6.3C was not used to estimate sludge from septic tanks, as activity data on this amount is collected in the waste data collection module in the IEEA Data Portal.

Equation 6.3D was used to estimate remaining organics in the effluent after treatment ($TOW_{EFFtreat}$), and the emissions from discharge were calculated based on this remaining organic matter.

N₂O Emissions from Domestic Wastewater

Equation 6.10 in Ch. 6, Vol 5 in the IPCC 2019 Refinements was used to estimate the total amount of nitrogen in each wastewater treatment and discharge pathway ($TN_{DOM,j}$). The factor for the fraction of nitrogen in protein (F_{NPR}), factor for non-consumed protein disposed in the sewer system ($F_{NON-CON}$), factor for industrial and commercial co-discharged protein ($F_{IND-COM}$), and additional nitrogen from household products added to the wastewater (N_{HH}) are derived from the IPCC 2019 Refinements and are shown in Table 7.20.

Table 7.20. Default parameters used to calculate the amount of nitrogen in the wastewater effluent.

Parameter	Default value	Remark
F_{NPR}	0.16 kg N / kg protein	Default value used
$F_{NON-CON}$	1 kg N / kg N	The default value in the IPCC 2019 Refinements is 1 for countries where food waste is disposed with solid waste. Food waste disposal in the sewer with sink grinders is very rare in Iceland. The same applies for Denmark, the most comparable country in Table 6.10B. Please note that this deviates from the IPCC 2006 Guidelines, where the default value was 1.1.
$F_{IND-COM}$	1.25 kg N / kg N	Default value used where wastewater is collected with a sewer system.
$F_{IND-COM}$ (septic)	1.1125 kg N / kg N	Based on the assumption that 45% of septic tanks treat wastewater that is collected with a sewer system in towns.
N_{HH}	1.08	Default value for Europe

Equation 6.9 in Ch. 6, Vol. 5 of the IPCC 2019 Refinements is used to calculate N₂O emissions from wastewater treatment. Sludge removed is not required in the updated IPCC 2019 Refinements methodology in equation 6.9. Equations 6.7 and 6.8 in Ch. 6, Vol. 5 of the IPCC 2019 Refinements were used to calculate the nitrogen in effluent and the N₂O emissions from discharging to effluent to a water body. Default nitrogen removal fractions from Table 6.10C in Ch. 6, Vol. 5 of the IPCC 2019 Refinements were used to account for the nitrogen removed during treatment, reducing the amount of nitrogen in effluent.

7.5.1.2 Industrial Wastewater (5D2)

CH₄ Emissions from Industrial Wastewater

The largest industry in Iceland, which produces organic wastewater, is fish processing. It is currently the only industry included separately in the inventory. It is not known if the wastewater from other industries is co-discharged with municipal wastewater or treated and discharged separately. Until more data has been gathered, it is assumed that they are included in factor for industrial and commercial co-discharge $I_j = 1.25$.

CH₄ emissions from Industrial Wastewater are calculated from total organics in industrial wastewater (TOW_i), using Equations 6.4 and 6.6 in Vol. 5 in the 2006 IPCC Guidelines. In the latter equation, the annual amount of TOW_i is a product of the total industrial product for industrial sector i (P_i), wastewater generated per ton of product (W_i) and chemical oxygen demand (COD_i) in the wastewater.

N₂O Emissions from Industrial Wastewater

In the IPCC 2006 Guidelines, "N₂O emissions from industrial sources are believed to be insignificant compared to emissions from domestic wastewater". This has changed in the IPCC 2019 Refinements, where N₂O emissions from industrial wastewater are calculated. Equations 6.12, 6.13 and 6.14 from Ch. 6, Vol. 5 in the IPCC 2019 Refinements are used to calculate the total nitrogen in wastewater from fish processing.

7.5.2 Activity Data

7.5.2.1 Domestic Wastewater (5D1)

CH₄ Emissions from Domestic Wastewater

Activity data for emissions from domestic wastewater treatment and discharge consists of the following:

- Population data by towns and tourist visits
- Sewage sludge mass from septic tanks and from biological treatment
- Wastewater treatment and receiving water body in each town

Data on overnight stays associated with foreign visitors to Iceland is used to calculate population equivalents (PE) from tourists. This is used to adjust the total population and, hence, include the additional emissions from wastewater treatment and discharge associated with foreign visitors to Iceland.

Data on the amount of sewage sludge was retrieved from three sources:

- The waste data collection module in the IEEA Data Portal (year 2024)
- The wastewater data collection module in the IEEA Data Portal (years 2020, 2022 and 2024)
- Sludge applied to soils from Land and Forest Iceland

Sewage sludge had previously been registered with screening waste, but this was changed in 2024 in the waste data collection module in the IEEA data portal. Sewage sludge is now separated from the screening waste and the companies/organizations registering sewage sludge must also indicate the origin of sewage sludge, i.e. from biological treatment or from septic tanks. As 2024 was the first year of this data delivery, the registered data had to be reviewed in cooperation with the companies/organizations registering the sludge. Data on sewage sludge was also collected in another module in the IEEA data portal, the wastewater data collection module. However, some years were missing in the data so an average amount of sludge for 2020-2024 was derived from the data. Data on the dry matter content of sewage sludge was gathered from various actors in the wastewater collection and treatment field. Dry matter of sewage sludge was converted to BOD using Equation 6.3B and sludge factor K_{rem} (kg BOD / kg sludge) from Table 6.6A in Ch. 6, Vol 5. in the IPCC 2019 Refinements.

Table 7.21 and Table 7.22 provide information on activity data used to estimate CH₄ emissions from Domestic Wastewater Treatment and Discharge in Iceland.

Table 7.21. Information on total population (incl. PE from foreign visitors) and total organic matter from households and tourists in domestic wastewater since 1990.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Population [n]	255 368	269 332	282 178	297 824	323 505	338 260	359 050	395 923	405 412
Total organic matter ¹ [kt BOD/yr]	7.9	8.4	8.7	9.2	10.0	10.5	11.1	12.3	12.6
Total sewage sludge [kt BOD/yr]	0.10	0.13	0.18	0.23	0.23	0.25	0.52	0.59	0.53

¹ This is TOW_j , i.e. including the correction factor I_j for additional BOD from commercial and industrial discharge into the sewer system.

The wastewater treatment fractions were revised in 2024 with more subdivision to keep track of both each treatment pathway, and each discharge pathway. There are emission factors available for two types of discharge pathways: a) Discharge to reservoirs, lakes and estuaries; and b) Discharge to sea and rivers. Information about the shares of different treatment

pathways and the receiving water body comes from status reports on wastewater treatment, which are prepared by the IEEA, from direct communication with waste treatment operators and health authorities, and from expert judgement (Hólmfríður Þorsteinsdóttir). These are shown in Table 7.22 along with respective shares of total wastewater discharge.

Table 7.22. Percentages of different domestic wastewater treatment and discharge pathways in Iceland since 1990.

Treatm.	Discharge	1990	1995	2000	2005	2010	2015	2020	2023	2024
No treatm.	To sea and rivers	94%	93%	60%	30%	27%	25%	17%	16%	16%
	To reservoirs, lakes and estuaries	0.89%	0.81%	0.74%	0.66%	0.60%	0.62%	0.60%	0.53%	0.47%
Pre-treatm.	To sea and rivers	0%	0%	31%	59%	64%	66%	74%	74%	74%
	To reservoirs, lakes and estuaries	0%	0%	0%	0%	0%	0%	0%	0.05%	0.09%
Septic tanks	With dispersion field, to groundwat.	0.10%	0.14%	0.17%	0.19%	0.18%	0.19%	0.23%	0.24%	0.24%
	Standalone, to sea and rivers	4.8%	6.3%	7.9%	8.3%	7.4%	6.6%	6.4%	6.2%	6.2%
	Standalone, to reservoirs, lakes and estuaries	0.13%	0.17%	0.21%	0.26%	0.20%	0.12%	0.12%	0.15%	0.16%
Primary treatm.	To sea and rivers	0%	0%	0%	0%	0%	0%	0%	0%	0%
	To reservoirs, lakes and estuaries	0%	0%	0%	0%	0%	0%	0%	0%	0%
Second. treat.	To sea and rivers	0%	0%	0%	0.97%	1.3%	1.8%	1.8%	1.9%	2.0%
	To reservoirs, lakes and estuaries	0%	0%	0%	0.01%	0.10%	0.13%	0.14%	0.14%	0.15%
Tertiary treatm.	To sea and rivers	0%	0%	0%	0%	0%	0%	0%	0%	0%
	To reservoirs, lakes and estuaries	0%	0%	0%	0%	0%	0.004%	0.02%	0.02%	0.02%

N₂O Emissions from Domestic Wastewater

The activity data needed to estimate N₂O emissions is the following

- Population data by towns and tourist visits
- Wastewater treatment and receiving water body in each town
- Protein consumption per person

The protein consumption per capita is country specific. The Icelandic Directorate of Health has conducted a number of dietary surveys both for adults (Embætti landlæknis, 2022; 2011; 2002; 1990), and for children of different ages (Þórsdóttir & Gunnarsdóttir, 2006; Gunnarsdóttir, Eysteinsdóttir, & Þórsdóttir, 2008). The studies showed a high protein intake of Icelanders of all age groups. Adults and adolescents consumed on average 90 g, 9-year-olds 78 g, and 5-year-olds 50 g per day. These values, as well as values for infants, were integrated over the whole population resulting in an average intake of 90 g per day and per Icelander, regardless of age.

Table 7.23 provides information on activity data used to estimate nitrous dioxide emissions from Wastewater Treatment and Discharge in Iceland.

Table 7.23. Activity data used to estimate N_2O emissions from Wastewater Treatment and Discharge in Iceland; Protein consumption and N in effluent.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Protein consumption [kg/person/yr]	37.2	35.4	33.6	32.9	32.9	32.9	33.0	33.0	33.0
N in domestic wastewater [kt N/year]	2.0	2.0	2.0	2.1	2.3	2.4	2.5	2.8	2.9

7.5.2.2 Industrial Wastewater (5D2)

CH₄ Emissions from Industrial Wastewater

The default COD_i for fish processing was used; 2.5 kg COD/m³_{wastew.} (2006 IPCC Guidelines, Volume 5, Table 6.9). Data on water use and amount of fish processed was collected from the 2018-2024 annual reports of two of the largest fishing companies in Iceland (Brim and Síldarvinnslan) to estimate the amount of wastewater generated per ton of fish processed (W_i), see Table 7.24. The observed wastewater generation (4-6 m³/t) is much lower than the default value from the 2006 IPCC Guidelines that was previously assumed (13 m³/t in Table 6, Ch. 6, Vol. 5). Activity data on the amount of processed fish was only available from 1992 and onwards. Therefore, the number for 1990-1991 was estimated based on the average of 1992-1995, see Table 7.24.

Table 7.24. Information on fish processing and organic matter in industrial wastewater since 1990.

	1990	1995	2000	2005	2010	2015	2020	2023	2024
Processed Fish [kt]	1,371	1,376	1,705	1,243	729	1,104	845	1,238	1,080
Wastewater generation W_i [m ³ /t _{product}]	5.8	5.8	5.8	5.8	5.8	5.8	5.8	4.3	5.9
TOW _i [kt COD/yr]	20.0	20.1	24.9	18.2	10.7	16.1	12.3	13.3	15.8

No treatment is considered to be the only pathway for industrial wastewater as emissions from industrial wastewater are solely estimated for fish processing which employs either pre-treatment or no wastewater treatment (i.e., no or negligible removal of small organic particles). Since no treatment is assumed, there is no sludge ($S_i = 0$), and no methane recovery ($R_i = 0$).

N₂O Emissions from Industrial Wastewater

The default nitrogen content in fish processing wastewater (0.60 kg TN / m³) was used (Table 6.12, Ch. 6, Volume 5, IPCC 2019 Refinements) in conjunction with the wastewater production (W_i) Table 7.24.

Since no treatment is assumed for fish processing, then no nitrogen is removed during treatment ($N_{\text{REM},j} = 0$) and the nitrogen in industrial wastewater ($TN_{\text{IND},i}$) is equivalent to the nitrogen in effluent ($N_{\text{EFFLUENT},\text{IND}}$).

Activity data on the amount of processed fish was used to calculate the N_2O emissions from industrial wastewater, see Table 7.24.

7.5.3 Emission Factors

7.5.3.1 Domestic Wastewater (5D1)

CH₄ Emissions from Domestic Wastewater

Discharge emissions

The CH₄ emission factor for domestic wastewater treatment and discharge pathway and system is a function of the maximum CH₄ producing potential (B_0) and the methane correction factor (MCF), from Equation 6.2 in Volume 5 of the 2006 IPCC Guidelines.

The default B_0 for domestic wastewater, 0.6 kg CH₄/kg BOD, was applied (Table 6.2 of the 2006 IPCC Guidelines).

In the IPCC 2019 Refinements, the Tier 2 values for discharge were chosen, as the input data allowed for separation of the discharge by different water bodies. For reservoirs, lakes and estuaries, the EF is 0.114 kg CH₄ / kg BOD. For other water bodies (sea and rivers), the EF is 0.021 kg CH₄ / kg BOD.

Iceland is sparsely populated, with two thirds of the population living in the capital area, and mainly habited along the coastline. Most of the wastewater is discharged into the ocean, which around the capital area, has an average max temperature of 12°C (in August)⁵⁴. According to the 2019 Refinements, CH₄ production becomes unlikely below 12°C. In reports with results from environmental research around sewer outlets in the ocean around Iceland, no circumstances that would hint at CH₄ production from wastewater were found (Auðunsson, 2006; 2009; 2015; Helgason, Þórðarson, & Eiríksson, 2002). Multi-year environmental research on the ocean floor in Faxaflói bay, before- and after the sewer outlets from the capital area were built, shows that no CH₄ should be produced from wastewater from the capital area. No accumulation of organic material from wastewater was detected and the release of sewage had no effect on the oxygen-saturation of the seawater, which was always sufficient to break down the organic matter (Auðunsson, 2006; 2015). Until now, it was that thought that wastewater discharge from a larger town on the South Coast, into the river Ölfusá, was possibly causing CH₄ production based on environmental research on the riverbed (Jónsson, Gunnarsson, Skúladóttir, & Árnason, 2020). However, expert judgement

⁵⁴ <https://seatemperature.net/current/iceland/reykjavik-sea-temperature>

from a specialist in the Ocean and Water Unit at the IEEA concluded that it was probably not the case, since the river has a large discharge volume of water and strong currents (Hólmfríður Þorsteinsdóttir, oral communication, 2023). This is well represented in the IPCC 2019 Refinement, where sea and river discharge has a lower emission factor than discharge to lakes, estuaries and reservoirs.

Treatment emissions

Sewage sludge is removed from wastewater treatment in septic tanks and secondary (aerobic) treatment plants, parameter S_j in Equation 6.1 in Ch. 6, Vol. 5 in the IPCC 2019 Refinements. Data on sewage sludge and its origin was collected for 2024 and the calculations were therefore updated according to the IPCC 2019 Refinements methodology. There is no CH_4 recovery in wastewater treatment in Iceland, so parameter R_j in Equation 6.1 is zero.

According to the 2019 Refinements, anaerobic digestion is highly temperature dependent, for which the optimal temperature is 30–38°C. At lower temperatures, the rate of anaerobic digestion decreases and CH_4 production becomes unlikely below 12°C. Inside septic tanks, the temperature is uncontrolled and is related to the surrounding soil temperature and the temperature of the discharge entering the tank. Of those two factors the soils temperature is the dominant one, because since the septic tank is buried underground, the effluent's temperature will quickly equalize with the surrounding soil temperature after entering the tank. However, wastewater in Iceland is rather warmer than elsewhere due to high use of geothermal hot water, both for domestic use and for heating. The influence of this on septic tank temperatures has yet to be assessed, and therefore it is assumed that soil temperature is predominant.

In Iceland, septic tanks are required to be installed below the frost line, or at least 2.0-2.5 m underground. At that depth, soil temperature remains relatively stable year-round. Figure 7.13 adapted from Figure 20 in (Petersen & Berber, 2018), illustrates the average monthly soil temperature in Reykjavík from 2007 to 2017. At one meter depth, the highest average temperature is 10.6°C and the lowest one is 2.0°C, with average and median at 5.9°C and 5.5°C, respectively.

EAI's guidelines on septic tanks (page 16, only available in Icelandic) state:

*"Due to the cold climate in Iceland, the activity of microorganisms in septic tanks is often low and the decomposition of organic matter is slow. As a result, more sludge accumulates in septic tanks and septic tanks need to be emptied more often than in warmer climates. It is recommended that the septic tank is emptied every two years."*⁵⁵

The information above suggests that methanogenesis of total organics in wastewater in septic tanks in Iceland is minimal. Given the prevailing soil temperatures at depths where

⁵⁵ EAI (2004). https://ust.is/library/Skrar/utgefid-efni/Annad/UST_Rotthraer_og_siturlagnir.pdf, p. 16.

methanogenesis is assumed to occur (i.e. the bottom of the septic tank, > 1m depth) never reaches 12°C, but methanogenesis is not proven to be none, the Tier 1 default MCF in the IPCC 2019 Refinements has been revised. The MCF was adjusted from 0.5 to 0.042 (i.e., $0.5/12 = 0.042$), reflecting conditions where methanogenesis may occurs only for one month per year. The emission factor for septic tank treatment is therefore 0.025 kg CH₄ / kg BOD.

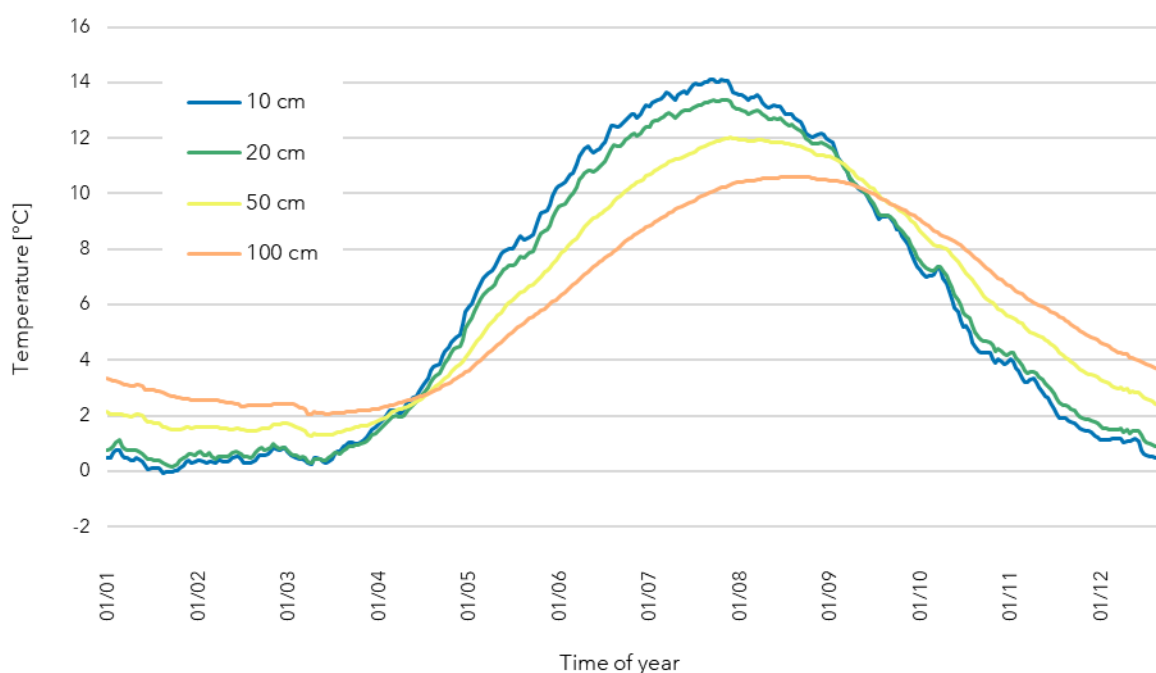


Figure 7.13. Monthly average soil temperature in Reykjavík, 2007-2017, adjusted from Figure 20 in (Petersen & Berber, 2018).

Wastewater in many places around the coastline, including the capital area, is treated in so-called pre-treatment plants (ísl. grófhreinsun). The wastewater in these plants goes through screens/sieves and then a grit chamber where the scum and grease are skimmed off the surface. Some of the plants wash the sand from the grit chamber to remove the organics in the sand and add the washed organics to the effluent. The sand is sent to a landfill, the scum and grease is sent to incineration, and the screening waste is sent to either. These plants resemble primary treatment plants except the sedimentation tank, the main component in primary treatment, is missing. The treatment efficiency in these pre-treatment plants is not high enough to count as primary treatment, although certain parameters in some plants are close to reaching primary treatment. No emission factor is available for pre-treatment plants. Anaerobic conditions probably form in the grit chamber but since the wastewater passes rather quickly through the plant, the emission factor is assumed to be zero.

For aerobic wastewater treatment plants, both secondary and tertiary, the CH₄ emission factor is 0.018 kg CH₄ / kg BOD from Table 6.3 in Vol. 5 in the IPCC 2019 Refinements.

N₂O Emissions from Domestic Wastewater

Discharge emissions

Lake Mývatn is the only water body in Iceland known to be nutrient-impacted with reports of algal blooms and potential extermination of the protected ball-shaped marimo algae (*aegagropila linnaei*)⁵⁶ The nutrient-impacted emission factor of 0.019 kg N₂O-N/kg N from Table 6.8A in Ch. 6, Vol. 5 in the IPCC 2019 Refinements was used for discharge to Lake Mývatn, and the emission factor 0.005 kg N₂O-N/kg N was used for discharge to all water bodies.

Treatment emissions

Emission factor 0.016 kg N₂O-N / kg N was used for estimating N₂O emissions from wastewater treatment in aerobic wastewater treatment plants, both secondary and tertiary. For septic tanks with dispersion fields, the N₂O emission factor is 0.0045 kg N₂O-N / kg N. Both emission factors are from Table 6.8A in Vol. 5 in the IPCC 2019 Refinements. No N₂O emissions are assumed from pre-treatment plants.

7.5.3.2 Industrial Wastewater (5D2)

CH₄ Emissions from Industrial Wastewater

The CH₄ emission factor for industrial wastewater is a function of B₀ and the MCF, from Equation 6.5 in Volume 5 of the 2006 IPCC Guidelines. The default B₀ for industrial wastewater, 0.25 kg CH₄/kg COD, was applied (2006 IPCC Guidelines). Since CH₄ emissions from industrial wastewater are only estimated for fish processing, the only pathway for industrial waste in the inventory is no treatment. Fish processing only takes place around the coastline in Iceland, so the wastewater is discharged to the sea, where the MCF is 0.035, and the resulting emission factor is 0.009 kg CH₄/kg COD.

Total CH₄ emissions from industrial wastewater are calculated with Equation 6.4 in Volume 5 from the 2019 IPCC Guidelines.

As no treatment is assumed for wastewater from fish processing, sludge (S_i) and methane recovery (R_i) are set to zero.

N₂O Emissions from Industrial Wastewater

It is assumed that wastewater from fish processing is discharged to sea. Emission factor for discharge to water bodies that are not nutrient-impacted, 0.005 kg N₂O-N/kg N, was used for calculation N₂O emissions from industrial wastewater.

⁵⁶ <https://www.ruv.is/frettir/innlent/skyr-merki-ofaudgunar-af-mannavoldum-i-myvatni>

7.5.4 Emissions

Total greenhouse gas emission estimates from Wastewater Treatment and Discharge have increased compared to 1990. An overview of the emissions is shown in Table 7.25 and Figure 7.14. CH₄ and N₂O emissions from domestic wastewater have increased since 1990, as the Icelandic population has grown. Overnight stays by foreign nationals affect the emissions from domestic wastewater. The drop in emissions in 2020 is due to travel restrictions during the COVID-19 pandemic. CH₄ emissions from industrial wastewater were at their highest in 1997 but have decreased since then due to less domestic fish processing.

Table 7.25. Emissions from wastewater treatment and discharge since 1990.

Emissions [kt CO ₂ e]	1990	1995	2000	2005	2010	2015	2020	2023	2024
Domestic Wastewater CH ₄	4.91	5.18	5.41	5.69	6.15	6.41	6.64	7.31	7.52
Domestic Wastewater N ₂ O	4.22	4.22	4.18	4.44	4.89	5.20	5.54	6.13	6.28
Industrial Wastewater CH ₄	4.91	4.93	6.10	4.45	2.61	3.95	3.02	3.27	3.88
Industrial Wastewater N ₂ O	10.01	10.05	12.44	9.07	5.32	8.06	6.17	6.67	7.92
Total	24.0	24.4	28.1	23.7	19.0	23.6	21.4	23.4	25.6
Relative change from 1990		1.3%	17.0%	-1.6%	-21.1%	-1.8%	-11.1%	-2.8%	6.5%

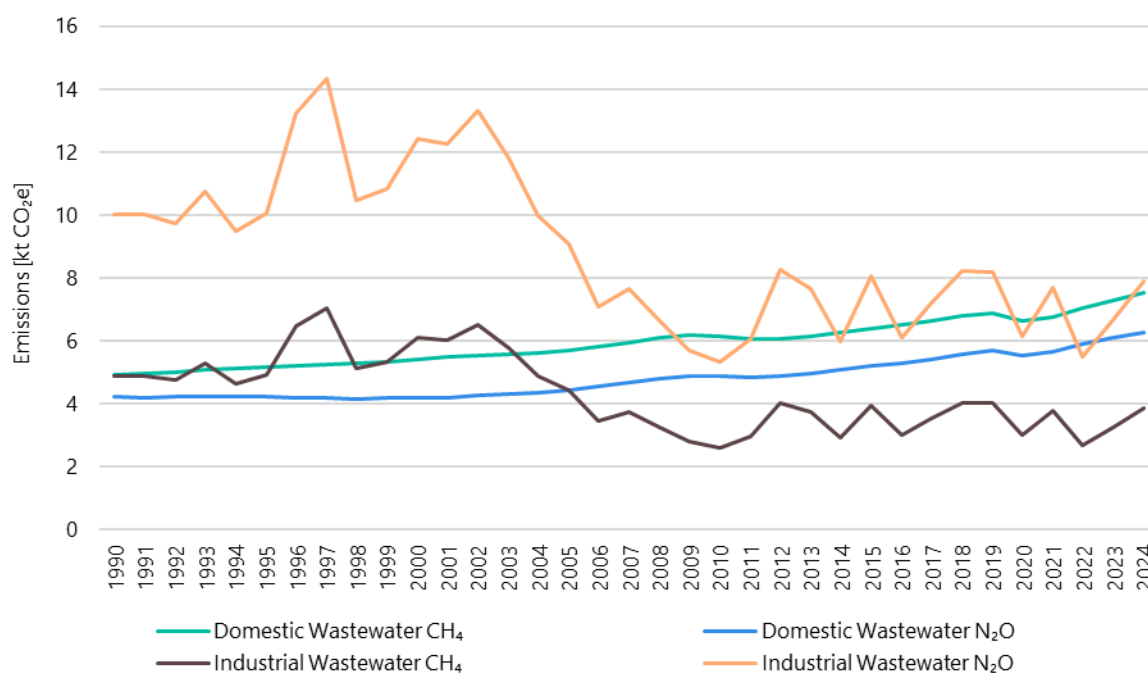


Figure 7.14. Emissions from Wastewater Treatment and Discharge (CRT 5D) since 1990.

Emissions from sludge removed are accounted for in CRT categories 5A1 Managed Waste Disposal Sites, 5C1aii4 Waste Incineration - Biogenic - Other - Sewage Sludge, and under the Agriculture sector, CRT category 3D1bii Organic N Fertilisers - Sewage Sludge Applied to Soils.

7.5.5 Uncertainties

The activity data uncertainty was calculated to be 74% and 103% for CH₄ emissions for domestic and industrial wastewater, respectively. The CH₄ emission factor uncertainty for domestic wastewater is 55% and industrial wastewater is 58% based on values from the 2019 Refinements. The combined uncertainties for CH₄ emissions from domestic and industrial wastewater are, therefore, 92% and 118%, respectively.

The activity data uncertainty of domestic wastewater for N₂O emissions is based on values from the 2019 Refinements and is 65% for domestic wastewater and 103% for industrial wastewater, while the emission factor uncertainty is 755% and 745% based on Table 6.8a, Vol. 5, in the 2019 Refinements, giving a combined uncertainty of 758% and 752%, respectively. The complete uncertainty analysis is shown in Annex 2: Assessment of Uncertainty.

7.5.6 Recalculations

In 2025, the wastewater emissions calculations for both domestic wastewater (5D1) and industrial wastewater (5D2) were upgraded from the IPCC 2006 Guidelines to the IPCC 2019 Refinements methodology. This involved various changes in the calculations.

For domestic wastewater, older activity data was revisited and more data collected to keep better track of fractions of wastewater going to different treatment and discharge pathways. Wastewater treatment and water body recipient has now been assessed for every town in Iceland with more than 50 people from 2002 and onwards. Various factors were updated according to the 2019 Refinements, including BOD per person, $F_{\text{NON-CON}}$ and N_{HH} . The CH₄ calculations now include new data on sewage sludge removed in biological treatment plants and from septic tanks. The N₂O calculations now include N₂O emissions from domestic wastewater treatment, which were previously neglected in the IPCC 2006 Guidelines. The overall effect on emissions from domestic wastewater can be seen in Table 7.26.

For industrial wastewater, N₂O emissions from industrial wastewater discharge from fish processing are now calculated, which were previously neglected in the IPCC 2006 Guidelines, and a country-specific value for wastewater generation in fish processing is used for the first time lowering the industrial CH₄ emissions. In previous submissions, the value used for wastewater generation in fish processing was obtained from the range provided in Table 6.9, in Vol. 5, of the 2006 IPCC Guidelines: $(8+18)/2 = 13 \text{ m}^3/\text{tonne}$ of fish processed. The country-specific value applied for this submissions was calculated using water use and fish processing values from two large companies, Brim and Síldarvinnslan, which process around 25% of all fish processed in Iceland. The water use and fish processing values are provided in their annual sustainability reports. The new country-specific value is not static over the timeline 1990-2024 but fluctuates between 3.5 and 7.5 m³/tonne, with an average of 5.8 m³/tonne, see Table 7.24. The country-specific value is closer to the revised wastewater generation value for fish processing, 5 m³/tonne, provided in Table 6.12, in Vol. 5, of the 2019 Refinements.

The recalculation for industrial wastewater are shown in Table 7.27.

Table 7.26. Recalculations of total emissions in sector 5D1 Domestic Wastewater.

CRT 5D1	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 Submission [kt CO ₂ e]	8.4	8.7	8.8	9.2	10.0	10.5	11.1	11.9	12.2
2026 Submission [kt CO ₂ e]	9.1	9.4	9.6	10.1	11.0	11.6	12.2	13.0	13.4
Change relative to the 2025 submission [kt CO ₂ e]	0.71	0.73	0.75	0.89	1.00	1.10	1.03	1.09	1.21
Change relative to the 2025 Submission [%]	8.4%	8.4%	8.5%	9.6%	9.9%	10.5%	9.3%	9.2%	9.9%

Table 7.27. Recalculations in sector 5D2 Industrial Wastewater.

CRT 5D2	1990	1995	2000	2005	2010	2015	2020	2022	2023
2025 Submission [kt CO ₂ e]	11	11	14	9.9	5.8	8.8	6.7	10	9.9
2026 Submission [kt CO ₂ e]	15	15	19	14	7.9	12	9.2	8.2	9.9
Change relative to the 2025 submission [kt CO ₂ e]	4.0	4.0	5.0	3.6	2.1	3.2	2.5	-1.9	0.083
Change relative to the 2025 Submission [%]	37%	37%	37%	37%	37%	37%	37%	-19%	0.84%

7.5.7 Planned Improvements

The Industrial Wastewater category is currently only calculated for fish processing on land and other industries are assumed to be included in the industrial and commercial co-discharge factor ($I_j = 1.25$). For future submissions it is planned to assess more industries individually, as relevant data becomes available. Preliminary work on mapping the missing data has begun and is ongoing.

8 Other (CRT sector 6)

Iceland has no activities and emissions to report under the CRT Sector 6. Reporting of activities at Climeworks, an experimental Direct Air Capture (DAC) plant at the site of the CarbFix reinjection site (see also Chapter 3.4.2) is currently being investigated. The Climeworks project captures CO₂ from the atmosphere; the captured CO₂ is then injected into the subsurface in the CarbFix well, where CO₂ mineralises to form calcite (CaCO₃). More about Climeworks can be found here: www.climeworks.com.

9 Indirect CO₂ and N₂O Emissions

9.1 Indirect CO₂ Emissions

The only indirect CO₂ emissions estimated in Iceland's greenhouse gas inventory are those occurring from atmospheric oxidation of NMVOC from road paving with asphalt and solvent use (CRT category 2D3). However, in order to comply with the reporting guidance provided in 2006 IPPC Guidelines related to the tracking of the non-energy use of fuels and in line with the reporting of other EU countries, IEEA followed recommendations outlined in a Guidance document related to the reporting indirect emissions, distributed by Working Group 1 under the EU Climate Change Committee. Thus, CO₂ emissions from the oxidation of NMVOC in Category 2D3 are reported in CRT Tables 2(I) and 2(I).A-H, and not as indirect emissions in CRT Table 6, and the CO₂ emissions related to this are included in the national totals.

9.2 Indirect N₂O Emissions

Indirect N₂O emissions are calculated and reported in the Agriculture and LULUCF chapters. These emissions all count towards the national total and are discussed in the relevant sectoral chapters. No other indirect N₂O emissions are estimated.

Methodology, Recalculations, and Planned Improvements

For more information on these topics the reader is referred to the appropriate sections in the sectoral chapters.

10 Recalculations and Improvements

10.1 Explanations and Justifications for Recalculations, Including in Response to the Review Process

The Icelandic 2026 greenhouse gas emission inventory was recalculated for several categories. Detailed information on the recalculations can be seen below, as well as in the respective sectoral chapters. Recalculations are mostly due to reviewers' comments, changes in activity data or emission factors, tier upgrade or issues detected by the sectoral experts.

Table 10.1 and Table 10.2 show the difference between the total emissions in the 2026 Submission and the 2025 Submission, without and with emissions from the LULUCF sector. Explanations for the differences are given in Chapter 10.3 Sector-specific Recalculations.

Table 10.1 Total emissions according to the 2026 Submission compared to the 2025 Submission, [kt CO₂e] - without LULUCF.

Inventory Year	2025 Submission	2026 Submission	Change [kt]	Change [%]
1990	3707	3667	-40	-1.1%
1995	3591	3549	-42	-1.2%
2000	4201	4167	-34	-0.8%
2005	4129	4099	-30	-0.7%
2010	4976	4944	-32	-0.6%
2015	4845	4820	-24	-0.5%
2020	4605	4579	-26	-0.6%
2022	4782	4776	-5.7	-0.1%
2023	4646	4644	-2.0	0.0%

Table 10.2 Total emissions according to the 2026 Submission compared to the 2025 Submission, [kt CO₂e] - with LULUCF.

Inventory Year	2025 Submission	2026 Submission	Change [kt]	Change [%]
1990	11850	10354	-1496	-12.6%
1995	11702	10188	-1514	-12.9%
2000	12296	10794	-1502	-12.2%
2005	12221	10748	-1472	-12.0%
2010	13064	11499	-1565	-12.0%
2015	12884	11178	-1707	-13.2%
2020	12605	10734	-1872	-14.8%
2022	12767	10907	-1861	-14.6%
2023	12631	10807	-1824	-14.4%

10.2 Most Recent Reviews

10.2.1 EU Review 2026

In February 2026, the inventory underwent the yearly EU step 1 review checks ("initial checks"). All questions were answered and addressed where possible, and appropriate changes were made for the March submission.

10.2.2 UNFCCC Review 2025

No UNFCCC review took place for Iceland's inventory submitted in 2025.

10.2.3 EU Review 2025

In February 2025, the inventory underwent the yearly EU step 1 review checks ("initial checks"). All questions were answered and addressed where possible, and appropriate changes were made for the March submission.

Iceland underwent a comprehensive review that took place in spring/summer 2025 as per Art. 38(1a) of Regulation (EU) 2018/1999. This Article has not yet been incorporated into the EEA Agreement and therefore Iceland underwent the comprehensive review voluntarily. All questions were answered and addressed where possible, and appropriate changes were made for the 2026 submission. The review report for emissions and removals pursuant to Regulation (EU) 2018/841 (LULUCF regulation) can be found on the website of the EFTA Surveillance Authority.⁵⁷

10.2.4 UNFCCC Review 2024

No UNFCCC review took place for Iceland's inventory submitted in 2024.

10.2.5 EU Review 2024

In February 2024, the inventory underwent the yearly EU step 1 review checks ("initial checks"). All questions were answered and addressed where possible, and appropriate changes were made for the March submission.

10.2.6 UNFCCC Review 2023

No UNFCCC review took place for Iceland's inventory submitted in 2023.

⁵⁷ Review report of 2025 Comprehensive Review pursuant to the LULUCF regulation:
[2025 LULUCF ReviewReport Iceland FINAL.pdf.pdf](#)

10.2.7 EU Review 2023

In February 2023, the inventory underwent the yearly EU step 1 review checks ("initial checks"). All questions were answered and addressed, and appropriate changes were made for the 15 March submission.

10.2.8 UNFCCC Review 2022

Iceland's inventory submitted to UNFCCC in April 2022 was subjected to a UNFCCC centralised review during the week from 19 to 24 September 2022. The expert review team (ERT) raised some issues that were solved during the review week and led to recalculations of Iceland's inventory. Iceland therefore resubmitted the 2022 inventory data (CRF) to the UNFCCC on 23rd of September 2022. Iceland's 2022 National Inventory Report (NIR) was updated in accordance with the latest submission of 2022 (v4). Therefore, Iceland's official 2022 Submission is that of September 2022. The recalculations which led to the resubmission were linked to KP-LULUCF accounting quantities for Art. 3.4 Activity "Revegetation," and changed the available removal units for use for the second commitment period of the Kyoto Protocol. The emission and removal figures reported in the review report of the 2022 submission⁵⁸ were the basis for Iceland's fulfilment of its commitments under the Kyoto Protocol.

10.3 Sector-specific Recalculations

10.3.1 Energy (CRT Sector 1)

Recalculations were performed for the Energy sector for this submission, leading to a difference in greenhouse gas emissions between the 2025 and the 2026 submissions throughout the timeline. The changes were +7.3 kt. in 2023, -2.2 kt. in 2005 and +0.012 kt in 1990. Other notable changes are that emissions increased by 19.3 kt in 2014, 13.8 kt in 2016, 11.5 kt in 2018, 15.8 kt in 2019, and approximately 7 kt each year from 2021-2023. The most significant decrease apart from 2005 is in 2004 with -1.6 kt. A summary of the changes made are presented here, and further details are documented under the specific "recalculations" sections in each individual subcategory of Chapter 3 (Energy). There are various reasons that caused these recalculations:

- 1A1ai and 1A1aiii Energy Industries: Minor recalculations in 1A1ai were necessitated by an update of residual fuel oil usage for the year 2000.
- 1A2 Manufacturing Industries and Construction: Updates received from companies on the use of LPG in 2020 and Diesel in 2022 led to minor shifts in CO₂ from 1A2b to

⁵⁸ https://unfccc.int/sites/default/files/resource/arr2022_ISL.pdf

1A2gviii in 2020, and from 1A2gviii to 1A2b in 2022. Neither adjustment affected the emissions total of the sector.

- 1A2gvii, 1A3eii, and 1A4cii Mobile Machinery: Updated fuel attribution to these categories required recalculations for all years from 1990-2020. For the years 1990-2018 the split between categories is based on category-specific activity data. Fuel assignment for the years 2019 and 2020 was corrected for suspected attribution inaccuracies.
- 1A3b Road Transport: Recalculations of CO₂, CH₄, and N₂O for throughout the timeline were required due to several improvements:
 - Vehicle stock data for the entire timeline is now obtained from the Icelandic Transport Authority. The vehicle classification scheme (category, type of fuel, segment, and period of activity) was improved in that context.
 - CO₂ emissions resulting from the unintentional combustion of lubricants were double counted previously in 1A3b and 2D1. They are now reported as part of the CO₂ emissions total from lubricant combustion in category 2D1 only.
 - COPERT 5.9.1 introduced a number of methodological changes. Significant impact on emission estimates is attributed to revisions of the consumption profile of light-duty vehicles, which yielded fuel consumption adjustments and, due to fuel-balancing, adjusted mileage figures for cars and vans. In addition, a revision of emission factors for Diesel in light-duty and heavy-duty vehicles led to an increase in CH₄ emissions from passenger cars, as well as to an increase of N₂O and a decrease of CH₄ in heavy-duty vehicles.
- 1B2av and 1B2bv Fugitive Emissions from Fuels: Recalculations for 2000-2023 were caused by updated residual fuel oil sales data for 2020, revised gas/Diesel oil usage data for 2022, as well as the inclusion of biofuels in the activity data.
- 1B2d Geothermal Energy: Updates in activity data from the geothermal power plants necessitated recalculations CH₄ emissions for 1990-2007, 2014-2020, and 2022-2023, as well as for CO₂ emissions for the entire timeline.

10.3.2 Industrial Processes and Products Use (CRT Sector 2)

Recalculations were performed for the IPPU sector for this submission, leading to a minor difference in greenhouse gas emissions between the 2025 and the 2026 submission amounting to 2.00 kt CO₂e for 2023, 0.959 kt CO₂e for 2005, and -0.100 kt CO₂e for 1990. A summary of the changes made are presented here, and further details are documented under the specific "recalculations" sections in each individual subcategory of Chapter 4 (IPPU). These recalculations were in the following subsectors:

- 2D3a Domestic Solvent Use: The methodology was updated from Tier 1 which was population-based to Tier 2b which is based on the amount of product (population numbers are still being used in specific cases).

- 2D3d Coating Application: Net import figures on solvent-based paint used in activity data was updated.
- 2F1b Domestic Refrigeration: The categories of imported household fridges and freezers were re-evaluated, with several categories removed and others added, leading to changed net import figures used in the activity data.
- 2F4a Metered Dose: Calculation error was fixed for year 1990.
- 2G4 Other: Tobacco: Waterpipe tobacco was removed from the activity data as it is not combusted, and updated import data for other cigars in 2023 was brought in.

10.3.3 Agriculture (CRT Sector 3)

Recalculations were performed in the Agriculture sector for this submission, leading to a decrease in greenhouse gas emissions between the 2025 and 2026 submission amounting to -32 kt CO₂e for 2023, -33 kt CO₂e for 2005, and -45 kt CO₂e for 1990. A summary of the changes made is presented here and further details are documented under the specific “recalculations” sections in each individual subcategory of Chapter 5 (Agriculture). There are various reasons that caused these recalculations:

- The cattle categories behind the category Growing Cattle were changed to increase the transparency of calculations. The category Young bulls and non-inseminated heifers has been split up by gender, and the non-inseminated heifers have been put in the same group as bred heifers forming the category Heifers. These changes only slightly affect the emissions.
- Updated animal weights and manure management system (MMS) fractions were obtained for all cattle categories, affecting 3A, 3B and 3D emissions. The change in MMS fraction was largest for Calves where the fraction of solid storage was decreased and slurry increased instead, and time in pasture was introduced as well based on better data from the IAAC. An error was also found and fixed for the Mature Dairy Cattle, the days in different systems didn’t add up to 365.
- The methodology used to estimate feed digestibility for cattle and sheep was updated. Instead of basing the calculations on data on dry matter digestibility they are now based on data on organic matter digestibility. The ash content of feed was also updated for cattle and sheep. This change increased the digestibility and therefore decreased 3A, 3B and 3D emissions due to cattle and sheep farming.
- The mortality rate of lambs was increased by around 2.5% for the whole timeline, affecting the sheep population size, and hence, emissions due to sheep farming.
- For goats updated gender fractions were received (12% adult males instead of 15%), updated number of kids per doe (1.5 instead of 1.3) and updated slaughter age (5.5 months instead of 5 months), affecting the population size of goats.
- Updated weights were received for foals (136 kg instead of 60 kg) and 1–3-year-old horses (318 kg instead of 175 kg), and those weights are now used to adjust the 3A

Emission factor for horses, while in the 2025 submission the weight of an adult horse was used to adjust the 3A EF used for all horse age groups. The weight change also effects the amount of volatile solids and nitrogen excreted. These changes led to recalculations in 3A, 3B and 3D.

- The Y_m values for sheep was updated from the one in the 2006 IPCC Guidelines to the one from the 2019 Refinements. Simultaneously, the methodology for calculating methane emission from enteric fermentation of lambs was changed to follow the example of Norway. The Lamb category contains lambs that are less than 4.5 months old. The Y_m value for this category is adjusted to account for the lower methane emissions pre-weaning in such a way: $Y_m = 0\%$ is applied the first 60 days and afterwards $Y_m = 6.5\%$ is applied. This approach gives slightly lower emissions pre-weaning than reality but higher emissions post-weaning but balances out for the Lamb category as a whole.
- N_2O emission factors for solid manure storage were updated in accordance with the updates in the 2019 Refinements, doubling the factors, and a decimal point error was fixed for the N_2O emission factors for solid manure storage for fur animals, which together with the 2019 RF update increased the factors almost 200-fold. No default EF is available for N_2O emissions from slurry for sheep, however, a ten times smaller factor had been in use for sheep than for cattle, without sufficient documentation of why. Hence, a decision was taken to use the cattle N_2O emission factor for sheep as well, increasing those emissions ten-fold. These changes are the main drivers behind the increase in N_2O emissions from 3B2 Sheep and from 3B4 Other, due to the change in factors for fur-animals and also affect the amount of manure available for application.
- Information on the use of straw in solid storage for sheep and calves was also updated with new data from the IAAC, causing recalculation for direct and indirect N_2O emissions from manure management as well as the amount of manure available for application. The effect is though not as much as from the updates and fixes to the direct N_2O emission factors from manure management. This change affects the year 1990-2007 for calves, up to 49% higher values for straw usage, and the whole timeline 1990-2023 for sheep, 70% lower values for straw usage.
- The types of inorganic fertilisers used were reevaluated causing recalculations for NH_3 emissions from fertiliser use. This did not affect the N_2O emissions from 3D1a Inorganic N Fertilizers but lead to recalculations of emissions form 3D2a Atmospheric Deposition.
- Errors were fixed in the fertiliser calculation sheets for the years 2012 and 2023 causing recalculations of N_2O emissions for those years. The amount of inorganic fertiliser used in forestry was also updated causing small recalculations for N_2O emissions for the years 2009-2023. However, due to how small those changes were the effect on emissions is less than 0.5% for all years.

- Updated feed digestibility, ash content of feed, animal mass, manure management system fractions for calves, early mortality of lambs and goat population size, as well as an error fixed in the calculations of the digestibility of feed for dairy cattle, all affect the amount of manure available for application. Emission factor updates to 2019 IPCC Refinements for N₂O emissions from manure management, error fixes to how these emission factors are applied for sheep, mink, foxes and rabbits, and new information from the IAAC on the use of straw in solid storage for sheep and calves, caused recalculations for category 3D1bi Animal Manure Applied to Soils by affecting the amount of manure available for application.
- The amount of organic fertiliser used in forestry was updated causing recalculations for N₂O emissions from 3D1biii Other Organic Fertilisers Applied to Soils for the years 2009-2023.
- Recalculations are due to the transition of emission factors from 2006 IPCC Guidelines to the 2019 Refinements for categories 3D1c Urine and Dung Deposited by Grazing Animals and 3D2b Nitrogen Leaching and Run-off. The factors in the 2019 Refinements were generally considered better researched and more appropriate than those in the 2006 IPCC Guidelines, hence it was decided to use the 2019 Refinements for the entire Agriculture sector.
- The methodology applied for category 3D1d Crop Residues was updated to the 2019 IPCC Refinements and emissions from residues from the cultivation of brassicas were added to the inventory.
- Recalculations were made to the activity data for 4B Cropland, 4C1 Cropland abandoned for more than 20 years and 4C2b Cropland converted to grassland throughout the timeseries. The changes were mostly driven by two factors: correction of artificial rise in IGLUD map data and subsequent reinterpretation of a key reference (Snæbjörnsson, o.fl., 2010).
- Activity data on fertiliser types was revisited resulting in recalculations for urea for the year 2020, decreasing the urea emissions by 1.5 kt CO₂ or 49% that year, and recalculations for CAN for the years 2010-2023. The change for 3G was miniscule, 0.6% increase in CO₂ emissions in one year, 2020.

10.3.4 LULUCF (CRT sector 4)

The recalculations have been completed in the estimates of emissions and removals for each land-use category. The effect of the recalculations on the emissions from the sector are shown in Table 10.3. Further explanations for the subsectors are also explained below.

Table 10.3 Total emissions from the LULUCF sector reported in the 2026 and 2025 submissions, kt CO₂e

Inventory Year	2025 Submission	2026 Submission	Difference [kt CO ₂ e]	Difference [%]
1990	8142	6686	-1456	-17.9%
1995	8111	6639	-1471	-18.1%
2000	8095	6627	-1468	-18.1%
2005	8092	6649	-1443	-17.8%
2010	8088	6556	-1532	-18.9%
2015	8039	6357	-1682	-20.9%
2020	8000	6154	-1846	-23.1%
2022	7986	6131	-1855	-23.2%
2023	7985	6163	-1822	-22.8%

Forest Land (CRT 4A)

The emission/removal estimates for Forest Land land-use category have been revised in comparison to previous 2025 submissions. Specifically:

- New CFC EF are now used for mineral soil in NBW, where NBW was divided into two age classes: 0–30 years and 30–60 years and applies for four land-use categories.
- Changed grid introduced in 2025 for CF of 1 km x 1 km, replacing the 0,5 km x 1 km grid used for 2005–2024.

More detailed information on the reason for the recalculations and their impact on the emissions/removals level is presented in Section 6.3.7.

Cropland (CRT 4B)

The emission and removal estimates for the Cropland land-use category have been revised for this year's submission. Specifically:

- changes in the area of 4B1 Cropland active due to a change in processing method of the IGLUD map data and a reinterpretation of a key reference for cropland area in 2008 and 1989,
- the inclusion of annual belowground biomass losses,
- the inclusion of DOM carbon stock changes, and
- the recalculation of annual mineral soil carbon stock changes for 4B2b Grassland converted to cropland.

More detailed information on the reason for the recalculation and its impact on the emissions/removals level is presented in Section 6.4.7.

Grassland (CRT 4C)

The emission/removal estimates for Grassland land-use category have been revised in comparison to previous 2025 submissions. Specifically:

- changes in the area of 4C2b Cropland converted to grassland and 4C1 Cropland abandoned for more than 20 years as a result of a revision of the Cropland timeseries;
- the estimation of carbon stock changes in the mineral soil pool for grazing areas and grassland without grazing under Grassland remaining Grassland;
- the recalculation of annual living biomass gains, including belowground biomass, for the subcategories Cropland converted to Grassland, Revegetation before 1990, Revegetation since 1990 (protected from grazing), and Revegetation since 1990 (limited grazing);
- the calculation of carbon stock changes in the dead organic matter (DOM) pool for these same subcategories; and
- the recalculation of carbon stock change emission factors (CSC EFs) for mineral soils in the subcategory Cropland converted to Grassland.

More detailed information on the reason for the recalculations and their impact on the emissions/removals level is presented in Section 6.5.7.

