Icelandic Environment and Energy Agency

2025

National Inventory Document

Emissions of Greenhouse Gases in Iceland from 1990 to 2023

Submitted under the United Nations Framework Convention on Climate Change

National Inventory Document 2025

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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 also part of the European Union's emission reduction target for 2030, 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.

According to the above-mentioned reporting obligations, Iceland has prepared a National Inventory Report (NIR) covering emissions and removals in the years 1990-2023. 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 (LaFI - *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 LaFI. 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 March 2025

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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
AUI	Agricultural University of Iceland (*Landbúnaðarháskóli Íslands*)
BAT	Best Available Technology
BEP	Best Environmental Practice
BOD	Biological Oxygen Demand
C_2F_6	Hexafluoroethane
C_3F_8	Octafluoropropane
CER	Certified Emission Unit
CF_4	Tetrafluoromethane
CFC	Chlorofluorocarbon
CH_4	Methane
CKD	Cement Kiln Dust
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	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
DOC	Degradable Organic Carbon
EAI	The Environment Agency of Iceland (*Umhverfisstofnun*)
EF	Emission Factor
ERT	Expert Review Team
ERU	Emission Reduction Unit
EU	European Union
EU ETS	European Union Greenhouse Gas Emission Trading System
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
IAAC	Icelandic Agricultural Advisory Centre (*Ráðgjafamiðstöð landbúnaðarins*)
IEEA	Icelandic Environment and Energy Agency (*Umhverfis- og orkustofnun*)
IEF	Implied Emission Factor
IFVA	Icelandic Food and Veterinary Association (*Matvælastofnun*)
IINH	Icelandic Institute of Natural History (*Náttúrufræðistofnun Íslands*)
IPCC	Intergovernmental Panel on Climate Change

ITA	Icelandic Transport Authority (*Samgöngustofa*)
ITL	International Transaction Log
IW	Industrial Waste
Kha	Kilohectare
KP	Kyoto Protocol
LaFI	Land and Forest Iceland
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 (*Umhverfis-, orku- og loftslagsráðuneytið*)
MFAF	Ministry of Food, Agriculture, and Fisheries (*Matvælaráðuneytið*)
MMR	Monitoring Mechanism Regulation
MSW	Municipal Solid Waste
N_2O	Nitrous Oxide
NEA	National Energy Authority (*Orkustofnun*)
NF_3	Nitrogen Trifluoride
NFI	National Forest Inventory
NID	National Inventory Document
NIR	National Inventory Report
NIRA	The National Inventory on Revegetation Area
NLSI	National Land Survey of Iceland (*Landmælingar Íslands*)
NMVOC	Non-Methane Volatile Organic Compounds
NO_x	Nitrogen Oxides
NPCI	National Power Company of Iceland (*Landsvirkjun*)
ODS	Ozone Depleting Substances
OECD	Organisation for Economic Co-operation and Development
OX	Oxidation Factor
PFC	Perfluorocarbons
POP	Persistent Organic Pollutant
QA/QC	Quality Assurance/Quality Control
RI	Registers Iceland (*Þjóðskrá Íslands*)
RMU	Removal Unit
SEF	Standard Electronic Format
SF_6	Sulphur Hexafluoride
Si	Silicon
SI	Statistics Iceland (*Hagstofa Íslands*)
SiO	Silicon Monoxide
SiO_2	Quartz
SO_2	Sulphur Dioxide
SO_2e	Sulphur Dioxide Equivalents
SOC	Soil Organic Carbon
SSPP	Systematic Sampling of Permanent Plots
SWD	Solid Waste Disposal
SWDS	Solid Waste Disposal Sites
t/t	Tonne per Tonne
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_2O	265
Sulphur hexafluoride	SF_6	23,500
Perfluorocarbons (PFCs):		
Tetrafluoromethane (PFC 14)	CF_4	6,630
Hexafluoroethane (PFC 116)	C_2F_6	11,100
Octafluoropropane (PFC 218)	C_3F_8	8,900
Hydrofluorocarbons (HFCs):		
HFC-23	CHF_3	12,400
HFC-32	CH_2F_2	677
HFC-125	C_2HF_5	3,170
HFC-134a	$C_2H_2F_4$ (CH_2FCF_3)	1,300
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	4,800
HFC-152a	$C_2H_4F_2$ (CH_3CHF_2)	138
HFC-227ea	C_3HF_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, ratified the Kyoto Protocol in 2002 and the Doha amendment to the Kyoto protocol in 2015, and accepted the Paris Agreement 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. In response to 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 and the Annexes to Commission Implementing Regulation 2020/1208, 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 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 (LaFI, 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 are continually being developed and improved.

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 Plan[1], 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 2020[2], 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 2024[3]. The update includes 150 climate actions, some of which are new while others were carried from the older action plan. Ongoing work aims to further analyse the potential mitigation effort from each action for a consolidated and effective two year implementation plan. The action plan is a key foundation for achieving Iceland's commitments towards the EU for the year 2030, as well as its carbon neutrality goals, which are set to be achieved by no later than 2040.

[1] Aðgerðaáætlun í loftslagsmálum 2018-2030: Climate Action plan 2018-2030, in Icelandic

[2] Aðgerðaáætlun í loftslagsmálum til 2030: Climate Action plan, updated second edition, in Icelandic

[3] 2024 Climate action plan (in Icelandic).

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

- Under the **Paris Agreement**, Iceland is acting jointly with the EU Member States, Norway and Iceland to reach an overall target of 55% reduction of greenhouse gas emissions by 2030 compared to 1990 levels[4]. For the period 2021-2030 Iceland will a) continue participation in the EU Emissions Trading Scheme, b) reduce emissions falling under the scope of the EU's Effort Sharing Regulation (Regulation (EU) 2018/842), and c) reduce net emissions falling under the scope of the EU's LULUCF Regulation[5]. The current Effort Sharing target for 2030 is 29% reduction relative to 2005, as determined according to the previous 2030 target of the EU, Iceland and Norway. At the time of this writing work is in progress to determine a new target in line with the updates of the EU's "Fit for 55" legislation package. Regarding net emissions from the LULUCF sector, the target for the period 2021-2025 consists of the no-debit rule, which corresponds to no increase in emissions over the period 2021-2025 compared to the reference period of 2005-2009. For the period 2026-2030, Member States, Norway and Iceland are assigned a budget for net emissions/removals for the period 2026-2029, calculated based on a target for the year 2030; this target has yet to be determined for Norway and Iceland and incorporated into the EEA Agreement.
- The **second commitment period of the Kyoto Protocol** ran for eight years, from 2013 to 2020. In 2015, it was agreed[6] between the European Union (EU), its Member States and Iceland that Iceland would participate in the joint fulfilment of commitments of the Union for the second commitment period of the Kyoto Protocol. Therein the Parties agreed to fulfil their quantified emission limitation and reduction commitments for the second commitment period inscribed in the third column of Annex B to the Kyoto Protocol jointly. According to this agreement, Iceland was allocated 15,327,217 t CO_2e 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 (CO_2) 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 CO_2 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.

[4] See Iceland's Nationally Determined Contribution (NDC), as communicated to the UNFCCC in February 2021.

[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 (https://www.efta.int/media/documents/legal-texts/eea/other-legal-documents/adopted-joint-committee-decisions/2019%20-%20English/269-2019.pdf) Work is underway to incorporate the updated ESR and LULUCF regulations into the EEA Agreement, including the new ESR and the new LULUCF targets.

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

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 (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_20)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)
- Nitrogen fluoride (NF_3)

Iceland reports emissions of CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6. NF_3 is not used in Iceland and has not been imported as such. In addition, there is currently no industry operating in Iceland that might use and/or emit NF_3.

Emissions that are reported in CO_2 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 over the UNFCCC sectors since 1990 excluding LULUCF is shown in Figure ES.1 and including LULUCF in Figure ES.2. The LULUCF sector contributes to approximately 63% of the national total (including LULUCF). The Energy sector and Industrial Processes contribute approximately 80% of emissions to the national total (excluding LULUCF). The emissions from the Agriculture and Waste sectors are considerably smaller.

A summary of Iceland's national emissions for selected years since 1990 is presented in Table ES.1. LULUCF is the largest sector, with emissions of more than double the combined emissions from the other sectors across the time series. 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.

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

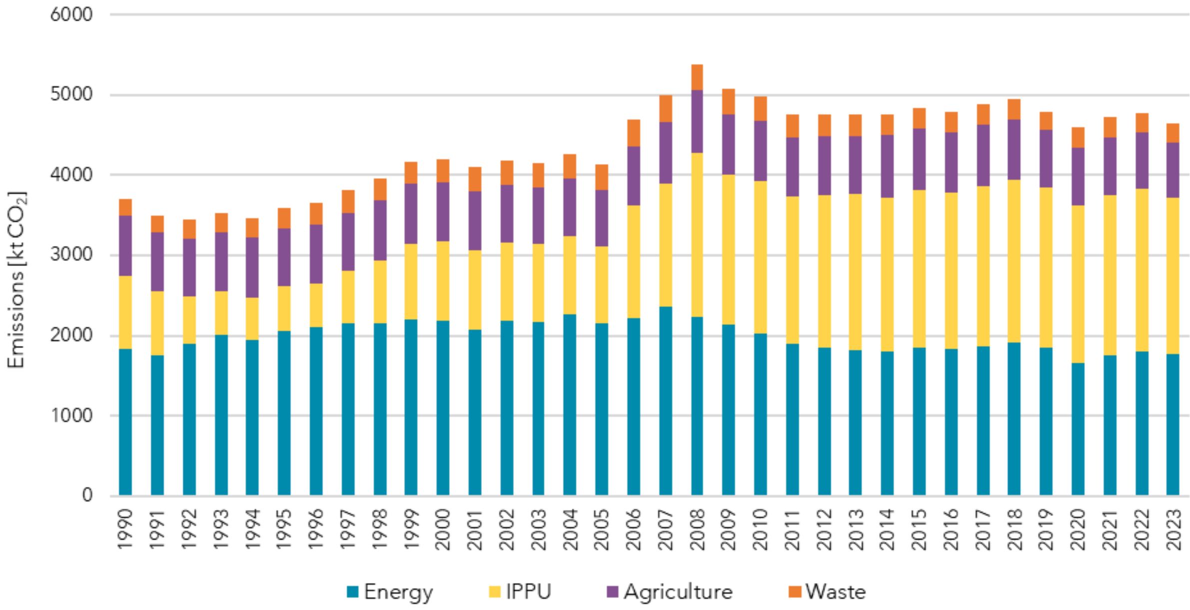

Figure ES.1 Emissions of greenhouse gases by sector, without LULUCF, since 1990, [kt CO_2e, calculated using GWP from AR5]

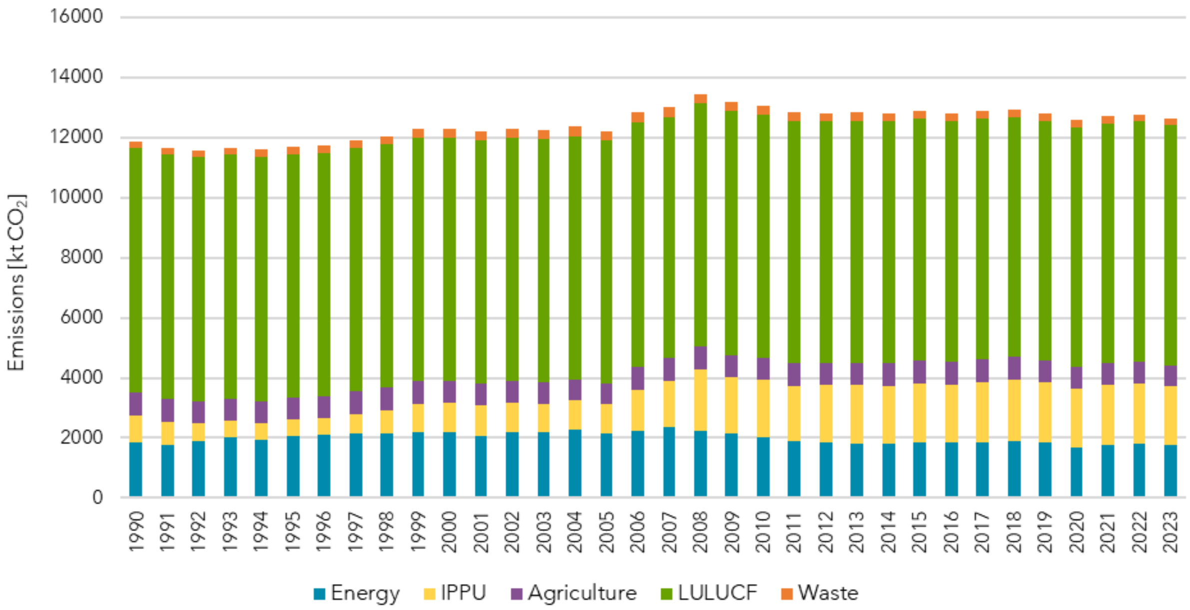

Figure ES.2 Emissions of greenhouse gases by sector, with LULUCF, since 1990, [kt CO_2e, calculated using GWP from AR5]

Table ES.1 Emissions of greenhouse gases by sector, since 1990, [kt CO_2e, calculated using GWP from AR5]

	1990	1995	2000	2005	2010	2015	2020	2022	2023	Change 1990-2023	Change 2022-2023
1 Energy	1841	2058	2185	2159	2027	1854	1664	1807	1774	-3.6%	-1.8%
2 Industrial Processes	902	553	991	950	1895	1965	1958	2016	1946	116%	-3.5%
3 Agriculture	757	726	732	711	749	762	723	712	692	-8.5%	-2.8%
4 Land Use, Land Use Change and Forestry	8142	8111	8095	8092	8088	8039	8000	7986	7985	-1.9%	-0.009%
5 Waste	207	255	293	309	306	264	259	247	233	12%	-5.4%
Total with LULUCF	**11850**	**11702**	**12296**	**12221**	**13064**	**12884**	**12605**	**12767**	**12631**	**6.6%**	**-1.1%**
Total without LULUCF	**3707**	**3591**	**4201**	**4129**	**4976**	**4845**	**4605**	**4782**	**4646**	**25%**	**-2.8%**

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. Recent research has indicated that there are significant emissions of CO_2 from drained organic soils. These emissions can be attributed to drainage of wetlands in the latter half of the 20th Century, which had largely ceased by 1990. These emissions of CO_2 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 2023	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)					
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_2O Emissions from Managed Soils	N_2O	✓	✓	
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	✓	✓	✓
4D1	Wetlands Remaining Wetlands	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 ES.3 Key categories of Iceland's greenhouse gas inventory (excluding LULUCF). ✓ = Key source category.

IPCC source category		Gas	Level 1990	Level 2023	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_2O	✓		✓
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_2O Emissions from Managed Soils	N_2O	✓	✓	✓
3D2	Indirect N_2O Emissions from Managed Soils	N_2O	✓	✓	
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 this 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, issues regarding the Reference Approach (RA) have been a point of focus in this past submission. The NCV as well as the C and H content for diesel were updated for the most recent years. Charcoal use was added for the years 1990-2018. The activity data for 1B2av Fugitive Emissions was changed from total imported fuel to the total fuel sold. Issues regarding the Reference Approach will again be a point of focus in the next submissions, as the IEEA is working to improve the data reported in the Reference Approach, as well as to identify the reasons for discrepancies between the Reference Approach and the Sectoral Approach (SA).

For this submission, the main improvement in **IPPU** was a tier change in 2D3a, Other Solvent Use Including Fungicides and changes in method in calculating NMVOC emissions from beer and malt in 2H2, Food and Beverage Industry. 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 to add heat pumps.

In **Agriculture**, calculations were updated to the 2019 IPCC Refinements methodology wherever possible. The 2019 IPCC Refinements are now applied in the 3A and 3B subsectors, where Tier 1 methodology and corresponding emission factors are used for emission calculations. Plans are underway to collect the necessary data and information to evaluate how to incorporate the 2019 Refinements into the calculations where Tier 2 methodology is applied in 3A and 3B, as well as for all calculations in 3D Agricultural Soils.

Research was launched in the end of 2024 with the aim to establish country specific methane production capacity (B_0) and methane conversion factors (MCFs) from slurry and pit storage in cattle and sheep farming. Results, expected in 2026, will be incorporated in the 2027 submission.

Preliminary steps will be undertaken to define a country specific value for the fraction leached from manure management from manure management systems (FracLeachMS) based on a 2021 UNFCCC review recommendation. Furthermore, the activity data on CAN (calcium ammonium nitrate) fertilisers is expected to improve over the next few years, as more detailed data recording is planned.

In the **LULUCF** sector various improvements were made for the 2025 submission. For Forest land, the country specific EF for Nitrous oxide emissions from drained organic soils was updated from 0.44 kg N_2O-N ha^{-1} yr^{-1} to 1.26 kg N_2O-N ha-1 yr-1. Indirect CO_2 emissions from drained organic soils (which are off-site emissions via waterborne carbon losses) is estimated for the first time in this year submission (2025) with country specific emission factor. Recalculation of areas of Intact mires managed vs unmanaged. For Settlements, until 2024 submission the mineral soils pool in the subcategory 4.E.2.3 All other Grassland categories converted to Settlements was reported as NE. In the 2025 submission a country specific CSC factor for this pool was calculated and relative emissions estimated (see section 6.7.4.2). Furthermore, indirect N_2O emission related to SOC mineralisation of Forest land converted to Settlement is reported for the first time.

In **Waste** the inconsistency between the reporting of landfill gas, between the Energy and the Waste sectors was partially fixed for the 2025 submission. 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 Industrial Wastewater category is currently only calculated for fish processing on land. Effort was put into adding the other major industries in Iceland to the inventory. The missing data was mapped out for various industries for the whole time series. However, collecting the missing data was too large a project to finish for the 2025 submission. This project is expected to take a few years.

1 National circumstances, institutional arrangements, and crosscutting information

1.1 Background Information

The 1992 United Nations Fraamework 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 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 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)

Under the Paris Agreement, Iceland is acting jointly with the EU member states, Iceland and Norway to reach a target of 55% reduction of greenhouse gas emissions by 2030 compared to 1990 levels. For the period 2021-2030 Iceland has committed to:

a) continuing its participation in the EU Emissions Trading Scheme (**EU ETS**) according to Directive 2003/87/EC. The main activities covered by the EU ETS in Iceland (apart from aviation) are the production of aluminium, ferrosilicon and silicon metal.

b) reducing emissions falling under the scope of the EU's Effort Sharing Regulation (Regulation (EU) 2018/842 – **ESR)** The main activities and sectors within the scope of the ESR are road transport, fishing, agriculture, waste and F-gases. The Effort Sharing target for 2030 currently in force in Iceland is 29% reduction relative to 2005, 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 determine a new target in line with EU's updated target of 55% reduction in emissions in 2030 relative to 1990;

c) implementing the reporting and accounting rules pertaining to emissions and removals from the Land Use, Land-use Change, and Forestry (**LULUCF**) as prescribed by the LULUCF regulation (Regulation (EU) 2018/841) The LULUCF target for 2030 currently in force in Iceland is according to the no-debit rule; as for the ESR discussed above, work is in progress to determine a LULUCF target in line with the the EU's updated 2030 targets.

Iceland's and Norway's collaboration 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) Agreement[7]. 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) 2918/1999) pursuant to the rules regarding the greenhouse gas inventories and replacing the MMR Regulation (Regulation (EU) No 525/2013). In 2021, two additional acts were added to the EEA Agreement[8]:Commission Implementing Regulation (EU) 2020/1208 on structure, format, submission processes and review of information to be reported, as well as Commission Delegated Regulation (EU) 2020/1044 on GWP, reporting guidelines and union inventory system. Iceland has implemented the LULUCF Regulation and the ESR through the Climate Act No 70/2012 ("*lög um loftslagsmál nr. 70/2012*").

Following the EU's updates to the ESR, the LULUCF Regulation and the Governance Regulation to align with the new target of 55% reduction by 2030 relative to 1990, work is currently underway to incorporate the updated inventory-related acts. This includes Regulation (EU) 2023/839 amending the LULUCF regulation, Regulation (EU) 2023/857 amending the ESR, and Commission Implementing Regulation (EU) 2024/1281 amending Commission Implementing Regulation (EU) 2020/1208.

At the time of writing, the Climate Act No 70/2012 is under complete revision by the Ministry of the Environment, Energy and Climate. Following the amendment of the Climate Act, Regulation No 520/2017 (on data collection and information from institutions related to Iceland's inventory of greenhouse gas emissions and carbon removal) will be revised to reflect the most recent legal framework.

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

In 2015 a Joint Fulfilment Agreement[9] 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. Therein the Parties agreed to fulfil jointly their quantified emission limitation and reduction commitments for the second commitment period inscribed in the third column of Annex B to 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/EC[10].

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

[7] Decision of the EEA Joint Committee No 269/2019

[8] Decision of the EEA Joint Committee No 223/2021

[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, but including removal units as eligible under Art. 3.3 and 3.4 of the Kyoto Protocol.

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.

At the end of the second commitment period, Iceland's emissions amounted to a total of 23,020,117 t CO_2e 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 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 (CO_2e). 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 (CO_2) 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 CO_2 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 CO_2e, corresponding to 3,257,140 tonnes CO_2e 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 CO_2e. Of these emissions, 2,655,824 tonnes were reported under the national totals, to match the total available amount 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 Plan[11], 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 2020[12], 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, the government shall, in consultation with stakeholders, review and update the Climate Action Plan every fourth 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 2024[15]. The update includes 150 climate actions, some which are new and while others were carried from the older action plan. Ongoing work aims to further analyse the potential mitigation effort from each action for a consolidated and effective two year implementation plan. The action plan is a key foundation for the government's carbon neutrality goals, which are set to be achieved by no later than 2040.

The 150 climate actions represent a significant increase from the 50 actions in the previous action plan. Current work aims to further analyse and focus the work on actions that are ready for implementation, and will be prioritized on the basis of a cost-benefit analysis as well as finance and project planning status.

The plan was subjected to public consultation in the summer of 2024, and a new interministerial committee was formed to lead the ongoing work of implementation and further development of the action plan.

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[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 Progress report on the Climate Action Plan, published September 2021 (in icelandic)

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

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

1.2 National System for Estimation of Greenhouse Gases

As described below, the main changes since the last submission in the national inventory system and in the national registry are due to the fact that the Environment Agency of Iceland ceased its operations at the end of 2024. In practice this does not directly influence the national system nor the national registry operation, as the duties and staff of the teams responsible for these projects remain essentially unchanged.

1.2.1 Institutional Arrangements

The Climate Act No 70/2012 establishes the national system for the estimation of greenhouse gas emissions. In accordance with this Act, the Icelandic Environment and Energy Agency (*Umhverfis- og orkustofnun*) (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), an agency under the auspices of the Ministry of the Environment, Energy, and Climate (*Umhverfis-, orku- og loftslagsráðuneytið*) (MEEC), carries the overall responsibility for the national inventory. The IEEA compiles and maintains the greenhouse gas emission inventory, except for the LULUCF sector which is compiled by Land and Forest Iceland (LaFI, 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, Head of Division) and is responsible for approving the final inventory before its submission to the UNFCCC.

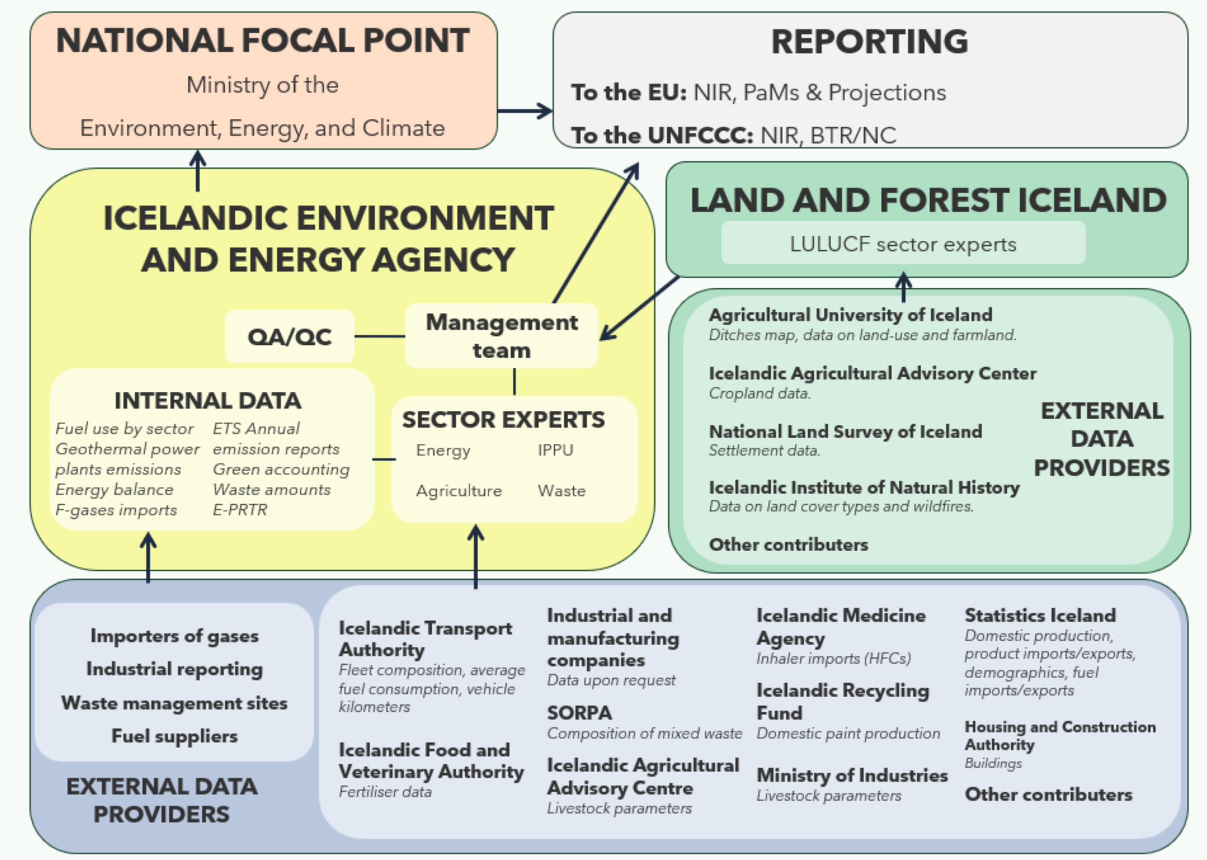


Figure 1.1 Information flow and distribution of responsibilities in the Icelandic emission inventory system for reporting to the UNFCCC.

1.2.2 National Legislation

1.2.2.1 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 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 Agency (now part of 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 520/2017as 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.

1.2.2.2 Regulation No 520/2017

Icelandic Regulation No 520/2017[16] 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.

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

Icelandic Act No 96/2023 on the EU Emissions Trading System implements EU Directive 2003/87/EC in Iceland 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). Under the System the polluters pay for their greenhouse gas emissions and it is based on a "cap and trade" principle, where emissions allowances, giving right to emit one tonne of CO_2 equivalent can be traded.

The IEEA is the competent authority for the EU ETS in Iceland.

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, there are plans to set up a steering committee for the inventory, as a part of the national system. The exact roles and modalities of functioning of such a committee are yet to be defined; it is thought 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, enhanced QA of the inventory as well as prioritisation 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 emissions inventories unit, various ministries as well as experts from other institutions, companies, universities, and research centres.

[16] https://www.reglugerd.is/reglugerdir/eftir-raduneytum/umhverfis--og-audlindaraduneyti/nr/0520-2017

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 LaFI 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 851/2002 on green accounting, industry is required to hold, and to publish annually, information on how environmental issues is handled, the amount of raw material and energy consumed, the amount of discharged pollutants, including greenhouse gas emissions, and waste generated. Emissions reported by installations must be verified by independent auditors, who need to sign the reports before their submission to the Environment and Energy Agency. The green accounts are then made publicly available on the website of the IEEA.
- 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.
- LaFI 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, taking into account 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 on 15 January and 15 March as per Art. 26 of Regulation (EU) 2018/1999 and as incorporated into Protocol 31 of the EEA Agreement. On 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.

1.3.3 Data storage

A document management system (Gopro.net), is used to store email communications concerning the greenhouse gas inventory at the IEEA. Digital copies of paper documents, e.g., written letters, are also stored on the document management 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 a server of LaFI, 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**: in 2020, training sessions were organised with the consultant, on the basics of estimating emissions from Agriculture, including practicalities of the excel files, imports into CRF/CRT, as well as specific aspects particular to the Icelandic

conditions. Aether staff was consulted in the preparation and the process of updating to the 2019 Refinements.

- **LULUCF:** During 2023 and 2024 the Icelandic LULUCF teams have been working in improving the compilation file for activity data and emissions/removals in collaboration with Aether staff members. The collaboration with Aether staff members has significantly improved land representation and estimations of greenhouse gases for 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.
- Participation in a "small inventory teams" group coordinated by Aether, which meets annually or biannually where various issues are discussed, including challenges encountered by small inventory teams.
- Waste disposal site visits.
- Course on Icelandic agriculture organised specifically for the inventory experts by the Agricultural University of Iceland.

- 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 LaFI completed the UNFCCC NIR/BTR reviewer training in 2024 (LULUCF sector), and two inventory compilers at the IEEA are aiming at completing the reviewer training later this year (Energy and Agriculture sectors, respectively).

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 working on updating the Climate action plan.

The LULUCF inventory team at LaFI consists of approximately 13 people. About two-thirds are working full time on the project but others are part-time. In additional 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 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 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 2023	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)					
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_2O Emissions from Managed Soils	N_2O	✓	✓	
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	✓	✓	✓
4D1	Wetlands Remaining Wetlands	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 2023	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_2O	✓		✓
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_2O Emissions from Managed Soils	N_2O	✓	✓	✓
3D2	Indirect N_2O Emissions from Managed Soils	N_2O	✓	✓	✓
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/AC)

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

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 unit members 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), who has overall responsibility for 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 (LaFI) (see below).

Within the emissions inventories unit at the IEEA there are two sectoral subgroups within the emissions inventories unit, one Energy/IPPU group and one 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 with EU, ESA and UNFCCC experts and expert review teams.
- NIR coordinator – responsible for leading the work on producing the greenhouse gas inventory.
- Sectoral experts – main knowledge holders on individual inventory sectors. They are responsible for completion of day-to-day data 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 (LaFI), who has overall responsibility for the completion of QA/QC activities, submission, improvements planning and review coordination. Within the inventory team at the LaFI 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 almost yearly 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 2025 as per Art. 37.4 of Regulation 2018/1999. 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.

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.

Aether also assists Iceland in the development of QA/QC activities and provided Iceland with a tool running several quality assurance checks on the latest inventory, including:

- Recalculations in comparison to the previous inventory (numerical and notation keys);
- Inter-annual variation within the time series;
- Identifying flat trends in the data;

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 standardised notation protocols in the calculation files to document changes, possible issues, and necessary improvements. This is done via an excel tool ("Q Comments," developed by Aether), which allows the documentation of changes and flagging of issues by use of comments starting with hashtags including the initials of the inventory compiler/QC reviewer, the date, and one or more flags pertaining to the type of issue (such as, for instance, potentially identified issue, transparency issue, or reason for change). When the QC checks are performed, the QC reviewer follows the QC guidance document and corresponding checklist. A summary of all comments can be generated for each calculation file, enabling for instance someone performing QC checks to track and verify changes made to the file, as well as check the status of flagged issues. The issues can then either be marked as resolved, addressed immediately or added to the improvement plan, depending on the type of issue. This tool is an important source of information if needed QC activities are performed. 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 and/or implemented.

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 LaFI.

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?
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 discrepancies between the sectoral approach and the reference approach. • Cross-checks with fuel sales data (previously from the National Energy Authority (*Orkustofnun*) (NEA)) 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 between IPCC subsectors is discussed.
IPPU	• Calculations of CO_2 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 the field. • Review of the IPPU chapter in this NID by external stakeholders (not every 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 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). • 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 2025 submission the following Q/C procedures were applied in accordance with Chapter 6 of the 2006 IPCC Guidelines: o Estimates were developed on parallel by Icelandic team and an external party (Aether). Any inconsistency between the results was discussed and clarified

Sector	QC Checks
	○ Apart from the standard QC check previously performed, additional automatic checks were integrated in the second version of the compilation file (that was created by the external party). ○ 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 each year 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.

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

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 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, SO_2, 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, SO_2 and NO_x, and each of these pollutants was under the required reported threshold of ±5% 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 7.5%), 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 (1.3) 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 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.

As mentioned above, it is also planned to coordinate and standardise the QC procedures between the IEEA and LaFI.

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 2023.

	With LULUCF		Without LULUCF	
	Uncertainty 2023 [%]	**Trend [%]**	**Uncertainty 2023 [%]**	**Trend [%]**
CO_2	23.9%	18.6%	1.6%	2.5%
CH_4	21.5%	6.5%	2.7%	4.1%
N_2O	1.3%	0.75%	3.5%	2.9%
HFCs	0.44%	0.0007%	1.2%	0.0021%
PFCs	0.081%	0.51%	0.22%	2.0%
SF_6	0.0065%	0.0072%	0.018%	0.023%
Total greenhouse gases	**32.2%**	**19.7%**	**4.9%**	**6.0%**

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 2023. Regarding sectoral coverage, all sources considered to be above the threshold of significance[17] are reported.

[17] As per paragraph 37(b) of annex I ("Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories") to Decisions 24/CP.19, an emission is considered insignificant if the likely level of emissions is below 0.05 per cent 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 main sectors. Emissions which are calculated 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 (CO_2) released from the conversion of carbon in fuel to CO_2 and generation of heat. The Energy sector also includes emissions of nitrous oxide (N_2O), methane (CH_4) 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.

- 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 CO_2 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 from gases released from animals (enteric fermentation), a digestive process in herbivores which emits CH_4, and from the management of animal manure which contains and emits CH_4 and N_2O. The methods of storage and treatment of manure impacts the quantity of CH_4 and N_2O emitted. The application of organic manure and synthetic fertiliser to land results in both direct and indirect N_2O from soils. Finally, liming and the application of carbon-containing fertilisers releases CO_2. It is worth mentioning that emissions from fuel consumption in machinery used in agriculture, such as tractors for instance, are not reported in this chapter; they are reported in the Energy sector.

- 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 CH_4 through the anaerobic (absence of oxygen) decomposition of solid or liquid waste, N_2O from the oxygenation of protein rich compounds (e.g., foods) in the waste streams and CO_2 from incineration of fossil-based waste materials (e.g., plastic). CH_4 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 also produce CH_4. The biological treatment of waste, such as composting, also results in CH_4 emissions (from anaerobic decomposition) and N_2O 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 CO_2 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 CO_2 from biomass (bio-CO_2).

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 (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)
- Nitrogen fluoride (NF_3)

Iceland reports emissions of CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6. There are no imports of products containing NF_3 nor industries potentially using that type of gas (e.g., semiconductors, LCD manufacture, solar panels, and chemical lasers), therefore there are no emissions of NF_3 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 CO_2 equivalents (CO_2e) and using Global

Warming Potentials (GWPs) based on the 100-year time horizon GWPs presented in the Fifth Assessment Report (AR5) of the IPCC[18].

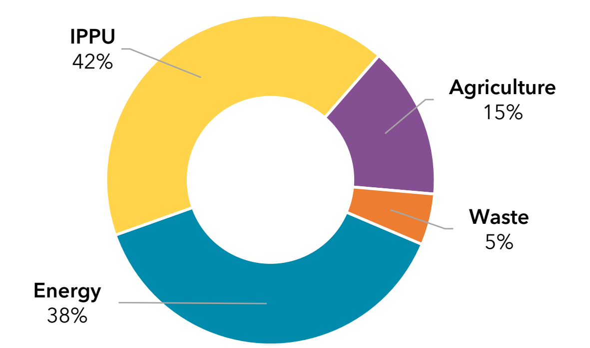
Iceland also reports precursor and indirect greenhouse gas emissions; these include:

- 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.

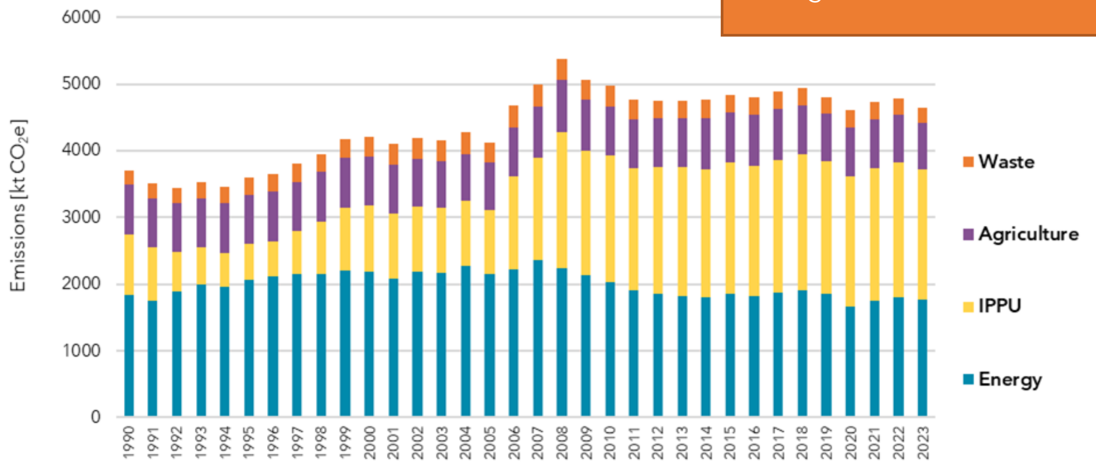
The emission trends for precursors and indirect greenhouse gases are presented separately in Section 2.3.

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

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.



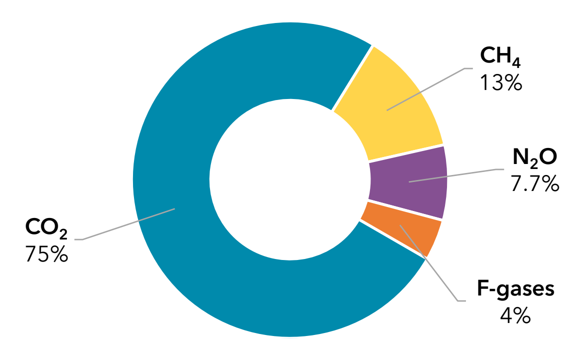
Change over the time series:



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 quarter 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 more than a quarter (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
- The Road Transport sector CO_2 emissions almost doubling since 1990 due to increases in population, 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 have seen an overall decline since 1990 from commercial fishing, with greenhouse gas emissions reducing by approximately 36% over the time series. Emissions from both domestic flights and navigation have also declined since 1990.

LULUCF net emissions have been mostly constant across the whole time series, and this is explained by emissions from organic soils already drained before 1990. Removals by forests and revegetation have been steadily increasing across the time series.

Emissions during 1990-1999

Total emissions show a slight decrease between 1990 and 1994, except for 1993. From 1995-1999, 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. In 2023, the total aluminium production was 870 thousand tonnes.

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 decreased 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, 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 2023, 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 CO_2e, calculated using GWP from AR5]

Sector	1990	1995	2000	2005	2010	2015	2020	2022	2023	Changes 1990-2023	Changes 2022-2023
1 Energy	1841	2058	2185	2159	2027	1854	1664	1807	1774	-3.6%	-1.8%
2 IPPU	902	553	991	950	1895	1965	1958	2016	1946	116%	-3.5%
3 Agriculture	757	726	732	711	749	762	723	712	692	-8.5%	-2.8%
4 LULUCF	8142	8111	8095	8092	8088	8039	8000	7986	7985	-1.9%	-0.009%
5 Waste	207	255	293	309	306	264	259	247	233	12%	-5.4%
Total with LULUCF	**11850**	**11702**	**12296**	**12221**	**13064**	**12884**	**12605**	**12767**	**12631**	**6.6%**	**-1.1%**
Total without LULUCF	**3707**	**3591**	**4201**	**4129**	**4976**	**4845**	**4605**	**4782**	**4646**	**25%**	**-2.8%**
International bunkers (memo items)	249	241	465	426	380	828	341	1142	1300	422%	14%

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 CO_2, followed by CH_4, N_2O, and fluorinated gases (PFCs, HFCs, and SF_6). Over the time series, emissions of CO_2 have increased the most, and PFCs and N_2O emissions have decreased significantly.

- The main contributors to CO_2 emissions are drained wetlands (LULUCF), process-related fuels in the metal industry (IPPU) and fuel combustion (Energy).
- CH_4 emissions originate mostly from wetlands and grasslands (LULUCF), livestock (Agriculture) and solid waste disposal (Waste).
- N_2O 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).
- SF_6 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 CO_2e].

GHG	1990	1995	2000	2005	2010	2015	2020	2022	2023	Changes 1990-2023	Changes 2022-2023	% total in latest year
CO_2	2222	2469	2933	2976	3627	3541	3339	3598	3508	58%	-2.5%	76%
CH_4	664	669	695	689	710	673	628	609	587	-12%	-3.6%	13%
N_2O	375	386	395	376	373	380	369	367	356	-5%	-3.1%	7.7%
HFCs	0.32	3.2	43	57	107	157	198	133	125	39325%	-7%	2.7%
PFCs	445	62	135	28	154	93	68	72	68	-85%	-5%	1.5%
SF_6	1.1	1.3	1.4	2.6	4.8	1.6	3.3	2.1	1.9	71%	-8%	0.042%
Total	**3707**	**3591**	**4201**	**4129**	**4976**	**4845**	**4605**	**4782**	**4646**	**25%**	**-2.8%**	**100%**

Table 2.3 Greenhouse gas emissions by gas, with LULUCF [kt CO_2e].

GHG	1990	1995	2000	2005	2010	2015	2020	2022	2023	Changes 1990-2023	Changes 2022-2023	% total in latest year
CO_2	8619	8835	9298	9359	10039	9921	9696	9947	9859	14%	-0.89%	78%
CH_4	2407	2412	2423	2396	2384	2329	2268	2242	2217	-7.9%	-1.1%	18%
N_2O	377	388	396	378	376	383	372	371	360	-4.4%	-2.9%	2.9%
HFCs	0.32	3.2	43	57	107	157	198	133	125	39325%	-6.5%	1.0%
PFCs	445	62	135	28	154	93	68	72	68	-85%	-5.1%	0.54%
SF_6	1.1	1.3	1.4	2.6	4.8	1.6	3.3	2.1	1.9	71%	-7.7%	0.015%
Total	**11850**	**11702**	**12296**	**12221**	**13064**	**12884**	**12605**	**12767**	**12631**	**6.6%**	**-1.1%**	**100%**

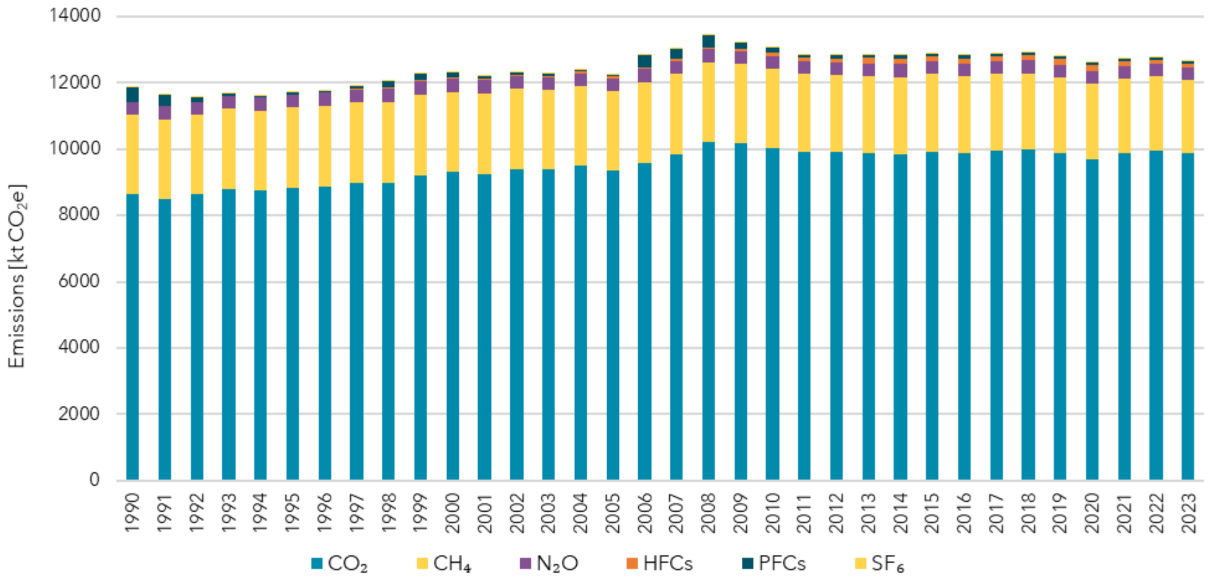


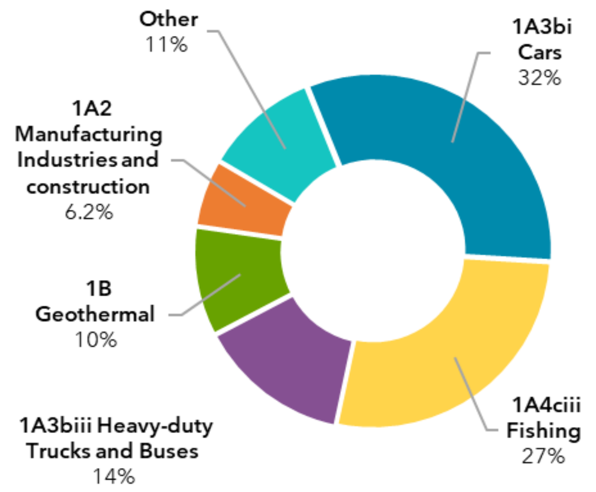
Figure 2.2: Total emissions, with LULUCF, for the reported time series disaggregated by gases.

2.2 Emission Trends by Sector and by Gas

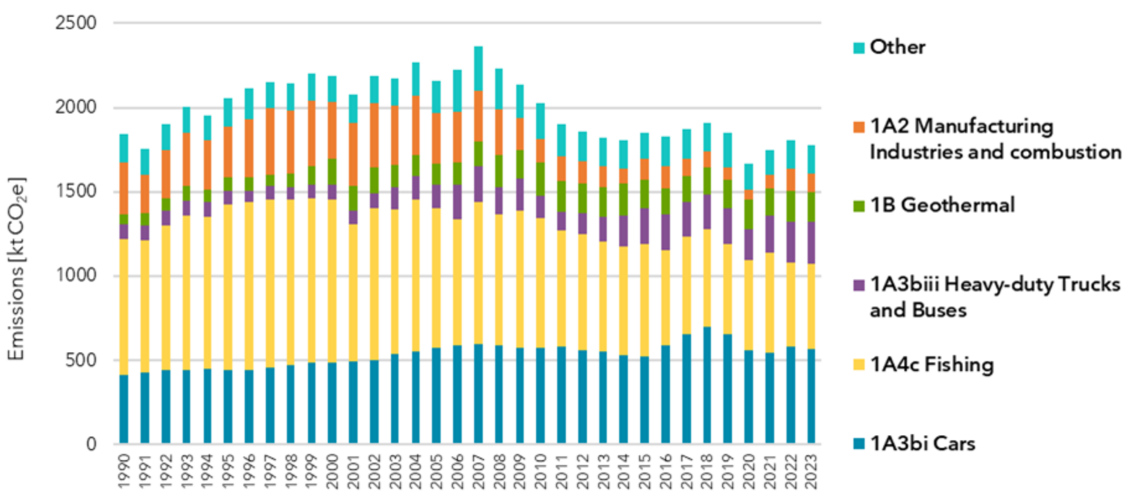
2.2.1 Energy (CRT Sector 1)

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 have high energy and transportation needs. Together with Road Transport, fishing industry dominate emissions of the Energy sector.

38% of total emissions (excluding LULUCF)



Change over the time series: **-3.6%**



The Energy sector is dominated by CO_2 emissions from Road Transport and the fishing industry. CO_2 emissions from geothermal energy exploitation have increased since 1990 with the opening of new geothermal power plants. CO_2 sequestration projects are ongoing to capture CO_2 emissions from geothermal plants and mineralise it underground for permanent storage.

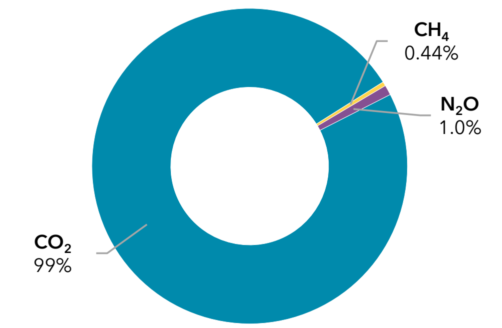


Figure 2.3 Overview of emissions from the Energy sector, from top to bottom: (1) emission by subsector for the latest year, (2) emission by subsector over the time series and (3) emissions by gas for the latest year.

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, 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 Energy Industries, 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.

Electricity and Heat Production

The Energy sector includes emissions from electricity and heat production. 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 have generally decreased since 1990. 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 source categories over the period 1990-2007 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 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 2019 after a decreasing trend from the previous 2007 peak, which has been 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

Fisheries dominate 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 due to the inherent nature of fisheries.

Geothermal Energy

Emissions from geothermal energy have accounted for 3-4% 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.

Distribution of Oil Products

Emissions from distribution of oil products are a minor source in Iceland (<1 kt CO_2e). 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 more than quadrupled since 1990, partly due to increased tourism in recent years.

CO_2 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.

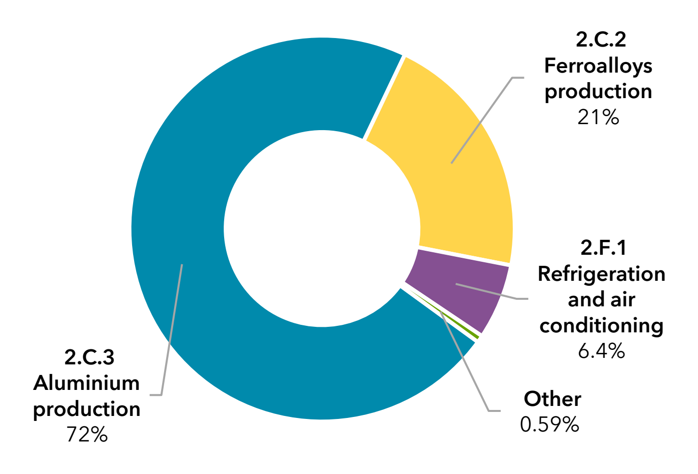
Table 2.4 Total greenhouse gas emissions from the Energy sector [kt CO_2e].