Wetlands (CRT 4D)

The emission/removal estimates for Wetlands land-use category have been revised in comparison to previous 2025 submissions. Specifically:

- Emissions and removals for intact mires – grazing areas (previously classified as intact mires – managed) were re-evaluated. The review determined that methodologies from the 2013 IPCC Wetlands Supplement were not appropriate for this subcategory because these soils are not drained and are only subject to grazing. Consequently, all carbon stock changes for this subcategory are now reported as NA, thereby removing previously misallocated emissions.

More detailed information on the reason for the recalculations and their impact on the emissions/removals level is presented in Section 6.6.7.

Settlements (CRT 4E)

Methodological updates have been implemented for the subcategory All other Grassland subcategories converted to Settlements. These updates include:

- Inclusion of direct and indirect N₂O emissions.
- Inclusion of annual estimates of carbon stock changes in BGB within living biomass losses.
- Inclusion of annual estimates of carbon stock changes in the dead organic matter (DOM).

More detailed information on the reason for the recalculations and their impact on the emissions/removals level is presented in Section 6.7.7.

Other Land (CRT 4F)

As for other land-use categories the methodology to estimate the time series for the Land-use category Other Land has been reviewed as shown in Section 6.8.4.

Harvested Wood Products (4G)

No recalculations performed.

Other (please specify) (CRT 4H)

No recalculations performed.

Direct and Indirect N₂O Emissions from N Inputs to Managed Soils (CRT 4(I))

Recalculation of nitrogen (N) in organic and inorganic fertilisers used in forestry for the period 2009–2024. The reason is that previously all fertiliser was reported as inorganic, whereas it is now separated into these two categories.

Emissions and Removals from Drainage and Rewetting and Other Management of Organic and Mineral Soils (CRT 4(II))

CO₂ and CH₄ estimates for intact mires – grazing areas were re-evaluated and are now reported as NA, as the 2013 IPCC Wetlands Supplement is not applicable to undrained soils subject only to grazing, removing previously misallocated emissions.

Direct and Indirect N₂O Emissions from N Mineralisation and Immobilisation (CRT 4(III))

Inclusion of direct and indirect N₂O emissions for the subcategory Grassland converted to Settlements.

Biomass burning (CRT 4(IV))

No recalculations were done in this category.

10.3.5 Waste (CRT sector 5)

Recalculations were performed in the waste sector for this submission, leading to a difference in greenhouse gas emissions between the 2025 and 2026 submissions amounting to 20.8 kt CO₂e for 2023, 4.5 kt CO₂e for 2005, and 4.7 kt CO₂e for 1990. A summary of the changes made is presented here and further details are documented under the specific “recalculations” sections in each individual subcategory of Chapter 7 (Waste). There are various reasons that caused these recalculations:

- 5A Solid Waste Disposal, recalculations were made for years 2020-2023 where CH₄ recovery at Álfarnes landfill was previously overestimated. The amount of CH₄ collected from the landfill included the CH₄ produced at the GAJA biogas and composting plant, which opened in 2020, leading to an overestimate of CH₄ recovery at Álfarnes. This has now been corrected, resulting in higher net CH₄ emissions from the landfill for years 2020-2023. Recalculations were also made for years 1997-2003 based on a summary document for these years from Sorpa, resulting in a net increase in CH₄ emissions for some years (1997) but decrease for others (1998-2003).
- 5B1 Composting, recalculations for years 2022-2023 because the amount of waste going to composting was underestimated. MSW composted at GAJA biogas and composting plant was registered as landfilled for years 2022-2023 because the compost did not meet standards and was unusable. The waste was nonetheless composted and should therefore be included in 5B1 Composting. This has now been corrected, leading to an increase in emissions.
- 5D1 Domestic Wastewater, recalculations for all years as the calculations were upgraded to the IPCC 2019 Refinements methodology. Activity data on wastewater treatment with a higher resolution/granularity was collected in order to keep track of treatment and discharge for every town in Iceland from 2002 onwards. Various factors were updated according to the 2019 Refinements, including BOD per person, $F_{NON-CON}$ and N_{HH} . The CH₄ calculations now include new data on sewage sludge removed in biological treatment plants and from septic tanks. The N₂O calculations now include N₂O emissions from domestic wastewater treatment, which were previously neglected in the IPCC 2006 Guidelines.
- 5D2 Industrial Wastewater, recalculations as the calculations were upgraded to the IPCC 2019 Refinements methodology. N₂O emissions from wastewater discharge from fish processing are now assessed and included, which were previously neglected in the IPCC 2006 Guidelines. Activity data was collected on wastewater generation per ton of processed fish to derive a country-specific value, leading to a decrease in CH₄ emissions. However, the introduction of N₂O emissions from fish processing wastewater discharge had a higher impact, so overall there was a net increase in emissions in 5D2 Industrial Wastewater.

10.4 Implications for Emission Levels and Trends, Including Time-series Consistency

The total emissions of greenhouse gases have changed for all inventory years due to the recalculations. Where applicable, all the years of the time series were recalculated. The main changes are due to the changes in the LULUCF sector. These changes were done across the whole time series and do therefore not affect time series consistency. As for emission levels, they decrease the total emissions with LULUCF, as can be seen in Table 10.2.

10.5 Overview of Implemented and Planned Improvements, Including in Response to the Review Process

Iceland's 2022 Submission was reviewed during the UNFCCC centralised review conducted remotely.

Table 10.4 - Table 10.9 show the status of implementation of each general recommendation for each sector listed in the 2022 review report.

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Table 10.4 Status of implementation of general recommendations in response to UNFCCC's review process.

CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementa tion	Chapter/ Section in the NIR
Article 3.14 (G.1, 2021) (G.10, 2019) KP reporting adherence	Report any changes in its information provided under Article 3, paragraph 14, of the Kyoto Protocol in accordance with decision 15/CMP.1 in conjunction with decision 3/CMP.11. Iceland reported in its NIR (p. 375) information under on minimization of adverse impacts in accordance with article 3, paragraph 14 of the Kyoto Protocol with the explanation that no changes have occurred since last submission.	FCCC/ARR/202 2/ISL/G.1	Implemented.		Was done for 2023 submission. No more Kyoto Protocol information reported in 2024, apart from CP2 accounting.
National registry (G.2, 2021) (G.2, 2019) (G.3, 2017) (G.4, 2016) KP reporting adherence	Include in the national registry disaster recovery plan information on the roles and responsibilities of primary and alternate registry personnel in disaster recovery; a communication procedure for the contingency plan; documentation for registry operation in a crisis situation; a periodic testing strategy based on procedures agreed with the registry host; and the time frame in which the registry could resume operations following a disaster. Party clarified during the review that the responsibility of the management of the registry rests with the European Union under the terms of the Agreement between the EU and its Member States, on the one part, and Iceland, on the other part, concerning Iceland's participation in the Joint Fulfilment of the commitments of the EU, its Member States and Iceland for the second commitment period of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (Brussels 11 November 2014). The original uptake of EU ETS Directive no. 2003/87/EC, which provides for all the obligations and commitments of Iceland regarding the EU registry, was done with Decision of the EEA Joint Committee No 146/2007, whereby the EU ETS directive was formally added to the EEA Agreement. The bilateral agreement on the joint fulfilment, from 11 November 2014, only refers briefly to the fact that Iceland is already part of the EU ETS; the main goal of the agreement is to set conditions for the emissions that do not fall under the EU ETS directive.	FCCC/ARR/202 2/ISL/G.2	Solved during review.		n/a

CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implemen- tation	Chapter/ Section in the NIR
QA/QC and verification (G.6, 2021) (G.6, 2019) (G.7, 2017) Convention reporting adherence	Report in the NIR complete information on the tools and spreadsheets used for QA/QC and present a summary of the revised QA/QC plan and manual once they are finalized. Iceland added more information on QA/QC tools and spreadsheets in the NIR (section 1.5) and an ongoing improvement plan (section 1.5.5, p. 18). During the review, the Party clarified that the full QA/QC Plan and manual will not be completed until the 2023 Submission.	FCCC/ARR/2022/ISL/G.3	Implemented.		Chapter 1.5
QA/QC and verification (G.7, 2021) (G.11, 2019) Convention reporting adherence	Use the 2006 IPCC Guidelines as the only guidelines for QA/QC procedures and for assessing completeness and remove all outdated references to earlier IPCC guidelines from the NIR in order to improve its transparency and comparability. Iceland removed outdated references to earlier IPCC Guidelines in NIR sections 1.3.2, 1.6 and 1.7 and confirmed that it uses only the 2006 IPCC Guidelines for QA/QC procedures and assessing of completeness.	FCCC/ARR/2022/ISL/G.4	Implemented.		Chapter 1.5
Recalculations (G.9, 2021) (G.12, 2019) Convention reporting adherence	Improve the QC for the NIR to ensure that all changes affecting the recalculation of a given category are included in the description of the recalculations in the NIR and to ensure consistent reporting of the recalculations between the NIR and the CRF tables. Iceland clarified during the review that it has established a new procedure for documenting recalculations for the Energy, IPPU, Agriculture and Waste sectors, but that the new procedure is still to be implemented for the LULUCF sector.	FCCC/ARR/2022/ISL/G.5	Implemented.		Throughout the report.
Inventory management	The Party reported in its NIR (p.5 chapter 1.2.3) that the Environment Agency's ability to collect data is intended to be clarified through a revision to the Regulation No 520/2017. The NIR states that the Regulation will be revised to "include clearer definitions of responsibilities of the various institutions and other data providers involved, clearer deadlines and clearer provisions on what can be done if data providers fail to provide the data required as per the regulation." During the review, the Party advised that the planned revision to this Regulation had been delayed. Report in its next NIR on whether there have been any difficulties for the National	FCCC/ARR/2022/ISL/G.6	Implemented.		Chapter 1.2.2

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CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementa tion	Chapter/ Section in the NIR
	Inventory Compiler in obtaining data from data providers and to provide an update on progress with the planned revision to Regulation 520/2017.				
Inventory management	The Party reported in its NIR (p.5 chapter 1.2.2) that the Environment Agency is responsible for compilation of the inventory but that other agencies prepare estimates for certain categories in the inventory preparation. In certain cases, there has been insufficient co-ordination among agencies and/or quality control checks by the coordinating agency resulting in double counting, or omission, or a lack of transparency about the allocation of emissions (see #A.8/#L.29 where it was not clear from the submission whether emissions from biomass burning of field residues were reported in the Agriculture or LULUCF sector or #L.32 where a case of double counting of emissions from nitrogen fertilizer application was identified across the Agriculture sector and the Revegetation activity). Take specific measures to improve co-ordination among agencies and improve the quality control cross checks across the Agriculture and LULUCF reporting categories for future submissions.	FCCC/ARR/2022/ISL/G.7	Implemented.		
Annual submission	Iceland did not report national total emission estimates with and without indirect CO₂ in the CRF tables 10.1-10.6. The ERT notes that Decision 24/CP.19, paragraph 29 states that "for Parties that decide to report indirect CO₂ the national totals shall be presented with and without indirect CO₂". During the review, the Party provided a spreadsheet with the total national emissions with and without indirect CO₂. The ERT noted that emissions are estimated in line with 2006 IPCC and UNFCCC Annex I reporting guidelines. Report national total emission with and without indirect CO₂ in CRF tables 10.1-10.6. The ERT notes that this can be done by including the indirect CO₂ emissions either under the sectoral level or the national level in the CRF Reporter (that uses this information to automatically update the CRF tables 10.1-10.6).	FCCC/ARR/2022/ISL/G.8	Solved during review, where Iceland submitted Table 10s1 with totals including indirect CO ₂ emissions.		Chapter 9

10.5.1 Energy (CRT Sector 1)

Various improvements were planned and implemented in this most recent submission in the Energy sector. The fuel attribution to 1A2gvii, 1A3eii, and 1A4cii Mobile Machinery was updated. In 1A3b Road Transport, the vehicle stock data is now obtained from the Icelandic Transport Authority for the whole timeline. CO₂ emissions resulting from the unintentional combustion of lubricants were double counted previously in 1A3b and 2D1. They are now reported as part of the CO₂ emissions total from lubricant combustion in category 2D1 only. Biofuels are now included in the activity data for 1B2av and 1B2bv Fugitive Emissions from Fuels. Issues regarding the Reference Approach will be a point of focus in the next submissions. The IEEA is working to improve the data reported in the Reference Approach, as well as identify the reasons for discrepancies between the Reference Approach and the Sectoral Approach (SA).

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Table 10.5. Status of implementation in the Energy sector in response to UNFCCC's review process.

CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
1. General (energy sector) – (E.3, 2021) (E.5, 2019) (E.18, 2017) Convention reporting adherence	Correct the errors and omissions in the national inventory, such as: (f) Missing use of charcoal. This issue is being considered under ID# E.17 below.	FCCC/ARR/2022/ISL /E.1	Addressed by ID# E.17		Chapter 3
Fuel combustion – reference approach – electrodes – CO ₂ (E.4, 2021) (E.22, 2019) Convention reporting adherence	Remove the separate entries for electrodes from the reference approach and report the correct apparent consumption for the reference approach, allowing for meaningful comparison between the estimated CO ₂ emissions resulting from the two approaches across the time series and explain the planned recalculation for the reference approach in the next NIR. Iceland continues to report in CRF table 1.A(b) "NO" for electrodes for the entire time series under the rationale that all electrodes are used and reported in the IPPU sector. The Party reported in section 3.5.2 (p.79) of its NIR information reiterating this interpretation. However, in accordance with the UNFCCC Annex I reporting guidelines, data on the consumption of feedstock and non-energy use of fuels requires to be reported in CRF table 1.A(b), with the amount of C excluded entered in cell P37 of CRF table 1.A(b), and reported in CRF table 1.A(d) together with an indication of under which category these emissions have been reported (see also ID#E.4 below).	FCCC/ARR/2022/ISL /E.2	Implemented. Electrodes are now included under non-energy use of fuels and all Carbon is excluded. This ensures transparency whole also allowing for meaningful comparison between the reference approach and sectoral approach.		
Fuel combustion – reference approach – CO ₂ (E.5, 2021) (E.26, 2019) Accuracy	Report the results of the data analysis by NEA in the NIR and ensure the use of consistent AD for the inventory estimates across the time series. Iceland reported the results of the data analysis in the NIR section 3.1.6 (p.46). According to the Party a comprehensive review was performed on how the fuels sales data from the NEA is attributed to IPCC sectors. The Party performed this analysis for the entire time series and harmonised methodologies from 1990 onwards.	FCCC/ARR/2022/ISL /E.3	Implemented		

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CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
Fuel combustion – reference approach – peat – CO ₂ (E.7, 2021) (E.28, 2019) Convention reporting adherence	Report on peat consistently between the sectoral and reference approach. Iceland continues to report in CRF table 1.A(b) “NO” for peat consumption for the entire time series under the rationale that all peat is used for non-energy purposes (mostly gardening purposes), with no associated GHG emissions, and reported in its NIR (p.302) that this issue has been implemented. However, in accordance with the UNFCCC Annex I reporting guidelines, data on the consumption of peat used for non-energy purposes requires to be reported in CRF table 1.A(b), with the amount of C excluded, entered in the column “Carbon fraction excluded from reference approach” of CRF table 1.A(b), and reported in CRF table 1.A(d) together with an indication of under which category these emissions have been reported.	FCCC/ARR/2022/ISL /E.4	Implemented		
Fuel combustion – reference approach – solid, liquid and other fossil fuels – CO ₂ (E.8, 2021) (E.29, 2019) Convention reporting adherence	Enhance the collaboration among NEA, IEA and relevant national authorities to resolve the errors detected in the data and report correctly in CRF table 1.A(b) the stock changes for coke oven/gas coke between 2007 and 2012 and make corrections to the emission estimates. Stock change values reported in the CRF table 1.A(b) for coke oven/gas coke between 2007-2012 is related only for sub-bituminous coal while for IEA it includes sub-bituminous coal and coke oven/gas coke. Therefore, AD is not disaggregated between sub-bituminous coal and coke oven/gas coke for these years in the CRF table 1.A(b). The Party clarified that it will investigate this issue and will check if the numbers for stocks under coke oven/gas coke reported in the inventory are correct.	FCCC/ARR/2022/ISL /E.5	In progress		
Feedstocks, reductants and other non- energy use of fuels – liquid fuels – CO ₂ (E.9, 2021) (E.30, 2019) Convention	(a) Correctly fill in CRF table 1.A(d) for lubricants. (b) Correctly estimate and consistently report the use of petroleum coke across the time series. (a) Iceland continues to report “IE” for CO ₂ emissions under “CO ₂ emissions from the NEU reported in the inventory” in CRF table 1.A(d) in cells I22 and I23 for lubricants and petroleum coke rather than specifying a value for these emissions in kt CO ₂ . (b) Iceland improved the consistency of the reporting for petroleum coke in order to resolve the double counting of	FCCC/ARR/2022/ISL /E.6	Implemented.		

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CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
reporting adherence	emissions between the energy and IPPU sector. The Party recalculated emissions under category 1.A.2.f (non-metallic minerals) for the years 2013-2019 by excluding petroleum coke from this category. Total emissions under category 1.A.2.f reduced by 0.07 – 0.13 kt CO ₂ e for 2013-2019. During the review, the Party clarified that petroleum coke was only accounted in the energy sector for 2004-2007, when it was used by a cement factory, but since that factory closed in 2007 it has not been used in the energy sector since then.				
1.A Fuel combustion – sectoral approach – all fuels – CO ₂ (E.10, 2021) (E.10, 2019) (E.21, 2017) Accuracy	Develop country-specific fuel properties (NCVs and carbon content of fuels) that would allow the tier 2 approach for key categories to be used in line with the 2006 IPCC Guidelines. Iceland reported in the NIR table 3.1 (p.43) the key categories for the Energy Sector and in table 3.2 (p.44) the used methodologies for each of the categories within the Energy Sector. The ERT acknowledges that the Party has developed country-specific NCV and c-content measurements for gasoline and diesel oil and applied a tier 2/tier 3 approach for key category 1.A.3.b (road transport) and a combined tier 1/tier 2 approach for key category 1.A.3.d (domestic navigation) and 1A4c (agriculture/forestry/fishing). However, the Party estimated emissions from key categories 1.A.2 (manufacturing industries and construction), 1.A.3.a (domestic aviation), 1.A.3.e (other mobile machinery), and 1.A.4.b (residential combustion) using a tier 1 approach with default NCVs and carbon content of fuels and has not provided an explanation in the NIR why it was unable to use a higher tier method. The ERT noted that this is not in accordance with paragraph 11 of the UNFCCC Annex I reporting guidelines, which states that Parties should make every effort to use a recommended method, in accordance with the corresponding decision trees in the 2006 IPCC Guidelines and explain in the NIR why it was unable to implement a recommended method in accordance with the decision trees in the 2006 IPCC Guidelines. In addition, the ERT acknowledges that the Party has included more information on how the EFs of CO ₂ were derived by including section 3.3.3.2 on EFs in its NIR (p.66). However, this	FCCC/ARR/2022/ISL /E.7	Implemented. CO ₂ EF for gasoline between 1990-2016 in accordance with C-content and NCV within this period.		Chapter 3

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CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
	does not address the increase in the CO ₂ EF for gasoline between 1990-2016, considering constant values of the c-content and NCV.				
1.A Fuel combustion – sectoral approach – liquid fuels – CO ₂ (E.11, 2021) (E.31, 2019) Convention reporting adherence	Report information on AD and emissions for the information item waste incineration with energy recovery in CRF table 1.A(a)s4. Iceland included in CRF table 1.A(a)s4 AD and emissions for the information item waste incineration with energy recovery for 1993-2013, biomass and fossil fuel. The Party reported in NIR section 3.2.1 (p.48) that from 2013 onward, no solid waste or fossil fuels were used for the production of heat because the district heating stations stopped burning waste for energy recovery. The Party accordingly reports NO after 2013 for both biomass and fossil fuels in CRF table 1.A(a)s4.	FCCC/ARR/2022/ISL /E.8	Implemented.		Chapter 3
1.A.2 Manufacturing industries and construction – solid and liquid fuels – CO ₂ , CH ₄ and N ₂ O (E.12, 2021) (E.1, 2019) (E.2, 2017) (E.2, 2016) (E.2, 2015) (21, 2014) Transparency	Report information on (b) steam coal consumption and (c) petroleum coke consumption that provides justification for significant inter-annual changes and gaps in the time series of fuel consumption and associated emissions under category 1.A.2.f (non-metallic minerals). Iceland reported in the NIR (p. 46) the methodology used to harmonize AD (fuel consumption) from sales statistics and why zero consumption is used in some years of the times series for some fuels or why the inter-annual variation occurs. Further information is added in NIR (p. 52), where the Party explains that sales statistics do not fully specify by which type of industry the fuel is being purchased and that to address this issue, the major industries report their fuel use to the Iceland environmental agency along with other relevant information for industrial processes. The difference between the given total for the sector and the sum of the fuel use as reported by industrial facilities is categorized as category 1.A.2.g.viii (other non-specified industry). In addition, the Party also updated some estimates since the original recommendation that improved estimates for other	FCCC/ARR/2022/ISL /E.9	Implemented.		Chapter 3

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CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
	bituminous coal and petroleum coke. For other bituminous coal (that due to a translation error was reported as steam coal in the 2014 NIR (p.54)), the Party applied NCV (25.8 TJ/kt) and carbon content (25.8 kg C/GJ) from the 2006 IPCC Guidelines as presented in NIR table 3.11 (p.52). For petroleum coke, the Party clarified that it is accounted in the energy sector only for 2004-2007, when it was used by a cement factory that closed since then. In the 2022 Submission the Party recalculated emissions under category 1.A.2.f (non-metallic minerals) because petroleum coke was accounted in the energy sector for the other years of the time series and doubled counted with the IPPU sector (see also ID# E.6).				
1.A.3.a Domestic aviation – jet kerosene – CO ₂ , CH ₄ and N ₂ O (E.25, 2021) Comparability	Correct the allocation of the AD reported for jet kerosene in 2014 between category 1.A.3.a (domestic aviation) and 1.D.1.a (international aviation). Iceland corrected the allocation of jet kerosene for 2014 between categories 1.A.3.a (domestic aviation) and 1.D.1.a (international aviation). The Party reported in NIR section 3.3.2.4 (p.64) explanation on the recalculation performed and AD for 2014 in CRF table 1.A(a)s3 changed from 542.43 TJ to 251.72 TJ and is consistent with the time series. Reallocation reduced AD in 2014 for category 1.A.3.a by 6.7 kt as indicated by the Party in the previous submission.	FCCC/ARR/2022/ISL /E.10	Implemented.		Chapter 3
1.A.3.b Road transportation – diesel oil – CH ₄ and N ₂ O (E.15, 2021) (E.15, 2019) (E.25, 2017) Transparency	Update the NIR with the CH₄ and N₂O EFs used for estimating emissions from diesel oil in road transportation. Original issue asked the Party to recalculate CH₄ and N₂O emissions using default EFs from the 2006 IPCC Guidelines (3.9 kg CH₄/TJ and 3.9 kg N₂O/TJ respectively) and resubmit emissions estimates (in response to a Saturday paper), what was implemented by the Party in subsequent submissions. In 2020 submission the Party changed the reporting for road transport by using COPERT model, which uses a tier 3 methodology to estimate N₂O and CH₄ emissions. The range of the CH₄ and N₂O IEF are in accordance with what is being used by other European countries using COPERT. Further information on the methodology applied are in NIR p.65.	FCCC/ARR/2022/ISL /E.11	Implemented by using COPERT.		Chapter 3

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CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
1.A.3.b Road transportation – gasoline – CO ₂ (E.26, 2021) Accuracy	Verify the measured carbon content for gasoline and apply the correct value, based on the pure fossil fuel, for estimate CO₂ emissions. Explain in the NIR how the CO₂ EF was derived, including values and assumption for NCVs and carbon content and how the bioethanol is considered in the calculation of the CO₂ EF. Iceland did not verify the measured carbon content for gasoline to ensure that the correct value (based on pure fossil fuel) is applied in inventory to estimate CO₂ emissions for road transportation. The Party applied constant NCVs and constant measured carbon content for 1990–2016 and the CO₂ EF varied in this period from 69,96–70,15 t CO₂/TJ. The Party reports in NIR section 3.3.3 (p.65) that measurements of carbon content in gasoline used in road transport were done from fuel samples from 2019, with new measurements conducted in 2020. However, during the 2021 review, the Party clarified that the measured carbon content for gasoline was for the fossil fuel blended with bioethanol. For CO₂ emission factors mainly depend upon the carbon content of the fuel, and it is therefore important to measure the correct carbon content for gasoline, which can be different considering the inclusion of bioethanol. The ERT notes that when the Party calculate CO₂ EF from gasoline considering the blended bioethanol, there is probably an overestimation in the CO₂ emissions in the energy sector. This should be clarified by the Party.	FCCC/ARR/2022/ISL /E.12	Implemented. The fuel volume was corrected for blending rate before emissions were calculated so that the carbon content represents pure fossil gasoline.		Chapter 3.3.3
1.A.3.b.i Cars – gasoline – CH ₄ and N ₂ O (E.17, 2021) (E.32, 2019) Transparency	Explain in the NIR any significant inter-annual and trend changes in the AD, emissions and IEFs for CH₄ and N₂O emissions related to the use of gasoline for passenger cars. Iceland implemented the COPERT model for road transport for the whole time series since 2020 submission and explained in NIR section 3.3.3 (p.65) the methodology used in the estimations. For the CH₄ EF no significant inter-annual and trend changes are observed. However, the N₂O EF shows a considerable inter-annual variation between 2005 and 2006, during which it drops from 5.16 t N₂O/TJ to 2.37 t N₂O/TJ, respectively, and the related emissions	FCCC/ARR/2022/ISL /E.13	Implemented.		Chapter 3

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CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
	drop from 0.034 kt N ₂ O in 2005 to 0.016 kt N ₂ O in 2006, which is not addressed and explained in the NIR.				
1.A.3.b.i Cars – biomass – CO ₂ , CH ₄ and N ₂ O (E.18, 2021) (E.33, 2019) Transparency	Explain any significant inter-annual changes in the AD used for biomass and provide information on the EFs used for biofuels to justify any significant inter-annual changes in the biomass IEFs. Iceland recalculated emissions under this sector using COPERT model since 2020 submission. The CO ₂ , CH ₄ and N ₂ O EFs for biomass in the 2022 Submission still present some inter-annual variation between 2012-2015, however, the ERT could not identify in the NIR explanation on the reasons for the annual changes or trends in AD and EFs or how EF was derived. The ERT notes that sales data from NEA is used as AD (NIR table 3.17. p.56). During the review the Party clarified that this issue will be addressed in next submission.	FCCC/ARR/2022/ISL /E.14	Implemented. The introduction of new biofuels to the biomass category affected the overall IEF.		Chapter 3
1.A.3.e Other transportation – liquid fuels – CO ₂ , CH ₄ and N ₂ O (E.20, 2021) (E.35, 2019) Comparability	Investigate the possibility of separately estimating and reporting fuel consumption by splitting it between ground activities at airports and harbours (category 1.A.3.e.ii), agriculture and forestry (category 1.A.4.c.ii) and manufacturing industries and construction (category 1.A.2) by developing institutional cooperation or by extending the reporting obligations included in Icelandic regulation 520/2017, which is expected to be updated soon. Iceland performed recalculations (NIR, p. 62) to correct the allocation of fuels used for off-road vehicles for 2019 and 2020 on categories 1.A.3.e.ii (off-road vehicles and other machinery), 1.A.4.c.ii (agriculture/forestry/fishing: off-road vehicles and other machinery) and 1.A.2.g.vii (off-road vehicles and other machinery in construction), as follow: (a) Fuels used in ground activities in airports and harbours that were previously reported under category 1.A.2.g.vii are now reported under category 1.A.3.e.ii. (b) Fuels consumed under category 1.A.2 (manufacture industry and construction), that were previously reported under category 1.A.2.g.v are now reported under category 1.A.2.g.vii. (c) Fuels consumed under category 1.A.4.c.ii were revised due to a	FCCC/ARR/2022/ISL /E.15	Implemented. Fuel split between categories for 1990-2018 is based on sector-specific AD as proxy. Outlined in detail in NID section 3.3.1.		Chapter 3

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CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
	change in activity data reported by the NEA. For 1990-2018, categories 1.A.2.g.v.ii and 1.A.4.c.ii are reported as IE and emissions included in 1.A.3.e.ii. During the review the Party explained that there is no sufficient data to make a distinction among the categories on the fuels consumed and that will extrapolate data back to 1990 in the next submission.				
1.A.4 Other sectors – liquid fuels – CO ₂ , CH ₄ and N ₂ O (E.27, 2021) Comparability	Change the notation key from "NO" to "IE" in CRF table 1.A(a) (sheet 4) for other machinery used in the category 1.A.4.a.ii (off-road vehicles and other machinery under commercial/institutional) and include in the NIR where AD and emissions related to other machinery are reported. Iceland changed the notation key in CRF table 1.A(a)s4 and is now reporting "IE" for category 1.A.4.a.ii (off-road vehicles and other machinery under commercial/institutional) for the entire time series. The Party did not include information in the NIR regarding where AD and emissions related to other machinery are reported or indicated in CRF table 9 where the emissions have been included. However, the ERT considers that to provide information in CRF table 9 is sufficient to be in accordance with paragraph 37(d) of the UNFCCC Annex I reporting guidelines, which states that "Parties should indicate, in the CRF completeness table (table 9), where in the inventory the emissions or removals for the displaced source/sink category that are reported as "IE" have been included".	FCCC/ARR/2022/ISL /E.16	Implemented.		Chapter 3
1.A.4 Other sectors – biomass – CO ₂ , CH ₄ and N ₂ O (E.21, 2021) (E.18, 2019) (E.27, 2017) Completeness	Collect AD on the consumption of charcoal, estimate emissions from charcoal consumption, report the corresponding CO ₂ emissions as a memo item and include the non- CO ₂ emissions in the corresponding CRF table and national totals. Iceland explained during the review that data on imports of charcoal for 2019-2021 was collected from Statistics Iceland with the amount of charcoal used in industry excluded from this data. Based on the emissions calculations for the charcoal imported and not used in industry, the GHG emissions are considered insignificant by the Party in terms of the overall level and trend in national emissions as it is approximately 0.03 kt CO ₂ eq per year, which is well below the significance threshold of around 2.35 kt	FCCC/ARR/2022/ISL /E.17	Implemented.		Chapter 3.2.3

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CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
	CO ₂ eq. The ERT recognizes that emissions are insignificant and does not have impact on accounting for the second commitment period of the Kyoto Protocol, but these emissions should be included in the estimates because justification for exclusion based on the likely level of emissions should be applied at category level and not to parts of a category or subcategory in accordance with footnote 7 of the UNFCCC Annex I reporting guidelines.				
1.A.4.c.ii Off-road vehicles and other machinery – (E.28, 2021) Transparency	Create a separate section in its NIR for providing information regarding off-road vehicles used in the category 1A.4.c.ii (off-road vehicles and other machinery in agriculture/forestry/fishing). Iceland created a separated section 3.3.1 in its NIR (p.60) that provides information on all categories related to mobile machinery, including 1.A.4.c.ii (agriculture/forestry/fishing: off-road vehicles and other machinery). The section covers mobile sources under categories 1.A.2 (manufacturing industries and construction), 1.A.3 (transport), and 1.A.4 (other sectors), which for the Party constitutes to categories 1.A.g.v.ii (off-road vehicles and other machinery in construction), 1.A.3.e.ii (off-road vehicles and other machinery), and 1.A.4.c.ii (agriculture/forestry/fishing: off-road vehicles and other machinery). The section describes the activity data, emission factors, emissions, recalculations, planned improvements, and uncertainties for these categories.	FCCC/ARR/2022/ISL /E.18	Implemented.		Chapter 3
1.B.2.d Other (oil, natural gas and other emissions from energy production) – CO ₂ and CH ₄ (E.22, 2021) (E.19, 2019) (E.28, 2017) Transparency	Improve the description provided in the NIR of the methodology used to estimate the emissions from geothermal power plants, as this is a key category accounting for 11.1 per cent of the GHG emissions of the energy sector, by providing the necessary details in order to facilitate the replication and assessment of the inventory. Iceland included in the 2022 NIR more information related to the “Icelandic report on the emissions of geothermal power plants in Iceland in 1970–2009” on direct measurements used to estimate CO ₂ and CH ₄ emissions (see NIR section 3.4.2.3, p.77).	FCCC/ARR/2022/ISL /E.19	Implemented.		Chapter 3

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CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
1.A Fuel combustion – sectoral approach – diesel oil – CO ₂	Iceland reported in table 3.3 of its NIR (p.47) the emission factors used for calculations emissions from stationary combustion which shows that only for gas/diesel oil country specific NCVs were used from 2017, based on annual measurements. Furthermore, table 3.29 of its NIR (p.61), which shows the emission factors from mobile combustion reported under 1.A.2.g.vii (off-road vehicles and other machinery in construction), 1.A.3.eii (off-road vehicles and other machinery) and 1.A.4.cii (agriculture/forestry/fishing: off-road vehicles and other machinery), also indicates that only for diesel oil country specific NCVs were used from 2017, based on annual measurements. However, Iceland performed a country-specific measurement of carbon content for diesel oil in 2019, with a new measurement performed in 2020. The ERT noted that Iceland is only using the country-specific carbon content measurement value for category 1.A.3.b (road transportation) and does not apply this country-specific value to estimate CO₂ emissions from diesel oil in other categories such as in stationary combustion and categories 1.A.2.g.vii, 1.A.3.eii and 1.A.4.cii. During the review, Iceland clarified that this was an error, and that the country-specific carbon content should have been applied to 1.A.2.g.vii, 1.A.3.eii, and 1.A.4.cii. Iceland recalculated the emissions for these categories for 2017, 2018, 2019, and 2020 as they should have been reported, and despite the error, the Party noted that the total change in emissions does not meet the threshold of significance in any of these years and will thus be fixed in the next submission. In 2017 and 2018, 1.A.2.g.vii and 1.A.4.cii were reported as IE, and were included as part of 1.A.3.eii. The corrected emissions in 1.A.3.eii were 1.01 kt CO₂e and 1.04 kt CO₂e lower than the originally reported values for 2017 and 2018, respectively. In 2019, the corrected emissions were 0.64 kt CO₂e lower than the originally reported value, as totaled for all three referenced categories. In 2020, the corrected emissions were 0.17 kt CO₂e higher than the originally reported value, as totaled for all three referenced categories. The ERT noted that the change in emissions is below the significance threshold of around 2.35 kt CO₂eq and that Iceland has therefore not included the emissions in the inventory at this	FCCC/ARR/2022/ISL /E.20	Implemented.		Chapter 3

CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
	time. Apply the country-specific carbon content value for diesel oil to estimate CO ₂ emissions in stationary combustion categories and in 1.A.2.g.vii, 1.A.3.eii and 1.A.4.cii, which could allow Iceland to apply a tier 2/tier 3 approach.				
1.A.3 Transport – all fuels– CH ₄ , N ₂ O	Iceland reported in section 3.3.3 of its NIR (p.65) the use of COPERT 5.5.1. model to estimate the CH₄ and N₂O emissions from road transport and the country-specific activity data that was used for COPERT. The ERT noted that considerable inter-annual variations can be observed in the CH₄ and N₂O IEFs for gasoline and diesel oil during the 1990-2020 period. This is mainly observed for CH₄ EFs, that reduces along the time series. The ERT acknowledges that CH₄ and N₂O emissions depend on vehicle technology, fuel, and operating characteristics, which differ for each vehicle and noted that the range of the IEFs is in accordance with what is being used by other European countries using COPERT, however, the ERT notes that no justification is provided in the NIR for explaining the trends and the reasons for the inter-annual variation of CH₄ and N₂O IEFs for gasoline and diesel oil during the 1990-2020 period. During the review the Party clarified that all emission factors in the COPERT model are based on the 2019 EEA/EMEP guidebook, which shows increased Euro standards for pollution control in 2020 compared to conventional technologies in 1990, and which influence the emission trends significantly. Provide sufficient verification information for the activity data in the COPERT model in section 3.3.3 of its NIR (p.65), such as technological improvements, changes in the fleet, or regulatory changes, to justify and verify the inter-annual changes in CH₄ and N₂O emissions as per paragraph 41 of the UNFCCC Annex I reporting guidelines that states that “Annex I Parties that prepare their estimates of emissions and/or removals using higher-tier (tier 3) methods and/or models shall provide in the NIR verification information consistent with the 2006 IPCC Guidelines”. The ERT notes that once the Party further clarifies the COPERT model parameters and the activity data used in section 3.3.3 of its	FCCC/ARR/2022/ISL /E.21	Partially implemented.		Chapter 3

CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
	NIR to justify and verify the inter-annual diesel oil and gasoline EFs variations for CH ₄ , and N ₂ O issues on ID#s E.11, E.13, and E.14 in table 3 could be resolved.				

10.5.2 Industrial Processes and Products Use (CRT Sector 2)

For the 2026 submission, main change done for the IPPU sector was a tier upgrade in 2D3a Domestic Solvent Use along with the re-evaluation of custom categories used in the activity data for 2F1b Domestic Refrigeration, 2G4 Other: Tobacco and 2H2 Food and Beverages. Implemented recommendations from the latest UNFCCC review can be seen in the table below. For future submissions, it is planned to continue updating the 2F sector with ongoing efforts to obtain more information about pre-charged amounts, recovery efficiency, and add heat pumps. It has also been planned to improve the estimation of emissions from spirit production through actual production data from distilleries.

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Table 10.6. Status of implementation in the IPPU sector in response to UNFCCC's review process.

CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Imple- mentation	Reason for Non-Imple- mentation	Chapter/ Section in the NID
2. General (IPPU) – CO ₂ , HFCs, PFCs, SF ₆ and NF ₃ (I.1, 2021) (I.1, 2019) (I.1, 2017) (I.3, 2016) Transparency	Report in the CRF tables emission estimates or the relevant notation keys, as appropriate, for the subcategories glass production (2.A.3), ammonia production (2.B.1), adipic acid production (2.B.3), soda ash production (2.B.7) and electronic industry (2.E), and for foam blowing agents (2.F.2), fire protection (2.F.3), solvents (2.F.5) and other applications (2.F.6). Iceland reported in its CRF Table 2(I).A-Hs1 notation keys for the subcategories glass production (2.A.3), ammonia production (2.B.1), adipic acid production (2.B.3) and soda ash production (2.B.7). In CRF table 2(II) there were still blank cells for subcategories 2.E.1 to 2.E.4 (under electronic industry (2.E)) and for foam blowing agents (2.F.2), fire protection (2.F.3), solvents (2.F.5) and other applications (2.F.6). During the review, the Party acknowledged the existence of these blank cells and clarified that notation keys in CRF table 2(II) were not uploaded due to a technical problem with CRF Reporter.	FCCC/ARR/20 22/ISL/I.1	Clarified during review.		Chapter 4
2.C.2 Ferroalloys production – CO ₂ (I.9, 2021) Convention reporting adherence	Correct the NIR table 4.4 (p.78) to reflect the correct emission as reported in CRF table 2(I)A-H (sheet 2). Iceland corrected the NIR table 4.4 (p.89) to reflect the correct emissions as reported in CRF table 2(I).A-Hs2 for selected years of the time series. For example, for 2020, emissions in the CRF table for ferroalloys production was 415.30 kt of CO ₂ and 0.12 kt for CH ₄ totalizing 418.35 kt CO ₂ eq. Emission reported in the NIR in table 4.4 is 418 kt CO ₂ eq and these number are consistent.	FCCC/ARR/20 22/ISL/I.2	Implemented.		Chapter 4
2.D.2 Paraffin wax use – CO ₂ (I.10, 2021) Transparency	Include in the NIR more detailed information on the methodology and assumptions used to estimate emissions from paraffin wax, as explained during the review. Iceland included in the NIR section 4.5.2 (p.96) the required information i.e. that paraffin wax consumption is calculated from the AD in tones multiplied by the NCV value of 40,2 TJ/k and that since the AD is twofold, it calculates the emissions considering both from candles and other paraffin as follow: (a) emissions from paraffin from candles based on net consumption of candles; (b) emissions from paraffin (without candles) based on net consumption of paraffin (without candles). To be able to add the two, the net consumption of candles is multiplied by the factor 0.66 since not all of the candle activity data is made of paraffin	FCCC/ARR/20 22/ISL/I.3	Implemented.		Chapter 4.5.2

10.5.3 Agriculture (CRT Sector 3)

For the 2026 submission the calculations were updated to the 2019 IPCC Refinements in most cases where an update is provided. The 2019 IPCC Refinements are now applied for most of the 3A, 3B and 3D subsectors.

The cattle categories behind the category Growing Cattle were changed to increase the transparency of calculations.

New data was obtained from the Icelandic Agricultural Advisory Centre (IAAC) on cattle and sheep livestock characterisation, manure management and use of straw in housing with solid storage. The IAAC also updated the methodology to estimate feed digestibility and provided updated input data related to feed digestibility.

Updated livestock characterisation was also obtained for goats and horses.

Updated information was obtained on the types of inorganic fertilisers imported to Iceland and on the amount of fertiliser-use in forestry.

Emissions from crop residues from the cultivation of brassicas were added to the inventory.

Regarding planned improvements for future submissions, country-specific emission factors are being developed at the Agricultural University of Iceland for methane emissions from enteric fermentation in dairy cows. When available, they will be incorporated into the inventory.

Research has been launched with the aim to establish country specific methane production capacity (B0) and methane conversion factors (MCFs) from slurry and pit storage in cattle and sheep farming. Results, expected in 2027, will be incorporated in the 2028 submission.

Preliminary steps will be undertaken to define a country specific $Frac_{LeachMS}$ based on a 2021 UNFCCC review recommendation.

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Table 10.7. Status of implementation in the Agriculture sector in response to UNFCCC's review process.

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
3. General (agriculture) – CH ₄ and N ₂ O (A.3, 2021) (A.3, 2019) (A.9, 2017) Accuracy	Update productivity data, in particular the weight categories for cattle, poultry productivity (live weight and living age) and swine productivity (piglets per sow) and include in the improvement plan activities to update the productivity data at regular intervals. Iceland updated since the previous review animal characterization data for mature dairy cattle for 2018-2020, for lambs for the years 2003-2020, and for mature ewes in 2018-2020. The weights for mature dairy cattle and lambs were also updated since the last review and are increasing over time. NIR tables 5.9 and 5.10 (pp. 135 and 137) show the characterisation of cattle and sheep. During the review the Party explained that another update of this data is planned for the 2023 Submission. The Party also explained that weights of other animal categories are stable for the whole period. Regarding poultry, the Party explained during the review that living age is used to estimate annual average populations from production data. The living age was mostly constant over time but it was updated in 2021 with new information from an expert. The living age were updated and changed slightly from 2018-2020. The live weights of poultry are constant over time. Based on the expert information, the categorization of poultry was updated in the 2022 Submission (see NIR sections 5.2.1, pp.132-133 and 5.2.4.1, p.143). For sows, the productivity (piglets per sow) is not presented in the NIR but, according to the Party, it was also updated in 2021 submission with new information from an expert. The age of slaughter for pigs changes over time (5.4-7.1 months) given in table 5.5 on p.133. The Party included in its improvement plan that it will update animal characterization parameters regularly for all livestock categories (p. 143). Upon an additional question, Iceland responded that the average lifetime of piglets was 215 days in the year 1990, then 180 days from 1991-1994. The lifetime of piglets has stayed the same, 165 days, since 1995. This has been confirmed by experts in 2005, 2012 and 2020. The number of piglets per sow has increased from 15 on average in 1990 to 26.5 on average in 2020. The number of piglets per sow was most recently changed from 25 to 26.5 on average in 2020. These numbers are received from expert farmers who have many years of experience in this field. Also, a spreadsheet with the productivity data for piglets was presented to the ERT for transparency for the years 1990-2020 in 5 year intervals. The ERT considers that the recommendation has not been fully addressed because sows data was not presented in the NIR, however, during the review, the Party submitted it to the ERT	FCCC/ARR/2022/ISL/A.1	Implemented. Information on animal population data has been expanded in the NIR to include separate descriptions and tables for all animals with a lifespan shorter than one year, including lambs, piglets, kids, foals and poultry.		Chapter 5.3.1.1
3. General (agriculture) – (A.28, 2021) Transparency	Clarify in the NIR how the population for horses is estimated by adding some explanations on the methodology applied for the inclusion of foals. Iceland did not include in the NIR explanation to clarify the reasons for the difference in the population of horses between NIR table 5.8 (p. 135) (e.g. 71,747 for 2020) and the CRF tables	FCCC/ARR/2022/ISL/A.2	Implemented. Explanations of horse population numbers have been improved in chapter 5.3.1		Chapter 5.3.1 and Chapter 5.3.1.1

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CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	3.As1 and 3.B(a)s1 (e.g 73,583 for 2020). During the review, the Party clarified that the horse population numbers in NIR table 5.8 only include mature horses (e.g. the number reported as the population number for 2020), not the total population including foals. The population numbers reported in CRF tables 3.As.1, 3.B(a)s1, 3.B(b), are the total number of horses (mature horses and foals). The ERT considers that a footnote to NIR table 5.8 could resolve this issue.		and a footnote has been added to Table 5.8. Furthermore, a detailed explanation on the calculation of of the foal population has been added to chapter 5.3.1.1.		
3. General (agriculture) – (A.29, 2021) Transparency	Present in the NIR additional explanations on the calculations implemented to estimate the population of young animals by indicating for each species the productivity (number of births per year), the rate of pregnancy and the early mortality considered. Iceland provided additional explanation on the calculations implemented to estimate the population of young animals by the addition of table 5.6 (p.133) in the NIR. However, the data in the table does not transparently described how calculations to estimate the population of young animals were implemented. It was also not clear how productivity (number of births per year), rate of pregnancy and early mortality is considered.	FCCC/ARR/2022/ISL/A.3	Implemented. Explanations of the calculations to estimate the population of young animals have been expanded in chapter 5.3.1.1.		Chapter 5.3.1.1
3.A.1 Cattle – CH ₄ (A.8, 2021) (A.30, 2019) Accuracy	Justify the appropriateness of the current parameters and/or update the input parameters and consequently the CH ₄ EF for future submissions, as planned. Iceland did not provide a justification of the parameters nor updated the input parameters. During the review, the Party indicated that there were no updates available regarding the livestock parametrization of other mature cattle. These parameters will be updated when such data will become available. The Party further explained that the Agricultural Advisory Centre is currently collaborating with the Environment Agency to update the parameters for future submissions.	FCCC/ARR/2022/ISL/A.4	Implemented. Parameters for cattle were updated for the 2023 and 2026 submissions.		Chapters 5.3.2 and 5.3.3
3.A.1 Cattle – CH ₄ (A.11, 2021) (A.33, 2019) Transparency	Revise the explanation of CH ₄ estimates for mature dairy cattle in the NIR by indicating the use of the Cfi value from the 2006 IPCC Guidelines and ensure that the approach is used consistently across the time series. Iceland revised the explanation of CH ₄ estimates for mature dairy cattle and indicated in the NIR table 5.11 (p. 138) the current Cfi value used in the calculations (0.3755) in accordance with the 2006 IPCC Guidelines. The CH ₄ IEF is between the default IPCC Range (90-128 kg CH ₄ /head/year) for the entire time series.	FCCC/ARR/2022/ISL/A.5	Implemented. The Cfi value is included in Table 5.14.		Chapter 5.3.2
3.D Direct and indirect N ₂ O emissions from agricultural soils – N ₂ O (A.30, 2021) Convention reporting adherence	Correct the reported value for FracGASM for the entire time series (e.g. for 2019 from 0.158 to 0.132 by adding NH ₃ and NO _x from other organic fertilizers, animal manure applied to soils and urine and dung deposited from grazing animals). Iceland corrected the value for FracGASM, for the entire time series, by adding NH ₃ and NO _x from other organic fertilizers, animal manure applied to soils and urine and dung deposited from grazing animals (see NIR section 5.8.5.1, p.172).	FCCC/ARR/2022/ISL/A.6	Implemented.		Chapter 5.8.5 in the 2022 submission.

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CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
3.D.b.1 Atmospheric deposition – N ₂ O (A.24, 2021) (A.23 2019) (A.24, 2017) Accuracy	Make a thorough examination of N flow to estimate emissions from N volatilized from atmospheric deposition reported in CRF table 3.D and consider including in the NIR a table with the overall mass balance of N, including information on N volatilized as NOX, nitric oxide and N₂O. Iceland provided Figure 5.3 (p. 155) with the complete N flow applied to the categories 3B Manure Management and 3D Agricultural soils for the year 2020 (mass balance including information on N volatilised as NOX, nitric oxide and N₂O). Regarding N volatilization from atmospheric deposition (category 3.D.b.1), the Party included the overall N volatilised, that included synthetic and other types of organic fertilizers.	FCCC/ARR/2 022/ISL/A.7	Implemented. The Nitrogen fluxes are demonstrated in Figure 5.4.		Chapter 5.5.2
3.F Field burning of agricultural residues – CH ₄ and N ₂ O (A.25, 2021) (A.24, 2019) (A.7, 2017) (A.5, 2016) (A.5, 2015) (54, 2014) Transparency	Include in the NIR additional information on the non-occurrence of the field burning of agricultural crop residues. Iceland reported in its CRF table 3.F that field burning from agricultural residues does not occur and used the notation key "NO". But, the text in the NIR (pp.173-174) does not provide any justification in this regard. Based on the information provided in the text (p.173-4) and the table 5.43 (p.174), it seemed that field burning of agricultural residues occurred in the country. During the review, the Party clarified in detail that hay is too valuable for bedding & feeding to be burned in Iceland and it searched from a variety of sources information on field burning which led to the conclusion that field burning of agricultural residues does not occur in Iceland. The Party explained in detail that field burning was banned with strict laws in 1992 (Act No 61/1992 – Law about the burning of straws and use of fire in open areas). Later laws almost closed the possibility to gain a permit, i.e. Act No 40/2015 (Law about the treatment of fire and fire prevention) and Regulation No 325/2016 about the treatment of fire and fire prevention. The ERT considers that the recommendation has not been fully addressed because the Party has not included the detailed information regarding the non-occurrence of field burning.	FCCC/ARR/2 022/ISL/A.8	Implemented. Detailed information on the non-occurrence has been included in the NIR.		Chapter 5.9
3.G Liming – CO ₂ (A.26, 2021) (A.39, 2019) Consistency	Implement the planned checks of the AD for the category and update them as planned and report CO₂ emissions from liming following the UNFCCC Annex I inventory reporting guidelines in future submissions, ensuring consistent reporting of the emissions across the entire time series under category 3.G. If the change is not made in the next submission, justify this in the NIR and include explanation of the allocation in CRF table 9. Iceland reported in CRF table 3.G-I, complete time series since 1990 for limestone thanks to an update in data collection from Statistics Iceland. Data for dolomite is however not available before 2002 and reported in the CRF tables as NE. During the review Iceland indicated that they contacted experts of the Agricultural University of Iceland and they clarified that dolomite has not been used in agriculture at that time, that is from 1990–2002. Just when one company started to import dolomite its use became more widespread. So, for	FCCC/ARR/2 022/ISL/A.9	Implemented. The notation key has been corrected.		Chapter 5.10

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CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	dolomite the appropriate notation key for the period 1990–2002 is “NO” instead of NE. The trend of recent years, the low value of dolomites used for known years and the expert judgement presented by Iceland can justify the use of NO in this category for the period 1990–2002. The ERT considers that the recommendation has not yet been fully addressed because the Party has not yet corrected the notation key from NE to NO for dolomite for 1990–2002 in CRF table 3.G-I.				
3.I Other carbon-containing fertilizers – CO ₂ (A.27, 2021) (A.40, 2019) Consistency	Report CO ₂ emissions from other carbon-containing fertilizers consistently across the time series under category 3.I. If the change is not made in the next submission, justify this in the NIR and include explanation of the allocation in CRF table 9. Iceland reported in its CRF table 3.G-I, AD for other carbon-containing fertilisers since 2003. For 1990–2002 the notation key not occurring “NO” is reported. The Party reported in its NIR (p.176) that based on expert judgement from specialists at the Agricultural University and the Icelandic Agricultural Advisory Centre received in 2021, there was no- or very little shell sand used during these years. Therefore, it is now estimated as not occurring for the period 1990–2002. The ERT considers that the expert judgement presented by Iceland can justify the use of NO in this category for the period 1990–2002.	FCCC/ARR/2022/ISL/A.10	Implemented.		Chapter 5.10
3.D.a.6 Cultivation of organic soils (i.e. histosols) – N ₂ O	Iceland reported the area of cultivated organic soils (i.e. histosols) in CRF table 3.D. as 323,583.75 ha in 2020. The ERT noted that the sum of the areas of organic soils under cropland in CRF table 4.B (64,750.69 ha) and areas of organic soils under grassland in CRF table 4.C (283,093.49 ha), totalizing 347,844.18 ha, is 7.5 % more than those reported in CRF table 3.D. During the review, the Party clarified that in CRF table 3.D it is not included area of organic soils related to natural birch shrubland (recently expanded into other grassland) and natural birch shrubland (old) because these areas are neither considered as cultivated/managed cropland nor as cultivated/managed grassland. Indicate in the NIR the difference in the areas reported for cultivated organic soils under category 3.D.a.6 and the sum of the areas of organic soils under cropland and grassland in CRF table 4.B and 4.C and explain that the reasons for the difference in the area reported is because area of natural birch (old and recently expanded) are not considered in the agriculture sector as these areas are neither considered as cultivated/managed cropland nor as cultivated/managed grassland.	FCCC/ARR/2022/ISL/A.11	Implemented at the time but not relevant anymore since N ₂ O emissions from Natural birch shrubland (recently expanded into grassland) and Natural birch shrubland (old) are now accounted for under CRT category 3.D.1.f.		

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
3.G Liming – CO ₂	Iceland reported “NE” for AD and CO ₂ emissions for category 3.G.2 (dolomite) in the CRF Table 3.G-I for 1990-2002. During the review, The Party clarified that it is an error and that the correct notation key should be NO. The Party also explained that for the 2021 submission it was confirmed by experts from the Agricultural University of Iceland and from the Agricultural Advisory Centre that no dolomite use was occurring in Iceland over those years. Correct the notation key from NE to NO for category 3.G.2 (dolomite) in CRF table 3.G-I for 1990-2002.	FCCC/ARR/2022/ISL/A.12	Implemented. The notation key has been corrected.		Chapter 5.10

10.5.4 LULUCF (CRT Sector 4)

10.5.4.1 Forest Land (4A)

Data from NFI are used to estimate main sources of carbon stock changes in the cultivated forest where changes in carbon stock are most rapid.

Sampling of soil, litter, and vegetation other than trees, is included as part of NFI and higher tier estimates of changes in the carbon stock in soil, dead organic matter, and other vegetation than trees are expected in future reporting when data from re-measurement of the permanent sample plot will be available and analysed for C-content.

Gradually improved estimates of carbon stock and carbon stock changes can thus be expected regarding forest and forestry in Iceland.

10.5.4.2 Cropland (4B)

Cropland Remaining Cropland:

In 2024, a project was launched focusing on the "Cropland Remaining Cropland" category. Soil samples, both mineral and organic, were collected during the summers of 2024 and 2025. The project is expected to conclude in early 2026, at which point we will have sufficient data to advance this category to Tier 2.

It is planned to process the geographically explicit IGLUD map data further to extract or estimate more accurately land transition data for cropland. Conversion of Grassland on organic soils to Cropland is a key flow that is currently missing in the LULUCF model but the aim is to add it before the 2027 submission.

A geographical analysis is planned to estimate areas where organic soils are located with much more detail than has previously been done. The analysis would take into account drainage ditches density, coupled with data on landscape conditions, inclination and connection to water bodies.

When country-specific emissions factors become available, it is planned to subdivide the 4C1 Cropland subcategory into lands that are mowed and lands that are ploughed. The division would be to account for higher soil emissions from tillage than from mowing.

Land Converted to Cropland:

This category is currently under revision, with the initial improvements included in this submission. The work is expected to be completed by the 2027 submission. The project initiated for mineral and organic soils under Cropland remaining Cropland, as described above, also covers mineral and organic soils within this category.

10.5.4.3 Grassland (5C)

Grassland Remaining Grassland:

The total emissions related to drained Grassland soils are a principal component in the net emissions reported for the land-use category. The estimation of this component is still based on T1 methodology and basically no disaggregation of the drainage area (Table 6-32). In 2023, Land and Forest Iceland initiated a project to systematically collect soil samples and perform in situ measurements of greenhouse gas fluxes from drained organic soils using portable flux chambers and analysers. The objective is to enhance emissions and removals estimates by upgrading the methodology to higher Tiers for this carbon pool. Preliminary data are being assessed and will be incorporated into the national inventory submission.

New map of ditches was released in 2025 and provide new estimates of changes in ditch network. Mapping of ditches is ongoing, now with emphasis on improving the timeseries. This work is ongoing.

The largest subcategory of Grassland, Other Grassland, is reported as two units: Grazing Areas and Grassland Without Grazing. The importance of the mineral soils pools must be emphasised since Icelandic mineral grassland soils are almost always andosols with a high carbon content capacity (Arnalds, Óskarsson, Gísladóttir, & Grétarsson, 2009; Arnalds & Óskarsson, 2009). Subdivision of those categories according to vegetation coverage and soil erosion was done for the first time in response to the 2025 TERT review. However, improvement on this subdivision is ongoing in relation to new data on ecosystem conditions and soil erosion.

In 2023, Land and Forest Iceland initiated a project to systematically collect soil samples and perform in situ measurements of greenhouse gas fluxes from Grassland remaining Grassland on mineral soils using portable flux chambers and analysers. The objective is to enhance emissions and removals estimates by upgrading the methodology to higher Tiers for this carbon pool. Preliminary data are being assessed and will be incorporated into the national inventory submission.

Land Converted to Grassland:

The planned improvements described above for drained areas of Grassland Remaining Grassland also applies for the drained area of Land Converted to Grassland.

Maps of Cropland in use have been improved, along with reformation of agricultural support payments. These improvements enable better tracking of abandoned Cropland, such as Cropland Converted to Grassland or other categories.

Improvements in sequestration rate estimates and recordings for other revegetation areas are aimed at establishing a transparent, verifiable inventory of carbon stock changes. The corresponding emissions and removal factors, based on the ongoing national inventory on

revegetation area (NIRA) update, have been delayed and are now expected to be partially included in the 2026 submission and presented in final form in the 2027 submission. When implemented, these improvements will provide more accurate area and removal factor estimates for revegetation, subdivided according to management regime, regions, and age.

10.5.4.4 Wetlands (4D)

Wetlands Remaining Wetlands:

In 2023, Land and Forest Iceland initiated a project to systematically collect soil samples and perform in situ measurements of greenhouse gas fluxes from _Rewetted wetland soils, intact mires and drained organic soils (see section 6.5.8), using portable flux chambers and analysers. The objective is to enhance emissions and removals estimates by upgrading the methodology to higher Tiers for this carbon pool. Preliminary data are being assessed and will be incorporated into the national inventory submission.

10.5.4.5 Settlements (4E)

There are no category-specific planned improvements for this category.

10.5.4.6 Other Land (4F)

No emissions are reported under this category.

10.5.4.7 Harvested Wood Products (4G)

There are no category-specific planned improvements for this category.

10.5.4.8 Other (4H)

There are no category-specific planned improvements for this category.

10.5.4.9 Direct and indirect N₂O Emissions from N Inputs to Managed Soils (4(I))

There are no category-specific planned improvements for this category.

10.5.4.10 Emissions and Removals from Drainage and Rewetting and Other Management of Organic and Mineral Soils (4(II))

There are no category-specific planned improvements for this category.

10.5.4.11 Direct N₂O Emissions from N Mineralisation and Immobilisation (4(III))

There are no category-specific planned improvements for this category.

10.5.4.12 Biomass Burning (4(IV))

Recording of the area where controlled biomass burning is licensed is still not practiced. General awareness on the risk of controlled burning getting out of hand is presently rising and concerns are frequently expressed by municipal fire departments regarding this matter. Prohibition or stricter licenses on controlled burning can be expected in near future. This development might involve better recordkeeping on biomass burning.

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Table 10.8 Status of implementation in the LULUCF and KP LULUCF sectors in response to UNFCCC's review process.

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
4. General (LULUCF) – (L.1, 2021) (L.1, 2019) (L.1, 2017) (L.2, 2016) (L.2, 2015) (67, 2014) Transparency	Enhance the transparency of the information in the NIR on the uncertainty analysis. Iceland reported in its NIR the additional information about uncertainty assessment related to forest land (pp.200, 205 and 243), and land converted to cropland (p. 212).	FCCC/ARR/ 2022/ISL/L. 1	Resolved in 2025. Detailed information on the uncertainty assessment reported in Annex 6 of the 2025 NID		Chapter 6/Annex 6 (NID 2026)
4. General (LULUCF) – CO ₂ , CH ₄ and N ₂ O (L.2, 2021) (L.2, 2019) (L.14, 2017) Convention reporting adherence	Conduct an uncertainty assessment of all carbon pools and gases in the LULUCF sector in accordance with decision 24/CP.19, annex I, paragraph 15. Iceland reported in its NIR information about the uncertainty assessment related to forest land (pp. 200, 205, 243) and for all carbon pools and gases (p. 243).	FCCC/ARR/ 2022/ISL/L. 2	Resolved in 2025. Detailed information on the uncertainty assessment reported in Annex 6 of the 2025 NID		Chapter 6/Annex 6 (NID 2026)
4. General (LULUCF) – (L.4, 2021) (L.30, 2019) Convention reporting adherence	Improve the QA/QC plan to avoid discrepancies in cross references between NIR sections and to ensure that section numbering is correct. Iceland improved cross references between the NIR sections. However, the ERT noted that there are still some discrepancies. During the review, the Party clarified that cross references are being checked by the NIR coordinator upon completion of the report. This is to be included in the QA/QC plan that should be ready for the 2023 Submission.	FCCC/ARR/ 2022/ISL/L. 3	Resolved in 2022 submission		Chapter 1.5 (NID 2026)
4. General (LULUCF) – (L.5, 2021) (L.31, 2019) Transparency	Provide transparent information in the NIR section discussing the land transition matrix on the use of the notation key "IE" where areas have been accounted for elsewhere. Iceland did not provide information in the NIR explaining about the land transition matrix and the use of the notation key "IE". The ERT noted that the Party reported IE for some land uses in CRF table 4.1 (cropland and wetlands (managed) converted to settlements, other land converted to cropland, other land converted to settlements). During the review, the Party clarified that the information regarding the use of the notation key "IE" was added in the documentation box in CRF Table 4.1, and that the Party will improve the transparency	FCCC/ARR/ 2022/ISL/L. 4	Resolved in 2024 Submission. Information regarding the use of the notation key "IE" are reported in Cell comments – official comment and NID 2024 under chapter 6.4.		Chapters 6.4.4.2 and 6.7.4.2 (NID 2026)

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	regarding the use of the notation key "IE" where areas have been accounted for elsewhere in the 2023 Submission.				
Land representation – (L.6, 2021) (L.4, 2019) (L.2, 2017) (L.3, 2016) (L.3, 2015) (68, 2014) Transparency	Select the required information and organize it in a manner that enables the reader to clearly understand the data sources and their quality and the methodology used to derive the land representation. Iceland added the section 6.1.1 (p.181) to the NIR with description of the data sources, their quality and the methodology used to derive the land representation. However, the Party has not reorganized the information of land representation. The ERT considers that Iceland could improve the transparency of its reporting by providing the following information on land representation in an appropriate format (such as tabular) for each category: (1) the data sources; (2) the time series of raw data; (3) the methodology applied for filling in gaps in the raw data, if any; (4) the methodology applied, including assumptions and inferences, to derive the land category areas from the raw data; (5) the methodology applied for filling in gaps in the time series of areas, if any; (6) the transition time of the land category (for land in conversion categories); and (7) any other relevant information. During the review, the Party clarified that the organization of information in an appropriate format will be considered in future submissions.	FCCC/ARR/2022/ISL/L.5	Resolved in 2025 submission. The Party has improved transparency. Please check section 6.2 "Land-use Definition and Classification System Used" in NID 2025.		Chapter 6.2 (NID 2026)
Land representation – (L.7, 2021) (L.5, 2019) (L.16, 2017) Accuracy	Improve the land representation data used to report LULUCF emissions and removals under the Convention by reconciling all data on areas contained in databases and land-use maps, as well as data collected from observations, including an estimation of uncertainties related to AD once land matrices are improved and updated. Iceland improved some inconsistencies of land areas detected between the land transition matrix (CRF table 4.1) and the corresponding CRF tables on carbon stocks (4.A, 4.B, 4.C and 4.E). The ERT observed that for CRF tables 4.D and 4.F the inconsistencies have remained. The ERT considers that the information provided by Iceland in sections 6.3 (p.192) and 11.2.2 (p.355) of the NIR has not been improved according to the previous recommendations. During the review, the Party clarified that very small inconsistencies between final areas in CRF table 4.1 and the corresponding total areas in CRF tables on carbon stocks for 4.C (Grassland) and 4.F (Other Land) still occur in the NIR. In the case of "Grassland" the inconsistency is only for the year 2007 where the final area in table 4.1 is 0.50 kha larger than the total area in CRF Table 4.C for the same year. In the case of "Other Land" inconsistencies are from the year 1991 to 2020 within a range from a maximum value of 0.03 kha (final area in Table 4.1 larger than CRF Table 4.F) to a minimal value of -0.80 kha (final area in Table 4.1 smaller than CRF Table 4.F). This can also be found in section 6.3 (p. 192). The party informed that it is working to improve the transparency of the land representation in future annual submissions.	FCCC/ARR/2022/ISL/L.6	Resolved. Annual land use transition matrices were introduced in the 2025 submission to build the time series and track annual changes between land use subcategories. These matrices ensure no discrepancies in CRT Table 4.1 as the final land-use areas for a given year align with the initial areas of the following year. See chapter 6.2.3 of the NID		Chapter 6.2.5 (NID 2026)

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CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
Land representation – CO ₂ (L.8, 2021) (L.25, 2019) Transparency	Improve the transparency of the AD reporting by providing information on the uncertainties related to habitat type classification, especially in relation to separating wetlands from grassland and other land. Iceland did not provide uncertainties related to habitat type. The ERT noted that the Party indicated in its NIR (p.185) increasing areas of grassland corresponding to areas of other land previously considered unmanaged, where instead grazing activities occur. The ERT noted that habitat type map is updated regularly, and the last update was in 2020. During the review, the Party clarified that it is working to improve this issue in future annual submissions.	FCCC/ARR/ 2022/ISL/L. 7	Resolved. The overall uncertainty assessment for LULUCF was significantly improved in the 2025 submission. All uncertainty rates were reviewed and updated where applicable. Additionally, the uncertainty rates associated with habitat type classification were evaluated based on the work of Gísladóttir, F. Ó., Brink, S. H., and Arnalds, Ó. (2014). For more information, please refer to Annex 6 (Table A6.8).		Annex VI (NID 2026)
4.A Forest land – CO ₂ (L.10, 2021) (L.7, 2019) (L.3, 2017) (L.4, 2016) (L.4, 2015) (69, 2014) Transparency	Provide an additional description of the processes by which CSC and associated emissions and removals are estimated, including tables with raw data and intermediate outputs stratified by year and forest type. Iceland added in its NIR new tables showing areas, CSC per area unit (ha) and total CSC of biomass, litter and soil separately (see table 6.8 and 6.10, pp. 200 and 205). Additionally, graphs showing change in age of CSC or carbon stocks in the two main forest categories, cultivated forest and natural birch forest and the area of age classes were added (see figure 6.7 and 6.8, pp. 197 and 203).	FCCC/ARR/ 2022/ISL/L. 8	Resolved in 2022 submission		Chapter 6.3 (NID 2026)
4.A Forest land – CO ₂ (L.11, 2021) (L.8, 2019) (L.17, 2017) Completeness	Improve the estimates of CSC under forest land, particularly by including estimates for the deadwood and litter carbon pools or provide an explanation in the NIR and in CRF table 9 of why these pools could not be estimated. Iceland reported net CSC of litter as notation key "NA" in CRF table 4.A including an explanation in its NIR (p. 173) about the use of tier 1 and the ERT considered CSC for litter. During the review, the Party clarified that in cultivated forest CSC in deadwood, measured as lying deadwood on NFI plots, is reported in Grassland converted to Forest land. Dead wood CSC in other categories of cultivated forest is included in this estimate and reported as IE. For natural birch forest "The Stock-Difference Method" as described in Chapter 2.3.1.1. with Equation 2.8 in AFOLU (IPCC, 2006) was used to measure changes in carbon pools. Deadwood, meeting the definition of lying deadwood (minimum diameter 10 cm and minimum length 1 m) was not found on NFI plots in both the first (2005-2011) and the second (2015-2021) inventory. CSC in the Dead wood pool of natural birch woodland is	FCCC/ARR/ 2022/ISL/L. 9	Resolved in 2022 and 2023 submission		Chapter 6.3 (NID 2026)

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	therefore considered not occurring. The Party also clarifies that this information will be added to the NIR in future annual submissions together with information on IE in CRF table 9 and NO in natural birch forest categories.				
4.A Forest land – CO ₂ (L.12, 2021) (L.33, 2019) Convention reporting adherence	Provide transparent information in CRF table 9 for reporting “IE” where GHG emissions have been accounted for elsewhere and correct the notation key from “NE” to “NA” for litter carbon stock in the forest land remaining forest land categories. Iceland has corrected the notation key from “NE” to “NA” for litter carbon stock in the forest land remaining forest land category. The ERT noted that the Party has not provided transparent information in CRF table 9 and documentation box in CRF table 4.A about the use of the notation key “IE” for CSC in deadwood for forest land remaining forest land (category 4.A.1) and for other land converted to forest land (category 4.A.2.5). During the review, the Party clarified that the main source of deadwood is cutting activities and harvest activities that cannot be separated between forest land remaining forest land and land converted to forest land. The Party informed that for this reason, all CSC in deadwood is included in grassland converted to forest land. The Party clarified that the issue related to CRF table 9 would be provided in future annual submissions.	FCCC/ARR/2022/ISL/L.10	Resolved in 2022 and 2023 submission		Chapter 6.3 (NID 2026)
4.A.2 Land converted to forest land – CO ₂ (L.13, 2021) (L.10, 2019) (L.18, 2017) Transparency	Include transparent information in the NIR on carbon stock for the land-use categories occurring in Iceland. Iceland has added new tables showing area, CSC per area unit (ha) and total CSC of biomass, litter and soil separately (see NIR table 6.8 and 6.10, pp. 200 and 205).	FCCC/ARR/2022/ISL/L.11	Resolved in 2022 submission		Chapter 6.3 (NID 2026)
4.A.2 Land converted to forest land – CO ₂ (L.14, 2021) (L.11, 2019) (L.18, 2017) Accuracy	Implement the calculation methods in line with equations 2.15 and 2.16 of volume 4 of the 2006 IPCC Guidelines with instant oxidation of all amounts of living biomass and litter when making land-use conversions, unless Iceland can document that the carbon stock before land-use conversion is maintained in the land converted. The ERT noted that there is no additional information about the calculation methods in line with equations 2.15 and 2.16 of volume 4 of the 2006 IPCC Guidelines in section land converted to forest land in the NIR or documentation to prove that the carbon stock before land-use conversion is maintained in the land converted.	FCCC/ARR/2022/ISL/L.12	Resolved in 2022 submission		Chapter 6.3 (NID 2026)

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
4.B.1 Cropland remaining cropland – CO ₂ (L.15, 2021) (L.34, 2019) Transparency	Provide information to justify the high EF for mineral soils in the next annual submission. Iceland provided more information in its NIR (section, 6.6.1.2, p. 208) for justifying the high EF for mineral soils. The Party also corrected the annual change of SOC for mineral soil of Cropland remaining Cropland from 0.1708 to 0.1525 tC/ha/year, after reviewing the original study on effects of different N fertilizers on soil properties	FCCC/ARR/ 2022/ISL/L. 13	Resolved in 2022 submission		Chapter 6.4.3.2 (NID 2026)
4.B.1 Cropland remaining cropland – CO ₂ (L.35, 2021) Accuracy	Apply the correct CSC for mineral soils for active cropland (0.1525 tC/ha/year) and revise the CSC for mineral soils for inactive cropland, because cropland inactive is not under cultivation and the content of carbon in mineral soils should be different from cropland active. Iceland explained during the review that the EF factor for CSC in mineral soils was estimated for the first time in 2018 submission. It is only based on one study (Helgason B., 1975) and consequently the current data on Cropland is severely limited. Therefore, it was decided to use the same EF for CSC in mineral soils both for cropland active and for cropland inactive. The ERT noted that the Party reported in its NIR (p. 208) an explanation as to why it used the same value of SOC and so CSC for active and inactive cropland. The Party clarified that will consider this issue in future submissions.	FCCC/ARR/ 2022/ISL/L. 14	Resolved. Iceland used the CS EF to estimate changes in carbon in mineral soils (Chapter 6.4.3.2). The areas of inactive cropland LU were redefined as a Grassland subcategory. Hence, Iceland considers the issue raised under Cropland Remaining Cropland might be assessed Resolved.		Chapter 6.4.3.2 (NID 2026)
4.B.2 Land converted to cropland – (L.16, 2021) (L.13, 2019) (L.7, 2017) (L.11, 2016) (L.11, 2015) Accuracy	Estimate the area of forest land and other land that was converted to cropland before 1990 and report these values under the appropriate categories. Iceland has not reported new information in its NIR about the estimation of the area of forest land and other land that was converted to cropland before 1990. With regard to notation key "IE" for other land converted to cropland, the Party has included an explanation in the CRF table 9. During the review, the Party clarified that an analysis of the conversion of forest land to cropland in the period 1970 – 1989 has not been done but is planned to be conducted in coming years.	FCCC/ARR/ 2022/ISL/L. 15	Resolved. Annual land-use transition matrices were introduced in the 2025 submission to build the time series and track annual changes between land-use subcategories. As part of the development of these transition matrices, Iceland conducted extensive research on the data and assumptions applied to report transitions between land-use categories. According to thoroughly reviewed data, Iceland reports that the conversion of forest land to cropland occurred in 2015, with no conversions		Chapter 6.2.5 (NID 2026)

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
			taking place before 1990. For other land-use categories converted to cropland, the data were also thoroughly reviewed and updated where necessary and applicable. The updated data were used to conduct the estimates. Moreover, Iceland may provide historical annual land-use transition matrices upon request. Therefore, Iceland considers the issue (recommendation) to be fully resolved.		
4.B.2.2 Grassland converted to cropland – CO ₂ (L.18, 2021) (L.14, 2019) (L.8, 2017) (L.6, 2016) (L.6, 2015) (71, 2014) Accuracy	Ensure the equivalence of climatic, historical and edaphic conditions when analysing pairs of samples (i.e. in cropland and grassland) to determine the dynamic of the soil carbon stocks associated with conversion among the two land uses. Iceland has not made improvements to ensure the equivalence of climatic, historical and edaphic conditions when analysing pairs of samples (i.e. in cropland and grassland) to determine the dynamic of the soil carbon stocks associated with conversion among the two land uses. During the review, the Party explained that it is planning to improve this issue in future submissions.	FCCC/ARR/ 2022/ISL/L. 16	Resolved. Iceland would like to recall the initial recommendation given in 2017: 71. The ERT noted that Iceland reports a net source from the conversion of grassland to cropland. In response to a question raised by the ERT during the review regarding the unusual emission/removal trend, the Party explained that the trend is calculated on the basis of preliminary results from the Iceland Geographical Land Use Database (IGLUD) sampling of mineral soils in grassland and cropland. Noting that cropland is usually cultivated on better soils and that the grassland category also covers		Chapter 6.4.4.2 (NID 2026)

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
			degraded areas, including those that are revegetated, the ERT recommends that the Party ensure the equivalence of climatic, historical and edaphic conditions when analysing pairs of samples (i.e. in cropland and grassland), to determine the dynamic of the soil carbon stocks associated with conversion among the two land uses. Hence, Iceland would like to emphasize that the recommendation was made based on the unusual emission/removal trend, which was constructed using preliminary data. Since the 2017 submission, Iceland has significantly improved the activity data on land-use areas by category. Moreover, Iceland used the CS-EF for mineral soils (see Chapter 6.4.4.2), which was evaluated as part of the study by Guðmundsson, Gísladóttir, Brink, and Óskarsson (2010) considering the national circumstances to evaluate the EF. Hence, the Party considers that the recommendation provided in 2017 should be considered as Resolved."		

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
4.C Grassland – CO ₂ (L.19, 2021) (L.15, 2019) (L.9, 2017) (L.7, 2016) (L.7, 2015) (72, 2014) (67, 2013) Completeness	Prepare estimates for the emissions from degraded areas of grassland. Iceland did not provide estimates for the emissions from degraded areas of grassland. During the review, the Party clarified that measurements and data collection from degraded grassland areas commenced in 2021 and that estimates of the emissions from these areas will be included in future submissions.	FCCC/ARR/ 2022/ISL/L. 17	Resolved. First of all, Iceland would like to recall the initial recommendation given in 2013: "67. Iceland's NIR (page 177) reports that large areas of degraded grassland, which are likely to be a source of emissions, have not been included in the inventory. In response to questions raised by the ERT during the review, the Party indicated that data are presently unavailable and inclusion of estimates is pending. The ERT recommends that Iceland report emissions from all areas of grassland, consistent with the IPCC good practice guidance for LULUCF". Iceland would like to clarify that, according to the land-use classification applied to the "Grassland remaining Grassland" (GLremGL) category, Iceland does not have "degraded grassland" as a subcategory within GLremGL and is not aware of any areas of degraded grassland occurring within this category in the country. Iceland is developing an assessment of emissions and removals in accordance with the list of categories established for GLremGL.		Chapter 6.5.3.2 (NID 2026)

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
			Iceland also considers that the recommendation is not consistent with the guidance provided in Figure 1.2 of Chapter 1 (Volume 4), which clarifies to focus on subcategories: Is LU a key category? -> yes -> Ask for each subcategory under LU: Is this subcategory significant?. Therefore, Iceland considers the recommendation outdated and considers its closure.		
4.C.1 Grassland remaining grassland – CO ₂ (L.21, 2021) (L.16, 2019) (L.10, 2017) (L.12, 2016) (L.12, 2015) Accuracy	(a) Estimate and report CSC in mineral soils under grassland remaining grassland for "Natural birch shrubland – old" (b) Estimate and report CSC in mineral soils under grassland remaining grassland for "Revegetated land older than 60 years". (a) Iceland reports the notation key "NA" for "natural birch shrubland – old" in the CRF table 4.C for CSC in mineral soils under grassland remaining grassland (and not more NE). The Party justified the use of NA explaining that CSC in mineral soils for natural birch shrubland is in equilibrium and it used a tier 1 approach, since "Natural birch shrubland – old" has more in common with natural birch forest than grassland, based on the survey results presented in the Iceland NFI and results from various researches showing that cold temperate forests in general are adding C to soil. (b) Iceland reports the notation key "NA" for "revegetated land older than 60 years" in the CRF table 4.C for CSC in mineral soils under grassland remaining grassland (and not more NE). The Party explained that it assumed this pool also as in equilibrium and applied a tier 1 approach, however clarified that current data is very limited and the extent is small. The Party explained that it has set up monitoring plots at selected sites within this land category with the aim at improving the reporting and when the results are available it will evaluate and update estimates.	FCCC/ARR/2022/ISL/L.18	(a) Resolved regarding "Natural birch shrubland old" in the 2022 submission. For more information, please see Table 6.23 of the 2025 NID (b) Partially resolved regarding "Revegetated land older than 60 years". The use of notation key NA assumes that the pool is in equilibrium as Tier 1 method. However, the Party is working to improve the reporting in future submissions when data from monitoring plots data will be available.	In 2023, Land and Forest Iceland initiated a project to systematically collect soil samples and perform in situ measurements of greenhouse gas fluxes from Grassland remaining Grassland on mineral soils using portable flux chambers and analysers. The objective is to enhance emissions and removals estimates by upgrading the methodology to higher Tiers for this carbon pool. Preliminary data are	Chapter 6.5.8 (NID 2026)

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CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
				being assessed and will be incorporated into the national inventory submission.	
4.C.1 Grassland remaining grassland – CO ₂ (L.23, 2021) (L.37, 2019) Transparency	Improve the transparency of the reporting of CSC under grassland mineral soils for revegetated land older than 60 years by providing an explanation in the NIR and in CRF table 9 as to why estimates could not be produced for this pool for 1990–2015 and by reporting “NA” where CSC is assumed to be in equilibrium (i.e. zero). Iceland has used notation key “NA” for CSC under grassland mineral soils for revegetated land older than 60 years for complete time series in the CRF table 4.C. The Party provided additional information for revegetated land older than 60 years in NIR section 6.7.1.1 (215). The Party has also provided information in the “Documentation box” and in the relevant cells of the CRF tables for CSC mineral soils for revegetated land older than 60 years	FCCC/ARR/2022/ISL/L.19	Resolved in 2022 submission		Chapter 6.5 (NID 2026)
4.C.2 Land converted to grassland – CO ₂ (L.24, 2021) (L.17, 2019) (L.19, 2017) Accuracy	Revise the CO₂ estimates for land converted to grassland using updated data on carbon sequestration in soils, especially for other land converted to grassland, and include in the NIR, in tabular format, the total estimates of CSC in living biomass, litter and soil, and the average CSC per area for the whole time series, in land converted to grassland and land converted to forest land. Iceland has not included new information about the review of the CO₂ estimates for land converted to grassland using updated data on carbon sequestration in soils, especially for other land converted to grassland or information on the total estimates of CSC in living biomass, litter and soil, and the average CSC per area for the whole time series, in land converted to grassland and land converted to forest land. The Party included in its NIR new tables showing area, CSC per area unit (ha) and total CSC of biomass, litter and soil for all land categories (p. 200, 205, 209, 212, 218, 224, 228, 230 and 235).	FCCC/ARR/2022/ISL/L.20	Resolved in 2022 submission		Chapter 6.5.4 (NID 2026)
4.D.1 Wetlands remaining wetlands – CO ₂ (L.26, 2021) (L.38, 2019) Accuracy	Develop a country-specific methodology for managed wetlands that would allow it to use the tier 2 approach for key categories in line with the 2006 IPCC Guidelines. Iceland did not develop the CS methodology as required. During the review, the Party clarified that it is working to improve this issue for future submissions.	FCCC/ARR/2022/ISL/L.21	Resolved in the 2026 submission, as emissions and removals for the subcategory Intact mires – grazing areas (previously classified as Intact mires – managed) were re-evaluated and are now reported as NA, following the EEA		Chapter 6.6.6 (NID 2026)

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
			comprehensive review conducted between May and June 2025, since methodologies from the IPCC Wetlands Supplement were found not to be applicable.		
4.D.1.2 Flooded land remaining flooded land – CO ₂ and CH ₄ (L.36, 2021) Accuracy	If reservoirs are defined as flooded land, use the methodology of the 2006 IPCC guidelines for flooded land (vol. 4, chap. 7.3, p.7.19). If reservoirs are considered as rewetted organic soils, then use the methodology of the wetlands Supplement (chap. 3). For the transparency of the report, include more information about the characteristic of the reservoirs in the NIR. The Party included additional text in its NIR section 6.8.1.1 (p 226) with more information about the characteristic of these specific reservoirs that improved transparency.	FCCC/ARR/2022/ISL/L.22	Resolved in 2022 submission		Chapters 6.6 and 6.11 (NID 2026)
4.D.2 Land converted to wetlands – CO ₂ (L.25, 2021) (L.18, 2019) (L.11, 2017) (L.13, 2016) (L.13, 2015) Transparency	Estimate and report CSC in mineral soils under land converted to wetlands. During the review, the Party clarified that it continues to report CSC in mineral soils under land converted to wetlands as "NE" because the 2006 IPCC Guidelines do not provide any methodology for estimating CSC in mineral soils under land converted to wetlands or flooded land, as noted already by the previous ERT. Additionally, the Party informed that it will continue to report CSC in mineral soils as "NE" under land converted to other wetlands and refilled lakes and ponds for future annual submissions. For the "Rewetted wetland soils" subcategory, the Party has provided additional information in the NIR 2022, section 6.8.2.1.	FCCC/ARR/2022/ISL/L.23	Resolved in 2024 submission. The Party reports CSCs in mineral soils for "Rewetted wetland soils" for the period 2016-2022 (see section 6.9.2.1 Category description in NID 2024). However, as no methodology is provide in IPCC 2006 Guidelines to estimate CSCs in mineral soils under land converted to wetlands or flooded land, the Party will report CSC for mineral soils in Land converted to Wetlands - Rifilled Lakes and ponds as NA from the 2024 submission.		"Chapter 6.6.4 (NID 2026)
4.E.2 Land converted to settlements – CO ₂ (L.28, 2021)	Estimate and report CSC in mineral soils under land converted to settlements. During the review, the Party clarified that the Party is working to improve this issue for future submissions.	FCCC/ARR/2022/ISL/L.24	Resolved in 2025 submission. The Party reports CSC and estimate in mineral soils for the subcategory "All other		Chapter 6.7.4 (NID 2026)

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CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
(L.20, 2019) (L.12, 2017) (L.14, 2016) (L.14, 2015) Completeness				Grassland subcategories converted to Settlements"	
4(I) Direct N ₂ O emissions from N input to managed soils – N ₂ O (L.37, 2021) Convention reporting adherence	Report the correct AD for inorganic fertilizer in CRF table 3.D for the entire time series and apply the correct notation key IE in CRF table 4(I) for AD explaining in the documentation box and in CRF table 9 where emissions are reported. Iceland reported in CRF table 3.D the correct AD for inorganic fertilizer for the entire time series and applied the notation key IE in CRF table 4(I) for inorganic fertilizer under category 4.A.2.1. In the documentation box the Party clarify that "under the LULUCF chapter it was decided to include the fertilizers used in Forestry under the total synthetic fertilizer in category 3.D.1. According to this decision use of inorganic fertilizers previously reported under land converted to forest land (grassland converted to forest land) have been replaced with IE". However, the ERT could not find explanation in the CRF table 9.	FCCC/ARR/2022/ISL/L.25	Resolved in the 2023 submission		Chapter 6.10 (NID 2026)
4(II) Emissions/removals from drainage and rewetting and other management of organic/mineral soils – CH ₄ (L.38, 2021) Convention reporting adherence	Correct in the NIR the proportion of ditches for drained organic soils (the correct value is 2.5 per cent) Iceland corrected in the NIR the proportion of ditches for drained organic soils by indicating the correct value (2.5 per cent) in its NIR (p. 239)	FCCC/ARR/2022/ISL/L.26	Resolved in the 2022 submission		Chapter 6.11 (NID 2026)
4(III) Direct N ₂ O emissions from N mineralization/immobilization – N ₂ O (L.31, 2021)	Report in the NIR the reasons for carbon accumulation on cropland soils, especially on mineral soils converted to cropland. Iceland explained in the NIR the reasons for carbon accumulation on cropland soils, especially on mineral soils converted to cropland. The Party provided additional information regarding the EF used for mineral soils in Cropland remaining Cropland in NIR section 6.6.1.2 (pp. 208-211).	FCCC/ARR/2022/ISL/L.27	Resolved in the 2022 submission. Additional information were added in NIR 2022 in section 6.6.1.2 for Cropland remaining Cropland and in		Chapter 6.12 (NID 2026)

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
(L.40, 2019) Transparency	The Party indicated that the CSC factor for mineral soils in Cropland active and Cropland inactive (Fallow) has been corrected from 0.1708 tC/ha/year to 0.1525 tC/ha/year.		section 6.6.2.2 for Land converted to Cropland.		
4(V) Biomass burning – CO ₂ , CH ₄ and N ₂ O (L.33, 2021) (L.24, 2019) (L.23, 2017) Convention reporting adherence	Correct the use of notation keys to report on emissions from biomass burning in CRF table 4(V). Iceland corrected the notation key for reporting the emissions from biomass burning. in its CRF table 4(V)	FCCC/ARR/ 2022/ISL/L. 28	Resolved in the 2023 submission		Chapter 6.13 (NID 2026)
4(V) Biomass burning – CO ₂ , CH ₄ and N ₂ O (L.34, 2021) (L.41, 2019) Convention reporting adherence	Include estimates of the emissions from biomass burning on cropland and grassland for the entire time series, or, if not, include information on the reporting of "NE" (both in the NIR and the CRF tables) and provide an explanation as to why these pools could not be estimated. The Party reported in its NIR detailed information on the use of key notation "NE" in NIR (pp. 246) and CRF table 4(V). Also, the Party provided a documentation box in CRF table 4(V) for Controlled burning activity data in Grassland remaining Grassland, Land converted to Grassland, Wetlands remaining wetlands and Land converted to Wetlands. For all other land use categories, Controlled burning is reported as NO and none "NE" notation key is used for biomass burning in Cropland.	FCCC/ARR/ 2022/ISL/L. 29	Resolved in 2022 submission. The Party added detailed information regarding the use of nk "NE" for Grassland and Wetlands in section 6.17.1 Category Description in NIR 2022. Additionally, information of the use of nk "NE" are reported in the documentation box and in Cell comments for Grassland and Wetlands		Chapter 6.13 (NID 2026)
4.A.2 Land converted to forest land – CO ₂	Iceland reported in its NIR section 6.5.2.2 (pp. 203-204) a description of the estimation of litter removals in land converted to forest and afforestation/reforestation.. Two separate research projects were used to estimate a country specific EF including both introduced tree species and the native <i>Betula pubescens</i> which is the main tree species of the natural birch forest (see also #KL.7). In the same section of the NIR the Party also informed about new research that will increase the understanding of CSC in litter and that information related to these ongoing projects will be added to the next submission (2023). Update the estimates of CSC litter as soon as new information is available.	FCCC/ARR/ 2022/ISL/L. 30	Will be implemented in later submissions when research results are available	Same results from the new research project as EF in submission 2026	Chapter 6.3.4.2 (NID 2026)

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CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
4.A.1 Forest land remaining forest land – CO ₂	Iceland reported in its CRF table 4.A.1 net carbon stock change in living biomass separately for “Natural Birch forest older than 50 years”, “Afforestations older than 50 years” and “Plantations in natural birch forest.” The ERT noted that losses of carbon from below-ground biomass for cultivated forest was reported as “NE” in table CRF 4(KP-I)B.1 (See #KL.10) for the entire time series. During the review the Party resubmitted updated values of losses from this carbon pool to complete the reporting under the second commitment period under the Kyoto protocol, e.g. values reported in CRF table 4(KP-I)B.1 for losses from below-ground biomass for “Cultivated forests” which were previously reported as “NE” is now -0.185 kt C for 2020. The ERT noted that this could lead also to a recalculation of the net changes in carbon stock changes reported under forest land remaining forest land (category 4.A.1) and ask the Party to explore whether these updated calculations should be reflected in the net carbon stock changes under forest land remaining forest land and if so report updated net carbon stock changes under forest land remaining forest land in its next annual submission.	FCCC/ARR/2022/ISL/L.31	Resolved in the 2023 submission		Chapter 6.3.3.2 (NID 2026)
General (KP-LULUCF) – CO ₂ , CH ₄ and N ₂ O (KL.1, 2021) (KL.2, 2019) (KL.2, 2017) (KL.4, 2016) (KL.4, 2015) Transparency	Include in the NIR country-specific information on the associated FM and AR and background levels of emissions associated with annual disturbances, as well as information on a margin and how to avoid the expectation of net credits or net debits during the commitment period, including through the use of a margin. Iceland reported in its NIR (p.363) country-specific information on the associated AR and FM and background levels of emissions associated with annual disturbances. As the associated emissions are so small that a background level and a margin cannot be established, Iceland now report “NO” for these parameters under AR and FM in CRF tables 4(KP-I)A.1.1 and. 4(KP-I)B.1.3. The ERT notes that no events qualifying for the natural disturbance mechanism occurred in Iceland during the second commitment period 2013-2020.	FCCC/ARR/2022/ISL/K L.1	Resolved in the 2022 submission		
General (KP-LULUCF) – CO ₂ , CH ₄ and N ₂ O (KL.2, 2021) (KL.3, 2019) (KL.3, 2017) (KL.5, 2016) (KL.5, 2015) Transparency	Report information clearly demonstrating that emissions by sources and removals by sinks resulting from FM under Article 3, paragraph 4, and any elected activities under Article 3, paragraph 4, are not accounted for under activities under Article 3, paragraph 3. Iceland included in its NIR (p. 363) section 11.5.5 information that demonstrates that emissions and removals resulting from elected Article 3.4 are not accounted for under activities under Article 3.3. The section (11.5.5) has been updated with the required information described in the 2021 ARR (ID# KL.2, 2021).	FCCC/ARR/2022/ISL/K L.2	Resolved in the 2022 submission		

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
General (KP-LULUCF) – CO ₂ , CH ₄ and N ₂ O (KL.3, 2021) (KL.4, 2019) (KL.7, 2017) Transparency	Provide in the NIR a description of the methodologies used for conducting an uncertainty analysis for KP-LULUCF activities (AR, deforestation, FM and HWP), including the methodology used in the uncertainty analysis of AD, EFs and emissions for each carbon pool. Iceland reported uncertainty estimates for HWP in section 11.6 (p. 364) and for AR and FM in section 11.3.2.5 (p. 358). During the review, the Party provided additional information related to the uncertainty estimate for deforestation, i.e. the Party explained that deforestation reporting in Iceland is built on data sampling of every deforestation event. The combined uncertainty of the area estimate and the CSC is judged to be 20 % of the reported net emissions. With this information provided during the review the ERT consider the issue	FCCC/ARR/2022/ISL/K L.3	Resolved in the 2022 submission		
General (KP-LULUCF) – CO ₂ , CH ₄ and N ₂ O (KL.4, 2021) (KL.5, 2019) (KL.8, 2017) Transparency	Provide information in the NIR on the approach used to develop background level and margin values for FM and AR and demonstrate how the approach taken avoids the expectation of net credits or net debits, in accordance with decision 2/CMP.7, annex, paragraph 33. See #KL.1 above.	FCCC/ARR/2022/ISL/K L.4	Resolved in the 2022 submission		
AR – CO ₂ , CH ₄ and N ₂ O (KL.5, 2021) (KL.6, 2019) (KL.4, 2017) (KL.1, 2016) (KL.1, 2015) (86, 2014) Transparency	Provide an additional description of the process by which CSC and associated emissions and removals are estimated, including tables with raw data and intermediate outputs stratified by year and forest type. The Party reported in its NIR (table 6.8, p. 200 and table 6.10, p. 205) the CSC per area unit and total CSC of biomass, litter and soil separated. Additionally, the Party in its NIR (figure. 6.7 p. 197 and figure 6.8 p. 203) included graphs showing area as well as CSC and carbon stocks related to age for the two main forest categories, cultivated forest and natural birch forest..	FCCC/ARR/2022/ISL/K L.5	Resolved in the 2022 submission		
AR – CO ₂ (KL.6, 2021) (KL.7, 2019) (KL.9, 2017) Transparency	Correct the use of notation keys by reporting CSC in the HWP pool under AR using the notation key "NO" for the whole time series and provide an explanation in the NIR that harvesting from afforestation lands has not yet occurred. Iceland reported in the NIR section 11.4.5 (p. 359) the use of the notation key "NO" by explaining that "afforestation since 1990 has not yet yielded wood removals as these forests are still too young for commercial thinning and therefore harvested wood products are reported as not occurring". However, in CRF table 4(KP-I)A.1 and CRF table 4(KP-I)C the Party still reports "NA" for CSC in the HWP pool under AR..	FCCC/ARR/2022/ISL/K L.6	Resolved in the 2022 submission		

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CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
AR – CO ₂ (KL.8, 2021) (KL.17, 2019) Transparency	Indicate in the NIR that the average EF obtained from the data from two research projects for litter on AR includes both natural birch forests and cultivated forests. Iceland did not include in the NIR the required information. In response to the previous review the Party clarified that EF for litter in cultivated forest under FM compared to EF for litter in cultivated forest under AR can be explained by the age of afforestation in FM. Part of the forest in FM was afforested more than 50 years ago and reported with no removal to litter. The part FM younger than 51 years were estimated with the same EF as in AR. The average for these two groups yields consequently lower EF than the country wise EF of 0.14 t C/ha. The ERT noted that the NIR section 6.5.2.2 (p. 203) mentioned the two research projects. During the review, the Party explained that the separate research projects used to estimate the CS average EF include both introduced tree species and the native <i>Betula pubescens</i> which is the main tree species of the natural birch forest and that more information will be added in the next NIR. The ERT recognize that this issue has no impact in accounting and considered this issue as resolved.	FCCC/ARR/2022/ISL/K L.7	Resolved in the 2022 submission		
Deforestation – CO ₂ , CH ₄ and N ₂ O (KL.9, 2021) (KL.8, 2019) (KL.5, 2017) (KL.2, 2016) (KL.2, 2015) (87, 2014) Accuracy	Recalculate CSC in soil organic matter by ensuring symmetry among the pairs of land-use conversions (e.g. grassland converted to forest land, and forest land converted to grassland). Iceland did not recalculate CSC in soil organic matter. The Party reported in its CRF table 4(KP-I)A.1 and 4(KP-I)A.2 the same CSC for soil organic carbon from previous submissions. During the review, the Party clarified that a recalculation using symmetrical emission factors for deforestation and for afforestation to estimate annual CSC in soil organic carbon would have a minimal effect on accounting. The annual loss of carbon would change from -0.03 kt C, to -0.02 kt C in 2020. The ERT acknowledge that this is the final year to report under the Kyoto protocol and that any issues related to the accounting needs to be resolved. However, the ERT also noted that the current estimate is conservative, i.e. it does not create any additional credits, and therefore accepted the current estimate.	FCCC/ARR/2022/ISL/K L.8	Resolved in the 2023 submission. Forest land converted to grassland has never been reported.		
Deforestation – CO ₂ and N ₂ O (KL.10, 2021) (KL.18, 2019) Completeness	Report the AD, CSC and related N₂O emissions for this category to avoid underestimating the emissions. If this is not possible, provide information that justifies the reporting of “NE” for AD and CSC related to N₂O emissions from mineralization and immobilization due to carbon loss or gain associated with land-use conversion and management change in mineral soils on land subject to deforestation in the NIR in the next annual submission and consider providing information in the documentation box to CRF table 4(KP-II)3. Iceland reported in its CRF table 4(KP-II)3, N₂O emissions from mineralization and immobilization due to carbon loss after deforestation for the first time by using default tier 1 methods. However, the ERT noted that there is no description of the methods in the NIR except in Table 10.8 (p. 499) where the Party reports the status of implementation in the LULUCF and KP LULUCF sectors in response to UNFCCC’s review process. The ERT considers,	FCCC/ARR/2022/ISL/K L.9	Resolved in the 2022 submission		

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	however, that the completeness issue is resolved and considering the clarification provided by the Party in NIR Table 10.8, consider this issue as resolved.				
FM – CO ₂ (KL.11, 2021) (KL.10, 2019) (KL.10, 2017) Completeness	Report information on CSC in below-ground biomass for FM or provide justification that the carbon pool is not a net source in accordance with decision 2/CMP.8, annex II, paragraph 2(e). Iceland did not include an estimate of losses from below-ground biomass for cultivated forests for the years 2013-2020 although losses from above ground biomass was reported. In CRF table 4(KP-I)B.1 losses of carbon from below ground biomass for cultivated forests under FM is reported as “NE”. The ERT listed this issue as a potential problem and in response, the Party provided revised estimates and a revised NIR during the review week. The revised estimates for the losses of carbon from below ground biomass for cultivated forests reported under FM. covered the entire time series (2013-2020), making the reporting of FM complete. The revised estimates resulted in a decrease in net removals reported and accounted for FM during the commitment period (2013-2020) of 6.634 kt CO ₂ eq. The ERT checked the resubmitted values in CRF table 4(KP-I)B.1 and concluded that the issue is now resolved.	FCCC/ARR/2022/ISL/K L.10	Partially resolved in the 2022 resubmission. Resolved in the 2023 submission		
FM – CO ₂ (KL.12, 2021) (KL.13, 2019) Transparency	Report transparently in the NIR any recalculations for FM (including changes in CSC factors for the pools, e.g. mineral and organic soils). Iceland reported transparently in the NIR recalculation made for FM. The Party reported in its NIR section 11.2.3.4 (p. 358), information on changes in data and methods since the previous submissions including all activities and pools reported (see also ID#KL.12).	FCCC/ARR/2022/ISL/K L.11	Resolved in the 2022 submission		
FM – CO ₂ (KL.13, 2021) (KL.14, 2019) Transparency	Provide information on any changes in data and methods from previous submissions, including those resulting from a detected error, in future annual submissions Iceland reported in its NIR (pp. 360-364) detailed description on the changes in data and methods used in the recalculations for FM. See also ID#KL.11.	FCCC/ARR/2022/ISL/K L.12	Resolved in the 2022 submission		
FM – CO ₂ (KL.14, 2021) (KL.19, 2019) Completeness	Report estimates for CSC in the litter of natural birch forests under FM or justify why the carbon pool is not a net source, in accordance with decision 2/CMP.8, annex II, paragraph 2(e). Iceland changed the notation key from NE to NA in its CRF table 4(KP-I)B.1 for CSC in litter in natural birch forests under FM for 2013–2020 and provided justification in the NIR (section 11.5.5, p. 364) why the pool is not a net source of emissions. According to the Party, forest management includes natural birch forests as estimated in the end of 1989. They are all defined as forest land remaining forest land and are not in a transitional state”. In section	FCCC/ARR/2022/ISL/K L.13	Resolved in the 2022 submission		

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
	11.3.1.1 (p. 356), it is highlighted that the reporting of CSC for litter and mineral soil for the part of FM that is defined as forest land remaining forest land is not occurring leading to the reporting of NA rfor the subcategory of natural birch forest. The Party further explain in the NIR that CSC in litter in FM follow the same pattern of variation as CSC in mineral soil (because CSC in litter are only reported for forests of 50 years old or younger under FM). Therefore, considering that all FM is defined as older than 50 years CSC in litter and mineral soil is likely to be a sink rather than a source . As Tier 1 approach these pools are assumed to be 0 (zero) as recommended in 2006 AFOLU Guidelines (see page 2.21)."				
FM – CO ₂ (KL.16, 2021) (KL.21, 2019) Accuracy	Provide the revised technical correction to the FMRL, as planned, before the end of the commitment period. Iceland reported in its NIR, section 11.5.3 (pp. 360-363) an updated technical correction with the calculations of a corrected FMRL and with explanation of the elements that changed in relation to the originally submitted FMRL (changes in area estimates, in carbon stock calculations and in emission factors). However, the ERT noted that the Party made a post-calibration of the projected removals in living biomass using the reported numbers for the period 2013-2020. During the review, in interaction with the Party, it was clarified that only updates to the historical data (2009) as well as the updated model for projection could be used to revise the estimate on living biomass in the FMRL. The ERT listed this issue as a potential problem and in response, the Party provided revised estimates and a revised NIR during the review week. The revised estimates consisted of an updated technical correction following the advice from the current ERT to not calibrate the FMRL using the reported removals for cultivated forests during the commitment period. The updated FMRLcorr reported during the review was -156.107 kt CO₂e/year and the updated technical correction was estimated to -1.755 kt CO₂e/year which have now been included in the CRF-tables 4(KP-I)B.1.1. The update of the FMRLcorr led to an increase in accounted net removals for FM of 146.240 kt CO₂ eq for the second commitment period. The ERT checked the values resubmitted in the CRF table 4(KP-I)B.1.1 and concluded that the issue is now resolved.	FCCC/ARR/ 2022/ISL/K L.14	Resolved in the 2022 resubmission		
RV – CO ₂ (KL.18, 2021) (KL.11, 2019) (KL.11, 2017) Accuracy	Revise estimates of carbon stock in living and dead biomass as well as carbon stock in soils in revegetated areas and revise estimates of carbon sequestration in revegetated land for the whole time series. Iceland did not revise the estimates as requested in the recommendation. However, the Party reported in its NIR, section 11.3.1.2 (p. 357) that the changes in carbon stocks at revegetation sites were estimated based on a country specific EF covering all carbon pools and clarified during the review, that the current estimates for CSC in living biomass and dead wood as well as CSC in soils are based on three peer-reviewed publications. The Party provided a full explanation on the studies used to estimate the CSC in living biomass and soil organic	FCCC/ARR/ 2022/ISL/K L.15	Resolved in the 2022 resubmission		