Energy Sector	1990	1995	2000	2005	2010	2015	2020	2022	2023	Changes 1990-2023	Changes 2022-2023
1A1 Energy industries	**14**	**15**	**6.5**	**3.4**	**8.6**	**4.2**	**2.6**	**10**	**11**	**-19%**	**+4.5%**
1A2 Manufacturing industries	**306**	**301**	**337**	**306**	**142**	**121**	**54**	**132**	**110**	**-64%**	**-17%**
1A3 Transport	**616**	**649**	**687**	**857**	**891**	**891**	**883**	**976**	**961**	**56%**	**-1.6%**
1A3a Domestic Aviation	34	30	28	26	21	21	13	24	23	-33%	-7.2%
1A3b Road Transport	531	558	616	775	815	827	830	926	921	74%	-0.51%
1A3d Domestic navigation	33	38	13	23	35	27	25	25	17	-49%	-31%
1A3e Other transportation	19	23	30	33	20	17	14	1.2	0.08	-100%	-94%
1A4 Other sectors	**843**	**1008**	**995**	**843**	**776**	**670**	**544**	**509**	**514**	**-39%**	**+0.90%**
1A4a Commercial/Institutional	8.1	7.8	6.7	4.9	1.7	2.1	1.6	2.1	2.3	-72%	8.7%
1A4b Residential	28	22	21	13	8.5	6.0	6.7	4.7	4.3	-85%	-9.4%
1A4c Fishing	760	922	892	742	727	621	509	481	485	-36%	1.0%
1A5 Other	**0.1**	**1.6**	**4.6**	**29**	**14**	**0.19**	**0.36**	**0.8**	**1.8**	**1353%**	**+137%**
1B2 Fugitive emissions	**62**	**83**	**155**	**120**	**195**	**168**	**180**	**179**	**177**	**186%**	**-0.79%**
1B2d Geothermal	62	82	154	119	195	168	179	178	177	187%	-0.81%
1 Total emissions	**1841**	**2058**	**2185**	**2159**	**2027**	**1854**	**1664**	**1807**	**1774**	**-3.6%**	**-1.8%**
1D1a International Aviation (Memo)	221	238	410	424	380	679	263	855	968	338%	+13%
1D1b International Navigation (Memo)	28	3.4	54	1.8	0.25	149	78	287	333	1085%	+16%
1D3 CO_2 from Biomass	2.4	6.3	7.5	10	10	46	64	59	55	2197%	-6.3%

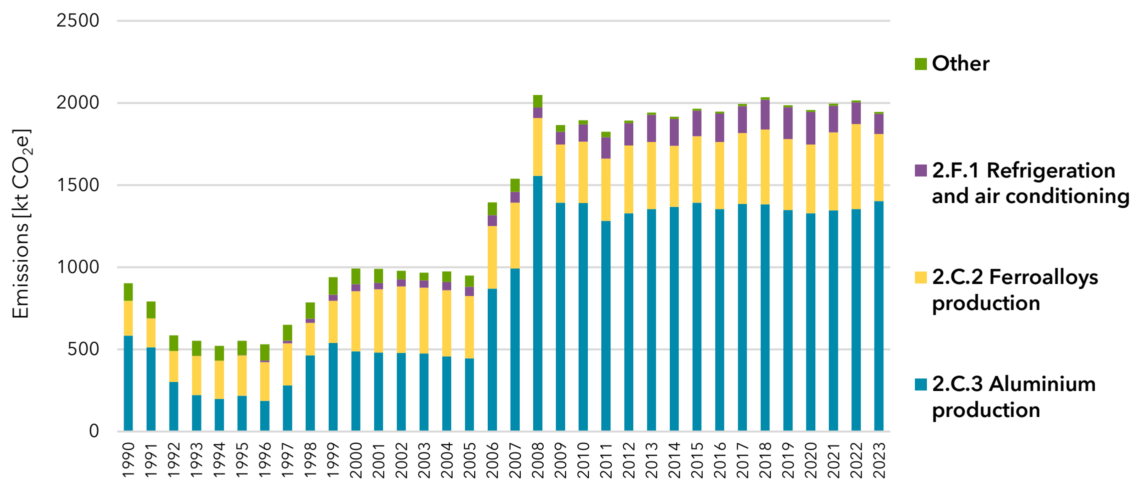
2.2.2 Industrial Processes and Product Use (CRT sector 2)

The emissions in this sector fall mostly under the EU emission trading system (EU ETS), where the main sub-sectors in Iceland are Aluminium and Ferroalloy production. The availability of renewable energy in Iceland like hydropower leads to lower greenhouse gas emissions per ton of metal produced compared to the use of fossil fuels for energy generation.

42% of total emissions (excluding LULUCF)



Change over the time series: **+116%**



Large part of the greenhouse gas emissions is in the form of CO_2 as a result of the oxidation of carbon-based reductants (coal, coke) used in metal production. F-gases in the form of PFCs are also formed during aluminium production, explaining part of the total F-gas emissions, while the rest can be assigned to Refrigeration and Air Conditioning, Electrical Equipment, and Metered Dose Inhalers.

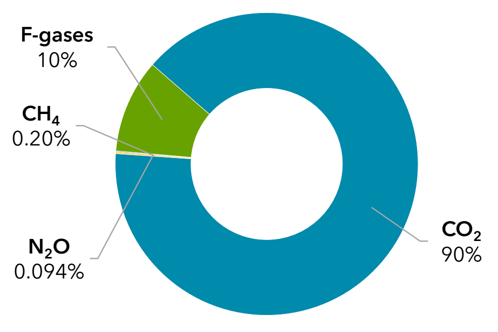


Figure 2.4 Overview of emissions from the IPPU sector, from top to bottom: (1) emission by subsector for the latest year, (2) emission by subsector over the time series and (3) emissions by gas for the latest year.

The Industrial Processes and Product Use (IPPU) sector is the sector largest contributor to national greenhouse gas emissions after LULUCF (when removals are included). The emissions from this sector are dominated by CO_2, 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, CF_4, and hexafluoroethane, C_2F_6), and to a small extent from refrigeration equipment (hexafluoroethane (C_2F_6) commercially known as PFC116, and octafluoropropane (C_3F_8), 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 approximately 90% of the IPPU sector emissions in recent years.

Aluminium Production

Aluminium Production is the main source within the metal production category, accounting for the majority of 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 CO_2 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 CO_2e/t Al produced.

Ferroalloy Production

Ferroalloy Production accounts for approximately a fifth of Industrial Processes emissions. CO_2 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. The new plant ceased operations in mid-2017, but 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. CO_2 derived from carbon in the shellsand used as raw material is the source of CO_2 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.

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 CO_2e.

The main source of SF_6 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 SF_6 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 CO_2 in the atmosphere over time. These CO_2 emissions are also included in this inventory.

Also included in the IPPU sector are emissions of N_2O from medical and other uses and emissions of CO_2 from lubricants and paraffin wax use. Other sources of emissions included in the Icelandic inventory are CH_4 and N_2O emissions from tobacco, as well as greenhouse gas and precursor emissions from firework use. Historically, Industrial Processes has been an important source of N_2O, 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 CO_2e].

Industry Sector	1990	1995	2000	2005	2010	2015	2020	2022	2023	Changes 1990-2023	Changes 2022-2023
2A Mineral Products	52	38	65	55	10	0.72	0.89	0.94	0.97	-98%	3.6%
2B Chemical Industry	42	36	16	0	0	0	0	0	0	-100%	–
2C Metal Production	795	462	853	825	1764	1797	1748	1872	1811	128%	-3.3%
2D Non-energy Products from Fuels and Solvent Use	6.8	7.5	7.4	6.9	5.2	5.7	5.7	5.9	5.7	-16%	-2.1%
2F Product Uses as Substitutes for Ozone Depleting Substances	0.32	3.2	43	57	107	157	198	133	125	39349%	-6.5%
2G Other Product Manufacture and Use	6.6	5.3	5.8	6.1	8.3	4.6	5.8	4.2	3.8	-42%	-8.6%
2 Total emissions	**902**	**553**	**991**	**950**	**1895**	**1965**	**1958**	**2016**	**1946**	**116%**	**-3.5%**

Table 2.6 Total HFC, PFC and SF_6 emissions from F-gas consumption [kt CO_2e].

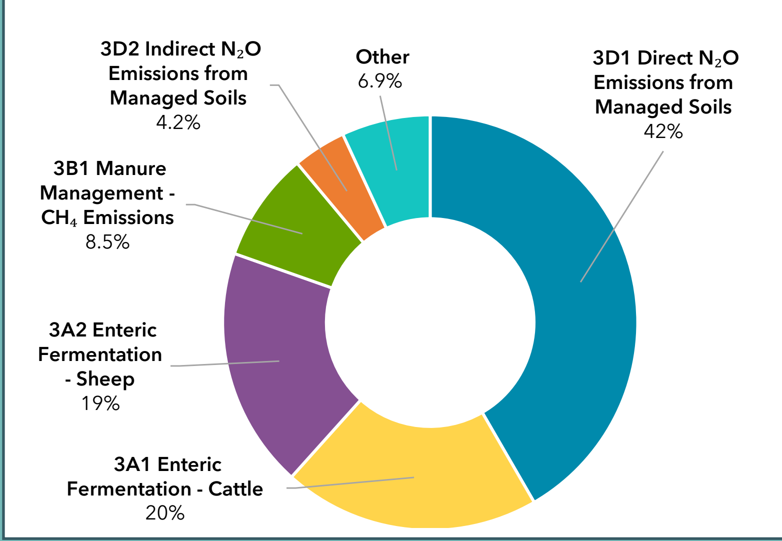
GHG	1990	1995	2000	2005	2010	2015	2020	2022	2023	Changes 1990-2023	Changes 2022-2023
HFCs	0.32	3.15	43	57	107	157	198	133	125	39325%	-6.5%
PFCs	445	62	135	28	154	93	68	72	68	-85%	-5.1%
SF_6	1.1	1.3	1.4	2.6	4.8	1.6	3.3	2.1	1.9	71%	-7.7%

2.2.3 Agriculture (CRT sector 3)

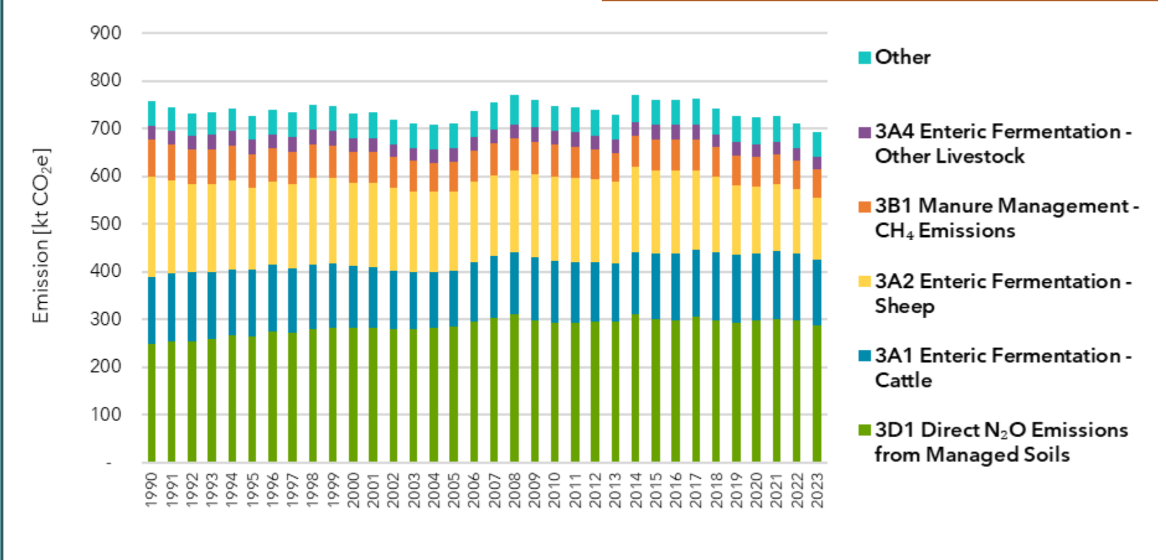
Emissions are dominated by agricultural soils and enteric fermentation throughout the time series.

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

15% of total emissions (excluding LULUCF)



Change over the time series: **-8.5%**



Enteric fermentation is the main source of CH_4. Agriculture is the main source of N_2O emissions which are generated from agricultural soils and manure management.

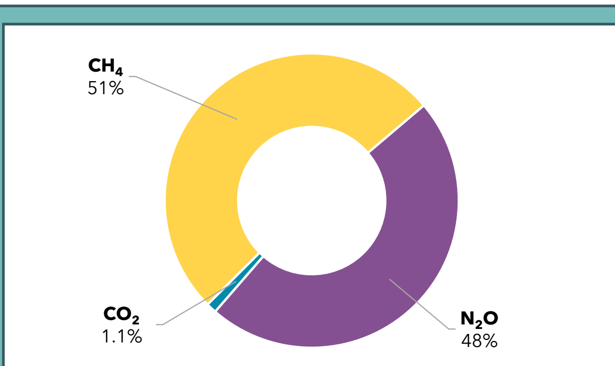


Figure 2.5 Overview of emissions from the Agriculture sector, from top to bottom: (1) emission by subsector for the latest year, (2) emission by subsector over the time series and (3) emissions by gas for the latest year..

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, beets, and carrots are grown on limited acreage. Emissions from agriculture are closely coupled with livestock population sizes, especially cattle and sheep. Another factor that has a considerable impact on emission estimates is the amount of nitrogen in fertiliser applied annually to agricultural soils. A decrease in livestock population size of sheep between 1990 and 2005 was partly counteracted by increases of livestock population sizes of horses, swine, and poultry, but led to overall emission decreases and resulted in a decrease of total agriculture emissions during the same period (Figure 2.5 and Table 2.7).

In 2005-2018 increased fertiliser use lead to higher emissions from agriculture. However, sharp decrease in sheep livestock numbers since 2016 and slight decrease in fertiliser use since 2018 have led to decreased emissions again. The emissions from Agriculture have though stayed relatively stable since 1992, hence, it is difficult to state whether the resent decrease in emissions will continue or not.

Table 2.7 Greenhouse gas emissions from Agriculture sector [kt CO_2e].

Agriculture Sector		1990	1995	2000	2005	2010	2015	2020	2022	2023	Changes 1990-2023	Changes 2022-2023
3A	Enteric Fermentation	379	342	332	316	338	344	312	304	296	-22%	-2.5%
3B	Manure Management	93	83	80	75	80	81	73	73	71	-23%	-2.0%
3D	Agricultural Soils	285	298	318	315	327	334	330	329	317	11.0%	-3.8%
3G	Liming	0.023	3.08E-06	0.0022	2.4	1.9	1.3	3.6	2.9	4.9	21148%	70%
3H	Urea Application	NO	NO	NO	NO	NO	0.007	3.1	1.6	1.8	-	14%
3I	Other Carbon-Containing Fertilisers	NO	2.4	2.8	2.1	2.0	1.8	1.5	1.5	1.1	-	-24%
	Total emissions	**757**	**726**	**732**	**711**	**749**	**762**	**723**	**712**	**692**	**-8.5%**	**-2.8%**

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 feed consumed. Cattle and sheep are the largest sources of enteric CH_4 emissions in Iceland. Due to a decrease in in sheep population, emissions from sheep have decreased by almost 40% since 1990, driving the decrease in emissions from Icelandic agriculture. Cattle now surpass sheep as the livestock category with the highest emissions from enteric fermentation. The only non-ruminant livestock category with substantial CH_4 emissions is horses. The population size of horses has been relatively stable from 1990, and therefore, their CH_4 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 CH_4 and N_2O.

Organic material in manure is transformed to CH_4 in an anaerobic environment by microbiological processes. During storage and handling of manure, some nitrogen is converted into N_2O. This makes cattle and sheep the largest sources of emissions from manure management in Iceland with mature dairy cattle, young bulls and non-inseminated heifers, and mature ewes being responsible for roughly two-thirds of CH_4 emissions from manure management. Other important livestock categories for CH_4 emissions from manure management are swine, horses, and poultry.

N_2O emissions from manure management include indirect emissions from manure management as atmospheric deposition of nitrogen on soils and water surfaces, due to nitrogen volatilisation. Solid storage of sheep manure is the largest single source of N_2O emissions from manure management.

Agricultural Soils

The largest sources of emissions are cultivated and uncultivated drained organic soils, accounting for 50-60% of the total emissions from agricultural soils (CRT 3D).

N_2O is produced naturally in soils through the microbial processes of nitrification and denitrification. However, certain agricultural activities lead to N_2O emissions. In Iceland, these activities include the application of inorganic nitrogen fertiliser, the application of organic nitrogen fertiliser (e.g., animal manure, sewage sludge), and the urine and dung deposited by grazing animals, along with crop residues and cultivation of organic soils.

Emissions from agricultural soils have increased on average since 1990 due to the expansion of cropland and grassland areas utilised in agriculture. However, there has been a downward trend in direct and indirect N_2O emissions in recent years, which can be explained by a decrease synthetic fertiliser usage and a decrease in the sheep population in Iceland.

Liming, Urea Application and Other Carbon-Containing Fertilisers

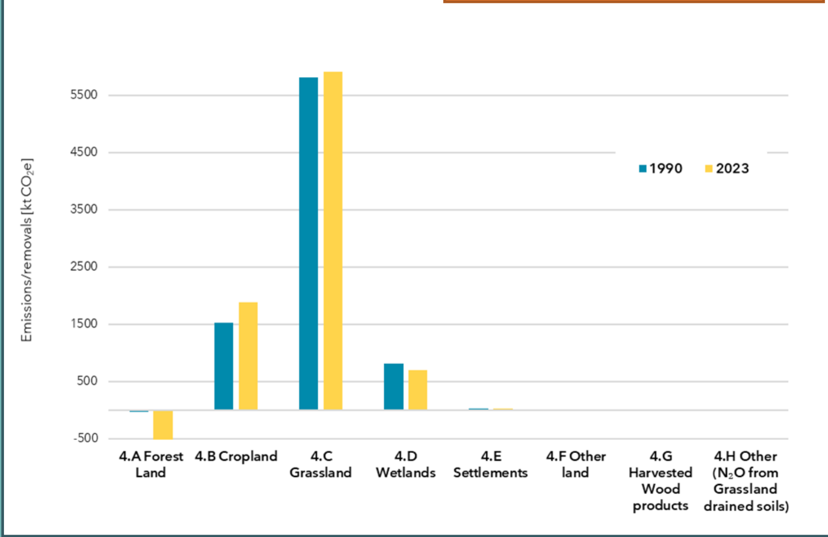
Combined CO_2 emissions from liming (3G), urea application (3H) and other carbon containing fertilisers (3I) account for around 1% of the total greenhouse gas emissions from the agricultural sector.

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 much less fertilisation.

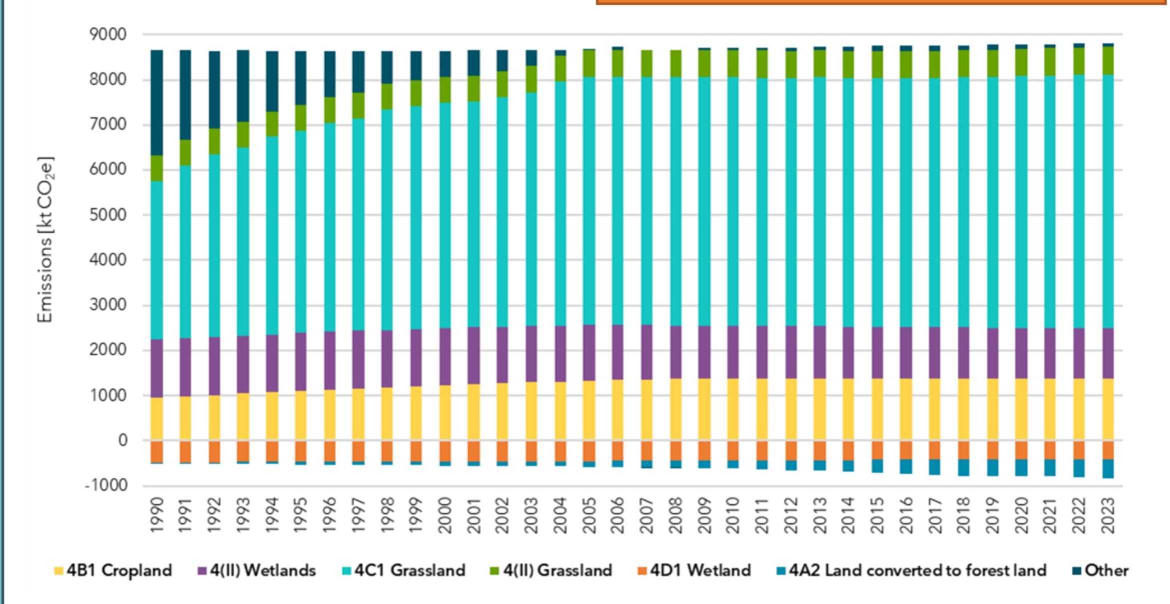
2.2.4 Land Use, Land-use Change, and Forestry (LULUCF, CRT sector 4)

63% of total emissions

Both emissions from sources and removals by sinks are reported for this sector. Overall, the LULUCF sector results in net emissions, which are greater that all other sectors combined. This is primarily due to emissions from Grassland, Wetlands and Cropland.



Change over the timeseries: **-1.9%**



The LULUCF sector is dominated by CO_2 emissions from the drainage of wetlands.

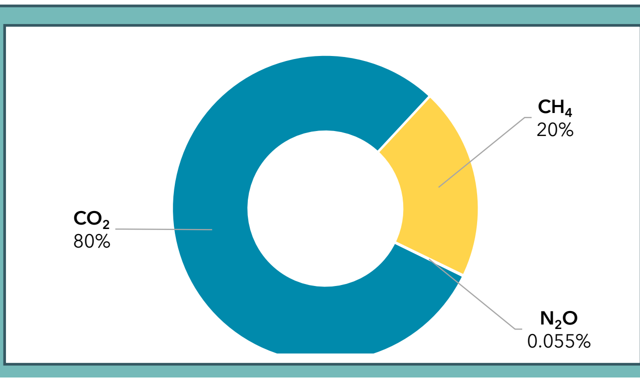


Figure 2.6 Overview of emissions and removals from the LULUCF sector, from top to bottom: (1) absolute emission and removals by subsector for the latest year, (2) emission and removals by subsector over the time series and (3) absolute emissions and removals by gas for the latest year.

LULUCF net emissions have remained relatively stable across the time series, with net emissions in the year 2023 within 1.9% of the 1990 levels.

Forest land

The increased removals in Forest Land are explained through afforestation and changes in forest growth with stand age.

Cropland

The increase in emissions from Cropland is explained by the increase in Cropland surface area. Emissions from the cultivation of organic soils were the primary source of emissions.

Grassland

The overall increase in emissions from Grassland is primarily due to the drainage of organic soils following the conversion of Wetlands to Grassland. However, these emissions are partially offset by increased carbon removals through revegetation activities within the category.

Wetlands

Wetlands exhibit a declining emission trend, primarily due to the reduction of managed wetland areas, which have been converted into other land categories for agricultural use.

Settlements

The increase in emissions from Settlements is driven by the expansion of populated areas.

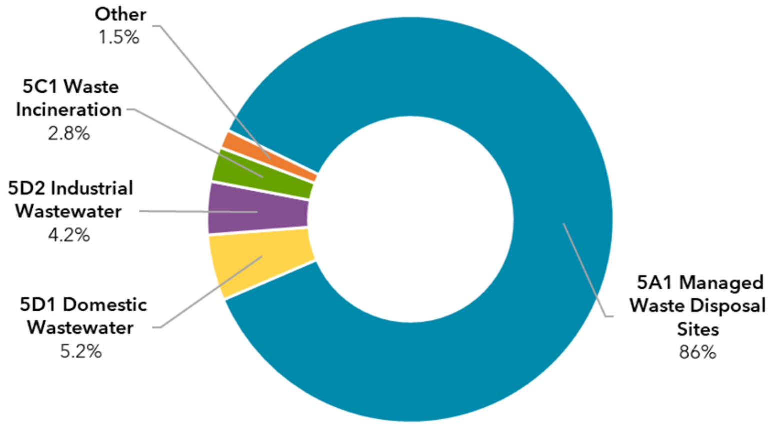
Table 2.8 Greenhouse gas emissions and removals from the LULUCF [kt CO_2e].

LULUCF Sector	1990	1995	2000	2005	2010	2015	2020	2022	2023	Changes 1990-2023	Changes 2022-2023
4.A Forest Land	-30	-53	-90	-140	-304	-409	-505	-534	-554	1772%	3.7%
4.B Cropland	1530	1540	1551	1563	1659	1747	1835	1870	1887	23%	0.9%
4.C Grassland	5809	5773	5788	5832	5940	5939	5923	5910	5918	1.9%	0.15%
4.D Wetlands	807	814	802	783	751	729	712	706	702	-13%	-0.49%
4.E Settlements	26	37	45	54	43	33	36	35	31	18%	-10%
4.F Other land	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	-	-
4.G Harvested Wood products	NO	NO	0.0032	0.0031	-0.033	-0.038	-0.041	-0.099	-0.22	-	+121%
4 Total emissions	**8142**	**8111**	**8095**	**8092**	**8088**	**8039**	**8000**	**7986**	**7985**	**-1.9%**	**-0.009%**

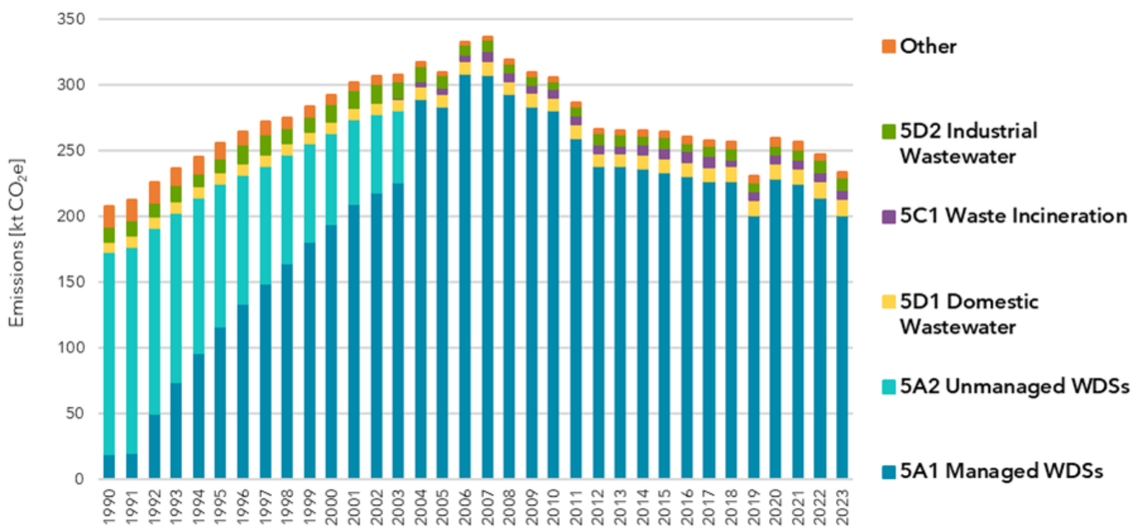
2.2.5 Waste (CRT sector 5)

5.0% of total emissions (excluding LULUCF)

Emissions from the Waste sector show a parabolic shape increasing from 1990 to 2007 and then decreasing to reach similar levels as were in 1990. Emissions are dominated by Solid Waste Disposal.



Change over the time series: **+12%**



In recent years, emissions from the Waste sector have been dominated by CH_4 emissions from Solid Waste Disposal.

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.

Most emissions from the Waste sector are CH_4 emissions from Solid Waste Disposal. The remaining emissions arose from Wastewater Treatment and Discharge, Waste Incineration, and Biological Treatment of Waste, e.g., Composting. 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 CH_4 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 CH_4 recovery at SWDS.

Composting

Emissions from Composting have been steadily increasing from 1995 when composting started. Improved collection of organic waste leads 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 CO_2e].

Waste Sector	1990	1995	2000	2005	2010	2015	2020	2022	2023	Changes 1990-2023	Changes 2022-2023
5A Solid Waste Disposal	173	225	263	284	280	234	229	215	201	17%	-6.3%
5B Biological Treatment of Solid Waste	NO	0.35	0.35	0.88	2.7	3.7	5.6	2.7	3.0	-	13%
5C Incineration and Open Burning of Waste	16	11	6.3	5.6	6.7	7.6	6.8	7.1	6.8	-56%	-4.8%
5D Wastewater Treatment and Discharge	19	20	22	19	16	19	18	22	22	14%	0.53%
5 Total emissions	**207**	**255**	**293**	**309**	**306**	**264**	**259**	**247**	**233**	**12%**	**-5.4%**

2.2.6 Carbon Dioxide (CO_2)

Carbon dioxide (CO_2) 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.

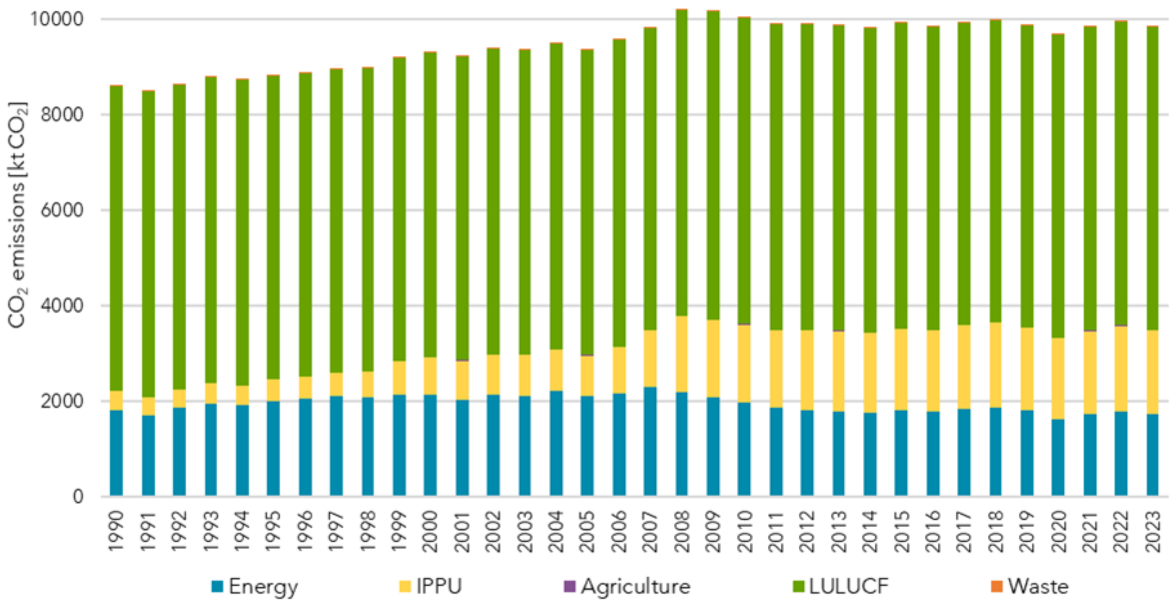


Figure 2.8: Carbon dioxide (CO_2) emissions in Iceland, divided by sectors.

2.2.7 Methane (CH_4)

Methane (CH_4) is the second largest contributor to greenhouse gas emissions in Iceland. The largest share of methane emissions originates from the LULUCF sector, predominantly from Wetland. 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.

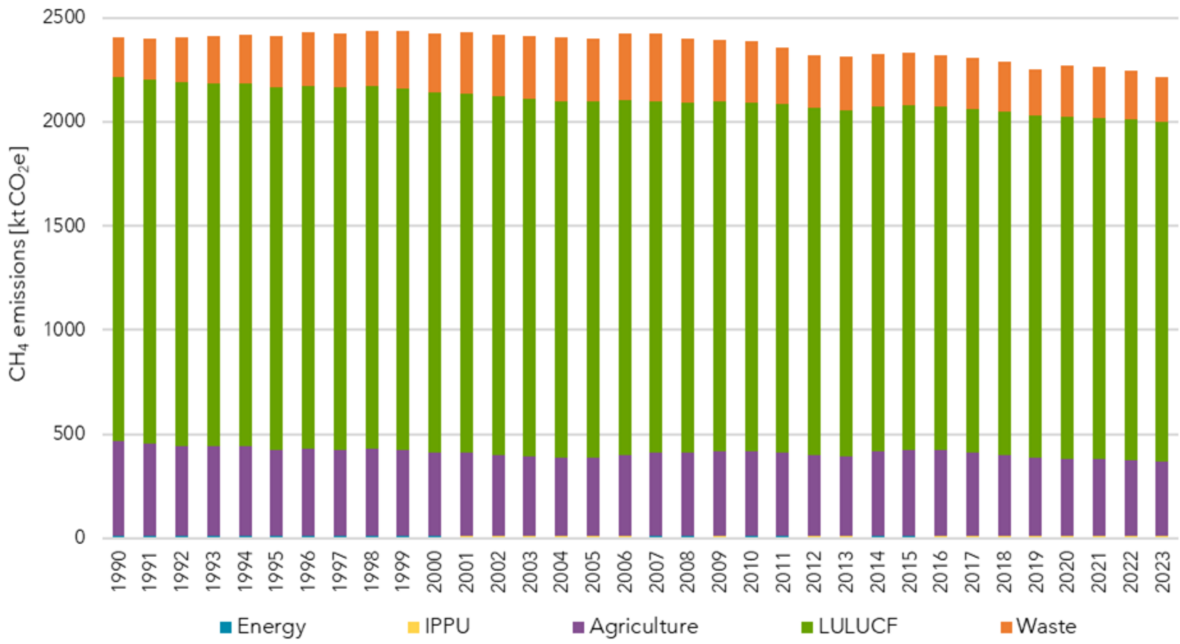


Figure 2.9: Methane (CH_4) emissions in Iceland, divided by sectors.

2.2.8 Nitrous Oxide (N_2O)

Nitrous oxide (N_2O) 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.

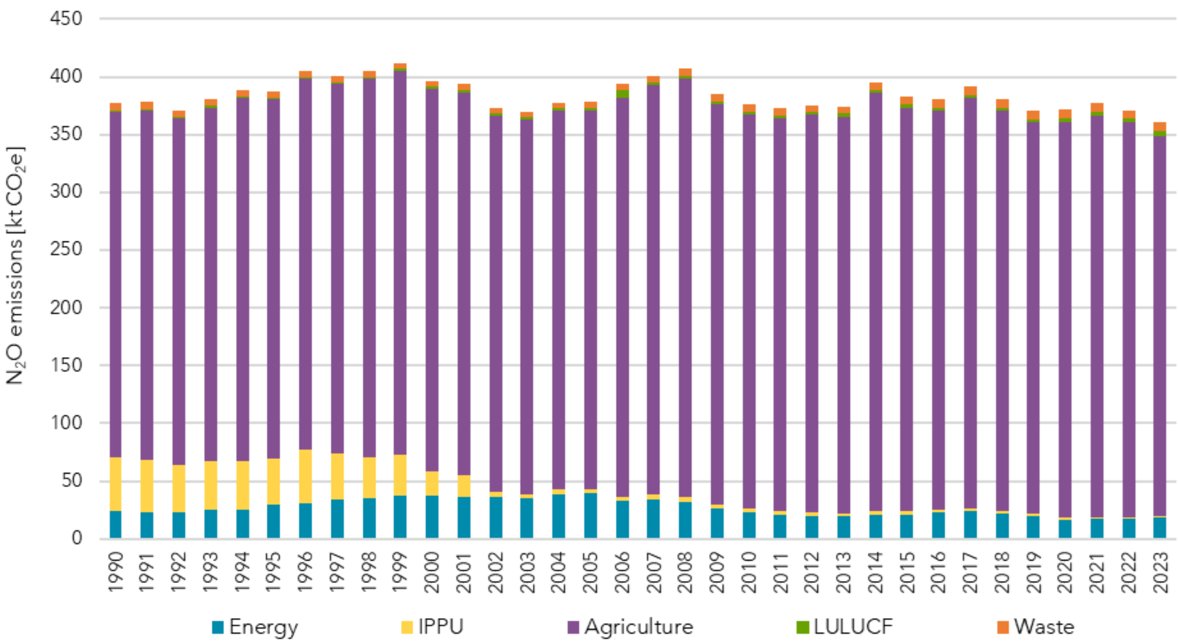


Figure 2.10: Nitrous oxide (N_2O) emissions in Iceland, divided by sectors.

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.

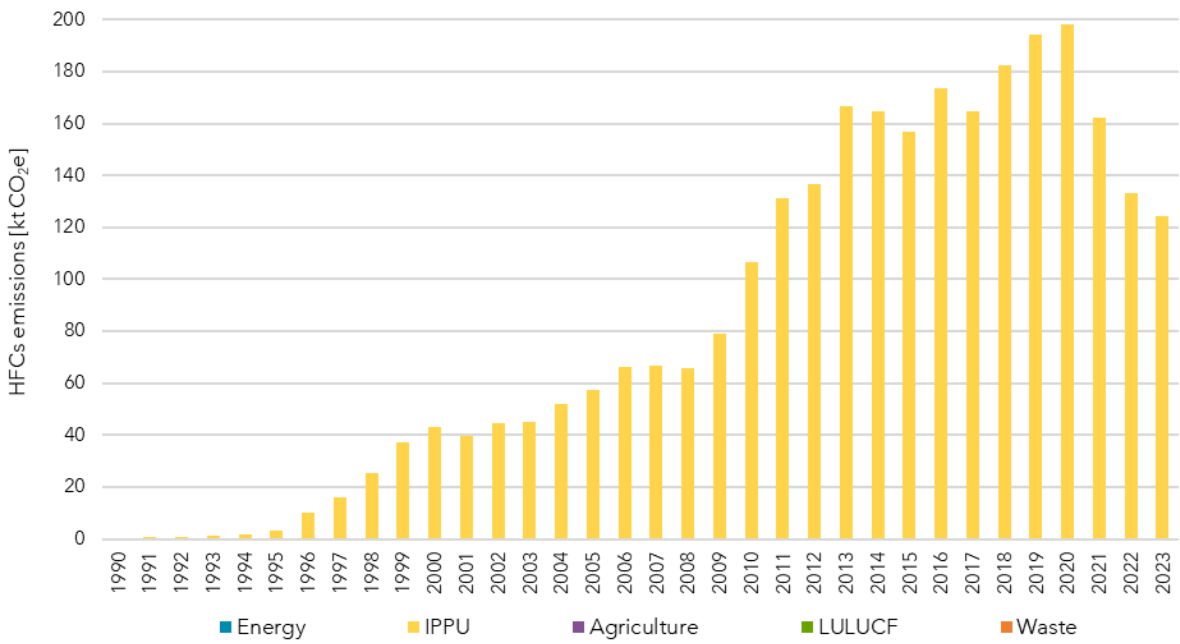


Figure 2.11: Hydrofluorocarbons (HFCs) emissions in Iceland, divided by sectors.

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.

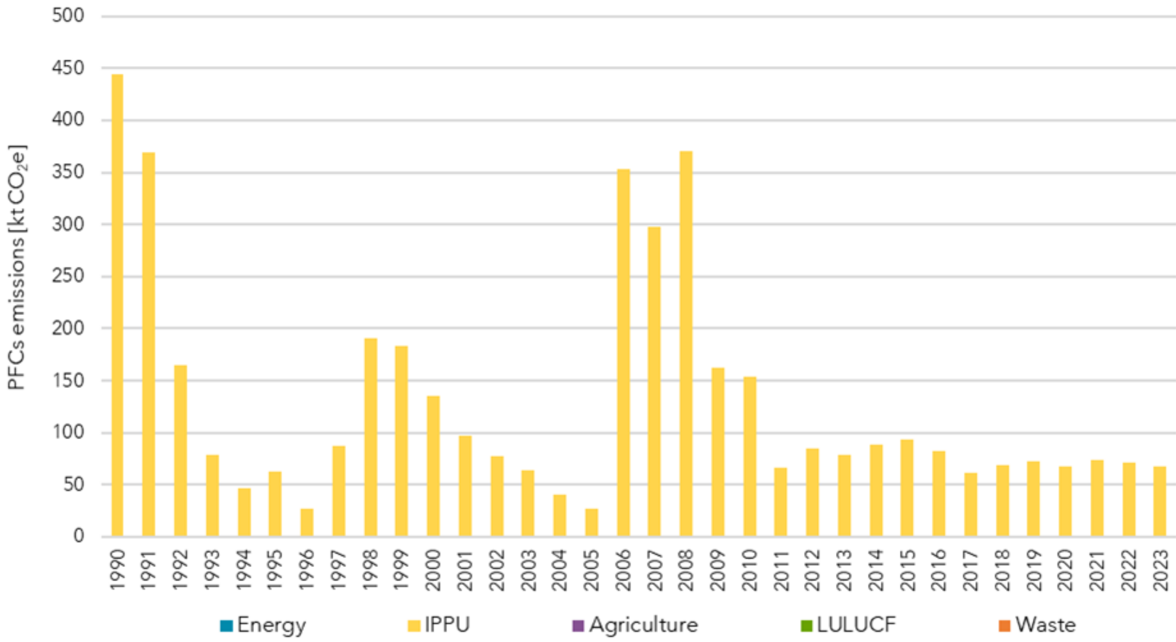


Figure 2.12: Perfluorocarbons (PFCs) emissions in Iceland, divided by sectors.

2.2.11 Sulphur Hexafluoride (SF_6)

Sulphur hexafluoride (SF_6) cause an insignificant amount of greenhouse gas emissions in Iceland. All SF_6 emissions are from the IPPU sector, predominantly from Electrical Equipment. The trend in SF_6 emissions is dominated by leakages in electrical equipment. Figure 2.13 shows the SF_6 dioxide emissions by sectors.

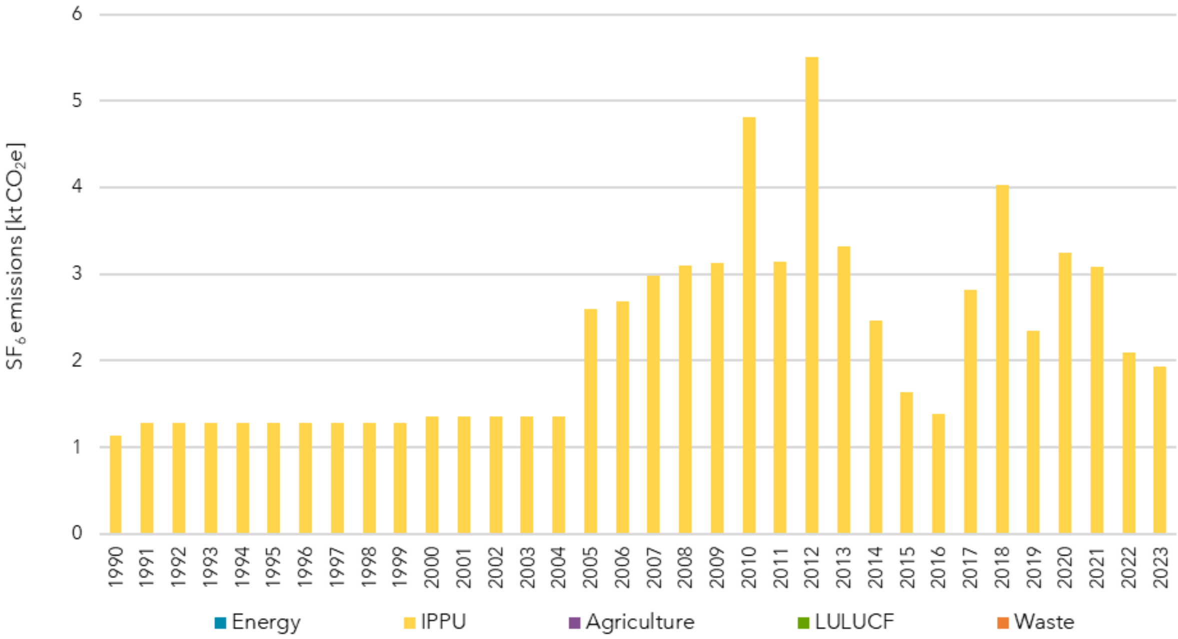


Figure 2.13: Sulphur hexafluoride (SF_6) emissions in Iceland, divided by sectors.

2.2.12 Nitrogen Trifluoride (NF_3)

There are no nitrogen trifluoride (NF_3) 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 (O_3). Sulphur dioxide (SO_2) and Ammonia (NH_3) 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 CLRTAP[19]. The emissions presented in this section are from the energy, IPPU, agriculture 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.

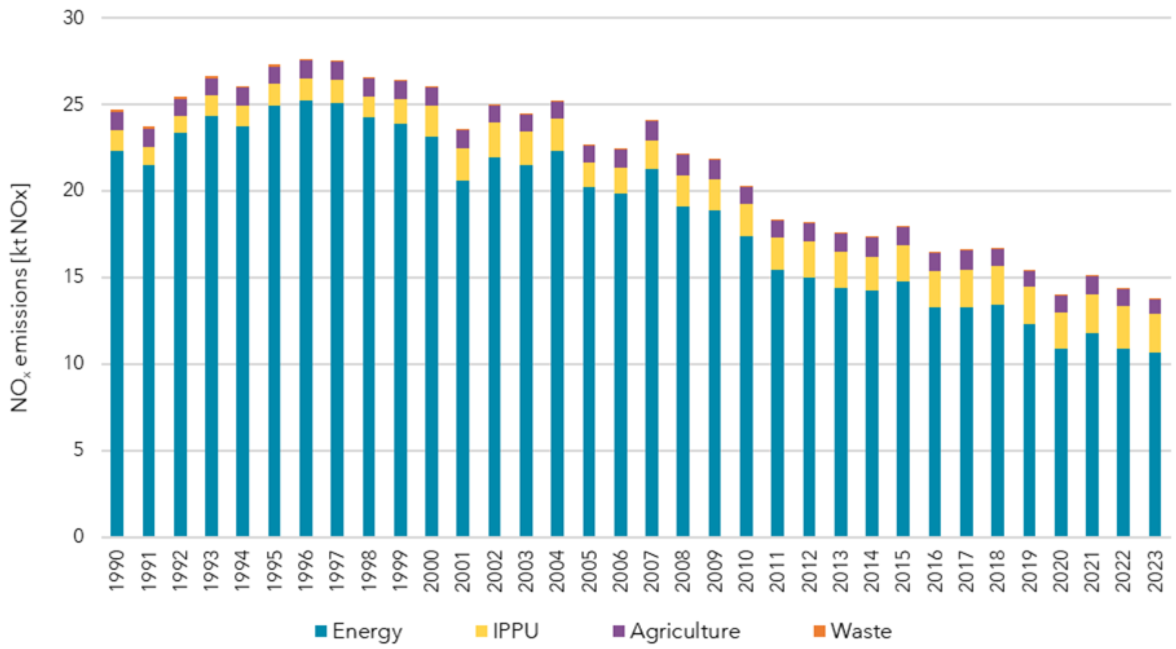


Figure 2.14 Emissions of NOx by sector for the reported time series [kt].

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,

[19] Convention on Long-Range Transboundary Air Pollution, find out more at: https://www.ceip.at/

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.

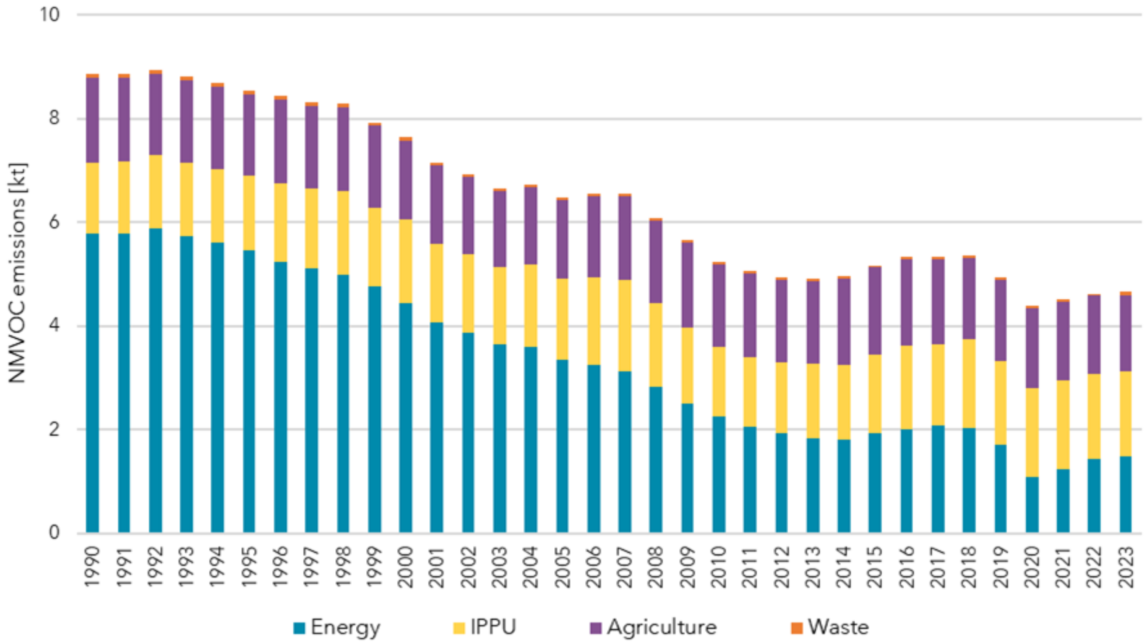


Figure 2.15 Emissions of NMVOC by sector for the reported time series [kt].

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.

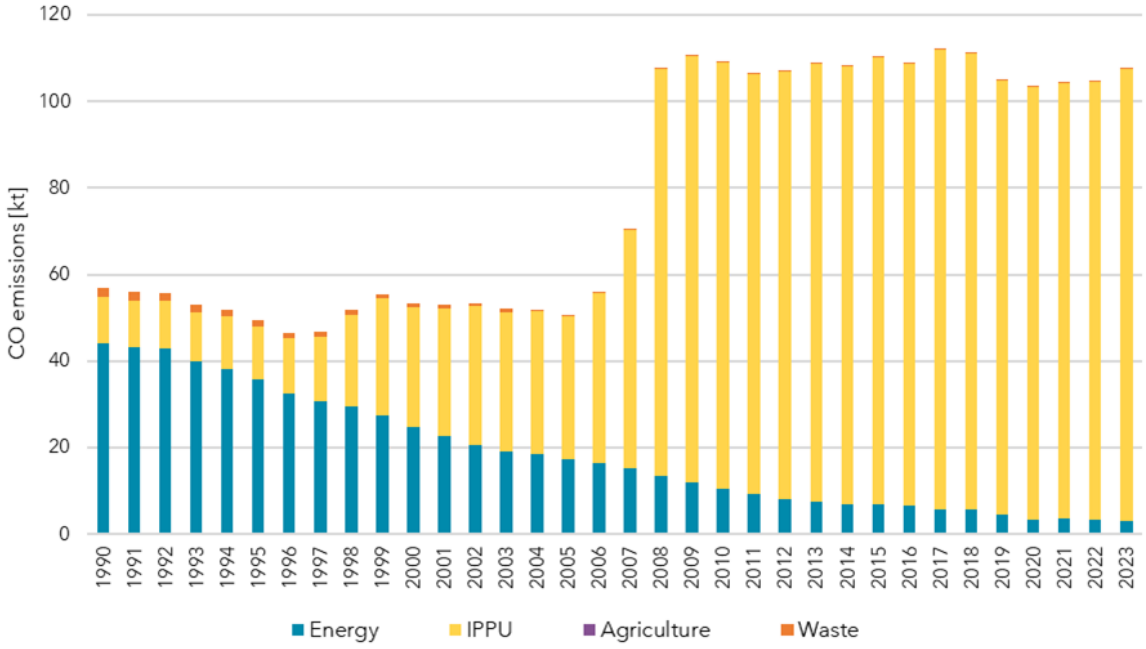


Figure 2.16 Emissions of CO by sector for the reported time series [kt].

2.3.4 Sulphur Dioxide (SO_2)

Geothermal energy exploitation is by far the largest source of SO_2 emissions in Iceland. Sulphur emitted from geothermal power plants is in the form of hydrogen sulphide and is reported here in kt SO_2-equivalents. Emissions have doubled since 1990 due to an increase in electricity production at geothermal power plants. Other significant sources of SO_2 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 SO_2 emissions. The fishmeal industry is the main contributor to SO_2 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.

SO_2 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 SO_2 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 SO_2 emissions in Iceland have more than doubled.

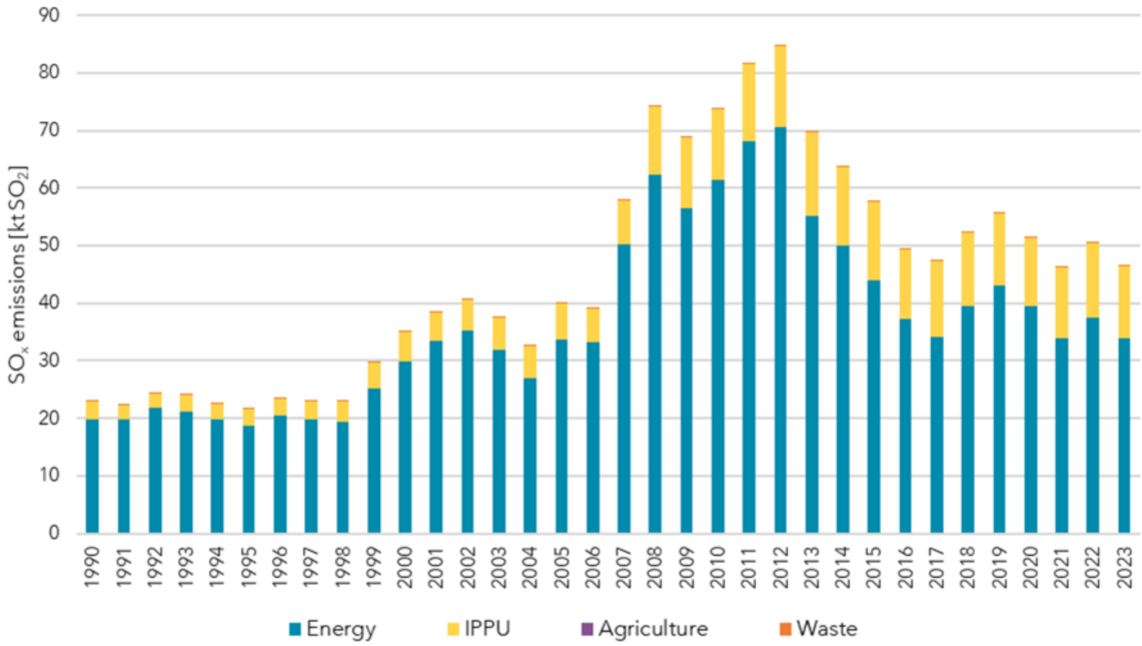


Figure 2.17 Emissions of SO_2 by sector for the reported time series [kt SO_2].

2.3.5 Ammonia (NH_3)

The main source of NH_3 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 between 4 and 5 kt NH_3 since 1990, see Figure 2.18. The trend in NH_3 emissions is relatively steady which is driven by relatively little overall variability in livestock numbers.

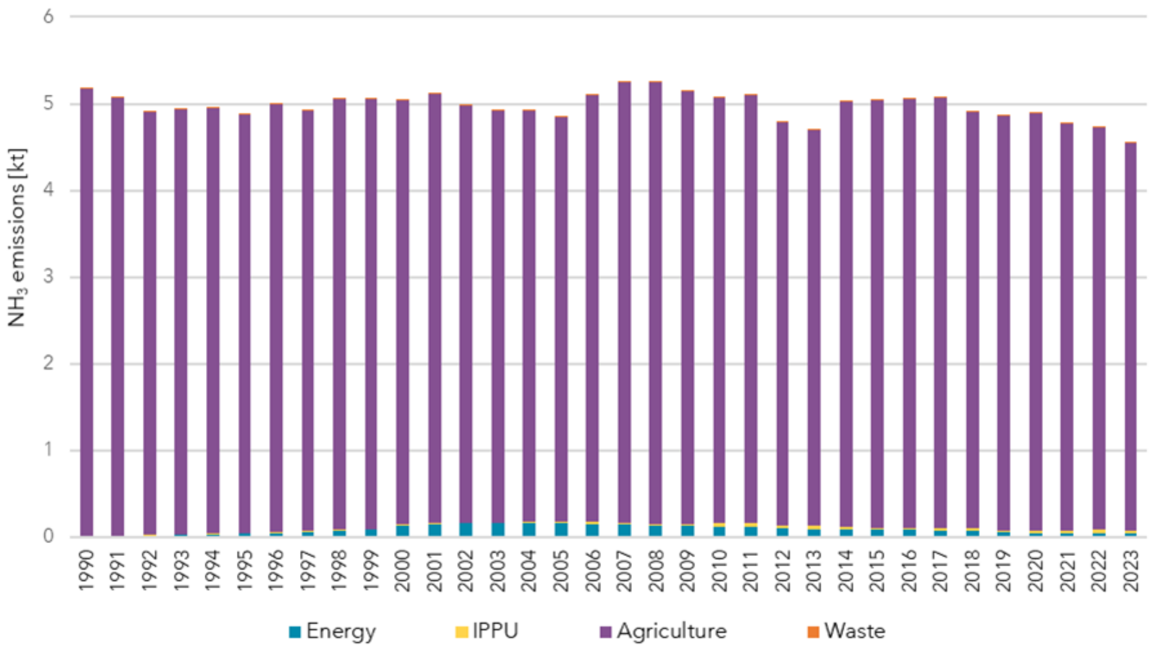


Figure 2.18 Emissions of NH_3 by sector for the reported time series [kt].

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 four 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)
- 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 5.8.1. which uses a Tier 3 methodology to estimate N_2O and CH_4 emissions, and a Tier 2 methodology to estimate CO_2 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_2O
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
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

Sources	Methodology		
	CO_2	CH_4	N_2O
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
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 LUUCF).

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

IPCC Source Category		Gas	Level 1990	Level 2023	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	✓	✓	✓

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

IPCC Source Category		Gas	Level 1990	Level 2023	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		✓	✓

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, NO: not occurring)

Sources	CO_2	CH_4	N_2O	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 2004
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	
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	NO	NO	NO	
c. Venting and Flaring	NO	NO	NO	
d. Other – Geothermal Energy	E	E	NO	
1C CO_2 Transport and Storage				
1. Transport of CO_2	NO	NO	NO	
2. Injections and Storage	NO	NO	NO	

Sources	CO_2	CH_4	N_2O	Notes
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	NO	NO	NO	
3. CO_2 Emissions from Biomass	E	E	E	
4. CO_2 Captured	NO	NO	NO	

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 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 between IPCC subsectors is discussed.

3.1.5 Activity Data

Activity data is data from the oil companies on fuel sales by sector and from the geothermal powerplants on emissions. 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 to collect the data by the NEA 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 make the adjustments from the sales statistics to the IPCC categories more transparent. This is what was done for each IPCC category to achieve the following:

- 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 Green Accounting reports (Regulation 851/2002) 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.

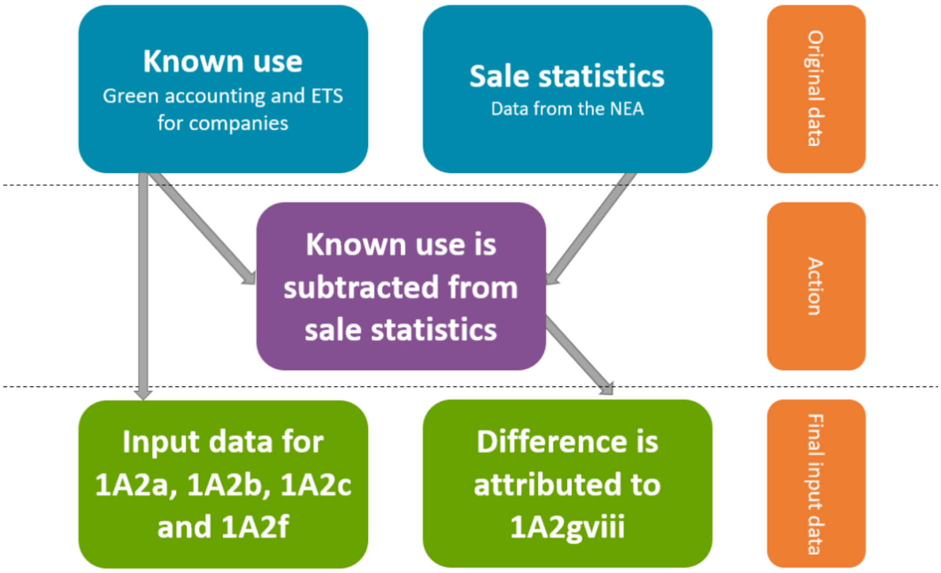


Figure 3.1 Description of adjustments in input data for IPCC category 1A2.

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 when substantial amount of fuel appears and making sure that it does not belong in another category. By doing this fuel have been correctly categorized elsewhere.

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 used. These emission factors for stationary combustion can be seen in Table 3.5. Emission factors for mobile combustion are shown in the chapters for each subsector as they vary.

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_2O emission factor	0.60	kg/TJ	Table 2.2 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_2O 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_2O 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_2O 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_2O 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_2O 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_2O 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_2O 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_2O 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_2O 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	2022	2023
Hydropower	4,159	4,677	6,350	7,015	12,592	13,781	13,157	14,196	14,226
Geothermal	283	290	1,323	1,658	4,465	5,003	5,961	5,916	6,006
Fuel Combustion	4.56	8.43	4.45	7.83	1.69	3.90	3.07	4.73	4.20
Wind Power	–	–	–	–	–	10.9	6.66	5.75	6.18
Total	**4,446**	**4,976**	**7,678**	**8,681**	**17,059**	**18,799**	**19,127**	**20,122**	**20,243**

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. 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	2010	2015	2020	2022	2023
Gas/Diesel Oil	1.30	1.09	1.07	0.0210	1.01	1.19	0.821	2.60	2.02
Residual Fuel Oil	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biomethane	NO	NO	NO	0.919	NO	NO	NO	NO	NO
Biodiesel	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. From 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	2022	2023
Gas/Diesel Oil	NO	NO	NO	NO	NO	NO	NO	0.709	1.435
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.

CO_2 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 CO_2 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 1A1aii 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, the emissions from electricity production 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.

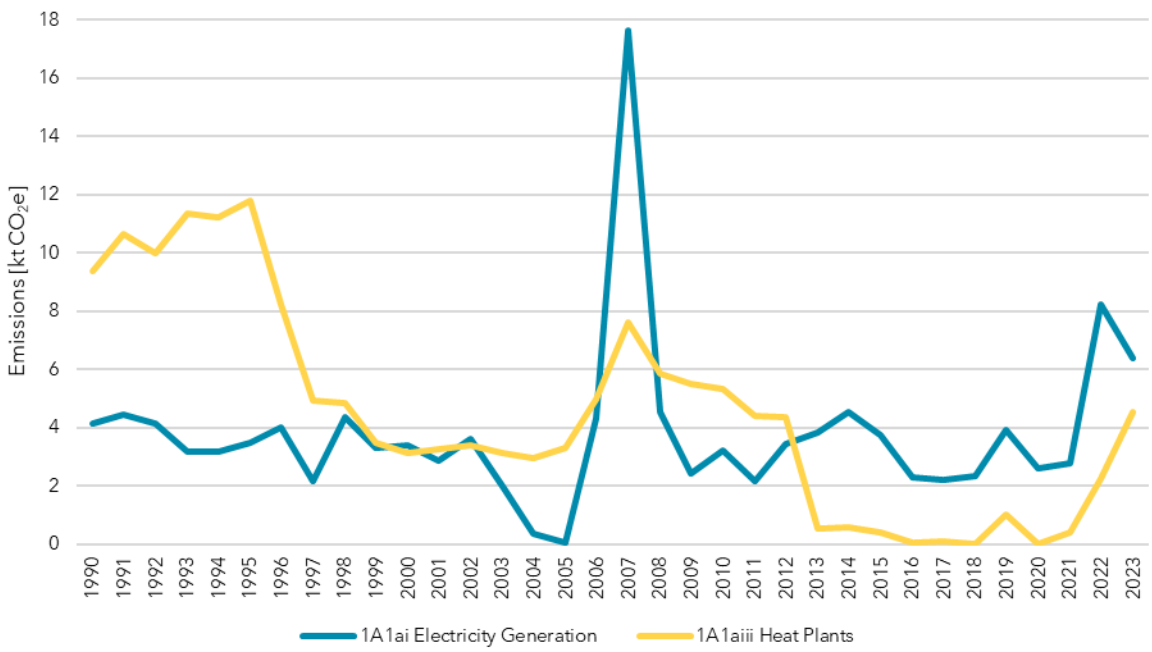


Figure 3.2 Emissions from 1A1 Energy industries.

Table 3.9 Emissions [kt CO_2e] from 1A1 Energy industries.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
1A1ai Electricity Generation	4.13	3.47	3.38	0.069	3.22	3.76	2.62	8.24	6.40
1A1aii Heat Plants	9.37	11.8	3.14	3.33	5.34	0.430	NO	2.25	4.55
Total Emissions [kt CO_2e]	**13.5**	**15.2**	**6.53**	**3.40**	**8.55**	**4.19**	**2.62**	**10.5**	**11.0**

3.2.1.4 Recalculations

Recalculations for the 2025 Submission

1A1ai: Electricity Generation

Some recalculations occurred for various reasons. First, there was updated AD for biomethane for the years 2002-2009 which caused recalculations in N_2O and CH_4 for these years. Second, a more precise NCV for diesel was obtained for the years 2021 and 2022 resulting in recalculations in N_2O and CH_4 for these two years. Third, the C and H content of diesel for 2022 was updated. It is now assumed to be the same as in the year 2021 when the latest measurement was done but in the last submission it was assumed to be the average of the results of measurements of three years. The updates and corrections led to minor recalculations as can be seen in Table 3.10.

Table 3.10 Recalculations in 1A1ai between submissions.

1A1ai Electricity Generation	2002	2004	2006	2008	2009	2021	2022
2024 submission [kt]	3.605	0.3562	4.3017	4.56226	2.4146	2.802409	8.25
2025 submission [kt]	3.606	0.3570	4.3020	4.56234	2.4148	2.802413	8.24
Change relative to the 2024 submission [kt]	0.001	0.0008	0.0003	0.0001	0.0002	0.000005	-0.0172
Change relative to the 2024 submission [%]	0.03%	0.22%	0.01%	0.002%	0.01%	0.0002%	-0.2%

1A1aiii: Heat Plants

A more precise NCV for diesel was obtained for the years 2021 and 2022 resulting in recalculations in N_2O and CH_4 for these two years. Also, the C and H content of diesel for 2022 was updated, see above in the text about electricity generation. The updates and corrections led to minor recalculations as can be seen in Table 3.13.

Table 3.11 Recalculations in 1A1aiii between submissions.

1A1aiii Heat Plants	2021	2022
2024 submission [kt]	0.40306	2.2549
2025 submission [kt]	0.40307	2.2502
Change relative to the 2024 submission [kt]	6.72E-07	-4.71E-03
Change relative to the 2024 submission [%]	0.00017%	-0.21%

Recalculations for the 2024 Submission

1A1ai: Electricity Generation

Some recalculations occurred for various reasons. First, updated emissions factors were applied for residual fuel oil for CH_4 and N_2O. Previously, diesel emissions factors were being used. Second, country specific NCV for diesel was missing for 2016. The updates and corrections led to minor recalculations, i.e. causing changes no larger than 0.02% between the 2023 and 2024 submission. Moreover, a part of the activity data for gas/diesel oil was not properly accounted for last year, but this has now been corrected and led to large recalculations for 2020 and 2021 (see Table 3.12).

Table 3.12 Recalculations in 1A1ai between submissions.

	2020	2021
2023 submission [kt CO_2e]	1.79	2.37
2024 submission [kt CO_2e]	2.62	2.80
Change relative to the 2023 submission [kt CO_2e]	0.830	0.427
Change relative to the 2023 submission [%]	46.6%	18.0%

1A1aiii: Heat Plants

A part of the activity data for gas/diesel oil was not properly accounted for 2021. This has now been corrected and led to recalculation (see Table 3.13). Additionally, NCV values were updated to account for the difference between waste and non-waste biomass, which led to recalculations of the activity data, but did not affect the emissions.

Table 3.13 Recalculations CO_2 in 1A1aiii between submissions.

	2021
2023 submission [kt CO2e]	0.194
2024 submission [kt CO2e]	0.403
Change relative to the 2023 submission [kt CO2e]	0.209
Change relative to the 2023 submission [%]	108.2%

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 CO_2 (2006 IPCC Guidelines default), 100% for CH_4 (central value for the default range given in the 2006 IPCC Guidelines) and 100% for N_2O (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 CO_2, 100% for CH_4, and 100% for N_2O. The complete uncertainty analysis is shown in Annex 2.

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

Table 3.14 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 3.14 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 (previously from the NEA which is now a part of the IEEA). 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 Act 70/2012 and the EU ETS Directive 2003/87/EC (metal production, fish meal production, and mineral wool) and from green accounts submitted by the industry in accordance with regulation No 851/2002. All major industries falling under Act 70/2012 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 3.15 shows the fuel sales statistics for the various fuel types used for stationary combustion in CRT sector 1A2:

Table 3.15 Fuel use [kt] from stationary combustion from subsectors in the Manufacturing Industry (1A2).

	1990	1995	2000	2005	2010	2015	2020	2022	2023
1A2a - Iron and Steel									
Gas/Diesel Oil	0.112	0.225	0.556	0.455	0.458	0.291	0.213	0.205	0.223
LPG	NO	NO	NO	NO	NO	0.098	0.203	0.222	0.193
1A2b - Non-ferrous Metals									
Gas/Diesel Oil	NO	NO	0.549	5.37	1.35	0.0457	1.72	1.33	0.13
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	0.699	1.262
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	14.60	5.3
Residual Fuel Oil	41.0	48.5	36.4	21.4	9.61	8.41	1.22	2.704	1.91
Waste Oil	NO	NO	NO	NO	1.36	1.59	0.374	4.63	4.18
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	3.03	2.22
Residual Fuel Oil	NO	NO	NO	NO	1.71	0.327	NO	NO	NO
1A2f - Non-metallic minerals (cement)									
Gas/Diesel Oil	NO	NO	0.00600	0.019	0.00500	NO	NO	NO	NO
Residual Fuel Oil	0.06	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	0.0739	0.106	0.128	0.128	0.139
Residual Fuel Oil	0.594	NO	NO	NO	NO	NO	NO	NO	NO
Petroleum Coke	NO	NO	NO	NO	NO	NO	NO	NO	NO

	1990	1995	2000	2005	2010	2015	2020	2022	2023
1A2gviii - Other Industry									
Gas/Diesel Oil	4.96	0.758	7.64	9.19	NO	2.92	2.13	2.27	2.40
Residual Fuel Oil	7.91	0.162	1.00E-05	3.56	0.295	0.0523	NO	NO	NO
LPG	NO	NO	0.186	0.270	0.441	0.320	0.565	0.549	0.248
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.

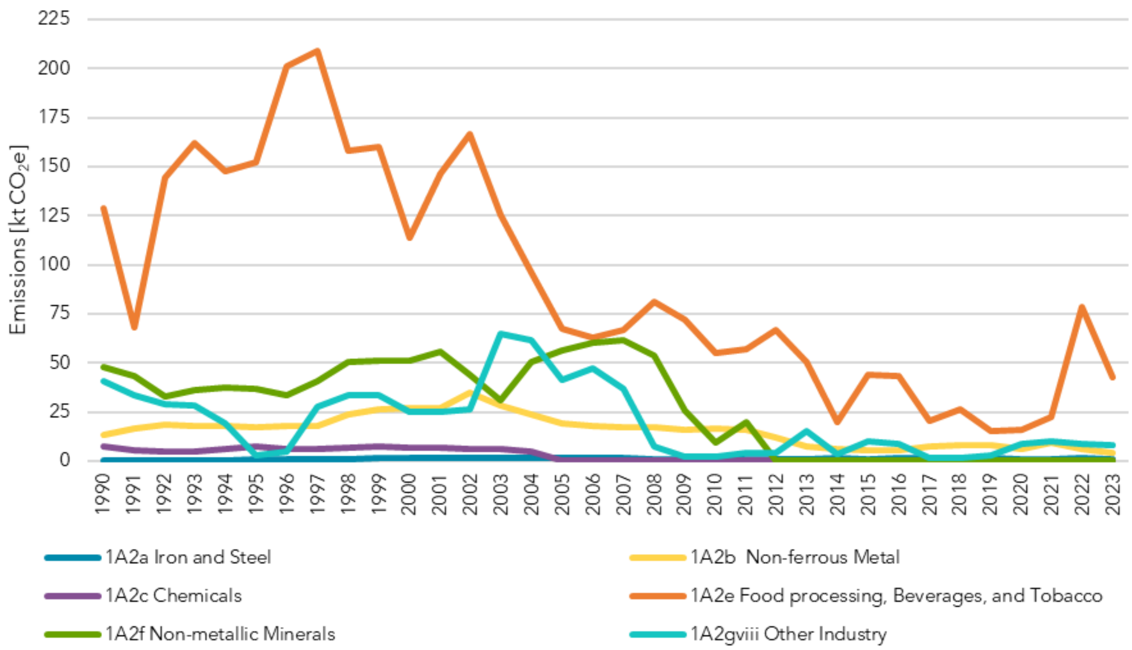


Figure 3.3 Emissions from stationary combustion of subcategories of CRT 1A2.

Table 3.16 Emissions [kt CO_2e] from stationary combustion of subcategories of CRT 1A2.

		1990	1995	2000	2005	2010	2015	2020	2022	2023
1A2a	Iron and Steel	0.354	0.714	1.76	1.45	1.46	1.22	1.28	1.31	1.28
1A2b	Non-ferrous Metals	13.5	17.1	27.3	19.0	16.5	5.69	6.16	6.29	4.19
1A2c	Chemicals	7.45	7.25	7.11	NO	NO	NO	NO	NO	NO
1A2e	Food Processing, Beverages, and Tobacco	129	152	114	67.2	55.0	44.1	15.7	78.5	42.6
1A2f	Non-metallic Minerals	47.7	36.8	51.4	56.3	9.21	0.338	0.409	0.407	0.440
1A2gviii	Other Industry	40.6	2.92	24.8	41.2	2.24	10.4	8.47	8.9	8.37
Total Emissions [kt CO_2e]		**238**	**217**	**226**	**185**	**84.4**	**61.7**	**32.0**	**95.3**	**56.9**

3.2.2.4 Recalculations

Recalculations for the 2025 Submission

A more precise NCV for diesel was obtained for the years 2021 and 2022 resulting in recalculations in N_2O and CH_4 for these two years. Also, the C and H content of diesel for 2022 was updated. It is now assumed to be the same as in the year 2021 when the latest measurement was done but in the last submission it was assumed to be the average of the results of measurements of three years. The updates and corrections led to minor recalculations as can be seen in the tables below for each subsector.

Table 3.17 Recalculations in 1A2a between submissions.

1A2a Iron and Steel	2021	2022
2024 submission [kt]	1.182905	1.315579
2025 submission [kt]	1.182907	1.314217
Change relative to the 2024 submission [kt]	0.000001	-0.001363
Change relative to the 2024 submission [%]	0.00011%	-0.10%

Table 3.18 Recalculations in 1A2b between submissions.

1A2b Non-ferrous Metals	2021	2022
2024 submission [kt]	9.19823	6.30
2025 submission [kt]	9.19824	6.29
Change relative to the 2024 submission [kt]	0.000014	-0.009
Change relative to the 2024 submission [%]	0.00016%	-0.14%

Table 3.19 Recalculations in 1A2e between submissions.

1A2e Food Processing, Beverages, and Tobacco	2021	2022
2024 submission [kt]	22.46870	78.58
2025 submission [kt]	22.46872	78.46
Change relative to the 2024 submission [kt]	0.000023	-0.12
Change relative to the 2024 submission [%]	0.00010%	-0.15%

Table 3.20 Recalculations in 1A2f between submissions.

1A2f Non-metallic Metals	2021	2022
2024 submission [kt]	0.407276	0.408
2025 submission [kt]	0.407277	0.407
Change relative to the 2024 submission [kt]	0.00000068	-0.00085
Change relative to the 2024 submission [%]	0.00017%	-0.21%

Table 3.21 Recalculations in 1A2gviii between submissions.

1A2gviii Other Industry	2021	2022
2024 submission [kt]	10.08101	8.21
2025 submission [kt]	10.08102	8.85
Change relative to the 2024 submission [kt]	0.000014	0.65
Change relative to the 2024 submission [%]	0.00014%	7.9%

Recalculations for the 2024 Submission

1A2a: Iron and Steel

There was one cause for recalculations for 1A2a for the 2024 submission. This is due to the fact that the country-specific NCV for diesel was not included for the year 2016 in the previous submission.

Table 3.22 Recalculations in 1A2a.

Iron and Steel	2016
2023 submission [kt CO2e]	1.561927
2024 submission [kt CO2e]	1.561943
Change relative to the 2023 submission [kt CO2e]	0.0000160
Change relative to the 2023 submission [%]	0.00102%

1A2b: Non-ferrous Metals

There was one minor recalculation for 1A2b the 2024 submission. This is due to the fact that the country-specific NCV for diesel was not included for the year 2016 in the previous submission.

Table 3.23 Recalculations in 1A2b.

Non-ferrous Metals	2016
2023 submission [kt CO2e]	5.717260709
2024 submission [kt CO2e]	5.717260771
Change relative to the 2023 submission [kt CO2e]	0.0000000616
Change relative to the 2023 submission [%]	0.00000118%

1A2c: Chemicals

No recalculations were necessary for this subsector for the 2024 submission.

1A2e: Food Processing, Beverages, and Tobacco

There was one minor recalculation for 1A2e the 2024 submission. This is due to the fact that the country-specific NCV for diesel was not included for the year 2016 in the previous submission.

Table 3.24 Recalculations in 1A2e.

Non-ferrous Metals	2016
2023 submission [kt CO2e]	43.6389
2024 submission [kt CO2e]	43.6393
Change relative to the 2023 submission [kt CO2e]	0.000386
Change relative to the 2023 submission [%]	0.000885%

1A2f: Non-metallic Metals

It was discovered that the emission factors for CH_4 and N_2O for waste oil were previously matched to diesel. This was corrected for this submission, which resulted in recalculations for all years since 1992 (except those years where the use of waste oil was non occurring). Additionally, the country-specific NCV for diesel was not included for the year 2016, resulting in a minor recalculation for that year.

Table 3.25 Recalculations in 1A2f.

Non-metallic Metals	1992	2006	2008	2009	2011	2016
2023 submission [kt CO_2e]	32.630	60.3755	53.659	25.5817	20.063	0.327469
2024 submission [kt CO_2e]	32.675	60.3768	53.664	25.5872	20.076	0.327474
Change relative to the 2023 submission [kt CO_2e]	0.0447	0.00133	0.00420	0.00553	0.0127	5.01 E-06
Change relative to the 2023 submission [%]	0.137%	0.00221%	0.00782%	0.0216%	0.0631%	0.00153%

1A2gviii: Other Industry

There were two reasons for recalculations in this sector. First, data updates from the NEA significantly increased the amount of LPG in 2021, which caused a large recalculation. Second, the country-specific NCV for diesel was not included for the year 2016, resulting in a minor recalculation for that year. The relevant years are shown in Table 3.26 below.

Table 3.26 Recalculations in 1A2gviii.

Other Industry	2016	2021
2023 submission [kt CO_2e]	8.688007	8.80
2024 submission [kt CO_2e]	8.688064	10.1
Change relative to the 2023 submission [kt CO_2e]	0.0000565	1.28
Change relative to the 2023 submission [%]	0.000650%	15%

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 CO_2 emissions (with an activity data uncertainty of 1.5% and emission factor uncertainty of 5% (Default 2006 IPCC Guidelines)), 100% for CH_4 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 N_2O 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 CO_2 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 CH_4 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 N_2O 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 IEEA 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 from the Commercial/Institutional sector and in the Residential sector are given in Table 3.27.

Table 3.27 Fuel use [in kt] from stationary combustion from subsectors of CRT 1A4.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
1A4ai Commercial/Institutional									
Gas/Diesel Oil	1.80	1.60	1.60	1.00	0.300	0.300	0.127	0.120	0.121
LPG	0.777	0.834	0.460	0.496	0.174	0.371	0.411	0.575	0.635
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	1.06	0.521	0.414
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	0.01
Charcoal	0.20	0.20	0.20	0.20	0.20	0.20	0.183	0.257	0.227
LPG	NO	NO	0.717	0.930	1.42	0.927	1.10	1.00	0.97
1A4ci Agriculture									
LPG	NO	NO	NO	NO	NO	0.0040	0.0080	0.0070	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, and therefore this influences the 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 3.28 and Figure 3.4.

Table 3.28 Emissions from Stationary Combustion of subsectors under CRT 1A4 [kt CO_2e].

	1990	1995	2000	2005	2010	2015	2020	2022	2023
1A4ai Commercial/Institutional	8.06	7.80	6.74	4.93	1.71	2.07	1.64	2.10	2.28
1A4bi Residential	28.1	22.1	21.3	13.1	8.50	5.94	6.72	4.71	4.26
1A4ci Agriculture	NO	NO	NO	NO	NO	0.0120	0.0239	0.0209	0.0120
Total Emissions [kt CO_2e]	**36.2**	**29.9**	**28.1**	**18.0**	**10.2**	**8.02**	**8.38**	**6.83**	**6.56**

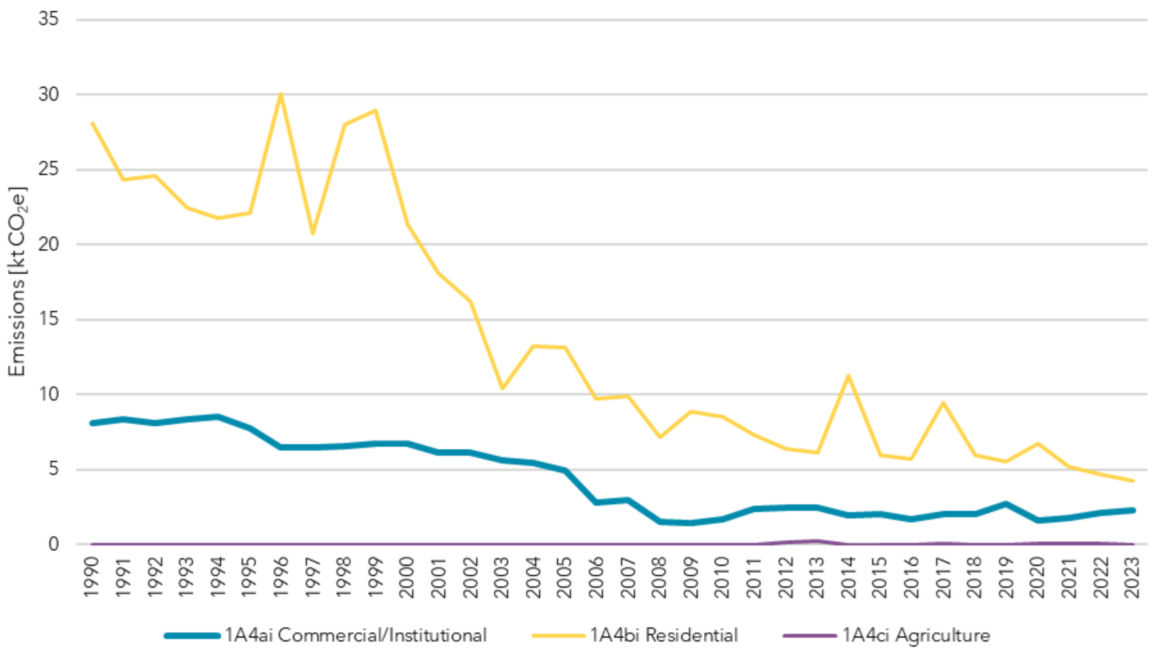


Figure 3.4 Emissions from stationary combustion of subsectors under CRT 1A4.

3.2.3.4 Recalculations

Recalculations for the 2025 Submission

1A4ai Commercial/Institutional Stationary

A more precise NCV for diesel was obtained for the years 2021 and 2022 resulting in recalculations in N_2O and CH_4 for these two years. Also, the C and H content of diesel for 2022 was updated. It is now assumed to be the same as in the year 2021 when the latest measurement was done but in the last submission it was assumed to be the average of the results of measurements of three years. The updates and corrections led to minor recalculations as can be seen in Table 3.29.

Table 3.29 Recalculations in 1A4ai between submissions.

1A4ai Commerical Stationary	2021	2022
2024 submission [kt]	1.742156	2.1024
2025 submission [kt]	1.742157	2.1016
Change relative to the 2024 submission [kt]	0.000001	-0.0008
Change relative to the 2024 submission [%]	0.000064%	-0.038%

1A4bi Residential Stationary

A more precise NCV for diesel was obtained for the years 2021 and 2022 resulting in recalculations in N_2O and CH_4 for these two years. Also, the C and H content of diesel for 2022 was updated. It is now assumed to be the same as in the year 2021 when the latest measurement was done but in the last submission it was assumed to be the average of the results of measurements of three years. Also, the AD on charcoal for the year 2022 was updated. Also, AD for the years 1990-2018 for charcoals was added (was NE). The updates and corrections led to minor recalculations as can be seen in Table 3.30

Table 3.30 Recalculations in 1A4bi between submissions.

1A4bi Residential Stationary	1990	1995	2000	2005	2010	2015	2021	2022
2024 submission [kt CO_2e]	28.11	22.09	21.34	13.10	8.50	5.94	5.217669	4.697
2025 submission [kt CO_2e]	28.14	22.13	21.37	13.14	8.53	5.97	5.217675	4.705
Change relative to the 2024 submission [kt CO_2e]	0.03	0.03	0.03	0.03	0.03	0.03	0.0000061	0.0084
Change relative to the 2024 submission [%]	0.1%	0.2%	0.2%	0.3%	0.4%	0.6%	0.00012%	0.18%

1A4ci Agricultural Stationary

No recalculations were necessary for this subsector for the 2025 submission.

Recalculations for the 2024 Submission

1A4ai Commercial/Institutional Stationary

There was one minor recalculation for 1A4ai for the 2024 submission. This is due to the fact that the country-specific NCV for diesel was not included for the year 2016 in the previous submission.

Table 3.31 Recalculations in 1A4ai.

Commercial/Institutional Stationary	2016
2023 submission [kt CO2e]	1.704104
2024 submission [kt CO2e]	1.704117
Change relative to the 2023 submission [kt CO2e]	0.0000132
Change relative to the 2023 submission [%]	0.000773%

1A4bi Residential Stationary

There was one minor recalculation for 1A4bi for the 2024 submission. This is due to the fact that the country-specific NCV for diesel was not included for the year 2016 in the previous submission.

Table 3.32 Recalculations in 1A4bi.

Residential Stationary	2016
2023 submission [kt CO2e]	5.74083
2024 submission [kt CO2e]	5.74091
Change relative to the 2023 submission [kt CO2e]	0.0000788
Change relative to the 2023 submission [%]	0.00137%

1A4ci Agricultural Stationary

No recalculations were necessary for this subsector for the 2024 submission.

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 CO_2 (2006 IPCC Guidelines default), 100% for CH_4 (central value for the default range given in the 2006 IPCC Guidelines), and 100% for N_2O (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 CO_2, 100% for CH_4, and 100% for N_2O. 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. For future submissions, the IEEA will work to try to investigate where these fuels were used so they can be attributed to the correct categories.

3.2.4.1 Activity Data

Activity data for 1A5 Other can be seen in Table 3.33.

Table 3.33 Fuel use [in kt] from sector 1A5 Other.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Gas/Diesel Oil	NO	0.46	1.4	8.9	2.7	NO	0.0840	0.16	0.52
Residual Fuel Oil	0.039	0.052	0.067	NO	1.6	NO	NO	NO	NO
Other Kerosene	NO	NO	NO	0.15	0.047	0.029	0.0300	0.08	0.031
LPG	NO	NO	NO	NO	NO	0.032	NO	0.006	0.0051
Biodiesel	NO	NO	NO	NO	NO	NO	0.0440	0.030	0.023
Biomethane	NO	NO	NO	NO	NO	NO	0.111	0.020	NO
Biogasoline	NO	NO	NO	NO	NO	NO	1.0E-03	1.6E-04	NO

3.2.4.2 Emission Factors

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

3.2.4.3 Emissions

Emissions from unallocated fuels from CRT 1A5 have been decreasing over the past years. There was a sharp increase in emissions in 2004-2006 and it is likely that this is fuel that should have been allocated to CRT 1A2e.

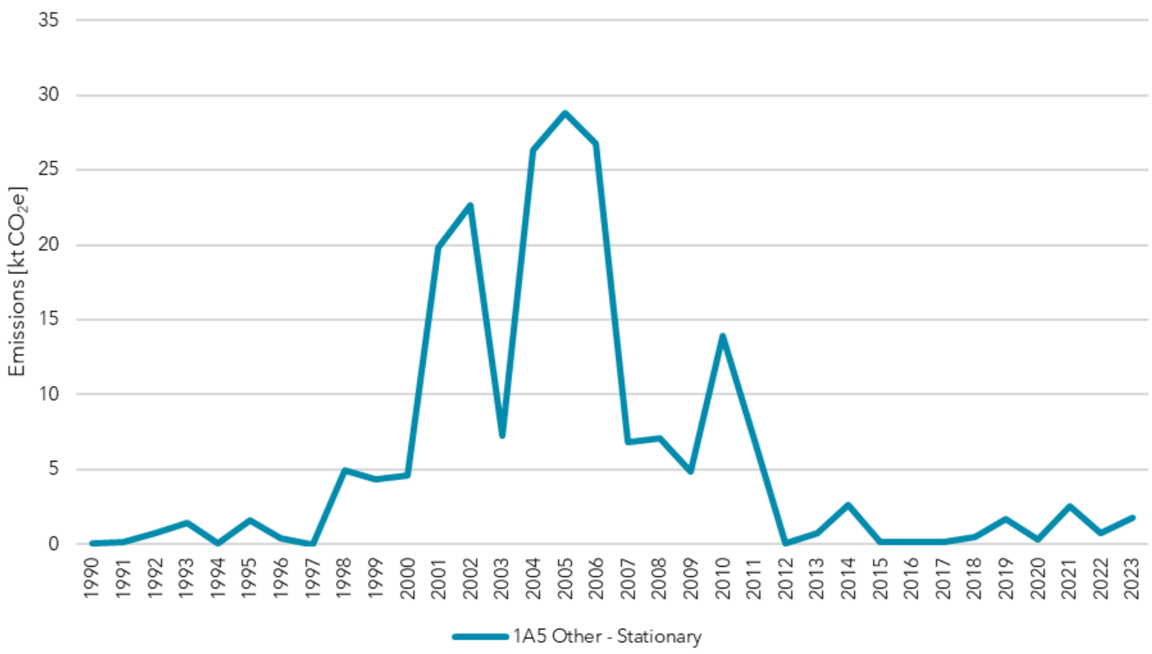


Figure 3.5 Emissions from Stationary Combustion from CRT 1A5.

Table 3.34 Emissions from Stationary Combustion from CRT 1A5 [kt CO_2e].

	1990	1995	2000	2005	2010	2015	2020	2022	2023
1A5 - Total emissions [kt CO_2e]	0.122	1.62	4.61	28.8	13.9	0.187	0.364	0.751	1.777

3.2.4.4 Recalculations

Recalculations for the 2025 Submission

A more precise NCV for diesel was obtained for the years 2021 and 2022 resulting in recalculations in N_2O and CH_4 for these two years. Also, the C and H content of diesel for 2022 was updated. It is now assumed to be the same as in the year 2021 when the latest measurement was done but in the last submission it was assumed to be the average of the results of measurements of three years. The updates and corrections led to minor recalculations as can be seen in Table 3.35.

Table 3.35 Recalculations in 1A5 between submissions.

1A5 Other	2021	2022
2024 submission [kt]	2.540656	0.752
2025 submission [kt]	2.540659	0.751
Change relative to the 2024 submission [kt]	0.000003	-0.0010
Change relative to the 2024 submission [%]	0.00011%	-0.137%

Recalculations from the 2024 Submission:

There were no recalculations for this subsector for the 2024 submission.

3.2.4.5 Uncertainties

The uncertainty of CO_2 emissions from 1A5 is 7% (with an activity data uncertainty of 5%, as estimated by IEEA, and emission factor uncertainty of 5%), 100% for CH_4 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 N_2O 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 work to try to 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 mobile sources that are included under CRT 1A2, 1A3, and 1A4. Information on the specific subsectors can be seen in Table 3.36.

Table 3.36 Information on subsectors reported as Mobile Machinery.

CRT code	IPCC name	Included
1A2gvii	Off-road Vehicles and Other Machinery in Construction	Extrapolation for 1990-2018, data for Mobile Machinery in Construction from 2019.
1A3eii	Off-road Vehicles and Other Machinery	Extrapolation for 1990-2018, all Other Machinery after 2019.
1A4cii	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	Extrapolation for 1990-2018, data for Mobile Machinery in Agriculture from 2019.

3.3.1.1 Activity Data

Activity data for Mobile Combustion in these sectors can be seen in Table 3.38. Activity data and information available for 1990-2018 do not allow the distinction between fuels sold to machinery in construction, agriculture, or other uses, but provides data on fuel sold from fuel delivery trucks (as opposed to fuel sold at petrol stations). However, improvements were made in the data gathering and it was possible to distinguish between off-road vehicles in agriculture and construction from the inventory years 2019 and onwards.

Prior to the 2023 submission, category 1A3eii Other Off-road Vehicles and Machinery included all emissions derived from fuels 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) as well as transport activities not reported under Road Transport, such as ground activities in airports and harbours (1A3eii). Categories 1A2gvii and 1A4cii were marked as "IE" in the CRT reporter for 1990-2018 and were all included under 1A3eii.

An extrapolation was made for 1990-2018 to split the diesel fuel previously reported under 1A3eii to the other categories for Mobile Machinery. An average proportion of each category was calculated based on the split from 2019 to 2022. The proportions for this submission can be seen in Table 3.37.

Table 3.37 Proportion used for 1990-201 extrapolation of mobile machinery.

CRT code	IPCC name	Proportion used for 1990-2018 extrapolation
1A2gvii	Off-road Vehicles and Other Machinery in Construction	51.2%
1A3eii	Off-road Vehicles and Other Machinery	14.0%
1A4cii	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	34.8%

For 2019 and onwards, Mobile Machinery in Construction (1A2gvii) and Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery (1A4cii) are reported separately, but other transport activities not reported under Road Transport (such as ground activities in airports and harbours) are still reported under 1A3eii.

Table 3.38 Fuel use (in kt) from Mobile Combustion in the Construction Industry (1A2gv), Agriculture (1A4cii), and Other (1A2gvii).

	1990	1995	2000	2005	2010	2015	2020	2022	2023
1A2gvii - Mobile Machinery in Construction									
Gas/Diesel Oil	19.4	23.9	31.7	34.7	16.5	16.9	6.41	10.36	15.1
1A3eii - Other Mobile Machinery									
Gas/Diesel Oil	5.30	6.53	8.64	9.47	4.50	4.62	3.72	0.319	NO
Other Kerosene	NO	NO	NO	0.0220	1.17	0.157	0.326	0.026	0.022
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A4cii - Mobile Machinery in Agriculture									
Gas/Diesel Oil	13.2	16.3	21.6	23.6	11.2	11.5	7.57	6.27	6.26

3.3.1.2 Emission Factors

All emission factors used to calculate emissions from fuel combustion from Mobile Machinery can be seen in Table 3.39. All factors, except NCV and carbon content for diesel, are from 2006 IPCC guidelines. The values in Table 3.39 represent the values used in the most recent inventory year.

Table 3.39 Emission factors for CO_2, CH_4, and N_2O from Mobile Combustion reported under 1A2gvii, 1A3eii, and 1A4cii.

Fuel / Factor	Value	Unit	Reference
Diesel Oil			
NCV	42.94	TJ/kt	Country Specific from 2017, based on measurements
C-content	20.15	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_2O 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_2O 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_2O 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

As can be seen in Figure 3.6 and Table 3.40, emissions from Mobile Machinery increased in the beginning of the times series, but they have generally been decreasing from 2008, albeit with some fluctuations.

Table 3.40 Emissions [kt CO_2e] from mobile machinery (1A2gvii, 1A3eii, and 1A4cii)

	1990	1995	2000	2005	2010	2015	2020	2022	2023
1A2gvii Mobile Machinery in Construction	67.9	83.6	111	121	57.6	59.2	22.4	36.3	52.9
1A3eii Other Mobile Machinery	18.5	22.8	30.2	33.2	19.8	16.7	14.1	1.21	0.08
1A4cii Mobile Machinery in Agriculture	46.2	56.9	75.3	82.5	39.2	40.3	26.5	21.9	21.9
Total	**133**	**163**	**216**	**237**	**117**	**116**	**63.1**	**59.5**	**74.9**

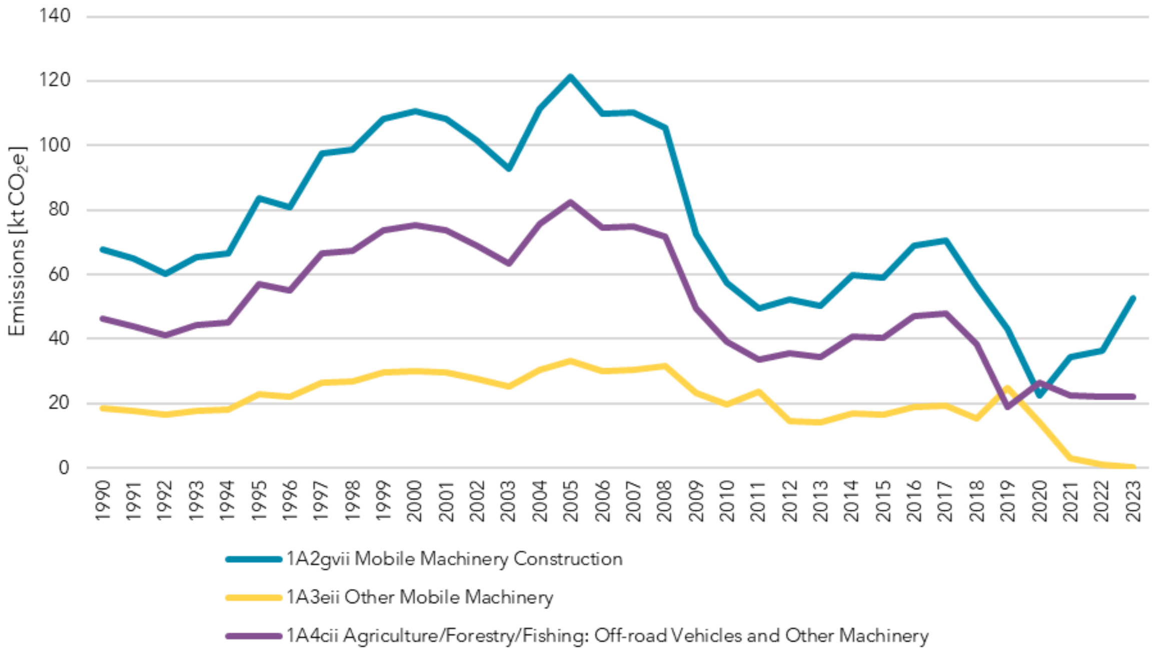


Figure 3.6 Emissions [kt CO_2e] from Mobile Machinery (1A2gvii, 1A3eii, and 1A4cii). Emission split for 1990-2018 is based on extrapolation.

3.3.1.4 Recalculations

Recalculations for the 2025 Submission

A more precise NCV for diesel was obtained for the years 2021 and 2022 resulting in recalculations in N_2O and CH_4 for these two years. Also, the C and H content of diesel for 2022 was updated. It is now assumed to be the same as in the year 2021 when the latest measurement was done but in the last submission it was assumed to be the average of the results of measurements of three years. The updates and corrections led to minor recalculations in all three subsectors as can be seen in Table 3.41, Table 3.42 and Table 3.43.

1A2gvii Off-road Vehicles and Other Machinery in Construction

Table 3.41 Recalculations in 1A2gvii between submissions.

1A2gvii Construction	2021	2022
2024 submission [kt]	34.5804	36.27
2025 submission [kt]	34.5820	36.30
Change relative to the 2024 submission [kt]	0.0017	0.0263
Change relative to the 2024 submission [%]	0.0048%	0.07%

1A3eii Off-road Vehicles and Other Machinery

Table 3.42 Recalculations in 1A4eii between submissions.

1A3eii Other mobile machinery	2021	2022
2024 submission [kt]	3.11331	1.2070
2025 submission [kt]	3.11346	1.2077
Change relative to the 2024 submission [kt]	0.00015	0.0008
Change relative to the 2024 submission [%]	0.0048%	0.064%

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

Table 3.43 Recalculations in 1A4cii between submissions.

1A4cii Agriculture Machinery	2021	2022
2024 submission [kt]	22.5983	21.93
2025 submission [kt]	22.5993	21.95
Change relative to the 2024 submission [kt]	0.0011	0.016
Change relative to the 2024 submission [%]	0.0048%	0.072%

Recalculations for the 2024 Submission

Recalculations for all three subcategories were performed for 1990-2018 due to the extrapolation of allocation of diesel fuels between the categories. This does not affect total emissions from mobile machinery as the same emission factors are used and all fuel is allocated, this recalculation was done for increased transparency of the inventory. Information on how this reallocation of fuels was done can be seen in Section 3.3.1.1.

1A2gvii Off-road Vehicles and Other Machinery in Construction

Besides the extrapolation discussed above, another reason for recalculations in this sector occurred due to the country-specific NCV for diesel not being included for the year 2016 in the previous submission.

Table 3.44 Recalculations in 1A2gvii

1A2gvii Off-road Vehicles and Other Machinery in Construction	1990	1995	2000	2005	2010	2015	2016	2018
2023 submission [kt CO_2e]	63.5	78.2	103.5	113	53.9	55.3	64.5	52.6
2024 submission [kt CO_2e]	67.9	83.6	110.7	121	57.6	59.2	69.0	56.3
Change relative to the 2023 submission [kt CO_2e]	4.40	5.41	7.17	7.85	3.73	3.83	4.50	3.64
Change relative to the 2023 submission [%]	6.93%	6.93%	6.93%	6.93%	6.93%	6.93%	6.97%	6.93%

1A3eii Off-road Vehicles and Other Machinery

Besides the extrapolation discussed above, another reason for recalculations in this sector occurred due to the country-specific NCV for diesel not being included for the year 2016 in the previous submission.

Table 3.45 Recalculations in 1A3eii

1A3eii Off-road Vehicles and Other Machinery	1990	1995	2000	2005	2010	2015	2016	2018
2023 submission [kt CO_2e]	23.9	29.4	38.9	42.7	24.3	21.3	24.4	19.9
2024 submission [kt CO_2e]	18.5	22.8	30.2	33.2	19.8	16.7	18.9	15.4
Change relative to the 2023 submission [kt CO_2e]	-5.35	-6.58	-8.71	-9.54	-4.54	-4.66	-5.42	-4.43
Change relative to the 2023 submission [%]	-22.4%	-22.4%	-22.4%	-22.3%	-18.6%	-21.8%	-22.2%	-22.3%

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

Besides the extrapolation discussed above, another reason for recalculations in this sector occurred due to the country-specific NCV for diesel not being included for the year 2016 in the previous submission.

Table 3.46 Recalculations in 1A4cii

1A4cii Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	1990	1995	2000	2005	2010	2015	2016	2018
2023 submission [kt CO_2e]	45.3	55.7	73.8	80.8	38.4	39.4	46.0	37.5
2024 submission [kt CO_2e]	46.2	56.9	75.3	82.5	39.2	40.3	47.0	38.3
Change relative to the 2023 submission [kt CO_2e]	0.945	1.16	1.54	1.69	0.802	0.823	0.981	0.783
Change relative to the 2023 submission [%]	2.09%	2.09%	2.09%	2.09%	2.09%	2.09%	2.09%	2.09%

3.3.1.5 Planned Improvements

No improvements are planned for this sector.

3.3.1.6 Uncertainties

The combined uncertainty of CO_2 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 CH_4 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 N_2O 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 flights departing from and subsequently landing in Iceland. Flights, that would be accounted under military operations in 1A5b are not occurring in Iceland as there is no Icelandic military.

Total use of jet kerosene and aviation gasoline is based on annual sales statistics for fossil fuels sold for flights in all airports that service domestic flights. These are all airports in Iceland except one, which services international flights. Activity data for fuel sales are given in Table 3.47.

Table 3.47 Fuel use [kt] for Domestic Aviation.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Aviation Gasoline	1.68	1.13	1.10	0.872	0.648	0.502	0.195	0.218	0.170
Jet Kerosene	8.92	8.41	7.87	7.39	6.07	5.99	3.98	7.42	6.92

3.3.2.2 Emission Factors

The emission factors for greenhouse gases are taken from the 2006 IPCC Guidelines and are presented in Table 3.48.

Table 3.48 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_2O emission factor	2.0	kg/TJ	Table 3.6.5 2006 IPCC Guidelines, V2, Ch4
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_2O emission factor	2.0	kg/TJ	Table 3.6.5 2006 IPCC Guidelines, V2, Ch4

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 3.49.

Table 3.49 Emissions [kt CO_2e] from 1A3a Domestic aviation.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Total Emissions [kt CO_2e]	33.6	30.2	28.5	26.2	21.3	20.6	13.2	24.3	22.5

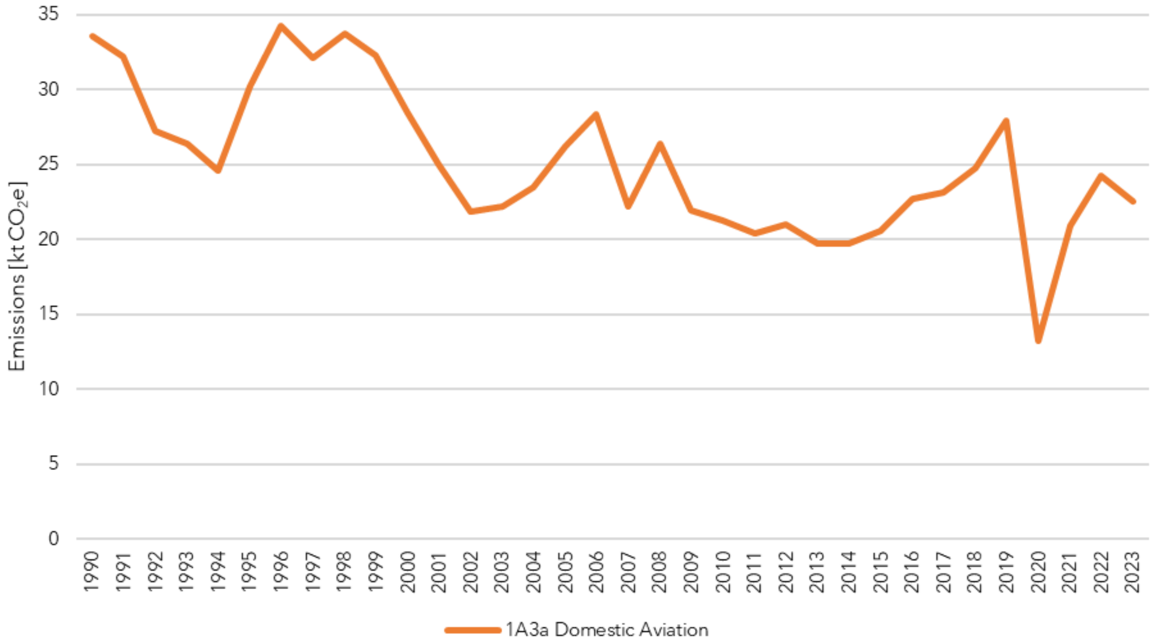


Figure 3.7 Emissions [kt CO_2e] from 1A3a Domestic Aviation.