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
	carbon, as follow: (a) Biomass: for 2013-2020 Iceland has been using for the category: 4(KP).B.4 (revegetation) an implied carbon stock changes factor of 0.057 t C/ha/yr for Gains in above ground biomass. According to one of the studies, "the annual rate of sequestration in aboveground biomass ranged from 0.01 to 0.5 t C/ha/yr the amount depending on the reclamation method used and site conditions". (b) Mineral soils: for 2013-2020 Iceland has been using for the Category: 4(KP).B.4 (revegetation) an implied carbon stock changes factor of 0.513 t C ha⁻¹ yr⁻¹ for mineral soils. According to one of the studies "reclamation of Icelandic deserts results in an average sequestration rate in soils of 0.6 t C ha⁻¹ yr⁻¹, which is maintained >50 yrs". In addition, it is considered "sequestration in aboveground or belowground biomass of 0.01–0.5 t/ha/yr". Moreover, another study estimated that "barren desert soils were sandy with unstable surface conditions subjected to intense cryoturbation and wind erosion are, the initial carbon stocks in soils of eroded, untreated areas were 0.1–0.3 kg m⁻², largely consisting of inert metal-humus and/or clay-humus complex characteristic of Andosols. Carbon content in the 5 cm surface layer increased from <0.3% up to >0.7% in some treated plots. Annual carbon accumulation of 0.04–0.063 kg C m⁻² yr⁻¹ was observed over the first seven years after initiation of restoration efforts, highest in treatments seeded with grasses and fertilized but no accumulation was observed in untreated controls. Carbon accumulation rate of >0.05 kg C m⁻² yr⁻¹ can potentially be maintained over >100 yr due to the nature of Andosols and a steady burial by an influx of eolian materials". The Party ensured that these estimates are conservative and there is no underestimate of emissions. The ERT recognize that this issue has no impact in accounting and considered this issue as resolved.				
HWP – CO₂ (KL.19, 2021) (KL.12, 2019) (KL.12, 2017) Transparency	Provide in the NIR information on the calculation of emissions from HWP, including the AD and methodology used, including information on HWP from FM and deforestation, as well as information on how Iceland distinguishes between domestic and imported HWP, in accordance with the requirements in decision 2/CMP.8, annex II, paragraph 2(g)(i). Iceland reported in its NIR, section 11.6 (pp. 364-365) new and improved information on the calculations of emissions from HWP including information on how HWP from FM and deforestation are distinguished, as well as information on how domestic and imported HWP are distinguished. Most of the deforestation event are either deforestation of young afforestation areas or of natural birch forest that do not yield harvested wood to be utilised as HWP. In two deforestation events (2006 – 4.3 ha and 2015 – 3.0 ha) harvested wood was partially removed from the area and used to make wood chips and firewood.	FCCC/ARR/ 2022/ISL/K L.16	Resolved in the 2022 submission		

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
Direct and indirect N ₂ O emissions from N fertilization – N ₂ O	During the review the ERT observed some problems related to the reporting and accounting under the Kyoto protocol. All these issues were resolved during the review, including the issues already included in table 3. Since this is the last review under the Kyoto protocol the issues not covered by table 3 are documented below. During the review it was observed that N₂O-emissions related to the application of organic fertilizers on land reported under Revegetation was missing for the years 2013, 2014 and 2015. To complete the reporting under the Kyoto protocol, the Party provided updated estimates through a resubmission of the CRF-tables during the review week. The resubmission included revised estimates of the entire time series as errors were detected by the Party during the recalculation process. However, the ERT also noted that the area reported and accounted for under Revegetation are also part of the area reported under grassland (CRF 4.C) and that N₂O-emissions related to the application of organic fertilizers to grassland are reported in the Agriculture sector (CRF table 3.D.a.1 and 3.D.a.2). After correspondence with the Party the Party detected that the reporting of N₂O-emissions related to the application of fertilizers under Revegetation (CRF table 4[KP-II]1) was considered to be a double counting of the emissions already reported in the Agriculture sector (CRF table 3.D.a.1 and 3.D.a.2). Therefore, the Party provided updated estimates through a second resubmission of the CRF-tables during the review week, i.e. by reporting N₂O-emissions related to the application of organic fertilizers using the notation key "IE" under RV. The resubmission led to a reduction of the accounted amount for the second commitment period of 284.218 kt CO₂e. The Party also provided background information and evidence on how the calculations have been made, that all N₂O-emissions related to the application of fertilizers was reported in the agricultural sector (CRF table 3.D) and why parts of the emissions was allocated to RV to demonstrate that there actually is a double counting of emissions. The calculations for the estimate of fertilization of RV were based on the quantities of inorganic and organic fertilizers recorded in the Soils Conservation Service of Iceland's database which records fertilizers used for all revegetation projects although these quantities were already captured in the estimate reported in the agricultural sector (CRF table 3.D).	FCCC/ARR/2022/ISL/K L.17	Resolved in the 2022 resubmission		
FM – CO ₂ , N ₂ O, CH ₄	It is good practice (see page 2.97 of the 2013 IPCC KP Supplement) to provide information in the NIR on the main factors generating the accounted quantity (i.e. the difference in net emissions between reporting of FM during CP2 and the FMRL) and whether the accounting quantity (AQ = FM - FMRL) is consistent with those factors, with the aim to show that AQ can be explained as deviations in actual policies compared to those historical policies included in the FMRL, rather than as differences in the methodological elements as factors/parameters, including increments, used in the FMRL and in the actual GHG emissions and removals. During the review, Iceland provided information that explained that the accounted quantity (-	FCCC/ARR/2022/ISL/K L.18	Resolved in the 2022 resubmission		

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CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non- implementation	Chapter/ Section in the NIR
	19.941 kt CO ₂ e/ year), i.e. difference between FM and FMRLcorr where to due with (i) a higher net removal in HWP due to an increase in harvest level since 2010 (the FMRLcorr considered the same harvest level as in 2010) (ii) an increase in forest growth during the commitment period compared to the growth in the FMRL. However, the causes for the increase in growth was not specifically explained by the Party.				
General (KP-LULUCF) –	The ERT observed that some of the information required according to decision 2/CMP.8 Annex II paragraph 2 was not provided in the NIR, i.e. information related to (i) The geographical location of the boundaries of the areas that encompass article 3.3 and 3.4 activities and (ii) The spatial assessment unit used for determining the area of accounting for afforestation, reforestation and deforestation. During the review the Party informed that boundaries encompassing activities under article 3.3 and 3.34 are the national boundaries of Iceland. The Party also informed that chapter 6.5 (page 195) in the NIR describes the systematic sampling grid of the NFI of cultivated forest and natural birch forest and that the sampling grid is used to separate ARD from FM. The spatial assessment unit is 50 ha in the case of Cultivated forest and 450 ha in the case of Natural birch forest.	FCCC/ARR/2022/ISL/K L.19	Resolved in the 2022 resubmission		

10.5.5 Waste (CRT Sector 5)

There still remains some inconsistency between the reporting of landfill gas, between the Energy and the Waste sectors, which will be tackled for future submissions.

Regarding emissions from Anaerobic Digestion the 5% value for unintentional leakage, suggested in the 2006 IPCC Guidelines, is currently used in the inventory. This estimate is considered conservative, as the facility is new, and leakage might be expected to be negligible. IEEA intends to refine this estimate with the data provider and facility experts in the coming years.

The whole wastewater chapter (5D) has now been updated according to the IPCC 2019 Refinements.

The Industrial Wastewater category is currently only calculated for fish processing on land. Preparations were made for including the other major industries in Iceland to the inventory. The missing data has been mapped out for various industries for the whole times series. However, collecting the missing data was not completed for the 2026 submission. This project is expected to take a few years. Emissions from fish processing wastewater discharge were, however, upgraded to the 2019 Refinements methodology and a country-specific value for wastewater generation per ton of fish was derived from collected data.

Most of the comments and suggestions received during the 2022 reviews have been addressed. Two comments remain, regarding separation of municipal solid waste and industrial waste, which is not possible for the time being due to lack of data; and fixing discrepancies between CH₄ in the Waste and Energy sectors.

The treatment of MSW at GAJA biogas and composting plant in years 2020-2023 did not deliver usable compost. Corrections were made in the 2026 submission to include emissions from composting of this waste for years 2022-2023. It has yet to be reviewed how this influences the amount of waste landfilled, depending on how this unusable compost was disposed of. This will be assessed and confirmed in future submissions.

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Table 10.9. Status of implementation in the Waste sector in response to UNFCCC's review process.

CRF Category/Issue	Review Recommendation	Review Report/Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/Section in the NIR
5.A Solid waste disposal on land – CH ₄ (W.1, 2021) (W.12, 2019) Transparency	Document and provide in the NIR all the parameters used in the estimation of CH ₄ emissions from solid waste disposal and include the population data and waste generation rates used as input data in the IPCC solid waste disposal model. Iceland included in the 2022 NIR a new annex (Annex 9 in 2022 Submission, Annex 6 in this submissions) with input data for managed and unmanaged SWDS, i.e. a table with the parameters applied (e.g.DOC, MCF, etc), and two tables with population and the types of waste assigned to managed and unmanaged SWDS for the entire time series. Further tables on waste generation and allocation data can be found in NIR tables 7.5 – 7.8 (pp. 258-260).	FCCC/AR R/2022/I SL/W.1	Implemented.		Chapter 7.2 and Annex 7
5.A Solid waste disposal on land – CH ₄ (W.2, 2021) (W.13, 2019) Accuracy	Investigate the composition of both municipal solid waste and industrial waste and reconsider estimating separately emissions from industrial waste. Iceland still assumes a similar composition of waste between municipal solid waste and industrial waste. The Party explained that the reason behind this is that the existing data on waste amounts does not support this distinction. Waste amounts are reported to the EA as either mixed or separated waste. The Party clarified that though the questionnaires sent to the waste industry contain the two categories mixed household and mixed production waste, the differentiation between the two on site is often neglected, and therefore, they are assumed to have similar content (see NIR section 7.22, p. 252). In addition, the Party explained that data received according to the European Waste Statistic Regulation (WStatR) (EC 2150/2002) does not exactly match IPCC categorization and that streamlining of the WStatR to IPCC categorization is in progress and those composition amounts may be revised in future submissions.	FCCC/AR R/2022/I SL/W.2	Implemented.		Chapter 7.2
5.A Solid waste disposal on land – CH ₄ (W.3, 2021) (W.13, 2019) Transparency	Report information on waste composition for municipal solid waste and industrial waste separately in order to enhance the transparency of the NIR. Iceland did not report information on waste composition separated by domestic and industrial waste (see ID# W.2 above).	FCCC/AR R/2022/I SL/W.3	Unable to resolve due to lack of data.	Existing data on waste amounts does not support this distinction. Waste amounts are reported to the EAI as either mixed or separated waste. Though the questionnaires sent to the waste industry contain the two categories mixed household and mixed production waste,	Chapter 7.2

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
				the differentiation between the two on site is often neglected, and therefore, they are assumed to have similar content (see NIR section 7.2.2). Information on the origin of the separated waste is not available to the EAI and even though some of the categories can be assumed to originate solely from industry, that can not be concluded for all of them. Hence, for the time being we are not able to report information on waste composition for municipal solid waste and industrial waste separately.	
5.A.1 Managed waste disposal sites – CO ₂ , CH ₄ and N ₂ O (W.4, 2021) (W.11, 2019) Completeness	Estimate emissions from the combustion of landfill gas for energy and transparently allocate them under the relevant categories in the energy sector (e.g. for electricity production in 2002–2009); Improve the explanation of the allocation of emissions from landfill gas in the inventory (NIR section 7.2.4.1). Iceland improved the explanation regarding landfill gas recovery in NIR section 7.2.4.1 (p. 261). However, it has not provided enough information on the allocation of emissions from landfill gas between categories 1.A.1.a (electricity generation) and 1.A.3.b (road transport). During the review, the Party clarified that there is still a discrepancy between the values reported under the Energy sector, retrieved from the National Energy Authority, and the values reported within the waste sector, based on numbers reported from the waste management company. The Party reported in its NIR (page 261) that it will investigate the differences with the aim of harmonizing the values. The ERT notes the differences between the values are low and cannot lead to an underestimation of emissions.	FCCC/AR R/2022/1 SL/W.4	Partially resolved. The investigation has started, but not yet been concluded. Therefore, there is still a slight discrepancy between the values reported under the Energy sector and the values reported under the Waste sector.		Chapter 7.2
5.B.1 Composting – CH ₄ and N ₂ O (W.8, 2021) Convention	(a) Report the amount of waste composted consistently between its NIR table 7.13 and CRF table 5.B., (b) Correctly reports in the NIR text the basis for the estimation, whether by dry weight or wet weight. (a) Iceland did not report consistently the amount of waste composted between the NIR table 7.10 (p.266) and the CRF table 5.B. In CRF table 5.B, the amount of composted waste is 12.42 kt dm and in NIR table	FCCC/AR R/2022/1 SL/W.5	Resolved in the 2023 Submission.		Chapter 7.3

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CRF Category/Issue	Review Recommendation	Review Report/Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/Section in the NIR
reporting adherence	7.10, 14 kt dm. The party also continues to report the CH ₄ and N ₂ O EFs in wet weight in the NIR table 7.12 (p. 266), i.e 4 g CH ₄ /kg waste and 0.24 g N ₂ O/kg. During the review, the Party explained that the correct waste amount composted was reported in CRF table 5.B and that it will correct the typo in Table 7.10 for the amount of waste composted in dry weight. (b) Iceland included in NIR table 7.10 (p. 266) a row with the amount of waste composted in dry weight and therefore this table presents AD in dry and wet weight. The Party added to the NIR information that “the basis for the estimation of emissions from composting is wet weight”.				
5.D Wastewater treatment and discharge – CH ₄ and N ₂ O (W.6, 2021) (W.6, 2019) (W.8, 2017) (W.5, 2016) (W.5, 2015) (81, 2014) (74, 2013) Transparency	Include in the NIR more background data on sludge removal (e.g. amount and N content), clearly indicating in which category the resulting emissions are accounted for. Iceland reported in NIR the amount of sewage sludge removed and the N effluent for relevant years of the time series. For 2020, sludge removed accounted for 3.3 kt DC and N effluent 2.6 kt N (see NIR section 7.5.4.2 and table 7.21, p.282). The Party also indicated that emissions from sludge removed are accounted for in categories 5. A.1.a (managed waste disposal sites, anaerobic) and 5.C.1.1.b.iv (waste incineration, biogenic, sewage sludge). However, the ERT noted that the Party reported sludge applied to soil (as fertilizer) in the agriculture sector. NIR table 5.34 (p.164) indicates that in 2020 the N content of sewage sludge applied to soil as fertilizer was 6.56 t N. During the review, the Party clarified that the amount of sewage sludge reported in the agriculture sector as organic fertilizer was not deducted from the calculations of N ₂ O emissions under category 5.D.1 (domestic wastewater) and clarified that it will correct these data in the next submission (see Section, 7.5.4.2, p. 282).	FCCC/AR R/2022/I SL/W.6	Resolved in the 2023 Submission.		Chapter 7.5
5.D Wastewater treatment and discharge – CH ₄ and N ₂ O (W.9, 2021) Transparency	Update the NIR to explain that correction factor 1 is applied for the pathways “not known, septic tanks urban and septic tank rural” and that correction factor 1.25 is applied for the pathways in which commercial activities are likely to occur as “not known into sea, river, lake, primary, secondary and tertiary treatment”. Iceland updated the NIR and included on section 7.5.2.1 (p. 276) the required information, explaining that “the correction factor is set to 1 for the pathways “not known, septic tanks urban and septic tanks	FCCC/AR R/2022/I SL/W.7	Implemented.		Chapter 7.5

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CRF Category/Issue	Review Recommendation	Review Report/Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/Section in the NIR
	rural", while for "not known into sea, river, lake, no treatment, primary, secondary and tertiary treatment" it is set to 1.25 to account for industrial wastewater discharge such as commercial activities, accommodation services, restaurants, shops which are commonly discharged in the same sewer system."				
5.D Wastewater treatment and discharge – CH ₄ and N ₂ O (W.9, 2021) Completeness	Verify if emissions from "overnight stays associated with foreign visitors to Iceland" are included in the inventory (in the pathways using correction factor 1.25), and if not, include the emissions estimates in the inventory, because justification for exclusion based on the likely level of emissions should be applied at category level and not to parts of a category or subcategory in accordance with footnote 7 of the UNFCCC Annex I reporting guidelines.	FCCC/AR R/2022/1 SL/W.8	Resolved for the 2024 submissions. Now the total population equivalents used to calculate wastewater emissions is adjusted to include overnight stays from foreign nationals.		Chapter 7
5.D Wastewater treatment and discharge – NO _x , CO, NMVOCs (W.10, 2021) Transparency	Update the notation key to "NA" for NO _x and CO. Continue to use "NE" for NMVOC until the Party is able to change AD and obtain the volume of wastewater handled, for calculating the GHG emissions based on tier 1 and using BOD from population. Provide in CRF table 9 the reasons for reporting "NE" for NMVOCs under domestic and industrial wastewater. Iceland updated the notation keys in CRF table 5. For category 5.D.1, the reported NA for NO _x and CO and continued to report NE for NMVOCs. For category 5.D.2, the Party reported correctly NE for NMVOCs, but continued to report NE (instead of NO) for NO _x and CO. During the review, the Party clarified that it was an error in updating the CRF table 5 and that it will address this issue in next submission. The Party did not provide in CRF table 9 the reasons for reporting "NE" for NMVOCs under domestic and industrial wastewater.	FCCC/AR R/2022/1 SL/W.9	Implemented. Explanations for the reasons for reporting "NE" for NMVOCs under domestic and industrial wastewater have been added to CRF.		Chapter 7

11 References

Legislation

European

Council Decision (EU) 2015/1339 of 13 July 2015 on the conclusion, on behalf of the European Union, of the Doha Amendment to the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint fulfilment of commitments thereunder OJ L 207, 4.8.2015, p. 1–5

Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC Text with EEA relevance OJ L 165, 18.6.2013, p. 13–40

Commission Implementing Regulation (EU) No 749/2014 of 30 June 2014 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) No 525/2013 of the European Parliament and of the Council OJ L 203, 11.7.2014, p. 23–90

Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC OJ L 275, 25.10.2003, p. 32–46

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives OJ L 312, 22.11.2008, p. 3–30

Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006 Text with EEA relevance OJ L 150, 20.5.2014, p. 195–230

Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases OJ L 161, 14.6.2006, p. 1–11

Decision of the EEA Joint Committee No 269/2019 of 25 October 2019 amending Protocol 31 to the EEA Agreement, on cooperation in specific fields outside the four freedoms [2023/92] OJ L 11, 12.1.2023, p. 38–45

National (in Icelandic)

3/1955 Lög um skógrækt – “Forestry Act”

70/2012 Lög um loftslagsmál – “Climate Act”

62/2015 Lög um breytingu á lögum um loftslagsmál, nr. 70/2012, með síðari breytingum (EES-reglur, geymsla koldíoxíðs, vistvæn ökutæki, Kyoto-bókunin). – “Act amending the Climate Act, no. 70/2012, with subsequent amendments (EEA regulations, storage of carbon dioxide, eco-friendly vehicles, Kyoto Protocol”

48/2007 Lög um breytingu á lögum nr. 87/2003, um Orkustofnun. – “Act amending Act no. 87/2003, on the National Energy Authority”

230/1998 Reglugerð um tiltekin efni sem stuðla að auknum gróðurhúsaáhrifum. – “Regulation on certain substances that contribute to increased greenhouse effect”

851/2002 Reglugerð um grænt bókhald. – “Regulation about Green Accounting”

990/2008 Reglugerð um umhverfisupplýsingar – “Regulation about Environmental information”

244/2009 Reglugerð um skil atvinnurekstrar á upplýsingum um losun gróðurhúsalofttegunda. – “Regulation on the provision of information on greenhouse gas emissions to business operators”

834/2010 Reglugerð um flúoraðar gróðurhúsalofttegundir – “Regulation on fluorinated greenhouse gases”

520/2017 Reglugerð um gagnasöfnun og upplýsingagjöf stofnana vegna bókhalds Íslands yfir losun gróðurhúsalofttegunda og bindingu kolefnis úr andrúmslofti. – “Regulation of data collection and reporting of agencies for Iceland's accounting of greenhouse gas emissions and carbon sequestration from the atmosphere”

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Annexes to the National Inventory Document

Annex 1 Key Category Analysis

According to the IPCC definition, key categories are those that add up to 95% of the total inventory in level and/or in trend. In the Icelandic Emission Inventory key categories are identified by means of Approach 1 described in Volume 1, Chapter 4 of the 2006 IPCC Guidelines.

Table 1.1 and Table 1.2 list identified key categories. Tables A1.1, A1.2, and A1.3 show the 1990 level, 2024 level and 1990-2024 trend assessment without LULUCF, and Table A1.4, A1.5, and A1.6 show the 1990 level, 2024 level and 1990-2024 trend assessment with LULUCF. All categories are listed in decreasing order of level or trend % contribution. All emission figures are reported in kt CO₂e, with CO₂ equivalents calculated using GWPs from the 5th assessment report of the IPCC (AR5).

Table A1.1. Key Category analysis approach 1 level assessment for 1990 excluding LULUCF, [kt CO₂e].

IPCC Code	IPCC Category	Gas	1990 Emissions [kt CO ₂ e]	Level Assessment [%]	Cumulative Total of Level [%]
1A4c	Agriculture/Forestry/Fishing	CO ₂	802.9	21.89%	21.89%
1A3b	Road Transport	CO ₂	519.8	14.17%	36.07%
2C3	Metal Production: Aluminium	PFC	444.8	12.13%	48.20%
1A2	Manufacturing and Construction	CO ₂	305.4	8.33%	56.53%
3D1	Agricultural Soils	N ₂ O	233.3	6.36%	62.89%
2C2	Metal Production: Ferroalloys	CO ₂	208.8	5.69%	68.58%
3A2	Enteric Fermentation: Sheep	CH ₄	186.2	5.08%	73.66%
5A2	Unmanaged Waste Disposal Sites	CH ₄	153.6	4.19%	77.85%
2C3	Metal Production: Aluminium	CO ₂	139.2	3.80%	81.64%
3A1	Enteric Fermentation: Cattle	CH ₄	127.2	3.47%	85.11%
1B2d	Fugitive Emissions	CO ₂	60.8	1.66%	86.77%
2A1	Mineral Products: Cement	CO ₂	51.6	1.41%	88.18%
3B1	Manure Management: Cattle	CH ₄	45.8	1.25%	89.43%
2B10	Other	N ₂ O	41.3	1.13%	90.56%
3D2	Agricultural Soils: Indirect	N ₂ O	39.5	1.08%	91.63%
1A3a	Domestic Aviation	CO ₂	33.3	0.909%	92.54%
1A3d	Domestic Navigation	CO ₂	32.6	0.889%	93.43%
1A4b	Residential Stationary	CO ₂	27.9	0.762%	94.19%
3A4	Enteric Fermentation: Other	CH ₄	25.6	0.697%	94.89%
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH ₄	18.9	0.515%	95.40%

Table A1.2. Key category analysis approach 1 level for 2024, excluding LULUCF, [kt CO₂e].

IPCC code	IPCC category	Gas	2024 Emissions [kt CO ₂ e]	Level Assessment [%]	Cumulative Total of Level [%]
2C3	Metal Production: Aluminium	CO ₂	1301.9	27.24%	27.24%
1A3b	Road Transport	CO ₂	888.4	18.59%	45.83%
1A4c	Agriculture/Forestry/Fishing	CO ₂	534.7	11.19%	57.02%
2C2	Metal Production: Ferroalloys	CO ₂	522.5	10.93%	67.95%
3D1	Agricultural Soils: Direct	N ₂ O	266.3	5.57%	73.53%
1B2d	Fugitive Emissions	CO ₂	218.7	4.58%	78.10%
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH ₄	187.1	3.92%	82.02%
3A1	Enteric Fermentation: Cattle	CH ₄	137.0	2.87%	84.88%
1A2	Manufacturing and Construction	CO ₂	127.7	2.67%	87.56%
3A2	Enteric Fermentation: Sheep	CH ₄	114.7	2.40%	89.96%
2F1	Refrigeration and Air Conditioning	HFC	106.7	2.23%	92.19%
2C3	Metal Production: Aluminium	PFC	58.5	1.22%	93.41%
3B1	Manure Management: Cattle	CH ₄	41.7	0.872%	94.29%
3D2	Agricultural Soils: Indirect	N ₂ O	35.1	0.734%	95.02%

Table A1.3. Key category analysis approach 1 1990-2024 trend assessment, excluding LULUCF, [kt CO₂e].

IPCC code	IPCC Category	Gas	Base Year (1990) Estimate E _{x,0} [kt CO ₂ e]	Current Year (2024) Estimate E _{x,t} [kt CO ₂ e]	Trend Assessment T _{x,t}	Contribution to Trend [%]	Cumulative Total of trend [%]
2C3	Metal Production: Aluminium	CO ₂	139.2	1301.9	30.55%	28.29%	28.29%
2C3	Metal Production: Aluminium	PFC	444.8	58.5	14.21%	13.16%	41.45%
1A4c	Agriculture/Forestry/Fishing	CO ₂	802.9	534.7	13.95%	12.92%	54.37%
1A2	Manufacturing and Construction	CO ₂	305.4	127.7	7.37%	6.83%	61.20%
2C2	Metal Production: Ferroalloys	CO ₂	208.8	522.5	6.83%	6.32%	67.52%
1A3b	Road Transport	CO ₂	519.8	888.4	5.75%	5.33%	72.85%
5A2	Unmanaged Waste Disposal Sites	CH ₄	153.6	0.0	5.46%	5.06%	77.91%
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH ₄	18.9	187.1	4.43%	4.10%	82.01%
1B2d	Fugitive Emissions	CO ₂	60.8	218.7	3.80%	3.52%	85.53%
3A2	Enteric Fermentation: Sheep	CH ₄	186.2	114.7	3.49%	3.23%	88.76%
2A1	Mineral Products: Cement	CO ₂	51.6	0.0	1.83%	1.70%	90.46%
2B10	Other	N ₂ O	41.3	0.0	1.47%	1.36%	91.82%
3D1	Agricultural Soils: Direct	N ₂ O	233.3	266.3	1.028%	0.95%	92.77%
1A4b	Residential Stationary	CO ₂	27.9	4.4	0.873%	0.81%	93.58%
1A3d	Domestic Navigation	CO ₂	32.6	13.3	0.794%	0.74%	94.32%

IPCC code	IPCC Category	Gas	Base Year (1990) Estimate $E_{x,0}$ [kt CO ₂ e]	Current Year (2024) Estimate $E_{x,t}$ [kt CO ₂ e]	Trend Assessment $T_{x,t}$	Contribution to Trend [%]	Cumulative Total of trend [%]
3A1	Enteric Fermentation: Cattle	CH ₄	127.2	137.0	0.78%	0.73%	95.04%

Table A1.4. Key Category analysis approach 1 Level Assessment for 1990, including LULUCF, [kt CO₂e].

IPCC code	IPCC Category	Gas	1990 Emissions / Removals [kt CO ₂ e]	Level Assessment [%]	Cumulative Total of Level [%]
4C1	Grassland Remaining Grassland	CO ₂	2093.5	20.10%	20.10%
4C2	Land Converted to Grassland	CO ₂	1793.1	17.21%	37.31%
4B1	Cropland Remaining Cropland	CO ₂	1383.4	13.28%	50.59%
1A4c	Agriculture/Forestry/Fishing	CO ₂	802.9	7.71%	58.30%
4B2	Land Converted to Cropland	CO ₂	709.5	6.81%	65.11%
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO ₂	146.4	5.32%	70.43%
1A3b	Road Transport	CO ₂	519.8	4.99%	75.42%
2C3	Metal Production: Aluminium	PFC	444.8	4.27%	79.69%
1A2	Manufacturing and Construction	CO ₂	305.4	2.93%	82.62%
3D1	Agricultural Soils: Direct	N ₂ O	233.3	2.24%	84.86%
2C2	Metal Production: Ferroalloys	CO ₂	208.8	2.00%	86.87%
3A2	Enteric Fermentation: Sheep	CH ₄	186.2	1.79%	88.66%
5A2	Unmanaged waste disposal sites	CH ₄	153.6	1.48%	90.13%
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH ₄	554.2	1.41%	91.54%
2C3	Metal Production: Aluminium	CO ₂	139.2	1.34%	92.87%
3A1	Enteric Fermentation: Cattle	CH ₄	127.2	1.22%	94.09%
1B2d	Fugitive Emissions	CO ₂	60.8	0.58%	94.68%
2A1	Mineral Products: Cement	CO ₂	51.6	0.49%	95.17%

Table A1.5. Key category analysis approach 1 level for 2024, including LULUCF, [kt CO₂e].

IPCC Code	IPCC Category	Gas	2024 Emissions/ Removals [kt CO ₂ e]	Level Assessment [%]	Cumulative Total of Level [%]
4C1	Grassland Remaining Grassland	CO ₂	4521.9	36.65%	36.65%
4B1	Cropland Remaining Cropland	CO ₂	1409.4	11.42%	48.08%
2C3	Metal Production: Aluminium	CO ₂	1301.9	10.55%	58.63%
1A3b	Road Transport	CO ₂	888.4	7.20%	65.83%

IPCC Code	IPCC Category	Gas	2024 Emissions/ Removals [kt CO ₂ e]	Level Assessment [%]	Cumulative Total of Level [%]
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO ₂	158.5	4.98%	70.81%
1A4c	Agriculture/Forestry/Fishing	CO ₂	534.7	4.33%	75.15%
2C2	Metal Production: Ferroalloys	CO ₂	522.5	4.24%	79.38%
4A2	Land Converted to Forest Land	CO ₂	-416.5	3.38%	82.76%
3D1	Agricultural Soils: Direct	N ₂ O	266.3	2.16%	84.92%
1B2d	Fugitive Emissions	CO ₂	218.7	1.77%	86.69%
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH ₄	187.1	1.52%	88.21%
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH ₄	614.4	1.28%	89.49%
4B2	Land Converted to Cropland	CO ₂	149.6	1.21%	90.70%
3A1	Enteric Fermentation: Cattle	CH ₄	137.0	1.11%	91.81%
4C2	Land Converted to Grassland	CO ₂	-128.0	1.04%	92.85%
1A2	Manufacturing and Construction	CO ₂	127.7	1.03%	93.89%
4A1	Forest land remaining forest land	CO ₂	-124.2	1.01%	94.89%
3A2	Enteric Fermentation: Sheep	CH ₄	114.7	0.93%	95.82%

Table A1.6. Key category analysis approach 1 - 1990-2024 trend assessment, including LULUCF, [kt CO₂e].

IPCC Code	IPCC Category	Gas	Base Year (1990) Estimate E _{x,0} [kt CO ₂ e]	Current Year (2024) Estimate E _{x,t} [kt CO ₂ e]	Trend Assessment T _{x,t}	Contribution to Trend [%]	Cumulative Total of trend [%]
4C2	Land Converted to Grassland	CO ₂	1793.1	-128.0	21.62%	23.57%	23.57%
4C1	Grassland Remaining Grassland	CO ₂	2093.5	4521.9	19.61%	21.38%	44.95%
2C3	Metal Production: Aluminium	CO ₂	139.2	1301.9	10.92%	11.90%	56.85%
4B2	Land converted to cropland	CO ₂	709.5	149.6	6.63%	7.23%	64.08%
2C3	Metal Production: Aluminium	PFC	444.8	58.5	4.50%	4.90%	68.99%
1A4c	Agriculture/ Forestry/ Fishing	CO ₂	802.9	534.7	4.00%	4.36%	73.34%
4A2	Land Converted to Forest Land	CO ₂	-29.6	-416.5	3.66%	3.99%	77.33%
2C2	Metal Production: Ferroalloys	CO ₂	208.8	522.5	2.64%	2.88%	80.22%
1A3b	Road Transport	CO ₂	519.8	888.4	2.62%	2.86%	83.07%
1A2	Manufacturing and Construction	CO ₂	305.4	127.7	2.25%	2.45%	85.52%
4B1	Cropland Remaining Cropland	CO ₂	1383.4	1409.4	2.20%	2.40%	87.92%

IPCC Code	IPCC Category	Gas	Base Year (1990) Estimate $E_{x,0}$ [kt CO ₂ e]	Current Year (2024) Estimate $E_{x,t}$ [kt CO ₂ e]	Trend Assessment $T_{x,t}$	Contribution to Trend [%]	Cumulative Total of trend [%]
5A2	Unmanaged waste disposal sites	CH ₄	153.6	0.0	1.75%	1.90%	89.82%
5A1a	Managed waste disposal sites (Anaerobic)	CH ₄	18.9	187.1	1.58%	1.72%	91.55%
1B2d	Fugitive Emissions	CO ₂	60.8	218.7	1.41%	1.54%	93.08%
4A1	Forest Land Remaining Forest Land	CO ₂	-1.86	-124.2	1.17%	1.28%	94.36%
3A2	Enteric Fermentation: Sheep	CH ₄	186.2	114.7	1.02%	1.11%	95.47%

Annex 2 Assessment of Uncertainty

The methodology for this assessment of uncertainty is discussed in Section 1.6 of this report. The assessment of uncertainty takes into account activity data and emission factor uncertainties, and their relationship to national totals.

Because emissions from the LULUCF sector represent such a large part of Iceland's inventory, the assessment of uncertainty changes considerably depending on whether it includes or excludes LULUCF. When including LULUCF, the overall trend uncertainty estimate for this submission is 21.8%, whereas the uncertainty in total inventory is 28.7%. When looking at the uncertainty analysis without LULUCF, the trend uncertainty is 6.2%, and the uncertainty in total inventory is 4.7%.

Table A2.1 and Table A2.2 show the complete uncertainty assessment, with and without LULUCF, respectively.

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Table A2.1. Uncertainty Analysis including LULUCF.

IPCC Category		Gas	1990 Emissions [kt CO ₂ e]	2024 Emissions [kt CO ₂ e]	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in Year x	Uncertainty in Trend Introduced by Emission Factor [%]	Uncertainty Introduced by Activity Data Uncertainty [%]	Uncertainty Introduced into the Trend in Total National Emissions [%]
1A1ai	Public Electricity and Heat Production (Electricity Generation)	CO ₂	4.12	15.40	5%	5%	7%	9.8E-09	0.005%	0.011%	0.000%
1A1aiii	Public Electricity and Heat Production (Heat Plants)	CO ₂	9.34	0.00	5%	5%	7%	0.0E+00	0.005%	0.000%	0.000%
1A2a	Iron and Steel	CO ₂	0.35	2.03	2%	5%	5%	9.3E-11	0.001%	0.000%	0.000%
1A2b	Non-Ferrous Metals	CO ₂	13.50	4.14	2%	5%	5%	3.9E-10	0.005%	0.001%	0.000%
1A2c	Chemicals	CO ₂	7.43	0.00	5%	5%	7%	0.0E+00	0.004%	0.000%	0.000%
1A2e	Food Processing, Beverages, and Tobacco	CO ₂	128.24	62.20	5%	5%	7%	1.6E-07	0.036%	0.042%	0.000%
1A2f	Non-metallic Minerals	CO ₂	47.42	0.52	5%	5%	7%	1.1E-11	0.024%	0.000%	0.000%
1A2g	Other Manufacturing Industries and Constructions	CO ₂	108.49	58.78	5%	5%	7%	1.4E-07	0.027%	0.040%	0.000%
1A3a	Domestic Aviation	CO ₂	33.34	20.34	5%	5%	7%	1.7E-08	0.007%	0.014%	0.000%
1A3b	Road Transport	CO ₂	519.81	888.42	7%	3%	8%	3.8E-05	0.091%	0.858%	0.007%
1A3d	Domestic Water-borne Navigation	CO ₂	32.59	13.34	5%	5%	7%	7.4E-09	0.010%	0.009%	0.000%
1A3e	Mobile Machinery – Other	CO ₂	2.24	0.92	5%	5%	7%	3.5E-11	0.001%	0.001%	0.000%
1A4a	Commercial/Institutional	CO ₂	8.02	2.41	5%	5%	7%	2.4E-10	0.003%	0.002%	0.000%
1A4b	Residential	CO ₂	27.94	4.40	5%	5%	7%	8.0E-10	0.012%	0.003%	0.000%
1A4c	Agriculture/Fishing	CO ₂	802.91	534.68	5%	5%	7%	1.2E-05	0.153%	0.365%	0.002%

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IPCC Category		Gas	1990 Emissions [kt CO ₂ e]	2024 Emissions [kt CO ₂ e]	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in Year x	Uncertainty in Trend Introduced by Emission Factor [%]	Uncertainty Introduced by Activity Data Uncertainty [%]	Uncertainty Introduced into the Trend in Total National Emissions [%]
1A5a	Other – Stationary	CO ₂	0.12	4.60	5%	5%	7%	8.8E-10	0.002%	0.003%	0.000%
1B2a5	Oil – Distribution of Oil Products	CO ₂	0.00	0.01	5%	50%	50%	7.4E-14	0.000%	0.000%	0.000%
1B2d	Other Emissions from Energy Production	CO ₂	60.84	218.73	0%	20%	20%	1.6E-05	0.298%	0.000%	0.001%
2A1	Cement Production	CO ₂	51.56	0.00	2%	30%	30%	0.0E+00	0.159%	0.000%	0.000%
2A4d	Other: Mineral Wool Production	CO ₂	0.70	0.92	2%	2%	3%	5.2E-12	0.000%	0.000%	0.000%
2B10a	Other: Silica Production	CO ₂	0.36	0.00	5%	10%	11%	0.0E+00	0.000%	0.000%	0.000%
2C1a	Metal Production – Iron and steel	CO ₂	0.00	0.00	10%	25%	27%	0.0E+00	0.000%	0.000%	0.000%
2C2	Metal Production – Ferroalloys	CO ₂	208.80	522.51	2%	2%	2%	1.0E-06	0.044%	0.107%	0.000%
2C3	Metal Production – Aluminium Production	CO ₂	139.21	1301.91	2%	2%	2%	6.3E-06	0.167%	0.267%	0.001%
2D1	Lubricants	CO ₂	4.06	2.01	5%	50%	50%	8.5E-09	0.011%	0.001%	0.000%
2D2	Paraffin Wax Use	CO ₂	0.17	0.29	5%	100%	100%	7.2E-10	0.001%	0.000%	0.000%
2D3a	Domestic Solvent Use Including Fungicide	CO ₂	0.59	3.86	2%	38%	38%	1.8E-08	0.012%	0.001%	0.000%
2D3b	Other (please specify) Road Paving with Asphalt	CO ₂	0.01	0.01	2%	303%	303%	5.5E-12	0.000%	0.000%	0.000%
2D3d	Coating Applications	CO ₂	1.12	0.85	2%	43%	44%	1.1E-09	0.001%	0.000%	0.000%
2D3e	Degreasing	CO ₂	0.17	0.11	2%	74%	74%	5.3E-11	0.000%	0.000%	0.000%
2D3f	Dry Cleaning	CO ₂	0.00	0.00	2%	496%	496%	4.9E-12	0.000%	0.000%	0.000%
2D3g	Chemical Products	CO ₂	0.03	0.01	2%	36%	36%	4.3E-14	0.000%	0.000%	0.000%

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2D3h	Printing	CO ₂	0.17	0.06	2%	207%	207%	1.3E-10	0.002%	0.000%	0.000%
2D3ia	Creosotes	CO ₂	0.00	0.00	2%	43%	43%	0.0E+00	0.000%	0.000%	0.000%
2D3ib	Organic Preservative	CO ₂	0.02	0.05	2%	5%	6%	7.0E-14	0.000%	0.000%	0.000%
2D3ic	De-icing	CO ₂	0.08	0.16	30%	75%	80%	1.4E-10	0.001%	0.001%	0.000%
2D3urea	Urea-based Catalysts	CO ₂	0.00	0.93	2%	5%	5%	2.1E-11	0.000%	0.000%	0.000%
2G4fw	Other: Fireworks	CO ₂	0.00	0.03	2%	50%	50%	1.6E-12	0.000%	0.000%	0.000%
3G	Liming	CO ₂	0.02	2.51	50%	50%	71%	2.6E-08	0.012%	0.017%	0.000%
3H	Urea Application	CO ₂	0.00	2.02	20%	50%	54%	9.8E-09	0.010%	0.006%	0.000%
3I	Other Carbon Containing Fertilisers	CO ₂	0.00	1.15	50%	50%	71%	5.5E-09	0.006%	0.008%	0.000%
4(II)	Cropland	CO ₂	30.87	22.62	20%	48%	52%	1.2E-06	0.047%	0.063%	0.000%
4(II)	Forest Land	CO ₂	0.09	0.66	3%	47%	47%	8.1E-10	0.003%	0.000%	0.000%
4(II)	Grasslands	CO ₂	115.4	134.8	18%	42%	45%	3.1E-05	0.049%	0.322%	0.001%
4(II)	Wetlands	CO ₂	0.0	0.4	24%	31%	39%	2.0E-10	0.001%	0.001%	0.000%
4(IV)	Biomass Burning	CO ₂	0.00	0.00	0%	0%	0%	0.0E+00	0.000%	0.000%	0.000%
4A1	Forest Land Remaining Forest Land	CO ₂	-1.86	-124.17	4%	30%	30%	1.2E-05	0.355%	0.061%	0.001%
4A2	Land Converted to Forest Land	CO ₂	-29.63	-416.49	2%	7%	7%	7.6E-06	0.255%	0.138%	0.001%
4B1	Cropland Remaining Cropland	CO ₂	1383.4	1409.4	21%	20%	29%	1.4E-03	0.113%	4.120%	0.170%
4B2	Land Converted to Cropland	CO ₂	709.5	149.6	11%	33%	35%	2.2E-05	1.907%	0.230%	0.037%

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4C1	Grassland Remaining Grassland	CO ₂	2093.5	4521.9	25%	61%	66%	7.4E-02	13.507%	15.544%	4.241%
4C2	Land Converted to Grassland	CO ₂	1793.1	-128.0	119%	204%	237%	7.6E-04	40.024%	2.084%	16.063%
4D1	Wetlands Remaining Wetlands	CO ₂	0.0	-0.5	29%	40%	49%	5.6E-10	0.002%	0.002%	0.000%
4D2	Land Converted to Wetlands	CO ₂	0.51	-1.46	45%	80%	92%	1.5E-08	0.015%	0.009%	0.000%
4E2	Land Converted to Settlements	CO ₂	30.41	25.05	4%	24%	24%	3.1E-07	0.017%	0.013%	0.000%
4G	Harvested Wood Products	CO ₂	0.00	-0.19	10%	50%	51%	8.2E-11	0.001%	0.000%	0.000%
5C	Incineration and Open Burning of waste	CO ₂	7.30	6.62	39%	40%	56%	1.1E-07	0.004%	0.035%	0.000%
1A1ai	Public electricity and heat production (electricity generation)	CH ₄	0.005	0.018	5%	100%	100%	2.6E-12	0.000%	0.000%	0.000%
1A1aiii	Public electricity and heat production (heat plants)	CH ₄	0.010	0.000	5%	100%	100%	0.0E+00	0.000%	0.000%	0.000%
1A2a	Iron and Steel	CH ₄	0.000	0.002	2%	100%	100%	2.5E-14	0.000%	0.000%	0.000%
1A2b	Non-Ferrous Metals	CH ₄	0.014	0.002	2%	100%	100%	3.0E-14	0.000%	0.000%	0.000%
1A2c	Chemicals	CH ₄	0.008	0.000	5%	100%	100%	0.0E+00	0.000%	0.000%	0.000%
1A2e	Food Processing, Beverages, and Tobacco	CH ₄	0.139	0.131	5%	100%	100%	1.4E-10	0.000%	0.000%	0.000%
1A2f	Non-metallic Minerals	CH ₄	0.137	0.001	5%	100%	100%	2.9E-15	0.001%	0.000%	0.000%

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1A2g	Other Manufacturing Industries and Constructions	CH ₄	0.152	0.086	5%	100%	100%	6.1E-11	0.001%	0.000%	0.000%
1A3a	Domestic Aviation	CH ₄	0.007	0.004	5%	100%	100%	1.3E-13	0.000%	0.000%	0.000%
1A3b	Road Transport	CH ₄	6.410	1.031	7%	197%	197%	3.4E-08	0.110%	0.001%	0.000%
1A3d	Domestic Water-borne Navigation	CH ₄	0.085	0.035	5%	50%	50%	2.6E-12	0.000%	0.000%	0.000%
1A3e	Mobile machinery – Other	CH ₄	0.004	0.001	5%	100%	100%	1.7E-14	0.000%	0.000%	0.000%
1A4a	Commercial/Institutional	CH ₄	0.027	0.006	5%	100%	100%	3.2E-13	0.000%	0.000%	0.000%
1A4b	Residential	CH ₄	0.139	0.050	5%	100%	100%	2.0E-11	0.001%	0.000%	0.000%
1A4c	Agriculture/Fishing	CH ₄	2.069	1.400	5%	50%	50%	4.1E-09	0.004%	0.001%	0.000%
1A5a	Other – Stationary	CH ₄	0.000	0.006	5%	100%	100%	3.0E-13	0.000%	0.000%	0.000%
1B2a5	Oil – Distribution of Oil Products	CH ₄	0.518	0.783	5%	50%	50%	1.3E-09	0.001%	0.001%	0.000%
1B2b5	Fugitive Emissions - Natural Gas	CH ₄	0.000	0.043	5%	120%	120%	2.2E-11	0.001%	0.000%	0.000%
1B2d	Other emission from Energy Production	CH ₄	0.222	4.570	0%	20%	20%	6.9E-09	0.008%	0.000%	0.000%
2C2	Metal Production – Ferroalloys	CH ₄	1.758	4.809	2%	10%	10%	2.0E-09	0.003%	0.001%	0.000%
2G4tob	Other – Tobacco	CH ₄	0.050	0.012	2%	50%	50%	3.1E-13	0.000%	0.000%	0.000%
2G4fw	Other – Fireworks use	CH ₄	0.003	0.015	2%	50%	50%	4.6E-13	0.000%	0.000%	0.000%
3A1	Enteric Fermentation – Cattle	CH ₄	127.2	137.0	5%	40%	40%	2.5E-05	0.007%	0.094%	0.000%

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3A2	Enteric Fermentation – Sheep	CH ₄	186.2	114.7	5%	40%	40%	1.8E-05	0.321%	0.078%	0.001%
3A3	Enteric Fermentation – Swine	CH ₄	1.232	1.600	5%	40%	40%	3.4E-09	0.001%	0.001%	0.000%
3A4 rabbit	Enteric Fermentation – Rabbit	CH ₄	0.005	0.000	5%	40%	40%	2.0E-17	0.000%	0.000%	0.000%
3A4 fur-bearing	Enteric Fermentation – Fur-bearing	CH ₄	0.134	0.013	5%	40%	40%	2.4E-13	0.000%	0.000%	0.000%
3A4 poultry	Enteric Fermentation – Poultry	CH ₄	0.379	0.480	5%	40%	40%	3.1E-10	0.000%	0.000%	0.000%
3A4 horses	Enteric Fermentation – Horses	CH ₄	24.932	22.491	10%	40%	41%	7.1E-07	0.015%	0.031%	0.000%
3A4 goats	Enteric Fermentation – Goats	CH ₄	0.109	0.631	5%	40%	40%	5.4E-10	0.002%	0.000%	0.000%
3B11	Manure Management – Cattle	CH ₄	45.844	41.679	23%	20%	31%	1.4E-06	0.014%	0.134%	0.000%
3B12	Manure Management – Sheep	CH ₄	16.335	8.704	54%	20%	58%	2.1E-07	0.017%	0.065%	0.000%
3B13	Manure Management – Swine	CH ₄	6.405	8.221	59%	30%	67%	2.5E-07	0.004%	0.067%	0.000%
3B14 rabbit	Manure Management – Rabbit	CH ₄	0.004	0.0001	59%	30%	67%	3.6E-17	0.000%	0.000%	0.000%
3B14 fur-bearing	Manure Management – Fur-bearing	CH ₄	0.910	0.091	59%	30%	67%	3.0E-11	0.003%	0.001%	0.000%
3B14 poultry	Manure Management – Poultry	CH ₄	4.597	0.839	59%	30%	67%	2.6E-09	0.012%	0.007%	0.000%
3B14 horses	Manure Management – Horses	CH ₄	1.389	1.255	60%	30%	67%	5.9E-09	0.001%	0.010%	0.000%

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3B14 goats	Manure Management – Goats	CH ₄	0.003	0.016	59%	30%	67%	9.2E-13	0.000%	0.000%	0.000%
4(II)	Cropland	CH ₄	114.4	83.8	5%	69%	69%	2.8E-05	0.250%	0.055%	0.001%
4(II)	Forest Land	CH ₄	0.127	0.931	3%	64%	65%	3.0E-09	0.005%	0.000%	0.000%
4(II)	Grassland	CH ₄	437.5	510.9	4%	59%	60%	7.7E-04	0.266%	0.291%	0.002%
4(II)	Wetlands	CH ₄	2.1	18.7	14%	65%	66%	1.3E-06	0.103%	0.035%	0.000%
4(IV)	Biomass Burning	CH ₄	0.000	0.298	100%	78%	127%	1.2E-09	0.002%	0.004%	0.000%
5A1a	Managed Waste Disposal Sites - Anaerobic	CH ₄	18.9	187.1	22%	48%	53%	8.1E-05	0.776%	0.572%	0.009%
5A1b	Managed Waste Disposal Sites - Semi-anaerobic	CH ₄	0.00	15.9	27%	55%	61%	7.8E-07	0.084%	0.059%	0.000%
5A2	Unmanaged Waste Disposal Sites	CH ₄	153.6	0.0	27%	55%	61%	0.0E+00	0.864%	0.000%	0.007%
5B	Biological Treatment of Solid Waste	CH ₄	0.000	4.434	16%	60%	62%	6.3E-08	0.026%	0.010%	0.000%
5C	Incineration and Open Burning of Waste	CH ₄	6.816	0.388	39%	100%	107%	1.4E-09	0.066%	0.002%	0.000%
5D1	Wastewater Treatment and Discharge Domestic Wastewater	CH ₄	4.911	7.522	74%	55%	92%	4.0E-07	0.012%	0.076%	0.000%
5D2	Wastewater Treatment and Discharge Industrial Wastewater	CH ₄	4.906	3.882	103%	58%	118%	1.7E-07	0.007%	0.055%	0.000%
1A1ai	Public electricity and heat production (electricity generation)	N ₂ O	0.009	0.033	5%	100%	100%	9.1E-12	0.000%	0.000%	0.000%