3.3.2.4 Recalculations

Recalculations for the 2025 Submission

No recalculations were performed for this submission for this sector.

Recalculations for the 2024 Submission

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 CO_2 emissions from Domestic Aviation is 7% (with an activity data uncertainty of 5% and emission factor uncertainty of 5% (2006 IPCC Guidelines)), whilst the CH_4 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 N_2O 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 COPERT 5.8.1 which uses a Tier 3 methodology to estimate N_2O and CH_4 emissions, and a Tier 2 methodology to estimate CO_2 emissions. All emission factors in COPERT are from the 2006 IPCC guidelines and 2023 EMEP/EEA guidebook. These factors are default in COPERT if country-specific data is not available.

3.3.3.1 Activity Data

Total use of diesel oil, gasoline, and biofuels in Road Transport are based on the annual sales statistics and can be found in Table 3.50 with the use of hydrogen and electricity.

Table 3.50 Fuel use [kt] and [GWh] in Road Transport.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Gasoline	67.1	118	143	157	148	132	91.6	91.8	93.9
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	197	193
Biomethane	NO	NO	0.00600	0.0390	0.595	2.18	1.44	1.56	1.57
Biodiesel	NO	NO	NO	NO	NO	11.9	13.0	4.2	2.92
Biogasoline	NO	NO	NO	NO	NO	1.93	11.04	20.6	20.7
Hydrogen	NO	NO	NO	9.00E-06	0.00215	NO	4.15E-04	2.51E-03	2.14E-03
Electricity [GWh]	NO	NO	NO	NO	NO	1.92	28.42	60.92	90.86

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

Activity Data for COPERT

A comprehensive dataset was purchased from Emisia[20], the company that develops COPERT. That data was used where country-specific data was not available.

The country-specific data that was available and used for input into COPERT was:

- Average temperature values were obtained from the Icelandic Met Office (*Veðurstofa Íslands*).
- Vehicle stock numbers from 2017 were obtained from the Icelandic Transport Authority. For other years, vehicle numbers from the Emisia dataset were used.
- Measurements collected by the IEEA for energy content, density, and sulphur content for fuels were used where available.
- Total fuel sales for all fuels were obtained from sales statistics collected for the whole times series.
- Measurements of carbon content (%C/%H/%O) in gasoline and diesel oil used in Road Transport were done from fuel samples from 2019, 2020, and 2021. The 2019 value was applied for 1990-2019 and the 2021 value was applied for the years after 2021. The measurements for gasoline were done on 5% blended fuel. A correction was made before emissions were calculated so that the carbon content represents pure fossil gasoline.

[20] https://www.emisia.com/utilities/copert-data/

3.3.3.2 Emission Factors

Emissions from Road Transportation are estimated using COPERT 5.8.1, which uses a Tier 3 methodology to estimate N_2O and CH_4 emissions, and a Tier 2 methodology to estimate CO_2 emissions. An energy balance feature in COPERT was used to ensure that emissions from all fuel sold was accounted. The emission factors can be seen in Table 3.51.

Table 3.51 Emission factors used for calculations emissions from Road Transport.

Fuel / Factor	1990-2015	2016	2017	2018	2019	2020	2021	2022	2023
Gasoline									
NCV [TJ/kt][1]	44.3	44.3	44.0	43.7	43.9	43.9	44.0	44.1	43.6
C-content [t/TJ][2]	19.5	19.5	19.7	19.8	19.7	19.8	19.8	19.8	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 after 2021. (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 CH_4 and N_2O are from Chapter *1.A.3.b.i-iv Road Transport 2023* in the 2023 EMEP/EEA Guidebook. There it can be seen that with improved technology in vehicles, the emission factor decreases, which explains the decrease in IEFs for CH_4 and N_2O 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 into the biomass category. Before 2012, biomethane was the only fuel reported as biomass. In 2012, biodiesel was introduced and increased the first years after, and in 2015 bioethanol was introduced as biofuel in Iceland. These additions 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 steady until 2015. Partly due to increased tourism, emissions started increasing again in 2016, but a drop in emissions were observed in 2020 due to the COVID pandemic. In 2021, there is a slight increase observed due to the post-pandemic economic recovery followed by a significant increase in 2022 and decrease in 2023. The emissions can be seen in Table 3.52 and Figure 3.8.

Only CH_4 and N_2O emissions from biofuels are included in the national totals, whereas CO_2 emissions are reported as a memo item under CRT category 1D3.

Table 3.52 Emissions from subcategories and total emissions [kt CO_2e] from 1A3b Road Transport.

Sector	1990	1995	2000	2005	2010	2015	2020	2022	2023
1A3bi Passenger Cars	413	444	490	577	577	527	559	580	570
1A3bii Light-duty Trucks	29.4	30.8	35.2	52.8	93.9	74.7	87.2	102.5	103
1A3bii Heavy-duty Trucks and Buses	86.0	80.3	87.5	142	134	216	182	243	247
1A3biv Motorcycles	2.38	2.55	2.69	3.45	9.40	9.66	1.27	1.21	1.22
Total [kt CO_2e]	**531**	**558**	**616**	**775**	**815**	**827**	**830**	**926**	**921**

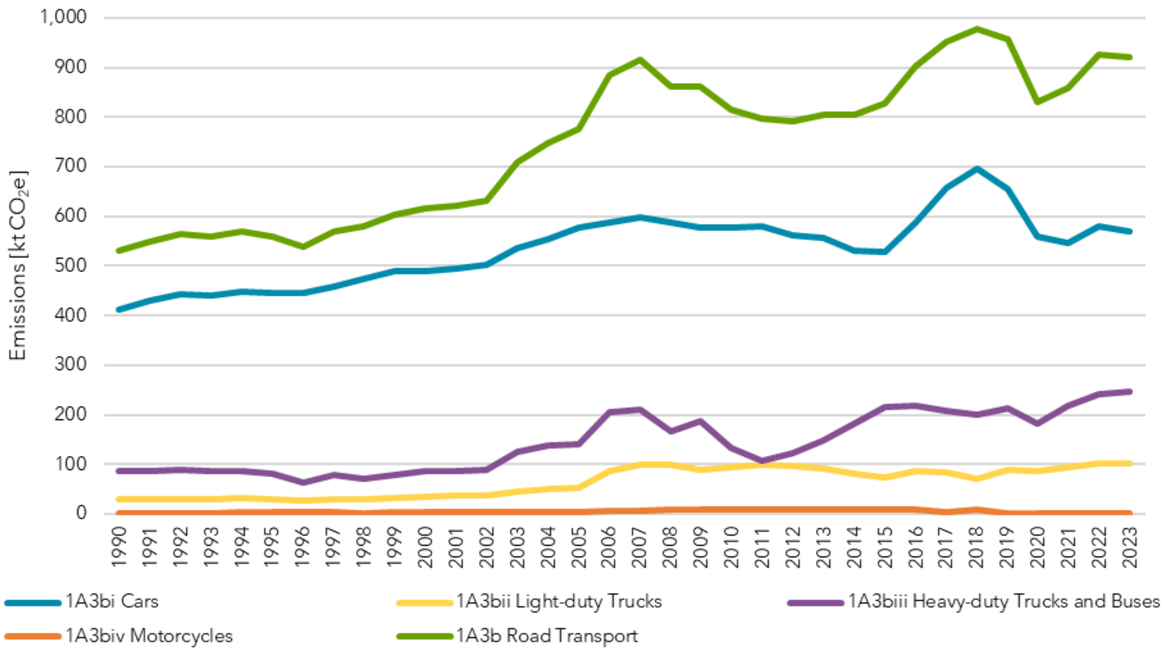


Figure 3.8 Emissions from subcategories and total emissions [kt CO_2e] from 1A3b Road Transport.

3.3.3.4 Recalculations

Recalculations for the 2025 Submission

With the latest version of COPERT some methodological changes were done based on new data and measurements. These changes are based on the September 2023 update and September 2024 update of COPERT (documentation on these changes can be found on the website of Emisia[21]). The main updates include the following:

2023 update: Euro VI diesel buses

The most influential change which effects the emissions of greenhouse gases is the change in energy consumption of Euro VI diesel buses. Based on new data the energy consumption of Euro VI diesel buses is higher at greater speeds that previously reported. This causes more fuel consumption for that vehicle type which then also causes less fuel consumption for other vehicle types because of the fuel balance.

[21] September 2023 update: https://copert.emisia.com/wp-content/uploads/2023/09/COPERT-v5.7-Report.pdf

September 2024 update: https://copert.emisia.com/wp-content/uploads/2024/10/What-is-new-in-COPERT-v5.8.pdf

The emissions are calculated based on the fuel consumption and therefore this change causes recalculations for all vehicle that use diesel. Euro VI diesel buses were introduced into the vehicle fleet in 2014 and therefore the recalculations are for all years from 2014.

2023 update: Euro 6 CNG passenger cars

Another methodological change in COPERT based on new data was fuel consumption of medium sized Euro 6 d-temp diesel passenger cars. Based on new measurements the fuel consumption for this vehicle type is less that what was previously reported. Therefore the emissions reported are also lower. This vehicle type was introduced into the car fleet in 2019 and therefore this has an impact on the recalculations from that year.

2024 update: Euro 6 HEV/PHEV cars

Passenger cars with Euro standard 6 using petrol were revised. The energy consumption was affected. Euro 6 HEV/PHEV cars were introduced into the car fleet in 2012 and therefore this has an impact on the recalculations from that year.

2024 update: Euro 5 motorcycles

Motorcycles with Euro standard 5 using petrol were revised. The energy consumption and the methane emissions were affected. Euro 5 motorcycles were introduced into the car fleet in 2020 and therefore this has an impact on the recalculations from that year.

Total recalculations

These reasons cause recalculations for all vehicle types. Also, it was believed that imported biodiesel was partly FAME since 2021, which has a fossil component. This was corrected and the FAME percentage was changed from 6.8% to 0% as all the data found only shows imports of HVO. That causes recalculations of emissions of Other Fossil Fuels in the years 2021 and 2022. The summary of the recalculations can be found in the table below:

Table 3.53 Summary of Road Transport recalculations done for this submission [kt CO_2e].

1A3b Road Transport	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2]	520	546	602	761	806	820	823	851.69	917.27
2025 submission [kt CO_2]	520	546	602	761	806	820	823	851.60	918.04
Change relative to the 2024 submission [kt CO_2]	0.00	0.00	0.00	0.00	0.00	5.3E-06	3.0E-04	-0.09	0.77
Change relative to the 2024 submission [%]	0%	0%	0%	0%	0%	6.5E-7%	3.6E-5%	-0.010%	0.084%
2024 submission [kt CH_4]	6.24	5.65	4.23	3.317	2.34	1.92	1.09	1.11	1.17
2025 submission [kt CH_4]	6.24	5.65	4.23	3.332	2.36	1.84	0.78	0.77	0.79
Change relative to the 2024 submission [kt CH_4]	0.00	0.00	0.00	0.015	0.02	-0.07	-0.31	-0.35	-0.37
Change relative to the 2024 submission [%]	0%	0%	0%	0.5%	0.7%	-3.9%	-28%	-31%	-32%

1A3b Road Transport	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt N_2O]	4.65	6.83	9.81	10.92	5.69	5.31	6.20	6.79	7.19
2025 submission [kt N_2O]	4.67	6.84	9.82	10.94	5.73	5.36	6.21	6.82	7.18
Change relative to the 2024 submission [kt N_2O]	0.013	0.012	0.012	0.017	0.037	0.054	0.013	0.031	-0.006
Change relative to the 2024 submission [%]	0.29%	0.18%	0.12%	0.16%	0.65%	1.02%	0.20%	0.45%	-0.08%
2024 submission [kt CO_2e]	530.69	558.15	615.72	774.95	814.45	826.79	830.58	859.59	925.62
2025 submission [kt CO_2e]	530.70	558.16	615.73	774.99	814.51	826.77	830.29	859.19	926.01
Change relative to the 2024 submission [kt CO_2e]	0.013	0.012	0.012	0.032	0.054	-0.020	-0.294	-0.404	0.392
Change relative to the 2024 submission [%]	0.003%	0.002%	0.002%	0.004%	0.007%	-0.002%	-0.035%	-0.047%	0.042%

Recalculations for the 2024 submission

Two minor recalculations were done in the Road Transport sector for the 2024 submission.

Recalculations were made for 2016 due to an update from a default NCV for diesel oil to a country specific NCV for gas/diesel oil and for 2021 due to revised sales of biomethane by the NEA. The changes in emissions can be seen in Table 3.54.

Table 3.54 Summary of Road Transport recalculations done for this submission [kt CO_2e].

1A3b Road Transport	2016	2021
2023 Submission CH_4 [kt CO_2e]	1.843	1.12
2024 Submission CH_4 [kt CO_2e]	1.844	1.11
Change relative to the 2023 submission CH_4 [kt CO_2e]	0.001	-0.010
2023 Submission N_2O [kt CO_2e]	5.83	6.789
2024 Submission N_2O [kt CO_2e]	5.85	6.788
Change relative to the 2023 submission N_2O [kt CO_2e]	0.018	-0.001
2023 Submission [kt CO_2e]	901.88	859.60
2024 Submission [kt CO_2e]	901.90	859.59
Total change relative to the 2023 submission [kt CO_2e]	**0.019**	**-0.011**
Total change relative to the 2023 submission [%]	**0.0021%**	**-0.0013%**

3.3.3.5 Planned Improvements

For future submissions, further collaboration with the Icelandic Transport Authority will be needed to obtain more detailed information on vehicle stock numbers. This data would go further back in time and be split by Euro standards and driven kilometres for each vehicle category.

3.3.3.6 Uncertainties

Fuel sales uncertainties are estimated by IEEA to be within 5%. The CO_2 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 CH_4 and N_2O are estimated to be 236% and 192%, respectively. The emission factor uncertainties for CH_4 and N_2O 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 CO_2 emissions from road vehicles is 5.7%, CH_4 emissions it is 248% and for N_2O 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 3.55.

Table 3.55 Fuel use [in kt] in 1A3d Domestic Navigation.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Residual Fuel Oil	3.94	4.76	0.542	0.881	2.61	0.441	NO	NO	NO
Gas/Diesel Oil	6.40	7.04	3.43	6.20	8.46	7.89	7.83	7.68	5.27
Biodiesel	NO	NO	NO	NO	NO	NO	NO	NO	NO

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 3.56.

Table 3.56 Fuel use [in kt] in 1A4ciii Fishing.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
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	150	152
Biodiesel	NO	NO	NO	NO	NO	0.0940	0.0750	0.0317	NO

3.3.4.2 Emission Factors

Default C contents and oxidation factor are used, as well as default emission factors for CH_4 and N_2O (taken from the 2006 IPCC guidelines, Table 3.5.3, Volume 2, Chapter 3 for ocean-going ships). A country-specific NCV for gas/diesel oil is used from 2017 and onwards based on measurements, for other fuels and years a default NCV is used. These factors are presented in Table 3.57.

Table 3.57 Emission factors for CO_2, CH_4 and N_2O for ocean-going ships.

Fuel / Factor	Value	Unit	Reference
Marine Diesel Oil			
NCV	42.94*	TJ/kt	Table 1.2 2006 IPCC Guidelines, V2, Ch1, country-specific from 2016, based on measurements
C-content	20.09*	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_2O 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_2O 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_2O 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 is dominated by the Fishing sector. Emissions from the fishing sector has decreased by approximately a third over the time series. These emissions can be seen in Table 3.58.

Table 3.58 Emissions [kt CO_2e] from ocean-going ships.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
1A3d Domestic Navigation	32.9	37.5	12.7	22.6	35.3	26.6	25.2	24.5	16.8
1A4ciii Fishing	760	922	892	742	727	621	509	481	485
Total	**793**	**959**	**904**	**765**	**762**	**648**	**535**	**505**	**502**

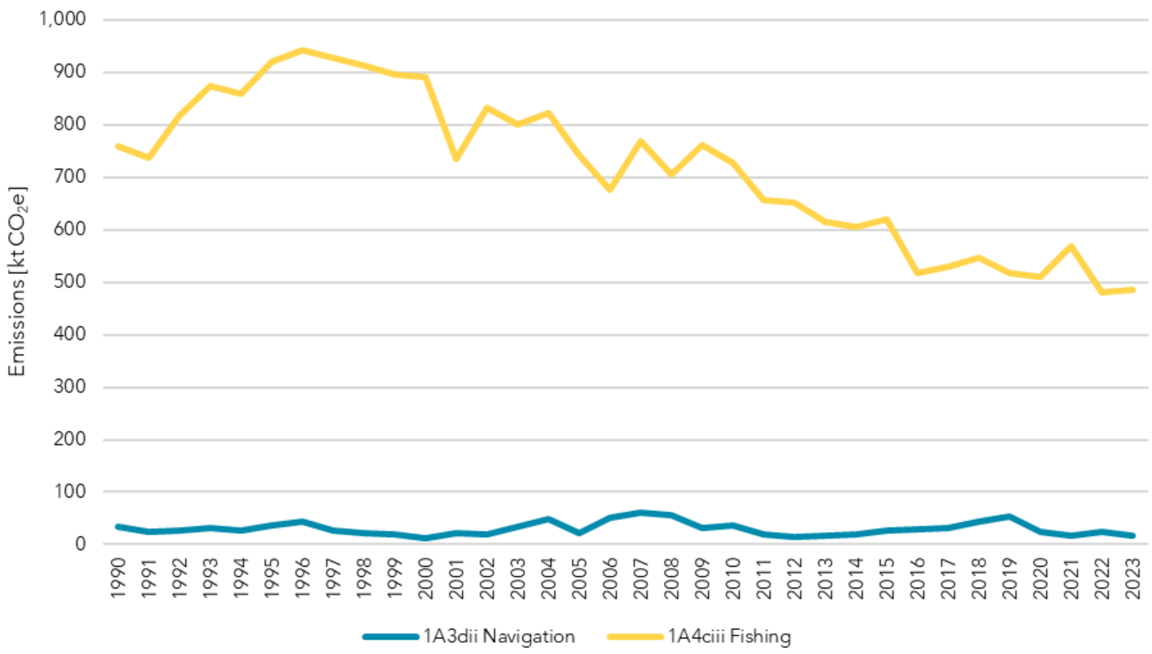


Figure 3.9 Emissions [kt CO_2e] from ocean-going ships for the whole time series.

3.3.4.4 Recalculations

Recalculations for the 2025 Submission

A more precise NCV for diesel was obtained for the years 2021 and 2022 resulting in recalculations in N_2O and CH_4 for these two years. Also, the C and H content of diesel for 2022 was updated. It is now assumed to be the same as in the year 2021 when the latest measurement was done but in the last submission it was assumed to be the average of the results of measurements of three years. The updates and corrections led to minor recalculations in both subsectors as can be seen in Table 3.59 and Table 3.60.

1A3d Domestic Navigation

Table 3.59 Recalculations in 1A3d between submissions.

1A3d Domestic Navigation	2021	2022
2024 submission [kt]	17.53115	24.595
2025 submission [kt]	17.53124	24.543
Change relative to the 2024 submission [kt]	0.00009	-0.052
Change relative to the 2024 submission [%]	0.00050%	-0.211%

1A4ciii Fishing

Table 3.60 Recalculations in 1A4ciii between submissions.

1A4ciii Fishing	2021	2022
2024 submission [kt]	569.419	481.52
2025 submission [kt]	569.421	480.50
Change relative to the 2024 submission [kt]	0.0028	-1.02
Change relative to the 2024 submission [%]	0.00050%	-0.21%

Recalculations for the 2024 Submission

1A3d Domestic Navigation

There were three reasons for recalculations in this sector for the 2024 submission. The first reason is that the country-specific NCV for diesel not being included for the year 2016 in the previous submission. The second reason relates to emission factors for CH_4 and N_2O from biodiesel. The previously used emissions factors were incorrectly for stationary fishing, affecting 2017 and 2019. This has now been corrected. Finally, for 2021 there was a reallocation of fuel by the NEA between domestic and international usage.

Table 3.61: Recalculations in 1A3dii Domestic Navigation between submissions.

1A3dii Domestic Navigation	2016	2017	2019	2021
2023 submission [kt CO_2e]	27.8268	31.6432507	53.202634	17.515
2024 submission [kt CO_2e]	27.8180	31.6432584	53.202641	17.531
Change relative to the 2023 submission [kt CO_2e]	0.00124	0.00000775	0.00000775	0.0160
Change relative to the 2023 submission [%]	0.00445%	0.0000245%	0.0000146%	0.0912%

1A4ciii Fishing

There were three reasons for recalculations in this sector for the 2024 submission. The first reason is that the country-specific NCV for diesel not being included for the year 2016 in the previous submission. The second reason relates to emission factors for CH_4 and N_2O from biodiesel. The previously used emissions factors were incorrectly for stationary fishing, affecting all years from 2013-2021, except for 2018. This has now been corrected. Finally, for 2021 there was a reallocation of fuel by the NEA between domestic and international usage.

Table 3.62: Recalculations in 1A4ciii Fishing between submissions.*

1A4ciii Fishing	2013	2016	2020	2021
2023 submission [kt CO_2e]	614.7228	518.7468	509.4936	574.18
2024 submission [kt CO_2e]	614.7235	518.7669	509.4942	569.42
Change relative to the 2023 submission [kt CO_2e]	0.000697	0.0201	0.000581	-4.76
Change relative to the 2023 submission [%]	0.00011%	0.00387%	0.000114%	-0.83%

* The table only show the first year, second last year and last year and 2016 of the recalculations

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 CH_4 and N_2O this subcategory.

3.3.4.6 Uncertainties

Fuel sales uncertainties are estimated by IEEA to be within 5%. The uncertainty of CO_2 emissions from domestic navigation is 7% (with an activity data uncertainty of 5% and emission factor uncertainty of 5%), whilst the CH_4 emissions uncertainty is 50% (with an activity data uncertainty of 5% and emission factor uncertainty of 50%) and the N_2O 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 or from 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. 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 use attributed to International Aviation are shown in Table 3.63.

Table 3.63 Fuel use [in kt] from International Aviation.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Jet Kerosene	69.4	74.6	129	133	120	214	82.9	269	305
Gasoline	0.199	0.184	0.0320	0.396	0.0100	0.00900	NO	NO	NO

3.3.5.2 Emission Factors

Emission factors for International Aviation are reported in Table 3.48.

3.3.5.3 Emissions

The greenhouse gas emissions are shown in Table 3.64.

Table 3.64 Resulting emissions [greenhouse gases, in kt CO_2e] from International Aviation.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Emissions [kt CO_2e]	221	238	410	424	380	679	263	855	968

3.3.5.4 Recalculations

Recalculations for the 2025 Submission

Updated activity data for jet kerosene for 2021-2022 resulted in recalculations for these two years as can be seen in Table 3.65.

Table 3.65 Recalculations in 1D1a between submissions.

1D1a International Aviation	2021	2022
2024 submission [kt CO_2e]	415.35	736.44
2025 submission [kt CO_2e]	486.14	854.75
Change relative to the 2024 submission [kt CO_2e]	70.79	118.30
Change relative to the 2024 submission [%]	17.0%	16.1%

Recalculations for the 2024 Submission

No recalculations were performed 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 CO_2 emissions from aviation is 7% (with an activity data uncertainty of 5% and emission factor uncertainty of 5% (2006 IPCC Guidelines)), whilst the CH_4 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 N_2O emissions uncertainty is 200% (with an activity data uncertainty of 5% and emission factor uncertainty of 200%). 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 3.66.

Table 3.66 Fuel use [in kt] from International Navigation.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Residual Fuel Oil	0.252	NO	2.00	0.438	0.0800	13.2	NO	7.53	6.23
Gas/Diesel Oil	8.53	1.05	15.0	0.116	NO	33.6	24.3	82.5	98.0

3.3.6.2 Emission Factors

Emission factors for International Navigation are reported in Table 3.57.

3.3.6.3 Emissions

Emission factors for International Aviation are reported in Table 3.67.

Table 3.67 Resulting emissions [greenhouse gases, in kt CO_2e] from International Navigation.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Emissions [kt CO_2e]	28.1	3.37	54.4	1.75	0.252	149	77.9	287	333

3.3.6.4 Recalculations

Recalculations for the 2025 Submission

A more precise NCV for diesel was obtained for the years 2021 and 2022 resulting in recalculations in N_2O and CH_4 for these two years. Also, the C and H content of diesel for 2022 was updated. It is now assumed to be the same as in the year 2021 when the latest measurement was done but in the last submission it was assumed to be the average of the results of measurements of three years. The updates and corrections led to minor recalculations as can be seen in Table 3.68.

Table 3.68 Recalculations in 1D1b between submissions.

1D1b International Navigation	2021	2022
2024 submission [kt CO_2e]	128.49657	287.79
2025 submission [kt CO_2e]	128.49715	287.23
Change relative to the 2024 submission [kt CO_2e]	0.00058	-0.56
Change relative to the 2024 submission [%]	0.00045%	-0.19%

Recalculations for the 2024 Submission

There were two reasons for recalculations in this sector for the 2024 submission. The first reason is the country-specific NCV for diesel not being included for the year 2016 in the previous submission. The second reason is that for 2021 there was a reallocation of fuel by the NEA between domestic and international usage.

Table 3.69 Recalculations for 1A3d Domestic Navigation between submissions.

1A3di(i) International Navigation (memo item)	2016	2021
2023 Submission [kt CO_2e]	186.2811	123.7
2024 Submission [kt CO_2e]	186.2861	128.5
Change relative to the 2023 Submission [kt CO_2e]	0.00499	4.75
Change relative to the 2023 Submission [%]	0.00268%	3.84%

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 CO_2 emissions from navigation is 7% (with an activity data uncertainty of 5% and emission factor uncertainty of 5% (2006 IPCC Guidelines)), whilst the CH_4 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 N_2O emissions uncertainty is 200% (with an activity data uncertainty of 5% and emission factor uncertainty of 200%). 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)

This sector includes emissions from distribution of oil products, which in Iceland includes distribution of gasoline, jet kerosene, gas/diesel oil, residual fuel oil, and LPG.

3.4.1.1 Activity Data

Activity data is the total fuel sold and is provided in Table 3.73.

Table 3.70 Fuel use [in kt] from distribution of oil products.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Gasoline	67	118	143	157	148	132	92	92	94
Gasoline, lead	60.7	18.0	-	-	-	-	-	-	-
Jet Kerosene	78.3	83.0	137	141	126	220	86.9	276	311
Gas/Diesel oil	309	335	404	386	318	353	386	480	485

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Residual Fuel Oil	99	121	71.1	59.1	89.1	76	1.2180	10.24	8.15
LPG	1.19	1.15	2.03	2.35	2.64	2.14	2.52	3.06	3.32

3.4.1.2 Emission Factors

The emission factors are taken from Table 4.2.4 in the 2006 IPCC GL. These emission factors can be seen in Table 3.71. Currently, N_2O emissions are however not included in national totals since it cannot be entered into the CRT.

Table 3.71 Emission factors for 1B2a5 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 Cards
CH_4 emission factor	2.50E-05	Gg per 1,000 m^3 total oil transported	Table 4.2.4 2006 IPCC Guidelines Tanker Trucks and Rail Cards
N_2O emission factor	NA		Table 4.2.4 2006 IPCC Guidelines Tanker Trucks and Rail Cards
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		Table 4.2.4 2006 IPCC Guidelines Liquefied Petroleum Gas
N_2O emission factor	2.20E-09	Gg per 1,000 m^3 total LPG	Table 4.2.4 2006 IPCC Guidelines Liquefied Petroleum Gas

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 3.72.

Table 3.72 Resulting greenhouse gas emissions [in kt CO_2e] from distribution of oil products.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Emissions [kt CO_2e]	0.520	0.570	0.642	0.635	0.581	0.666	0.484	0.733	0.768

3.4.1.4 Recalculations

Recalculations for the 2025 Submission

In the previous submissions, the activity data was the total imported fuel. It is now the total fuel sold which is considered to be more representative of oil distributed. This caused recalculations for the whole timeline as can be seen in the table below.

Table 3.73 Summary of recalculations done for this submission [kt CO_2e].

1B2av Oil Distribution	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	0.55	0.56	0.67	0.67	0.55	0.68	0.50	0.54	0.78
2025 submission [kt CO_2e]	0.52	0.57	0.64	0.64	0.58	0.67	0.48	0.58	0.73
Change relative to the 2024 submission [kt CO_2e]	-0.03	0.01	-0.03	-0.03	0.03	-0.02	-0.02	0.04	-0.05
Change relative to the 2024 submission [%]	-5.0%	2.0%	-4.7%	-5.1%	5.0%	-2.6%	-3.4%	7.0%	-6.5%

Recalculations for the 2024 Submission

No recalculations were performed for this sector.

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 IEEA to be 5%. Emission factor uncertainties are 5% for CO_2 (2006 IPCC Guidelines default) and 100% for CH_4 (central value for the default range given in the 2006 IPCC Guidelines). When combining the AD and EF uncertainties, total uncertainty is 7% for CO_2 and 100% for CH_4. 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, including (as of 2023) two power plants, one heat plant and five combined heat and power plants (CHP 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 CO_2, small amounts of methane and considerable quantities of sulphur in the form of hydrogen sulphide (H_2S) are emitted from geothermal power plants. The H_2S values are stoichiometrically converted to SO_2 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 CO_2, CH_4, and H_2S emissions from CHP plants, electric power plants, and one heat plant.

Table 3.74 shows the electricity production with geothermal energy and the total CO_2, CH_4 (in CO_2e), and H_2S emissions (in SO_2e).

Table 3.74 Electricity production and emissions from geothermal energy in Iceland.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Electricity Productions [GWh]	283	290	1,323	1,658	4,465	5,003	5,961	5,916	6,006
CO_2 emissions [kt]	61.4	82.2	153	118	190	163	175	174	172
CH_4 emissions [kt CO_2e]	0.22	0.22	1.02	1.28	5.12	4.42	4.32	4.23	4.51
H_2S emissions [kt SO_2e]	13.3	11.0	26.0	30.3	58.7	42.4	39.3	37.1	33.7

3.4.2.2 Method Approach

The CO_2 concentration in the geothermal steam is site- and time-specific and can vary greatly with time, as well as between areas and within a given.

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 CH_4 and H_2S are also calculated in a similar way that CO_2 is calculated, e.g., based on chemical measurements. H_2S has been measured for the whole time series. Methane has been measured consistently at most plants from 2008. Based on the measurements from 2008-2016 an average methane emission factor was calculated and used for the years where no information has been provided. The emission factors used for 1990-2007 is 27.6 kg/GWh.

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*, has been pioneering CO_2 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 CO_2. The CO_2 captured and injected can be seen in Table 3.75. A sister project, *SulFix*, consists of separating H_2S from the stream and also reinjecting the gas into the subsurface and mineralizing on contact with the basalt host rock.

Table 3.75 Amount of CO_2 captured and injected using the Carbfix method.

	2012	2014	2015	2016	2017	2018	2019	2020	2022	2023
CarbFix – Mineralised [kt CO_2]	-0.055	-2.38	-3.91	-6.64	-10.2	-12.2	-9.7	-11.7	-12.1	-12.3

At the George Olah Renewable Methanol Plant in *Svartsengi*, on the Reykjanes peninsula in southwest Iceland, Carbon Recycling International recycled part of the CO_2 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.

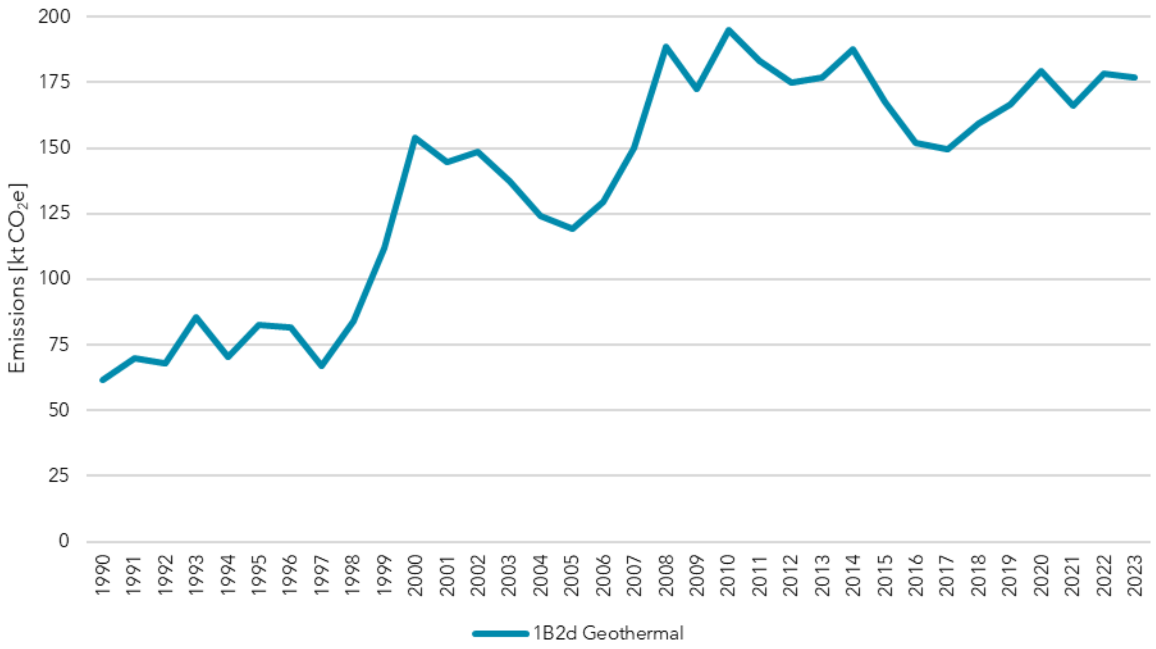


Figure 3.10 Emissions from 1B2d Geothermal Power.

3.4.2.4 Recalculations

Recalculations for the 2025 Submission

Recalculations were performed for CH_4 and CO_2 emission in this sector for the 2025 submission. For 2021 and 2022 emission number were updated based on error in the calculations. This caused a change in the emissions for 2021 and 2022.

Table 3.76 Summary of recalculations done for this submission [kt CO_2e].

	2021	2022
2024 submission [kt CO_2e]	179.7	190.3
2025 submission [kt CO_2e]	166.4	178.1
Change relative to the 2024 submission [kt CO_2e]	-13.32	-12.12
Change relative to the 2024 submission [%]	-7.4%	-6.4%

Recalculations for the 2024 Submission

No recalculations were performed for this sector.

3.4.2.5 Planned Improvements

No improvements are planned for this sector.

3.4.2.6 Uncertainties

CO_2 and CH_4 emissions have an uncertainty of 10% for the CO_2 values, and of 25% for the CH_4 values. The complete uncertainty analysis is shown in Annex 2.

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

3.5.1 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 is likely to be within ±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 ±5% (Table 3.77). 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 ±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 3.77 Apparent consumption for the Reference and Sectoral Approaches.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Liquid fuels									
Sectoral Approach (TJ)	23,090	25,726	26,313	26,649	24,289	22,555	19,871	21,703	21,257
Reference Approach (TJ)	23,629	23,682	24,131	24,721	21,776	22,588	20,293	23,004	22,503
Difference (%)	2.3%	-7.9%	-8.3%	-7.2%	-10.3%	0.1%	2.1%	6.0%	5.9%
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	186	168
Reference Approach (TJ)	NO	16	21	21	36	NO	NO	NO	NO
Difference (%)	-	-92%	-92%	-78%	-60%	-100%	-100%	-100%	-100%
Total									
Sectoral Approach (TJ)	23,570	26,166	26,919	26,999	24,473	22,619	19,886	21,889	21,425
Reference Approach (TJ)	23,964	23,879	24,513	25,103	21,915	22,588	20,293	23,004	22,503
Difference (%)	1.67%	-8.7%	-8.9%	-7.0%	-10.5%	-0.1%	2.0%	5.1%	5.0%

The aggregated discrepancy between the RA and SA apparent consumption has exceeded the IPCC guideline of ±5% twice in 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.

3.5.2 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 (CRF 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 Green Accounting (according to Icelandic regulation No 851/2002) 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.

NF_3 is reported in the Icelandic Inventory as “NO” or “NA.” The Chemical Unit of the IEEA has confirmed that NF_3 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 NF_3 (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
2B10	Fertiliser Production (until 2001)	N_2O	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

CRT	Sector name	Reported emissions	Method	Emission factor
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 1	D
2D3b	Road paving w. asphalt	CO_2	Tier 1	D
2D3d	Coating applications	CO_2	Tier 2	D
2D3e	Degreasing	CO_2	Tier 1	D
2D3f	Dry cleaning	CO_2	Tier 2	D
2D3g	Paint manufacturing	CO_2	Tier 2	D
2D3h	Printing	CO_2	Tier 1	D
2D3i	Other: Creosote	CO_2	Tier 2	D
2D3i	Other: Organic preservatives	CO_2	Tier 2	D
2D3i	Other: De-icing	CO_2	Tier 2	D
2D3	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
2G2	SF_6 and PFCs from Other Product Use	SF_6	Tier 2	CS
2G3	N_2O from Product Use	N_2O	D	D
2G4	Other: Tobacco consumption	CH_4	Tier 2	OTH
2G4	Other: Tobacco consumption	N_2O	Tier 2	OTH
2G4	Other: Fireworks use	CO_2	Tier 2	OTH
2G4	Other: Fireworks use	CH_4	Tier 2	OTH
2G4	Other: Fireworks use	N_2O	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 4.4 (compared to total emissions with LULUCF).

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

IPCC source category		Gas	Level 1990	Level 2023	Trend
IPPU (CRT sector 2)					
2A1	Mineral Industry - Cement	CO_2	✓		✓
2B10	Fertiliser Production	N_2O	✓		✓
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 2023	Trend
IPPU (CRT sector 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).

	Greenhouse gases						Indirect Greenhouse Gases			
Sector	CO_2	CH_4	N_2O	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]
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									

Sector	Greenhouse gases						Indirect Greenhouse Gases			
	CO_2	CH_4	N_2O	HFC	PFC	SF_6	NO_x	CO	NMVOC	SO_2
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
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 OCCURRING**									
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										

Sector	Greenhouse gases						Indirect Greenhouse Gases			
	CO_2	CH_4	N_2O	HFC	PFC	SF_6	NO_x	CO	NMVOC	SO_2
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_2O 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] CO_2 emissions linked to process use of soda ash are included in 2B10 Diatomite production (Diatomite production stopped in 2004)

[2] CO_2 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 CO_2 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 N_2O 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 CO_2 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 IEEA 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 CO_2 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 CO_2 emissions. Emissions are thus corrected with plant specific cement kiln dust correction factor.

Equation 2.2

$$CO_2\ Emissions = M_{cl} * EF_{cl} * CF_{ckd}$$

Where:

- CO_2 Emissions = emissions of CO_2 from cement production, tonnes
- M_{cl} = weight (mass) of clinker production, tonnes
- EF_{cl} = clinker emission factor, tonnes CO_2/tonnes clinker; EF_{cl} = 0.785 × 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 CO_2 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 CO_2 IEF between 2010 and 2011.

4.2.1.2 Recalculations

Recalculations for the 2025 Submission

No category-specific recalculations were done for this submission.

Recalculations for the 2024 Submission

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 CO_2e/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 CO_2e/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, EF and NCV, as well as C-content of shell sand. Emissions of CO_2 are calculated from the carbon content and the amount of shell sand and electrodes used in the production process. Emissions of SO_2 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 0.97 kt CO_2e in 2023. Fluctuations in greenhouse gas emissions reflect fluctuations in annual production.

Recalculations

Recalculations for the 2025 Submission

No category-specific recalculations were done for this submission.

Recalculations for the 2024 Submission

No category-specific recalculations were done for this submission.

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. CO_2 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 CO_2 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 CO_2. The CO_2 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 CO_2 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. CO_2 emissions from the silicic sludge derive from organic carbon and therefore are not included in the totals. CO_2 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 CO_2 emissions ranged from 0.24 to 0.49 kt CO_2, and the annual NO_x emissions ranged from 0.31 to 0.48 kt NO_x.

Recalculations

Recalculations for the 2025 Submission

No category-specific recalculations were done for this submission.

Recalculations for the 2024 Submission

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 CO_2 emission factor uncertainty was estimated to be 10%, leading to a combined uncertainty of 11%. The complete uncertainty analysis is shown in Annex 2.

4.3.10.2Fertiliser 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. CO_2 and CH_4 emissions are considered insignificant, as the fertiliser plant used H_2 produced on-site by electrolysis.

Methodology

NO_x and N_2O emissions were reported directly by the factory to the IEEA.

Recalculations

Recalculations for the 2025 Submission

No category-specific recalculations were done for this submission.

Recalculations for the 2024 Submission

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 N_2O 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 CO_2 emissions amounted between 0.34 and 0.83 kt CO_2 during the years of operation (2014-2016).

Methodology

CO_2 emissions are calculated using production data provided by the plant in their annual Green Accounting reports, 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 EFs for Electric Arc Furnaces in the 2023 EMEP/EEA Guidebook (EEA, 2023).

Recalculations

Recalculations for the 2025 Submission

No category-specific recalculations were done for this submission.

Recalculations for the 2024 Submission

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 CO_2 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

CO_2 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 CO_2 per tonne limestone, assuming the fractional purity of the limestone is 1.

CH_4 emissions are calculated using the Tiers 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 CO_2e] from the production of ferroalloys.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Electrodes, Casings, and Paste	3.8	3.9	5.7	6.0	4.8	4.9	4.8	5.4	4.7
Carbon Blocks	NO	NO	NO	NO	NO	0.12	0.28	0.10	0.03
Anthracite/Coking Coal	45.1	52.4	73.2	86.9	96.1	115	129	165	128
Coke Oven Coke	24.9	30.1	46.6	42.6	30.3	30.9	23.5	21.7	19.8
Charcoal	NO	NO	NO	2.1	NO	NO	1.7	9.8	14.0
Wood	16.7	7.7	16.2	15.6	11.3	27.2	59.9	100	72
Limestone	NO	NO	0.47	1.62	0.50	2.19	0.95	3.01	2.08
FeSi, Silicon Metal Production	62.8	71.4	109	111	102	118	116	144	128
Total Emissions [kt CO_2e]	**211**	**246**	**366**	**380**	**373**	**404**	**419**	**518**	**408**

Plant- and year specific emission factors for CO_2 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 Green Accounting 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 CO_2 per tonne Ferrosilicon in 1998, to 3.7 tonne CO_2 per tonne Ferrosilicon in 2018. The CH_4 emission factor is the default value for FeSi75 production in furnaces operating in sprinkle-charging mode (1 kg CH_4/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 CH_4/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 CO_2, with CH_4 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 CO_2/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

CO_2 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.

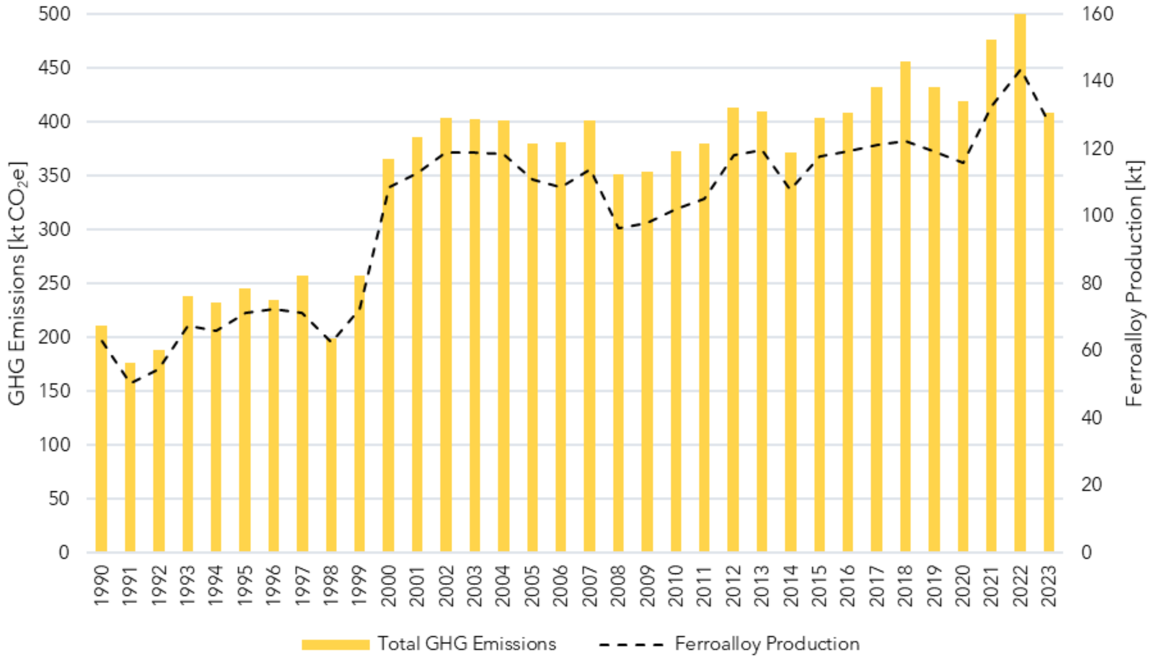


Figure 4.1 Total greenhouse gas emissions (CO_2 and CH_4) from the Ferroalloy production [kt CO_2e], and annual production [kt].

4.4.2.3 Recalculations

Recalculations for the 2025 Submission

No category-specific recalculations were done for this submission.

Recalculations for the 2024 Submission

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 CO_2 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 CH_4 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 CH_4. 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 CO_2 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 CO_2 originate from the consumption of electrodes during the electrolysis process, whereas 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.

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 IEEA 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, CO_2 and PFC emissions, IEF for CO_2 and PFC since 1990.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Primary Aluminium Production [kt]	87.8	100	226	272	819	857	831	840	866
CO_2 emissions [kt]	139	154	353	417	1,238	1,300	1,261	1,282	1,335
PFC emissions [kt CO_2e]	445	62.4	135	27.7	154	93.2	67.5	71.7	68.1
CO_2 [t/t Al]	1.58	1.54	1.56	1.53	1.51	1.52	1.52	1.53	1.54
PFC [t CO_2e/t Al]	5.06	0.623	0.595	0.102	0.189	0.109	0.081	0.09	0.08
Total emissions [kt CO_2e]	**584**	**216**	**488**	**445**	**1,392**	**1,393**	**1,329**	**1,354**	**1,403**

CO_2 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

$$E_{CF4} = S_{CF4} * AEM * MP$$

and

$$E_{C2F6} = E_{CF4} * F_{C2F6/CF4}$$

Where:

- E_{CF4} = emissions of CF_4 from aluminium production, kg CF_4
- E_{C2F6} = emissions of C_2F_6 from aluminium production, kg C_2F_6
- S_{CF4} = 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
- $F_{C2F6/CF4}$ = 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.

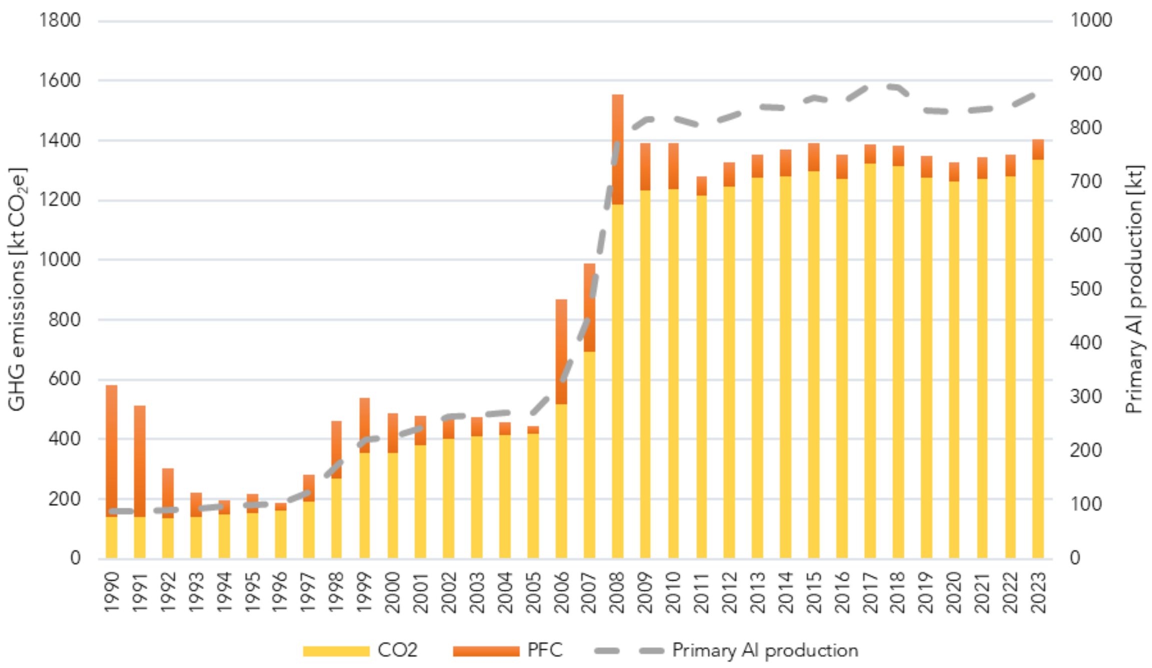


Figure 4.2: GHG emissions (CO_2 and PFC) from primary Al production [kt CO_2e], and annual production [kt].

Category-specific QA/QC and Verification

CO_2 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

Recalculation for the 2025 Submission

An updated slope factor was used to estimate the CF_4 and C_2F_6 emissions of a plant using the “slope method” for PFC emission estimation, resulting in recalculations of CF_4 and C_2F_6 emissions for the years 2019, 2020, and 2021.

Table 4.8 Comparison between the 2024 Submission and the 2025 Submission for CF_4, C_2F_6, and total PFC CO_2 equivalent emission from Aluminium production (2C3) for 2019-2021.

2C3, Aluminium Production	2019	2020	2021
2024 submission CF_4 [t]	11.5	11.3	11.7
2025 submission CF_4 [t]	9.52	8.90	9.66
Change relative to the 2024 submission CF_4 [t]	-1.97	-2.43	-2.06
Change relative to the 2024 submission CF_4 [%]	-17.1%	-21.4%	-17.6%
2024 submission C_2F_6 [t]	0.99	0.97	1.01
2025 submission C_2F_6 [t]	0.83	0.77	0.83
Change relative to the 2024 submission C_2F_6 [t]	-0.17	-0.20	-0.17
Change relative to the 2024 Submission C_2F_6 [%]	-16.7%	-21.0%	-17.2%
2024 submission PFC [kt CO_2e]	87.2	85.9	88.9
2025 submission PFC [kt CO_2e]	72.3	67.6	73.3
Change relative to the 2024 submission PFC [kt CO_2e]	-14.9	-18.4	-15.6
Change relative to the 2024 Submission PFC [%]	-17.1%	-21.4%	-17.5%

Recalculation for the 2024 Submission

No category-specific recalculations were done for the 2024 submission.

Planned Improvements

No improvements are currently planned for this category.

Uncertainties

The uncertainty of CO_2 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 CO_2 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.

CO_2 emissions from lubricant use have generally been following a decreasing trend since 1990: From 4.06 kt CO_2e in 1990, the emissions decreased to 1.87 kt CO_2e in 2009. Since 2010, the emissions have been rather stable or 2.3 kt CO_2e on average.

4.5.1.2 Recalculations

Recalculation for the 2025 submission

There were recalculations for the years 2002-2022 due to updated import/export data from Statistics Iceland, see Table 4.9.

Table 4.9 Recalculations in 2D1 Lubricant Use due to updated activity data between submissions.

2D1, Lubricant Use	2002	2005	2010	2015	2020	2021	2022
2024 submission CO_2 [kt]	3.552	3.630	2.448	2.575	2.175	2.109	2.222
2025 submission CO_2 [kt]	3.540	3.591	2.371	2.537	2.098	2.092	2.202
Change relative to 2024 submission CO_2 [kt]	-0.012	-0.038	-0.077	-0.038	-0.076	-0.017	-0.020
Change relative to 2024 submission CO_2 [%]	-0.3%	-1.1%	-3.2%	-1.5%	-3.5%	-0.8%	-0.9%

Recalculation for the 2024 submission

There were recalculations for the years 2002-2021 due to updated import/export data from Statistics Iceland, see Table 4.10.

Table 4.10 Recalculations in 2D1 Lubricant Use due to updated activity data between submissions.

2D1, Lubricant Use	2002	2005	2010	2015	2020	2021
2023 submission CO_2 [kt]	3.54	3.59	2.37	2.54	2.10	2.09
2024 submission CO_2 [kt]	3.55	3.63	2.45	2.57	2.17	2.11
Change relative to 2023 submission CO_2	0.36%	1.1%	3.3%	1.5%	3.6%	0.79%

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, CH_4 and N_2O emissions are possible but no default methodology for estimating those is provided, therefore those emissions are marked as "NA" in the CRT tables.