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1A1a	Public electricity and heat production (heat plants)	N ₂ O	0.019	0.000	5%	100%	100%	0.0E+00	0.000%	0.000%	0.000%
1A2a	Iron and Steel	N ₂ O	0.001	0.003	2%	100%	100%	7.3E-14	0.000%	0.000%	0.000%
1A2b	Non-ferrous Metals	N ₂ O	0.026	0.002	2%	100%	100%	2.9E-14	0.000%	0.000%	0.000%
1A2c	Chemicals	N ₂ O	0.015	0.000	5%	100%	100%	0.0E+00	0.000%	0.000%	0.000%
1A2e	Food Processing, Beverages, and Tobacco	N ₂ O	0.264	0.205	5%	100%	100%	3.5E-10	0.001%	0.000%	0.000%
1A2f	Non-metallic Minerals	N ₂ O	0.195	0.001	5%	100%	100%	1.0E-14	0.002%	0.000%	0.000%
1A2g	Other Manufacturing Industries and Construction	N ₂ O	7.097	5.016	5%	100%	100%	2.1E-07	0.024%	0.003%	0.000%
1A3a	Domestic Aviation	N ₂ O	0.248	0.151	5%	150%	150%	4.2E-10	0.002%	0.000%	0.000%
1A3b	Road Transport	N ₂ O	5.003	16.053	7%	130%	130%	3.6E-06	0.135%	0.016%	0.000%
1A3d	Domestic Water-borne Navigation	N ₂ O	0.230	0.096	5%	140%	140%	1.5E-10	0.002%	0.000%	0.000%
1A3e	Mobile Machinery – Other	N ₂ O	0.230	0.094	5%	250%	250%	4.6E-10	0.004%	0.000%	0.000%
1A4a	Commercial/Institutional	N ₂ O	0.013	0.002	5%	100%	100%	3.1E-14	0.000%	0.000%	0.000%
1A4b	Residential	N ₂ O	0.062	0.006	5%	100%	100%	3.0E-13	0.001%	0.000%	0.000%
1A4c	Agriculture/Fishing	N ₂ O	10.517	5.722	5%	140%	140%	5.3E-07	0.074%	0.004%	0.000%
1A5a	Other – Stationary	N ₂ O	0.000	0.011	5%	100%	100%	9.2E-13	0.000%	0.000%	0.000%
1B2a5	Oil – Distribution of Oil Products	N ₂ O	0.000	0.000	5%	0%	5%	0.0E+00	0.000%	0.000%	0.000%
2B10b	Other – Fertiliser Production	N ₂ O	41.340	0.000	5%	40%	40%	0.0E+00	0.170%	0.000%	0.000%

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2G3a	N ₂ O from Product Uses: Medical Applications	N ₂ O	4.711	1.023	6%	5%	8%	5.3E-11	0.002%	0.001%	0.000%
2G3b	N ₂ O from Product Uses: Other	N ₂ O	0.639	0.389	6%	5%	8%	7.7E-12	0.000%	0.000%	0.000%
2G4tob	Other – Tobacco	N ₂ O	0.010	0.002	2%	50%	50%	1.1E-14	0.000%	0.000%	0.000%
2G4fw	Other – Fireworks	N ₂ O	0.058	0.330	2%	50%	50%	2.2E-10	0.001%	0.000%	0.000%
3B21	Manure Management – Cattle	N ₂ O	0.171	1.079	40%	100%	108%	1.1E-08	0.009%	0.006%	0.000%
3B22	Manure Management – Sheep	N ₂ O	11.234	6.958	56%	100%	115%	5.3E-07	0.048%	0.054%	0.000%
3B24 rabbit	Manure Management – Rabbit	N ₂ O	0.157	0.004	55%	100%	114%	1.6E-13	0.002%	0.000%	0.000%
3B24 fur- bearing	Manure Management – Fur-bearing	N ₂ O	2.746	0.234	55%	100%	114%	5.9E-10	0.026%	0.002%	0.000%
3B24 poultry	Manure Management – Poultry	N ₂ O	0.038	0.174	60%	100%	117%	3.4E-10	0.001%	0.001%	0.000%
3B24 horses	Manure Management – Horses	N ₂ O	1.319	1.199	51%	100%	112%	1.5E-08	0.002%	0.008%	0.000%
3B24 goats	Manure Management – Goats	N ₂ O	0.010	0.060	51%	100%	112%	3.7E-11	0.000%	0.000%	0.000%
3B25	Manure Management – Indirect	N ₂ O	8.156	7.279	208%	80%	223%	2.2E-06	0.011%	0.207%	0.000%
3D1.1	Inorganic N Fertilisers	N ₂ O	51.932	44.449	5%	80%	80%	1.1E-05	0.083%	0.030%	0.000%
3D1.2a	Organic N Fertilisers	N ₂ O	23.576	20.720	61%	80%	100%	3.6E-06	0.033%	0.172%	0.000%
3D1.2b	Organic N Fertilisers	N ₂ O	0.000	0.139	10%	80%	81%	1.0E-10	0.001%	0.000%	0.000%
3D1.2c	Organic N Fertilisers	N ₂ O	0.000	1.263	20%	175%	176%	4.1E-08	0.021%	0.003%	0.000%

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3D1.3	Urine and Dung Deposited by Grazing Animals	N ₂ O	9.768	7.676	71%	175%	189%	1.7E-06	0.046%	0.075%	0.000%
3D1.4	Crop Residues	N ₂ O	0.194	0.265	200%	80%	215%	2.7E-09	0.000%	0.007%	0.000%
3D1.6	Cultivation of Organic Soils	N ₂ O	147.784	191.776	17%	44%	47%	6.7E-05	0.148%	0.438%	0.002%
3D2.1	Indirect N ₂ O Emissions	N ₂ O	11.256	11.021	200%	80%	215%	4.7E-06	0.007%	0.301%	0.001%
3D2.2	Nitrogen Leaching and Run-off	N ₂ O	28.222	24.043	19%	201%	202%	1.9E-05	0.115%	0.061%	0.000%
4(I)	Direct and Indirect nitrous oxide (N ₂ O) emissions from nitrogen (N) inputs to managed soils	N ₂ O	0.016	2.528	5%	193%	193%	2.0E-07	0.047%	0.002%	0.000%
4(II)	Forest Land	N ₂ O	0.322	2.365	3%	0%	3%	4.7E-11	0.000%	0.001%	0.000%
4(III)	Direct N ₂ O emissions from N Mineralization/Immobiliz ation	N ₂ O	6.549	2.511	13%	127%	127%	8.5E-08	0.054%	0.005%	0.000%
4(IV)	Biomass Burning	N ₂ O	0.000	0.258	100%	95%	138%	1.0E-09	0.002%	0.004%	0.000%
5B	Biological Treatment of Solid Waste	N ₂ O	0.000	2.027	16%	113%	114%	4.4E-08	0.022%	0.004%	0.000%
5C	Incineration and Open Burning of Waste	N ₂ O	1.489	0.465	39%	100%	107%	2.1E-09	0.011%	0.002%	0.000%
5D1	Wastewater Treatment and Discharge Domestic Wastewater	N ₂ O	4.223	6.281	65%	755%	758%	1.9E-05	0.131%	0.056%	0.000%

IPCC Category		Gas	1990 Emissions [kt CO ₂ e]	2024 Emissions [kt CO ₂ e]	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in Year x	Uncertainty in Trend Introduced by Emission Factor [%]	Uncertainty Introduced by Activity Data Uncertainty [%]	Uncertainty Introduced into the Trend in Total National Emissions [%]
5D2	Wastewater Treatment and Discharge Industrial Wastewater	N ₂ O	10.007	7.919	103%	745%	752%	2.9E-05	0.195%	0.111%	0.001%
2F1	Refrigeration and Air Conditioning	HFC	0.000	106.745	0%	0%	65%	4.0E-05	0%	0%	0%
2F4	Aerosols	HFC	0.629	0.972	5%	5%	7%	3.9E-11	0.0001%	0.0007%	0.0000%
2C3	Metal Production – Aluminium Production	PFC	444.816	58.501	2%	15%	15%	6.4E-07	0.5993%	0.0120%	0.0036%
2F1	Refrigeration and Air Conditioning	PFC	0.000	0.067	0%	0%	65%	1.6E-11	0%	0%	0%
2G1	Electrical Equipment	SF ₆	1.130	1.63106450	30%	30%	42%	4.0E-09	0.0012%	0.0067%	0.0000%
2G2b	Accelerators	SF ₆	0.0001	0.0002679	2%	30%	30%	5.4E-17	0.0000%	0.0000%	0.0000%
Total Emissions			10353.69	10994.96							
Total Uncertainties			% Uncertainty in total inventory (including LULUCF):						27.7%	Trend uncertainty:	45.3%

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Table A2.2. Uncertainty Analysis excluding LULUCF.

IPCC Category		Gas	1990 Emissions [kt CO ₂ e]	2023 Emissions [kt CO ₂ e]	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in Year x	Uncertainty in Trend Introduced by Emission Factor [%]	Uncertainty Introduced by Activity Data Uncertainty [%]	Uncertainty Introduced into the Trend in Total National Emissions [%]
1A1ai	Public Electricity and Heat Production (Electricity Generation)	CO ₂	4.12	15.40	5%	5%	7%	5.2E-08	0.0137%	0.0297%	0.0000%
1A1aiii	Public Electricity and Heat Production (Heat Plants)	CO ₂	9.34	0.00	5%	5%	7%	0.0E+00	0.0166%	0.0000%	0.0000%
1A2a	Iron and Steel	CO ₂	0.35	2.03	2%	5%	5%	4.9E-10	0.0021%	0.0012%	0.0000%
1A2b	Non-Ferrous Metals	CO ₂	13.50	4.14	2%	5%	5%	2.0E-09	0.0183%	0.0024%	0.0000%
1A2c	Chemicals	CO ₂	7.43	0.00	5%	5%	7%	0.0E+00	0.0132%	0.0000%	0.0000%
1A2e	Food Processing, Beverages, and Tobacco	CO ₂	128.24	62.20	5%	5%	7%	8.5E-07	0.1430%	0.1199%	0.0003%
1A2f	Non-metallic Minerals	CO ₂	47.42	0.52	5%	5%	7%	5.9E-11	0.0835%	0.0010%	0.0001%
1A2g	Other Manufacturing Industries and Constructions	CO ₂	108.49	58.78	5%	5%	7%	7.6E-07	0.1126%	0.1133%	0.0003%
1A3a	Domestic Aviation	CO ₂	33.34	20.34	5%	5%	7%	9.1E-08	0.0315%	0.0392%	0.0000%
1A3b	Road Transport	CO ₂	519.81	888.42	7%	3%	8%	2.0E-04	0.1611%	2.4226%	0.0589%
1A3d	Domestic Water-borne Navigation	CO ₂	32.59	13.34	5%	5%	7%	3.9E-08	0.0397%	0.0257%	0.0000%
1A3e	Mobile Machinery – Other	CO ₂	2.24	0.92	5%	5%	7%	1.9E-10	0.0027%	0.0018%	0.0000%
1A4a	Commercial/Institutional	CO ₂	8.02	2.41	5%	5%	7%	1.3E-09	0.0110%	0.0046%	0.0000%
1A4b	Residential	CO ₂	27.94	4.40	5%	5%	7%	4.2E-09	0.0436%	0.0085%	0.0000%
1A4c	Agriculture/Fishing	CO ₂	802.91	534.68	5%	5%	7%	6.3E-05	0.6961%	1.0310%	0.0155%
1A5a	Other – Stationary	CO ₂	0.12	4.60	5%	5%	7%	4.6E-09	0.0061%	0.0089%	0.0000%
1B2a5	Oil – Distribution of Oil Products	CO ₂	0.00	0.01	5%	50%	50%	3.9E-13	0.0000%	0.0000%	0.0000%

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IPCC Category		Gas	1990 Emissions [kt CO ₂ e]	2023 Emissions [kt CO ₂ e]	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in Year x	Uncertainty in Trend Introduced by Emission Factor [%]	Uncertainty Introduced by Activity Data Uncertainty [%]	Uncertainty Introduced into the Trend in Total National Emissions [%]
1B2d	Other Emissions from Energy Production	CO ₂	60.84	218.73	0%	20%	20%	8.4E-05	0.7603%	0.0000%	0.0058%
2A1	Cement Production	CO ₂	51.56	0.00	2%	30%	30%	0.0E+00	0.5496%	0.0000%	0.0030%
2A4d	Other: Mineral Wool Production	CO ₂	0.70	0.92	2%	2%	3%	2.7E-11	0.0000%	0.0008%	0.0000%
2B10a	Other: Silica Production	CO ₂	0.36	0.00	5%	10%	11%	0.0E+00	0.0013%	0.0000%	0.0000%
2C1a	Metal Production – Iron and steel	CO ₂	0.00	0.00	10%	25%	27%	0.0E+00	0.0000%	0.0000%	0.0000%
2C2	Metal Production – Ferroalloys	CO ₂	208.80	522.51	2%	2%	2%	5.4E-06	0.1024%	0.3022%	0.0010%
2C3	Metal Production – Aluminium Production	CO ₂	139.21	1301.91	2%	2%	2%	3.3E-05	0.4581%	0.7531%	0.0078%
2D1	Lubricants	CO ₂	4.06	2.01	5%	50%	50%	4.5E-08	0.0447%	0.0039%	0.0000%
2D2	Paraffin Wax Use	CO ₂	0.17	0.29	5%	100%	100%	3.8E-09	0.0019%	0.0006%	0.0000%
2D3a	Domestic Solvent Use Including fungicide	CO ₂	0.59	3.86	2%	38%	38%	9.6E-08	0.0323%	0.0030%	0.0000%
2D3b	Other (please specify) Road Paving with Asphalt	CO ₂	0.01	0.01	2%	303%	303%	2.9E-11	0.0002%	0.0000%	0.0000%
2D3d	Coating Applications	CO ₂	1.12	0.85	2%	43%	44%	6.0E-09	0.0072%	0.0007%	0.0000%
2D3e	Degreasing	CO ₂	0.17	0.11	2%	74%	74%	2.8E-10	0.0022%	0.0001%	0.0000%
2D3f	Dry cleaning	CO ₂	0.00	0.00	2%	496%	496%	2.6E-11	0.0001%	0.0000%	0.0000%
2D3g	Chemical Products	CO ₂	0.03	0.01	2%	36%	36%	2.3E-13	0.0004%	0.0000%	0.0000%
2D3h	Printing	CO ₂	0.17	0.06	2%	207%	207%	7.0E-10	0.0091%	0.0000%	0.0000%
2D3ia	Creosotes	CO ₂	0.00	0.00	2%	43%	43%	0.0E+00	0.0000%	0.0000%	0.0000%
2D3ib	Organic preservative	CO ₂	0.02	0.05	2%	5%	6%	3.7E-13	0.0000%	0.0000%	0.0000%
2D3ic	De-icing	CO ₂	0.08	0.16	30%	75%	80%	7.5E-10	0.0012%	0.0019%	0.0000%

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IPCC Category		Gas	1990 Emissions [kt CO ₂ e]	2023 Emissions [kt CO ₂ e]	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in Year x	Uncertainty in Trend Introduced by Emission Factor [%]	Uncertainty Introduced by Activity Data Uncertainty [%]	Uncertainty Introduced into the Trend in Total National Emissions [%]
2D3urea	Urea-based Catalysts	CO ₂	0.00	0.93	2%	5%	5%	1.1E-10	0.0013%	0.0007%	0.0000%
2G4fw	Other – Fireworks	CO ₂	0.00	0.03	2%	50%	50%	8.5E-12	0.0003%	0.0000%	0.0000%
3G	Liming	CO ₂	0.02	2.51	50%	50%	71%	1.4E-07	0.0338%	0.0484%	0.0000%
3H	Urea Application	CO ₂	0.00	2.02	20%	50%	54%	5.2E-08	0.0275%	0.0156%	0.0000%
3I	Other Carbon Containing Fertilisers	CO ₂	0.00	1.15	50%	50%	71%	2.9E-08	0.0157%	0.0222%	0.0000%
5C	Incineration and Open Burning of Waste	CO ₂	7.30	6.62	39%	40%	56%	6.0E-07	0.0315%	0.0997%	0.0001%
1A1ai	Public Electricity and Heat Production (Electricity Generation)	CH ₄	0.00	0.02	5%	100%	100%	1.4E-11	0.0003%	0.0000%	0.0000%
1A1aiii	Public Electricity and Heat Production (Heat Plants)	CH ₄	0.01	0.00	5%	100%	100%	0.0E+00	0.0004%	0.0000%	0.0000%
1A2a	Iron and Steel	CH ₄	0.00	0.00	2%	100%	100%	1.3E-13	0.0000%	0.0000%	0.0000%
1A2b	Non-ferrous Metals	CH ₄	0.01	0.00	2%	100%	100%	1.6E-13	0.0004%	0.0000%	0.0000%
1A2c	Chemicals	CH ₄	0.01	0.00	5%	100%	100%	0.0E+00	0.0003%	0.0000%	0.0000%
1A2e	Food Processing, Beverages, and Tobacco	CH ₄	0.14	0.13	5%	100%	100%	7.5E-10	0.0014%	0.0003%	0.0000%
1A2f	Non-metallic Minerals	CH ₄	0.14	0.00	5%	100%	100%	1.5E-14	0.0048%	0.0000%	0.0000%
1A2g	Other Manufacturing Industries and Construction	CH ₄	0.15	0.09	5%	100%	100%	3.2E-10	0.0031%	0.0002%	0.0000%
1A3a	Domestic Aviation	CH ₄	0.01	0.00	5%	100%	100%	7.0E-13	0.0001%	0.0000%	0.0000%
1A3b	Road Transport	CH ₄	6.41	1.03	7%	197%	197%	1.8E-07	0.3940%	0.0028%	0.0016%
1A3d	Domestic Water-borne Navigation	CH ₄	0.09	0.04	5%	50%	50%	1.4E-11	0.0010%	0.0001%	0.0000%

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1A3e	Mobile machinery – Other	CH ₄	0.00	0.00	5%	100%	100%	9.2E-14	0.0001%	0.0000%	0.0000%
1A4a	Commercial/Institutional	CH ₄	0.03	0.01	5%	100%	100%	1.7E-12	0.0008%	0.0000%	0.0000%
1A4b	Residential	CH ₄	0.14	0.05	5%	100%	100%	1.1E-10	0.0036%	0.0001%	0.0000%
1A4c	Agriculture/Fishing	CH ₄	2.07	1.40	5%	50%	50%	2.2E-08	0.0177%	0.0027%	0.0000%
1A5a	Other – Stationary	CH ₄	0.00	0.01	5%	100%	100%	1.6E-12	0.0002%	0.0000%	0.0000%
1B2a5	Oil – Distribution of Oil Products	CH ₄	0.52	0.78	5%	50%	50%	6.8E-09	0.0015%	0.0015%	0.0000%
1B2b5	Fugitive Emissions - Natural Gas	CH ₄	0.00	0.04	5%	120%	120%	1.2E-10	0.0014%	0.0001%	0.0000%
1B2d	Other emissions from Energy Production	CH ₄	0.22	4.57	0%	20%	20%	3.7E-08	0.0233%	0.0000%	0.0000%
2C2	Metal Production – Ferroalloys	CH ₄	1.76	4.81	2%	10%	10%	1.0E-08	0.0069%	0.0028%	0.0000%
2G4tob	Other – Tobacco	CH ₄	0.05	0.01	2%	50%	50%	1.6E-12	0.0007%	0.0000%	0.0000%
2G4fw	Other – Fireworks	CH ₄	0.00	0.01	2%	50%	50%	2.4E-12	0.0002%	0.0000%	0.0000%
3A1	Enteric Fermentation – Cattle	CH ₄	127.19	136.98	5%	40%	40%	1.3E-04	0.3137%	0.2641%	0.0017%
3A2	Enteric Fermentation – Sheep	CH ₄	186.23	114.72	5%	40%	40%	9.4E-05	1.3950%	0.2212%	0.0200%
3A3	Enteric Fermentation – Swine	CH ₄	1.23	1.60	5%	40%	40%	1.8E-08	0.0001%	0.0031%	0.0000%
3A4 rabbit	Enteric Fermentation – Rabbit	CH ₄	0.01	0.00	5%	40%	40%	1.1E-16	0.0001%	0.0000%	0.0000%
3A4 fur-bearing	Enteric Fermentation – Fur-bearing	CH ₄	0.13	0.01	5%	40%	40%	1.3E-12	0.0018%	0.0000%	0.0000%
3A4 poultry	Enteric Fermentation – Poultry	CH ₄	0.38	0.48	5%	40%	40%	1.6E-09	0.0002%	0.0009%	0.0000%
3A4 horses	Enteric Fermentation – Horses	CH ₄	24.93	22.49	10%	40%	41%	3.8E-06	0.1091%	0.0867%	0.0002%
3A4 goats	Enteric Fermentation – Goats	CH ₄	0.11	0.63	5%	40%	40%	2.8E-09	0.0053%	0.0012%	0.0000%
3B11	Manure Management – Cattle	CH ₄	45.84	41.68	23%	20%	31%	7.2E-06	0.0985%	0.3769%	0.0015%

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3B12	Manure Management – Sheep	CH ₄	16.34	8.70	54%	20%	58%	1.1E-06	0.0686%	0.1823%	0.0004%
3B13	Manure Management – Swine	CH ₄	6.41	8.22	59%	30%	67%	1.3E-06	0.0010%	0.1882%	0.0004%
3B14 rabbit	Manure Management – Rabbit	CH ₄	0.00	0.00	59%	30%	67%	1.9E-16	0.0000%	0.0000%	0.0000%
3B14 fur-bearing	Manure Management – Fur-bearing	CH ₄	0.91	0.09	59%	30%	67%	1.6E-10	0.0090%	0.0021%	0.0000%
3B14 poultry	Manure Management – Poultry	CH ₄	4.60	0.84	59%	30%	67%	1.4E-08	0.0421%	0.0192%	0.0000%
3B14 horses	Manure Management – Horses	CH ₄	1.39	1.25	60%	30%	67%	3.1E-08	0.0045%	0.0290%	0.0000%
3B14 goats	Manure Management – Goats	CH ₄	0.00	0.02	59%	30%	67%	4.9E-12	0.0001%	0.0004%	0.0000%
5A1a	Managed Waste Disposal Sites - Anaerobic	CH ₄	18.89	187.13	22%	48%	53%	4.3E-04	2.1311%	1.6136%	0.0715%
5A1b	Managed Waste Disposal Sites - Semi-anaerobic	CH ₄	0.00	15.94	27%	55%	61%	4.2E-06	0.2385%	0.1655%	0.0008%
5A2	Unmanaged waste disposal sites	CH ₄	153.65	0.00	27%	55%	61%	0.0E+00	2.9939%	0.0000%	0.0896%
5B	Biological treatment of solid waste	CH ₄	0.00	4.43	16%	60%	62%	3.4E-07	0.0730%	0.0270%	0.0001%
5C	Incineration and Open Burning of waste	CH ₄	6.82	0.39	39%	100%	107%	7.6E-09	0.2316%	0.0058%	0.0005%
5D1	Wastewater Treatment and Discharge Domestic Wastewater	CH ₄	4.91	7.52	74%	55%	92%	2.1E-06	0.0167%	0.2141%	0.0005%
5D2	Wastewater Treatment and Discharge Industrial Wastewater	CH ₄	4.91	3.88	103%	58%	118%	9.3E-07	0.0399%	0.1543%	0.0003%
1A1ai	Public Electricity and Heat Production (Electricity Generation)	N ₂ O	0.01	0.03	0.0006%	0.0001%	0.0000%	0.0006%	0.0001%	0.0001%	0.0000%
1A1aiii	Public Electricity and Heat Production (Heat Plants)	N ₂ O	0.02	0.00	0.0007%	0.0000%	0.0000%	0.0007%	0.0000%	0.0000%	0.0000%

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IPCC Category		Gas	1990 Emissions [kt CO ₂ e]	2023 Emissions [kt CO ₂ e]	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in Year x	Uncertainty in Trend Introduced by Emission Factor [%]	Uncertainty Introduced by Activity Data Uncertainty [%]	Uncertainty Introduced into the Trend in Total National Emissions [%]
1A2a	Iron and Steel	N ₂ O	0.00	0.00	0.0001%	0.0000%	0.0000%	0.0001%	0.0000%	0.0000%	0.0000%
1A2b	Non-ferrous Metals	N ₂ O	0.03	0.00	0.0009%	0.0000%	0.0000%	0.0009%	0.0000%	0.0000%	0.0000%
1A2c	Chemicals	N ₂ O	0.02	0.00	0.0005%	0.0000%	0.0000%	0.0005%	0.0000%	0.0000%	0.0000%
1A2e	Food Processing, Beverages, and Tobacco	N ₂ O	0.26	0.21	0.0038%	0.0004%	0.0000%	0.0038%	0.0004%	0.0004%	0.0000%
1A2f	Non-metallic Minerals	N ₂ O	0.19	0.00	0.0069%	0.0000%	0.0000%	0.0069%	0.0000%	0.0000%	0.0000%
1A2g	Other Manufacturing Industries and Construction	N ₂ O	7.10	5.02	0.1154%	0.0097%	0.0001%	0.1154%	0.0097%	0.0097%	0.0001%
1A3a	Domestic Aviation	N ₂ O	0.25	0.15	0.0070%	0.0003%	0.0000%	0.0070%	0.0003%	0.0003%	0.0000%
1A3b	Road Transport	N ₂ O	5.00	16.05	0.3383%	0.0438%	0.0012%	0.3383%	0.0438%	0.0317%	0.0025%
1A3d	Domestic Water-borne Navigation	N ₂ O	0.23	0.10	0.0078%	0.0002%	0.0000%	0.0078%	0.0002%	0.0002%	0.0000%
1A3e	Mobile Machinery – Other	N ₂ O	0.23	0.09	0.0140%	0.0002%	0.0000%	0.0140%	0.0002%	0.0002%	0.0000%
1A4a	Commercial/Institutional	N ₂ O	0.01	0.00	0.0004%	0.0000%	0.0000%	0.0004%	0.0000%	0.0000%	0.0000%
1A4b	Residential	N ₂ O	0.06	0.01	0.0020%	0.0000%	0.0000%	0.0020%	0.0000%	0.0000%	0.0000%
1A4c	Agriculture/Fishing	N ₂ O	10.52	5.72	0.3048%	0.0110%	0.0009%	0.3048%	0.0110%	0.0111%	0.0010%
1A5a	Other – Stationary	N ₂ O	0.00	0.01	0.0003%	0.0000%	0.0000%	0.0003%	0.0000%	0.0000%	0.0000%
1B2a5	Oil – Distribution of Oil Products	N ₂ O	0.00	0.00	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%
2B10b	Other – Fertiliser Production	N ₂ O	41.34	0.00	0.5876%	0.0000%	0.0035%	0.5876%	0.0000%	0.0000%	0.0036%
2G3a	N ₂ O from Product Uses – Medical Applications	N ₂ O	4.71	1.02	0.0070%	0.0024%	0.0000%	0.0070%	0.0024%	0.0024%	0.0000%
2G3b	N ₂ O from Product Uses – Other	N ₂ O	0.64	0.39	0.0006%	0.0009%	0.0000%	0.0006%	0.0009%	0.0009%	0.0000%
2G4tob	Other – Tobacco	N ₂ O	0.01	0.00	0.0001%	0.0000%	0.0000%	0.0001%	0.0000%	0.0000%	0.0000%

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IPCC Category		Gas	1990 Emissions [kt CO ₂ e]	2023 Emissions [kt CO ₂ e]	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in Year x	Uncertainty in Trend Introduced by Emission Factor [%]	Uncertainty Introduced by Activity Data Uncertainty [%]	Uncertainty Introduced into the Trend in Total National Emissions [%]
2G4fw	Other – Fireworks	N ₂ O	0.06	0.33	0.0035%	0.0003%	0.0000%	0.0035%	0.0003%	0.0003%	0.0000%
3B21	Manure Management – Cattle	N ₂ O	0.17	1.08	0.0233%	0.0165%	0.0000%	0.0233%	0.0165%	0.0166%	0.0000%
3B22	Manure Management – Sheep	N ₂ O	11.23	6.96	0.2095%	0.1512%	0.0007%	0.2095%	0.1512%	0.1535%	0.0007%
3B24 rabbit	Manure Management – Rabbit	N ₂ O	0.16	0.00	0.0055%	0.0001%	0.0000%	0.0055%	0.0001%	0.0001%	0.0000%
3B24 fur-bearing	Manure Management – Fur-bearing	N ₂ O	2.75	0.23	0.0912%	0.0050%	0.0001%	0.0912%	0.0050%	0.0050%	0.0001%
3B24 poultry	Manure Management – Poultry	N ₂ O	0.04	0.17	0.0034%	0.0040%	0.0000%	0.0034%	0.0040%	0.0041%	0.0000%
3B24 horses	Manure Management – Horses	N ₂ O	1.32	1.20	0.0142%	0.0235%	0.0000%	0.0142%	0.0235%	0.0236%	0.0000%
3B24 goats	Manure Management – Goats	N ₂ O	0.01	0.06	0.0013%	0.0012%	0.0000%	0.0013%	0.0012%	0.0012%	0.0000%
3B25	Manure Management – Indirect	N ₂ O	8.16	7.28	0.0731%	0.5849%	0.0035%	0.0731%	0.5849%	0.6571%	0.0044%
3D1.1	Inorganic N fertilisers	N ₂ O	51.93	44.45	0.5066%	0.0857%	0.0026%	0.5066%	0.0857%	0.0861%	0.0028%
3D1.2a	Animal Manure Applied to Soils	N ₂ O	23.58	20.72	0.2182%	0.4846%	0.0028%	0.2182%	0.4846%	0.4901%	0.0029%
3D1.2b	Animal Manure Applied to Soils	N ₂ O	0.00	0.14	0.0030%	0.0005%	0.0000%	0.0030%	0.0005%	0.0005%	0.0000%
3D1.2c	Animal Manure Applied to Soils	N ₂ O	0.00	1.26	0.0603%	0.0097%	0.0000%	0.0603%	0.0097%	0.0098%	0.0000%
3D1.3	Urine and Dung Deposited by Grazing Animals	N ₂ O	9.77	7.68	0.2411%	0.2114%	0.0010%	0.2411%	0.2114%	0.2123%	0.0007%
3D1.4	Crop Residues	N ₂ O	0.19	0.26	0.0003%	0.0204%	0.0000%	0.0003%	0.0204%	0.0205%	0.0000%
3D1.6	Cultivation of Organic Soils (e.g., histosols)	N ₂ O	147.78	191.78	0.0097%	1.2367%	0.0153%	0.0097%	1.2367%	1.3389%	0.0211%
3D2.1	Atmospheric Deposition	N ₂ O	11.26	11.02	0.0796%	0.8503%	0.0073%	0.0796%	0.8503%	0.8158%	0.0067%
3D2.2	Nitrogen Leaching and Run-off	N ₂ O	28.22	24.04	0.6970%	0.1730%	0.0052%	0.6970%	0.1730%	0.1747%	0.0109%
5B	Biological Treatment of Solid Waste	N ₂ O	0.00	2.03	0.0622%	0.0124%	0.0000%	0.0622%	0.0124%	0.0124%	0.0001%

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IPCC Category		Gas	1990 Emissions [kt CO ₂ e]	2023 Emissions [kt CO ₂ e]	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in Year x	Uncertainty in Trend Introduced by Emission Factor [%]	Uncertainty Introduced by Activity Data Uncertainty [%]	Uncertainty Introduced into the Trend in Total National Emissions [%]
5C	Incineration and Open Burning of Waste	N ₂ O	1.49	0.46	0.0402%	0.0070%	0.0000%	0.0402%	0.0070%	0.0075%	0.0000%
5D1	Wastewater Treatment and Discharge Domestic Wastewater	N ₂ O	4.22	6.28	0.1603%	0.1576%	0.0005%	0.1603%	0.1576%	0.1583%	0.0005%
5D2	Wastewater Treatment and Discharge Industrial Wastewater	N ₂ O	10.01	7.92	1.0406%	0.3148%	0.0118%	1.0406%	0.3148%	0.3162%	0.0125%
2F1	Refrigeration and Air Conditioning	HFC	0.00	106.75	0%	0%	65%	2.1E-04	0%	0%	0%
2F4	Aerosols	HFC	0.63	0.97	5%	5%	7%	2.1E-10	0.0002%	0.0019%	0.0000%
2C3	Metal Production – Aluminium Production	PFC	444.82	58.50	2%	15%	15%	3.4E-06	2.1292%	0.0338%	0.0453%
2F1	Refrigeration and Air Conditioning	PFC	0.00	0.07	0%	0%	65%	8.5E-11	0%	0%	0%
2G1	Electrical Equipment	SF ₆	1.13	1.63	30%	30%	42%	2.1E-08	0.0013%	0.0189%	0.0000%
2G2b	Accelerators	SF ₆	0.00	0.00	2%	30%	30%	2.8E-16	0.0000%	0.0000%	0.0000%
Total Emissions			3667.2	4779.0							
Total Uncertainties			% Uncertainty in total inventory (excluding LULUCF):					4.6%	Trend uncertainty:		6.2%

Annex 3 National Energy Balance for 2024

The Icelandic energy balance is compiled by the Icelandic Environment and Energy Agency (Umhverfis- og orkustofnun) (IEEA) using fuel sales data (previously from the National Energy Authority (Orkustofnun) (NEA)) and Statistics Iceland (Hagstofa) (SI). Work has begun in collaboration with the agencies that provide the data to improve the energy balance for Iceland.

The energy balance can be seen in Table A3.1. The available final energy consumption is based on the Reference Approach for this submission. That data is based on fuel sales data from fuel suppliers and data from SI. Data for final energy consumption is disaggregated by CRT subsector and is used for the Sectoral Approach.

The total absolute difference between the Sectoral and Reference approaches is 166 TJ, which is 0.8% of the total final energy consumption in Iceland in 2024. The biggest relative discrepancies in fuel use are in LPG (14%), landfill gas (11%) and jet kerosene (8.5%). This discrepancy will be further analysed with the agencies that provide the data.

A comparison of CO₂ emissions [kt] between the sectoral approach and the reference approach are shown in Table A3.2.

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Table A3.1. National Energy Balance for 2024 [TJ].

2024	Gasoline	Jet Kerosene	Gas Diesel Oil	Residual Fuel Oil	LPG	Bitumen	Lubricants	Petroleum Coke	Other oil	Anthracite	Coke oven Gas	Peat	Liquid Biomass	Landfill gas	Total	Total without biofuel
Indigenous Production	—	—	—	—	—	—	—	—	—	—	—	—	—	80	80.0	0
Imports	4547	14109	21053	197	176.7	687	145	599	33	4441	326	20.26	876	—	47210	46334
Exports	—	—	—	—	—	—	—	—	—	—	—	0.024	—	—	0	0
International Bunkers	—	13978	4331	16	—	—	—	—	—	—	—	—	—	—	18325	18325
Stock Change	123.7	-174	104	-7	3.55	—	—	—	—	—	—	—	38.0	—	88	50
Primary Energy Supply	4423	305	16618	188	173	687	145	599	33	4441	326	20.24	838.16	80	28877	27959
Non-Energy Use of Fuels						687	137	599	33	4441	326	20.24			6243	6243
Available Final Energy Consumption [TJ]	4423	305	16618	188	173	0	7.6	0	0	0	0	0	838	80	22633	21715
1A1ai Electricity generation	—	—	208.8	—	—	—	—	—	—	—	—	—	—	—	209	209
1A1aiii Heat Plants	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0	0.0
1A2a Iron and Steel	—	—	16.6	—	12.8	—	—	—	—	—	—	—	—	—	29.4	29.4
1A2b Non-Ferrous Metals	—	—	1.0	—	64.5	—	—	—	—	—	—	—	—	—	65.5	65.5
1A2c Chemicals	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	0
1A2e Food Processing, Beverage and Tobacco	—	—	658	181	—	—	—	—	—	—	—	—	—	—	839	839
1A2f Non-Metallic Minerals	—	—	7.0	—	—	—	—	—	—	—	—	—	—	—	7.0	7.0
1A2gvii Off-Road Vehicles and Mobile Machinery	—	—	660	—	—	—	—	—	—	—	—	—	—	—	660	660
1A2gviii Other industry	—	—	95.5	NO	46.8	—	—	—	—	—	—	—	—	—	142	142

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2024	Gasoline	Jet Kerosene	Gas Diesel Oil	Residual Fuel Oil	LPG	Bitumen	Lubricants	Petroleum Coke	Other oil	Anthracite	Coke oven Gas	Peat	Liquid Biomass	Landfill gas	Total	Total without biofuel
1A3a Domestic Aviation	5.49	279	—	—	-	—	—	—	—	—	—	—	—	—	285	285
1A3b Road Transport	4350	—	7699	—	—	—	—	—	—	—	—	—	882	81.3	13012	12048
1A3dii Domestic Navigation	—	—	181	—	—	—	—	—	—	—	—	—	0.13	—	181	181
1A3eii Other Mobile Machinery	—	0.48	0.28	—	—	—	—	—	—	—	—	—	—	—	0.8	0.8
1A4ai Commercial/Institutional: Stationary Combustion	—	—	7.29	—	29.7	—	—	—	—	—	—	—	—	—	36.9	36.9
1A4bi Residential: Stationary Combustion	—	—	18.9	—	47.7	—	—	—	—	—	—	—	—	—	66.6	66.6
1A4ci Stationary Agriculture	—	—	—	—	0.189	—	—	—	—	—	—	—	—	—	0.189	0.189
1A4cii Off Road in Agriculture	—	—	267	—	—	—	—	—	—	—	—	—	—	—	267	267
1A4ciii Fishing	—	—	6983	—	—	—	—	—	—	—	—	—	—	—	6983	6983
1A5 Other	—	1.62	60.82	—	—	—	—	—	—	—	—	—	2.538	8.38	73.4	62.4
Final Energy Consumption [TJ]	4355	281	16863	180.6	202	—	—	—	—	—	—	—	885	89.7	22856	21882
Statistical Differences [TJ]	68	24	-245	7.31	-28.4	—	—	—	—	—	—	—	-46.8	-9.7	-223	-166
Difference [%]	1.6%	8.5%	-1.5%	4.0%	-14%	—	—	—	—	—	—	—	-5.3%	-11%	-1.0%	-0.8%

Table A3.2. A comparison of CO₂ emissions [kt] between the sectoral approach and the reference approach.

CO ₂ emissions [kt]		1990	1995	2000	2005	2010	2015	2020	2023	2024
Liquid fuels	Reference Approach	1744	1747	1771	1813	1597	1660	1499	1653	1598
	Sectoral Approach	1700	1898	1932	1961	1786	1656	1465	1562	1606

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CO ₂ emissions [kt]		1990	1995	2000	2005	2010	2015	2020	2023	2024
	Difference [kt]	44	-150	-161	-148	-189	4.0	33.6	91	-8.5
	Difference [%]	2.6%	-7.9%	-8.3%	-7.5%	-11%	0.24%	2.3%	5.8%	-0.53%
Solid fuels	Reference Approach	31.7	17.1	34.2	34.2	9.76	NO	NO	NO	NO
	Sectoral Approach	45.4	21.1	32.4	24.2	8.90	NO	NO	NO	NO
	Difference [kt]	-13.7	-4.02	1.81	10.0	0.86	—	—	—	—
	Difference [%]	-30%	-19%	5.6%	41%	9.7%	—	—	—	—
Other fossil fuel	Reference Approach	NO	0.64	0.83	0.82	1.56	NO	NO	NO	NO
	Sectoral Approach	NO	16.9	20.7	8.21	9.38	4.70	1.10	12.3	5.9
	Difference [kt]	—	-16.3	-19.8	-7.39	-7.82	-4.70	-1.10	-12.31	-5.87
	Difference [%]	—	-96%	-96%	-90%	-83%	-100%	-100%	-100%	-100%
Total	Reference Approach	1776	1765	1806	1848	1608	1660	1499	1653	1598
	Sectoral Approach	1746	1936	1985	1993	1804	1661	1466	1575	1612
	Difference [kt]	29.9	-171	-179	-145	-196	-0.73	32.5	78.4	-14.4
	Difference [%]	1.7%	-8.8%	-9.0%	-7.3%	-11%	-0.04%	2.2%	5.0%	-0.9%

Annex 4 ETS vs. Non-ETS

Information on consistency of reported emissions with data from the EU Emission Trading System according to Article 10 in the Implementing Regulation No 749/2014. According to Art.10 shall report the information referred to in Article 7(1)(k) of Regulation (EU) No 525/2013 in accordance with the tabular format set out in Annex V to the same Regulation. All emission figures are reported in kt CO₂e, with CO₂ equivalents calculated using GWPs from the 5th assessment report of the IPCC (AR5).

Table A4.1. Total greenhouse gas inventory emissions vs. emissions verified under the EU ETS.

Category ⁽¹⁾	Gas	Total Emissions (CO ₂ e)			Comment ⁽²⁾
		GHG inventory emissions [kt CO ₂ e] ⁽³⁾	Verified emissions under Directive 2003/87/EC [kt CO ₂ e] ⁽³⁾	Ratio in % (Verified emissions/inventory emissions) ⁽³⁾	
Greenhouse gas emissions (for GHG inventory: total GHG emissions, including indirect CO ₂ emissions if reported, without LULUCF, and excluding emissions from domestic aviation; for Directive 2003/87/EC: GHG emissions from stationary installations under Article 2(1) of Directive 2003/87/EC)	Total GHG	4758.5	1889.2	39.7%	
CO ₂ emissions (for GHG inventory: total CO ₂ emissions, including indirect CO ₂ emissions if reported, without LULUCF, and excluding CO ₂ emissions from domestic aviation; for Directive 2003/87/EC: CO ₂ emissions from stationary installations under Article 2(1) of Directive 2003/87/EC)	CO ₂	3656.6	1830.6	50.1%	

For footnotes, see under Table A4.4 below.

Table A4.2. Total GHG inventory CO₂ emissions vs. emissions verified under the EU ETS, by CRT sector.

Category ⁽¹⁾	CO ₂ Emissions				Comment ⁽²⁾
	Gas	GHG inventory emissions [kt CO ₂] ⁽³⁾	Verified emissions under Directive 2003/87/EC [kt CO ₂] ⁽³⁾	Ratio in % (Verified emissions/inventory emissions) ⁽³⁾	
1.A Fuel combustion activities, total	CO₂	1612.2	6.2	0.4%	
1.A Fuel combustion activities, stationary combustion	CO ₂	145.5	6.2	4.3%	
1.A.1 Energy industries	CO ₂	15.4	NO		Not verified emissions under Directive 2003/87/EC
1.A.1.a Public electricity and heat production	CO ₂	15.4	NO		Not verified emissions under Directive 2003/87/EC
1.A.1.b Petroleum refining	CO ₂	NO	NO		Does not occur in Iceland
1.A.1.c Manufacture of solid fuels and other energy industries	CO ₂	NO	NO		Does not occur in Iceland
Iron and steel total (1.A.2, 1.B, 2.C.1) ⁽⁴⁾	CO ₂	524.5	524.5	100.0%	
1.A.2. Manufacturing industries and construction	CO ₂	127.7	6.2	4.9%	
1.A.2.a Iron and steel	CO ₂	2.0	2.0	100.2%	Differences due to slightly different NCV values used by ETS companies vs. inventory
1.A.2.b Non-ferrous metals	CO ₂	4.1	4.1	100.1%	Differences due to slightly different NCV values used by ETS companies vs. inventory
1.A.2.c Chemicals	CO ₂	NO	NO		Does not occur in Iceland
1.A.2.d Pulp, paper, and print	CO ₂	NO	NO		Does not occur in Iceland
1.A.2.e Food processing, beverages, and tobacco	CO ₂	62.2	NO		Not verified emissions under Directive 2003/87/EC
1.A.2.f Non-metallic minerals	CO ₂	0.5	NO		Not verified emissions under Directive 2003/87/EC
1.A.2.g Other	CO ₂	58.8	0.1	0.1%	One company is included in ETS, others are not
1.A.3. Transport	CO ₂	923.0	NO		Not verified emissions under Directive 2003/87/EC
1.A.3.e Other transportation (pipeline transport)	CO ₂	NO	NO		Does not occur in Iceland
1.A.4 Other sectors	CO ₂	541.5	NO		Not verified emissions under Directive 2003/87/EC
1.A.4.a Commercial / Institutional	CO ₂	2.4	NO		Not verified emissions under Directive 2003/87/EC

CO ₂ Emissions					
1.A.4.c Agriculture/ Forestry / Fisheries	CO ₂	534.7	NO		Not verified emissions under Directive 2003/87/EC
1.B Fugitive Emissions from Fuels	CO ₂	218.7	NO		Not verified emissions under Directive 2003/87/EC
1.C CO ₂ Transport and Storage	CO ₂	NO	NO		Does not occur in Iceland
1.C.1 Transport of CO ₂	CO ₂	NO	NO		Does not occur in Iceland
1.C.2 Injection and Storage	CO ₂	NO	NO		Does not occur in Iceland
1.C.3 Other 2.A Mineral Products	CO ₂	NO	NO		Does not occur in Iceland
2.A Mineral Products	CO₂	0.9	NO		Not verified emissions under Directive 2003/87/EC
2.A.1 Cement Production	CO ₂	NO	NO		Does not occur in Iceland
2.A.2. Lime Production	CO ₂	NO	NO		Does not occur in Iceland
2.A.3. Glass Production	CO ₂	NO	NO		Does not occur in Iceland
2.A.4. Other Process Uses of Carbonates	CO ₂	0.9	NO		Not verified emissions under Directive 2003/87/EC
2.B Chemical Industry	CO₂	NO	NO		Does not occur in Iceland
2.B.1. Ammonia Production	CO ₂	NO	NO		Does not occur in Iceland
2.B.3. Adipic Acid Production (CO ₂)	CO ₂	NO	NO		Does not occur in Iceland
2.B.4. Caprolactam, Glyoxal, and Glyoxylic Acid Production	CO ₂	NO	NO		Does not occur in Iceland
2.B.5. Carbide Production	CO ₂	NO	NO		Does not occur in Iceland
2.B.6 Titanium Dioxide Production	CO ₂	NO	NO		Does not occur in Iceland
2.B.7 Soda Ash Production	CO ₂	NO	NO		Does not occur in Iceland
2.B.8 Petrochemical and Carbon Black Production	CO ₂	NO	NO		Does not occur in Iceland
2.C Metal Production	CO₂	1824.4	1824.4	100.0%	
2.C.1. Iron and Steel Production	CO ₂	NO	NO		Does not occur in Iceland
2.C.2 Ferroalloys Production	CO ₂	522.5	522.5	100.0%	
2.C.3 Aluminium Production	CO ₂	1301.9	1301.9	100.0%	
2.C.4 Magnesium Production	CO ₂	NO	NO		Does not occur in Iceland
2.C.5 Lead Production	CO ₂	NO	NO		Does not occur in Iceland
2.C.6 Zinc Production	CO ₂	NO	NO		Does not occur in Iceland
2.C.7 Other Metal Production	CO ₂	NO	NO		Does not occur in Iceland

For footnotes, see under Table A4.4 below.

Table A4.3. GHG inventory N₂O emissions vs. emissions verified under the EU ETS, by CRT sector [kt CO₂e].

N ₂ O Emissions					
Category ⁽¹⁾	Gas	GHG inventory emissions [kt CO ₂ e] ⁽³⁾	Verified emissions under Directive 2003/87/EC [kt CO ₂ e] ⁽³⁾	Ratio in % (Verified emissions/inventory emissions) ⁽³⁾	Comment ⁽²⁾
2.B.2. Nitric Acid Production	N ₂ O	NO	NO		Does not occur in Iceland
2.B.3. Adipic Acid Production	N ₂ O	NO	NO		Does not occur in Iceland
2.B.4. Caprolactam, Glyoxal, and Glyoxylic Acid Production	N ₂ O	NO	NO		Does not occur in Iceland

For footnotes, see under Table A4.4 below.

Table A4.4. GHG inventory PFC emissions vs. emissions verified under the EU ETS, by CRT sector [kt CO₂e].

PFC Emissions					
Category ⁽¹⁾	Gas	GHG inventory emissions [kt CO ₂ e] ⁽³⁾	Verified emissions under Directive 2003/87/EC [kt CO ₂ e] ⁽³⁾	Ratio in % (Verified emissions/inventory emissions) ⁽³⁾	Comment ⁽²⁾
2.C.3 Aluminium Production	PFC	58.5	58.5	100.0%	

⁽¹⁾ The allocation of verified emissions to disaggregated inventory categories at four-digit level must be reported where such allocation of verified emissions is possible and emissions occur. The following notation keys should be used: NO = not occurring; IE = included elsewhere; C = confidential

Negligible = small amount of verified emissions may occur in respective CRT category, but amount is < 5 % of the category.

⁽²⁾ The column comment should be used to give a brief summary of the checks performed and if a Member State wants to provide additional explanations with regard to the allocation reported.

⁽³⁾ Data to be reported up to one decimal point for kt and % values.

⁽⁴⁾ To be filled on the basis of combined CRT categories pertaining to 'Iron and Steel', to be determined individually by each Member State; the stated formula is for illustration purposes only.

Annex 5 Values used in Calculation of Digestible Energy of Cattle and Sheep Feed

Table A5.1. Values used in calculation of digestible energy of gross energy intake of feed (%DE): Mature Dairy Cattle.