The emissions from Paraffin Wax Use are estimated to be 0.17 kt CO_2 in 1990 and 0.28 kt CO_2 in 2023.

4.5.2.1 Methodology

CO_2 emissions from paraffin wax use are calculated using equation 5.4 (Tier 1), Volume 3, in the IPCC 2006 guidelines.

Equation 5.4

$$\mathrm{CO_2\ Emissions} = \mathrm{PW} * \mathrm{CC_{wax}} * \mathrm{ODU_{wax}} * 44/12$$

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 CCWax factor of 20.0 kg C/GJ (on a Lower Heating Value basis) and the default ODUWax 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:

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

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 2024 (chapter 4.5.2 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

Recalculation for the 2025 Submission

There was recalculation for the years 1995-2022. The recalculation was due to updated import/export data of candles from Statistics Iceland, see Table 4.11.

Table 4.11: Comparison between the 2024 submission and the 2025 submission for CO_2 emission from Paraffin Wax Use (2D2) for the years 1995-2022.

2D2, Paraffin Wax Use	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission CO_2 [kt]	0.2116	0.297	0.325	0.258	0.343	0.356	0.339	0.323
2025 submission CO_2 [kt]	0.2115	0.297	0.324	0.258	0.343	0.340	0.338	0.322
Change relative to 2024 submission CO_2 [kt]	-0.00011	-0.00085	-0.00083	-0.00027	-0.00013	-0.017	-0.0011	-0.0003
Change relative to 2024 submission CO_2 [%]	-0.050%	-0.28%	-0.26%	-0.11%	-0.039%	-4.7%	-0.34%	-0.08%

Recalculation for the 2024 Submission

There was recalculation for the years 1995-2021. The recalculation was due to updated import/export data of candles from Statistics Iceland, see Table 4.12.

Table 4.12: Comparison between the 2023 submission and the 2024 submission for CO_2 emission from Paraffin Wax Use (2D2) for the years 1995-2021.

2D2, Paraffin Wax Use	1995	2005	2010	2015	2020	2021
2023 submission CO_2 [kt]	0.2115	0.3241	0.2577	0.3429	0.3397	0.3389
2024 submission CO_2 [kt]	0.2116	0.3250	0.2580	0.3430	0.3564	0.3390
Change relative to 2023 submission CO_2	0.050%	0.26%	0.11%	0.039%	4.9%	0.024%

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 CO_2 in the atmosphere over a period of time, and the associated CO_2 emissions are considered indirect. However, in order for these emissions to count towards national totals in the CRT reporter, we are including these CO_2 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 4.13 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 CO_2 was done using the general formula provided in Box 7.2, Vol. 1 Chapter 7 of the 2006 IPCC Guidelines:

$$Inputs\ (CO_2) = Emissions_{NMVOC} * C * 44/12$$

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) is calculated using Tier 1 methodology according to Table 3.1 in the 2023 EMEP/EEA Guidebook. The emission factor is 1.8 kg NMVOC per person.

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 SO_2, NO_x and CO are expected to originate mainly from combustion and are therefore not estimated here but accounted for under sector 1A2.

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, 2024) 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.

Degreasing (2D3e)

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.

Dry Cleaning (2D3f)

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.

Chemical Products, Manufacturing, and Processing (2D3g)

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.

Printing (2D3h)

NMVOC emissions for printing (2D3h) 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, 2024).

Other Solvent and Product Use (2D3i)

Emissions from wood preservation (2D3i) 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. Emissions from Aircraft de-icing (2D3i) 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.

Urea-based Catalytic Converters

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 (stochiometric conversion from urea ($CO(NH_2)_2$) 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 4.13 and Figure 4.3 show the NMVOC emissions from the sector 2D3 from 1990.

Table 4.13 NMVOC emissions [kt] from all sub-categories, and total emissions from subsector 2D3 [kt CO_2e] due to NMVOC.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
2D3a Domestic solvent use	0.457	0.481	0.502	0.528	0.572	0.581	0.637	0.657	0.675
2D3b Road paving with asphalt	0.0028	0.0028	0.0052	0.0054	0.0038	0.0031	0.0042	0.0059	0.0045
2D3d Coating applications	0.509	0.547	0.560	0.342	0.289	0.318	0.442	0.359	0.350
2D3e Degreasing	0.076	0.057	0.085	0.058	0.038	0.046	0.043	0.047	0.056
2D3f Dry cleaning	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
2D3g Paint manufacturing	0.016	0.016	0.012	0.005	0.003	0.003	0.008	0.003	0.003
2D3h Printing	0.077	0.109	0.198	0.305	0.189	0.207	0.078	0.090	0.045
2D3i Wood preservation	0.009	0.019	0.025	0.086	0.031	0.026	0.038	0.026	0.032
2D3i Aircraft de-icing	0.037	0.037	0.037	0.037	0.037	0.031	0.038	0.049	0.061
Total NMVOC [kt]	1.18	1.27	1.43	1.37	1.16	1.22	1.29	1.24	1.23
Total NMVOC [kt CO_2e]	**2.60**	**2.79**	**3.14**	**3.01**	**2.56**	**2.68**	**2.84**	**2.72**	**2.70**

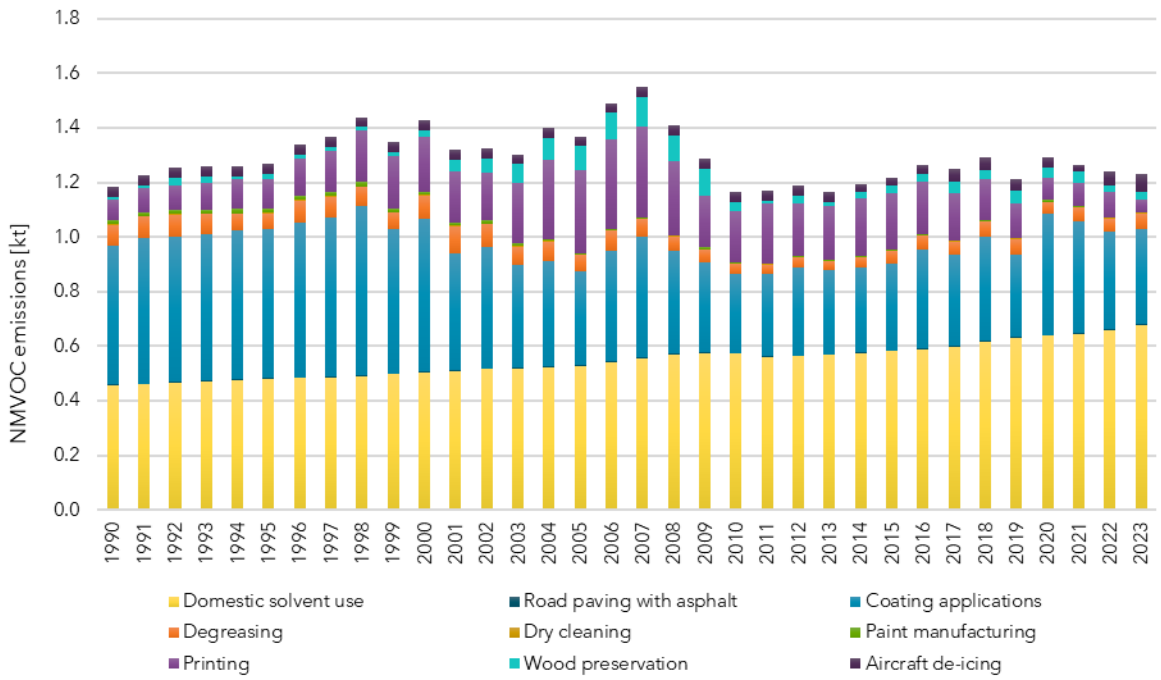


Figure 4.3 NMVOC emissions from all subgroups of Sector 2D3, Other Non-Energy Products from Fuels and Solvent use.

4.5.3.3 Recalculations

Recalculation for the 2025 Submission

For the 2025 submission, recalculations within the 2D3 subsector were due to updated data from Statistics Iceland regarding population statistics from the year 2011 and updated import data from Statistics Iceland from the year 1995. Also, emissions from domestic solvent use are now based on population only as in tier 1 but not tier 2b since no data on product use is available. See tables below.

Table 4.14: Recalculations of emissions within 2D3a (Domestic Solvent Use Including Fungicides) for 1990-2022.

2D3a, Domestic Solvent Use	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	1.37	1.45	1.51	1.59	1.72	1.78	1.97	2.00	2.04
2025 submission [kt CO_2e]	1.00	1.06	1.11	1.16	1.26	1.28	1.40	1.42	1.45
Change relative to 2024 submission [kt CO_2]	-0.37	-0.39	-0.41	-0.43	-0.46	-0.50	-0.57	-0.58	-0.59
Change relative to 2024 submission [%}	-27%	-27%	-27%	-27%	-27%	-28%	-29%	-29%	-29%

Table 4.15: Recalculations of emissions within 2D3d (Coating) for 1995-2022.

2D3d, Coating	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	1.2046	1.2361	0.7912	0.6464	0.7084	1.0301	0.9035	0.7985
2025 submission [kt CO_2e]	1.2043	1.2322	0.7533	0.6352	0.7002	0.9727	0.8936	0.7896
Change relative to 2024 submission [kt CO_2]	-0.0003	-0.004	-0.04	-0.011	-0.008	-0.057	-0.010	-0.009
Change relative to 2024 submission [%}	-0.02%	-0.3%	-4.8%	-1.7%	-1.2%	-5.6%	-1.1%	-1.1%

Table 4.16: Recalculations of emissions within 2D3e (Degreasing) for 2010, 2011, 2014, 2016, 2018-2022.

2D3e, Degreasing	2010	2011	2014	2016	2020	2021	2022
2024 submission [kt CO_2e]	0.08350	0.07493	0.081369	0.1100	0.1022	0.1139	0.1029
2025 submission [kt CO_2e]	0.08349	0.07492	0.081375	0.1098	0.0947	0.1138	0.1023
Change relative to 2024 submission [kt CO_2]	-0.00001	-0.00001	0.00001	-0.0002	-0.01	-0.0002	-0.0006
Change relative to 2024 submission [%}	-0.01%	-0.02%	0.007%	-0.20%	-7.3%	-0.2%	-0.6%

Table 4.17: Recalculations of emissions within 2D3f (Dry Cleaning) for 2011-2022.

2D3f, Dry cleaning	2011	2015	2020	2021	2022
2024 submission [kt CO_2e]	0.0041	0.00423	0.0047	0.00474	0.00483
2025 submission [kt CO_2e]	0.0040	0.00415	0.0045	0.00460	0.00469
Change relative to 2024 submission [kt CO_2]	-0.0001	-0.00008	-0.00013	-0.00013	-0.00015
Change relative to 2024 submission [%}	-2.1%	-1.8%	-2.8%	-2.8%	-3.0%

Table 4.18: Recalculations of emissions within 2D3h (Printing) for 1997, 1999, 2000, 2002-2022.

2D3h, Printing	1997	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	0.32856	0.4359	0.6758	0.4155	0.4549	0.1779	0.1884	0.1976
2025 submission [kt CO_2e]	0.32855	0.4360	0.6713	0.4153	0.4547	0.1724	0.1877	0.1971
Change relative to 2024 submission [kt CO_2]	-0.00001	0.0001	-0.0045	-0.0002	-0.0002	-0.005	-0.0007	-0.0005
Change relative to 2024 submission [%}	-0.003%	0.02%	-0.7%	-0.043%	-0.05%	-3.1%	-0.4%	-0.3%

Table 4.19: Recalculations of emissions within 2D3i (Organic Solvent Borne Preservative) for 1997-1999, 2001, 2003-2006, 2008, 2011, 2013, 2020, 2022.

2D3i, Organic Solvent Borne Preservative	1997	2001	2003	2006	2011	2013	2020	2022
2024 submission [kt CO_2e]	0.0337	0.088852	0.1499	0.2146	0.0513	0.0394	0.082744	0.05704
2025 submission [kt CO_2e]	0.0336	0.088846	0.1485	0.2121	0.0196	0.0382	0.082742	0.05700
Change relative to 2024 submission [kt CO_2]	-1.0E-04	-0.00001	-0.0014	-0.0025	-0.032	-0.0011	-0.000002	-0.00004
Change relative to 2024 submission [%}	-0.31%	-0.007%	-0.9%	-1.2%	-61.8%	-2.9%	-0.0025%	-0.1%

Table 4.20: Recalculations of emissions within 2D3i (Total Wood Preservation) for 1997, 1998, 1999, 2001, 2003-2006, 2008, 2011, 2013, 2020, 2022.

2D3i, Total Wood Preservation	1997	1999	2001	2005	2008	2011	2013	2020	2022
2024 submission [kt CO_2e]	0.0347	0.0369	0.0897	0.1898	0.2020	0.0513	0.0394	0.082744	0.05704
2025 submission [kt CO_2e]	0.0346	0.0329	0.0897	0.1890	0.2012	0.0196	0.0382	0.082742	0.05700
Change relative to 2024 submission [kt CO_2]	-0.0001	-0.0040	-6.2E-06	-0.0008	-0.0008	-0.03	-0.0011	-2.1E-06	-4.2E-05
Change relative to 2024 submission [%}	-0.3%	-10.8%	-0.007%	-0.4%	-0.4%	-61.8%	-2.9%	-0.0025%	-0.07%

Table 4.21: Recalculations of emissions within 2D3 (Other Than Road Paving) for 1990-2022.

2D3, Other (Other Than Road Paving)	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	2.97	3.17	3.54	3.47	3.03	3.19	3.47	3.36	3.31
2025 submission [kt CO_2e]	2.60	2.79	3.13	3.00	2.55	2.67	2.83	2.77	2.71
Change relative to 2024 submission [kt CO_2]	-0.37	-0.39	-0.41	-0.47	-0.47	-0.51	-0.64	-0.59	-0.60
Change relative to 2024 submission [%}	-12.4%	-12.3%	-11.6%	-13.6%	-15.7%	-16.1%	-18.5%	-17.6%	-18.2%

Recalculation for the 2024 Submission

For the 2024 submission, recalculations within the 2D3 subsector were due to updated data from Statistics Iceland, see Table 4.22, Table 4.23, Table 4.24, Table 4.25, Table 4.26, Table 4.27, and Table 4.28.

Table 4.22: Recalculations of emissions within 2D3d (Coating) for 1995-2021 between the 2023 and 2024 submissions.

2D3d, Coating	1995	2000	2005	2010	2015	2020	2021
2023 submission [kt CO_2e]	1.204	1.232	0.753	0.635	0.700	0.973	0.901
2024 submission [kt CO_2e]	1.205	1.236	0.791	0.646	0.708	1.030	0.903
Change relative to 2023 submission	0.024%	0.32%	5.0%	1.8%	1.2%	5.9%	0.24%

Table 4.23: Recalculations of emissions within 2D3e (Degreasing) for 2010, 2011, 2016, 2018, 2019, 2020, and 2021 between the 2023 and 2024 submissions.

2D3e, Degreasing	2010	2011	2018	2019	2020	2021
2023 submission [kt CO_2e]	0.08349	0.07492	0.12070	0.12721	0.09472	0.11388
2024 submission [kt CO_2e]	0.08350	0.07493	0.12075	0.12805	0.10215	0.11395
Change relative to 2023 submission	0.012%	0.019%	0.044%	0.66%	7.8%	0.064%

Table 4.24: Recalculations of emissions within 2D3h (Printing) for 1997, 2000, 2002-2021 between the 2023 and 2024 submissions.

2D3h, Printing	1997	2000	2002	2005	2010	2015	2020	2021
2023 submission [kt CO_2e]	0.32855	0.435922	0.3800	0.6713	0.4153	0.4547	0.1724	0.1882
2024 submission [kt CO_2e]	0.32856	0.435923	0.3801	0.6758	0.4155	0.4549	0.1779	0.1884
Change relative to 2023 submission	0.0033%	0.00025%	0.0035%	0.67%	0.043%	0.052%	3.2%	0.11%

Recalculations for 2D3i, Total Wood Preservation, is only due to change in data for Organic solvent borne preservative. Table 4.25 only includes changes larger than 0.1% and therefore excluding recalculations for 2001 and 2020. The emissions in 2001 and 2020 went from 0.08971 kt CO_2e to 0.08972 kt CO_2e and 0.082742 kt CO_2e to 0.082744 kt CO_2e respectively.

Table 4.25: Recalculations of emissions within 2D3i (Total Wood Preservation) for 1997, 1998, 1999, 2003, 2004, 2005, 2006, 2008, 2011, and 2013 between the 2023 and 2024 submissions.

2D3i, Total Wood Preservation	1997	1998	1999	2003	2004	2005	2006	2008	2011	2013
2023 submission [kt CO_2e]	0.0346	0.025	0.033	0.149	0.179	0.189	0.213	0.201	0.020	0.038
2024 submission [kt CO_2e]	0.0347	0.036	0.037	0.150	0.181	0.190	0.215	0.202	0.051	0.039
Change relative to 2023 submission	0.30%	41%	12%	0.94%	1.2%	0.41%	1.2%	0.38%	162%	2.9%

Table 4.26: Recalculations of emissions within 2D3 (Other Than Road Paving) for 1995-2021 between the 2023 and 2024 submissions.

2D3, Other (Other Than Road Paving)	1995	2000	2005	2010	2015	2020	2021
2023 submission [kt CO_2e]	3.1747	3.5341	3.4266	3.0140	3.1780	3.4003	3.3564
2024 submission [kt CO_2e]	3.1750	3.5380	3.4698	3.0254	3.1865	3.4706	3.3589
Change relative to 2023 submission	0.0093%	0.11%	1.3%	0.38%	0.27%	2.1%	0.073%

Table 4.27: Recalculations of emissions within 2D3 (Other: Road Paving with Asphalt) for 2020 and 2021 between the 2023 and 2024 submissions.

2D3, Other: Road Paving with Asphalt	2020	2021
2023 submission CO_2 [kt]	0.0070	0.0080
2024 submission CO_2 [kt]	0.0077	0.0097
Change relative to 2023 submission	9.6%	21%

Table 4.28: Recalculations of emissions within 2D3 (Other: Urea Based Catalytic Converters) for 2021 between the 2023 and 2024 submissions.

2D3, Other: Urea Based Catalytic Converters	2021
2023 submission CO_2 [kt]	0.75
2024 submission CO_2 [kt]	0.57
Change relative to 2023 submission	-23%

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 EF uncertainty is 5% based on 2006 IPCC Guidelines default value for CO_2). 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 hydrochlorofluorocarbons (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 4.29 Use of HFCs and PFCs in other sub-source categories of sector 2F is not occurring. SF_6 is used only in electric switchgear and medical accelerators and is reported under 2G1 Electrical Equipment and 2G2 SF_6 and PFCs from Other Product Use (see chapter 4.8.1 and 4.8.2) while NF_3 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 4.29 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

$$Total\ Emissions = Assembly/Manufacture\ Emissions + Operation\ Emissions + Disposal\ Emissions$$

Where:

- Assembly or 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

$$E_{\mathrm{charge},t} = M_t * \frac{k}{100}$$

Where:

- $E_{charge,t}$= 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

$$E_{\mathrm{lifetime},t} = B_t * \frac{x}{100}$$

Where:

- $E_{lifetime,t}$= 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

$$E_{\text{end-of-life},t} = M_{t-d} * \frac{p}{100} * \left(1 - \frac{\eta_{\text{rec,d}}}{100}\right)$$

Where:

- $E_{\text{end-of-life},t}$= emissions at system disposal, in year t, kg
- $M_{t\text{-}d}$= 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.

- 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 4.30. 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 4.31 and an average of 2020 and 2022 was used for the year 2021. For years since 2022, the 2022 values are used.

Table 4.30 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_2F_6	0%	100%	0%

Table 4.31 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_2F_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 C_3F_8, 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 C_3F_8 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).

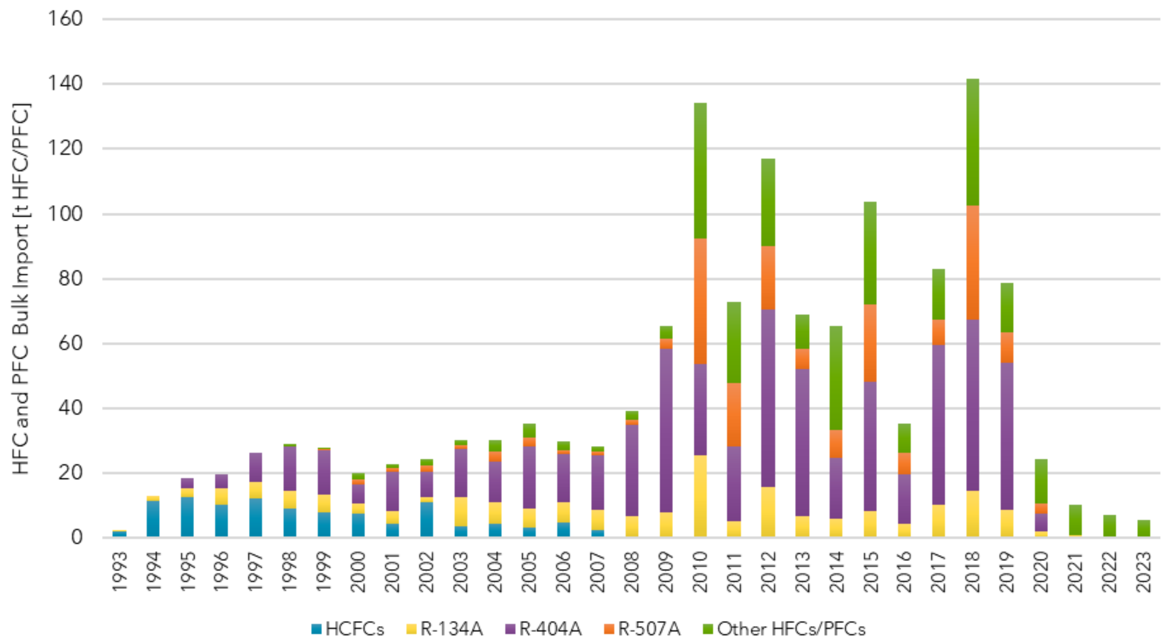


Figure 4.4 Quantity of F-gases imported in bulk to Iceland since 1993.

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 4.32. 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 4.32 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 EF 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 EFs. These initial EFs 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 EFs 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 EF 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 EF of shipping vessels has decreased since the introduction of HFCs. The lifetime EF 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 EF 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 EF 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% EF. 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 subsources, 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 $\eta_{\mathrm{rec,d}}$ 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 CO_2e. All values and fractions below relating to aggregated emissions are expressed in CO_2e.

Total HFC and PFC emissions from all refrigeration and air conditioning equipment disaggregated to constituents are shown in Table 4.33.

Table 4.33 HFC and PFC emissions [kt CO_2e] for all individual compounds, calculated into kt CO_2e.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
HFC-23	NO	NO	NO	0.0346	0.0136	0.0136	0.0518	0.0685	0.0757
HFC-32	NO	NO	0.00512	0.0157	0.0566	0.102	0.410	0.586	0.722
HFC-125	NO	0.800	18.8	22.2	40.9	59.7	72.7	49.8	47.9
HFC-134a	NO	1.73	5.60	10.1	12.3	18.3	29.1	21.6	14.6
HFC-143a	NO	0.170	18.7	25.2	53.6	79.1	97.1	62.0	61.4
HFC-152a	NO	0.0084	0.067	0.0468	0.0400	0.00166	NO	NO	NO

	1990	1995	2000	2005	2010	2015	2020	2022	2023
HFC-227ea	NO	NO	NO	0.108	0.0227	0.312	0.189	0.182	0.147
Total HFC [kt CO_2e]	**NO**	**2.49**	**42.3**	**56.5**	**106**	**156**	**197**	**132**	**124**
C_2F_6 (PFC-116) [kt CO_2e]	NO	NO	NO	0.00321	0.0012	0.00800	0.0669	0.0711	0.0837
C_2F_8 (PFC-218) [kt CO_2e]	NO	NO	NO	NO	0.0006	0.00021	0.00007	0.000047	0.000040
Total PFC [kt CO_2e]	NO	NO	NO	0.00292	0.0018	0.0075	0.0609	0.0648	0.0762
Total HFC+PFC [kt CO_2e]	**NO**	**2.49**	**42.3**	**56.5**	**106**	**156**	**197**	**132**	**124**

Figure 4.5 shows the total emissions (assembly emissions, lifetime emissions and disposal emissions) expressed as kt CO_2e 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.

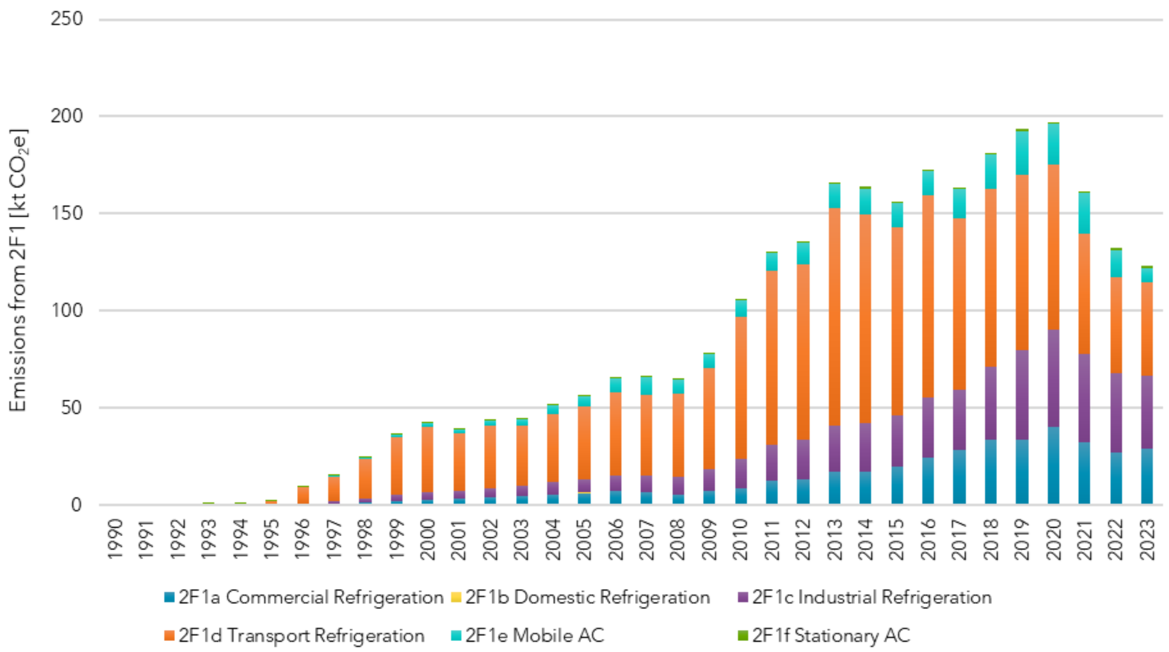


Figure 4.5 Total F-gas emissions from Refrigeration and Air Conditioning, split by subcategories [kt CO_2e].

4.7.2.2 Recalculations

Recalculation for the 2025 Submission

No category-specific recalculations were done for this submission.

Recalculation for the 2024 Submission

There were recalculations for subcategories 2F1a, 2F1c, 2F1d, for the whole timeline and from 2008-2021 for 2F1e due to changes in EF for 2F1e. Additionally, there were recalculations for 2021 due to the new survey of distribution of unallocated blends for 2022. Finally, recovery efficiency of 2F1c and 2F1f were updated, see Table 4.34, Table 4.35, Table 4.36, Table 4.37, and Table 4.38.

Table 4.34 Recalculation for 2F1a Commercial RAC due to improvements in EF and distribution of blends.

2F1a, Commercial RAC	1990	1995	2000	2005	2010	2015	2020	2021
2023 submission HFC-134a [kt CO_2e]	–	0.00116	0.034	0.076	0.109	0.247	0.499	0.398
2024 submission HFC-134a [kt CO_2e]	–	0.00115	0.032	0.072	0.105	0.242	0.494	0.391
Change relative to 2023 submission	–	-0.98%	-4.79%	-6.36%	-4.26%	-2.16%	-1.04%	-1.85%
2023 submission HFC-32 [kt CO_2e]	–	–	0.00004	0.0002	0.0003	0.001	0.02	0.02799
2024 submission HFC-32 [kt CO_2e]	–	–	0.00004	0.0002	0.0003	0.001	0.02	0.02803
Change relative to 2023 submission	–	–	–	–	–	–	–	0.15%

Table 4.35 Recalculation for 2F1c Industrial refrigeration due to improvements in EF, change in recovery efficiency, and update of distribution of blends.

2F1c, Industrial refrigeration	1990	1995	2000	2005	2010	2015	2020	2021
2023 submission total emissions [kt CO_2e]	–	0.10788	3.801	6.97	15.1	26.6	50.3	45.8
2024 submission total emissions [kt CO_2e]	–	0.10787	3.799	6.96	14.9	26.4	49.7	45.5
Change relative to 2023 submission	–	-0.01%	-0.06%	-0.08%	-1.35%	-0.79%	-1.20%	-0.74%

Table 4.36 Recalculation for 2F1d Transport refrigeration due to improvements in EF and distribution of blends.

2F1d, Transport refrigeration	1990	1995	2000	2005	2010	2015	2020	2021
2023 submission HFC-134a [kt CO_2e]	–	1.5290	3.22	3.30	2.53	3.92	3.81	3.93
2024 submission HFC-134a [kt CO_2e]	–	1.5289	3.20	3.27	2.50	3.90	3.79	3.92
Change relative to 2023 submission	–	-0.005%	-0.57%	-0.88%	-0.99%	-0.65%	-0.39%	-0.23%
2023 submission HFC-32 [kt CO_2e]	–	–	0.0006	0.001	0.001	0.007	0.12	0.136
2024 submission HFC-32 [kt CO_2e]	–	–	0.0006	0.001	0.001	0.007	0.12	0.135
Change relative to 2023 submission	–	–	–	–	–	–	–	-0.08%

Table 4.37 Recalculation for 2F1e Mobile AC due to improvements in EF.

2F1e, Mobile AC	2008	2010	2015	2020	2021
2023 submission HFC-134a [kt CO_2e]	9.70	11.16	16.14	17.89	15.23
2024 submission HFC-134a [kt CO_2e]	6.79	8.16	11.87	21.09	20.81
Change relative to 2023 submission	-30.0%	-27.0%	-26.5%	17.9%	36.6%

Table 4.38 Recalculation for 2F1f Stationary AC due to change in recovery efficiency.

2F1f, Stationary AC	1990	1995	2000	2005	2010	2015	2020	2021
2023 submission total emissions [kt CO_2e]	–	–	0.0452	0.1376	0.55	0.80	1.03	0.93
2024 submission total emissions [kt CO_2e]	–	–	0.0452	0.1376	0.51	0.76	0.95	0.88
Change relative to 2023 submission	–	–	–	–	-7.4%	-4.7%	-7.4%	-5.8%

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 4.39. Overview of the uncertainties can be found in Annex 2.

Table 4.39 EFs used along with EF ranges given in the 2006 IPCC Guidelines; calculated combined EF 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%

Sector		EF Used	Lower Bound	Upper Bound	EF Uncertainty	AD uncertainty
	Recovery Effic.			NA		
2F1e Mobile air-con.	Lifetime EF	14	9	16	25%	70%
	Initial Em.			No first fills in Iceland		
	Operation Em.	7[1]	7[1]	20	93%	70%
	Recovery Effic.			NA		
2F1f Stationary air-con.	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

Emissions from MDIs are assumed to be 50% from year of import plus 50% of import from the previous year.

Activity Data

The Icelandic Medicines Agency records import of MDIs containing R-134A since 2002 and R-227ea since 2014. The amount of HFCs in MDIs imported has been oscillating between 500 and 660 kg since 2002. No import data is available for the time period 1990-2001. Therefore, the activity data was extrapolated by determining the average MDI import per capita for the period 2002 to 2015, and by using this average to calculate MDI imports as a function of population for the period 1990-2001.

4.7.5.2 Emissions

Emissions from MDIs in 2023 were approx. 1.02 kt CO_2e.

4.7.5.3 Recalculations

Recalculation for the 2025 Submission

Recalculations were made within the subsector 2F4a Metered Dose Inhalers due to updated activity data from the Icelandic Medicines Agency for the years 2021-2022. Recalculations were also due to updated data from Statistics Iceland regarding population statistics from the year 2011. Through the extrapolation in the past, that resulted in recalculations for the years 1990-2002.

Table 4.40: Recalculations of emissions within 2F4a (Metered Dose Inhalers).

2F4a, Metered Dose Inhalers	1990	1995	2000	2021	2022
2024 submission HFC-134a [kt CO_2e]	0.31364	0.6575	0.6856	0.77588	0.9105
2025 submission HFC-134a [kt CO_2e]	0.31588	0.6622	0.6905	0.77593	0.9113
Change relative to 2024 submission HFC-134a [kt CO_2]	0.0022	0.0047	0.0049	0.00006	0.0008
Change relative to 2024 submission [%}	0.71%	0.71%	0.71%	0.01%	0.09%

Recalculation for the 2024 Submission

No category-specific recalculations were done for the 2024 submission.

4.7.5.4 Planned Improvements

There are no category-specific improvements planned for future submissions.

4.7.5.5 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 (SF_6 emissions from use of electrical equipment), 2G3 (N_2O from product use, mostly in medical applications) and 2G4 where we report CH_4, N_2O, NO_x, CO and NMVOC emissions from tobacco consumption and CO_2, CH_4, N_2O, NO_x, CO and SO_2 emissions from fireworks use.

4.8.1 Electrical Equipment (CRT 2G1)

4.8.1.1 Use of Electrical Equipment (2G1b)

Sulphur hexafluoride (SF_6) is used as insulation gas in gas insulated switchgear (GIS) and circuit breakers. The number of SF_6 users in Iceland is small. The bulk of SF_6 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 SF_6.

Methodology

SF_6 nameplate capacity development data as well as SF_6 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 SF_6 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 SF_6 in Iceland, the approach is based on the yearly amount of SF_6 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 SF_6 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 SF_6 within the electrical equipment in order to obtain the yearly stock of SF_6 in the country.

Iceland acquired its first SF_6 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 distribution[22]. Based on this information the amount "Remaining in products at decommissioning" and the resulting emissions "from disposal" and the "recovery" is reported as "NO."

[22] https://www.lota.is/power-and-energy/?lang=en

Emissions

Figure 4.6 shows the evolution of SF_6 in switchgear and the associated emissions due to leakage. The increase in emissions is less than proportional compared to the net increase in SF_6 nameplate capacity since 1990. The spike in 2010 is caused by two unrelated incidents during which switchgear was destroyed and SF_6 emitted. The spike in 2012 is caused by an increase of emissions from Landsnet LLC.

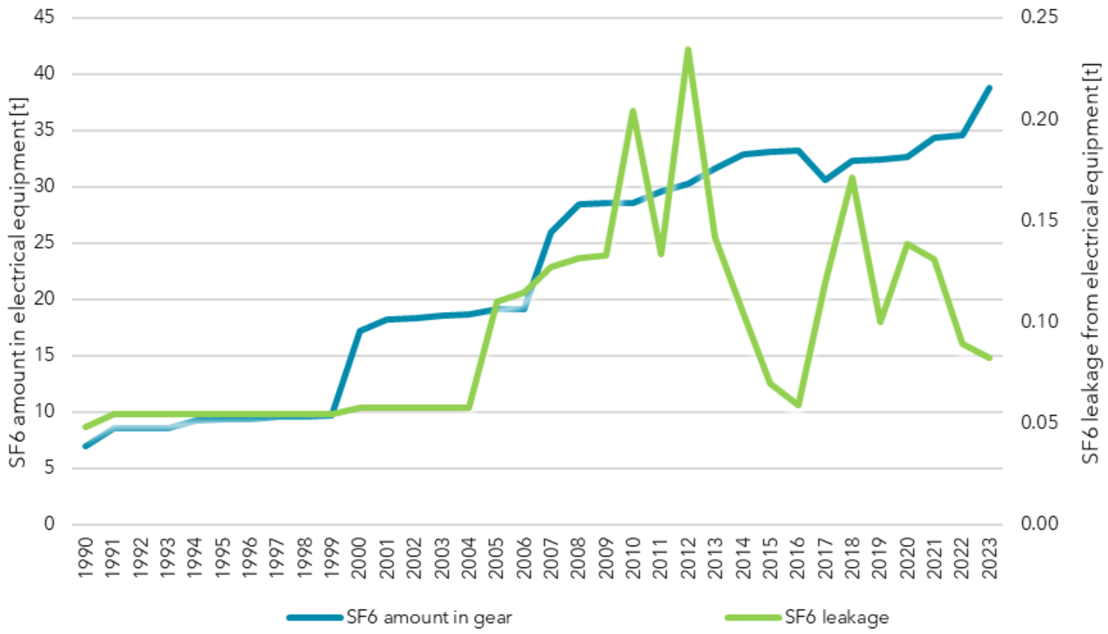


Figure 4.6 Total SF_6 amounts contained in and SF_6 leakage from electrical equipment [t].

Recalculations

Recalculation for the 2025 Submission

No recalculation was made for the 2025 submission.

Recalculation for the 2024 Submission

Recalculations were made for 2020 and 2021 due to updates in activity data. As for 2020, a leakage value was updated with an extra decimal. As for 2021, a leakage value was updated due to additional information from a power distribution company.

Table 4.41: Recalculations for SF_6 emission within 2G1 between 2023 and 2024 submissions.

2G1, Electrical Equipment	2020	2021
2023 submission SF6 [t]	0.138368	0.127
2024 submission SF6 [t]	0.138381	0.131
Change relative to 2023 submission	0.0092%	3.5%

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 SF_6 and PFCs from Other Product Use (CRT 2G2)

Medical particle accelerators are used in Iceland which use SF_6 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 SF_6 per year (0.0002679 kt CO_2e) since then. From 1990 – 1995 the emissions were 5.7 g of SF_6 per year.

4.8.2.3 Recalculations

Recalculation for the 2025 Submission

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

Recalculation for the 2024 Submission

No category-specific recalculations were done for the 2024 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 N_2O from Product Use (CRT 2G3)

N_2O in Iceland is almost exclusively used as anaesthetic and analgesic in medical applications (CRT subsector 2G3a). Minor uses of N_2O 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

N_2O 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

N_2O to Iceland and is therefore confidential. It is assumed that all N_2O 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 N_2O 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 N_2O 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 N_2O that could be emitted from whipped cream containers, Iceland follows the Finnish example of applying an average of the EFs used in Central Europe, that is, 3.3 g N_2O/inhabitant/year.

Equation 8.24

$$E_{N_2O}(t) = \sum_i \{[0.5 * A_i(t) + 0.5 * A_i(t-1)] \cdot EF_i\}$$

Where:

- $E_{N2O}(t)$ = emissions of N_2O in year t, tonnes
- A_i (t) = total quantity of N_2O supplied in year t for application type i, tonnes
- A_i (t-1) = total quantity of N_2O 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 N_2O. This emission factor is also used for other N_2O uses. Total emissions from medical use of N_2O decreased from 17.8 t N_2O in 1990 (4.7 kt CO_2e) to about 4-5 t in recent years (1.2-1.3 kt CO_2e). 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 N_2O 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 N_2O comprise the emissions from aerosol cans of cream and whipped cream cartridges for the whole time series. In 1990, emissions from the use of N_2O from other product use including fuel oxidants for motorsport, fire extinguishers and whipped cream applications were 2.4 t N_2O (0.64 kt CO_2e) and around 1.5 t N_2O (0.40 kt CO_2e) in recent years.

4.8.3.2 Recalculations

Recalculation for the 2025 Submission

For the 2025 submission, recalculations within the 2G3 subsector were due to updated data from Statistics Iceland regarding population statistics from the year 2011, see the table below.

Table 4.42: Recalculations of emissions within 2G3 (N_2O from product use).

2G3, N_2O from product use	2011	2015	2020	2021	2022
2024 submission [kt CO_2e]	3.2615	2.5606	2.2569	1.6020	1.6691
2025 submission [kt CO_2e]	3.2557	2.5553	2.2481	1.5928	1.6592
Change relative to 2024 submission [kt CO_2]	-0.0058	-0.0053	-0.0088	-0.0092	-0.0099
Change relative to 2024 submission [%}	-0.18%	-0.21%	-0.39%	-0.57%	-0.59%

Recalculation for the 2024 Submission

No category-specific recalculations were done for the 2024 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 CH_4, N_2O, 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). CH_4 and N_2O emissions are calculated using the Danish country-specific approach (Danish Centre for Environment and Energy, 2018) with emission factors of 3.187 t CH_4/kt tobacco used and 0.064 t N_2O/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. CO_2 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.

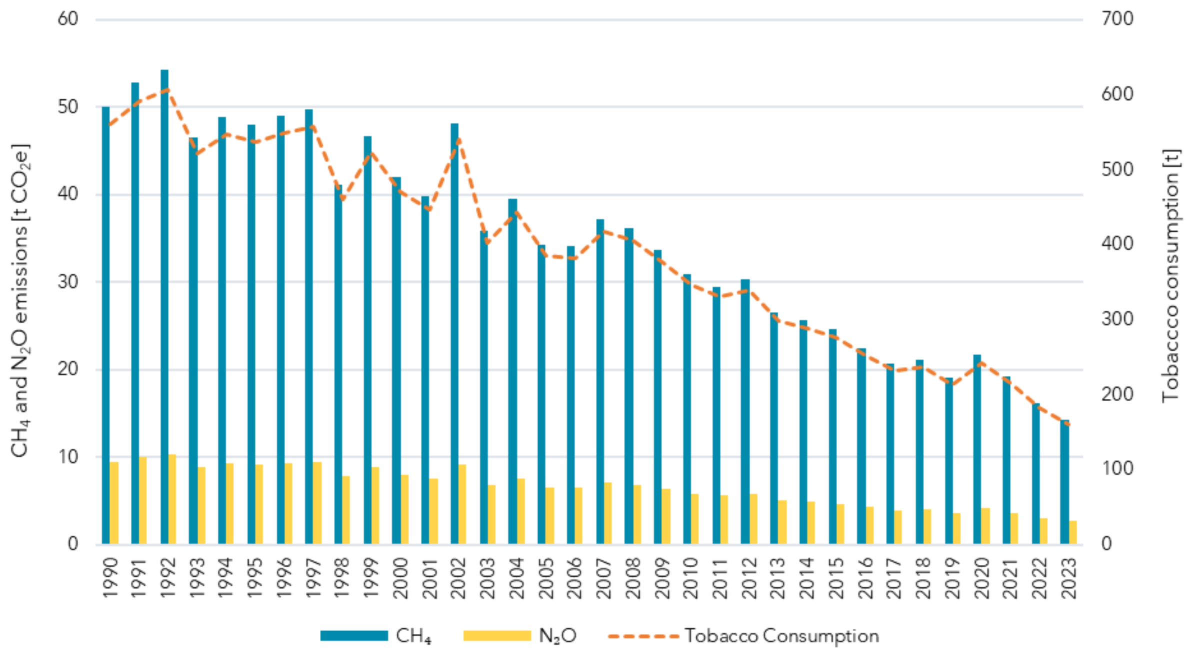


Figure 4.7 Tobacco imports and greenhouse gas emissions [t CO_2e] from tobacco use.

Recalculations

Recalculation for the 2025 Submission

For the 2025 submission, there were recalculations for 2005, 2007- 2010 and 2020-2022 due to updated import/export data from Statistics Iceland, see the table below.

Table 4.43: Recalculations of emissions within 2G4 (Other: Tobacco).

2G4 Other Tobacco	2005	2007	2010	2020	2021	2022
2024 submission [kt CO_2e]	0.0408494	0.044333	0.03683	0.025750	0.022953	0.019317
2025 submission [kt CO_2e]	0.0408490	0.044330	0.03670	0.025778	0.022906	0.019312
Change relative to 2024 submission [kt CO_2e]	-3.2E-07	-3.0E-06	-1.3E-04	2.8E-05	-4.7E-05	-5.1E-06
Change relative to 2024 submission [%}	-0.00078%	-0.0067%	-0.34%	0.11%	-0.20%	-0.026%

Recalculation for the 2024 Submission

For the 2024 submission, there were recalculations for 2005, 2007, 2008, 2009, 2010, 2020 and 2021 due to updated import/export data from Statistics Iceland, see Table 4.44.

Table 4.44 only includes changes larger than 0.001% and therefore excluding recalculations for 2005 and 2009. As for CH_4 emissions, the relative change to 2023 submission were less than 50 g CH_4 for both 2005 and 2009. As for N_2O emissions, the relative change to 2023 submissions were less than 1 g N_2O for both 2005 and 2009.

Table 4.44: Recalculation in 2G4, Tobacco due to updated activity data between submissions.

2G4, Other: Tobacco	2007	2008	2010	2020	2021
2023 submission CH_4 [kt]	1.33036 E-03	1.29135 E-03	1.1015 E-03	7.72736 E-04	6.874 E-04
2024 submission CH_4 [kt]	1.33045 E-03	1.29138 E-03	1.1053 E-03	7.72768 E-04	6.888 E-04
Change relative to 2023 submission CH_4	-0.0067%	-0.0022%	-0.34%	-0.0041%	-0.20%
2023 submission N_2O [kt]	2.67158 E-05	2.59324 E-05	2.2120 E-05	1.55178.E-05	1.3805 E-05
2024 submission N_2O [kt]	2.67176 E-05	2.59329 E-05	2.2195 E-05	1.55184.E-05	1.3833 E-05
Change relative to 2023 submission N_2O	0.0067%	0.0022%	0.34%	0.0041%	0.20%

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 CH_4 and 50% for N_2O 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 CO_2, CH_4, N_2O, NO_x, CO and SO_2 emissions.

Methodology

Activity data for fireworks use was collected from Statistics Iceland and is based on yearly imports. CO_2, CH_4 and N_2O emissions were calculated using emission factors from the Netherland National Water Board (2008). Emissions of SO_2, 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 N_2O, with about 90% of total emissions (when calculated in CO_2e).

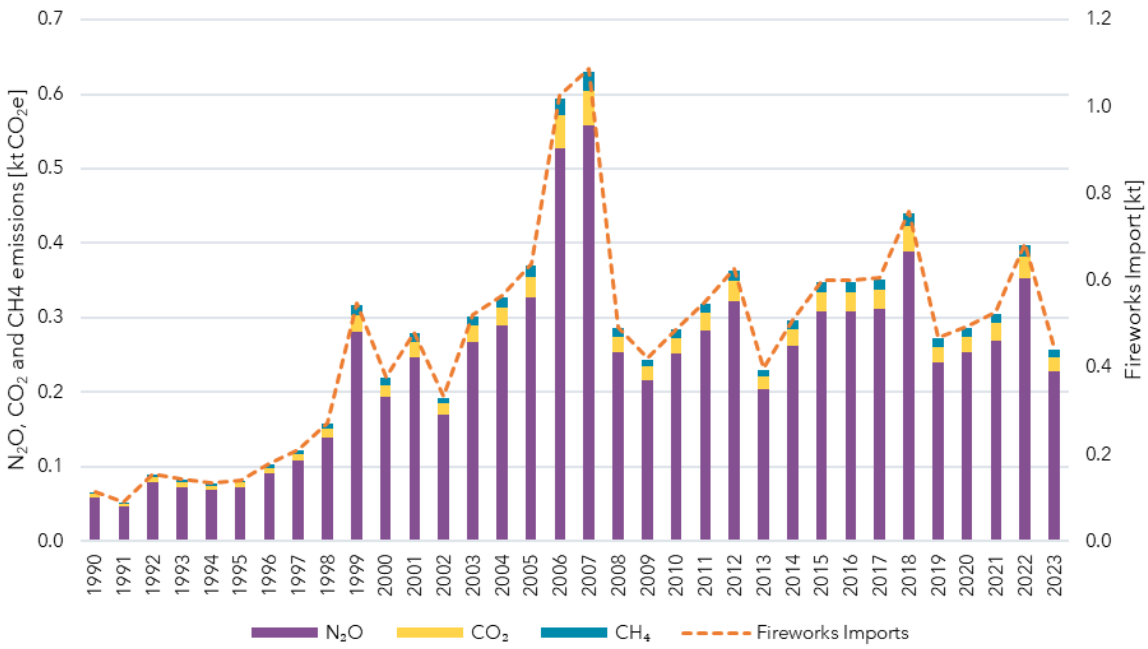


Figure 4.8 Fireworks import and greenhouse gas emissions [kt CO_2e] from firework use.

Recalculations

Recalculation for the 2025 Submission

For the 2025 submission, there were recalculations for 2007, 2009-2010, 2012, 2016, 2018 and 2020 due to updated import/export data from Statistics Iceland, see the table below.

Table 4.45: Recalculations of emissions within 2G4 (Other: Fireworks).

2G4 Other Fireworks	2007	2009	2010	2012	2016	2018	2020
2024 submission [kt CO_2e]	0.6320	0.2451	0.284035	0.363708	0.348630	0.439806	0.286041
2025 submission [kt CO_2e]	0.6297	0.2440	0.283999	0.363702	0.348590	0.439801	0.286028
Change relative to 2024 submission [kt CO_2e]	-0.0022	-0.0010	-3.6E-05	-6.4E-06	-3.9E-05	-5.2E-06	-1.4E-05
Change relative to 2024 submission [%}	-0.35%	-0.42%	-0.013%	-0.0018%	-0.011%	-0.0012%	-0.0049%

Recalculation for the 2024 Submission

For the 2024 submission, there were recalculations for the years 2007, 2009, 2010, 2012, 2016, 2018, and 2020 due to updated import/export data from Statistics Iceland, see Table 4.46.

Table 4.46 only shows recalculations with changes larger than 0.01% and therefore excluding 2012, 2018 and 2020. As for CO_2 emissions, the relative change to 2023 submission was 476 g CO_2 for 2012, 389 g CO_2 for 2018 and 1038 g CO_2 for 2020. As for N_2O and CH_4 emissions, the relative change to 2023 submission were all less than 50 g N_2O/CH_4.

Table 4.46: Recalculation in 2G4, Fireworks due to updated activity data between submissions.

2G4, Other: Fireworks	2007	2009	2010	2016
2023 submission CO_2 [kt]	0.0470	0.0182	0.021210	0.02603
2024 submission CO_2 [kt]	0.0472	0.0183	0.021212	0.02604
Change relative to 2023 submission CO_2	0.35%	0.42%	0.013%	0.011%
2023 submission N_2O [kt]	2.10E-03	8.15E-04	9.489E-04	1.1647E-03
2024 submission N_2O [kt]	2.11E-03	8.19E-04	9.490E-04	1.1649E-03
Change relative to 2023 submission N_2O	0.35%	0.42%	0.013%	0.011%
2023 submission CH_4 [kt]	8.97E-04	3.48E-04	4.0458E-04	4.9659E-04
2024 submission CH_4 [kt]	9.00E-04	3.4 E-04	4.0463E-04	4.9665E-04
Change relative to 2023 submission CH_4	0.35%	0.42%	0.013%	0.011%

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 CO_2, 50% for CH_4 and 50% for N_2O 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).

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

Production statistics for animal feed are available for 2005-2013. The statistics were linearly extrapolated for earlier and later years in the times series.

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.

Production of bread, cakes/biscuits, meat, fish, poultry, coffee, 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), (Embætti Landlæknis, 2011), (Embætti Landlæknis, 2002), (Embætti Landlæknis, 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 coffee and 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 coffee and 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.

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 4.47.

Table 4.47 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 CO_2 emission from NMVOC emission oxidation from this subsector.