1. Dairy Cattle, stallfed, lactation period		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Feed intake [kg/day]	Barley	0.17	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Feed intake [kg/day]	Concentrate	2.1	2.5	3.7	4.2	4.8	5.2	5.2	5.4	5.2
Organic matter digestibility [%]	Hay	72.6	74.2	75.0	74.0	77.1	79.0	77.3	77.5	74.0
Organic matter digestibility [%]	Barley	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0
Organic matter digestibility [%]	Concentrate	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.3	7.4	7.7	8.0	7.8
Ash content [%]	Barley	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Ash content [%]	Concentrate	8.0	8.0	8.0	8.0	8.6	9.0	9.0	9.0	9.0
Weighted average organic matter digestibility [%]		73.3	74.9	76.6	77.9	77.4	79.8	81.1	80.1	80.2
Weighted average ash content [%]		7.2	7.1	7.1	7.2	7.2	7.6	7.9	8.0	8.2
Time in feeding situation [days]		235	235	236	241	246	251	256	258	258

2. Dairy Cattle, stallfed, non-lactation		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	10.0	10.0	10.0	10.0	10.0	9.4	9.0	9.0	9.0
Feed intake [kg/day]	Concentrate	0.20	0.20	0.21	0.25	0.30	0.43	0.50	0.50	0.50
Organic matter digestibility [%]	Hay	70.0	71.1	72.2	73.0	73.0	73.0	73.0	73.3	73.5
Organic matter digestibility [%]	Concentrate	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.0	7.3	7.5	7.4	7.7
Ash content [%]	Concentrate	8.0	8.0	8.0	8.0	8.0	8.6	9.0	9.0	9.0
Weighted average organic matter digestibility [%]		67.0	70.3	71.4	72.4	73.3	73.3	73.5	73.6	73.9

2. Dairy Cattle, stallfed, non-lactation	1990	1995	2000	2005	2010	2015	2020	2023	2024
Weighted average ash content [%]	7.0	7.0	7.0	7.0	7.0	7.0	7.4	7.6	7.5
Time in feeding situation [days]	35	40	40	40	43	45	48	50	51

3. Dairy Cattle, pasture, lactation period		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Feed intake [kg/day]	Concentrate	2.0	2.1	2.5	3.7	4.2	4.4	4.5	4.5	4.5
Organic matter digestibility [%]	Hay	75.0	75.0	75.0	75.0	75.0	78.1	80.0	80.0	80.0
Organic matter digestibility [%]	Concentrate	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
Ash content [%]	Hay	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Ash content [%]	Concentrate	8.0	8.0	8.0	8.0	8.0	8.6	9.0	9.0	9.0
Weighted average organic matter digestibility [%]		73.9	76.5	76.6	76.8	77.4	77.7	80.0	81.4	81.4
Weighted average ash content [%]		7.6	7.5	7.5	7.5	7.5	7.6	7.7	7.9	7.9
Time in feeding situation [days]		65	70	70	69	64	59	54	49	47

4. Dairy Cattle, pasture, non-lactation		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Organic matter digestibility [%]	Hay	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
Ash content [%]	Hay	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Weighted average organic matter digestibility [%]		72.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
Weighted average ash content [%]		7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Time in feeding situation [days]		25	20	20	20	17	15	12	10	9

Conversion of organic matter digestibility to digestible energy % of gross energy intake ⁵⁹	1990	1995	2000	2005	2010	2015	2020	2023	2024
Digestible organic matter in dry matter (DOMD) [g/kg]	685	695	707	717	714	731	741	733	733
Ratio of DOMD to metabolisable energy [kJ/g]	15	15	15	15	15	15	15	15	15
Metabolisable energy in dry matter (ME) [kJ/kg]	10,270	10,429	10,602	10,753	10,716	10,971	11,117	10,990	10,991
Ratio of metabolisable to digestible energy [kJ/kJ]	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy in dry matter [kJ/kg]	12,679	12,875	13,089	13,275	13,230	13,545	13,725	13,568	13,569
Gross energy in dry matter [kJ/kg]	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450
Digestible energy of gross energy intake [%]	68.7	69.8	70.9	72.0	71.7	73.4	74.4	73.5	73.5

Table A5.2. Values used in calculation of digestible energy of gross energy intake of feed (%DE): Other Mature Cattle.

1. Other Mature Cattle, stallfed		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Feed intake [kg/day]	Concentrate	0.10	0.10	0.10	0.10	0.20	0.26	0.30	0.30	0.30
Organic matter digestibility [%]	Hay	69.0	70.6	71.8	73.0	72.0	72.6	73.0	73.3	73.5
Organic matter digestibility [%]	Concentrate	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.0	7.3	7.5	7.2	7.2
Ash content [%]	Concentrate	8.0	8.0	8.0	8.0	8.0	8.6	9.0	9.0	9.0
Weighted average organic matter digestibility [%]		69.2	70.7.2	71.9	73.1	72.3	72.9	73.3	73.6	73.8
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.3	7.5	7.3	7.3
Time in feeding situation [days]		30	30	30	30	30	30	30	30	30

2. Other Mature Cattle, pasture		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

⁵⁹ Energy allowances and feeding systems for ruminants (1975).

2. Other Mature Cattle, pasture		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Grass (grazing)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Organic matter digestibility [%]	Hay	69.0	70.6	71.8	73.0	72.0	72.6	73.0	73.3	73.5
Organic matter digestibility [%]	Grass (grazing)	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.2
Ash content [%]	Grass (grazing)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Weighted average organic matter digestibility [%]		74.4	75.6	76.2	76.7	77.2	76.8	77.0	77.2	77.3
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Time in feeding situation [days]		335	335	335	335	335	335	335	335	335

Conversion of organic matter digestibility to digestible energy % of gross energy intake ⁶⁰	1990	1995	2000	2005	2010	2015	2020	2023	2024
Digestible organic matter in dry matter (DOMD) [g/kg]	698	705	710	715	711	713	715	716	716
Ratio of DOMD to metabolisable energy [kJ/g]	15	15	15	15	15	15	15	15	15
Metabolisable energy in dry matter (ME) [kJ/kg]	10,472	10,569	10,647	10,722	10,660	10,693	10,719	10,742	10,746
Ratio of metabolisable to digestible energy [kJ/kJ]	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy in dry matter [kJ/kg]	12,928	13,049	13,144	13,237	13,161	13,201	13,233	13,261	13,266
Gross energy in dry matter [kJ/kg]	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450
Digestible energy of gross energy intake [%]	70.1	70.7	71.2	71.7	71.3	71.5	71.7	71.9	71.9

Table A5.3. Values used in calculation of digestible energy of gross energy intake of feed (%DE): Heifers.

1. Heifers, stallfed		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	5.0	5.0	5.0	5.0	5.0	5.0	5.5	5.5	5.5
Feed intake [kg/day]	Concentrate	0.50	0.55	0.60	0.65	0.70	0.70	0.70	0.70	0.70

⁶⁰ Energy allowances and feeding systems for ruminants (1975)

1. Heifers, stallfed		1990	1995	2000	2005	2010	2015	2020	2023	2024
Organic matter digestibility [%]	Hay	69.0	70.6	71.8	73.0	72.0	74.2	76.0	75.3	75.5
Organic matter digestibility [%]	Concentrate	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.0	7.3	7.5	7.2	7.2
Ash content [%]	Concentrate	8.0	8.0	8.0	8.0	8.0	8.6	9.0	9.0	9.0
Weighted average organic matter digestibility [%]		66.7	70.5	72.5	74.3	75.3	74.6	76.4	77.7	77.1
Weighted average ash content [%]		7.0	7.1	7.0	6.8	6.8	6.8	7.1	7.3	7.1
Time in feeding situation [days]		245	245	245	245	245	245	245	245	245

2. Heifers, pasture		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Feed intake [kg/day]	Grass (grazing)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Organic matter digestibility [%]	Hay	69.0	70.6	71.8	73.0	72.0	73.9	75.0	75.3	75.5
Organic matter digestibility [%]	Grass (grazing)	78.0	78.0	78.0	78.0	78.0	77.4	77.0	77.0	77.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.0	7.3	7.5	7.2	7.2
Ash content [%]	Grass (grazing)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Weighted average organic matter digestibility [%]		77.8	76.4	76.6	76.9	77.1	76.9	76.7	76.6	76.7
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.0
Time in feeding situation [days]		120	120	120	120	120	120	120	120	120

Conversion of organic matter digestibility to digestible energy % of gross energy intake ⁶¹	1990	1995	2000	2005	2010	2015	2020	2023	2024
Digestible organic matter in dry matter (DOMD) [g/kg]	673	686	699	707	701	711	718	716	717
Ratio of DOMD to metabolisable energy [kJ/g]	15	15	15	15	15	15	15	15	15

⁶¹ Energy allowances and feeding systems for ruminants (1975)

Conversion of organic matter digestibility to digestible energy % of gross energy intake⁶¹	1990	1995	2000	2005	2010	2015	2020	2023	2024
Metabolisable energy in dry matter (ME) [kJ/kg]	10,093	10,297	10,489	10,600	10,520	10,661	10,766	10,733	10,751
Ratio of metabolisable to digestible energy [kJ/kJ]	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy in dry matter [kJ/kg]	12,460	12,712	12,949	13,087	12,988	13,161	13,291	13,251	13,272
Gross energy in dry matter [kJ/kg]	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450
Digestible energy of gross energy intake [%]	67.8	69.0	70.0	70.7	70.2	71.1	71.7	71.4	71.5

Table A5.4. Values used in calculation of digestible energy of gross energy intake of feed (%DE): Young bulls.

1. Young bulls, stallfed		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	7.0	7.0	7.0	7.0	7.0	7.0	7.5	7.5	7.5
Feed intake [kg/day]	Barley	0.00	0.19	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Feed intake [kg/day]	Concentrate	0.50	0.55	0.60	0.65	0.70	0.70	0.70	0.70	0.70
Organic matter digestibility [%]	Hay	69.0	70.6	71.8	73.0	72.0	74.2	76.0	75.3	75.5
Organic matter digestibility [%]	Barley	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0
Organic matter digestibility [%]	Concentrate	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.0	7.3	7.5	7.2	7.2
Ash content [%]	Barley	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Ash content [%]	Concentrate	8.0	8.0	8.0	8.0	8.0	8.6	9.0	9.0	9.0
Weighted average organic matter digestibility [%]		67.7	70.1	72.0	73.7	74.8	74.0	75.9	77.3	76.7
Weighted average ash content [%]		7.1	7.1	7.0	6.8	6.8	6.8	7.2	7.4	7.1
Time in feeding situation [days]		307	365	365	365	365	365	365	365	365

Conversion of organic matter digestibility to digestible energy % of gross energy intake ⁶²	1990	1995	2000	2005	2010	2015	2020	2023	2024
Digestible organic matter in dry matter (DOMD) [g/kg]	651	669	686	696	689	704	716	712	714
Ratio of DOMD to metabolisable energy [kJ/g]	15	15	15	15	15	15	15	15	15
Metabolisable energy in dry matter (ME) [kJ/kg]	9,767	10,042	10,294	10,447	10,335	10,565	10,741	10,687	10,711
Ratio of metabolisable to digestible energy [kJ/kJ]	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy in dry matter [kJ/kg]	12,058	12,397	12,708	12,897	12,760	13,043	13,261	13,194	13,224
Gross energy in dry matter [kJ/kg]	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450
Digestible energy of gross energy intake [%]	65.4	67.2	68.9	69.9	69.2	70.7	71.9	71.5	71.7

Table A5.5. Values used in calculation of digestible energy of gross energy intake of feed (%DE): Calves

1. Calves, first 90 days		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Milk/formula	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Feed intake [kg/day]	Hay	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Feed intake [kg/day]	Concentrate	0.20	0.20	0.20	0.26	0.31	0.37	0.40	0.40	0.40
Organic matter digestibility [%]	Milk/formula	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0
Organic matter digestibility [%]	Hay	71.0	72.6	73.8	75.0	74.0	76.2	78.0	77.3	77.5
Organic matter digestibility [%]	Concentrate	82.0	82.0	82.0	82.0	82.0	82.0	85.0	85.0	85.0
Ash content [%]	Milk/formula	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.0	7.3	7.5	7.7	8.0
Ash content [%]	Concentrate	8.0	8.0	8.0	8.0	8.0	8.6	9.0	9.0	9.0
Weighted average organic matter digestibility [%]		89.4	89.6	89.7	89.8	89.6	89.2	89.1	89.9	89.8
Weighted average ash content [%]		8.7	8.7	8.7	8.7	8.7	8.6	8.8	8.9	8.9
Time in feeding situation [days]		90	90	90	90	90	90	90	90	90

⁶² Energy allowances and feeding systems for ruminants (1975)

2. Calves, days 91-365		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	2.0	2.2	2.3	2.5	2.6	2.8	2.9	2.9	2.9
Feed intake [kg/day]	Concentrate	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Organic matter digestibility [%]	Hay	71.0	72.6	73.8	75.0	74.0	75.1	76.0	75.3	75.5
Organic matter digestibility [%]	Concentrate	82.0	82.0	82.0	82.0	82.0	82.0	85.0	85.0	85.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.0	7.3	7.5	7.5	7.5
Ash content [%]	Concentrate	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Weighted average organic matter digestibility [%]		70.8	73.2	74.3	75.3	76.2	75.3	76.2	77.3	76.7
Weighted average ash content [%]		7.2	7.2	7.2	7.2	7.2	7.2	7.4	7.6	7.6
Time in feeding situation [days]		275	275	275	275	275	275	275	275	275

Conversion of organic matter digestibility to digestible energy % of gross energy intake ⁶³	1990	1995	2000	2005	2010	2015	2020	2023	2024
Digestible organic matter in dry matter (DOMD) [g/kg]	700	708	715	722	714	719	728	723	724
Ratio of DOMD to metabolisable energy [kJ/g]	15	15	15	15	15	15	15	15	15
Metabolisable energy in dry matter (ME) [kJ/kg]	10,497	10,622	10,722	10,828	10,712	10,786	10,920	10,846	10,867
Ratio of metabolisable to digestible energy [kJ/kJ]	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy in dry matter [kJ/kg]	12,959	13,113	13,237	13,368	13,225	13,317	13,481	13,391	13,416
Gross energy in dry matter [kJ/kg]	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450
Digestible energy of gross energy intake [%]	70.2	71.1	71.7	72.5	71.7	72.2	73.1	72.6	72.7

Table A5.6. Values used in calculation of digestible energy of gross energy intake of feed (%DE): Sheep

1. Sheep, stallfed		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6

⁶³ Energy allowances and feeding systems for ruminants (1975)

1. Sheep, stallfed		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Concentrate	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Organic matter digestibility [%]	Hay	68.0	69.6	70.8	72.0	71.0	73.8	76.0	74.0	76.0
Organic matter digestibility [%]	Concentrate	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.0	7.2	7.4	7.8	7.8
Ash content [%]	Concentrate	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Weighted average organic matter digestibility [%]		65.1	68.1	69.7	70.9	72.1	71.1	73.8	76.1	74.1
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.0	7.2	7.4	7.8
Time in feeding situation [days]		200	200	200	200	200	200	200	200	200

2. Sheep, pasture		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Hay	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Feed intake [kg/day]	Grass (grazing)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Organic matter digestibility [%]	Hay	71.0	72.6	73.8	75.0	74.0	76.2	78.0	78.0	78.0
Organic matter digestibility [%]	Grass (grazing)	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
Ash content [%]	Hay	7.0	7.0	7.0	7.0	7.0	7.2	7.4	7.8	7.8
Ash content [%]	Grass (grazing)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Weighted average organic matter digestibility [%]		77.0	77.8	78.1	78.5	78.8	78.5	79.1	79.5	79.5
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.2
Time in feeding situation [days]		60	60	60	60	60	60	60	60	60

3. Sheep, range		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Grass (grazing)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Organic matter digestibility [%]	Grass (grazing)	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0
Ash content [%]	Grass (grazing)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Weighted average organic matter digestibility [%]		70.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0

3. Sheep, range	1990	1995	2000	2005	2010	2015	2020	2023	2024
Weighted average ash content [%]	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Time in feeding situation [days]	105	105	105	105	105	105	105	105	105

Conversion of organic matter digestibility to digestible energy % of gross energy intake ⁶⁴	1990	1995	2000	2005	2010	2015	2020	2023	2024
Digestible organic matter in dry matter (DOMD) [g/kg]	664	672	678	685	680	693	703	692	701
Ratio of DOMD to metabolisable energy [kJ/g]	15	15	15	15	15	15	15	15	15
Metabolisable energy in dry matter (ME) [kJ/kg]	9,960	10,081	10,177	10,270	10,193	10,390	10,548	10,382	10,522
Ratio of metabolisable to digestible energy [kJ/kJ]	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy in dry matter [kJ/kg]	12,297	12,446	12,564	12,679	12,583	12,827	13,022	12,817	12,991
Gross energy in dry matter [kJ/kg]	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450
Digestible energy of gross energy intake [%]	66.6	67.5	68.1	68.7	68.2	69.5	70.6	69.5	70.4

Table A5.7. Values used in calculation of digestible energy of gross energy intake of feed (%DE): Lambs

1. Lambs, pre-weaning		1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Grass (grazing)	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Feed intake [kg/day]	Milk	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Organic matter digestibility [%]	Grass (grazing)	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0
Organic matter digestibility [%]	Milk	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
Ash content [%]	Grass (grazing)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Ash content [%]	Milk	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Weighted average organic matter digestibility [%]		79.9	81.7	81.7	81.7	81.7	81.7	81.7	81.7	81.7
Weighted average ash content [%]		6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2

⁶⁴ Energy allowances and feeding systems for ruminants (1975)

1. Lambs, pre-weaning	1990	1995	2000	2005	2010	2015	2020	2023	2024
Time in feeding situation [days]	60	60	60	60	60	60	60	60	60

2. Lambs, after-weaning	1990	1995	2000	2005	2010	2015	2020	2023	2024
Feed intake [kg/day]	Grass (grazing)	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Feed intake [kg/day]	Rape/rye grass etc.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Feed intake [kg/day]	Milk	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Organic matter digestibility [%]	Grass (grazing)	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0
Organic matter digestibility [%]	Rape/rye grass etc.	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.0
Organic matter digestibility [%]	Milk	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
Ash content [%]	Grass (grazing)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Ash content [%]	Rape/rye grass etc.	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Ash content [%]	Milk	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Weighted average organic matter digestibility [%]		79.4	81.6	81.6	81.6	81.6	81.6	81.6	81.6
Weighted average ash content [%]		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Time in feeding situation [days]		70	70	70	70	70	70	70	70

Conversion of organic matter digestibility to digestible energy % of gross energy intake ⁶⁵	1990	1995	2000	2005	2010	2015	2020	2023	2024
Digestible organic matter in dry matter (DOMD) [g/kg]	758	758	758	758	758	758	758	758	758
Ratio of DOMD to metabolisable energy [kJ/g]	15	15	15	15	15	15	15	15	15
Metabolisable energy in dry matter (ME) [kJ/kg]	11,375	11,375	11,375	11,375	11,375	11,375	11,375	11,375	11,375
Ratio of metabolisable to digestible energy [kJ/kJ]	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy in dry matter [kJ/kg]	14,043	14,043	14,043	14,043	14,043	14,043	14,043	14,043	14,043

⁶⁵ Energy allowances and feeding systems for ruminants (1975)

Conversion of organic matter digestibility to digestible energy % of gross energy intake ⁶⁵	1990	1995	2000	2005	2010	2015	2020	2023	2024
Gross energy in dry matter [kJ/kg]	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450	18,450
Digestible energy of gross energy intake [%]	76.1	76.1	76.1	76.1	76.1	76.1	76.1	76.1	76.1

Table A5.8. Conversion of organic matter digestibility into digestible energy of gross energy intake.

2022	Organic matter digestibility	Digestible organic matter in dry matter	Metabolisable energy	Digestible energy of gross energy intake
	OMD [%]	DOMD [g/kg]	ME [kJ/kg dm]	DE [%]
Calculations	cf. A-G	$10 \cdot (\text{OM in DM}) \cdot \text{OMD} / 100$	$15 \cdot \text{OMD}$	$\frac{\text{ME}}{0.81 \cdot 18450} \cdot 100$
Dairy Cattle	79.8	733	10,991	73.5
Other Mature Cattle	77.1	716	10,746	71.9
Heifers	77.1	717	10,751	71.5
Young Bulls	76.9	714	10,711	71.7
Young Cattle	78.5	724	10,867	72.7
Sheep	75.8	701	10,522	70.4
Lambs	81.6	758	11,375	76.1

Annex 6 Uncertainty rates associated with activity data and emission factors used in the LULUCF sector estimates

Table A6.1. Uncertainty rates associated with Forest Land use category

Category	Uncertainty rate	Reference
4.A.1. Forest land remaining Forest Land		
Area	-	The CI associated with the area estimates is based on the statistical calculation of the proportions of the systematic sample plots. Of the 1,625 plots in the sample area, 865 are classified as forest. The associated uncertainty rate was calculated based on the above-mentioned information.
All FL remaining FL LU sub-categories	±4%	
Living biomass: Gains/Losses		The uncertainty range evaluation (relative 95% CI) for paired carbon stock change measurements was conducted on 135 systematic sample plots from the NFI in the Natural Birch Forest part of the Natural Birch Woodland (NBW) (Snorrason et al. in prep.).
4.A.1. Natural Birch Forest older than 50 years	±34%	
Living biomass: Gains		The uncertainty range evaluation (relative 95% CI) for carbon stock change of the systematic sample plots from the NFI for the years 2021-2025 (n=865), which are paired with measurements taken in 2016-2020, is based on calculations using raw data from December 2025. In addition, the measurements in research projects (Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008) were consulted.
4.A.1. Afforestation older than 50 years	±10%	
4.A.1. Plantations in natural birch forest		
Living biomass: Losses		Although Gains statistics are generally reliable, with uncertainty likely to be below 5%, the biomass loss calculation is based on simplifications using country-specific expansion factors. Therefore, it is an expert assessment to double the uncertainty of the harvest statistics and apply a 10% uncertainty for biomass losses.
4.A.1. Afforestation older than 50 years	±10%	
4.A.1. Plantations in natural birch forest		
DOM (Dead wood C-stock changes)		The uncertainty is the same as that for biomass losses (10%) because deadwood input is calculated as a ratio of losses.
4.A.1. Afforestation older than 50 years	±10%	
4.A.1. Plantations in natural birch forest		
Organic soils, EFs	-130% ...127%	Table 2.1 (Forest Land, drained, including shrubland and drained land that may not be classified as forest; Nutrient-poor) in the 2013 Wetlands Supplement.
4.A.2. Land converted to Forest Land		
Area		It was assumed that the uncertainty rate is the same as for Cultivated Forest LU sub-category. The value was entirely based on field mapping. The uncertainty range from field mapping are lower than the systematic sample errors of the SSI NFI for NBW.
All Land converted to FL LU sub-categories	±4%	
Living biomass: Gains		

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Category	Uncertainty rate	Reference
4.A.2.b. Afforestation 1-50 years old - Cultivated forest	±10%	Error calculation (relative 95% Confidence interval) on CSC of the 2021-2025 NFI systematic sample plots (n=865, paired with measurments in 2016-2020). (Build on calculation on raw data in December 2025).
Afforestation 1-50 years old		
4.A.2.b. Grassland converted to Forest land - Afforestation natural birch forest 1-50 years old	±47%	The confidence interval (CI) was calculated based on the mean age (15 year) of the Natural Birch Woodland plots.
4.A.2.e. Other Land Converted to Forest land -- Afforestation natural birch forest 1-50 years old		
Living biomass: Losses		
4.A.2.b. Afforestation 1-50 years old -Cultivated forest	±10%	Although harvest statistics are rather dependable with uncertainty likely to be below 5%, the biomass loss calculation is built on simplification by using country vice expansion factors. It is therefore an expert judgement to double the harvest statistic uncertainty and use 10% uncertainty for biomass losses.
4.A.2.a. Afforestation 1-50 years old		
DOM		
Deadwood	±10%	The uncertainty is the same as that for biomass losses (10%) because deadwood input is calculated as a ratio of losses.
Litter	±18%	The arithmetic average of the relative 95% CIs from two research results was used to estimate carbon stock change in litter. Bjarnadóttir (2009) and Snorrason et al. (2000; 2002).
SOC, mineral soils, EFs:		
4.A.2.b. Grassland converted to Forest land - Afforestation natural birch forest 1-50 years old	±10%	The average of the relative 95% CIs from research results used to estimate carbon stock change in minaral soils in NBW : See chapter 6.3.4.2. in NID (Sanchez 2025 et.al., see table 6.8 on page 137).
4.A.2.b. Grassland converted to Forest land - Afforestation 1-50 years old - Cultivated forest		
4.A.2.e. Other Land Converted to Forest land - Afforestation 1-50 years old	±13%	The EF was evaluated using the relative stock change factors reported in Table 6.2 (Moderate degraded grassland, Temperate/Boreal) of the 2006 IPCC Guidelines. The uncertainty rates assigned to the factors have been applied in the assessment.
4.A.2.e. Other Land Converted to Forest land - Afforestation natural birch forest 1-50 years old	±10%	The average of the relative 95% CIs from research results used to estimate carbon stock change in minaral soils in NBW : See chapter 6.3.4.2. in NID (Sanchez 2025 et.al., see table 6.8 on page 137).
Organic soils, EFs	-130%...127%	Table 2.1 (Forest Land, drained, including shrubland and drained land that may not be classified as forest; Nutrient-poor) in the 2013 Wetlands Supplement.

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Table A6.2 Uncertainty rates associated with Cropland and Grassland land use categories

Category	Uncertainty rate	Reference
4.B.1. Cropland remaining Cropland		
4.B.2. Land converted to Cropland		
Area		
Area (Cropland remaining Cropland)	±21%	See the explanation below the table.
4.B.2.a Forest land converted to Cropland (Area of organic soils)	±4%	The uncertainty rate was evaluated based on data collected to assess the deforestation rate(s) in the country, where each deforestation event is mapped and reported with high spatial accuracy.
All LU sub-categories, except FL converted to CL)	±21%	The same as for Cropland remaining Cropland
Living biomass: Gains		
4.B.2.a. Forest land converted to Cropland	±75%	Table 5.9 of the 2006 IPCC Guidelines
4.B.2.b. Grassland converted to Cropland	±75%	Table 5.9 of the 2006 IPCC Guidelines
4.B.2.c. Wetlands converted to Cropland	±75%	Table 5.9 (Temperate climate) of the 2006 IPCC Guidelines
Living biomass: Losses		
4.B.2.a. Forest land converted to Cropland	50%	Biomass on one plot at the area deforested. Variation in biomass density assumed to be 50%
4.B.2.b. Grassland converted to Cropland	±75%	Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010
4.B.2.c. Wetlands converted to Cropland	±75%	Table 5.9 (Temperate climate) of the 2006 IPCC Guidelines
DOM		
4.B.2.b. Grassland converted to Cropland	-53%...+147%	Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010; Aradóttir et al. (2000). See Section 6.4.4.2.
4.B.2.c. Wetlands converted to Cropland	-53%...+147%	Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010; Aradóttir et al. (2000). See Section 6.4.4.2.
SOC, mineral soils, EFs		
4.B.1. Cropland remaining Cropland	-61%...150%	Helgason 1975. The study focused on the evaluation of the CS EFs and provided upper and lower bounds for the mean value.
4.B.2.b. Grassland converted to Cropland	±17%	Table 5.5 (Flu-Temperate/Boreal-Moist) of the 2006 IPCC Guidelines
Organic soils, EFs		
4.B.1. Cropland remaining Cropland	-18%...+ 19%	Table 2.1 (Cropland, drained - Boreal and Temperate) of the 2013 Wetlands Supplement
4.B.2.a. Forest land converted to Cropland	-18% ...19%	Table 2.1 (Cropland, drained - Boreal and Temperate) of the Wetlands Supplement
4.B.2.c. Wetlands converted to Cropland	-18%...+19%	Table 2.1 (Drained inland organic soils) of the Wetlands Supplement
4.C.1. Grassland remaining Grassland		
Area		

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Category	Uncertainty rate	Reference
4.C.1. Cropland abandoned for more than 20 years	±21%	Assumed the same value as for Cropland remaining Cropland
4.C.1. Organic soils drained for more than 20 years	±21%	
4.C.1. Natural birch shrubland - recently expanded into other grassland	±4%	Mineral soils: area estimates of Natural Birch Shrubland are identical to the area estimates of Natural Birch Forest.
4.C.1. Natural birch shrubland – old	±4%	
Living biomass: Gains/Losses		
4.C.1. Natural birch shrubland - recently expanded into other grassland	±47%	CS value. The rate was assumed to be similar to those developed for Natural Birch Forest. Confidence interval (CI) was calculated based on the mean age of the Natural Birch Woodland plots.
4.C.1. Natural birch shrubland – old	±94%	A 95% CI was calculated based on 58 paired sample plot measurements from the shrubland section of the Natural Birch Woodland.
DOM		
4.C.1. Natural birch shrubland - recently expanded into other grassland	±18%	The arithmetic average of the 95% CIs from two research results was used to estimate CSC in litter. For more details, see Bjarnadóttir, 2009, as well as Snorrason et al. (2000; 2002).
Mineral soils, EFs		
4.C.1. Natural birch shrubland - recently expanded into other grassland	±10%	The average of the relative 95% CIs from research results used to estimate carbon stock change in minaral soils in NBW : See chapter 6.3.4.2. in NID (Sanchez 2025 et.al., see table 6.8 on page 137).
4.C.1. Grazing areas	±17%	Table 5.5 (Flu-Temperate/Boreal-Moist) of the 2006 IPCC Guidelines
4.C.1. Grassland without grazing	±17%	Table 5.5 (Flu-Temperate/Boreal-Moist) of the 2006 IPCC Guidelines
Organic soils, EFs		
4.C.1. Cropland abandoned for more than 20 years	-130%...+127%	Table 2.1 (Forest Land, drained, including shrubland and drained land that may not be classified as forest; Nutrient-poor) of the Wetlands Supplement
4.C.1. Natural birch shrubland - recently expanded into other grassland	-130%...+127%	
4.C.1. Natural birch shrubland - old		
4.C.1. Organic soils drained for more than 20 years	-49%...+51%	Table 2.1 (Grassland, drained; Boreal) of the Wetlands Supplement
4.C.2. Land converted to Grassland		
Area		
4.C.2.b. Cropland converted to Grassland	±21%	The reference and extensive explanation is provided below.
4.C.2.e. Revegetation before 1990	±30%	

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Category	Uncertainty rate	Reference
4.C.2.e. Revegetation since 1990 - protected from grazing		Assessment of land restoration areas conducted between 2007 and 2011 (Unpublished data – Jóhann Thorsson)
4.C.2.e. Revegetation since 1990 - limited grazing allowed		
4.C.2.e. Other land converted to natural birch shrubland	±4%	Since the area estimate of Natural Birch Woodland is entirely based on field mapping, sample error propagation is not applicable. It can be stated that the errors (uncertainty range) in the area estimates from field mapping are less than the systematic sample errors of the National Forest Inventory (NFI) for Natural Birch Woodland. Half of the 95% CI for the area estimate of the cultivated forest this year is estimated to be 4%. The same relative error will be used in the uncertainty evaluation for the area of Natural Birch Woodland.
Living biomass: Gains/Losses		
4.C.2.e. Other land converted to natural birch shrubland	±47%	The value is assumed to be the same as that for the 'Land Converted to Natural Birch Forest' land use sub-category.
All other Land converted to GL land use sub-categories	±75	The value was evaluated using conservative approach based on the data of Table 5.9 (all moisture regions) of the 2006 IPCC Guidelines and Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010
DOM		
4.C.2.e. Other land converted to natural birch shrubland)	±18%	The arithmetic average of the 95% CI was evaluated based on two research results conducted to estimate CSC in litter. Bjarnadóttir (2009) and Snorrason et al. (2000; 2002).
4.C.2.2. Cropland converted to Grassland	-53%...147%	Aradóttir et al. (2000). See Section 6.5.4.2.
4.C.2.e. Revegetation before 1990	-53%...147%	Aradóttir et al. (2000). See Section 6.5.4.2.
4.C.2.e. Revegetation since 1990 – protected from grazing	-53%...147%	Aradóttir et al. (2000). See Section 6.5.4.2.
4.C.2.e. Revegetation since 1990 – limited grazing allowed	-53%...147%	Aradóttir et al. (2000). See Section 6.5.4.2.
SOC, mineral soils, EFs:		
4.C.2.2. Cropland converted to grassland	±17%	The EF was evaluated using the relative stock change factors reported in Table 5.5 of the 2006 IPCC Guidelines. However, the uncertainty rates assigned to the F_{lv} factor (Set aside < 20 yrs – Temperate/Boreal and Tropical – Moist/Wet) have been applied in the assessment.
All Land converted to GL land use sub-categories	±13%	The EF was evaluated using the relative stock change factors reported in Table 6.2 (Moderate degraded grassland, Temperate/Boreal) of the 2006 IPCC Guidelines. However, the uncertainty rates assigned to the F_{mg} factor (Moderately degraded grassland – Temperate/Boreal) have been applied in the assessment.
Organic soils, EFs		
All land use sub-categories	-49%...+51%	Table 2.1 (Grassland, drained; Boreal) of the Wetlands Supplement

Cropland LU-category:

The uncertainty rates associated with mineral/organic soils area for Cropland remaining Cropland Category have been obtained as a result of the IGLUD data verification activities. Namely, mapping within IGLUD has been verified through systematic sampling (Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010), where land use is recorded at randomly preselected sampling points. Preliminary results show that 91% of the land mapped as Cropland correspond to actual cropland (AUI unpublished data). Additionally, a survey was conducted in 2010 to validate the IGLUD cropland map. Randomly selected squares, each measuring 500m×500m and located below 200 m a.s.l., were visited to assess the accuracy of Cropland land use and other land uses mapping within these areas. A total number of squares, covering an area of 9,187 ha, were visited and surveyed, whereas including mapped Cropland of 998 ha. The results of the survey demonstrated that 216 ha (21%) were incorrectly classified as Cropland and 38 ha (4%) were found not included in the map layer. As a result, the overall uncertainty in the mapped Cropland area was set as 21%. Additionally, the data on the areas of mineral and organic soils cultivated as cropland were assessed as part of the IGLUD mapping process and from a scientific literature source. Namely, the proportion of hayfields on organic soils was estimated as 44% by Þorvaldsson (1994), and the time series of Croplands on organic soils has been adjusted to reflect this ratio. In the summer 2011, a survey on Cropland soils was initiated as part of the IGLUD project, involving systematic sampling on a 50m×50m grid of randomly selected polygons of the Cropland mapping unit. The results from this sampling effort demonstrated the similar ratio of organic soils managed as cropland. Hence, the uncertainty rates associated with the data on areas of mineral and organic soils managed as cropland were considered to have the same values as those for the entire cropland area in the country (i.e., ±21%).

Grassland LU-category:

The size of the drained area is estimated from IGLUD as described in the main body text. Improvements in ascertaining the extent of drained organic soils in total and within different land-use categories and soil types has been a priority in the IGLUD data sampling. In summer 2011, a drainage control project aimed at improving the geographical identification of drained organic soils was initiated within the IGLUD. This project involved the testing of plant index and soil characters as proxies to evaluate the effectiveness of drainage. Preliminary results indicate that of 966 points included within the area estimated as drained, 492 (51%) are confirmed as drained and 311 (32%) as not drained, with the remaining 163 (17%) points needing further analyses or determined as uncertain. (AUI unpublished results). Of the 210 points outside the area estimated drained, 42 (20%) are confirmed as drained and 102 (49%) as not drained, with the remaining

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66 (31%) points needing further analyses or determined as uncertain. The uncertainty is thus higher in the spatial identification of the drained land than in the total area.

Many factors can potentially contribute to the uncertainty of the size of drained area. Among these is the quality of the ditch map. Ongoing surveying on the type of soil drained has already revealed that some features mapped as ditches are not ditches but are actually tracks or fences. During the summer of 2010, the reliability of the ditch map was evaluated. Randomly selected squares of 500 m x 500 m were controlled for ditches. Preliminary results show that 91% of the ditches mapped were confirmed and 5% of ditches in the squares were not already mapped.

The starting width of the buffer zone, applied on the mapped ditches, is set to be 200 m to each side as determined from an analysis of the Farmland Database (Gísladóttir, Metúsalemsson, & Óskarsson, 2007). The map layers used to exclude certain types of land cover from the buffer zone to estimate area of drained land have their own uncertainty, which is transferred to the estimate of the area of drained land.

Table A6.3 Uncertainty rates associated with Wetlands and Settlements land use categories

Category	Uncertainty rate	Reference
4.D.1. Wetlands remaining Wetlands		
Area (all subcategories, including Land converted to Wetlands)	±29%	The area of Intact Mires and Lakes and Rivers, the two largest Wetlands Remaining Wetlands subcategories, is not recorded specifically, but rather is estimated through the process of compilation of the land-use map. The increase in extent of drained land is not directly recorded either but is estimated through a time series for drainage ditches. The accuracy of the time series of drainage has not been estimated. Therefore, the same rate of uncertainty calculated for the land use category Cropland is assumed.
4.D.1.c. Rewetted mires - organic soils, EF	-40%...-38%...	Table 3.1 (Boreal, Rich) of the 2013 Wetlands Supplement
4.D.2. Land converted to Wetlands		
Area (for all categories of reservoirs and land use changes)	±29%	The area estimates of the category Intact Mires is based on the IGLUD land-use map plus adjustments based on other information (i.e., on the uncertainties related to habitat type classification). Both the hierarchy of the map layers used and the quality of the original mapping can affect the accuracy of the area estimate of the IGLUD land-use map. According to the study completed by Gísladóttir et al., 2014, the accuracy of HMI mapping was estimated to range from 57 to 86%, with an average at 70%. Hence, the uncertainty rate associated was approximated to be 29%. Response to recommendation FCCC/ARR/2022/ISL/L.7)

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Category	Uncertainty rate	Reference
4.D.2.b.v. Low SOC – EFs	-53%...142%	The uncertainty range is evaluated based on the data developed within Óskarsson and Guðmundsson 2001, Óskarsson and Guðmundsson, 2008.
4.D.2.b.iii. Medium SOC – EFs	-64%...121%	The uncertainty range is evaluated based on the data developed within Óskarsson and Guðmundsson 2001, Óskarsson and Guðmundsson, 2008.
4.D.2.c.iii. Rewetted wetland Soils: Organic/Mineral soils – EFs	-38%...40%	Table 3.1 (Boreal, Rich) of the 2013 Wetlands Supplements
4.E.2. Land converted to Settlements		
Area		
4.E.2.a. Forest land converted to Settlements	4%	In accordance with the Forest Law (Alþingi, 2019), all woodland conversion must be thoroughly mapped and reported to Land and Forest Iceland. The mapping quality is very high and is set to the same accuracy as the cultivated forest map.
4.E.2.c. Grassland converted to Settlements – Natural birch shrubland converted to Settlements		
4.E.2.c. Grassland converted to Settlements – All other Grassland subcategories converted to Settlements	5%	Area estimation of Settlements has been constructed adopting Approach 3.
Living biomass: Gains/Losses		
4.E.2.c. Grassland converted to Settlements – All other Grassland subcategories converted to Settlements	±75%	It was assumed that the uncertainty range is the same as that reported in Table 6.4 of the 2006 IPCC Guidelines.
DOM		
4.E.2.c. Grassland converted to Settlements – All other Grassland subcategories converted to Settlements	-53% - 147%	Aradóttir et al. (2000). See Section 6.7.4.2.
SOC, mineral soils, EFs		
4.E.2.a. Forest land converted to settlements	±23%	The uncertainty range was developed based on the inversion of CSC for afforested land (13–23% uncertainty) and the default Tier 1 uncertainty rate.
4.E.2.c. Natural birch shrubland converted to Settlements		
4.E.2.c. All other Grassland subcategories converted to Settlement		

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Table A6.4 Uncertainty rates associated with activity data and emission factors used to estimate the emissions reported in CRT 4(I), 4(II), 4(III), 4(IV) reporting categories

Category	Uncertainty rate	Reference
CRF 4(I) Direct and indirect nitrous oxide (N₂O) emissions from nitrogen (N) inputs to managed soils		
Amount of synthetic fertilizers applied	±5%	See chapter 6.10.
EF1 for N additions from mineral fertilisers	-70%...200%	Table 11.1 of Chapter 11 of the 2006 IPCC Guidelines
EF1 for N additions from organic fertilisers	-70%...200%	Table 11.1 of Chapter 11 of the 2006 IPCC Guidelines
EF4 [N volatilisation and re-deposition], kg N ₂ O–N	-80%...400%	Table 11.3 of Chapter 11 of the 2006 IPCC Guidelines
EF5 [leaching/runoff], kg N ₂ O–N (kg N leaching/runoff)	-93%...233%	
CRF 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils		
Area (All land use categories)	See the data in Uncertainty Assessment table developed for relevant land category.	
4(II).A.1 Forest land remaining ForestLand		
4(II).A.2 Land converted to Forest Land		
CO ₂ EF	±58%	Country specific EF for forest land on drained organic soils. Bjarnardottir et al. (2021)
N ₂ O EF	±51%	Country specific EF for uncultivated drained organic soils. Guðmundsson et al. (2024)
CH ₄ EF	±81%	Table 2.4 (Boreal/Temperate, Drained Forest Land) of the 2013 Wetlands Supplement
4(II).B.1 Cropland remaining Cropland,		
4(II).B.2 Land converted to Cropland		
CO ₂ EF	-42%...50%	Table 2.2 (Boreal) of the 2013 Wetlands Supplement
CH ₄ EF	±71%	Table 2.4 (Boreal/Temperate, Deep drained Grassland/Cropland) of the 2013 Wetlands Supplement
4(II).C.1 Grassland remaining Grassland		
4(II).C.2 Land converted to Grassland		
CO ₂ EF	As two EFs were applied to estimate CO ₂ emissions from various sub-categories, two uncertainty rates are reported and referenced here:	

Category	Uncertainty rate	Reference
4(II).C.1 Cropland abandoned for more than 20 years		
4(II).C.1 Organic soils drained for more than 20 years	-42%...50%	Table 2.2 (Boreal) of the 2013 Wetlands Supplement
4(II).C.1 Natural birch shrubland - recently expanded into other grassland	±58%	Bjarnadottir et al. 2021. See Section 0.
4(II).C.1 Natural birch shrubland - old	±58%	Bjarnadottir et al. 2021. See Section 0.
CH ₄ EF		As two EFs were applied to estimate CH ₄ emissions from various sub-categories, two uncertainty rates are reported and referenced here:
4(II).C.1 Cropland abandoned for more than 20 years		
4(II).C.1 Organic soils drained for more than 20 years	±71%	Table 2.4 (Boreal/Temperate, Deep-drained Grassland) of the 2013 Wetlands Supplement
4(II).C.1 Natural birch shrubland - recently expanded into other grassland		
4(II).C.1 Natural birch shrubland - old	±81%	Table 2.4 (Boreal/Temperate, Drained Forest Land) of the 2013 Wetlands Supplement
4(II).D.1. Wetlands remaining wetlands		
4(II):D.2.b Land converted to flooded land (all subcategories)		
CO ₂ EF	-25%...38%	Table 3.2, Boreal of the 2013 Wetlands Supplement.
CH ₄ EF		
4(II).D.1.b. Intact mires converted to reservoirs more than 20 years	-23%...28%	Table 6.3 in Óskarsson, H., & Guðmundsson, J. (2008). See Section 0.
4(II).D.1.b. Low SOC to reservoirs more than 20 years	-64%...98%	Lower and upper 95% CI of the range EF values for reservoirs.
4(II).D.1.b. Medium SOC to reservoirs more than 20 years		
4(II):D.2.b. Grassland converted to flooded land (Medium SOC to reservoirs)	-63%...121%	Lower and upper 95% CI of the range EF values for reservoirs.
4(II).D.1.b. Refilled lakes and ponds >20 years		

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Category	Uncertainty rate	Reference
4(II).D.1.c. Rewetted mires		
4(II):D.2.b. Other land converted to flooded land (Low SOC to reservoirs)	-54%...143%	Lower and upper 95% CI of the range EF values for reservoirs.
CRF 4(III) Direct and indirect nitrous oxide (N₂O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils		
EF1 for N additions from mineral fertilisers	-70%...200%	Table 11.1 of Chapter 11 of the 2006 IPCC Guidelines
EF5 [leaching/runoff], kg N ₂ O–N (kg N leaching/runoff)	-93%...233%	Table 11.3 of Chapter 11 of the 2006 IPCC Guidelines
CRF 4(IV) Biomass Burning		
Area burnt, ha	-	It was assumed that the uncertainty rates associated with the burnt area are similar to those developed for the total area of the respective LU category. See the relevant chapter of the NID.
Combustion factor	±100%	The CS factor was applied. However, the uncertainty rate associated with was not evaluated. Therefore, the IPCC default for ‘All boreal forest’ (Table 2.6 of the 2006 IPCC Guidelines) was used.
EFs, Forest Land:		
CH ₄	±81%	Table 2.5 of the 2006 IPCC Guidelines
N ₂ O	±54%	
EFs, Other LU categories:		
CH ₄	±78%	Table 2.5 of the 2006 IPCC Guidelines
N ₂ O	±95%	
4.Gs1 Harvested wood products (HWP)		
Activity data	±10%	Uncertainty same as for biomass loss 10%.
Emission factor	±50%	Uncertainty of default emission calculation 50%.

Annex 7 Input data for Solid Waste Disposal Sites for the IPCC First Order Decay Model (5A1a, 5A1b, 5A2)

Table A7.1. Parameters used in the IPCC First Order Decay Model for Iceland, Managed and Unmanaged SWDS.

All SWDS			
	DOC	DOCf	CH ₄ generation rate constant (k)
	Weight fraction, wet basis	fraction	years ⁻¹
Food waste	0.15	0.7	0.185
Garden	0.20	0.7	0.1
Paper	0.40	0.5	0.06
Wood and straw	0.43	0.1	0.03
Textiles	0.24	0.5	0.06
Disposable nappies	0.24	0.5	0.1
Sewage sludge	0.05	0.7	0.185
Industrial waste	0.04	0.1	0.03
Delay time		6	
Fraction of methane (F) in developed gas		0.5	
Managed, anaerobic (5A1a)		Managed well – Semi-aerobic (5A1b) and Unmanaged (5A2)	
Oxidation factor (OX)	0.1	Oxidation factor (OX)	0
MCF Managed	1	MCF Unmanaged Shallow – Large	0.4
		MCF Unmanaged Shallow – Small	0.2
		MCF Managed well – Semi-aerobic – Large	0.5
		MCF Managed well – Semi-aerobic – Small	0.2
		MCF Unmanaged Deep	0.8
Starting year	1972	Starting year	1950

Table A7.2. Amounts Deposited in Managed anaerobic SWDS (CRT 5A1a).

Year	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Nappies [kt]	Sludge [kt]	Inert [kt]	Industrial [kt]	Recovery [kt]	Total [kt]
There were no managed SWDS before 1972.											
1972	4.9	0.4	1.7	0.4	0.3	0.0	0.2	2.9	0.7	NO	11.4
1973	5.4	0.4	1.9	0.4	0.3	0.0	0.2	3.3	0.7	NO	12.6
1974	5.4	0.4	1.9	0.4	0.3	0.0	0.2	3.3	0.7	NO	12.8
1975	5.2	0.4	1.9	0.4	0.3	0.0	0.2	3.3	0.7	NO	12.4
1976	5.6	0.5	2.1	0.5	0.3	0.0	0.2	3.6	0.8	NO	13.6

Year	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Napp-ies [kt]	Sludge [kt]	Inert [kt]	Indus-trial [kt]	Recov-ery [kt]	Total [kt]
1977	6.2	0.5	2.4	0.5	0.4	0.0	0.3	4.1	0.9	NO	15.4
1978	1.9	0.2	0.7	0.2	0.1	0.0	0.1	1.3	0.3	NO	4.7
1979	6.6	0.6	2.7	0.6	0.4	0.0	0.3	4.6	1.0	NO	16.7
1980	6.8	0.6	2.9	0.6	0.4	0.0	0.3	4.9	1.0	NO	17.5
1981	6.8	0.6	3.0	0.6	0.5	0.1	0.3	5.2	1.0	NO	18.1
1982	6.5	0.6	3.1	0.6	0.5	0.2	0.3	5.4	1.0	NO	18.3
1983	6.0	0.6	3.0	0.6	0.4	0.2	0.3	5.4	1.0	NO	17.5
1984	5.8	0.6	3.1	0.6	0.4	0.3	0.3	5.6	1.0	NO	17.8
1985	5.7	0.6	3.2	0.6	0.5	0.4	0.3	5.9	1.0	NO	18.2
1986	5.8	0.7	3.5	0.7	0.5	0.5	0.3	6.5	1.1	NO	19.6
1987	6.0	0.7	3.9	0.7	0.5	0.6	0.4	7.4	1.2	NO	21.5
1988	5.6	0.7	3.9	0.7	0.5	0.7	0.4	7.4	1.2	NO	21.1
1989	5.2	0.7	3.8	0.7	0.5	0.8	0.4	7.5	1.2	NO	20.8
1990	6.6	1.0	5.4	1.0	0.7	1.2	0.5	10.6	1.6	NO	28.6
1991	57.7	8.4	46.6	8.3	6.3	10.3	4.4	92.2	14.2	NO	248.2
1992	56.1	8.2	45.3	8.1	6.1	10.0	4.2	89.7	13.9	NO	241.6
1993	56.4	8.2	45.5	8.1	6.1	10.0	4.3	90.1	13.9	NO	242.6
1994	58.4	8.5	47.2	8.4	6.3	10.4	4.4	93.4	14.4	NO	251.5
1995	60.8	8.8	49.1	8.7	6.6	10.8	4.6	97.1	15.0	NO	261.6
1996	62.0	9.0	50.1	8.9	6.7	11.0	4.7	99.1	15.3	0.1	267.0
1997	63.5	9.2	51.2	9.1	6.9	11.3	4.8	101.4	15.7	0.2	273.1
1998	66.8	9.7	53.9	9.6	7.3	11.9	5.1	106.7	16.5	0.2	287.4
1999	68.0	9.9	54.9	9.8	7.4	12.1	5.1	108.7	16.8	0.3	292.8
2000	70.7	10.3	57.0	10.2	7.7	12.6	5.3	112.9	17.4	0.3	304.0
2001	70.2	10.2	56.7	10.1	7.6	12.5	5.3	112.3	17.3	0.3	302.3
2002	69.5	10.1	56.1	10.0	7.6	12.4	5.3	111.1	17.2	0.5	299.2
2003	71.1	10.3	57.4	10.2	7.7	12.6	5.4	113.6	17.5	0.7	305.8
2004	71.1	10.3	57.4	10.2	7.7	12.6	5.4	113.7	17.6	0.7	306.1
2005	66.4	9.7	53.6	9.5	7.2	11.8	5.0	106.1	16.4	1.2	285.8
2006	58.9	8.6	47.6	8.5	6.4	10.5	4.5	94.2	14.5	0.4	253.6
2007	32.7	12.1	39.8	13.1	5.8	7.1	5.0	61.8	19.5	0.4	197.0
2008	43.1	2.7	44.6	6.5	7.1	8.2	3.1	69.3	1.6	0.6	186.4
2009	40.1	2.0	17.2	4.8	7.1	9.0	2.8	52.4	1.2	0.8	136.5
2010	32.1	1.2	25.6	1.5	2.5	8.6	1.8	46.6	0.2	0.5	120.2
2011	46.5	1.6	25.7	2.3	3.1	8.7	1.9	29.7	4.1	0.9	123.7
2012	51.4	4.5	23.1	2.7	2.8	7.3	1.6	36.4	2.2	1.5	132.1
2013	63.6	4.5	9.3	3.6	3.7	9.5	2.0	36.1	0.8	1.3	133.2
2014	61.9	0.8	13.4	1.2	3.3	8.2	2.2	38.0	4.1	1.3	133.0
2015	65.8	2.4	13.5	3.5	4.6	8.2	2.9	39.8	2.4	1.3	143.2

Year	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Nappies [kt]	Sludge [kt]	Inert [kt]	Industrial [kt]	Recovery [kt]	Total [kt]
2016	68.5	2.4	17.3	5.1	5.8	8.5	2.5	44.7	3.7	1.3	158.4
2017	87.9	2.1	16.3	6.5	5.3	8.0	2.4	47.0	4.5	1.4	180.0
2018	92.3	1.8	15.2	7.7	4.6	10.5	2.4	44.3	6.3	1.6	185.1
2019	86.4	1.1	13.3	8.7	5.1	9.2	1.3	42.2	5.2	2.8	172.5
2020	61.7	1.4	10.8	15.4	4.7	10.2	2.0	37.0	2.8	1.8	146.1
2021	47.3	1.8	11.0	10.1	5.2	12.9	2.8	34.1	6.1	1.6	131.4
2022	37.3	1.5	8.9	6.5	4.2	10.3	5.8	28.9	2.4	1.7	105.9
2023	32.1	1.2	7.2	5.6	3.4	8.4	5.2	24.7	2.7	1.7	90.5
2024	15.1	0.3	2.3	4.6	1.2	3.5	4.1	35.4	4.4	1.1	70.8

Table A7.3. Amounts Deposited in Managed well – Semi-aerobic (CRT 5A1b).

Year	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Nappies [kt]	Sludge [kt]	Inert [kt]	Industrial [kt]	Total [kt]
Before 2004 these sites were categorised as unmanaged SWDS. There is not recovery at these sites.										
2004	8.3	1.2	6.7	1.2	0.9	1.5	0.6	13.3	2.1	35.9
2005	14.0	2.0	11.3	2.0	1.5	2.5	1.1	22.4	3.5	60.2
2006	12.4	1.8	10.0	1.8	1.3	2.2	0.9	19.8	3.1	53.4
2007	11.9	0.7	3.3	0.3	0.3	0.6	0.1	13.5	1.3	32.0
2008	16.0	10.0	5.8	1.1	0.8	1.0	3.5	28.5	4.9	71.7
2009	14.2	4.6	2.1	0.5	0.7	1.1	1.2	16.9	3.7	45.0
2010	11.7	2.3	2.9	0.9	0.5	1.0	0.5	21.9	2.9	44.6
2011	14.2	2.7	3.2	0.8	0.5	1.1	0.7	9.3	3.8	36.4
2012	13.0	0.2	2.4	1.7	0.4	0.8	0.9	10.7	1.6	31.7
2013	11.4	0.8	1.0	1.2	0.5	1.0	1.0	6.9	2.1	25.9
2014	5.6	0.1	0.8	0.3	0.2	0.5	0.4	37.0	0.9	45.8
2015	5.0	0.3	1.0	0.3	0.3	0.6	0.3	43.9	1.1	52.6
2016	3.9	0.1	1.0	0.5	0.3	0.5	0.2	49.0	1.3	56.8
2017	4.2	0.1	0.7	0.4	0.2	0.3	0.4	20.4	1.5	28.3
2018	5.0	0.1	0.7	0.5	0.2	0.5	1.1	22.1	1.2	31.5
2019	4.6	0.1	0.6	7.7	0.2	0.4	1.0	29.4	2.3	46.3
2020	5.5	0.3	0.8	1.0	0.4	0.8	0.5	31.4	2.4	43.1
2021	4.3	0.3	0.9	1.1	0.4	1.0	0.3	33.9	1.0	43.3
2022	3.5	0.3	0.8	2.6	0.6	0.9	0.1	30.6	0.8	40.3
2023	2.5	0.1	0.5	1.0	0.5	0.6	0.4	30.6	0.4	36.7
2024	3.3	0.1	0.3	0.6	0.2	0.5	1.0	3.6	0.0	9.7

Table A7.4. Amounts Deposited in Unmanaged SWDS (CRT 5A2).

Year	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Nappies [kt]	Sludge [kt]	Inert [kt]	Industrial [kt]	Total [kt]
No landfilling in unmanaged SWDS since 2003. No recovery was at these sites.										
1950	29.6	1.8	5.0	1.8	1.4	0.0	0.9	10.0	3.1	53.6
1951	28.3	1.7	5.0	1.7	1.3	0.0	0.9	9.8	3.0	51.7
1952	27.9	1.7	5.1	1.7	1.3	0.0	0.9	9.9	3.0	51.5
1953	32.2	2.0	6.1	2.0	1.5	0.0	1.1	11.8	3.5	60.2
1954	35.2	2.2	6.9	2.2	1.7	0.0	1.2	13.2	3.8	66.4
1955	38.2	2.5	7.7	2.4	1.8	0.0	1.3	14.7	4.2	72.8
1956	38.4	2.5	8.0	2.5	1.9	0.0	1.3	15.2	4.2	73.9
1957	37.7	2.5	8.1	2.5	1.9	0.0	1.3	15.3	4.2	73.4
1958	41.0	2.7	9.1	2.7	2.0	0.0	1.4	17.0	4.6	80.5
1959	41.5	2.8	9.5	2.8	2.1	0.0	1.4	17.7	4.7	82.5
1960	41.7	2.8	9.8	2.8	2.1	0.0	1.5	18.2	4.8	83.7
1961	42.5	2.9	10.3	2.9	2.2	0.0	1.5	19.0	5.0	86.3
1962	45.5	3.2	11.4	3.1	2.4	0.0	1.6	20.9	5.4	93.4
1963	49.2	3.5	12.7	3.4	2.6	0.0	1.8	23.1	5.9	102.1
1964	54.0	3.8	14.3	3.8	2.9	0.0	2.0	26.0	6.5	113.3
1965	58.4	4.2	16.0	4.1	3.1	0.0	2.2	28.9	7.1	124.0
1966	62.1	4.5	17.5	4.5	3.4	0.0	2.3	31.5	7.7	133.5
1967	59.2	4.3	17.2	4.3	3.2	0.0	2.3	30.7	7.4	128.6
1968	55.5	4.1	16.6	4.1	3.1	0.0	2.1	29.5	7.0	122.0
1969	56.1	4.2	17.3	4.2	3.2	0.0	2.2	30.6	7.2	125.0
1970	61.2	4.7	19.4	4.6	3.5	0.0	2.4	34.2	7.9	138.0
1971	68.5	5.3	22.3	5.2	3.9	0.0	2.7	39.3	9.0	156.3
1972	68.8	5.4	23.1	5.3	4.0	0.0	2.8	40.4	9.1	158.8
1973	74.4	5.9	25.7	5.8	4.4	0.0	3.1	44.8	10.0	174.0
1974	74.5	6.0	26.5	5.9	4.5	0.0	3.1	46.0	10.1	176.4
1975	70.3	5.7	25.7	5.6	4.3	0.0	3.0	44.5	9.7	168.7
1976	74.5	6.1	28.0	6.1	4.6	0.0	3.2	48.3	10.4	181.2
1977	80.9	6.7	31.3	6.7	5.0	0.0	3.5	53.8	11.4	199.4
1978	24.0	2.0	9.6	2.0	1.5	0.0	1.1	16.4	3.4	60.0
1979	83.8	7.2	34.3	7.1	5.4	0.0	3.7	58.6	12.2	212.3
1980	85.8	7.4	36.2	7.4	5.6	0.0	3.9	61.5	12.6	220.3
1981	87.0	7.9	38.7	7.8	5.9	1.0	4.1	67.1	13.3	232.7
1982	84.6	8.0	39.9	7.9	6.0	2.0	4.2	70.2	13.5	236.1
1983	78.4	7.7	39.2	7.6	5.8	2.8	4.0	70.2	13.1	228.9
1984	77.4	8.0	41.1	7.9	6.0	3.9	4.2	74.8	13.6	236.8
1985	75.8	8.2	42.9	8.1	6.2	5.0	4.3	79.3	14.0	243.8
1986	78.3	9.0	47.2	8.9	6.7	6.6	4.7	88.7	15.2	265.1

Year	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Nappies [kt]	Sludge [kt]	Inert [kt]	Industrial [kt]	Total [kt]
1987	82.2	9.9	53.1	9.8	7.4	8.5	5.2	101.1	16.9	294.2
1988	77.3	9.9	53.6	9.8	7.4	9.7	5.1	103.3	16.8	292.8
1989	71.6	9.8	53.5	9.6	7.3	10.7	5.1	104.5	16.6	288.7
1990	66.7	9.7	53.9	9.6	7.2	11.9	5.0	106.7	16.5	287.2
1991	17.1	2.5	13.8	2.5	1.9	3.0	1.3	27.4	4.2	73.7
1992	16.4	2.4	13.3	2.4	1.8	2.9	1.2	26.2	4.1	70.7
1993	16.3	2.4	13.1	2.3	1.8	2.9	1.2	26.0	4.0	70.1
1994	16.6	2.4	13.4	2.4	1.8	3.0	1.3	26.6	4.1	71.5
1995	12.2	1.8	9.8	1.8	1.3	2.2	0.9	19.5	3.0	52.4
1996	11.4	1.7	9.2	1.6	1.2	2.0	0.9	18.2	2.8	49.0
1997	11.4	1.7	9.2	1.6	1.2	2.0	0.9	18.2	2.8	48.9
1998	8.7	1.3	7.0	1.3	0.9	1.6	0.7	13.9	2.2	37.6
1999	8.7	1.3	7.0	1.2	0.9	1.5	0.7	13.8	2.1	37.2
2000	8.8	1.3	7.1	1.3	1.0	1.6	0.7	14.1	2.2	38.0
2001	8.5	1.2	6.9	1.2	0.9	1.5	0.6	13.6	2.1	36.7
2002	8.3	1.2	6.7	1.2	0.9	1.5	0.6	13.3	2.1	35.8
2003	8.4	1.2	6.8	1.2	0.9	1.5	0.6	13.4	2.1	36.2

Annex 8 Emissions covered by the ESR

Information on greenhouse gas emissions covered by Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013.

Table A8.1. Emissions covered by the Effort Sharing Regulation (ESR) (Regulation (EU) 2018/842).

Greenhouse gas emissions	2021 emissions [kt CO ₂ e]	2022 emissions [kt CO ₂ e]	2023 emissions [kt CO ₂ e]	2024 emissions [kt CO ₂ e]
Total greenhouse gas emissions without LULUCF	4,718.015	4,776.063	4,644.014	4,779.043
Total verified emissions from stationary installations under Directive 2003/87/EC	1,828.020	1,875.076	1,812.530	1,889.154
CO ₂ emissions from 1.A.3.a civil aviation	20.735	24.085	22.341	20.344
Total ESR emissions (= C-D-E)	2,869.260	2,876.902	2,809.143	2,869.545

Annex 9 CRT (Common Reporting Table) Summary 2

Tables for 1990-2024 (GWP from AR5)

1990

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,346.40	1,170.86	389.86	0.63	444.82	NO	1.13	NO	10,353.69
1. Energy	1,806.69	9.95	23.93						1,840.57
1.A. Fuel combustion	1,745.85	9.21	23.93						1,778.98
1.A.1. Energy industries	13.46	0.01	0.03						13.50
1.A.2. Manufacturing industries and construction	305.43	0.45	7.60						313.48
1.A.3. Transport	587.97	6.51	5.71						600.19
1.A.4. Other sectors	838.87	2.23	10.59						851.69
1.A.5. Other	0.12	0.00	0.00						0.12
1.B. Fugitive emissions from fuels	60.85	0.74	NO						61.59
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	60.85	0.74	NO						61.59
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	407.05	1.81	46.76	0.63	444.82	NO	1.13	NO	902.20
2.A. Mineral industry	52.26	NA	NA						52.26
2.B. Chemical industry	0.36	NA,NO	41.34	NO	NO	NO	NO	NO	41.70
2.C. Metal industry	348.01	1.76	NO	NO	444.82	NO	NO	NO	794.58
2.D. Non-energy products from fuels and solvent use	6.42	NA,NO	NA,NO						6.42
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				0.63	NO	NO		NO	0.63
2.G. Other product manufacture and use	0.00	0.05	5.42	NO	NO	NO	1.13	NO	6.61
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	0.02	415.70	296.56						712.29
3.A. Enteric fermentation		340.21							340.21
3.B. Manure management		75.49	23.83						99.32
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	272.73						272.73
3.E. Prescribed burning of savannahs			NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.02								0.02
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	NO								NO
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,125.33	554.23	6.89						6,686.45
4.A. Forest land	-31.40	0.13	0.34						-30.94
4.B. Cropland	2,123.78	114.45	6.35						2,244.58
4.C. Grassland	4,002.03	437.51	IE,NA,NO						4,439.54
4.D. Wetlands	0.51	2.15	NA,NE,NO						2.66
4.E. Settlements	30.41	NA	0.20						30.61
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	NO								NO
4.H. Other	NA	NA	NA						NA
5. Waste	7.30	189.17	15.72						212.18
5.A. Solid waste disposal		172.54							172.54
5.B. Biological treatment of solid waste		NO	NO						NO
5.C. Incineration and open burning of waste	7.30	6.82	1.49						15.60
5.D. Waste water treatment and discharge		9.82	14.23						24.05
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO
Memo items:⁽¹⁾									
1.D.1. International bunkers	247.24	0.12	1.83						249.19
1.D.1.a. Aviation	219.44	0.04	1.63						221.11
1.D.1.b. Navigation	27.81	0.07	0.20						28.08
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	2.39								2.39
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						
Indirect CO₂⁽⁴⁾	NA,NE								
Total CO₂ equivalent emissions without LULUCF									3,667.23
Total CO₂ equivalent emissions with LULUCF									10,353.69
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF									3,667.23
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF									10,353.69

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,219.97	1,168.94	390.43	0.63	369.25	NO	1.28	NO	10,150.50
1. Energy	1,722.27	9.91	23.30						1,755.47
1.A. Fuel combustion	1,652.83	9.21	23.30						1,685.33
1.A.1. Energy industries	15.05	0.02	0.03						15.10
1.A.2. Manufacturing industries and construction	228.12	0.36	6.79						235.26
1.A.3. Transport	594.77	6.68	5.97						607.42
1.A.4. Other sectors	814.75	2.16	10.51						827.42
1.A.5. Other	0.14	0.00	0.00						0.14
1.B. Fugitive emissions from fuels	69.44	0.70	NO						70.14
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	69.44	0.70	NO						70.14
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	372.64	1.46	44.94	0.63	369.25	NO	1.28	NO	790.20
2.A. Mineral industry	48.63	NA	NA						48.63
2.B. Chemical industry	0.31	NA,NO	40.02	NO	NO	NO	NO	NO	40.33
2.C. Metal industry	317.42	1.41	NO	NO	369.25	NO	NO	NO	688.08
2.D. Non-energy products from fuels and solvent use	6.27	NA,NO	NA,NO						6.27
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				0.63	NO	NO		NO	0.63
2.G. Other product manufacture and use	0.00	0.05	4.92	NO	NO	NO	1.28	NO	6.27
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	0.01	403.29	299.76						703.06
3.A. Enteric fermentation		329.84							329.84
3.B. Manure management		73.45	22.80						96.25
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	276.96						276.96
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.01								0.01
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	NO								NO
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,117.82	560.47	6.73						6,685.02
4.A. Forest land	-33.02	0.17	0.44						-32.41
4.B. Cropland	2,111.57	114.08	5.90						2,231.55
4.C. Grassland	4,000.58	437.78	IE,NA,NO						4,438.37
4.D. Wetlands	6.16	8.44	NA,NE,NO						14.60
4.E. Settlements	32.52	NA	0.39						32.92
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	NO								NO
4.H. Other	NA	NA	NA						NA
5. Waste	7.24	193.80	15.70						216.74
5.A. Solid waste disposal		177.18							177.18
5.B. Biological treatment of solid waste		NO	NO						NO
5.C. Incineration and open burning of waste	7.24	6.77	1.48						15.48
5.D. Waste water treatment and discharge		9.86	14.22						24.08
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items: ⁽³⁾									
1.D.1. International bunkers	235.64	0.08	1.74						237.46
1.D.1.a. Aviation	221.77	0.04	1.64						223.46
1.D.1.b. Navigation	13.87	0.04	0.10						14.00
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	2.39								2.39
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	3,465.48
Total CO₂ equivalent emissions with LULUCF	10,150.50
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	3,465.48
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,150.50

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,344.70	1,165.64	379.66	0.64	164.60	NO	1.28	NO	10,056.52
1. Energy	1,865.42	10.28	23.44						1,899.14
1.A. Fuel combustion	1,798.31	9.57	23.44						1,831.33
1.A.1. Energy industries	14.06	0.02	0.03						14.10
1.A.2. Manufacturing industries and construction	290.88	0.42	6.88						298.17
1.A.3. Transport	606.74	6.78	6.22						619.74
1.A.4. Other sectors	885.84	2.35	10.32						898.51
1.A.5. Other	0.79	0.00	0.00						0.80
1.B. Fugitive emissions from fuels	67.10	0.71	NO						67.81
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	67.10	0.71	NO						67.81
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	375.86	1.58	40.21	0.64	164.60	NO	1.28	NO	584.17
2.A. Mineral industry	45.67	NA	NA						45.67
2.B. Chemical industry	0.25	NA,NO	35.78	NO	NO	NO	NO	NO	36.03
2.C. Metal industry	323.55	1.52	NO	NO	164.60	NO	NO	NO	489.67
2.D. Non-energy products from fuels and solvent use	6.38	NA,NO	NA,NO						6.38
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				0.64	NO	NO		NO	0.64
2.G. Other product manufacture and use	0.01	0.06	4.44	NO	NO	NO	1.28	NO	5.78
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	0.03	385.71	294.06						679.80
3.A. Enteric fermentation		316.79							316.79
3.B. Manure management		68.92	21.38						90.30
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	272.68						272.68
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.03								0.03
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	NO								NO
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,096.35	560.34	6.53						6,663.22
4.A. Forest land	-38.37	0.22	0.57						-37.59
4.B. Cropland	2,098.51	113.72	5.37						2,217.60
4.C. Grassland	3,995.49	437.97	IE,NA,NO						4,433.46
4.D. Wetlands	6.08	8.44	NA,NE,NO						14.52
4.E. Settlements	34.64	NA	0.59						35.23
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	NO								NO
4.H. Other	NA	NA	NA						NA
5. Waste	7.04	207.74	15.41						230.19
5.A. Solid waste disposal		191.33							191.33
5.B. Biological treatment of solid waste		NO	NO						NO
5.C. Incineration and open burning of waste	7.04	6.61	1.44						15.09
5.D. Waste water treatment and discharge		9.80	13.97						23.77
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items: ⁽³⁾									
1.D.1. International bunkers	223.70	0.09	1.65						225.44
1.D.1.a. Aviation	203.42	0.04	1.51						204.97
1.D.1.b. Navigation	20.28	0.05	0.15						20.48
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	2.39								2.39
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	3,393.31
Total CO₂ equivalent emissions with LULUCF	10,056.52
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	3,393.31
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,056.52

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,500.07	1,178.43	389.87	1.44	79.35	NO	1.28	NO	10,150.43
1. Energy	1,968.30	10.30	25.17						2,003.77
1.A. Fuel combustion	1,883.44	9.55	25.17						1,918.15
1.A.1. Energy industries	14.42	0.04	0.08						14.54
1.A.2. Manufacturing industries and construction	306.00	0.44	6.55						312.99
1.A.3. Transport	608.52	6.55	6.57						621.64
1.A.4. Other sectors	953.05	2.52	11.96						967.54
1.A.5. Other	1.44	0.00	0.00						1.44
1.B. Fugitive emissions from fuels	84.87	0.75	NO						85.62
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	84.87	0.75	NO						85.62
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	424.80	1.94	42.00	1.44	79.35	NO	1.28	NO	550.81
2.A. Mineral industry	39.65	NA	NA						39.65
2.B. Chemical industry	0.24	NA,NO	37.63	NO	NO	NO	NO	NO	37.87
2.C. Metal industry	378.27	1.89	NO	NO	79.35	NO	NO	NO	459.51
2.D. Non-energy products from fuels and solvent use	6.62	NA,NO	NA,NO						6.62
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				1.44	NO	NO		NO	1.44
2.G. Other product manufacture and use	0.01	0.05	4.37	NO	NO	NO	1.28	NO	5.70
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	0.02	384.96	300.14						685.12
3.A. Enteric fermentation		316.44							316.44
3.B. Manure management		68.52	21.81						90.33
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	278.33						278.33
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.02								0.02
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	NO								NO
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,100.95	562.04	6.32						6,669.31
4.A. Forest land	-43.86	0.24	0.63						-43.00
4.B. Cropland	2,086.21	113.35	4.91						2,204.47
4.C. Grassland	4,015.76	440.01	IE,NA,NO						4,455.77
4.D. Wetlands	6.08	8.45	NA,NE,NO						14.53
4.E. Settlements	36.75	NA	0.78						37.54
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	NO								NO
4.H. Other	NA	NA	NA						NA
5. Waste	6.00	219.19	16.25						241.43
5.A. Solid waste disposal		203.10							203.10
5.B. Biological treatment of solid waste		NO	NO						NO
5.C. Incineration and open burning of waste	6.00	5.72	1.25						12.97
5.D. Waste water treatment and discharge		10.36	15.00						25.36
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items: ⁽³⁾									
1.D.1. International bunkers	225.02	0.12	1.66						226.80
1.D.1.a. Aviation	195.45	0.04	1.45						196.94
1.D.1.b. Navigation	29.57	0.08	0.21						29.86
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	5.52								5.52
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	3,481.12
Total CO₂ equivalent emissions with LULUCF	10,150.43
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	3,481.12
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,150.43

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,436.82	1,189.23	396.90	1.85	47.24	NO	1.28	NO	10,073.33
1. Energy	1,916.84	10.05	25.72						1,952.60
1.A. Fuel combustion	1,847.23	9.30	25.72						1,882.24
1.A.1. Energy industries	14.28	0.04	0.08						14.40
1.A.2. Manufacturing industries and construction	286.80	0.44	6.67						293.91
1.A.3. Transport	609.30	6.34	7.03						622.67
1.A.4. Other sectors	936.74	2.48	11.93						951.15
1.A.5. Other	0.10	0.00	0.00						0.10
1.B. Fugitive emissions from fuels	69.61	0.75	NO						70.36
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	69.61	0.75	NO						70.36
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	425.91	1.90	41.87	1.85	47.24	NO	1.28	NO	520.06
2.A. Mineral industry	37.35	NA	NA						37.35
2.B. Chemical industry	0.35	NA,NO	37.90	NO	NO	NO	NO	NO	38.25
2.C. Metal industry	381.64	1.85	NO	NO	47.24	NO	NO	NO	430.73
2.D. Non-energy products from fuels and solvent use	6.56	NA,NO	NA,NO						6.56
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				1.85	NO	NO		NO	1.85
2.G. Other product manufacture and use	0.01	0.05	3.98	NO	NO	NO	1.28	NO	5.32
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	0.01	385.85	308.26						694.12
3.A. Enteric fermentation		318.11							318.11
3.B. Manure management		67.75	22.27						90.01
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	285.99						285.99
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.01								0.01
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	NO								NO
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,088.54	562.48	6.16						6,657.19
4.A. Forest land	-47.09	0.27	0.69						-46.13
4.B. Cropland	2,074.49	112.99	4.49						2,191.97
4.C. Grassland	4,016.19	440.76	IE,NA,NO						4,456.95
4.D. Wetlands	6.08	8.47	NA,NE,NO						14.55
4.E. Settlements	38.87	NA	0.98						39.85
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	NO								NO
4.H. Other	NA	NA	NA						NA
5. Waste	5.53	228.94	14.88						249.35
5.A. Solid waste disposal		213.84							213.84
5.B. Biological treatment of solid waste		NO	NO						NO
5.C. Incineration and open burning of waste	5.53	5.31	1.16						12.00
5.D. Waste water treatment and discharge		9.79	13.72						23.51
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	247.06	0.13	1.82						249.01
1.D.1.a. Aviation	213.41	0.04	1.58						215.03
1.D.1.b. Navigation	33.65	0.09	0.24						33.98
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	5.52								5.52
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	3,416.13
Total CO₂ equivalent emissions with LULUCF	10,073.33
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	3,416.13
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,073.33

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,538.39	1,186.23	396.62	3.15	62.38	NO	1.28	NO	10,188.05
1. Energy	2,017.69	10.07	29.92						2,057.67
1.A. Fuel combustion	1,935.61	9.27	29.92						1,974.80
1.A.1. Energy industries	15.10	0.05	0.10						15.24
1.A.2. Manufacturing industries and construction	293.70	0.55	8.69						302.94
1.A.3. Transport	615.57	6.02	7.62						629.21
1.A.4. Other sectors	1,009.63	2.66	13.50						1,025.79
1.A.5. Other	1.61	0.00	0.00						1.62
1.B. Fugitive emissions from fuels	82.08	0.79	NO						82.87
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	82.08	0.79	NO						82.87
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	443.31	2.05	40.03	3.15	62.38	NO	1.28	NO	552.19
2.A. Mineral industry	37.84	NA	NA						37.84
2.B. Chemical industry	0.46	NA,NO	36.04	NO	NO	NO	NO	NO	36.50
2.C. Metal industry	397.93	2.00	NO	NO	62.38	NO	NO	NO	462.31
2.D. Non-energy products from fuels and solvent use	7.07	NA,NO	NA,NO						7.07
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				3.15	NO	NO		NO	3.15
2.G. Other product manufacture and use	0.01	0.05	3.99	NO	NO	NO	1.28	NO	5.32
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	2.44	371.14	305.20						678.77
3.A. Enteric fermentation		304.77							304.77
3.B. Manure management		66.37	21.21						87.58
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	283.99						283.99
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.00								0.00
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.44								2.44
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,070.08	563.12	6.05						6,639.25
4.A. Forest land	-57.73	0.30	0.78						-56.65
4.B. Cropland	2,063.05	112.62	4.09						2,179.77
4.C. Grassland	4,017.69	441.73	IE,NA,NO						4,459.43
4.D. Wetlands	6.08	8.47	NA,NE,NO						14.55
4.E. Settlements	40.98	NA	1.18						42.16
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	NO								NO
4.H. Other	NA	NA	NA						NA
5. Waste	4.87	239.86	15.43						260.16
5.A. Solid waste disposal		224.79							224.79
5.B. Biological treatment of solid waste		0.22	0.13						0.35
5.C. Incineration and open burning of waste	4.87	4.74	1.04						10.65
5.D. Waste water treatment and discharge		10.10	14.27						24.37
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	239.25	0.06	1.77						241.08
1.D.1.a. Aviation	235.92	0.05	1.75						237.71
1.D.1.b. Navigation	3.33	0.01	0.02						3.37
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	6.29								6.29
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	3,548.80
Total CO₂ equivalent emissions with LULUCF	10,188.05
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	3,548.80
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,188.05

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,581.82	1,200.83	416.99	10.09	26.66	NO	1.28	NO	10,237.68
1. Energy	2,072.68	9.92	30.41						2,113.01
1.A. Fuel combustion	1,991.57	9.05	30.41						2,031.04
1.A.1. Energy industries	12.11	0.05	0.12						12.28
1.A.2. Manufacturing industries and construction	334.73	0.60	8.18						343.51
1.A.3. Transport	606.46	5.66	8.28						620.39
1.A.4. Other sectors	1,037.89	2.74	13.84						1,054.47
1.A.5. Other	0.38	0.00	0.00						0.39
1.B. Fugitive emissions from fuels	81.11	0.87	NO						81.97
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	81.11	0.87	NO						81.97
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	442.70	2.08	46.50	10.09	26.66	NO	1.28	NO	529.31
2.A. Mineral industry	41.76	NA	NA						41.76
2.B. Chemical industry	0.40	NA,NO	42.14	NO	NO	NO	NO	NO	42.54
2.C. Metal industry	393.47	2.03	NO	NO	26.66	NO	NO	NO	422.16
2.D. Non-energy products from fuels and solvent use	7.06	NA,NO	NA,NO						7.06
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				10.09	NO	NO		NO	10.09
2.G. Other product manufacture and use	0.01	0.05	4.36	NO	NO	NO	1.28	NO	5.71
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	2.65	375.20	315.71						693.56
3.A. Enteric fermentation		308.70							308.70
3.B. Manure management		66.50	22.51						89.01
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	293.20						293.20
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.02								0.02
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.63								2.63
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,059.43	565.71	5.87						6,631.00
4.A. Forest land	-61.90	0.31	0.82						-60.76
4.B. Cropland	2,051.33	112.25	3.68						2,167.26
4.C. Grassland	4,019.26	442.65	IE,NA,NO						4,461.91
4.D. Wetlands	7.64	10.49	NA,NE,NO						18.13
4.E. Settlements	43.09	NA	1.37						44.47
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	0.00								0.00
4.H. Other	NA	NA	NA						NA
5. Waste	4.37	247.92	18.50						270.79
5.A. Solid waste disposal		231.72							231.72
5.B. Biological treatment of solid waste		0.22	0.13						0.35
5.C. Incineration and open burning of waste	4.37	4.29	0.94						9.59
5.D. Waste water treatment and discharge		11.69	17.44						29.13
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items: ⁽³⁾									
1.D.1. International bunkers	290.26	0.10	2.15						292.51
1.D.1.a. Aviation	271.24	0.05	2.01						273.30
1.D.1.b. Navigation	19.02	0.05	0.14						19.20
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	7.36								7.36
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	3,606.67
Total CO₂ equivalent emissions with LULUCF	10,237.68
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	3,606.67
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,237.68

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,668.25	1,212.51	414.44	16.14	87.30	NO	1.28	NO	10,399.92
1. Energy	2,109.13	9.59	34.13						2,152.85
1.A. Fuel combustion	2,042.44	8.67	34.13						2,085.25
1.A.1. Energy industries	7.00	0.05	0.11						7.15
1.A.2. Manufacturing industries and construction	396.15	0.67	10.65						407.46
1.A.3. Transport	618.39	5.28	9.09						632.76
1.A.4. Other sectors	1,020.87	2.68	14.30						1,037.85
1.A.5. Other	0.04	0.00	0.00						0.04
1.B. Fugitive emissions from fuels	66.69	0.91	NO						67.60
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	66.69	0.91	NO						67.60
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	501.93	2.05	39.52	16.14	87.30	NO	1.28	NO	648.22
2.A. Mineral industry	46.52	NA	NA						46.52
2.B. Chemical industry	0.44	NA,NO	35.14	NO	NO	NO	NO	NO	35.57
2.C. Metal industry	448.00	2.00	NO	NO	87.30	NO	NO	NO	537.30
2.D. Non-energy products from fuels and solvent use	6.97	NA,NO	NA,NO						6.97
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				16.14	NO	NO		NO	16.14
2.G. Other product manufacture and use	0.01	0.05	4.38	NO	NO	NO	1.28	NO	5.73
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	2.56	376.28	315.55						694.38
3.A. Enteric fermentation		310.45							310.45
3.B. Manure management		65.82	22.95						88.77
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	292.60						292.60
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.03								0.03
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.52								2.52
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,050.42	567.10	5.68						6,623.20
4.A. Forest land	-68.86	0.34	0.89						-67.63
4.B. Cropland	2,039.23	111.89	3.23						2,154.35
4.C. Grassland	4,027.29	444.22	IE,NA,NO						4,471.51
4.D. Wetlands	7.55	10.65	NA,NE,NO						18.20
4.E. Settlements	45.21	NA	1.57						46.78
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.01								-0.01
4.H. Other	NA	NA	NA						NA
5. Waste	4.21	257.49	19.55						281.25
5.A. Solid waste disposal		240.89							240.89
5.B. Biological treatment of solid waste		0.22	0.13						0.35
5.C. Incineration and open burning of waste	4.21	4.11	0.90						9.22
5.D. Waste water treatment and discharge		12.27	18.53						30.79
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items: ⁽³⁾									
1.D.1. International bunkers	329.95	0.16	2.43						332.54
1.D.1.a. Aviation	291.83	0.06	2.16						294.05
1.D.1.b. Navigation	38.12	0.10	0.27						38.49
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	7.36								7.36
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	3,776.72
Total CO₂ equivalent emissions with LULUCF	10,399.92
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	3,776.72
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,399.92

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,684.52	1,226.99	412.24	25.46	190.94	NO	1.28	NO	10,541.43
1. Energy	2,101.93	9.49	34.62						2,146.04
1.A. Fuel combustion	2,018.32	8.35	34.62						2,061.28
1.A.1. Energy industries	9.03	0.05	0.11						9.19
1.A.2. Manufacturing industries and construction	373.65	0.68	11.32						385.64
1.A.3. Transport	621.83	4.95	9.47						636.25
1.A.4. Other sectors	1,008.84	2.66	13.71						1,025.22
1.A.5. Other	4.97	0.01	0.01						4.99
1.B. Fugitive emissions from fuels	83.62	1.14	NO						84.76
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	83.62	1.14	NO						84.76
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	530.00	1.80	35.15	25.46	190.94	NO	1.28	NO	784.64
2.A. Mineral industry	54.36	NA	NA						54.36
2.B. Chemical industry	0.40	NA,NO	30.63	NO	NO	NO	NO	NO	31.03
2.C. Metal industry	467.90	1.75	NO	NO	190.94	NO	NO	NO	660.59
2.D. Non-energy products from fuels and solvent use	7.33	NA,NO	NA,NO						7.33
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				25.46	NO	NO		NO	25.46
2.G. Other product manufacture and use	0.01	0.05	4.52	NO	NO	NO	1.28	NO	5.86
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	2.55	385.72	321.32						709.59
3.A. Enteric fermentation		317.62							317.62
3.B. Manure management		68.10	22.92						91.02
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	298.40						298.40
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.00								0.00
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.55								2.55
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,046.47	569.17	5.58						6,621.22
4.A. Forest land	-77.59	0.38	0.98						-76.24
4.B. Cropland	2,027.88	111.52	2.84						2,142.24
4.C. Grassland	4,041.18	446.44	IE,NA,NO						4,487.62
4.D. Wetlands	7.68	10.83	NA,NE,NO						18.51
4.E. Settlements	47.32	NA	1.76						49.09
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	0.00								0.00
4.H. Other	NA	NA	NA						NA
5. Waste	3.57	260.82	15.56						279.95
5.A. Solid waste disposal		246.64							246.64
5.B. Biological treatment of solid waste		0.22	0.13						0.35
5.C. Incineration and open burning of waste	3.57	3.53	0.77						7.87
5.D. Waste water treatment and discharge		10.43	14.66						25.09
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO
Memo items:⁽³⁾									
1.D.1. International bunkers	389.32	0.20	2.87						392.40
1.D.1.a. Aviation	337.80	0.07	2.50						340.37
1.D.1.b. Navigation	51.52	0.14	0.37						52.03
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	7.36								7.36
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						
Indirect CO₂⁽⁴⁾	NA,NE								
Total CO₂ equivalent emissions without LULUCF									3,920.21
Total CO₂ equivalent emissions with LULUCF									10,541.43
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF									3,920.21
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF									10,541.43

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,890.40	1,230.72	419.77	36.99	183.61	NO	1.28	NO	10,762.77
1. Energy	2,156.26	9.58	36.76						2,202.61
1.A. Fuel combustion	2,045.03	8.05	36.76						2,089.84
1.A.1. Energy industries	6.68	0.04	0.10						6.83
1.A.2. Manufacturing industries and construction	388.84	0.73	12.20						401.76
1.A.3. Transport	643.71	4.63	9.96						658.30
1.A.4. Other sectors	1,001.44	2.65	14.49						1,018.57
1.A.5. Other	4.36	0.00	0.01						4.38
1.B. Fugitive emissions from fuels	111.23	1.53	NO						112.77
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	111.23	1.53	NO						112.77
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	679.00	2.08	35.58	36.99	183.61	NO	1.28	NO	938.54
2.A. Mineral industry	61.41	NA	NA						61.41
2.B. Chemical industry	0.43	NA,NO	30.93	NO	NO	NO	NO	NO	31.36
2.C. Metal industry	610.13	2.03	NO	NO	183.61	NO	NO	NO	795.76
2.D. Non-energy products from fuels and solvent use	7.01	NA,NO	NA,NO						7.01
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				36.99	NO	NO		NO	36.99
2.G. Other product manufacture and use	0.02	0.06	4.65	NO	NO	NO	1.28	NO	6.02
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	2.76	380.08	326.19						709.03
3.A. Enteric fermentation		313.86							313.86
3.B. Manure management		66.22	22.34						88.56
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	303.85						303.85
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.00								0.00
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.76								2.76
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,049.46	571.40	5.43						6,626.29
4.A. Forest land	-84.24	0.40	1.04						-82.80
4.B. Cropland	2,016.35	111.16	2.44						2,129.94
4.C. Grassland	4,060.24	448.99	IE,NA,NO						4,509.23
4.D. Wetlands	7.68	10.85	NA,NE,NO						18.52
4.E. Settlements	49.43	NA	1.96						51.39
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	0.00								0.00
4.H. Other	NA	NA	NA						NA
5. Waste	2.92	267.58	15.81						286.31
5.A. Solid waste disposal		253.73							253.73
5.B. Biological treatment of solid waste		0.22	0.13						0.35
5.C. Incineration and open burning of waste	2.92	2.95	0.65						6.52
5.D. Waste water treatment and discharge		10.67	15.04						25.71
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	401.93	0.17	2.97						405.07
1.D.1.a. Aviation	363.01	0.07	2.69						365.77
1.D.1.b. Navigation	38.92	0.10	0.28						39.30
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	7.46								7.46
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,136.48
Total CO₂ equivalent emissions with LULUCF	10,762.77
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,136.48
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,762.77

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,980.63	1,228.89	405.66	42.97	134.79	NO	1.35	NO	10,794.30
1. Energy	2,138.57	9.15	37.00						2,184.71
1.A. Fuel combustion	1,985.46	7.47	37.00						2,029.93
1.A.1. Energy industries	6.47	0.04	0.10						6.62
1.A.2. Manufacturing industries and construction	349.67	0.69	13.58						363.93
1.A.3. Transport	646.24	4.15	9.95						660.34
1.A.4. Other sectors	978.48	2.58	13.36						994.43
1.A.5. Other	4.60	0.01	0.01						4.61
1.B. Fugitive emissions from fuels	153.11	1.68	NO						154.78
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	153.11	1.68	NO						154.78
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	788.99	3.09	20.31	42.97	134.79	NO	1.35	NO	991.50
2.A. Mineral industry	65.45	NA	NA						65.45
2.B. Chemical industry	0.41	NA,NO	15.93	NO	NO	NO	NO	NO	16.33
2.C. Metal industry	715.56	3.04	NO	NO	134.79	NO	NO	NO	853.40
2.D. Non-energy products from fuels and solvent use	7.56	NA,NO	NA,NO						7.56
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				42.97	NO	NO		NO	42.97
2.G. Other product manufacture and use	0.02	0.05	4.38	NO	NO	NO	1.35	NO	5.80
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	2.76	366.86	325.38						694.99
3.A. Enteric fermentation		301.87							301.87
3.B. Manure management		64.99	21.97						86.95
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	303.41						303.41
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.00								0.00
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.76								2.76
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,047.57	573.93	5.59						6,627.09
4.A. Forest land	-95.87	0.50	1.35						-94.02
4.B. Cropland	2,005.92	110.79	2.12						2,118.83
4.C. Grassland	4,083.35	451.79	IE,NA,NO						4,535.14
4.D. Wetlands	7.68	10.85	NA,NE,NO						18.52
4.E. Settlements	46.50	NA	2.12						48.62
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	0.00								0.00
4.H. Other	NA	NA	NA						NA
5. Waste	2.74	275.87	17.38						295.99
5.A. Solid waste disposal		261.24							261.24
5.B. Biological treatment of solid waste		0.22	0.13						0.35
5.C. Incineration and open burning of waste	2.74	2.89	0.63						6.26
5.D. Waste water treatment and discharge		11.51	16.63						28.14
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	461.20	0.22	3.40						464.83
1.D.1.a. Aviation	407.33	0.08	3.02						410.43
1.D.1.b. Navigation	53.86	0.14	0.39						54.39
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	7.46								7.46
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,167.21
Total CO₂ equivalent emissions with LULUCF	10,794.30
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,167.21
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,794.30

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,919.20	1,242.49	401.44	39.80	97.16	NO	1.35	NO	10,701.45
1. Energy	2,028.77	8.52	35.75						2,073.03
1.A. Fuel combustion	1,885.02	6.78	35.75						1,927.55
1.A.1. Energy industries	5.97	0.04	0.10						6.12
1.A.2. Manufacturing industries and construction	383.58	0.68	13.30						397.56
1.A.3. Transport	656.97	3.88	10.19						671.04
1.A.4. Other sectors	818.75	2.16	12.12						833.02
1.A.5. Other	19.75	0.02	0.04						19.81
1.B. Fugitive emissions from fuels	143.75	1.74	NO						145.48
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	143.75	1.74	NO						145.48
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	831.34	3.21	17.97	39.80	97.16	NO	1.35	NO	990.83
2.A. Mineral industry	58.66	NA	NA						58.66
2.B. Chemical industry	0.49	NA,NO	13.81	NO	NO	NO	NO	NO	14.30
2.C. Metal industry	765.37	3.16	NO	NO	97.16	NO	NO	NO	865.69
2.D. Non-energy products from fuels and solvent use	6.80	NA,NO	NA,NO						6.80
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				39.80	0.00	NO		NO	39.80
2.G. Other product manufacture and use	0.02	0.05	4.16	NO	NO	NO	1.35	NO	5.58
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	2.70	368.17	325.10						695.97
3.A. Enteric fermentation		302.51							302.51
3.B. Manure management		65.66	22.27						87.93
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	302.83						302.83
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.00								0.00
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.69								2.69
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,053.81	576.34	5.47						6,635.62
4.A. Forest land	-102.02	0.53	1.41						-100.08
4.B. Cropland	1,995.08	110.43	1.77						2,107.28
4.C. Grassland	4,104.81	454.14	IE,NA,NO						4,558.95
4.D. Wetlands	7.68	11.24	NA,NE,NO						18.92
4.E. Settlements	48.26	NA	2.29						50.55
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	0.00								0.00
4.H. Other	NA	NA	NA						NA
5. Waste	2.58	286.25	17.16						306.00
5.A. Solid waste disposal		271.93							271.93
5.B. Biological treatment of solid waste		0.22	0.13						0.35
5.C. Incineration and open burning of waste	2.58	2.59	0.57						5.74
5.D. Waste water treatment and discharge		11.51	16.46						27.98
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	407.79	0.22	3.01						411.02
1.D.1.a. Aviation	348.78	0.07	2.59						351.43
1.D.1.b. Navigation	59.01	0.16	0.42						59.59
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	7.46								7.46
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,065.83
Total CO₂ equivalent emissions with LULUCF	10,701.45
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,065.83
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,701.45

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,058.04	1,228.97	381.84	44.62	76.90	NO	1.35	NO	10,791.73
1. Energy	2,138.90	8.53	35.32						2,182.75
1.A. Fuel combustion	1,991.53	6.77	35.32						2,033.61
1.A.1. Energy industries	6.85	0.05	0.11						7.00
1.A.2. Manufacturing industries and construction	387.86	0.65	12.08						400.60
1.A.3. Transport	660.42	3.63	10.27						674.33
1.A.4. Other sectors	913.79	2.41	12.81						929.01
1.A.5. Other	22.60	0.02	0.05						22.67
1.B. Fugitive emissions from fuels	147.37	1.76	NO						149.13
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	147.37	1.76	NO						149.13
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	848.68	3.38	3.88	44.62	76.90	NO	1.35	NO	978.80
2.A. Mineral industry	39.31	NA	NA						39.31
2.B. Chemical industry	0.45	NA,NO	NA,NO	NO	NO	NO	NO	NO	0.45
2.C. Metal industry	801.83	3.33	NO	NO	76.89	NO	NO	NO	882.05
2.D. Non-energy products from fuels and solvent use	7.06	NA,NO	NA,NO						7.06
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				44.62	0.01	NO		NO	44.63
2.G. Other product manufacture and use	0.01	0.06	3.88	NO	NO	NO	1.35	NO	5.30
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	2.42	359.62	318.87						680.91
3.A. Enteric fermentation		296.30							296.30
3.B. Manure management		63.33	21.87						85.20
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	297.00						297.00
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	0.00								0.00
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.41								2.41
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,065.65	579.58	5.52						6,650.75
4.A. Forest land	-111.09	0.57	1.55						-108.97
4.B. Cropland	1,985.46	110.06	1.52						2,097.04
4.C. Grassland	4,133.81	457.03	IE,NA,NO						4,590.84
4.D. Wetlands	7.45	11.92	NA,NE,NO						19.37
4.E. Settlements	50.02	NA	2.45						52.47
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	0.00								0.00
4.H. Other	NA	NA	NA						NA
5. Waste	2.40	277.86	18.26						298.52
5.A. Solid waste disposal		263.14							263.14
5.B. Biological treatment of solid waste		0.22	0.13						0.35
5.C. Incineration and open burning of waste	2.40	2.41	0.53						5.34
5.D. Waste water treatment and discharge		12.08	17.60						29.68
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	394.53	0.29	2.90						397.72
1.D.1.a. Aviation	309.54	0.06	2.29						311.90
1.D.1.b. Navigation	84.99	0.23	0.61						85.83
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	8.91								8.91
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,140.97
Total CO₂ equivalent emissions with LULUCF	10,791.73
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,140.97
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,791.73

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,044.95	1,230.13	376.35	45.08	63.38	NO	1.35	NO	10,761.25
1. Energy	2,129.58	8.16	33.70						2,171.44
1.A. Fuel combustion	1,993.28	6.43	33.70						2,033.40
1.A.1. Energy industries	4.99	0.04	0.10						5.14
1.A.2. Manufacturing industries and construction	362.96	0.52	11.56						375.03
1.A.3. Transport	754.28	3.57	10.62						768.47
1.A.4. Other sectors	863.77	2.28	11.40						877.45
1.A.5. Other	7.28	0.01	0.02						7.31
1.B. Fugitive emissions from fuels	136.30	1.74	NO						138.04
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	136.30	1.74	NO						138.04
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	849.60	3.38	3.84	45.08	63.38	NO	1.35	NO	966.64
2.A. Mineral industry	32.98	NA	NA						32.98
2.B. Chemical industry	0.48	NA,NO	NA,NO	NO	NO	NO	NO	NO	0.48
2.C. Metal industry	809.34	3.33	NO	NO	63.37	NO	NO	NO	876.04
2.D. Non-energy products from fuels and solvent use	6.79	NA,NO	NA,NO						6.79
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				45.08	0.01	NO		NO	45.09
2.G. Other product manufacture and use	0.02	0.05	3.84	NO	NO	NO	1.35	NO	5.26
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	4.67	353.55	316.45						674.68
3.A. Enteric fermentation		291.90							291.90
3.B. Manure management		61.65	21.22						82.87
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	295.24						295.24
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	2.42								2.42
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.25								2.25
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,059.04	581.33	5.56						6,645.93
4.A. Forest land	-121.59	0.62	1.66						-119.31
4.B. Cropland	1,976.02	109.70	1.29						2,087.00
4.C. Grassland	4,145.48	458.81	IE,NA,NO						4,604.29
4.D. Wetlands	7.36	12.20	NA,NE,NO						19.55
4.E. Settlements	51.78	NA	2.61						54.40
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	0.00								0.00
4.H. Other	NA	NA	NA						NA
5. Waste	2.05	283.71	16.80						302.56
5.A. Solid waste disposal		269.89							269.89
5.B. Biological treatment of solid waste		0.34	0.19						0.53
5.C. Incineration and open burning of waste	2.05	2.10	0.46						4.61
5.D. Waste water treatment and discharge		11.39	16.15						27.53
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	351.89	0.12	2.60						354.61
1.D.1.a. Aviation	332.67	0.07	2.47						335.20
1.D.1.b. Navigation	19.22	0.05	0.14						19.41
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	9.52								9.52
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,115.32
Total CO₂ equivalent emissions with LULUCF	10,761.25
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,115.32
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,761.25

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,167.29	1,243.63	382.61	52.14	40.90	NO	1.36	NO	10,887.92
1. Energy	2,224.33	8.28	37.32						2,269.93
1.A. Fuel combustion	2,101.46	6.45	37.32						2,145.23
1.A.1. Energy industries	3.16	0.04	0.10						3.30
1.A.2. Manufacturing industries and construction	368.61	0.58	14.01						383.20
1.A.3. Transport	807.19	3.44	10.71						821.35
1.A.4. Other sectors	896.30	2.36	12.44						911.10
1.A.5. Other	26.20	0.03	0.06						26.29
1.B. Fugitive emissions from fuels	122.87	1.83	NO						124.70
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	122.87	1.83	NO						124.70
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	873.67	3.37	3.60	52.14	40.90	NO	1.36	NO	975.03
2.A. Mineral industry	50.81	NA	NA						50.81
2.B. Chemical industry	0.39	NA,NO	NA,NO	NO	NO	NO	NO	NO	0.39
2.C. Metal industry	814.54	3.32	NO	NO	40.89	NO	NO	NO	858.75
2.D. Non-energy products from fuels and solvent use	7.90	NA,NO	NA,NO						7.90
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				52.14	0.00	NO		NO	52.14
2.G. Other product manufacture and use	0.02	0.05	3.60	NO	NO	NO	1.36	NO	5.03
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	4.78	347.16	321.05						672.99
3.A. Enteric fermentation		287.02							287.02
3.B. Manure management		60.14	21.65						81.79
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	299.40						299.40
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	2.63								2.63
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.15								2.15
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,059.28	583.32	5.67						6,648.28
4.A. Forest land	-128.70	0.62	1.69						-126.39
4.B. Cropland	1,968.54	109.33	1.21						2,079.07
4.C. Grassland	4,158.83	461.07	IE,NA,NO						4,619.89
4.D. Wetlands	7.29	12.30	NA,NE,NO						19.58
4.E. Settlements	53.33	NA	2.78						56.11
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	0.00								0.00
4.H. Other	NA	NA	NA						NA
5. Waste	5.23	301.50	14.97						321.69
5.A. Solid waste disposal		289.36							289.36
5.B. Biological treatment of solid waste		0.34	0.19						0.53
5.C. Incineration and open burning of waste	5.23	1.27	0.42						6.92
5.D. Waste water treatment and discharge		10.52	14.35						24.88
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	400.47	0.13	2.96						403.56
1.D.1.a. Aviation	379.62	0.07	2.81						382.51
1.D.1.b. Navigation	20.84	0.06	0.15						21.05
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	9.06								9.06
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,239.64
Total CO₂ equivalent emissions with LULUCF	10,887.92
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,239.64
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,887.92

2005

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,034.50	1,242.54	383.75	57.17	27.66	NO	2.60	NO	10,748.23
1. Energy	2,111.12	7.87	37.34						2,156.33
1.A. Fuel combustion	1,993.16	5.92	37.34						2,036.42
1.A.1. Energy industries	3.26	0.04	0.10						3.40
1.A.2. Manufacturing industries and construction	323.49	0.52	14.82						338.82
1.A.3. Transport	813.37	3.17	9.72						826.26
1.A.4. Other sectors	824.30	2.15	12.64						839.09
1.A.5. Other	28.75	0.03	0.06						28.84
1.B. Fugitive emissions from fuels	117.96	1.96	NO						119.92
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	117.96	1.96	NO						119.92
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	856.90	3.16	3.45	57.17	27.66	NO	2.60	NO	950.94
2.A. Mineral industry	54.98	NA	NA						54.98
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	793.98	3.11	NO	NO	27.66	NO	NO	NO	824.75
2.D. Non-energy products from fuels and solvent use	7.91	NA,NO	NA,NO						7.91
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				57.17	0.00	NO		NO	57.17
2.G. Other product manufacture and use	0.03	0.05	3.45	NO	NO	NO	2.60	NO	6.12
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	4.53	350.34	323.04						677.92
3.A. Enteric fermentation		289.10							289.10
3.B. Manure management		61.25	21.14						82.39
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	301.90						301.90
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	2.41								2.41
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.13								2.13
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,057.15	586.09	5.82						6,649.07
4.A. Forest land	-148.64	0.65	1.75						-146.24
4.B. Cropland	1,961.06	108.96	1.13						2,071.15
4.C. Grassland	4,182.75	463.93	IE,NA,NO						4,646.67
4.D. Wetlands	6.89	12.55	NA,NE,NO						19.44
4.E. Settlements	55.09	NA	2.94						58.03
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	0.00								0.00
4.H. Other	NA	NA	NA						NA
5. Waste	4.79	295.08	14.10						313.97
5.A. Solid waste disposal		283.88							283.88
5.B. Biological treatment of solid waste		0.56	0.32						0.88
5.C. Incineration and open burning of waste	4.79	0.50	0.27						5.56
5.D. Waste water treatment and discharge		10.14	13.51						23.65
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items: ⁽³⁾									
1.D.1. International bunkers	422.96	0.09	3.13						426.18
1.D.1.a. Aviation	421.23	0.08	3.12						424.43
1.D.1.b. Navigation	1.74	0.00	0.01						1.75
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	9.91								9.91
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,099.16
Total CO₂ equivalent emissions with LULUCF	10,748.23
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,099.16
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,748.23