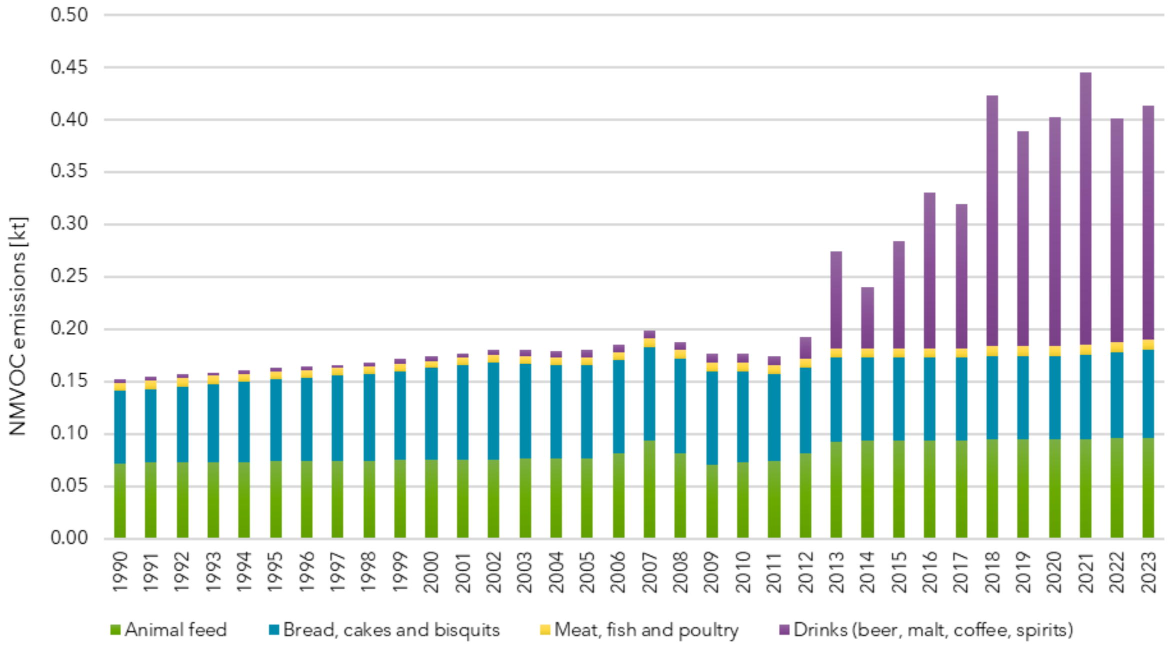


Figure 4.9 NMVOC emissions [kt NMVOC] for various food and beverage processing.

4.9.1.3 Recalculations

Recalculation for the 2025 Submission

The method of estimating NMVOC emissions from beer and malt was changed. In the 2024 submission, it was based on the survey about the diet of Icelanders and the import/export, as in the case of spirits (see above). Now, production data from the main producers was gathered which is considered a better estimate. This led to recalculations for the NMVOC emissions for the whole timeline. Another reason for recalculations were updates in import/export data from Statistics Iceland and updated data from Statistics Iceland regarding population statistics from the year 2011. The recalculations can be seen in the table below.

Table 4.48: Recalculations of emissions within 2H2 (Food and beverages industry) between submissions.

2H, Food and Beverages Industry	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission NMVOC [kt]	0.1532	0.1614	0.1704	0.1758	0.1717	0.2820	0.4021	0.479	0.455
2025 submission NMVOC [kt]	0.1525	0.1627	0.1740	0.1798	0.1762	0.2844	0.4027	0.446	0.402
Change relative to the 2024 submission NMVOC [kt]	-0.0007	0.0013	0.0036	0.0039	0.0045	0.0024	0.0006	-0.034	-0.054
Change relative to the 2024 submission NMVOC [%]	-0.43%	0.80%	2.1%	2.2%	2.6%	0.86%	0.15%	-7.0%	-11.8%

Recalculation for the 2024 Submission

For the current submission. There were recalculations for 2020 and 2021 due to updated import/export data from Statistics Iceland, see Table 4.49.

Table 4.49: Recalculations of emissions within 2H2 (Food and beverages industry) between submissions.

2H, Food and Beverages Industry	2020	2021
2023 submission NMVOC [kt]	0.40235	0.51
2024 submission NMVOC [kt]	0.40207	0.48
Change relative to 2023 submission	-0.072%	-5.6%

4.9.1.4 Planned Improvements

No improvements are currently planned for this subsector.

5 Agriculture (CRF 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, turnips, and carrots are grown on limited acreage.

An overview over emissions from Agriculture are in Table 5.1. The decrease of greenhouse gas emissions since 1990 is mainly due to a decrease in sheep livestock population, reducing methane (CH_4) emissions from enteric fermentation and manure management. Enteric fermentation causes most of the CH_4 emissions from agriculture and fertiliser use and cultivation of organic soils stand behind most of the nitrous oxide (N_2O) emissions.

Table 5.1 Emission of greenhouse gases in the Agriculture sector in Iceland since 1990 (kt CO_2e).

	1990	1995	2000	2005	2010	2015	2020	2022	2023
CH_4	458	412	398	378	403	410	373	364	356
N_2O	299	311	332	328	341	349	343	342	329
CO_2	0.02	2.44	2.76	4.53	3.90	3.14	8.11	5.99	7.88
Total	757	726	732	711	749	762	723	712	692
Emission change compared to 1990 emissions.		-4.2%	-3.2%	-6.1%	-1.1%	0.6%	-4.5%	-6.0%	-8.5%

5.1.1 Methodology

The methodology for the Agriculture sector is currently being updated from the 2006 IPCC Guidelines for to the 2019 Refinements. For the main animal categories: cattle and sheep, livestock characterisation still follows the Tier 2 methodology of the 2006 IPCC Guidelines, Volume 4 (AFOLU). CH_4 emissions from enteric fermentation and manure management build upon this livestock characterisation and are calculated by applying the 2006 IPCC Guidelines using, when available, country specific emission factors. For the other animal categories: swine, horses, poultry, goats and fur-animals, the 2019 Refinements are used to estimate emissions both from enteric fermentation and manure management. N_2O 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 CH_4 emissions, the factors from the 2019 Refinements are used for all animal categories except cattle and sheep, where country specific factors are mainly used along with some factors from the 2006 IPCC Guidelines. 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 N_2O emissions and other nitrogen species and consistency with the reporting under CLTRAP. The 2006 IPCC Guidelines and output from the nitrogen flow model are used to calculate N_2O emissions from agricultural soils. Carbon dioxide (CO_2) 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_2O	T1a, T2	CS, D
3C	Rice Cultivation	CH_4	NA	NA
3D	Agricultural Soils	N_2O	T1, T2	CS, D
3E	Prescribed Burning of Savannas	CH_4, N_2O	NA	NA
3F	Field Burning of Agricultural Residues	CH_4, N_2O	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 2023	Trend
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_2O Emissions from Managed Soils	N_2O	✓	✓	✓
3D2	Indirect N_2O Emissions from Managed Soils	N_2O	✓	✓	

Table 5.4 Key categories for Agriculture (including LULUCF).

IPCC Source Category		Gas	Level 1990	Level 2023	Trend
Agriculture (CRT Sector 3)					
3A1	Enteric Fermentation - Cattle	CH_4	✓	✓	✓
3A2	Enteric Fermentation - Sheep	CH_4	✓		✓
3D1	Direct N_2O Emissions from Managed Soils	N_2O	✓	✓	

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 (E: estimated, NA: not applicable, NE: not estimated).

Sources		CO_2	CH_4	N_2O
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

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 0.98 and can be seen in Figure 5.1.

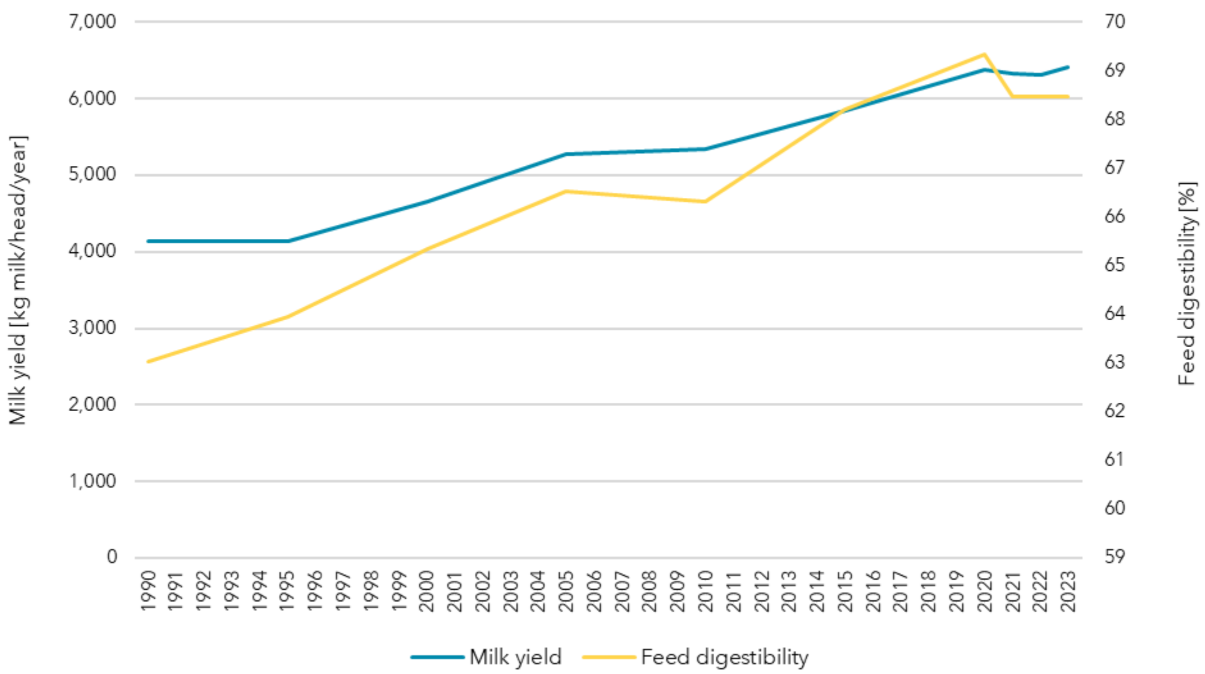


Figure 5.1 Correlation between milk yield and feed digestibility.

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 datasets[23]. 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

[23] 2023 data is not yet available in the FAO and IFA dataset at the time of this writing.

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 failures also affect the purchase of fertilisers.

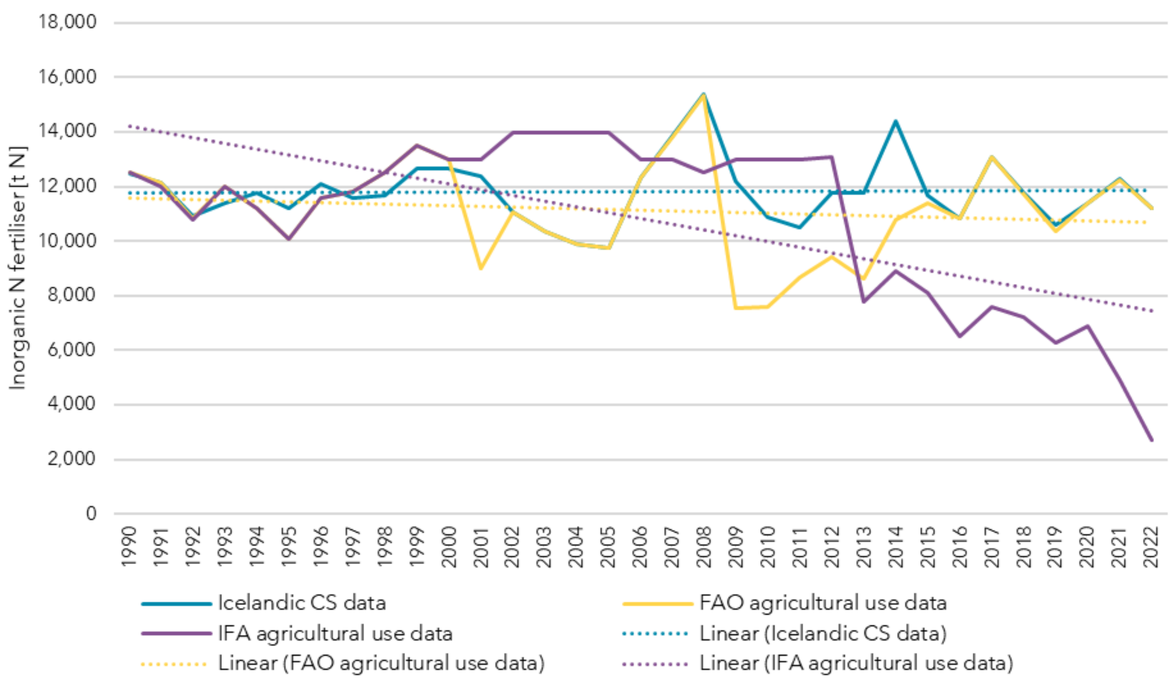


Figure 5.2 Comparison of different datasets on synthetic fertiliser use in Agriculture.

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

In the 3A and 3B subsectors to the Agriculture sector, the 2019 IPCC Refinements are applied where Tier 1 methodology and corresponding emission factors are used for emission calculations. In cases where Tier 2 methodology is used, the 2006 IPCC Guidelines remain in use as sufficient data is not yet available to support the emission factors from the 2019 Refinements. Additionally, evidence suggests that the 2006 IPCC emission factors may be a better fit for Icelandic conditions in some instances. Therefore, further research is needed before making a final decision. A future improvement would involve mapping out available data and identifying any gaps to inform decision-making and ultimately determine which emission factors to use moving forward. Research was launched in the end of 2024 with the aim to establish country specific methane production capacity (B_0) and methane conversion factors (MCFs) from slurry and pit storage in cattle and sheep farming. Results, expected in 2026, will be incorporated in the 2027 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-/#Tab4 bustofn.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 (LaFI)	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 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
Food and Agriculture Organization of the United Nations (FAO)		fao.org	Annual area of crops harvested

[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). A similar collaboration was undertaken for the 2020 submission, where some livestock parameters were updated for the sub-categories Mature Dairy Cattle and Lambs for the year 2018. For the collaboration for the 2023 submission, data was also collected for the years 1990, 1999, 2005, and 2010 as well to improve the trend. The parameters were extrapolated linearly between those years to complete the timeline, with advice from the IAAC. In the future it is planned 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 IEEA 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.

Table 5.7 Comparison between animal numbers 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	2022	2023
Mature Dairy Cattle	Statistics Iceland	32,246	30,428	27,066	24,538	25,711	27,386	25,763	25,719	25,860
	NIR	31,604	30,428	27,066	24,488	25,379	27,441	25,941	25,841	25,638
Other Mature Cattle	Statistics Iceland	[*]	[*]	949	1,355	1,672	2,049	3,295	3,726	3,652
	NIR	645	737	953	1,355	1,608	2,049	3,296	3,741	3,511
Sheep	Statistics Iceland	548,508	458,341	465,777	454,950	479,841	480,656	401,022	365,290	354,986
	NIR	548,707	458,367	465,637	454,726	477,294	473,553	401,839	368,626	355,512
Goats	Statistics Iceland	345	350	416	439	729	990	1,621	1,875	1,835
	NIR	332	350	375	450	695	1,011	1,653	1,889	1,835
Swine	Statistics Iceland	3,116	3,726	3,862	3,982	3,615	3,550	3,063	3,000	2,984
	NIR	3,148	3,726	3,862	4,017	3,399	3,518	3,063	3,000	2,968
Laying hens	Statistics Iceland	214,936	164,402	193,097	166,119	173,419	238,000	203,643	172,670	175,900
	NIR	214,975	164,402	193,097	152,217	144,429	119,811	203,643	217,270	194,245
Mink	Statistics Iceland	42,000	29,941	36,593	35,935	37,409	47,691	15,764	10,552	5,167
	NIR	42,804	30,501	36,593	35,990	39,734	47,693	15,764	12,862	5,167
Foxes	Statistics Iceland	4,800	7,308	4,132	774	5	0	0	0	0
	NIR	4,974	7,308	4,132	833	5	2	4	0	0
Rabbits	Statistics Iceland	1,800	84	706	239	105	336	81	59	62
	NIR	1,814	84	706	270	165	343	81	62	60

* 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). MFAF is in the process of setting up a better system by linking *Worldfengur*, the studbook of origin for the Icelandic horse[24] with the annual autumn census. When numbers are submitted through the studbook, the fate of a single horse can be followed through the birth number which is assigned to each individual. In this way, double counting is avoided. This new system has been implemented since 2019 and it will take some time to be fully reliable. However, 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 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 the autumn census of IFVA and the studbook Worldfengur for since 2015 and calculated horse numbers to be used in this submission.[25]

Source	2015	2016	2017	2018	2019	2020	2021	2022	2023
MFAF (bustofn.is)	67,478	67,334	64,816	53,628	55,387	58,567	54,241	53,137	50,227
Studbook (worldfengur.com)	97,941	97,955	96,840	96,689	93,733	91,648	91,166	91,472	92,185
Calculated for NIR	77,632	77,541	75,491	67,982	70,725	71,799	69,011	68,471	67,010

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.

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.

[24] https://www.worldfengur.com/

[25] 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.

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

$$NLPA = \left(1 - Rate_{\mathrm{Mortality}}\right) \times \left(Frac_{\mathrm{ewes}} \times \mathrm{N}_{\mathrm{ewes}} + Frac_{\mathrm{afr}} \times N_{\mathrm{afr}}\right)$$

Where:

- NLPA = Number of lambs produced annually
- $\mathrm{Rate}_{\mathrm{Mortality}}$ = Early mortality rate
- $\mathrm{Frac}_{\mathrm{ewes}}$ = Birth rate fraction for ewes
- $\mathrm{Frac}_{\mathrm{afr}}$ = Birth rate fraction for animals for replacement
- $\mathrm{N}_{\mathrm{ewes}}$ = Number of ewes
- $\mathrm{N}_{\mathrm{afr}}$ = 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	2022	2023
Mature ewes	Count	445,635	372,222	373,240	360,119	372,684	373,278	315,654	289,750	276,537
Lambs born per mature ewe	Count	1.81	1.81	1.82	1.82	1.83	1.83	1.83	1.84	1.84
Female young sheep	Count	79,708	64,683	71,122	74,155	83,261	79,790	67,074	60,629	61,211
Lambs born per female young sheep	Count	0.83	0.85	0.87	0.88	0.90	0.92	0.94	0.97	0.97
Lambs born	Count	870,529	728,636	739,148	721,151	755,498	756,817	641,825	593,230	569,431
Early mortality	%	5.0%	4.8%	4.6%	4.3%	4.1%	3.9%	3.5%	3.5%	3.5%
Number of lambs produced annually (NLPA)	Count	827,003	693,806	705,440	689,848	724,366	727,294	619,116	572,240	549,283
Age at slaughter	Days	136.9	136.9	136.9	136.9	139.0	140.0	138.0	139.0	139.0
AAP of lambs	Count	310,126	260,177	264,540	258,693	275,854	278,962	234,077	217,922	209,179

Piglets

The number of piglets was calculated with data on the number of piglets born to each sow per year[26]. 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	2022	2023
Sows	Count	2,964	3,516	3,693	3,908	3,331	3,453	3,021	2,958	2,934
Piglets born per sow	Count	15.0	17.0	17.0	20.0	23.0	25.0	26.5	26.5	26.5
Piglets born (NAPA)	Count	44,454	59,772	62,781	78,160	76,613	86,325	80,057	78,387	77,751
Age at slaughter	Days	215	165	165	165	165	165	165	165	165
AAP of piglets	Count	26,185	27,020	28,380	35,333	34,633	39,024	36,190	35,435	35,148

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	2022	2023
Goats (female)	Count	282	298	319	383	591	859	1,405	1,606	1,560
Single birth rate	%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Double birth rate	%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Kids born (NAPA)	Count	367	387	414	497	768	1,117	1,827	2,087	2,028
Age at slaughter	Months	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
AAP of kids	Count	153	161	173	207	320	465	761	870	845

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 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.

[26] The Farmer's Association of Iceland, sections for each livestock category: https://www.bondi.is/bugreinadeildir

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	2022	2023
Total horses	Count	72,030	78,202	73,669	74,820	77,196	77,632	71,799	68,471	67,010
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	Count	6,763	7,141	4,828	5,692	6,906	6,708	6,204	5,917	5,791
Slaughtered foals	Count	4,409	4,905	4,706	4,341	3,968	4,323	3,998	3,813	3,731
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	Count	8,600	9,185	6,789	7,501	8,559	8,510	7,870	7,505	7,345

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.

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	2022	2023
Chicken	Total hens	Count	506,165	186,295	284,612	212,795	164,374	171,161	240,853	254,770	241,745
Chicken	Total pullets	Count	24,020	27,824	63,039	205,418	73,195	75,834	66,048	75,648	68,731
Chicken	Total chicks	Count	1,517,395	1,517,395	2,009,471	3,792,508	4,283,876	5,008,057	5,401,052	5,536,578	5,546,837
Chicken	Age of chicks at slaughter	Days	33	33	33	33	33	33	35	35	34
Chicken	AAP of chicks	Count	137,189	137,189	181,678	342,884	387,309	452,783	513,470	526,354	517,148
Chicken	**Total population**	**Count**	**667,374**	**351,308**	**529,329**	**761,097**	**624,878**	**699,778**	**820,371**	**856,772**	**827,624**
Ducks	Total hens	Count	3,618	3,129	884	1,239	1,079	794	519	439	424
Ducks	Total chicks	Count	11,944	11,944	8,936	1,610	0	794	0	0	0
Ducks	Age of chicks at slaughter	Days	50	50	50	50	50	50	50	50	50
Ducks	AAP of chicks	Count	1,636	1,636	1,224	221	0	109	0	0	0
Ducks	**Total population**	**Count**	**5,254**	**4,765**	**2,108**	**1,460**	**1,079**	**903**	**519**	**439**	**424**
Turkeys	Total hens	Count	845	355	4,505	534	957	1,102	1,200	1,200	1,200
Turkeys	Total chicks	Count	12,571	12,571	29,938	35,587	38,295	50,065	48,838	52,793	57,382
Turkeys	Age of turkeys at slaughter	Days	77	77	77	77	77	77	83	83	84
Turkeys	AAP of chicks	Count	2,652	2,652	6,316	7,507	8,079	10,562	11,052	11,947	13,206
Turkeys	**Total population**	**Count**	**3,497**	**3,007**	**10,821**	**8,041**	**9,035**	**11,664**	**12,252**	**13,147**	**14,406**

5.3.2 Livestock Characterisation

Emissions from enteric fermentation and manure management are calculated separately for each of the cattle subcategories in Table 5.14 and then aggregated into to the categories Mature Dairy Cattle, Other Mature Cattle and Growing Cattle. The category Other Mature Cattle comprises cows used for meat production, while the category Growing Cattle summarises the three categories of the autumn census: 1) Pregnant heifers 2) Young bulls and non-inseminated heifers (12-25-month-old bullocks and 12-18-month-old heifers) and 3) Calves (males and females up to 12 months of age).

Table 5.14 Clarification of cattle categories, English translations of Icelandic categories.

Icelandic	English Translation	Category in NIR
Mjólkurkýr	Dairy cattle	Mature Dairy Cattle
Holdakýr til undaneldis	Beef cattle for reproduction	Other Mature Cattle
Kelfdar kvígur	Pregnant heifer. Heifers pass into this category when they are inseminated at the age of 18 months and remain here until they are calving	Pregnant Heifers
Geldneyti	12-25 months old intact males and 12-18 months old females	Young bulls and non-inseminated heifers
Kálfar yngri en eins árs	Female and male calves younger than 12 months	Calves

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 category Lambs is calculated from the number of mature ewes and female young sheep, the pregnancy rates of these two groups of ewes, and the early mortality rate of lambs. Livestock characterisation is carried out applying the Tier 2 method from Chapter 10, Volume 4, of the 2006 IPCC Guidelines for cattle and sheep.

Table 5.15 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 5.15 Animal performance data used in emission calculations for cattle for 2023. (NA: Not applicable, NO: Not occurring).

	Mature Dairy Cattle	Other Mature Cattle	Pregnant Heifers	Young bulls and non-inseminated heifers[1]	Calves
Weight [kg]	471	470	372	320	137
Mature body weight [kg]	NA	NA	505	516	516
Daily weight gain [kg]	NO	NO	0.44	0.56	0.50
Days in stall	309	30	245	307	365
Days on pasture	56	335	120	58	0
Milk per day [kg]	17.6	5.5	NA	NA	NA
Fat content of milk [%]	4.3	4.2	NA	NA	NA
Protein content of milk [%]	3.4	3.4	NA	NA	NA
Pregnancy rate [%]	92%	81%	75%	NA	NA

[1] The category Young bulls, and non-inseminated heifers consists of both bulls older than one year and young cows between the age of 12 and 18 months. While the latter are allowed outside for approximately 120 days a year, the male animals remain indoors throughout. Therefore, the calculated average time on pasture for the total category Young bulls and non-inseminated heifers is 58 days.

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 470 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), one Norwegian Cattle (NRF), two Swedish breeds (SRB, SLB) and one breed from New Zealand (NZF).

	NRF	SRB	SLB	NZF	ISL
Weight at birth [kg]	40	40	41	40	32
Weight at first calf [kg]	500	510	570	410	405
Mature body weight [kg]	550	550	670	530	470
Age at first calf [months]	25	28	28	24	26

NFR: Norwegian Red, SRB: Swedish Red and White, SLB Swedish Friesian, NZF: New Zealand Friesian, ISL: Icelandic breed

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 5.16 shows national parameters used for emission calculations for sheep for 2023.

Table 5.16 Animal performance data used for emission calculations for sheep for 2023. NA: Not applicable, NO: Not occurring.

	Mature Ewes	Rams	Young sheep	Lambs
Weight [kg]	65	93	50	22
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	0.70	NA	0.13	NA
Triple birth fraction	0.09	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 5.17. 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 5.17 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	175	
Foals	60	

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). Dry 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. Dry matter digestibility was transformed into digestible energy content using a formula from Guðmundsson and Eiríksson (1995).

Table 5.18 shows the equations used in calculating net energy needed for maintenance, activity, growth, lactation, wool production and pregnancy for cattle and sheep subcategories. The ratio of net energy available in diet for maintenance to digestible energy consumed (REM) is calculated by applying Eq. 10.14 in the 2006 IPCC Guidelines, the ratio of net energy available for growth in a diet to digestible energy consumed (REG) is calculated by applying Eq. 10.15. The gross energy (GE) requirement is derived based on the summed net energy requirements and the energy availability characteristics of the feed. The output of the equations in Table 5.18 is, therefore, used along with information on REM, REG and digestible energy to calculate the GE according to Eq. 10.16.

Table 5.18. Overview of equations used to calculate gross energy intake in enhanced livestock population characterisation for cattle and sheep (NA: Not applicable).

Subcategory	Equations from Chapter 10, vol. 4 of the 2006 IPCC Guidelines. Net Energy for Maintenance, Activity, Growth, Lactation, Wool, and Pregnancy					
	Maintenance NEm	Activity NEa	Growth NEg	Lactation NEl	Wool NEwool	Pregnancy NEp
Mature Dairy Cows	10.3	10.4	NA	10.8	NA	10.13
Other Mature Cattle	10.3	10.4	NA	10.8	NA	10.13
Pregnant Heifers	10.3	10.4	10.6	NA	NA	4.8
Young bulls and non-inseminated heifers	10.3	10.4	10.6	NA	NA	NA
Calves	10.3	10.4	10.6	NA	NA	NA
Mature Ewes	10.3	10.4	NA	10.1	10.12	10.13
Rams	10.3	10.4	NA	NA	10.12	NA
Young sheep[1]	10.3	10.4	10.7	10.1	10.12	10.13
Lambs	10.3	10.4	10.7	NA	10.12	NA

[1] Young sheep are considered from 4.5 months (when lambs are slaughtered) to 16.5 months, i.e., one year later, when they will be categories as mature in the autumn census.

Table 5.19 shows dry matter digestibility, digestible energy, and ash content of feed in latest inventory year, for all cattle and sheep categories, as well as the gross energy. All values used as well as calculations and formulas 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 5.19 Dry matter digestibility, digestible energy and ash content of cattle and sheep feed in 2023.

	DMD [%]	DE [%]	Ash in feed [%]	GE [MJ/day]
Mature Dairy Cattle	74.8	68.6	7.7	269.4
Other Mature Cattle	75.5	69.3	7.0	164.5
Pregnant Heifers	74.9	68.7	7.4	123.3
Young bulls and non-inseminated heifers	75.4	69.1	7.1	109.4
Calves	78.4	72.1	7.9	49.1
Mature Ewes	72.0	65.9	7.5	24.2
Rams	72.0	65.9	7.5	26.5
Young sheep	72.0	65.9	7.5	24.3
Lambs	76.7	65.9	6.7	17.9

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 over the and lambs have been growing in average body weight. These elements mainly explain their increased gross energy intake.

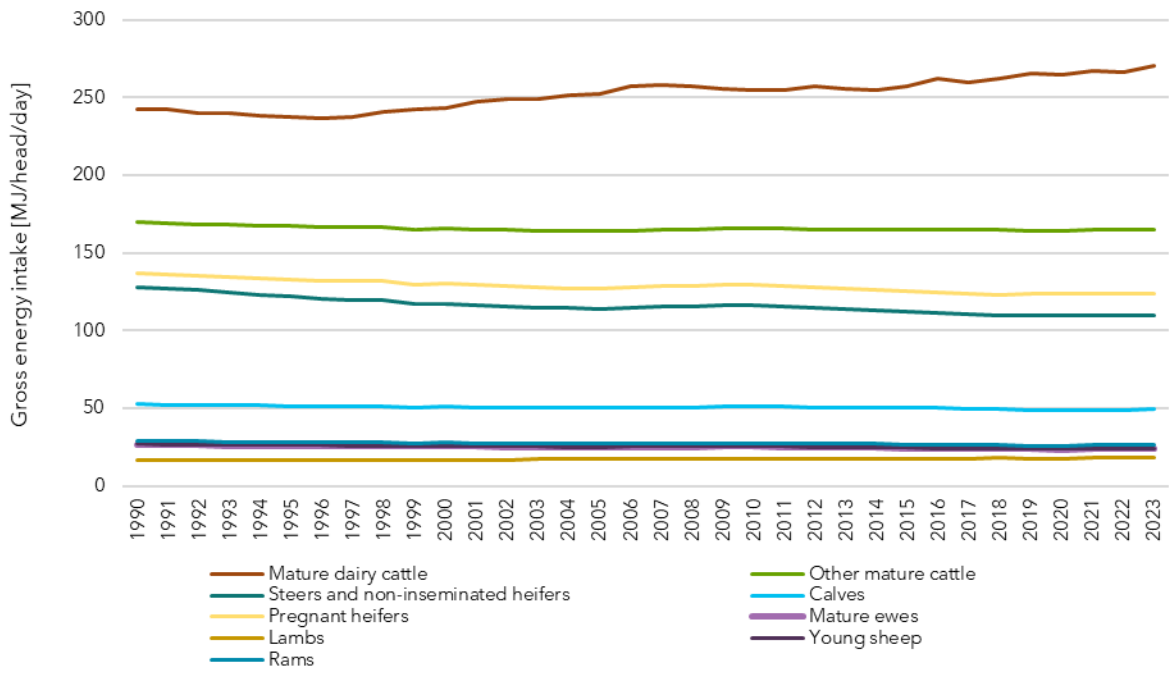


Figure 5.3 Gross energy intake [MJ/animal/day] for cattle and sheep subcategories since 1990.

The livestock category Growing Cattle comprises the categories Pregnant heifers, Young bulls and non-inseminated heifers, and Calves. Emissions are calculated separately for each category, as shown in Table 5.20, but uploaded in CRT as a sum. Manure management system fractions for growing cattle can be seen in Table 5.31.

Table 5.20 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	2022	2023
Population Pregnant Heifers	4,579	12,781	6,361	6,728	6,620	7,157	6,168	5,937	5,948
Population Young bulls and non-inseminated heifers	17,957	15,379	19,848	15,250	18,873	19,757	22,989	22,582	21,384
Population Calves	20,118	13,874	17,916	18,149	20,029	22,372	22,776	21,901	21,553
Weighted average Body weight (BW) [kg]	239	275	253	246	247	244	246	247	246
Weighted average digestible energy (DE) [%]	66.0	66.6	68.1	69.0	68.3	69.4	70.4	70.4	70.4
Weighted average gross energy (GE) [MJ/day]	93.2	102.0	91.9	87.4	89.2	85.8	84.5	84.8	84.5
Weighted average Volatile solid excretion (VS) [kg VS/day]	1.8	2.0	1.7	1.6	1.6	1.5	1.4	1.5	1.5
Weighted average Nex [kg N/head/year]	38.1	44.0	40.0	39.2	39.1	37.0	35.9	36.0	35.9

5.3.4 Recalculations

Recalculations for the 2025 Submission

Recalculations are due to livestock numbers being fetched for the whole timeline at once, instead of just updating the newest years, affecting most livestock categories. For the latest historical years there are also some updates in livestock numbers due to farmers late registration of livestock to MFAF. Broilers chickens, which are bred for meat production, were previously categorised as Chicken but are now under the category Broiler, resulting in recalculations.

Previously, there was a calculation error in the category Pullets, resulting in an underestimate of their number, which has now been fixed.

All changes in livestock numbers can be viewed in Table 5.21.

The body weight gain for pregnant heifers was updated from 0.5 kg/day to 0.443 kg/day based on data from the IAAC. The gender ratios in the category Young bulls and non-inseminated heifers was changed from 71% young bulls to 42% young bulls based on 2022 data from the IAAC, and in the Calves category from 46% male to 45% on average.

Table 5.21 Recalculations due to updated population numbers for most livestock categories.

Population (in 1000s)		1990	1995	2000	2005	2010	2015	2020	2021	2022
Sheep	2024 submission	858	719	730	713	753	753	636	613	586
	2025 submission	859	719	730	713	753	753	636	613	587
	Change relative to 2024 submission	0.83	–	–	–	0.028	–	0.022	0.16	0.07
	Change relative to 2024 submission [%]	0.10%	–	–	–	0.0038%	–	0.0034%	0.026%	0.012%
Swine	2024 submission	29.8	30.7	32.2	39.3	38.0	42.5	39.3	38.4	38.4
	2025 submission	29.3	30.7	32.2	39.3	38.0	42.5	39.3	38.4	38.4
	Change relative to 2024 submission	-0.44	–	–	–	–	–	–	–	–
	Change relative to 2024 submission [%]	-1.46%	–	–	–	–	–	–	–	–
Horses	2024 submission	73.9	80.2	75.6	76.6	78.8	79.4	73.4	70.5	70.1
	2025 submission	73.9	80.2	75.6	76.6	78.8	79.4	73.5	70.6	70.1
	Change relative to 2024 submission	–	–	–	–	–	0.042	0.068	0.090	-0.0061
	Change relative to 2024 submission [%]	–	–	–	–	–	0.052%	0.093%	0.13%	-0.0088%
Goats	2024 submission	0.485	0.511	0.548	0.657	1.01	1.48	2.37	2.44	2.75
	2025 submission	0.485	0.511	0.548	0.657	1.01	1.48	2.41	2.44	2.76
	Change relative to 2024 submission	–	–	–	–	–	–	0.047	–	0.0044
	Change relative to 2024 submission [%]	–	–	–	–	–	–	2.0%	–	0.16%
Fur Animals	2024 submission	49.6	37.9	41.4	37.1	39.9	48.0	15.8	16.7	12.9
	2025 submission	47.8	37.8	40.7	36.8	39.7	47.7	15.8	16.6	12.9
	Change relative to 2024 submission	-1.8	-0.084	-0.71	-0.27	-0.17	-0.34	-0.081	-0.072	-0.062
	Change relative to 2024 submission [%]	-3.7%	-0.22%	-1.7%	-0.73%	-0.41%	-0.71%	-0.51%	-0.43%	-0.48%
Poultry	2024 submission	665	345	508	656	598	675	802	796	834
	2025 submission	677	360	543	771	635	712	833	845	870
	Change relative to 2024 submission	12	14	34	115	37	38	31	50	37
	Change relative to 2024 submission [%]	1.8%	4.1%	6.7%	18%	6.2%	5.6%	3.9%	6.3%	4.4%

Recalculations for the 2024 Submission

After the 2023 submission, it was noticed that the overall pregnancy ratio of heifers (75%) had been incorrectly used to represent the pregnancy ratio of pregnant heifer, which should definitely be 100%. Additionally, updated livestock population numbers for cattle, sheep and horses effected emissions in sector 3A, 3B and 3D. The updates are due to farmers late registration of livestock to MFAF.

5.3.5 Planned Improvements

Iceland is continuing to work on improving the quality of the animal characterisation data by working with the MFAF and the IAAC with the aim of updating productivity data, such as the digestible energy content of feed and gross energy intake, approximately every three years for the Tier 2 livestock categories. In addition, it is planned to continue to update animal characterisation parameters regularly for all livestock categories, as was done for Tier 1 livestock categories in the 2022 submission, and Tier 2 livestock categories in the 2023 submission.

A closer cooperation is planned with the MFAF to streamline data acquisition. The MFAF collects agricultural data, some of which corresponds to activity data required for the inventory, in relation to grants given out to farmers annually. There is potential to restructure the MFAF database to correspond better with activity data required for the inventory and to collaborate on data acquisition in the future.

Activity data regarding manure management systems for sheep is lacking. The IAAC will collect data on MMS fractions in sheep farming and research just started at the Icelandic Agricultural University, that should result in country-specific MCF factors from slurry and pit storage in cattle and sheep farming, which should be available for use in the 2027 submission.

5.4 CH_4 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 CH_4 emissions in Iceland and therefore the Tier 2 methodology proposed by the 2006 IPCC Guidelines is applied. For all other livestock categories Tier 1 is applied and for those categories the methodology in the 2019 Refinements is applied.

5.4.1 Emission Factors

Tier 1

The CH_4 emissions from Swine, Horses and Goats are calculated using emission factors from the Table 10.10 in the 2019 Refinements. The emission factors for both Horses and Goats are adjusted using the average Icelandic animal weight 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 5.17). The adjustment is done as follows for adult horses, young horses and foals:

$$Approximate\ EF_{Group\ 1} = \left[\frac{Weight\ Icelandic\ horse_{Group\ 1}}{Liveweight\ in\ Table\ 10.10}\right]^{0.75} \times Tier\ 1\ EF$$

Similar adjustments are made for goats, where the low productivity emission factor is adjusted with the average weight of the Icelandic goats.

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 5.22 Emission factors used for Tier 1 calculations.

Livestock Category	EF [kg CH_4/head/year]	Source
Swine	1.5	IPCC 2019 Refinements, Table 10.10, high productivity system
Horses	13	IPCC 2019 Refinements, Table 10.10, weight adjusted
Goats	7.3	IPCC 2019 Refinements, Table 10.10, low productivity system, weight adjusted
Minks, Foxes, Rabbits	0.1	2019 Norwegian NIR
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 paragraph 5.3.3. These values, together with the default values of the CH_4 conversion rates from the 2006 IPCC Guidelines and reported in Table 5.23, were used to calculate emission factors for CH_4 emissions from Enteric Fermentation by applying Equation 10.21, Vol. 4. Table 5.24 shows the country specific emission factors for Cattle and Sheep and the respective subcategories. For all subcategories other than Mature Dairy Cattle and Lambs the emission factor has been decreasing due to increased feed digestibility. The increase for Mature Dairy Cattle is mainly due to the increase in milk production during the last two decades. For Lambs, it is the increased average body weight that has driven the emission factor increase.

Table 5.23 Methane conversion rates for cattle and sheep (from tables 10.12 and 10.13, IPCC 2006 Guidelines). The value for the young sheep is a weighted average between the Y_m for Mature Sheep and Lambs.

Category/Subcategory	Cattle	Mature Ewes	Young sheep	Lambs
Y_m	6.5%	6.5%	5.3%	4.5%

Table 5.24 Country-specific emission factors [kg CH_4/head/year] for cattle and sheep.

Livestock Category	2023	Relative change 1990-2023
Mature Dairy Cattle	114.9	11%
Other Mature Cattle	70.1	-3%
Pregnant Heifers	52.6	-10%
Young bulls and non-inseminated heifers	46.6	-14%
Calves	20.9	-6%
Mature Ewes	10.3	-8%
Rams	11.3	-8%
Young sheep	8.4	-10%
Lambs	5.3	10%

5.4.2 Emissions

CH_4 emissions from Enteric Fermentation in domestic livestock are calculated by multiplying the emission factors from paragraph 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 5.25.

The livestock category Growing Cattle comprises the categories Pregnant heifers, Young bulls and Non-Inseminated Heifers and Calves. CH_4 emissions are calculated separately for each category, as shown in Table 5.25, but are reported in the CRT as a total sum. In the CRT, all relevant parameters are expressed as a weighted average (see Table 5.20), 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 40% 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 CH_4 emissions are fairly constant.

Table 5.25 CH_4 emissions from Enteric Fermentation [t CH_4].

Livestock category	1990	1995	2000	2005	2010	2015	2020	2022	2023
Mature Dairy Cattle	3,266	3,072	2,802	2,631	2,755	3,000	2,923	2,929	2,945
Other Mature Cattle	47	53	67	95	113	144	231	262	246
Pregnant Heifers	267	724	353	365	364	382	324	312	313
Young Bulls and Non-Inseminated Heifers	978	799	988	742	932	943	1,072	1,053	997
Calves	450	305	388	388	434	477	475	458	451
Ewes	4,999	4,077	4,022	3,821	4,006	3,874	3,151	2,986	2,850
Rams	163	148	143	130	142	134	121	122	114
Young Sheep	833	665	709	722	813	746	615	569	575
Lambs	1,485	1,268	1,312	1,305	1,404	1,437	1,179	1,151	1,105
Swine	44	46	48	59	57	64	59	58	57
Horses	968	1,051	991	1,004	1,033	1,040	962	918	898
Goats	3.5	3.7	4.0	4.8	7.4	10.8	17.6	20.1	19.5
Fur Animals	5.0	3.8	4.1	3.7	4.0	4.8	1.6	1.3	0.5
Poultry	13.5	7.2	10.9	15.4	12.7	14.2	16.7	17.4	16.8
Total CH_4 emissions [t]	**13,521**	**12,223**	**11,842**	**11,286**	**12,079**	**12,271**	**11,148**	**10,857**	**10,588**
Emission change compared to 1990		-9.6%	-12.4%	-16.5%	-10.7%	-9.2%	-17.6%	-19.7%	-21.7%

5.4.3 Recalculations

Recalculations for the 2025 Submission

Recalculations are due to updated body weight gain for pregnant heifers, as well as updated gender ratios in the Young bulls and Non-Inseminated Heifers category and Calves category, see Table 5.26.

The 2019 Refinements methodology is now applied for Tier 1 animal categories, which results in recalculations for horses and goats. The new methodology allows for emission factor scaling by weight (see footnotes 2 and 3 with Table 10.10 and explanation in section

10.2.4 on page 33 in 2019 Refinements), which was applied to horses and goats, see Table 5.27.

A correction was made to the number of pullets for the whole timeline. The number for pullets in the livestock census data is the AAP number but had been believed to be the number of animals produced annually, see Table 5.27.

Finally, population numbers were fetched for the entire time series (1990-2023) for each animal category for this submission, following improvements in the connection to the livestock census database. This resulted in small changes for some livestock categories in certain years. Additionally, updates were made to livestock numbers for the most recent historical years due to delayed registration of livestock by farmers with the MFAF. See Table 5.21.

Table 5.26 Recalculations due to updated body weight gain for pregnant heifers, as well as updated gender ratios in the Young Bulls and Non-Inseminated Heifers category, and Calves category.

CRT 3A1, Cattle	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	143.2	142.0	132.0	120.8	131.9	141.8	144.2	144.9	143.9
2025 submission [kt CO_2e]	140.2	138.7	128.7	118.2	128.8	138.5	140.7	141.3	140.4
Change relative to the 2024 submission [kt CO_2e]	-3.0	-3.3	-3.2	-2.6	-3.1	-3.3	-3.5	-3.5	-3.5
Change relative to the 2024 submission [%]	-2.1%	-2.3%	-2.4%	-2.2%	-2.4%	-2.3%	-2.5%	-2.4%	-2.4%

Table 5.27 Recalculations due to methodology update to 2019 Refinements and livestock population correction for pullets.

CRT 3A4, Other livestock	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	37.8	40.8	38.6	39.2	40.3	40.7	37.8	36.4	36.2
2025 submission [kt CO_2e]	27.7	29.8	28.3	28.8	29.6	30.0	27.9	26.9	26.8
Change relative to the 2024 submission [kt CO_2e]	-10.1	-11.0	-10.3	-10.4	-10.7	-10.8	-9.9	-9.5	-9.4
Change relative to the 2024 submission [%]	-26.7%	-26.9%	-26.8%	-26.6%	-26.6%	-26.4%	-26.1%	-26.0%	-26.0%

Recalculations for the 2024 Submission

A number of changes in data sources led to recalculations for CH_4 emissions from enteric fermentation. Updated livestock population numbers for cattle, sheep and horses effected emissions in CRT sector 3A1, 3A2 and 3A4. Furthermore, the pregnancy ratio of heifers (75%) had been used to represent the pregnancy ratio of pregnant heifer, which should be 100%.

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 CH_4 emissions is 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), 3A3 (Swine), and for 3A4 (Other livestock) is 40%. The complete uncertainty analysis is shown in Annex 2.

5.4.5 Planned improvements

The emissions calculations for animal categories on Tier 1 level were updated to the 2019 Refinement methodology for the 2025 submission. It is planned to gather the information needed to be able to decide how to update the calculations for the Tier 2 livestock categories.

5.5 Emissions from Manure Management (CRT 3B)

The relevant greenhouse gases emitted from this source category are CH_4 (CRT 3Ba) and N_2O (CRT 3Bb). Cattle and sheep are the largest sources of emissions from manure management in Iceland and, therefore, Tier 2 methodology proposed by the 2006 IPCC Guidelines is applied. For all other livestock categories Tier 1 methodology from the 2019 Refinements is applied.

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 CH_4 in an anaerobic environment by microbiological processes and during storage and handling of manure, some nitrogen is converted to N_2O. Indirect N_2O emissions from deposition are also estimated from NH_3 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 CH_4

As stated earlier, for all livestock categories other than cattle and sheep, the Tier 1 methodology from the 2019 Refinements is applied, using Tables 10.13, as well as10.14 and Equations 10.22a and 10.22 (Volume 4, AFOLU, chapter 10).

For the livestock categories Cattle and Sheep, Tier 2 methodology from the 2006 IPCC Guidelines is applied. Based on the livestock characterisation described in 5.3.2, the volatile solid excretion rate is calculated using Equation 10.24 of the 2006 IPCC Guidelines. Subsequently, Equation 10.23 is used to calculate the CH_4 emission factor from manure management.

5.5.1.2 N_2O

A nitrogen mass-flow approach, as presented in the 2019 version of the EMEP/EEA Guidebook is used for the N_2O calculations. This approach has been designed to be fully consistent with the 2006 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 2006 IPCC Guidelines for nitrogen excretion is incorporated into the N-flow model.

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. N_2O 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 NH_3 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:

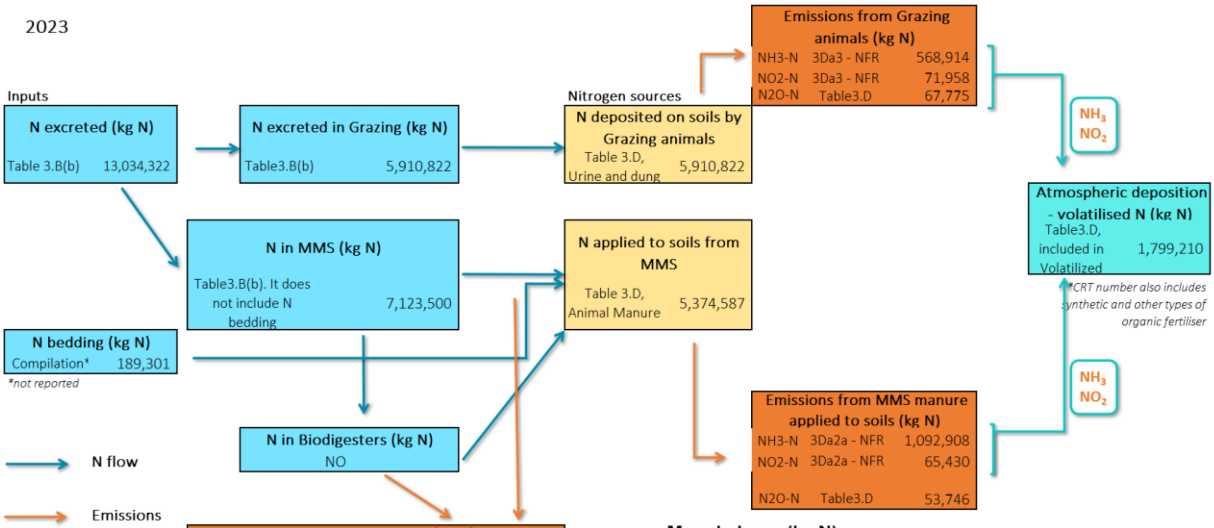
- Calculation of the amount of the annual nitrogen excreted, which is deposited in different areas (housed, yards, grazing), depending on the time period in which animals are for example housed inside or outside.
- Multiplication with the default proportions of TAN that can be found in table 3.9 of the 2023 EMEP/EEA Guidebook.
- Calculation of the amount of TAN and total nitrogen deposited in buildings as liquid/slurry or as solid.
- NH_3-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 (NH_3-N, N_2O-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.

For cattle and sheep, the nitrogen excretion rate is calculated according to Equations 10.31 and 10.32[27] in the 2006 IPCC Guidelines, as well as Equation 10.33 for cattle and Table 10.20 for sheep. For all other animal categories, the nitrogen excretion rates used come from Table 10.19 in the 2019 Refinements.

[27] Equation 10.32 is identical between the 2006 IPCC guidelines and the 2019 Refinements, however, in the 2019 refinements it is stated that the equation is valid for both cattle and sheep, instead of just for cattle and it is used for both animal categories in the Icelandic inventory.

Indirect emissions from housing are calculated by multiplying the nitrogen volatilised as NH_3-N and NO-N, deriving from the above-described N-flow methodology with the default emission factors (EF_4 = 0.01 kg N_2O-N) from the 2006 IPCC Guidelines (identical emission factor in 2019 Refinement).

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 (NH_3-N, NO_x-N, N_2O-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.



Mass balance (kg N)

INPUT	Total N excreted		13,034,322
INPUT	Total bedding		189,301
OUTPUT	Total N ex. GRAZING all livestock		5,910,822
OUTPUT	total N loss in Manure management systems (not grazing)		1,938,214
OUTPUT	total N available to apply to soils		5,374,587
BALANCE	check	SHOULD BE "0"	0

Figure 5.4 Complete Nitrogen flow applied to the categories 3B Manure Management and 3D Agricultural soils for 2023. 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 (NH_3 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 5.17, and manure management system fractions, Table 5.29. 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 5.15, Table 5.16 and Table 5.19. The volatile solid excretion (VS) and nitrogen excretion (Nex) rates can be seen in Table 5.28. 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 5.28 Volatile solids (VS) and nitrogen excretion (Nex) rates for the newest historical inventory year for all animal categories (NE: Not estimated).

Livestock Category	VS excretion [kg VS/head/day]	Nex [kg N/head/year]
Mature Dairy Cattle	4.77	94.9
Other Mature Cattle	2.88	69.2
Pregnant Heifers	2.19	57.1
Young bulls and non-inseminated heifers	1.92	46.3
Calves	0.78	19.7
Growing Cattle	1.45	35.9
Mature Ewes	0.46	10.3
Rams	0.51	11.4
Young sheep	0.46	10.4
Lambs	0.30	7.7
Swine	0.46	26.4
Piglets	0.32	16.9
Horses (weighted average)	1.64	27.5
Goats	0.42	7.8
Minks	NE	7.3
Foxes	NE	19.3
Rabbits	NE	13.0
Poultry	0.018	0.54

The fractions of total manure, managed in the different manure management systems (MMS), impact both CH_4 and N_2O emissions from manure management and consequently N_2O emissions from agricultural soils. The fractions used for all Cattle subcategories were updated for the entire time series for the 2023 submission (IAAC, 2022). 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 5.29.

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, hence, by applying the gender ratios of the young bulls and heifers, the category as a whole is 16% of the time in pasture, range and paddock. Most cattle manure is managed as slurry without a natural crust cover. The use of solid storage for Calves increased from 10% to 74% from 1990-2008 and has been stable since then. 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 (17%) than PRP (1%) 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 2006 IPCC Guidelines (0.19 kg CH_4/head/year, cool conditions, Table 10.15 in the 2006 IPCC Guidelines), 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 5.29 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%	75%		15%
Other Mature Cattle		8%		92%
Pregnant Heifers	7%	60%		33%
Young bulls and non-inseminated heifers	10%	75%		16%
Calves		26%	74%	
Mature Ewes		19%	36%	45%
Rams		19%	36%	45%
Young sheep		19%	36%	45%
Lambs			2%	98%
Goats			55%	45%
Horses			14%	86%
Young horses			14%	86%
Foals				100%
Sows		100%		
Piglets		100%		
Poultry			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, a significant increase from 47 kg/animal/year in 1990, when only 10% of calf manure was stored in solid storage. In the Cattle subcategory, straw is otherwise used only for calving cows in Iceland, with an estimated use of 3 kg/animal/year. For Sheep, Goats and Horses, the default straw values from the 2023 EME/EEA Guidebook (Table 3.7) are adjusted for a different housing period. For example, sheep have a default housing period of 30 days, but in Iceland, it is 200 days. Therefore, the default straw value of 20 kg/animal/year is multiplied by 200/30 to obtain 133.3 kg/animal/year.