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,250.50	1,288.28	399.01	66.25	353.22	NO	2.69	NO	11,359.95
1. Energy	2,180.23	8.56	31.86						2,220.64
1.A. Fuel combustion	2,052.84	5.81	31.86						2,090.51
1.A.1. Energy industries	9.03	0.08	0.18						9.29
1.A.2. Manufacturing industries and construction	329.47	0.48	14.97						344.93
1.A.3. Transport	956.18	3.30	6.75						966.22
1.A.4. Other sectors	731.51	1.92	9.90						743.33
1.A.5. Other	26.65	0.03	0.06						26.74
1.B. Fugitive emissions from fuels	127.39	2.74	NO						130.13
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	127.39	2.74	NO						130.13
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	966.14	3.10	3.67	66.25	353.22	NO	2.69	NO	1,395.07
2.A. Mineral industry	62.17	NA	NA						62.17
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	895.02	3.05	NO	NO	353.22	NO	NO	NO	1,251.29
2.D. Non-energy products from fuels and solvent use	8.90	NA,NO	NA,NO						8.90
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				66.25	0.00	NO		NO	66.25
2.G. Other product manufacture and use	0.04	0.06	3.67	NO	NO	NO	2.69	NO	6.46
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	4.42	360.92	340.17						705.51
3.A. Enteric fermentation		295.75							295.75
3.B. Manure management		65.17	21.99						87.17
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	318.17						318.17
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.74								1.74
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.69								2.69
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,094.71	596.29	10.90						6,701.90
4.A. Forest land	-155.81	0.69	1.86						-153.26
4.B. Cropland	1,953.58	108.62	1.06						2,063.25
4.C. Grassland	4,232.50	473.28	3.87						4,709.64
4.D. Wetlands	6.89	13.71	1.00						21.61
4.E. Settlements	57.55	NA	3.10						60.65
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	0.00								0.00
4.H. Other	NA	NA	NA						NA
5. Waste	4.99	319.40	12.43						336.82
5.A. Solid waste disposal		308.73							308.73
5.B. Biological treatment of solid waste		0.90	0.51						1.40
5.C. Incineration and open burning of waste	4.99	0.48	0.28						5.75
5.D. Waste water treatment and discharge		9.29	11.64						20.93
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items: ⁽³⁾									
1.D.1. International bunkers	516.57	0.14	3.82						520.53
1.D.1.a. Aviation	499.40	0.10	3.70						503.20
1.D.1.b. Navigation	17.16	0.04	0.12						17.33
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	11.53								11.53
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,658.05
Total CO₂ equivalent emissions with LULUCF	11,359.95
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,658.05
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,359.95

2007

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,502.26	1,296.82	406.43	66.91	298.01	NO	2.98	NO	11,573.41
1. Energy	2,319.76	9.52	32.68						2,361.96
1.A. Fuel combustion	2,172.43	6.01	32.68						2,211.12
1.A.1. Energy industries	24.94	0.10	0.23						25.27
1.A.2. Manufacturing industries and construction	319.18	0.59	14.62						334.39
1.A.3. Transport	992.06	3.14	6.70						1,001.90
1.A.4. Other sectors	829.46	2.16	11.12						842.75
1.A.5. Other	6.80	0.01	0.01						6.82
1.B. Fugitive emissions from fuels	147.33	3.51	NO						150.84
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	147.33	3.51	NO						150.84
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	1,164.41	3.26	4.08	66.91	298.01	NO	2.98	NO	1,539.65
2.A. Mineral industry	64.33	NA	NA						64.33
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	1,091.13	3.20	NO	NO	298.00	NO	NO	NO	1,392.33
2.D. Non-energy products from fuels and solvent use	8.90	NA,NO	NA,NO						8.90
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				66.91	0.00	NO		NO	66.92
2.G. Other product manufacture and use	0.05	0.06	4.08	NO	NO	NO	2.98	NO	7.17
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	4.06	368.69	350.22						722.97
3.A. Enteric fermentation		301.41							301.41
3.B. Manure management		67.28	22.08						89.36
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	328.13						328.13
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.04								1.04
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	3.02								3.02
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,006.07	595.99	6.15						6,608.21
4.A. Forest land	-273.85	0.71	1.92						-271.23
4.B. Cropland	1,946.10	108.23	0.97						2,055.30
4.C. Grassland	4,267.86	473.95	0.01						4,741.81
4.D. Wetlands	7.39	13.11	NA,NE,NO						20.49
4.E. Settlements	58.59	NA	3.26						61.86
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.01								-0.01
4.H. Other	NA	NA	NA						NA
5. Waste	7.96	319.35	13.30						340.61
5.A. Solid waste disposal		308.03							308.03
5.B. Biological treatment of solid waste		1.12	0.64						1.76
5.C. Incineration and open burning of waste	7.96	0.47	0.30						8.73
5.D. Waste water treatment and discharge		9.73	12.36						22.09
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items: ⁽³⁾									
1.D.1. International bunkers	522.97	0.13	3.87						526.98
1.D.1.a. Aviation	511.03	0.10	3.79						514.92
1.D.1.b. Navigation	11.94	0.03	0.08						12.06
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	12.62								12.62
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,965.19
Total CO₂ equivalent emissions with LULUCF	11,573.41
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,965.19
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,573.41

2008

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,859.40	1,289.06	412.16	65.58	369.94	NO	3.10	NO	11,999.25
1. Energy	2,193.96	8.98	31.00						2,233.94
1.A. Fuel combustion	2,008.06	5.47	31.00						2,044.53
1.A.1. Energy industries	10.16	0.07	0.17						10.40
1.A.2. Manufacturing industries and construction	296.88	0.55	14.64						312.08
1.A.3. Transport	939.34	2.86	6.42						948.62
1.A.4. Other sectors	754.60	1.97	9.75						766.31
1.A.5. Other	7.09	0.01	0.02						7.11
1.B. Fugitive emissions from fuels	185.90	3.51	NO						189.41
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	185.90	3.51	NO						189.41
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	1,605.49	2.75	3.64	65.58	369.94	NO	3.10	NO	2,050.50
2.A. Mineral industry	61.80	NA	NA						61.80
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	1,536.09	2.70	NO	NO	369.94	NO	NO	NO	1,908.73
2.D. Non-energy products from fuels and solvent use	7.57	NA	NA						7.57
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				65.58	0.00	NO		NO	65.58
2.G. Other product manufacture and use	0.02	0.05	3.64	NO	NO	NO	3.10	NO	6.81
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	7.02	372.93	358.79						738.74
3.A. Enteric fermentation		305.01							305.01
3.B. Manure management		67.92	21.81						89.73
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	336.98						336.98
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	3.67								3.67
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	3.35								3.35
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,046.63	600.40	6.35						6,653.37
4.A. Forest land	-278.19	0.73	1.95						-275.51
4.B. Cropland	1,938.62	107.87	0.89						2,047.37
4.C. Grassland	4,318.27	478.67	0.06						4,797.00
4.D. Wetlands	7.39	13.13	0.02						20.54
4.E. Settlements	60.56	NA	3.43						63.99
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.01								-0.01
4.H. Other	NA	NA	NA						NA
5. Waste	6.31	304.01	12.39						322.70
5.A. Solid waste disposal		293.02							293.02
5.B. Biological treatment of solid waste		1.19	0.67						1.86
5.C. Incineration and open burning of waste	6.31	0.44	0.27						7.02
5.D. Waste water treatment and discharge		9.36	11.45						20.81
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	474.94	0.21	3.50						478.64
1.D.1.a. Aviation	427.40	0.08	3.17						430.65
1.D.1.b. Navigation	47.53	0.12	0.33						47.98
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	10.29								10.29
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	5,345.88
Total CO₂ equivalent emissions with LULUCF	11,999.25
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	5,345.88
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,999.25

2009

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,738.05	1,285.79	387.63	78.79	161.91	NO	3.13	NO	11,655.30
1. Energy	2,102.82	8.43	24.99						2,136.24
1.A. Fuel combustion	1,932.75	5.24	24.99						1,962.98
1.A.1. Energy industries	7.75	0.06	0.13						7.94
1.A.2. Manufacturing industries and construction	190.21	0.32	7.95						198.48
1.A.3. Transport	912.18	2.73	6.14						921.05
1.A.4. Other sectors	817.79	2.13	10.76						830.68
1.A.5. Other	4.81	0.01	0.01						4.83
1.B. Fugitive emissions from fuels	170.07	3.19	NO						173.26
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	170.07	3.19	NO						173.26
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	1,616.08	2.79	3.20	78.79	161.91	NO	3.13	NO	1,865.91
2.A. Mineral industry	28.69	NA	NA						28.69
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	1,582.10	2.75	NO	NO	161.91	NO	NO	NO	1,746.76
2.D. Non-energy products from fuels and solvent use	5.28	NA	NA						5.28
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				78.79	0.00	NO		NO	78.80
2.G. Other product manufacture and use	0.02	0.04	3.20	NO	NO	NO	3.13	NO	6.39
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	5.72	378.95	341.08						725.75
3.A. Enteric fermentation		310.69							310.69
3.B. Manure management		68.25	22.11						90.36
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	318.97						318.97
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	3.07								3.07
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.65								2.65
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	6,007.17	601.05	6.71						6,614.92
4.A. Forest land	-291.56	0.77	2.35						-288.44
4.B. Cropland	1,888.71	106.11	0.76						1,995.59
4.C. Grassland	4,340.35	480.51	0.00						4,820.86
4.D. Wetlands	7.37	13.66	NA,NE,NO						21.03
4.E. Settlements	62.32	NA	3.59						65.91
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.03								-0.03
4.H. Other	NA	NA	NA						NA
5. Waste	6.26	294.58	11.65						312.48
5.A. Solid waste disposal		283.75							283.75
5.B. Biological treatment of solid waste		1.43	0.81						2.24
5.C. Incineration and open burning of waste	6.26	0.41	0.23						6.90
5.D. Waste water treatment and discharge		8.99	10.61						19.59
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO
Memo items:⁽³⁾									
1.D.1. International bunkers	351.15	0.09	2.60						353.84
1.D.1.a. Aviation	343.01	0.07	2.54						345.61
1.D.1.b. Navigation	8.15	0.02	0.06						8.22
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	8.05								8.05
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						
Indirect CO₂⁽⁴⁾	NA,NE								
Total CO₂ equivalent emissions without LULUCF									5,040.38
Total CO₂ equivalent emissions with LULUCF									11,655.30
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF									5,040.38
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF									11,655.30

2010

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,574.29	1,282.68	376.72	106.61	154.37	NO	4.81	NO	11,499.49
1. Energy	1,993.89	10.61	21.68						2,026.18
1.A. Fuel combustion	1,804.29	4.90	21.68						1,830.86
1.A.1. Energy industries	8.36	0.06	0.14						8.55
1.A.2. Manufacturing industries and construction	137.40	0.23	5.74						143.37
1.A.3. Transport	868.27	2.56	5.84						876.67
1.A.4. Other sectors	776.38	2.03	9.93						788.34
1.A.5. Other	13.88	0.02	0.03						13.92
1.B. Fugitive emissions from fuels	189.60	5.72	NO						195.32
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	189.60	5.72	NO						195.32
1.C. CO ₂ transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	1,623.00	2.90	3.45	106.61	154.37	NO	4.81	NO	1,895.15
2.A. Mineral industry	10.40	NA	NA						10.40
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	1,607.25	2.86	NO	NO	154.37	NO	NO	NO	1,764.48
2.D. Non-energy products from fuels and solvent use	5.33	NA	NA						5.33
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				106.61	0.00	NO		NO	106.61
2.G. Other product manufacture and use	0.02	0.04	3.45	NO	NO	NO	4.81	NO	8.32
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	3.92	376.18	333.51						713.62
3.A. Enteric fermentation		310.67							310.67
3.B. Manure management		65.51	22.34						87.85
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	311.17						311.17
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.86								1.86
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.07								2.07
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,947.40	601.66	6.68						6,555.74
4.A. Forest land	-314.94	0.79	2.49						-311.66
4.B. Cropland	1,856.92	104.35	0.72						1,961.99
4.C. Grassland	4,350.96	482.68	0.00						4,833.64
4.D. Wetlands	7.31	13.85	0.00						21.16
4.E. Settlements	47.19	NA	3.46						50.65
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.03								-0.03
4.H. Other	NA	NA	NA						NA
5. Waste	6.07	291.32	11.41						308.80
5.A. Solid waste disposal		280.46							280.46
5.B. Biological treatment of solid waste		1.71	0.97						2.68
5.C. Incineration and open burning of waste	6.07	0.39	0.22						6.69
5.D. Waste water treatment and discharge		8.76	10.22						18.98
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	377.14	0.07	2.80						380.01
1.D.1.a. Aviation	376.89	0.07	2.79						379.75
1.D.1.b. Navigation	0.25	0.00	0.00						0.25
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	8.06								8.06
1.D.4. CO₂ captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,943.74
Total CO₂ equivalent emissions with LULUCF	11,499.49
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,943.74
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,499.49

2011
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,394.81	1,261.39	372.86	131.32	67.01	NO	3.14	NO	11,230.55
1. Energy	1,875.60	9.08	20.02						1,904.70
1.A. Fuel combustion	1,696.14	4.55	20.02						1,720.71
1.A.1. Energy industries	6.42	0.04	0.11						6.57
1.A.2. Manufacturing industries and construction	137.62	0.24	4.34						142.19
1.A.3. Transport	838.18	2.41	6.14						846.73
1.A.4. Other sectors	707.05	1.84	9.43						718.32
1.A.5. Other	6.88	0.01	0.01						6.90
1.B. Fugitive emissions from fuels	179.46	4.52	NO						183.99
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	179.46	4.52	NO						183.99
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,617.52	2.99	3.54	131.32	67.01	NO	3.14	NO	1,825.53
2.A. Mineral industry	20.14	NA	NA						20.14
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	1,591.77	2.95	NO	NO	67.01	NO	NO	NO	1,661.73
2.D. Non-energy products from fuels and solvent use	5.58	NA,NO	NA,NO						5.58
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				131.32	0.01	NO		NO	131.33
2.G. Other product manufacture and use	0.02	0.04	3.54	NO	NO	NO	3.14	NO	6.75
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	3.86	376.07	330.78						710.71
3.A. Enteric fermentation		309.74							309.74
3.B. Manure management		66.32	22.11						88.44
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	308.67						308.67
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.93								1.93
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	1.93								1.93
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,891.05	602.32	6.49						6,499.87
4.A. Forest land	-342.61	0.80	2.47						-339.34
4.B. Cropland	1,824.98	102.57	0.68						1,928.24
4.C. Grassland	4,361.48	484.86	IE,NA,NO						4,846.34
4.D. Wetlands	1.60	14.09	NA,NE,NO						15.69
4.E. Settlements	45.67	NA	3.34						49.01
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.06								-0.06
4.H. Other	NA	NA	NA						NA
5. Waste	6.78	270.94	12.03						289.75
5.A. Solid waste disposal		259.94							259.94
5.B. Biological treatment of solid waste		1.60	0.91						2.51
5.C. Incineration and open burning of waste	6.78	0.37	0.23						7.39
5.D. Waste water treatment and discharge		9.02	10.89						19.91
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	471.13	0.21	3.47						474.81
1.D.1.a. Aviation	421.51	0.08	3.12						424.72
1.D.1.b. Navigation	49.62	0.13	0.35						50.10
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	7.39								7.39
1.D.4. CO₂ captured	-0.01								-0.01
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,730.68
Total CO₂ equivalent emissions with LULUCF	11,230.55
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,730.68
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,230.55

2012

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,361.90	1,228.70	380.57	136.49	84.53	NO	5.51	NO	11,197.71
1. Energy	1,828.19	8.06	19.47						1,855.72
1.A. Fuel combustion	1,656.22	4.34	19.47						1,680.03
1.A.1. Energy industries	7.71	0.04	0.10						7.85
1.A.2. Manufacturing industries and construction	118.09	0.18	3.80						122.07
1.A.3. Transport	820.07	2.28	5.18						827.53
1.A.4. Other sectors	710.26	1.84	10.39						722.50
1.A.5. Other	0.09	0.00	0.00						0.09
1.B. Fugitive emissions from fuels	171.97	3.72	NO						175.68
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	171.97	3.72	NO						175.68
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,660.41	3.36	3.46	136.49	84.53	NO	5.51	NO	1,893.76
2.A. Mineral industry	0.51	NA	NA						0.51
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,654.33	3.31	NO	NO	84.53	NO	NO	NO	1,742.17
2.D. Non-energy products from fuels and solvent use	5.54	NA,NO	NA,NO						5.54
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				136.49	0.00	NO		NO	136.50
2.G. Other product manufacture and use	0.03	0.04	3.46	NO	NO	NO	5.51	NO	9.04
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	4.35	364.62	336.41						705.37
3.A. Enteric fermentation		303.00							303.00
3.B. Manure management		61.62	21.91						83.53
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	314.49						314.49
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.79								1.79
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.55								2.55
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,862.41	602.94	7.17						6,472.52
4.A. Forest land	-354.06	0.81	3.31						-349.94
4.B. Cropland	1,792.89	100.79	0.64						1,894.32
4.C. Grassland	4,377.65	487.19	0.01						4,864.86
4.D. Wetlands	1.58	14.14	NA,NE,NO						15.72
4.E. Settlements	44.42	NA	3.21						47.63
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.07								-0.07
4.H. Other	NA	NA	NA						NA
5. Waste	6.54	249.72	14.07						270.34
5.A. Solid waste disposal		237.97							237.97
5.B. Biological treatment of solid waste		1.25	0.71						1.96
5.C. Incineration and open burning of waste	6.54	0.37	0.21						7.11
5.D. Waste water treatment and discharge		10.13	13.15						23.29
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	465.47	0.15	3.44						469.05
1.D.1.a. Aviation	441.72	0.09	3.27						445.08
1.D.1.b. Navigation	23.75	0.06	0.16						23.97
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	6.82								6.82
1.D.4. CO₂ captured	-0.04								-0.04
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,725.19
Total CO₂ equivalent emissions with LULUCF	11,197.71
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,725.19
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,197.71

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,317.35	1,223.51	377.02	166.66	79.28	NO	3.32	NO	11,167.14
1. Energy	1,792.90	8.71	19.00						1,820.60
1.A. Fuel combustion	1,619.86	4.18	19.00						1,643.04
1.A.1. Energy industries	4.37	0.01	0.02						4.41
1.A.2. Manufacturing industries and construction	112.73	0.21	4.18						117.12
1.A.3. Transport	835.28	2.23	5.39						842.90
1.A.4. Other sectors	666.72	1.73	9.40						677.85
1.A.5. Other	0.76	0.00	0.00						0.76
1.B. Fugitive emissions from fuels	173.04	4.52	NO						177.56
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	173.04	4.52	NO						177.56
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,686.46	3.38	3.06	166.66	79.28	NO	3.32	NO	1,942.17
2.A. Mineral industry	0.55	NA	NA						0.55
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,680.35	3.35	NO	NO	79.28	NO	NO	NO	1,762.98
2.D. Non-energy products from fuels and solvent use	5.54	NA,NO	NA,NO						5.54
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				166.66	0.00	NO		NO	166.66
2.G. Other product manufacture and use	0.02	0.04	3.06	NO	NO	NO	3.32	NO	6.44
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	4.25	357.62	334.68						696.55
3.A. Enteric fermentation		297.60							297.60
3.B. Manure management		60.01	22.95						82.97
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	311.73						311.73
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.89								1.89
3.H. Urea application	NO								NO
3.I. Other carbon-containing fertilizers	2.36								2.36
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,828.25	603.66	6.49						6,438.39
4.A. Forest land	-371.94	0.81	2.73						-368.40
4.B. Cropland	1,760.64	99.00	0.60						1,860.24
4.C. Grassland	4,395.05	489.58	0.08						4,884.71
4.D. Wetlands	1.54	14.27	NA,NE,NO						15.80
4.E. Settlements	43.03	NA	3.08						46.10
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.07								-0.07
4.H. Other	NA	NA	NA						NA
5. Waste	5.50	250.14	13.79						269.43
5.A. Solid waste disposal		238.19							238.19
5.B. Biological treatment of solid waste		1.68	0.95						2.63
5.C. Incineration and open burning of waste	5.50	0.37	0.22						6.09
5.D. Waste water treatment and discharge		9.91	12.62						22.53
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	576.65	0.30	4.24						581.19
1.D.1.a. Aviation	498.57	0.10	3.70						502.36
1.D.1.b. Navigation	78.08	0.20	0.55						78.83
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	10.23								10.23
1.D.4. CO₂ captured	-0.06								-0.06
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,728.75
Total CO₂ equivalent emissions with LULUCF	11,167.14
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,728.75
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,167.14

2014

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,252.68	1,244.99	395.75	164.47	89.05	NO	2.46	NO	11,149.40
1. Energy	1,798.26	9.00	21.08						1,828.34
1.A. Fuel combustion	1,596.59	4.02	21.08						1,621.69
1.A.1. Energy industries	5.10	0.01	0.01						5.12
1.A.2. Manufacturing industries and construction	77.78	0.13	4.84						82.75
1.A.3. Transport	839.66	2.13	6.00						847.79
1.A.4. Other sectors	671.39	1.74	10.23						683.36
1.A.5. Other	2.65	0.01	0.01						2.67
1.B. Fugitive emissions from fuels	201.67	4.98	NO						206.65
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	201.67	4.98	NO						206.65
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,655.11	3.05	2.83	164.47	89.05	NO	2.46	NO	1,916.98
2.A. Mineral industry	0.55	NA	NA						0.55
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,648.76	3.02	NO	NO	89.05	NO	NO	NO	1,740.83
2.D. Non-energy products from fuels and solvent use	5.78	NA,NO	NA,NO						5.78
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				164.47	0.00	NO		NO	164.47
2.G. Other product manufacture and use	0.02	0.04	2.83	NO	NO	NO	2.46	NO	5.35
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	3.82	379.99	352.02						735.83
3.A. Enteric fermentation		315.29							315.29
3.B. Manure management		64.70	23.17						87.86
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	328.85						328.85
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.61								1.61
3.H. Urea application	0.01								0.01
3.I. Other carbon-containing fertilizers	2.21								2.21
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,787.98	604.32	7.03						6,399.34
4.A. Forest land	-395.54	0.82	3.48						-391.24
4.B. Cropland	1,728.23	97.20	0.56						1,826.00
4.C. Grassland	4,412.15	491.90	0.04						4,904.09
4.D. Wetlands	1.66	14.41	0.01						16.07
4.E. Settlements	41.60	NA	2.95						44.55
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.12								-0.12
4.H. Other	NA	NA	NA						NA
5. Waste	7.50	248.63	12.78						268.91
5.A. Solid waste disposal		236.75							236.75
5.B. Biological treatment of solid waste		2.26	1.28						3.54
5.C. Incineration and open burning of waste	7.50	0.39	0.39						8.29
5.D. Waste water treatment and discharge		9.23	11.10						20.33
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	650.91	0.30	4.80						656.01
1.D.1.a. Aviation	580.37	0.11	4.30						584.79
1.D.1.b. Navigation	70.53	0.18	0.50						71.22
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	15.17								15.17
1.D.4. CO₂ captured	-2.78								-2.78
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,750.06
Total CO₂ equivalent emissions with LULUCF	11,149.40
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,750.06
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,149.40

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,292.40	1,250.41	383.18	156.81	93.25	NO	1.63	NO	11,177.69
1. Energy	1,828.67	9.09	22.26						1,860.01
1.A. Fuel combustion	1,660.71	4.06	22.26						1,687.03
1.A.1. Energy industries	4.18	0.00	0.01						4.19
1.A.2. Manufacturing industries and construction	105.82	0.19	4.76						110.77
1.A.3. Transport	869.00	2.10	7.10						878.20
1.A.4. Other sectors	681.52	1.77	10.39						693.68
1.A.5. Other	0.19	0.00	0.00						0.19
1.B. Fugitive emissions from fuels	167.96	5.03	NO						172.98
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	167.96	5.03	NO						172.98
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,707.99	3.34	2.87	156.81	93.25	NO	1.63	NO	1,965.89
2.A. Mineral industry	0.72	NA	NA						0.72
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,700.82	3.30	NO	NO	93.24	NO	NO	NO	1,797.37
2.D. Non-energy products from fuels and solvent use	6.42	NA,NO	NA,NO						6.42
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				156.81	0.01	NO		NO	156.82
2.G. Other product manufacture and use	0.03	0.04	2.87	NO	NO	NO	1.63	NO	4.57
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	3.19	386.03	336.62						725.85
3.A. Enteric fermentation		318.85							318.85
3.B. Manure management		67.19	22.91						90.09
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	313.72						313.72
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.35								1.35
3.H. Urea application	0.01								0.01
3.I. Other carbon-containing fertilizers	1.84								1.84
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,745.62	605.12	6.52						6,357.26
4.A. Forest land	-420.42	0.82	2.98						-416.62
4.B. Cropland	1,696.82	95.41	0.52						1,792.75
4.C. Grassland	4,427.37	494.39	0.16						4,921.91
4.D. Wetlands	1.64	14.50	0.04						16.18
4.E. Settlements	40.26	NA	2.82						43.08
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.04								-0.04
4.H. Other	NA	NA	NA						NA
5. Waste	6.93	246.83	14.91						268.67
5.A. Solid waste disposal		233.69							233.69
5.B. Biological treatment of solid waste		2.39	1.35						3.74
5.C. Incineration and open burning of waste	6.93	0.39	0.29						7.62
5.D. Waste water treatment and discharge		10.36	13.26						23.62
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	821.66	0.52	6.04						828.22
1.D.1.a. Aviation	673.99	0.13	5.00						679.12
1.D.1.b. Navigation	147.66	0.39	1.05						149.10
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	39.58								39.58
1.D.4. CO₂ captured	-4.98								-4.98
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,820.43
Total CO₂ equivalent emissions with LULUCF	11,177.69
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,820.43
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,177.69

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,197.03	1,249.67	378.69	173.62	82.56	NO	1.39	NO	11,082.97
1. Energy	1,809.01	8.50	25.24						1,842.75
1.A. Fuel combustion	1,650.00	3.74	25.24						1,678.98
1.A.1. Energy industries	2.36	0.00	0.01						2.37
1.A.2. Manufacturing industries and construction	128.49	0.20	7.27						135.97
1.A.3. Transport	946.90	2.04	9.00						957.94
1.A.4. Other sectors	572.09	1.50	8.96						582.55
1.A.5. Other	0.16	0.00	0.00						0.16
1.B. Fugitive emissions from fuels	159.01	4.76	NO						163.77
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	159.01	4.76	NO						163.77
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,684.81	3.39	2.32	173.62	82.56	NO	1.39	NO	1,948.09
2.A. Mineral industry	0.77	NA	NA						0.77
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,677.31	3.35	NO	NO	82.54	NO	NO	NO	1,763.21
2.D. Non-energy products from fuels and solvent use	6.70	NA,NO	NA,NO						6.70
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				173.62	0.02	NO		NO	173.64
2.G. Other product manufacture and use	0.03	0.04	2.32	NO	NO	NO	1.39	NO	3.77
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	3.59	388.66	331.28						723.54
3.A. Enteric fermentation		321.38							321.38
3.B. Manure management		67.28	22.52						89.80
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	308.76						308.76
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.25								1.25
3.H. Urea application	0.39								0.39
3.I. Other carbon-containing fertilizers	1.96								1.96
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,692.14	605.73	6.68						6,304.55
4.A. Forest land	-444.96	0.82	3.50						-440.63
4.B. Cropland	1,663.30	93.60	0.48						1,757.39
4.C. Grassland	4,435.11	496.46	IE,NA,NO						4,931.57
4.D. Wetlands	-0.12	14.85	NA,NE,NO						14.73
4.E. Settlements	38.90	NA	2.70						41.59
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.09								-0.09
4.H. Other	NA	NA	NA						NA
5. Waste	7.48	243.39	13.18						264.05
5.A. Solid waste disposal		230.92							230.92
5.B. Biological treatment of solid waste		2.55	1.45						4.01
5.C. Incineration and open burning of waste	7.48	0.40	0.32						8.20
5.D. Waste water treatment and discharge		9.51	11.41						20.92
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO
Memo items:⁽³⁾									
1.D.1. International bunkers	1,101.38	0.66	8.10						1,110.14
1.D.1.a. Aviation	916.88	0.18	6.80						923.86
1.D.1.b. Navigation	184.50	0.48	1.31						186.29
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO ₂ emissions from biomass	43.69								43.69
1.D.4. CO ₂ captured	-8.97								-8.97
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						
Indirect CO₂⁽⁴⁾	NA,NE								
Total CO₂ equivalent emissions without LULUCF									4,778.42
Total CO₂ equivalent emissions with LULUCF									11,082.97
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF									4,778.42
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF									11,082.97

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,244.34	1,238.79	391.83	164.58	61.12	NO	2.81	NO	11,103.46
1. Energy	1,842.01	7.48	27.62						1,877.11
1.A. Fuel combustion	1,693.12	3.60	27.62						1,724.34
1.A.1. Energy industries	2.31	0.00	0.01						2.32
1.A.2. Manufacturing industries and construction	99.45	0.18	7.16						106.78
1.A.3. Transport	1,000.32	1.88	11.09						1,013.29
1.A.4. Other sectors	590.87	1.54	9.36						601.78
1.A.5. Other	0.17	0.00	0.00						0.17
1.B. Fugitive emissions from fuels	148.89	3.88	NO						152.77
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	148.89	3.88	NO						152.77
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,760.73	3.53	2.14	164.58	61.12	NO	2.81	NO	1,994.91
2.A. Mineral industry	0.90	NA	NA						0.90
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,752.78	3.50	NO	NO	61.10	NO	NO	NO	1,817.38
2.D. Non-energy products from fuels and solvent use	7.03	NA,NO	NA,NO						7.03
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				164.58	0.01	NO		NO	164.59
2.G. Other product manufacture and use	0.03	0.03	2.14	NO	NO	NO	2.81	NO	5.02
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	4.30	381.51	341.32						727.13
3.A. Enteric fermentation		314.99							314.99
3.B. Manure management		66.51	21.90						88.42
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	319.42						319.42
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.59								1.59
3.H. Urea application	0.67								0.67
3.I. Other carbon-containing fertilizers	2.04								2.04
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,629.44	606.46	6.38						6,242.29
4.A. Forest land	-483.25	0.83	3.33						-479.09
4.B. Cropland	1,630.43	91.77	0.44						1,722.65
4.C. Grassland	4,445.10	498.82	0.03						4,943.95
4.D. Wetlands	-0.18	15.04	0.01						14.86
4.E. Settlements	37.50	NA	2.57						40.07
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.15								-0.15
4.H. Other	NA	NA	NA						NA
5. Waste	7.85	239.80	14.36						262.01
5.A. Solid waste disposal		226.76							226.76
5.B. Biological treatment of solid waste		2.43	1.38						3.81
5.C. Incineration and open burning of waste	7.85	0.41	0.35						8.60
5.D. Waste water treatment and discharge		10.20	12.64						22.83
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items: ⁽³⁾									
1.D.1. International bunkers	1,357.98	0.77	9.99						1,368.74
1.D.1.a. Aviation	1,146.71	0.22	8.50						1,155.44
1.D.1.b. Navigation	211.27	0.55	1.49						213.30
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO ₂ emissions from biomass	48.03								48.03
1.D.4. CO ₂ captured	-12.27								-12.27
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,861.17
Total CO₂ equivalent emissions with LULUCF	11,103.46
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,861.17
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,103.46

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,243.80	1,230.07	381.85	182.44	68.70	NO	4.03	NO	11,110.88
1. Energy	1,887.43	7.59	27.53						1,922.54
1.A. Fuel combustion	1,726.00	3.45	27.53						1,756.97
1.A.1. Energy industries	2.35	0.00	0.01						2.36
1.A.2. Manufacturing industries and construction	95.39	0.17	6.09						101.65
1.A.3. Transport	1,038.26	1.72	13.41						1,053.39
1.A.4. Other sectors	589.48	1.55	8.01						599.04
1.A.5. Other	0.52	0.00	0.00						0.53
1.B. Fugitive emissions from fuels	161.43	4.15	NO						165.57
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	161.43	4.15	NO						165.57
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,774.74	3.57	2.60	182.44	68.70	NO	4.03	NO	2,036.08
2.A. Mineral industry	0.91	NA	NA						0.91
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,766.12	3.54	NO	NO	68.66	NO	NO	NO	1,838.31
2.D. Non-energy products from fuels and solvent use	7.69	NA,NO	NA,NO						7.69
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				182.44	0.04	NO		NO	182.48
2.G. Other product manufacture and use	0.03	0.04	2.60	NO	NO	NO	4.03	NO	6.70
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	4.38	371.26	329.69						705.34
3.A. Enteric fermentation		306.66							306.66
3.B. Manure management		64.60	20.24						84.85
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	309.45						309.45
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	1.73								1.73
3.H. Urea application	0.81								0.81
3.I. Other carbon-containing fertilizers	1.84								1.84
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,572.09	607.07	6.36						6,185.52
4.A. Forest land	-512.88	0.83	3.59						-508.46
4.B. Cropland	1,597.39	89.94	0.40						1,687.74
4.C. Grassland	4,462.45	501.14	IE,NA,NO						4,963.59
4.D. Wetlands	-0.36	15.15	NA,NE,NO						14.79
4.E. Settlements	25.57	NA	2.37						27.94
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.08								-0.08
4.H. Other	NA	NA	NA						NA
5. Waste	5.16	240.57	15.67						261.40
5.A. Solid waste disposal		226.65							226.65
5.B. Biological treatment of solid waste		2.69	1.53						4.22
5.C. Incineration and open burning of waste	5.16	0.40	0.32						5.88
5.D. Waste water treatment and discharge		10.83	13.83						24.66
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	1,525.25	0.88	11.22						1,537.35
1.D.1.a. Aviation	1,285.04	0.25	9.53						1,294.82
1.D.1.b. Navigation	240.21	0.63	1.70						242.53
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	57.07								57.07
1.D.4. CO₂ captured	-12.14								-12.14
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,925.36
Total CO₂ equivalent emissions with LULUCF	11,110.88
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,925.36
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	11,110.88

2019

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,112.93	1,195.89	371.34	194.33	72.34	NO	2.34	NO	10,949.18
1. Energy	1,836.27	7.22	26.04						1,869.53
1.A. Fuel combustion	1,664.15	3.16	26.04						1,693.35
1.A.1. Energy industries	4.95	0.01	0.01						4.97
1.A.2. Manufacturing industries and construction	82.06	0.14	5.61						87.80
1.A.3. Transport	1,030.46	1.56	14.30						1,046.32
1.A.4. Other sectors	545.01	1.45	6.12						552.58
1.A.5. Other	1.68	0.00	0.00						1.68
1.B. Fugitive emissions from fuels	172.12	4.06	NO						176.18
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	172.12	4.06	NO						176.18
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,712.99	3.64	2.49	194.33	72.34	NO	2.34	NO	1,988.14
2.A. Mineral industry	0.96	NA	NA						0.96
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,704.85	3.61	NO	NO	72.30	NO	NO	NO	1,780.76
2.D. Non-energy products from fuels and solvent use	7.16	NA,NO	NA,NO						7.16
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				194.33	0.05	NO		NO	194.37
2.G. Other product manufacture and use	0.02	0.03	2.49	NO	NO	NO	2.34	NO	4.88
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	7.77	361.79	321.02						690.58
3.A. Enteric fermentation		298.08							298.08
3.B. Manure management		63.71	19.29						83.00
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	301.73						301.73
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	2.29								2.29
3.H. Urea application	3.15								3.15
3.I. Other carbon-containing fertilizers	2.33								2.33
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,549.73	608.13	6.07						6,163.93
4.A. Forest land	-514.36	0.84	3.53						-509.99
4.B. Cropland	1,564.19	88.10	0.36						1,652.65
4.C. Grassland	4,477.05	503.31	IE,NA,NO						4,980.36
4.D. Wetlands	-0.60	15.88	NA,NE,NO						15.28
4.E. Settlements	23.49	NA	2.18						25.66
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.04								-0.04
4.H. Other	NA	NA	NA						NA
5. Waste	6.17	215.11	15.72						237.00
5.A. Solid waste disposal		201.11							201.11
5.B. Biological treatment of solid waste		2.67	1.52						4.19
5.C. Incineration and open burning of waste	6.17	0.40	0.31						6.88
5.D. Waste water treatment and discharge		10.93	13.89						24.82
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	1,159.90	0.72	8.54						1,169.16
1.D.1.a. Aviation	956.38	0.19	7.09						963.65
1.D.1.b. Navigation	203.52	0.53	1.45						205.51
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	56.36								56.36
1.D.4. CO₂ captured	-10.43								-10.43
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,785.25
Total CO₂ equivalent emissions with LULUCF	10,949.18
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,785.25
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,949.18

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	8,876.28	1,219.18	369.11	198.08	67.61	NO	3.25	NO	10,733.50
1. Energy	1,639.42	7.04	22.58						1,669.04
1.A. Fuel combustion	1,465.99	2.71	22.58						1,491.28
1.A.1. Energy industries	2.61	0.00	0.01						2.62
1.A.2. Manufacturing industries and construction	57.16	0.08	2.66						59.90
1.A.3. Transport	863.17	1.18	13.25						877.61
1.A.4. Other sectors	542.69	1.43	6.66						550.78
1.A.5. Other	0.36	0.00	0.00						0.36
1.B. Fugitive emissions from fuels	173.43	4.33	NO						177.76
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	173.43	4.33	NO						177.76
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,684.54	3.44	2.51	198.08	67.61	NO	3.25	NO	1,959.42
2.A. Mineral industry	0.89	NA	NA						0.89
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,676.61	3.41	NO	NO	67.55	NO	NO	NO	1,747.56
2.D. Non-energy products from fuels and solvent use	7.01	NA,NO	NA,NO						7.01
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				198.08	0.06	NO		NO	198.15
2.G. Other product manufacture and use	0.02	0.03	2.51	NO	NO	NO	3.25	NO	5.81
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	6.99	355.90	324.40						687.29
3.A. Enteric fermentation		293.24							293.24
3.B. Manure management		62.66	18.96						81.61
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	305.44						305.44
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	3.60								3.60
3.H. Urea application	1.57								1.57
3.I. Other carbon-containing fertilizers	1.82								1.82
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,538.91	609.71	5.67						6,154.29
4.A. Forest land	-518.05	0.86	3.19						-514.00
4.B. Cropland	1,530.83	86.27	0.34						1,617.44
4.C. Grassland	4,489.64	505.13	0.02						4,994.79
4.D. Wetlands	-1.13	17.45	0.00						16.32
4.E. Settlements	37.66	NA	2.11						39.78
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.04								-0.04
4.H. Other	NA	NA	NA						NA
5. Waste	6.43	243.09	13.95						263.47
5.A. Solid waste disposal		229.72							229.72
5.B. Biological treatment of solid waste		3.59	2.02						5.60
5.C. Incineration and open burning of waste	6.43	0.12	0.23						6.77
5.D. Waste water treatment and discharge		9.66	11.71						21.37
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items: ⁽³⁾									
1.D.1. International bunkers	338.55	0.25	2.49						341.30
1.D.1.a. Aviation	261.36	0.05	1.94						263.35
1.D.1.b. Navigation	77.19	0.20	0.55						77.95
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	60.14								60.14
1.D.4. CO₂ captured	-11.51								-11.51
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,579.22
Total CO₂ equivalent emissions with LULUCF	10,733.50
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,579.22
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,733.50

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,009.99	1,228.53	375.48	162.41	73.38	NO	3.08	NO	10,852.86
1. Energy	1,725.44	7.47	24.47						1,757.37
1.A. Fuel combustion	1,563.15	2.91	24.47						1,590.52
1.A.1. Energy industries	3.19	0.00	0.01						3.21
1.A.2. Manufacturing industries and construction	74.37	0.17	3.38						77.92
1.A.3. Transport	891.81	1.14	14.91						907.86
1.A.4. Other sectors	591.25	1.59	6.16						599.00
1.A.5. Other	2.53	0.01	0.01						2.54
1.B. Fugitive emissions from fuels	162.29	4.56	NO						166.85
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	162.29	4.56	NO						166.85
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,752.02	4.01	1.87	162.41	73.38	NO	3.08	NO	1,996.76
2.A. Mineral industry	0.93	NA	NA						0.93
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,744.25	3.98	NO	NO	73.32	NO	NO	NO	1,821.55
2.D. Non-energy products from fuels and solvent use	6.81	NA,NO	NA,NO						6.81
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				162.41	0.06	NO		NO	162.47
2.G. Other product manufacture and use	0.02	0.03	1.87	NO	NO	NO	3.08	NO	5.00
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	6.83	355.74	328.74						691.30
3.A. Enteric fermentation		292.24							292.24
3.B. Manure management		63.49	18.89						82.38
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	309.85						309.85
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	3.54								3.54
3.H. Urea application	1.37								1.37
3.I. Other carbon-containing fertilizers	1.92								1.92
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,519.14	610.65	5.05						6,134.85
4.A. Forest land	-519.97	0.91	2.65						-516.41
4.B. Cropland	1,497.30	84.39	0.28						1,581.97
4.C. Grassland	4,495.78	507.19	0.01						5,002.99
4.D. Wetlands	-1.39	18.15	NA,NE,NO						16.76
4.E. Settlements	47.43	NA	2.12						49.55
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.01								-0.01
4.H. Other	NA	NA	NA						NA
5. Waste	6.56	250.66	15.35						272.58
5.A. Solid waste disposal		236.24							236.24
5.B. Biological treatment of solid waste		3.77	1.76						5.53
5.C. Incineration and open burning of waste	6.56	0.10	0.23						6.90
5.D. Waste water treatment and discharge		10.55	13.36						23.92
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO
Memo items:⁽³⁾									
1.D.1. International bunkers	609.72	0.43	4.49						614.64
1.D.1.a. Aviation	482.47	0.09	3.58						486.14
1.D.1.b. Navigation	127.25	0.34	0.91						128.50
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	85.05								85.05
1.D.4. CO₂ captured	-13.44								-13.44
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						
Indirect CO₂⁽⁴⁾	NA,NE								
Total CO₂ equivalent emissions without LULUCF									4,718.02
Total CO₂ equivalent emissions with LULUCF									10,852.86
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF									4,718.02
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF									10,852.86

2022

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,110.39	1,218.80	370.30	133.18	71.81	NO	2.10	NO	10,906.57
1. Energy	1,780.96	7.80	25.39						1,814.15
1.A. Fuel combustion	1,607.26	2.83	25.39						1,635.48
1.A.1. Energy industries	10.45	0.01	0.02						10.49
1.A.2. Manufacturing industries and construction	127.60	0.30	3.73						131.63
1.A.3. Transport	966.01	1.16	16.17						983.34
1.A.4. Other sectors	502.45	1.36	5.46						509.28
1.A.5. Other	0.75	0.00	0.00						0.75
1.B. Fugitive emissions from fuels	173.70	4.97	NO						178.66
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	173.70	4.97	NO						178.66
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,803.78	4.49	2.01	133.18	71.81	NO	2.10	NO	2,017.37
2.A. Mineral industry	0.94	NA	NA						0.94
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,795.71	4.46	NO	NO	71.75	NO	NO	NO	1,871.92
2.D. Non-energy products from fuels and solvent use	7.10	NA,NO	NA,NO						7.10
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				133.18	0.06	NO		NO	133.24
2.G. Other product manufacture and use	0.03	0.03	2.01	NO	NO	NO	2.10	NO	4.17
2.H. Other	NA	NA	NA	NO	NO	NO		NO	NA,NO
3. Agriculture	6.02	353.31	322.82						682.15
3.A. Enteric fermentation		288.46							288.46
3.B. Manure management		64.85	18.23						83.08
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	304.59						304.59
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	2.89								2.89
3.H. Urea application	1.60								1.60
3.I. Other carbon-containing fertilizers	1.53								1.53
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,513.17	611.39	5.94						6,130.51
4.A. Forest land	-550.17	0.92	3.44						-545.82
4.B. Cropland	1,563.23	84.57	0.55						1,648.35
4.C. Grassland	4,480.71	507.22	IE,NA,NO						4,987.93
4.D. Wetlands	-1.57	18.68	NA,NE,NO						17.11
4.E. Settlements	21.07	NA	1.95						23.02
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.10								-0.10
4.H. Other	NA	NA	NA						NA
5. Waste	6.46	241.80	14.13						262.39
5.A. Solid waste disposal		226.69							226.69
5.B. Biological treatment of solid waste		4.99	2.41						7.40
5.C. Incineration and open burning of waste	6.46	0.39	0.30						7.15
5.D. Waste water treatment and discharge		9.73	11.42						21.15
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	1,132.74	0.92	8.32						1,141.98
1.D.1.a. Aviation	848.29	0.17	6.29						854.75
1.D.1.b. Navigation	284.45	0.75	2.04						287.23
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	54.02								54.02
1.D.4. CO₂ captured	-12.33								-12.33
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,776.06
Total CO₂ equivalent emissions with LULUCF	10,906.57
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,776.06
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,906.57

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	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,049.65	1,201.79	360.51	124.50	68.17	NO	1.94	NO	10,806.56
1. Energy	1,746.61	8.11	27.03						1,781.75
1.A. Fuel combustion	1,574.53	2.74	27.03						1,604.31
1.A.1. Energy industries	10.92	0.01	0.02						10.96
1.A.2. Manufacturing industries and construction	104.31	0.26	5.18						109.74
1.A.3. Transport	950.56	1.10	16.33						967.99
1.A.4. Other sectors	506.97	1.36	5.50						513.84
1.A.5. Other	1.77	0.00	0.00						1.78
1.B. Fugitive emissions from fuels	172.08	5.36	NO						177.44
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	172.08	5.36	NO						177.44
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,747.67	3.88	1.84	124.50	68.17	NO	1.94	NO	1,948.00
2.A. Mineral industry	0.97	NA	NA						0.97
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO	NO	NO	NO	NA,NO
2.C. Metal industry	1,738.91	3.85	NO	NO	68.09	NO	NO	NO	1,810.85
2.D. Non-energy products from fuels and solvent use	7.78	NA,NO	NA,NO						7.78
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				124.50	0.08	NO		NO	124.58
2.G. Other product manufacture and use	0.02	0.03	1.84	NO	NO		1.94	NO	3.82
2.H. Other	NA	NA	NA	NO	NO			NO	NA,NO
3. Agriculture	8.08	344.13	308.03						660.24
3.A. Enteric fermentation		282.26							282.26
3.B. Manure management		61.88	17.45						79.33
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	290.57						290.57
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	4.91								4.91
3.H. Urea application	1.83								1.83
3.I. Other carbon-containing fertilizers	1.34								1.34
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,541.20	613.52	7.82						6,162.55
4.A. Forest land	-542.46	0.93	4.67						-536.86
4.B. Cropland	1,550.12	83.91	0.64						1,634.68
4.C. Grassland	4,511.94	509.95	0.69						5,022.58
4.D. Wetlands	-1.59	18.74	NA,NE,NO						17.15
4.E. Settlements	23.41	NA	1.82						25.22
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.22								-0.22
4.H. Other	NA	NA	NA						NA
5. Waste	6.09	232.15	15.79						254.03
5.A. Solid waste disposal		215.59							215.59
5.B. Biological treatment of solid waste		5.59	2.67						8.25
5.C. Incineration and open burning of waste	6.09	0.39	0.33						6.81
5.D. Waste water treatment and discharge		10.58	12.80						23.37
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	1,289.74	1.06	9.48						1,300.29
1.D.1.a. Aviation	960.35	0.19	7.12						967.65
1.D.1.b. Navigation	329.40	0.87	2.36						332.64
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	50.29								50.29
1.D.4. CO₂ captured	-12.55								-12.55
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,644.01
Total CO₂ equivalent emissions with LULUCF	10,806.56
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,644.01
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,806.56

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SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF ₆	NF ₃	Total
	CO ₂ equivalents (kt) ⁽²⁾								
Total (net emissions)⁽¹⁾	9,270.47	1,184.74	371.83	107.72	58.57	NO	1.63	NO	10,994.96
1. Energy	1,830.91	8.17	27.40						1,866.48
1.A. Fuel combustion	1,612.18	2.77	27.40						1,642.35
1.A.1. Energy industries	15.40	0.02	0.03						15.45
1.A.2. Manufacturing industries and construction	127.66	0.22	5.23						133.11
1.A.3. Transport	923.03	1.07	16.39						940.49
1.A.4. Other sectors	541.49	1.46	5.73						548.67
1.A.5. Other	4.60	0.01	0.01						4.62
1.B. Fugitive emissions from fuels	218.73	5.40	NO						224.13
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	218.73	5.40	NO						224.13
1.C. CO ₂ transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	1,833.72	4.84	1.74	107.72	58.57		1.63	NO	2,008.22
2.A. Mineral industry	0.92	NA	NA						0.92
2.B. Chemical industry	NA,NO	NA,NO	NO	NO	NO			NO	NA,NO
2.C. Metal industry	1,824.42	4.81		NO	58.50			NO	1,887.73
2.D. Non-energy products from fuels and solvent use	8.35	NA,NO	NA,NO						8.35
2.E. Electronic Industry			NO	NO	NO			NO	NO
2.F. Product uses as ODS substitutes				107.72	0.07			NO	107.78
2.G. Other product manufacture and use	0.03	0.03	1.74	NO	NO		1.63	NO	3.43
2.H. Other	NA	NA	NA	NO	NO			NO	NA,NO
3. Agriculture	5.68	337.73	318.34						661.74
3.A. Enteric fermentation		276.92							276.92
3.B. Manure management		60.80	16.99						77.79
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	301.35						301.35
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	2.51								2.51
3.H. Urea application	2.02								2.02
3.I. Other carbon-containing fertilizers	1.15								1.15
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	5,593.54	614.72	7.66						6,215.92
4.A. Forest land	-539.99	0.93	4.89						-534.17
4.B. Cropland	1,581.60	83.83	0.81						1,666.24
4.C. Grassland	4,528.66	511.22	0.26						5,040.14
4.D. Wetlands	-1.59	18.74	0.00						17.15
4.E. Settlements	25.05	NA	1.70						26.76
4.F. Other land	NA,NO	NA	NA						NA,NO
4.G. Harvested wood products	-0.19								-0.19
4.H. Other	NA	NA	NA						NA
5. Waste	6.62	219.30	16.69						242.61
5.A. Solid waste disposal		203.07							203.07
5.B. Biological treatment of solid waste		4.43	2.03						6.46
5.C. Incineration and open burning of waste	6.62	0.39	0.46						7.47
5.D. Waste water treatment and discharge		11.40	14.20						25.60
5.E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1)						NO		NO	NO

Memo items:⁽³⁾									
1.D.1. International bunkers	1,320.10	1.05	9.71						1,330.86
1.D.1.a. Aviation	999.45	0.20	7.41						1,007.06
1.D.1.b. Navigation	320.64	0.85	2.30						323.80
1.D.2. Multilateral operations	NE	NE	NE						NE
1.D.3. CO₂ emissions from biomass	83.80								83.80
1.D.4. CO₂ captured	-12.14								-12.14
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N₂O			NA,NE						

Indirect CO₂⁽⁴⁾	NA,NE								

Total CO₂ equivalent emissions without LULUCF	4,779.04
Total CO₂ equivalent emissions with LULUCF	10,994.96
Total CO₂ equivalent emissions, including indirect CO₂, without LULUCF	4,779.04
Total CO₂ equivalent emissions, including indirect CO₂, with LULUCF	10,994.96