5.5.3 Emission Factors

5.5.3.1 CH_4

Tier 1

Default CH_4 emission factors are used for all livestock categories except Cattle and Sheep, shown in Table 5.30. 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 5.17. For the livestock categories Pigs, Horses and Poultry, the emissions are calculated in a disaggregated level to reflect the different emission factors and then summed.

Table 5.30 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]	9.7
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 CH_4/head/year.

Tier 2

MCF and maximum CH_4-producing capacity of manure (B_0) values for both livestock categories, Cattle and Sheep, are taken from the 2006 IPCC Guidelines, see Table 5.31.

Table 5.31 CH_4 conversion factor (MCF) and CH_4-producing capacity (B_0) from the 2006 IPCC Guidelines used for the calculations of CH_4 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, 2006 IPCC	1%	2%	10% [1] / 17% [2]	Same as for cattle
		Mature Dairy Cattle		Other Cattle	Sheep
B_0	Tables 10A-4, 10A-9, 2006 IPCC	0.24		0.18	0.19

[1] With natural crust cover. [2] Without natural crust cover.

The emission factors are calculated with VS rates, MCFs, and manure management fractions for Cattle and Sheep, and are shown in Table 5.32. Mature Dairy Cattle have the highest emission factors for CH_4 from manure management.

Table 5.32 Emission factors values and range for the Tier 2 calculations of CH_4 emissions from manure management.

Livestock Category	Emission factor [kg CH_4/head/year]	Emission factors range 1990-2023 [kg CH_4/head/year]
Mature Dairy Cattle	38.91	33.17 - 38.91
Other Mature Cattle	2.93	2.81 - 3.18
Pregnant Heifers	10.80	8.73 - 14.14
Young bulls and non-inseminated heifers	11.66	8.8 - 16.05
Calves	2.03	1.8 - 6.25
Mature Ewes	0.95	0.79 - 1.14
Rams	1.04	0.87 - 1.24
Young sheep	0.95	0.79 - 1.16
Lambs	0.14	0.13 - 0.15

5.5.3.2 N_2O

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 5.33.

Table 5.33 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.

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_2O-N Storage[1]	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	0.02	0.01
All Other Cattle[2]	0.6	0.70	0.30	305	Slurry	0.24	0.25	0/0.01	0.0001
					Solid	0.08	0.32	0.02	0.01
Sheep	0.5	0.35	0.65	200	Slurry	0.24[3]	0.25[3]	0.001	0.0001
					Solid	0.22	0.32	0.02	0.01
Swine - piglets	0.7	1	0	365	Slurry	0.27	0.11	0	0.0001
					Solid	0.23	0.29	0.01	0.01
Swine - Sows	0.7	1	0	365	Slurry	0.35	0.11	0	0.0001
					Solid	0.24	0.29	0.01	0.01
Goats	0.5	0	1	200	Solid	0.22	0.28	0.02	0.01
Horses	0.6	0	1	51	Solid	0.22	0.35	0.02	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
Other (fur animals)	0.6	0	1	365	Solid	0.27	0.09	0.002	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] All Other Cattle consists of Other Mature Cattle, Pregnant Heifers, Young bulls and non-inseminated heifers and Calves. A weighted average is used for fraction slurry/solid and housing period for these subcategories.

[3] No EFs exist for NH_3 emissions from slurry for sheep in the 2019 EMEP/EEA Guidebook. Hence, the EFs for Cattle are applied.

The emission factors used to calculate emissions of N_2O-N during manure storage (Table 5.33) are based on the default emission factor from the 2006 IPCC Guidelines. While the IPCC emission factors are expressed as a proportion of total nitrogen at excretion, the EMEP/EEA emission factors are expressed as proportions of TAN in manure entering storage. In order to convert from the IPCC emission factors to the EMEP/EEA emission factors, the IPCC ones are divided by the proportion of TAN in manure-N entering storage. Further information can be found in the annex (Table A1.8) of the EMEP/EEA 2023 Guidebook, chapter 3B.

The emission factor for indirect emissions due to volatilised NH_3-N and NO-N is taken from the 2006 IPCC Guidelines (Volume 4, chapter 11), EF_4, and corresponds to 0.01 kg N_2O-N/(kg NH_3–N + NO–N volatilised). Indirect emissions from leaching and runoff from storage are not estimated, further information on this can be found in Section 5.5.5.

5.5.4 Emissions

5.5.4.1 CH_4 Emissions

The emission factor variations, which can be seen for Cattle subcategories in Table 5.32, are due to changes in feed digestibility and gross energy intake, 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.

Three livestock subcategories alone are responsible for roughly two thirds of CH_4 emissions from manure management: Mature Dairy Cattle, Young bulls and non-inseminated heifers, and Mature Ewes. Other important livestock categories for CH_4 emissions from manure management are Swine, Horses, and Poultry, as seen in Table 5.34.

Table 5.34 CH_4 emissions from manure management [t].

Livestock category	1990	1995	2000	2005	2010	2015	2020	2022	2023
Mature Dairy Cattle	1,210	1,126	1,002	921	980	1,020	967	992	998
Other Mature Cattle	2.0	2.3	2.9	4.0	4.8	6.1	9.7	11.0	10.3
Pregnant Heifers	65	170	80	80	81	81	67	64	64
Young Bulls and Non-Inseminated Heifers	288	225	268	196	250	243	267	263	249
Calves	126	75	74	62	44	48	46	44	44
Mature Ewes	506	404	391	365	389	360	283	275	263
Other Mature Sheep	17	15	14	12	14	12	11	11	11
Young sheep	104	81	85	86	98	86	68	65	66
Lambs	40	34	35	35	38	39	32	31	30
Swine	229	241	253	306	295	329	303	296	294
Horses	44	46	46	47	47	48	44	42	41
Goats	0.09	0.09	0.10	0.12	0.19	0.27	0.44	0.50	0.49
Fur Animals (minks and foxes)	32	26	28	25	27	32	11	9	4
Rabbits	0.15	0.01	0.06	0.02	0.01	0.03	0.01	0.00	0.00
Poultry	164	63	94	79	59	52	49	44	36
Total CH_4 from manure management	**2,827**	**2,508**	**2,372**	**2,219**	**2,326**	**2,357**	**2,158**	**2,149**	**2,109**
Emission change 1990-2023		-11%	-16%	-22%	-18%	-17%	-24%	-24%	-25%

5.5.4.2 N_2O Emissions

N_2O emissions from manure management can be seen in Table 5.35, including indirect emission from manure management as atmospheric deposition of nitrogen on soils and water surfaces, due to volatilisation of nitrogen.

Table 5.35 N_2O emissions from manure management [t N_2O]

[t N_2O]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Liquid systems	1.5	1.7	2.2	2.3	2.9	3.3	3.4	3.3	3.3
Solid storage (sheep, goats)	16.5	13.9	14.4	14.0	14.8	13.6	10.8	10.5	10.1
Other solid storage	3.3	3.5	4.8	5.5	7.0	7.5	7.0	6.8	6.7
Indirect N_2O emissions: atmospheric deposition	31.2	28.9	29.2	28.4	29.5	30.5	27.8	27.3	26.5
Total N_2O from manure management	**52.5**	**48.0**	**50.7**	**50.2**	**54.3**	**54.9**	**49.0**	**47.9**	**46.6**
Emission change 1990-2023		-9%	-4%	-4%	3%	4%	-7%	-9%	-11%

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 N_2O emissions from manure management.

Figure 5.5 shows N_2O 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.

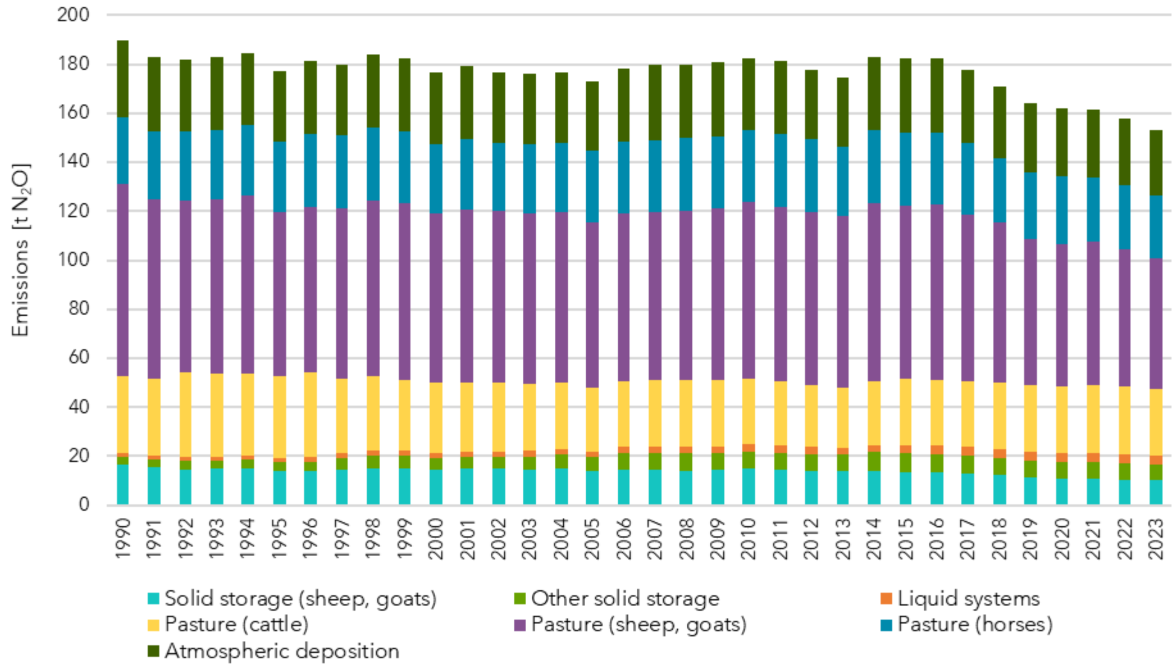


Figure 5.5 N_2O emissions from manure management and from urine and dung from grazing animals, including indirect emissions due to volatilisation from manure management, [t N_2O].

5.5.4.3 Indirect Emissions from Leaching and Run-Off from Storage

While detailed information is available on the nitrogen entering different manure stores and the losses to air during storage, Iceland lacks country-specific data on the fraction of nitrogen from manure storage that contributes to leaching and run-off. This data is necessary to calculate emissions resulting from leaching and run-off from storage.

Having reviewed the approaches used in several other countries (Denmark, Sweden, Norway, Finland), it is clear that a wide variety of approaches and assumptions are applied to estimate this source, particularly the fraction of stored nitrogen contributing to leaching and run-off. Consequently, it was not considered appropriate to arbitrarily select a value from the 1-20% range quoted in the 2006 IPCC Guidelines. Notably, no default fraction is provided to support a Tier 2 calculation.

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 a slight overestimation of N_2O 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 N_2O. The emission factor for leaching and run-off (0.0075 kg N_2O-N / kg N leaching and run-off) is smaller than that from storage and/or application (0.01 kg N_2O-N / kg N applied).

Leaching and run-off that may arise from nitrogen inputs to agricultural soils are considered in 3D Managed soils.

5.5.5 Recalculations

Recalculations for the 2025 Submission

The 2019 Refinements methodology is now applied for Tier 1 animal categories, which results in recalculations for all groups. The largest absolute changes in CH_4 emissions are an increase for pigs and decrease for horses and poultry. This methodology change also affects N_2O emissions, mainly from goats and poultry. The animal weight of some of the Tier 1 animals was updated, which also affected both CH_4 and N_2O emissions. A correction was made to the number of pullets for the entire time series. The number for pullets in the livestock census data is the AAP number but had been believed to be the number of animals produced annually. This correction affects both CH_4 and N_2O emissions from manure management. The recalculations for the CRT categories 3B3 and 3B4 can be seen in

Table 5.38,

Table 5.39 and

Table 5.40.

An error was found in the fractions of slurry with and without crust in the N_2O calculation sheet, causing recalculations for all Cattle subcategories. For the adult cattle categories the protein content in milk was used instead of the milk fat content in the nitrogen retention calculations, which affected the Nex rate for these categories, and hence, the direct and indirect N_2O emissions. Updated body weight gain for pregnant heifers, as well as updated gender ratios in the Young Bulls and Non-Inseminated Heifers category and Calves category, had a minor effect on the emissions from manure management, mostly visible in the CH_4 emissions, but which also affected the N_2O emissions. The effects of these recalculations for Cattle can be seen in Table 5.36 and Table 5.37.

Finally, population numbers for the entire time series (1990-2023) were retrieved for each animal category for this submission, following improvements in the connection to the livestock census database. This led to minor changes in some livestock categories for certain year. Additionally, updates were made to livestock numbers for recent historical years due to farmers' late registration of livestock with the MFAF. See Table 5.21.

All of the above recalculations affected the indirect N_2O emissions due to atmospheric deposition as can be seen in Table 5.41.

Table 5.36 Recalculations due to updated body weight gain for pregnant heifers, as well as updated gender ratios in the Young bulls and Non-Inseminated Heifers category and Calves category.

CRT 3B1, CH_4 emissions	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	48.2	45.7	40.8	36.1	38.9	40.0	39.0	39.7	39.5
2025 submission [kt CO_2e]	47.3	44.8	39.9	35.4	38.1	39.1	38.0	38.7	38.5
Change relative to the 2024 submission [kt CO_2e]	-0.90	-0.92	-0.88	-0.70	-0.86	-0.90	-0.96	-0.96	-0.95
Change relative to the 2024 submission [%]	-1.9%	-2.0%	-2.2%	-1.9%	-2.2%	-2.2%	-2.5%	-2.4%	-2.4%

Table 5.37 Recalculations due to updated fractions of slurry with and without crust for all cattle categories, as well as due to the usage of protein content in milk in Nex calculations for adult cattle categories, and due to updated body weight gain for pregnant heifers, as well as updated gender ratios in the Young bulls Non-Inseminated Heifers category and Calves category.

CRT 3B1, N_2O emissions	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	0.87	0.90	1.17	1.24	1.69	1.80	1.76	1.74	1.72
2025 submission [kt CO_2e]	0.32	0.46	0.89	1.06	1.61	1.79	1.82	1.80	1.78
Change relative to the 2024 submission [kt CO_2e]	-0.55	-0.44	-0.28	-0.18	-0.078	-0.003	0.062	0.063	0.061
Change relative to the 2024 submission [%]	-63.2%	-49.2%	-23.6%	-14.7%	-4.6%	-0.16%	3.5%	3.6%	3.6%

Table 5.38 Recalculations due to methodology update to 2019 Refinements and updated animal weights.

CRT 3B3, CH_4 emissions	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	5.0	5.2	5.4	6.6	6.4	7.1	6.6	6.4	6.5
2025 submission [kt CO_2e]	6.4	6.8	7.1	8.6	8.2	9.2	8.5	8.3	8.3
Change relative to the 2024 submission [kt CO_2e]	1.4	1.6	1.7	2.0	1.9	2.1	1.9	1.8	1.8
Change relative to the 2024 submission [%]	28.1%	30.7%	30.6%	29.7%	29.1%	28.7%	28.5%	28.5%	28.5%

Table 5.39 Recalculations due to methodology update to 2019 Refinements, livestock population correction for pullets, and updated animal weights.

CRT 3B4, CH_4 emissions	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	20.4	10.1	12.9	10.6	8.8	7.9	6.3	5.7	5.4
2025 submission [kt CO_2e]	6.7	3.8	4.7	4.2	3.7	3.7	2.9	2.8	2.7
Change relative to the 2024 submission [kt CO_2e]	-13.7	-6.4	-8.2	-6.4	-5.0	-4.2	-3.4	-2.9	-2.7
Change relative to the 2024 submission [%]	-67.0%	-62.7%	-63.6%	-60.2%	-57.4%	-52.9%	-53.6%	-51.3%	-50.6%

Table 5.40 Recalculations due to methodology update to 2019 Refinements, livestock population correction for pullets, and updated animal weights.

CRT 3B4, N_2O emissions	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	0.69	0.69	0.72	0.76	0.76	0.83	0.82	0.81	0.83
2025 submission [kt CO_2e]	0.75	0.74	0.77	0.83	0.82	0.88	0.80	0.78	0.78
Change relative to the 2024 submission [kt CO_2e]	0.058	0.053	0.054	0.068	0.060	0.053	-0.026	-0.025	-0.050
Change relative to the 2024 submission [%]	8.4%	7.7%	7.6%	9.0%	7.9%	6.3%	-3.2%	-3.1%	-6.0%

Table 5.41 Recalculations for the CRT category 3B5 Indirect N_2O emissions due to updated fractions of slurry with and without crust for all cattle categories, as well as due to the usage of protein content in milk in Nex calculations for adult cattle categories, and due to updated body weight gain for pregnant heifers, as well as updated gender ratios in the Young bulls and non-inseminated heifers category and Calves category. Also, due to methodology change from 2006 IPCC Guidelines to 2019 Refinements for all Tier 1 animal categories and updated animal weights.

CRT 3B5, N_2O emissions	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	8.44	7.29	7.43	7.02	7.25	7.43	6.86	6.82	6.73
2025 submission [kt CO_2e]	8.27	7.65	7.75	7.52	7.83	8.08	7.36	7.34	7.22
Change relative to the 2024 submission [kt CO_2e]	-0.17	0.36	0.32	0.50	0.58	0.64	0.50	0.52	0.49
Change relative to the 2024 submission [%]	-2.0%	4.9%	4.3%	7.1%	8.0%	8.6%	7.3%	7.6%	7.3%

Recalculations for the 2024 Submission

A number of changes in data sources led to recalculations for emissions from manure management. Updated livestock population numbers for cattle, sheep and horses effected emissions. Furthermore, the pregnancy ratio of heifers (75%) had been used to represent the pregnancy ratio of pregnant heifer, which should be 100%. The manure management CH_4 emission factor for horses was corrected from 1.58 kg CH_4/head/year to 1.56 kg CH_4/head/year to fit the emission factor for developed countries in cool climate according to Table 10.15, 2006 IPCC Guidelines.

The wet/dry fractions in manure management for Layers were updated for the 2024 submission. These fractions have been evolving over the timeline from mostly wet to mostly dry, affecting the emissions from Poultry manure management.

The methodology used for NMVOC emissions calculations from Manure management was updated for the 2024 submission from Tier 1 to Tier 2 for Cattle. The methodology follows the 2019 EMEP/EEA Guidebook.

5.5.6 Uncertainties

The complete uncertainty analysis is shown in Annex 2: Assessment of Uncertainty.

The activity data uncertainties, affecting both CH_4 and N_2O 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 CH_4

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) 45%.

5.5.6.2 N_2O

The additional N_2O 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 61% 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) 84%. Indirect emissions from manure management have a combined uncertainty of 451%, with 208% uncertainty for activity data and 400% 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

The emissions calculations for animal categories on Tier 1 level were updated to the 2019 Refinement methodology for the 2025 submission. It is planned to gather the information needed to be able to decide how to update the calculations for the Tier 2 livestock categories.

Research was launched in the end of 2024 with the aim to establish country specific B_0 and MCFs from slurry and pit storage in cattle and sheep farming. Results, expected in 2026, will be incorporated in the 2027 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 N_2O Emissions from Managed Soils (CRT 3D)

The largest sources of emissions are cultivated and uncultivated drained organic soils, causing 50-60% of the total emissions from Agricultural Soils (CRT 3D). The overall emissions from Agricultural Soils have increased since 1990.

N_2O is produced naturally in soils through the microbial processes of nitrification and denitrification. The following agricultural activities lead to N_2O 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 N_2O emitted. The emissions of N_2O that result from anthropogenic nitrogen inputs also occur through two indirect pathways:

- Volatilisation of nitrogen as NH_3 and NO_x from agricultural fertilisers and manure and subsequent atmospheric deposition.
- Leaching and runoff of applied fertiliser and animal manure, crop residues and urine and dung deposition.

5.7.1 Methodology

Direct N_2O emissions from Agricultural Soils are calculated applying the Tier 1 methodology from the 2006 IPCC Guidelines using Equation 11.1.

To calculate the amount of N_2O-N deposited, the amounts of NH_3-N and NO_2-N volatilised from inorganic nitrogen fertilisers, animal manure applied to soils, urine and dung deposited by grazing animals, and from sewage sludge applied to soils are first calculated separately. The sum of these values is then multiplied with the default emission factor of 0.01 (kg N_2O-N per kg of NH_3-N & NO-N) from the 2006 IPCC Guidelines (Table 11.3, EF_4). A comparison of this method with the IPCC 2006 Guidelines Tier 1a (using FracGas) was carried out and the proportion of synthetic nitrogen volatilised as NH_3 and NO is only about 0.022 compared to the 0.1 assumed with FracGas. Considering, however, that not much urea is used in Iceland, combined with the cool climate and normal pH soils, this method seems more accurate.

A large proportion of nitrogen applied to 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 30% is leached or runs-off (default $Frac_{LEACH-(H)}$ from the 2006 IPCC Guidelines). Indirect N_2O emissions from leaching and run-off are then calculated by multiplying the resulting nitrogen amount with the emission factor from the 2006 IPCC Guidelines (see Equation 11.10).

5.7.2 Activity data

Table 5.42 shows the activity data used for emissions calculations from Agricultural Soils. Further description is in the following subsections.

Table 5.42 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	2022	2023
Inorganic fertilizers [t N]	12,471	11,193	12,665	9,757	10,858	11,652	11,365	11,184	9,034
Manure applied to soils [t N]	6,460	5,947	6,028	5,845	6,162	6,313	5,674	5,522	5,375
Sewage sludge [t N]	NO	NO	NO	NO	NO	1.69	13.69	18.55	43.36
Other organic fertilisers [t N]	NO	NO	NO	21.0	109	179	209	325	302
Urine and dung from grazing animals [t N]	7,733	7,150	7,097	6,998	7,303	7,256	6,308	6,101	5,911
Organic soils - cropland [kha]	48.9	49.5	50.0	50.6	52.0	54.7	57.5	58.6	59.1
Organic soils - grasslands [kha]	169	215	239	264	265	266	269	271	272
Total area [kha]	217	265	289	315	317	320	327	329	331

5.7.2.1 Inorganic N Fertiliser (F_{SN})

In Iceland, all fertilisers imported into the country must be registered by customs, and the IFVA must be notified of every import or domestic manufacture of fertilisers, in accordance with the Icelandic laws No 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. 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 SI [28].

In the case of fertilisers used in forestry by Land and Forest Iceland (LaFI), the amount of inorganic fertilisers used is subtracted from the overall national fertiliser use, since it is accounted for in the Land Use, Land-use Change and Forestry sector.

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 5.7). In addition, according to the expert at the IFVA, 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.

5.7.2.2 Organic N Fertiliser (F_{ON})

Animal Manure Applied to Soils

The amount of manure applied and the amount of urine and dung from grazing animals comes from the N-flow approach, 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 5.42).

[28] https://hagstofa.is/talnaefni/atvinnuvegir/landbunadur/aburdur/

Sewage Sludge Applied to Soils

The regulations 799/1999 (about handling of sewage sludge) and 737/2003 (on waste management) define 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 LaFI. 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 (Magnus H. Johannson, e-mail, June 2022 and Guðný H. Indriðadóttir, e-mail, June 2023). 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 5.7 the emissions from the application of sewage sludge are low.

Other Organic Fertilisers Applied to Soils

Information on type and quantity of other organic fertilisers applied to soils is received from LaFI. No application of these types of fertilisers is known from before the year 2002. Information on nitrogen content in bonemeal, gore and compost were retrieved from LaFI (Sveinsson, oral communication, 2020) and Molta Ltd. (Molta, 2020).

An effort was made for the 2023 submission to prevent underreporting of organic fertiliser use in the Icelandic inventory. The IFVA maintains a list of companies licenced to sell organic fertilisers in Iceland since 1990. All companies on the list were contacted for sales data of organic fertilisers, but the response was incomplete. Furthermore, it would be impossible to separate fertiliser sold by the companies and subsequently used by LaFI in forestry projects from the data LaFI has already provided on total usage in both land reclamation and forestry projects. Therefore, to prevent double counting it was decided not to use any of the obtained fertiliser sales data for this submission.

This category reports other organic fertilisers used by LaFI for land-reclamation purposes: bone meal and a by-product of slaughterhouses, stomach, and gut contents of sheep. 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 produced by one company in Iceland with a high nitrogen content has been added to this subcategory. Figure 5.7 shows the N_2O emissions from this category.

5.7.2.3 Urine and Dung Deposited by Grazing Animals (F_{PRP})

Nitrogen deposited from animals at pasture, range and paddock is also 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 (FCR)

There are three types of nitrogen fixing crops cultivated in Iceland: tubers (potatoes), barley, and root crops (turnips and carrots). After harvest, crop residues are returned to soils. The amount of residue returned to soils is derived from crop production data. The crop yield data, retrieved from SI, is reported in harvested fresh yield and is therefore corrected for dry weight by using Equation 11.7 from the 2006 IPCC Guidelines. For the residue to crop ratio, dry matter fraction and nitrogen fraction, the IPCC default values from Table 11.2 are used. It is estimated that 80% of barley residue is used as fodder, as well as bedding for calves.

Data on the total annual areas harvested of each crop were exported from the FAO database for the time series available. The years, for which data on annual areas harvested was missing, were gap filled based the following assumptions:

- The time series, from 1990 to second latest inventory year, is available for potatoes and carrots. The ratio between the annual areas harvested with the crop yield for the latest known 8 years is used to calculate the annual areas harvested in the latest inventory year.
- The years since 2015 have area harvested for barley. The rest of the years are gap filled, using the ratio between the annual areas harvested with the crop yield for known years. The calculated ratio is then multiplied with the crop yield of barley for 1990-2014.
- No data is available for turnips. The annual areas of turnips harvested is gap filled for all years by using the ratio for carrots. This ratio is then multiplied with the crop yield of turnips since 1990.

The amount of residue per crop returned to soils is subsequently calculated using Equation 11.6 from the 2006 IPCC Guidelines. Crop produce amounts and associated N_2O emissions are shown in Figure 5.6.

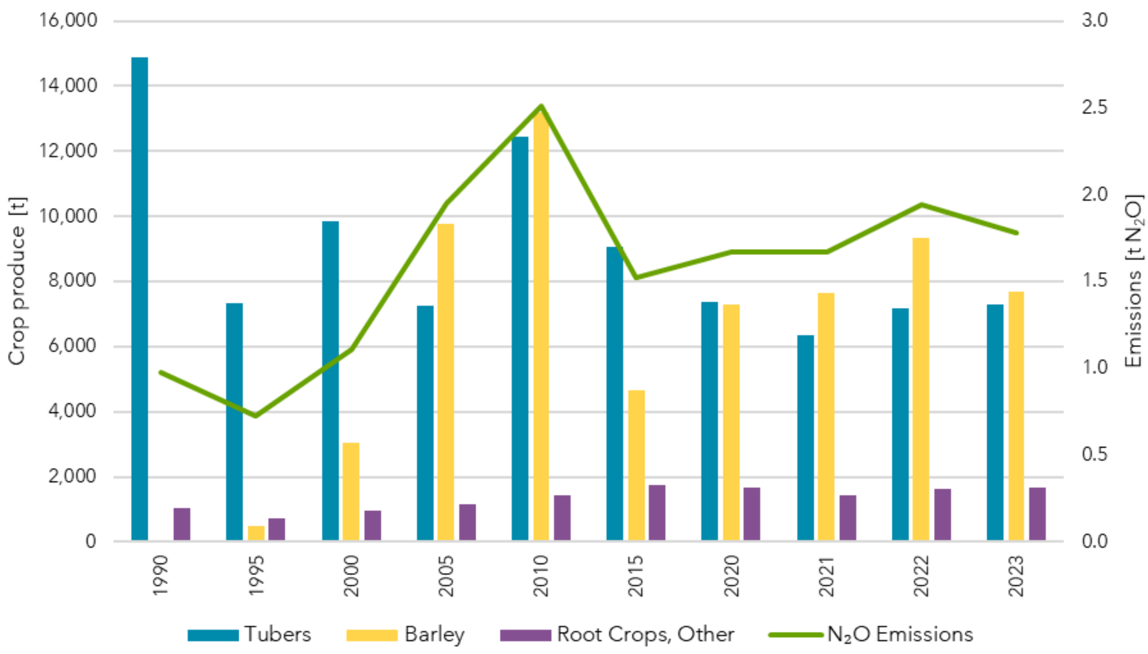


Figure 5.6 Crop produce and associated N_2O emissions since 1990.

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 land remaining cropland or in land converted to cropland, and therefore 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 used for the grazing of animals are calculated. The areas of the organic soils are calculated by the LULUCF team at LaFI and communicated to the IEEA. The areas and associated N_2O emissions are reported in Table 5.42 and Figure 5.7.

5.7.2.7 Activity Data for Indirect Emissions

All the 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

The emission factors applied in emissions calculations from Agricultural Soils are from the 2006 IPCC Guidelines, Vol. 4, chapter 11 and are reported in Table 5.43 and Table 5.44.

Iceland uses two country specific emission factors to calculate the emissions from organic soils; 2.24 kg N_2O-N/ha/yr for the emissions from cultivated drained histosols comprising mostly hay fields and 1.26 kg N_2O-N/ha/yr for drained organic soils used for grazing. 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.

Table 5.43 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 2006
Animal manure applied to soils	EF_1	0.01	Table 11.1 IPCC 2006
Sewage sludge applied to soils	EF_1	0.01	Table 11.1 IPCC 2006
Urine and Dung deposited by grazing animals	EF_{PRP}	0.02 cattle, poultry, pigs	Table 11.1 IPCC 2006
	EF_{PRP}	0.01 sheep and other	
Crop residues	EF_1	0.01	Table 11.1 IPCC 2006
Cultivation of organic soils	EF_{OS}	2.24/1.26 [kg N_2O-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 5.44 Emission factors used for the estimation of indirect N_2O emissions from agricultural soils.

		N_2O Emission Factor	Source
N Volatilisation and redeposition	EF4	0.01 [kg N_2O-N / (kg NH_3-N + NO_x-N volatilised)]	Table 11.3 IPCC 2006
Leaching and runoff	EF5	0.0075 [kg N_2O-N / (kg N leaching/runoff)]	Table 11.3 IPCC 2006
$Frac_{LEACH-(H)}$		0.3 [kg N (kg N additions or deposition by grazing animals)]	Table 11.3 IPCC 2006

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 5.7. There is a downward trend in direct and indirect N_2O emissions in the last few years, which can be explained by a decrease synthetic fertiliser usage and a decrease in the sheep population in Iceland.

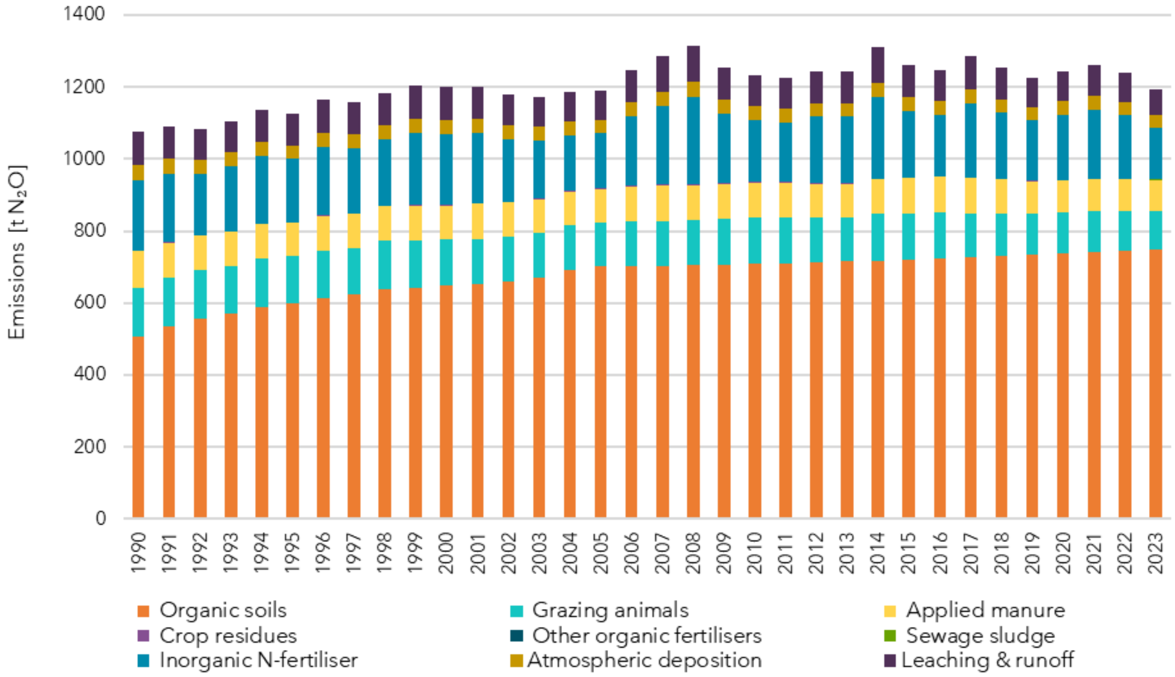


Figure 5.7 Direct N_2O emissions from Agricultural Soils [t N_2O].

5.7.5 Recalculations

Recalculations from the 2025 Submission

The largest change in emissions from Agricultural Soils between submissions occurred in the subsector Cultivation of Organic Soils. This change is due to the publication of a peer-reviewed paper in 2024, which introduced updated emissions factors. These emission factors are based on the same research as previous ones, originally derived from a report published after the research concluded. In the newly published paper, the statistical analysis was revisited, resulting in higher emission factors. The factor for cropland increased from 0.99 kg N_2O-N/ha/yr to 2.24 kg N_2O-N/ha/yr and the factor for grassland increased from 0.44 kg N_2O-N/ha/yr to 1.26 kg N_2O-N/ha/yr. The effect on emissions can be seen in Table 5.45.

Table 5.45 Recalculation due to updated emission factors in 3D1f Cultivation of Organic Soils.

CRT 3D1f Cultivation of Organic Soils	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 Submission [kt CO_2e]	45	54	59	64	65	66	68	68	68
2025 Submission [kt CO_2e]	134	159	172	186	188	191	195	196	197
Change relative to the 2024 submission [kt CO_2e]	89	105	113	122	123	124	127	128	128
Change relative to the 2024 Submission [%]	196%	194%	193%	191%	188%	188%	188%	188%	188%

For the 2025 submission, population numbers were updated for the entire time series (1990-2023) across all animal category due to improved access to the livestock census database, resulting in minor changes in livestock numbers for some categories and years. Additionally, livestock numbers for the most recent historical years were updated due to farmers' late registration of livestock with the MFAF. These updates have slight impacts on the N_2O emissions from managed soils, see Table 5.21.

Recalculations from the 2024 Submission

Several recalculations were made for the 2024 submission which affected N_2O emissions from managed soils. Inorganic fertiliser use in forestry is now reported in LULUCF sector but was previously reported in Agriculture. Inorganic fertiliser use in Agriculture has been adjusted because of this.

A number of changes in data sources led to recalculations in 3D12a Organic N Fertiliser. Updated livestock population numbers for cattle, sheep and horses, as well as updated pregnancy ratio of pregnant heifers, affected emissions in CRT sector 3D12a.

For the 2024 submission, better data was obtained for the nitrogen content of sewage sludge used as a fertiliser. This update led to some changes to the emissions from subsector 3D12b.

Updated data on bone meal used as fertiliser from 2014 to 2021 led to recalculations in sector 3D12c.

Updated area for potatoes, barley, turnips, and carrots caused recalculations from 1990 to 2021.

All the above recalculations also affected the Indirect N_2O Emissions from Managed Soils.

Recalculations were in sector 3D1f Cultivation of Organic Solis due to updated Cropland and Grassland areas.

5.7.6 Uncertainties

5.7.6.1 Direct N_2O 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 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.

The emission factor uncertainties for N_2O emissions are calculated using the lower and upper range values of the default emission factors from the 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.1, and amount to 200%. The 3D1f combined emission factor uncertainty is based on the uncertainty for the EFs for cultivated and uncultivated drained land, 66% and 51% respectively, taken into account the size of each land group. The combined uncertainty is 43%.

The combined uncertainties of activity data and emission factors are the following: 3D1a Inorganic Fertilisers 200%, 3D1b Organic Fertilisers 197%, 3D1c Urine and Dung Deposited by Grazing Animals 209%, 3D1d Crop Residues 283%, and 3D1f Cultivation of Organic Soils 46%. The complete uncertainty analysis is shown in Annex 2.

5.7.6.2 Indirect N_2O Emissions

Activity data uncertainty is 200% for atmospheric deposition and 27% 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 2006 IPCC Guidelines, as well as for $Frac_{LEACH-(H)}$, resulting in 400% emission factor uncertainty for atmospheric deposition and 287% for nitrogen leaching and run-off. Combined uncertainty is 447% and 288% for atmospheric deposition and nitrogen leaching and run-off, respectively.

5.7.7 Planned improvements

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 was updated from NE (not estimated) to NO (not occurring) for the 2023 submission.

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 unuse 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 CO_2 Emissions from Liming, Urea Application, and Other Carbon-containing Fertilisers (CRT 3G, 3H, 3I)

Combined CO_2 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.

5.10.1 Methodology

Tier 1 methodology from the 2006 IPCC Guidelines, Volume 4, Chapter 11 is applied for all three subsectors.

Annual CO_2 emissions from Liming 3G, i.e., emissions from the application of limestone, shellsand (90% $CaCO_3$), and dolomite, are estimated by using Eq. 11.12 from the 2006 IPCC Guidelines. Since shellsand is 90% limestone, the total limestone amount is obtained by adding 90% of the shellsand weight to the other limestone data.

Annual CO_2 emissions from urea application (CRT 3H) 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, averaging 21-22% between 2020 and 2023. To estimate the weight of pure CAN, 20% of the total fertiliser weight is subtracted. 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.

CO_2 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 CO_2 emissions from CAN application (Tier 1)

$$CO_2 - C\ Emission = M_{\mathrm{CANfertiliser}} \times 0.8 \times 0.23 \times EF_{\mathrm{Dolomite}}$$

Where:

- CO_2-C Emission = emission of C from CAN application, t C/yr
- $M_{CANfertiliser}$ = 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.

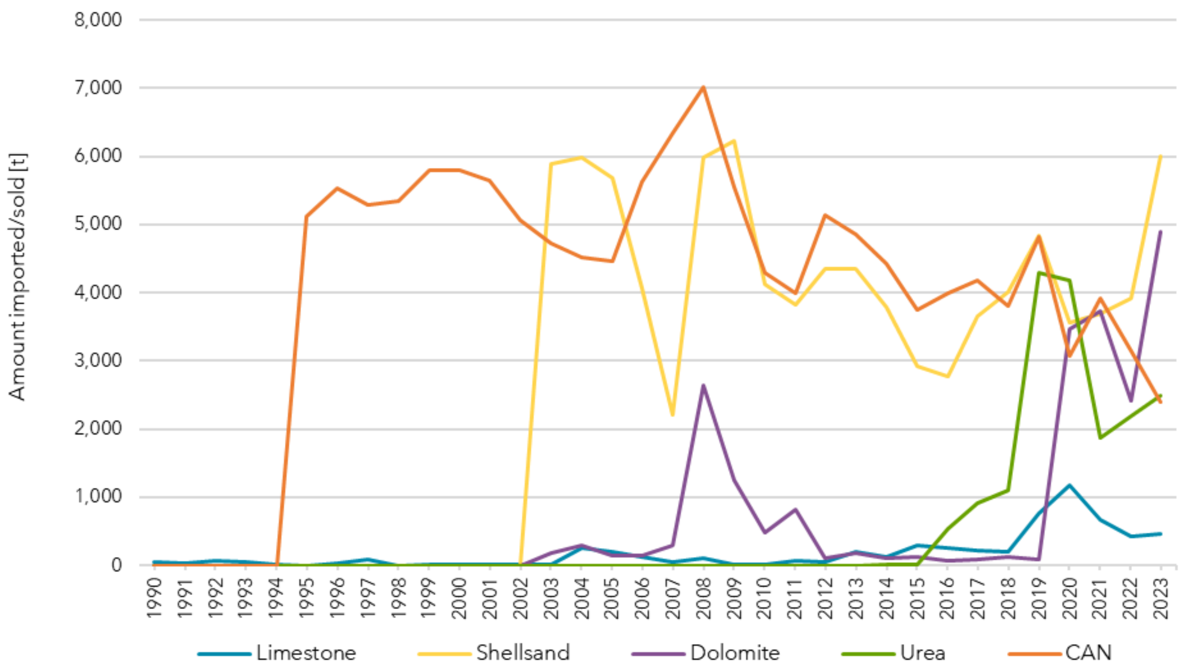


Figure 5.8 The amount of limestone, dolomite, urea and calcium ammonium nitrate (CAN) imported and shellsand sold since 1990.

5.10.2.1 Liming

Data on liming is based on imported pure limestone and dolomite, as well as sold shell sand. 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.[29]

[29] https://www.yara.is/kolkun-er-grundvallaratridi-thegar-kemur-ad-godri-upptoku-naeringarefna/

5.10.2.2Urea 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.

5.10.2.3Other 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 CO_2 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 since then been 22-48%. 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 CO_2-C/t applied, and dolomite, 0.13 t CO_2-C/t applied, are used. Since the limestone amount in shellsand has been added to the other limestone data, only the limestone emission factor is needed for this group. The emission factor for the application of urea fertilisers is 0.2 t CO_2-C/t applied.

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. Hence, the dolomite emission factor is used for all CAN fertilisers to not underestimate the emissions.

5.10.4 Emissions

The CO_2 emissions due to liming of cropland and use of urea and CAN fertilisers are shown in Table 5.46 and Figure 5.9.

Table 5.46 CO_2 emissions from liming (limestone, shellsand and dolomite), urea application and other carbon containing fertilisers (CAN).

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Limestone + shellsand	23	3.1E-03	2.2	2,341	1,633	1,288	1,924	1,735	2,577
Dolomite	NO	NO	NO	65	225	58	1,651	1,151	2,331
Urea	NO	NO	NO	NO	NO	6.6	3,070	1,600	1,826
CAN	NO	2,437	2,760	2,127	2,046	1,787	1,469	1,502	1,145
Total CO_2 Emissions [t]	**23**	**2,437**	**2,762**	**4,533**	**3,904**	**3,139**	**8,113**	**5,988**	**7,879**
Relative change since 1990		10450%	11857%	19522%	16801%	13487%	35021%	25822%	34008%

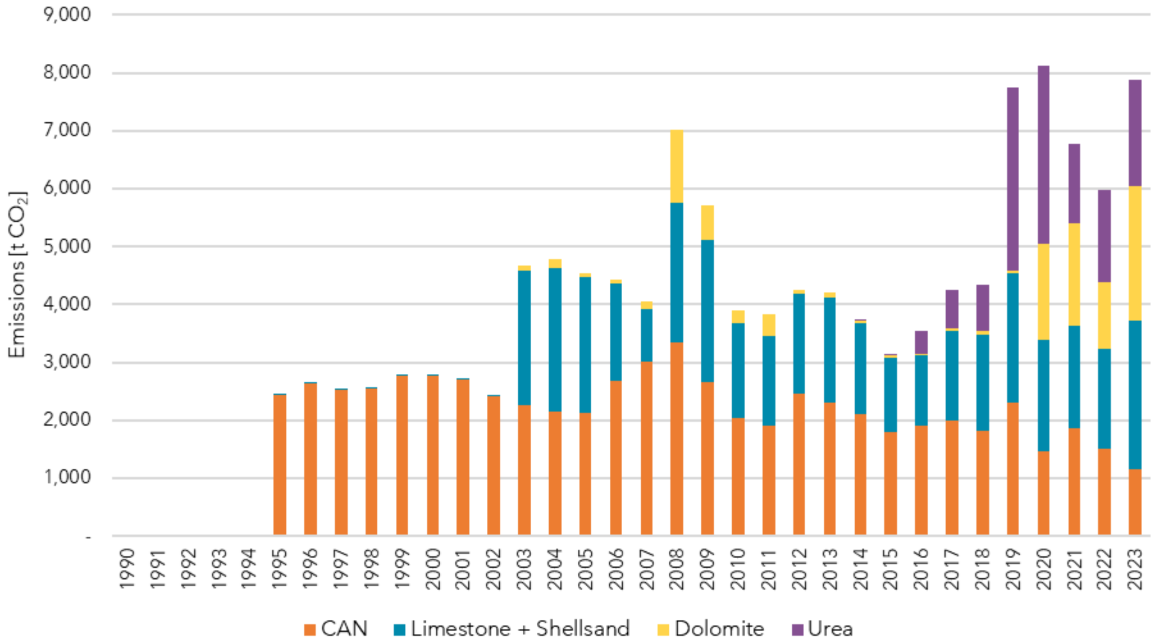


Figure 5.9 CO_2 emissions from liming (limestone, shellsand and dolomite), urea application and other carbon containing fertilisers (CAN).

5.10.5 Recalculations

Recalculations from the 2025 Submission

The main change for limestone involved resolving a double counting-issue before the 2025 submission, resulting in recalculations for the years 2012-2022 for limestone, see Table 5.47.

Table 5.47 Recalculation for 3G Liming due to updated activity data.

CRT 3G Liming	2012	2015	2020	2021	2022
2024 submission [kt CO_2e]	1.81	1.34	5.29	5.79	3.81
2025 submission [kt CO_2e]	1.79	1.35	3.57	3.54	2.89
Change relative to the 2024 submission [kt CO_2e]	-0.018	0.0015	-1.72	-2.25	-0.93
Change relative to the 2024 submission [%]	-1.0%	0.11%	-32%	-39%	-24%

Activity data on fertiliser types was revisited with a fertiliser expert in the spring of 2024 resulting in some recalculations for limestone, dolomite, urea and CAN, see Table 5.48 and Table 5.49.

Table 5.48 Recalculation for 3H Urea due to updated activity data.

CRT 3H Urea	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	NO	NO	NO	NO	NO	0.0066	1.67	1.48	1.56
2025 submission [kt CO_2e]	NO	NO	NO	NO	NO	0.0066	3.07	1.37	1.60
Change relative to the 2024 submission [kt CO_2e]	–	–	–	–	–	–	1.4	-0.11	0.044
Change relative to the 2024 submission [%]	–	–	–	–	–	–	84%	-7.4%	2.8%

Table 5.49 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	2021	2022
2024 submission [kt CO_2e]	NO	2.44	2.76	2.13	1.46	1.42	1.87	1.93	1.17
2025 submission [kt CO_2e]	NO	2.44	2.76	2.13	2.05	1.79	1.47	1.87	1.50
Change relative to the 2024 submission [kt CO_2e]	–	–	–	–	0.58	0.37	-0.40	-0.06	0.33
Change relative to the 2024 submission [%]	–	–	–	–	40%	26%	-22%	-3.3%	29%

Recalculations from the 2024 Submission

After receiving new data from SI about limestone and dolomite imported to Iceland, the activity data was updated. Previously, the import data had been higher as some of the limestone included had not been used in agriculture, but manufacturing. Furthermore, updated activity data on CAN led to a change in emissions from sector 3I.

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 CO_2 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)

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 N_2O 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 N_2O 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 of 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 (LaFI), a joint institution of the Soil Conservation Service of Iceland and the Icelandic Forest Service.

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 (Figure 6.1).

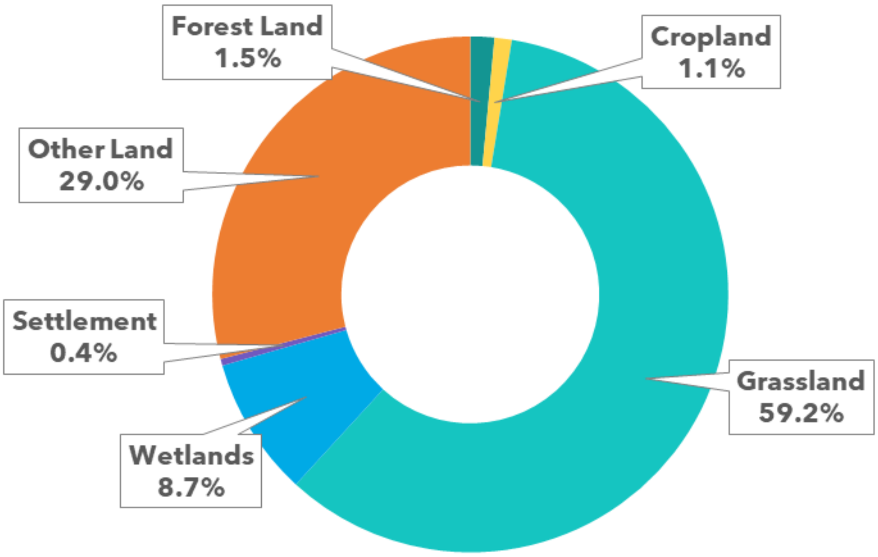


Figure 6.1 Relative size of land-use categories in Iceland as reported for 2023, %.

The total amount of emissions was 9677.8 kt CO_2e[30] in 2023. CO_2 was the dominant greenhouse gas in the sector, accounting for 84% of the net emissions, followed by CH_4, which contributed 17% of the total net emissions. The direct and indirect N_2O emissions have relatively small share to the overall emission in the sector (Figure 6.3).

Both emissions from sources and removals by sinks are reported for this sector. The net contribution of the land use categories for the 2025 submission is summarised in Figure 6.2.

[30] The associated emissions also cover non-CO_2 emissions reported under Table 4(I), Table 4(II), Table 4(III), Table 4(IV).

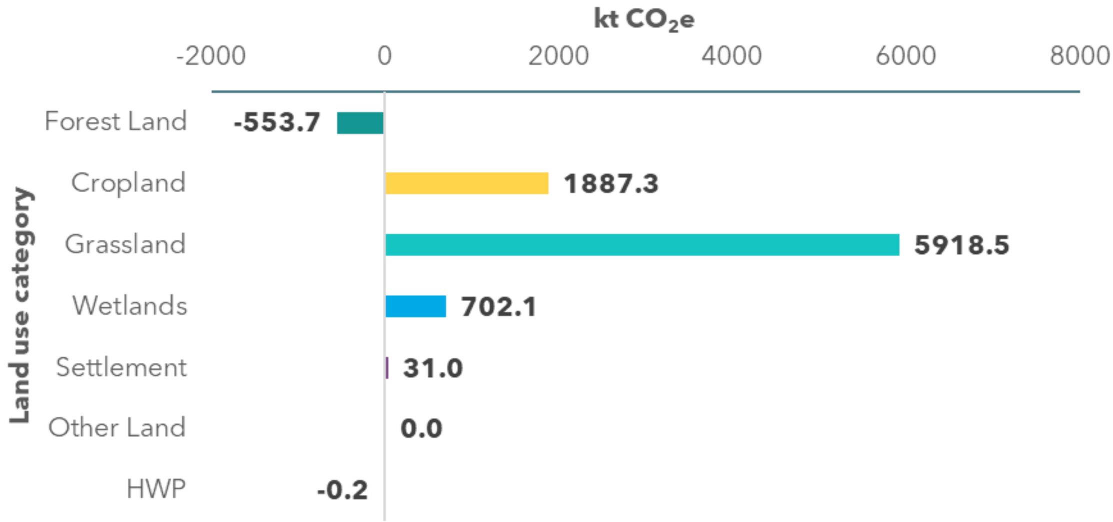


Figure 6.2 The net emissions/removals [kt CO_2e] of land-use categories in 2023.

Among the sources, cultivation of drainage of organic soils contributed to 87.4% of the total emissions, or 8,505.6 kt CO_2e in 2023. Managed wetlands accounted for 10.7% or 1,047.0 kt CO_2e in 2023.

The total amount of CO_2 removals was 1692.62 kt CO_2 in 2023, what is lower than the total amount of emissions. The largest sink was due to sequestration of CO_2 by biomass and mineral SOC pools of Grassland (41.6% or 704.6 kt CO_2), by biomass and SOC of mineral soils in forest (33.4% or 564.5 kt CO_2). and by wetlands (24.2% or 410.0 kt CO_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 2023 and over the whole reporting period, whereas all the land use categories except Forest land act as a net source of emissions. The net amount of emissions from the LULUCF sector was equal to 7,985.0kt CO_2 in 2023, contributing to 63% of the total emissions in the country.

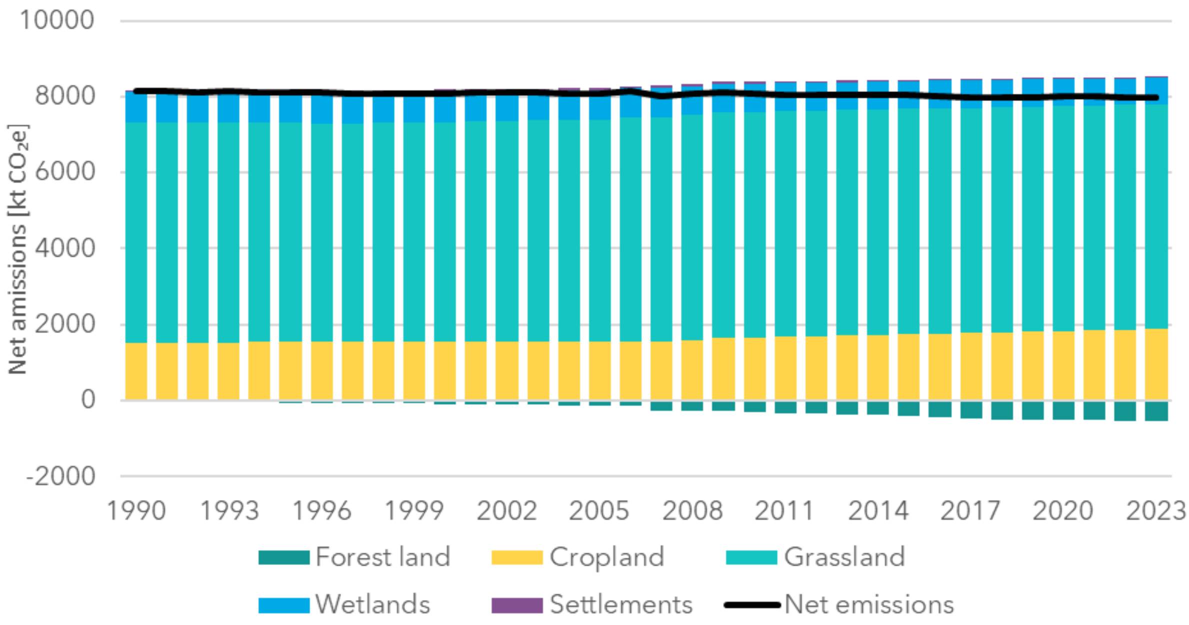


Figure 6.3 Emissions trends (kt CO_2e) for all land use categories from 1990. Note that these trends include non-CO_2 gases.

Between 1990 and 2023 there is a net 1.9% decrease in emissions from LULUCF of around 157.2 kt CO_2e. This decrease is driven by 527.4kt CO_2e more carbon removals from Forest land in 2023 compared to 1990 (Figure 6.3). Furthermore, emissions from Wetlands have also decreased by 105.0kt CO_2e across the timeseries. In contrast emissions from Cropland, Grassland and Settlements have increased between 1990 and 2023 with an increase of 357.4 kt CO_2e, 109.9 kt CO_2e, and 4.8 kt CO_2e respectively.

Since 2022, there is a net decrease in emissions of 0.01% or around 0.7 kt CO_2e. This is driven by increase in removals by Forest land (19.7 kt CO_2e), and by decreases in emissions from Wetlands (3.4 kt CO_2e), and Settlements (5.9 kt CO_2e). There are some increases to emissions from Cropland and Grassland of 17.5 kt CO_2e, and 8.6 kt CO_2e respectively.

Emissions from carbon pools living biomass, mineral soil organic carbon (SOC), and dead organic matter are net sinks across the timeseries with an overall decrease of 435.9 kt CO_2e, 354.6 kt CO_2e and 33.2 kt CO_2e respectively since 1990 (see Figure 6.4). Organic soil organic carbon (SOC) emissions are a large increasing source of emissions for Iceland with an increase of 809.6 kt CO_2e between 1990 and 2023.

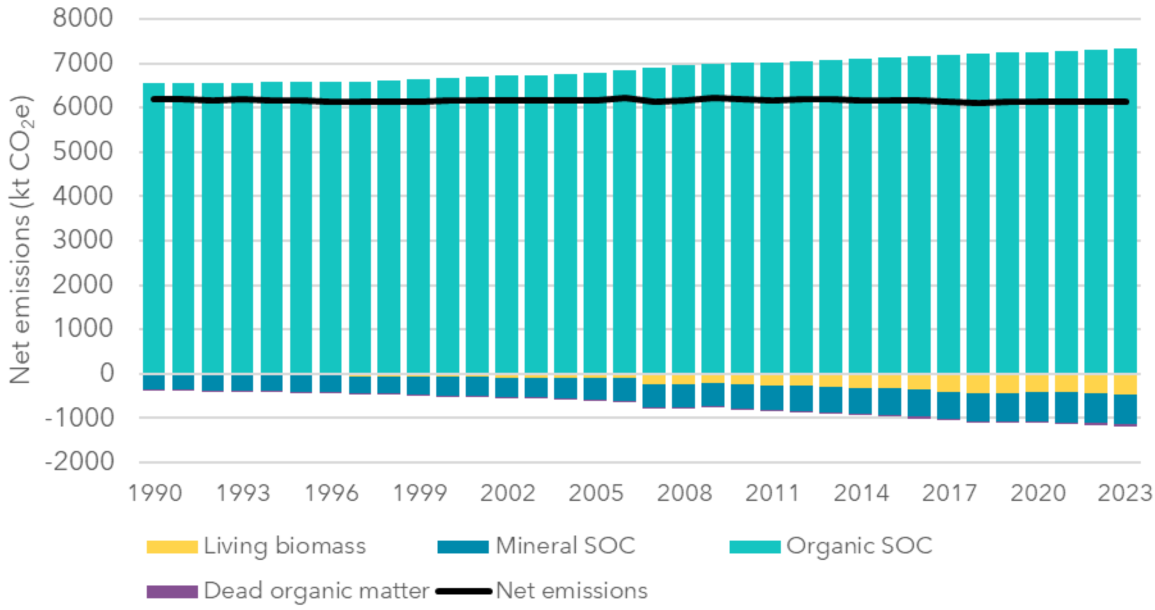


Figure 6.4 Emissions trends (kt CO_2) for carbon pools living biomass, mineral soil organic carbon (SOC), organic soil organic carbon (SOC) and dead organic matter from 1990. Note that these trends do not include non-CO_2 gases.

Between 2022 and 2023 there is an increase in emissions from the dead organic matter (DOM) pool (1.9 kt CO_2e) and Organic soil organic carbon (SOCorg) pool (27.0 kt CO_2e). There is a decrease in emissions between 2022 and 2023 from the living biomass pool and mineral soil organic carbon (SOCmin) pool of 20.8 kt CO_2e and 6.9 kt CO_2e respectively.

Table 6.1 Emissions trends (kt CO_2e) broken down by pollutant from 1990

Pollutant	Units	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023
Carbon dioxide (CO_2)	kt CO_2e	6,397	6,366	6,365	6,382	6,412	6,380	6,357	6,363	6,349	6,351
Methane (CH_4)	kt CO_2e	1,743	1,743	1,728	1,707	1,674	1,656	1,640	1,637	1,633	1,630
Nitrous oxide (N_2O)	kt CO_2e	1.6	1.7	1.9	2.1	2.4	2.9	3.2	3.4	3.5	4.4
Total	**kt CO_2e**	**8,142**	**8,111**	**8,095**	**8,092**	**8,088**	**8,039**	**8,000**	**8,003**	**7,986**	**7,985**

Across the timeseries, emissions from carbon dioxide (CO_2) and methane (CH_4) decrease by 47.0 kt CO_2e and 113.0 kt CO_2e respectively, whereas nitrous oxide (N_2O) increase by and 2.7 kt CO_2e (see Table 6.1). Between 2022 and 2023, the overall net decrease in emissions is driven by the 2.8 kt CO_2e decrease in CH_4 emissions. This compensates for the small increase in CO_2 and N_2O emissions of 1.2 kt CO_2e and 0.9 kt CO_2e between 2022 and 2023.

6.1.2 Key Category Analysis

Analyses 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. Moreover, a list of key categories identified based on Level Assessment (LA) and Trend Assessment (TA), and assessment of significant carbon pools[31] are presented in Table 6.2.

Table 6.2 Key categories identified for the LULUCF sector.

IPCC Source Category		Gas	Level 1990	Level 2023	Trend
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	✓	✓	✓
4D1	Wetlands Remaining Wetlands	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 removal of most sources and sinks are estimated in the 2025 submission. More detailed information please see a relevant land use category-specific section of the LULUCF chapter.

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 and NA when tier 1 equilibrium assumption is used and NO or NA 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.

[31] Those that accounts for at the least 25% of emissions and removals in a source or sink

- 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.

Additionally, 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 in 2023. The checklist can be provided upon request. The checklist was used by the internal team and by experts from Aether for the 2025 submission. 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

In Iceland, all land is considered managed except "Other land" and the Wetland's subcategory Lakes and rivers and Intact mires above 200 m a.s.l.

Definitions of the six mainland-use categories are presented in Table 6.3. More information on the subcategory's definitions is provided in the respective category-specific chapters. Moreover, it should be noted that, through significant improvements in the transparency of reporting on land representation, 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).

Table 6.3 Definitions of the main land use categories

LU category	Definition
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, 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.
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
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.
etlands	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.
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 metres 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 centres with fewer than 200 inhabitants are therefore not considered urban/settlement.
Other land	This category 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 lands in this category are unmanaged.

6.2.2 Description of activity data

The information on land representation in the current reporting is based on land use categories as recorded in the Icelandic Geographical Land-Use Database (IGLUD). This database has been designed to support land-use classification and carbon accounting requirements under the LULUCF reporting.

IGLUD employs a grading system that ranks datasets by precision, resolution, and LULUCF applicability, spanning from high-precision GPS measurements to broad-scale remote sensing data (Table 6.4). Complementary data, including ArcticDEM, buildings and structures from Open Street Map and derived spatial data are also used to enhance, adjust, or calibrate the primary 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	Use in IGLUD/LULUCF
A	Vector	Direct GPS-based measurements	1:500 1:2000	±10 m	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	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	Applied in agriculture and precise land usage mapping
D	Vector	Interpretation of aerial and high-resolution satellite imagery	1:1000 1:3000	High resolution	General land classification and boundary delineation
E	Vector	GPS-based measurements, undefined scale	1:10.000 1:20.000	50 cm (aerial imagery)	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	Supports integrated land use mapping through analysis-derived layers
G	Raster	Remote sensing using RapidEye, SPOT, LANDSAT, and aerial imagery	1:25.000	5 m (25 m²)	Essential for general land cover mapping with field verification for accuracy
H	Raster	Remote sensing with LANDSAT and SPOT	1:50.000	15m (225 m²)	Suitable for broad land cover mapping with medium resolution

IGLUD map combines 109 geographical layers from various sources (Table 6.5) to provide land-cover classification suitable for LULUCF reporting.

Table 6.5 Summary table for all sources used for the preparation of the IGLUD land – use map.

Land use category	Type	SOURCE
Forest Land remaining forest land and Land converted to Forest land	Cultivated forest	Land and Forest Iceland (LaFI)
	Natural birch forest	Land and Forest Iceland (LaFI)
Cropland remaining cropland and Land converted to cropland		IGLUD - AUI, RI, IAAC, NLSI Snæbjörnsson A., et al.
Grassland remaining grassland and Land converted to Grassland	Cropland converted to Grassland	IGLUD, AUI
	Natural birch forest converted to Grassland	Land and Forest Iceland
	Revegetation	NIRA database
	Wetland converted to Grassland	Ditches map AUI/NLSI
	Grazing on other land	IGLUD, AUI
Flooded land remaining Flooded land and Land converted to Flooded land		Agricultural research institute (Rannsóknastofnun landbúnaðarins)

<table>
<tr><th>Land use category</th><th>Type</th><th>SOURCE</th></tr>
<tr><td rowspan="3">Other wetlands remaining other wetlands
and
Land converted to other wetlands</td><td>Lakes and rivers</td><td>The National Power Company of Iceland (Landsvirkjun)</td></tr>
<tr><td>Intact mires</td><td></td></tr>
<tr><td>Rewetted land and refilled lakes and ponds</td><td>Land and Forest Iceland (LaFI)</td></tr>
<tr><td>Settlements remaining settlements</td><td rowspan="4"></td><td rowspan="4">Land and Forest Iceland (LaFI)</td></tr>
<tr><td>Forest land converted to settlements</td></tr>
<tr><td>Grassland converted to settlements</td></tr>
<tr><td>Other land remaining other land</td></tr>
</table>

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). IGLUD map contains many map layers of different sources representing individual land cover classes or specific land uses. The database includes also geographically referenced datasets and anayses 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 sources from the compilation of different geographical data, serving as a base map for IGLUD map with 18 layers.

In 2019 the Habitat Type Map (HMI), prepared by the Icelandic Institute of Natural History (IINH) (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 includes 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.

The specific information regarding uncertainties for the habitat type classification in HMI 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). Moreover, the process of describing and mapping habitat types in Iceland has been the most extensive project undertaken by the IINH to date in collaboration with numerous individuals and natural history 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 SCSI).

In preparing the IGLUD land use map, other map layers, also included in previous versions of IGLUD, are still utilised. This includes 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 Shrubland, and a map of Settlements. These specialized layers often contain more detailed or focused information about particular land-use types. 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 combination of broad habitat mapping with specialized thematic layers creates a framework that supports both general land-use classification and detailed analysis of specific areas of interest.

6.2.3 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.

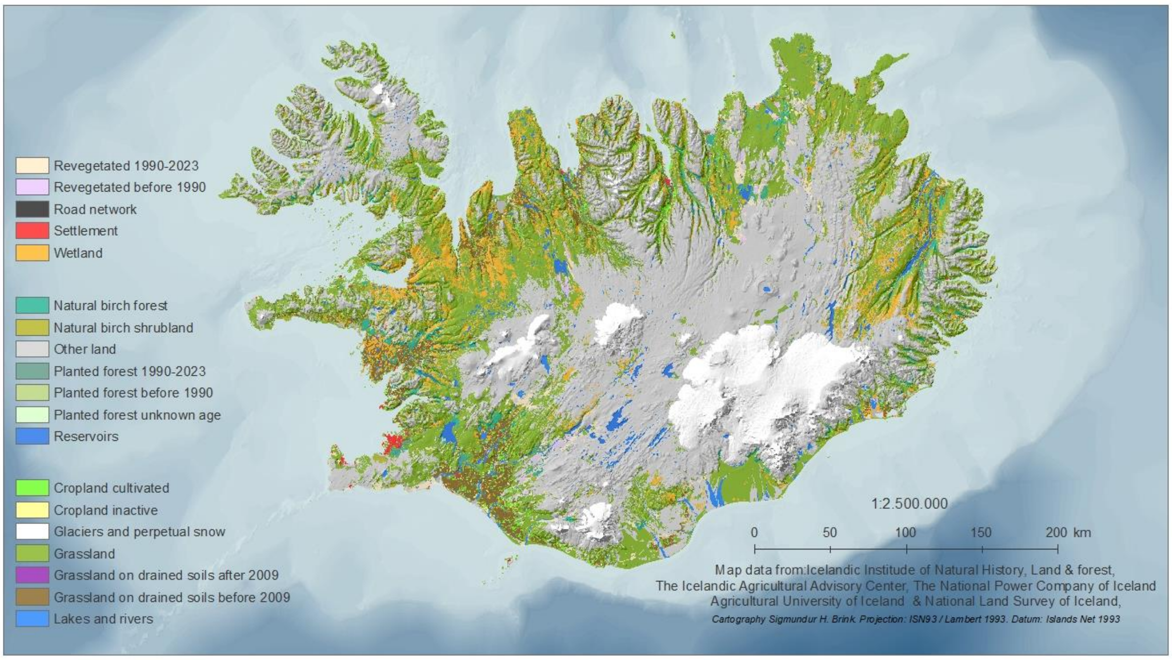


Figure 6.5 The land-use map of IGLUD prepared for 2023 reporting year.

A sample of land-use map for 2023, showing Grassland on drained soils is demonstrated in Figure 6.6.

Figure 6.6 A sample of land-use map for 2023, showing Grassland on drained soils before 2009 (brown polygons) and after 2009 (purple polygons).

The estimation of areas converted from one land category to another land category reported in the current Icelandic inventory is based on several specific independent time series.

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 (Iceland addressed FCCC/ARR/2022/ISL/L.6 recommendation provided by the ERT in 2017). The CRT tables 4.1 for the latest three inventory years are reported below 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 6.6 Table 4.1 Land Transition Matrix for the inventory year 2021

Table 4.1 LAND TRANSITION MATRIX 2021

Areas and changes in areas between the previous and the current inventory year (1) ISL-CRT-2025-V0.1

Iceland

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TO: / FROM:	Forest land (managed)	Forest land (unmanaged)	Cropland	Grassland (managed)	Grassland (unmanaged)	Wetlands (managed)	Wetlands (unmanaged)	Settlements	Other land	Total unmanaged land	Initial area
	(kha)										
Forest land (managed) (2)	147.36	NO	NO	NO	NO	NO	NO	0.02	NO	NO	147.39
Forest land (unmanaged) (2)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Cropland (2)	NO	NO	107.17	0.33	NO	NO	NO	IE	NO	NO	107.50
Grassland (managed) (2)	0.82	NO	0.63	6,056.13	NO	0.14	NO	0.40	NO	NO	6,058.12
Grassland (unmanaged) (2)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Wetlands (managed) (2)	NO	NO	0.68	0.34	NO	264.59	NO	IE	NO	NO	265.62
Wetlands (unmanaged) (2)	NO	NO	NO	NO	NO	NO	631.26	NO	NO	NO	631.26
Settlements (2)	NO	NO	NO	NO	NO	NO	NO	41.54	NO	NO	41.54
Other land (2)	0.41	NO	IE	7.70	NO	NO	NO	IE	2,978.63	NO	2,986.74
Total unmanaged land (3)	IE	NO	IE	IE	NO	IE	NO	IE	NO	NO	IE,NO
Final area	148.59	NO	108.48	6,064.51	NO	264.73	631.26	41.96	2,978.63	NO	10,238.16
Net change (4)	1.20	NO	0.98	6.39	NO	-0.89	0.00	0.42	-8.11	IE,NO	0.00

Table 6.7 Table 4.1 Land Transition Matrix for the inventory year 2022

Table 4.1 LAND TRANSITION MATRIX 2021

Areas and changes in areas between the previous and the current inventory year (1) ISL-CRT-2025-V0.1

Iceland

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TO: / FROM:	Forest land (managed)	Forest land (unmanaged)	Cropland	Grassland (managed)	Grassland (unmanaged)	Wetlands (managed)	Wetlands (unmanaged)	Settlements	Other land	Total unmanaged land	Initial area
	(kha)										
Forest land (managed) (2)	147.36	NO	NO	NO	NO	NO	NO	0.02	NO	NO	147.39
Forest land (unmanaged) (2)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Cropland (2)	NO	NO	107.17	0.33	NO	NO	NO	IE	NO	NO	107.50
Grassland (managed) (2)	0.82	NO	0.63	6,056.13	NO	0.14	NO	0.40	NO	NO	6,058.12
Grassland (unmanaged) (2)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Wetlands (managed) (2)	NO	NO	0.68	0.34	NO	264.59	NO	IE	NO	NO	265.62
Wetlands (unmanaged) (2)	NO	NO	NO	NO	NO	NO	631.26	NO	NO	NO	631.26
Settlements (2)	NO	NO	NO	NO	NO	NO	NO	41.54	NO	NO	41.54
Other land (2)	0.41	NO	IE	7.70	NO	NO	NO	IE	2,978.63	NO	2,986.74
Total unmanaged land (3)	IE	NO	IE	IE	NO	IE	NO	IE	NO	NO	IE,NO
Final area	148.59	NO	108.48	6,064.51	NO	264.73	631.26	41.96	2,978.63	NO	10,238.16
Net change (4)	1.20	NO	0.98	6.39	NO	-0.89	0.00	0.42	-8.11	IE,NO	0.00

Table 6.8 Table 4.1 Land Transition Matrix for the inventory year 2023

Table 4.1 LAND TRANSITION MATRIX 2023

Areas and changes in areas between the previous and the current inventory year (1) ISL-CRT-2025-V0.1

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FROM: \ TO:	Forest land (managed)	Forest land (unmanaged)	Cropland	Grassland (managed)	Grassland (unmanaged)	Wetlands (managed)	Wetlands (unmanaged)	Settlements	Other land	Total unmanaged land	**Initial area**
	(kha)										
Forest land (managed) (2)	150.37	NO	NO	NO	NO	NO	NO	NO	NO	NO	150.37
Forest land (unmanaged) (2)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Cropland (2)	NO	NO	109.14	0.33	NO	NO	NO	IE	NO	NO	109.47
Grassland (managed) (2)	2.99	NO	0.63	6,061.67	NO	0.01	NO	0.34	NO	NO	6,065.64
Grassland (unmanaged) (2)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Wetlands (managed) (2)	NO	NO	0.68	0.34	NO	262.79	NO	IE	NO	NO	263.81
Wetlands (unmanaged) (2)	NO	NO	NO	NO	NO	NO	631.26	NO	NO	NO	631.26
Settlements (2)	NO	NO	NO	NO	NO	NO	NO	42.39	NO	NO	42.39
Other land (2)	0.44	NO	IE	2.18	NO	NO	NO	IE	2,972.61	NO	2,975.22
Total unmanaged land (3)	IE	NO	IE	IE	NO	IE	NO	IE	NO	NO	IE,NO
Final area	153.79	NO	110.45	6,064.52	NO	262.80	631.26	42.72	2,972.61	NO	10,238.16
Net change (4)	3.42	NO	0.98	-1.12	NO	-1.01	0.00	0.34	-2.61	IE,NO	0.00

6.3 Forest Land (CRT 4A)

6.3.1 Category description

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.

Between 1990 and 2023, the total forest area increased by approximately 61%, from 95.6 kha in 1990 to 153.8 kha in 2023 (Figure 6.7). Specifically, during the 1990–1994 period, the area grew from 95.6 kha to 101.2 kha, demonstrating gradual but consistent growth. The growth rate appears slightly faster between 1995 and 2010, increasing from 104.0 kha in 1995 to 135.0 kha in 2010. During the 2011–2023 period, the upward trajectory remained steady, with the area expanding from 136.4 kha in 2011 to 153.8 kha in 2023.

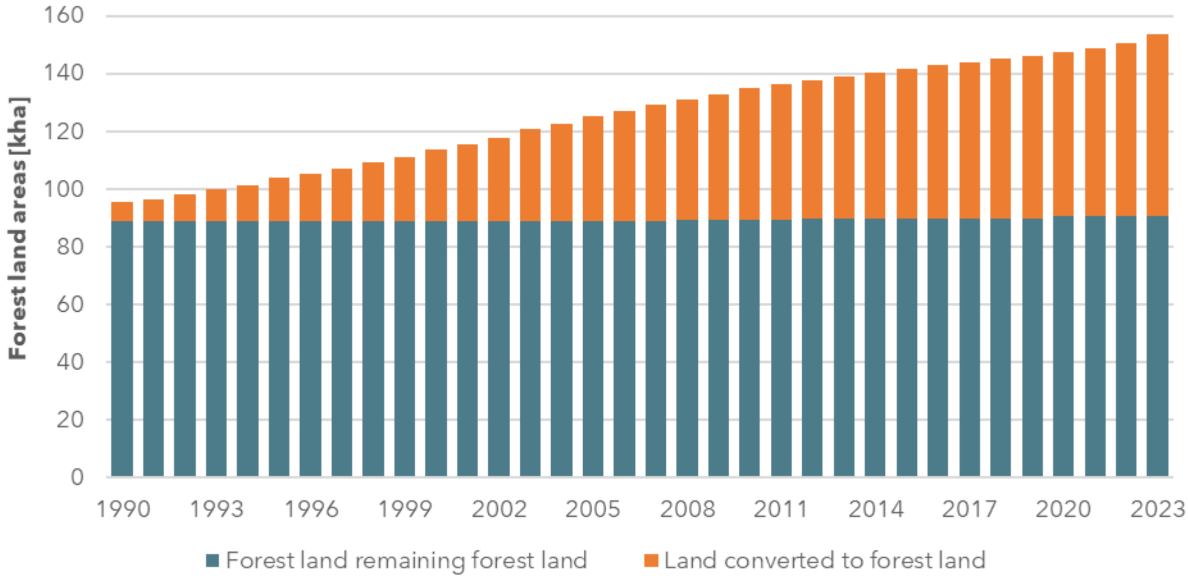


Figure 6.7. Forest Land area by category in Iceland in 1990 – 2023, kha

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 – three in Forest land remaining forest land and two in Land converted to forest land. Their definitions are presented in the Table 6.9 below.

Table 6.9 Definitions of forest land use subcategories

LU category	Definition	LU subcategory	Definition	Allocation	Conversion period
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 Forest Land are also included if their actual zones do not reach 20 m, the minimum width of Forest Land.	Natural birch forest older than 50 years	Natural birch forest existing for more than 50 years. Includes all Natural Birch Forest that were mapped in the 1987-1991 survey.	FLrFL	-
		Afforestation older than 50 years	Afforested area of Cultivated Forest that was afforested more than 50 years ago. Cultivated forests consist of tree plantation, direct seeding, or natural regeneration originating from Cultivated Forest	FLrFL	-
		Plantations in natural birch forest	Natural Birch Forest that has been converted to Cultivated Forest by plantation.	FLrFL	-
		Afforestation natural birch 1-50 y.o.	This subcategory includes a natural expansion of Natural Birch Forest 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	LUC to FL	50 years

LU category	Definition	LU subcategory	Definition	Allocation	Conversion period
			come proportionally from all Grassland categories other than Natural Birch Shrubland.		
		Cultivated forest 1-50 y.o.	This subcategory refers to mostly active afforestation with plantation on Grassland and Other land. Land use conversions from Grassland to Cultivated forest 1-50 y.o. In rare cases natural expansion of Cultivated Forest	LUC to FL	50 years

The main source of data for Forest Land is the NFI. In the NFI, there are two strata to be sampled Natural Bich Woodland (NBW) and Cultivated Forest (CF). 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 (Umhverfisráðuneytið), 2007). Most of the woodland was used for grazing and still is, although some areas have been protected from grazing. CF consist of tree plantation, direct seeding, or natural regeneration originating from Cultivated Forest. The sampling fraction in the NBW is lower than in the CF. Each 200 m^2 plot is placed on the intersection of 1.5 x 3.0 km grid but in the NFI of CF the grid is 0.5 x 1.0 km (Snorrason A. , 2010). All plots in the NFI are permanent. CF-NFI plots are visited in five-year intervals, and every year one-fifth of the plots are visited. NBW-NFI plots are visited in ten-year intervals. The sample population for NBW is the mapped area of NBW. The sample population of CF is an aggregation of maps of forest management reports from stakeholders in forestry in Iceland. In some cases, the NFI staff does mapping in the field of private CF. To ensure that forest areas are not outside the population area, the population for both strata is increased with buffering of the mapped border. Current buffering is 24 m. The area of the sampling population was 88.02 kha in this year submission.

The third inventory cycle of CF and the second one of the NBW was ongoing in the period 2015-2019. The fourth inventory cycle of CF started in 2020 and remaining plots of the second cycle of the NBW were measured in 2021. The fourth inventory cycle of CF was finished in the autumn of 2024. 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).

By analysing the age structure in the NBW that did not geographically merge the old map from the survey in 1987-1991, it was possible to re-estimate the area of NBW in 1987-1991 and 2010-2014. The area was estimated to be 137.69 kha at the time of the initial survey in 1987-1991 (Snorrason, et al., 2016). Earlier analyses of the 1987-1991 survey resulted in 115.40 kha (Traustason & Snorrason, 2008). The difference was the area that was missed in the earlier survey. The area of NBW was estimated 150.65 kha in the 2010-2014 mapping survey. The difference of 12.95 kha is an estimate of a natural expansion over the period of 1989 to 2012 (23 years) where the midyears of the two surveys are chosen as reference years. In the map of 2010-2014, 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. Natural Birch Forest (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 Grassland or Other Land Converted to Forest Land with a mean annual increase of 0.36 kha. The 2010-2014 map of NBW are used to classify soils into mineral and organic soils as these soils attributes were sampled when mapping was done.

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), LaFI and the National Planning Agency 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 LaFI and the National Planning Agency. LaFI samples activity data of the affected areas and data about the forest and Natural birch shrubland 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, and 2021. 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 of deforestation 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 Forest Land Converted to Settlements.
- The third type of deforestation 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 Settlement chapters.

Table 6.10 gives an overview of methods used for land identification of the Forest land categories in different time periods.

Table 6.10 Methodology and data sources for constructing the time series of Forest land category

Land use category	1989	1990	-	2000	-	2008	-	2010	-	2012	-	2019	-	2023
Forest Land remaining forest land and	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	Assumptions										

6.3.3 Forest Land Remaining Forest Land (CRT 4A1)

6.3.3.1 Category Description

Three categories are defined as Forest Land Remaining Forest Land:

- Afforestation older than 50 years
- Plantations in Natural Birch Forest
- Natural Birch Forest older than 50 years

whereas Natural Birch Forest older than 50 years remained the most significant throughout the entire reporting period (Figure 6.8).

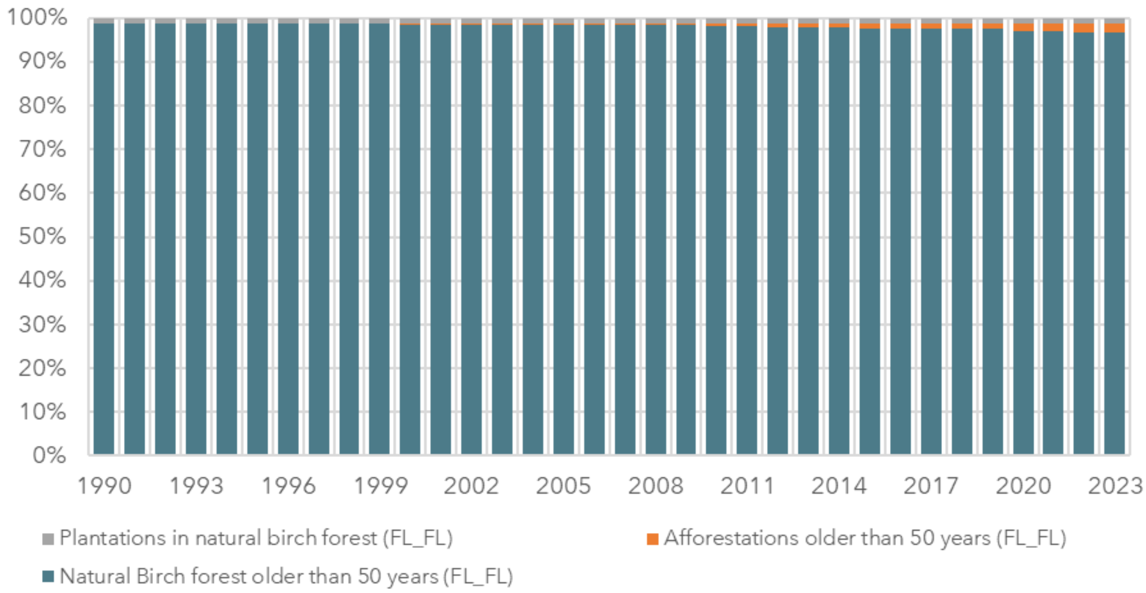


Figure 6.8 Relative shares of Forest land remaining Forest Land by subcategories in Iceland in 1990 – 2023, %

As for the most significant pools contributing to CO_2 removals/emissions, living biomass remains the most prominent throughout the entire reporting period, followed by mineral soils. Organic soils act as a source, but their contribution is not significant (Figure 6.9).

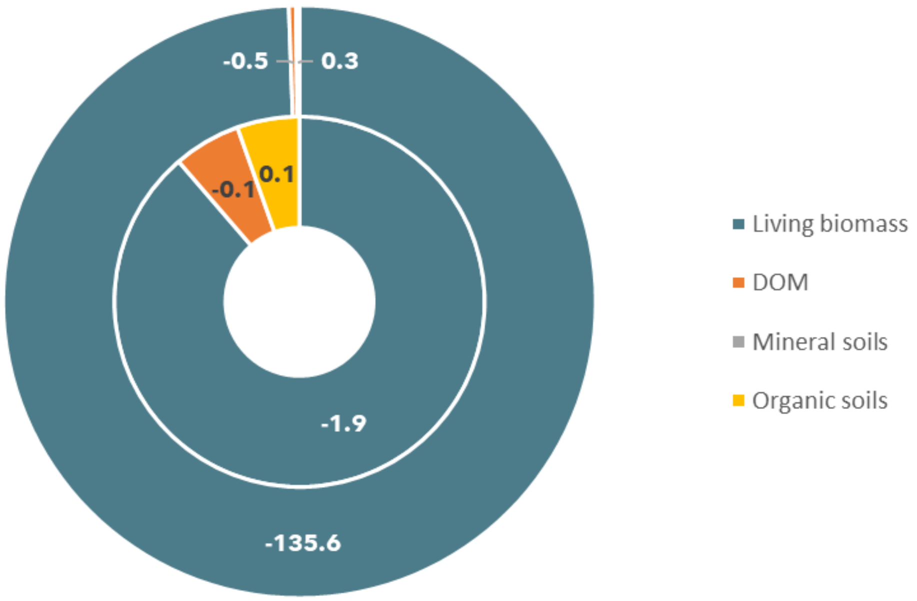


Figure 6.9. CO_2 emissions resulting from Forest land remaining Forest land by pool in 1990 (inner circle) and 2023 (outer circle) in Iceland [kt].

Activity data sources

The AD for Afforestation older than 50 years and Plantations in Natural Birch Forest subcategories are extracted from the systematic sample plot (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 over 50 years. The soil on each plot is described and further classified into mineral or drained organic soil.

The AD for Natural Birch Forest older than 50 years category is extracted from the SSP-NFI of NBW and the 2010-2014 mapping survey of the NBW. All NBFs that existed before the 1987-1991 survey are assumed to be existing more than 50 years ago. The majority are pristine Natural Birch Forests. 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.

6.3.3.2 Methodology

Table 6.11 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 Forest Land Remaining Forest Land category and to report information in the relevant CRT table. More detail information is presented in textural format below.

Table 6.11 Tier-level approaches, notation keys, and emission factors used for the Forest land remaining Forest land category

Land-Use Category	LB		Dead wood		Soils	
	Gains	Losses		Litter	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 "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

As already mentioned in Chapter 6.3.2, the mapping of the CF is done by annually adding the mapping of afforestation to the map activity; this is collected from forest management centres around the country. This map has turned out to be inaccurate and overestimates the area of CF by approximately 10%. Accordingly, another approach is used to estimate the area of CF. The land classification results on the SSP-NFI and area is calculated by proportions as described in Annex 3 A.3 in Chapter 3 of the 2006 IPCC Guidelines (IPCC, 2006). The mapped area of CF was 59.41 kha in year 2023 compared to 53.90 kha calculated by proportions for the same year. Historical area and time series of CF are estimated by the age distribution of the forest in the sample.

The area of the third category, Natural Birch Forest older than 50 years, is estimated directly from the new mapping survey of the NBW (Snorrason, et al., 2016).

Living biomass: Natural Birch Forest

The net C-stock change of the biomass of the NBW is 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. Net C-stock changes in biomass of the Natural Birch Woodland for the period 2007-2021 are estimated with data of the above-ground biomass from the second NFI of NBW conducted in 2015-2021 compared to biomass estimates from the first NFI 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 $ha^{-1}yr^{-1}$ 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.). 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 6.10 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.

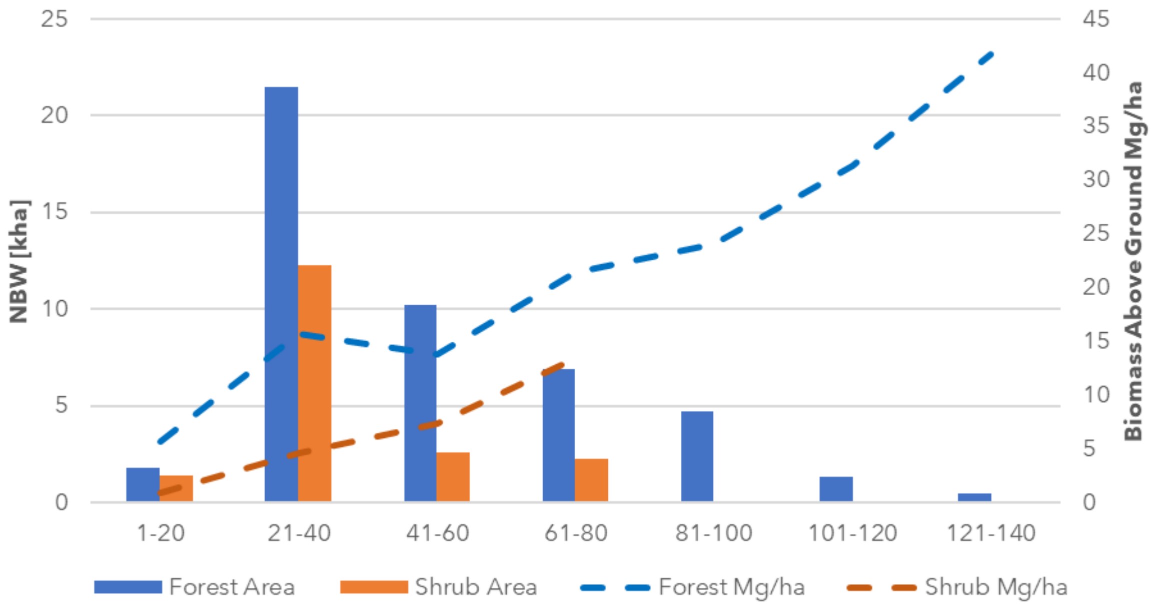


Figure 6.10 Age distribution and the mean stock of biomass aboveground of the Natural Birch Woodland as estimated in the 2015-2021 inventory. The forest area is reported to Forest Land but the Shrub area as Grassland

An older analysis of the comparison of the 1987-1988 tree data sampling (Jónsson T. H., 2004) with the data from the 2005-2011 SSPI of NBW was used to estimate the woody above-ground biomass of the NBW in 1987 and 2007 (the midyear of the 2005-2011 first NBW-NFI), 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-NFI´s. C-stocks in above-ground biomass of birch trees and shrubs in NBW was according to this estimate 752 kt C (±88 kt Standard Error (SE), n=272) with an average of 5.45 t C ha^{-1} in 1987. A rough, older estimate of 1,300 kt C from same raw data, with an average of 11 t C ha^{-1} (Sigurdsson & Snorrason, 2000). A new estimate of the C-stocks of the Natural Birch Woodland built on the first NBW-NFI of 2005-2011 was 728 kt C (±90 kt SE, n=181), with average of 5.28 t C ha^{-1}. The C-stock in the forest and the shrub part of the Natural Birch Woodland was estimated to 576 kt C with an average of 6.46 t C ha^{-1} and 152 kt C with average of 3.13 t C ha^{-1}, respectively. The net change in the tree biomass C-stock between 1987 and 2007 turned out to be insignificant (Snorrason, Jónsson, & Eggertsson, 2019). Consequently, the net C-stock change in tree biomass is reported as "not occurring" in the period 1990-2006 for the categories of Natural Birch Forest older than 50 years and Natural Birch Shrubland 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 NFI. The figures provided by LaFI are based on the NFI data from 2005-2024. In 2010, the second inventory round of Cultivated Forest started with remeasurement of plots measured in 2005 and of new plots since 2005 on new afforested areas. The fourth inventory cycle finished in the autumn of 2024, and the oldest plots have then been measured four times. 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 CO_2 removal by sink.

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 6.12. The most accurate estimates are for 2007-2022, as they 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 forwarded and backwarded. For 2023, the estimate is forwarded one year respectively, compared to the mid-value for 2022. The forward value for 2023 was calibrated by the average difference between mid-values and forward values of 2008-2022, 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 2023 build on measurement years 2021-2025 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 6.12 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
	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

Dead Wood pool: Cultivated Forest

C stock changes caused by harvest (biomass losses and change in the dead wood pool) are reported for the second time both in FrF and LcF subcategories of cultivated forest. 79% are reported in FrF categories and 21% in LcF categories 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 Chapter 6.3.4.2.

Litter: All Forest land remaining Forest land subcategories

For C-stock changes in litter and mineral soil for Land Converted to Forest Land, country-specific removal factors are used, built on in-country research as explained below. No evidence from research literature exists for Forest Remaining Forest 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 Remaining Forest are likely to be sinks rather than sources and are therefore reported as not applicable. 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 CO_2-emissions from drained organic soil are estimated by default emission factor of 0.37 t CO_2-C ha^{-1} yr^{-1} for "Forest Land, drained, including shrubland and drained land that may not be classified as forest". Newly published research of Eddy Covariance CO_2 estimates on the 23-25-year-old Black Cottonwood plantation on drained peatland in South Iceland unexpectedly resulted in a net sink in DOC of drained organic soil and litter of 0.53 t C ha^{-1} yr^{-1} (Bjarnadóttir B., 2021). This result supports the use of emission factor with low emission compared to other related factors for drained organic soil on Forest Land as done in this submission.

Emission factors used to estimate carbon stock changes for Forest Land Remaining Forest Land subcategories are summarised in Table 6.13.

Table 6.13 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
Natural Birch Forest 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-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.).
	Organic Soils	D	-0.37	Table 2.1 in the 2013 Wetlands Supplement
Afforestation older than 50 years	Biomass Gains	OTH	3.3	Estimated each year from data of the NFI of the CF (this year data from 958 plots measured in 2020-2024)
	Biomass Losses	OTH	-1.25	Jóhannsdóttir Þ., 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 Chapter 6.3.4.2
	Organic Soils	D	-0.37	Table 2.1 in the 2013 Wetlands Supplement
Plantations in natural birch forest	Biomass Gains	OTH	2.46	Estimated each year from data of the NFI of the CF (this year data from 958 plots measured in 2020-2024)
	Biomass Losses	OTH	-1.25	Jóhannsdóttir Þ., 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 Chapter 6.3.4.2

6.3.4 Land Converted to Forest Land (CRT 4A2)

6.3.4.1 Category Description

Four categories are defined as Land Converted to Forest Land:

- Grassland Converted to Forest Land (4.A.2.2)
    - Afforestation 1-50 years old – Cultivated Forest
    - Afforestation 1-50 years old – Natural Birch Forest
- *Other Land* Converted to Forest Land (4.A.2.5)
    - Afforestation 1-50 years old – Cultivated Forest
    - Afforestation 1-50 years old – Natural Birch Forest

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 6.7 kha in 1990 to 63.2 kha in 2023 (Figure 6.11). All subcategories demonstrated a consistent upward trend. Natural birch forests aged 1–50 years increased steadily from 0.2 kha in 1990 to 7.1 kha in 2023, with gradual increments each year. Similarly, cultivated forests aged 1–50 years demonstrated a growth, starting at 5.6 kha in 1990 and reaching 40.6 kha in 2023. In the other land categories, both natural birch forests and afforested areas showed consistent increases, with natural birch forests rising from 0.2 kha to 5.1 kha and other afforestation rising from 0.8 kha to 10.4 kha over the same period.

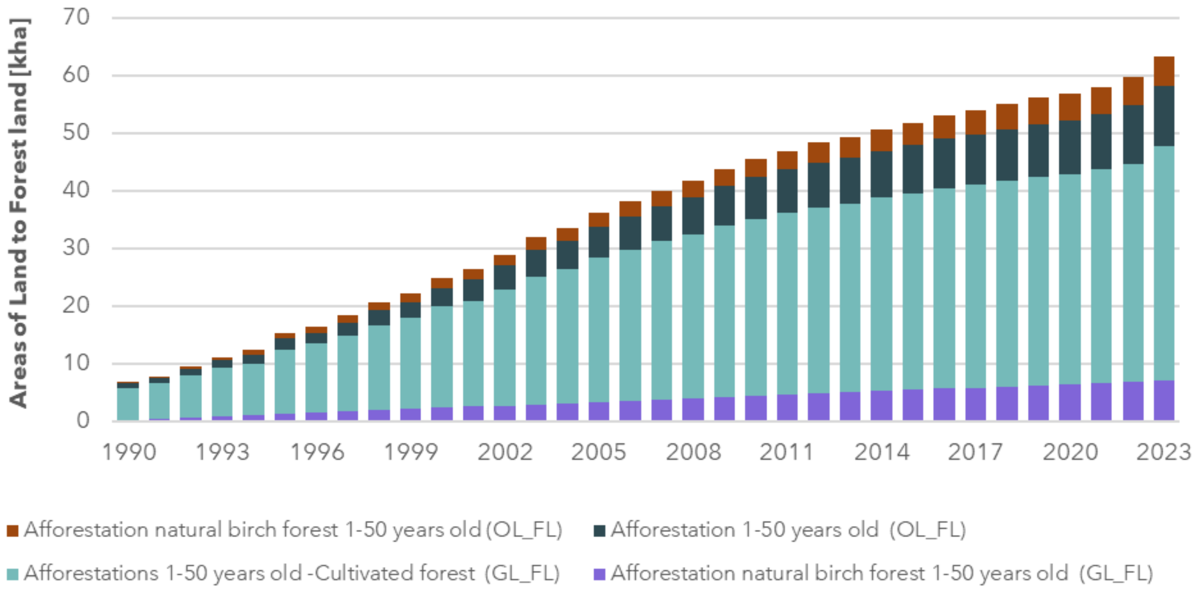


Figure 6.11 Land converted to Forest Land by land-use subcategory, kha

The changes in land use resulted in a consistent increase in carbon removals across most pools between 1990 and 2023, contributing significantly to CO_2 sequestration. The changes in Living biomass pool demonstrated the largest removals, starting at -16.7 kt CO_2 in 1990 and reaching -308.6 kt CO_2 in 2023. The DOM pool and removals, respectively, also increased steadily, from -3.5 kt CO_2 in 1990 to -32.8 kt CO_2 in 2023. The carbon pool of mineral soils (SOC_min) followed a similar pattern, with removals rising from -8.8 kt CO_2 in 1990 to -87.0 kt CO_2 in 2023. However, organic soils (SOC_org) were a source and showed only slight increases, contributing minor removals from 0.7 kt CO_2 in 1990 to 6.2 kt CO_2 in 2023.

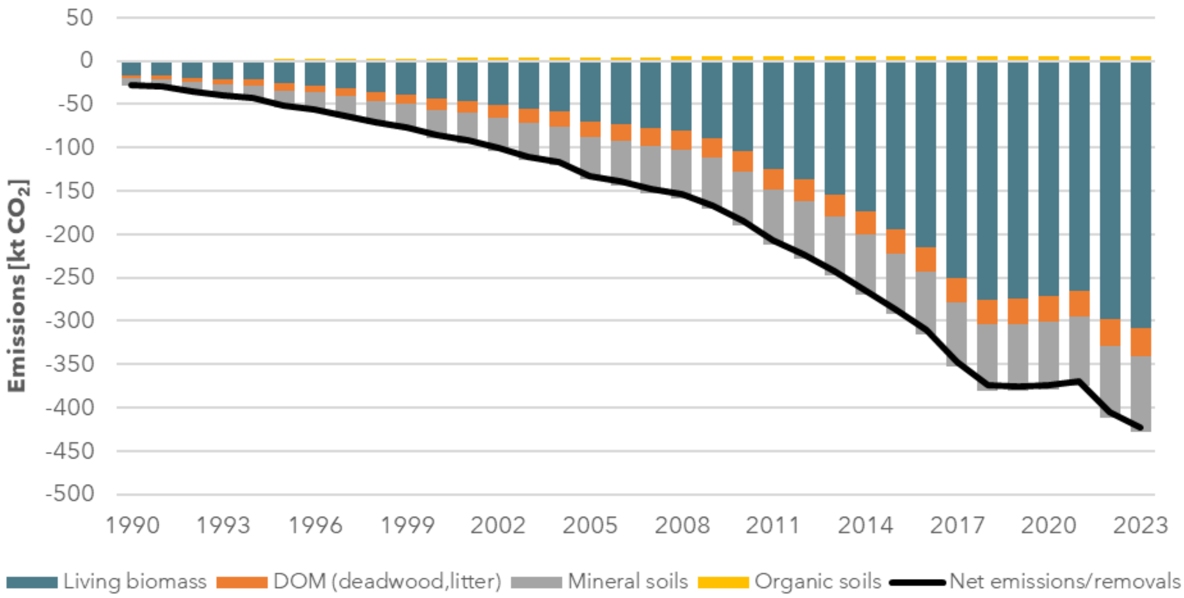


Figure 6.12 Emissions (+) and removals (-) due to conversion of Land to Forest land by carbon pool, kt CO_2

Activity data sources:

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 soil organic carbon (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 choose of conversion period of 50 years for Land Converted to Forest Land.

Both categories of Cultivated Forest are extracted from the systematic sample plot (SSP) of the NFI 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 NFI SSP database.

The categories of Natural Birch Forest are extracted from the mapping survey of the NBW. All NBF that did not exist before the 1987-1991 survey were converted to Forest Land in the period 1989-2012. Specifically, they expanded from zero in 1989 to 8.25 kha in 2012. 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 but for the NBF 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 6.14 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 Forest Land category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Table 6.14 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
Cropland Converted to Forest Land	NO	NO	NO	NO	NO	NO
Grassland Converted to Forest Land						
Afforestation Natural Birch Forest 1-50 years old	T3 (OTH)	IE[1]	NO	T2 (CS)	T2 (CS)	T1 (D)
Afforestation 1-50 years old – Cultivated Forest	T2 (CS)	T3(OTH)	T3(OTH)	T2 (CS)	T2 (CS)	T1 (D)
Wetlands Converted to Forest Land	NO	NO	NO	NO	NO	NO
Settlements Converted to Forest Land	NO	NO	NO	NO	NO	NO
Other Land Converted to Forest Land						
Afforestation 1-50 years old	T3 (OTH)	T3 (OTH)	T3 (OTH)	T2 (CS)	T2 (CS)	NO
Afforestation Natural Birch Forest 1-50 years old	T2 (CS)	IE	NO	T2 (CS)	T2 (CS)	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 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 Cultivated Forest. Skewed age distributions with high ratios of young age classes are accelerating the annual increase of C-stock change in tree biomass, as can be seen in Figure 6.13.

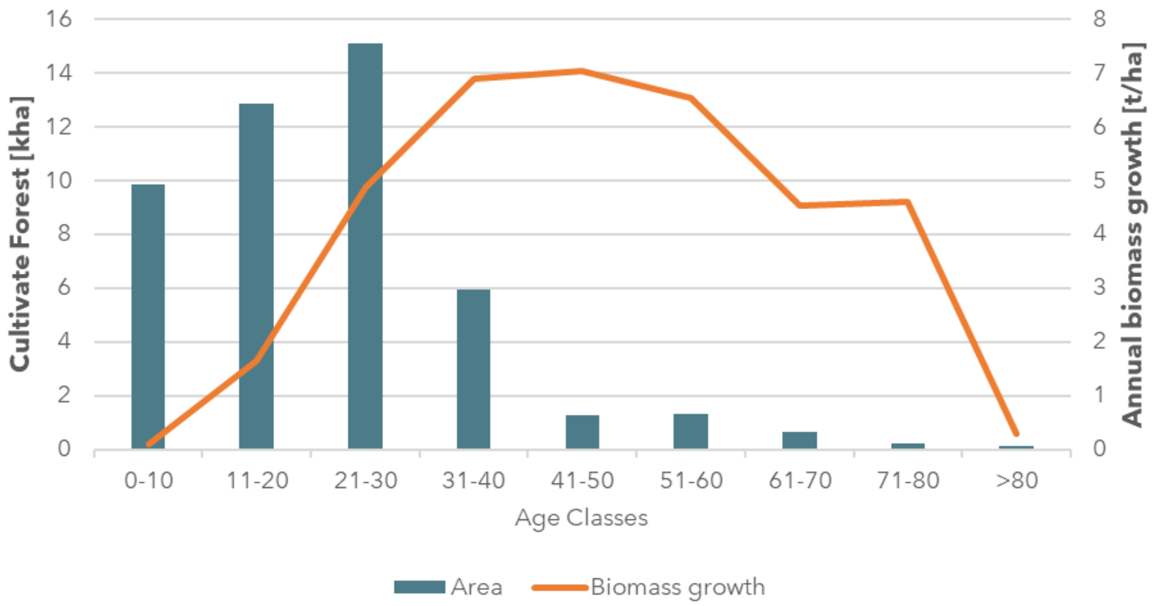


Figure 6.13 Age distribution of Cultivated Forest in 2023 showing area and current annual biomass growth per hectare of each 10 years age class.

For the NBF expansion since 1989, a linear regression between biomass per area unit in trees and age 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.).

In the already mentioned ICEWOODS research project, the carbon stock in vegetation other than trees showed very low increases 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

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 Þ., 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 LaFI. 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 $d_{0.5}$ 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 6.15).

Deadwood

The dead wood components of biomass losses due to harvest (Sign H in Table 6.15) are moved to the dead wood C-stock pool. Half-life of the decay of deadwood is set to 30 years with annual decay rate of 0.023 with reference to (Hararuk, Kurz, & Didion, 2020) for annual mean temperature of 5°C and annual precipitation under 1837 mm.

Table 6.15 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

Carbon stock samples of litter are collected on field plots under the field measurement in the NFI. Estimates of carbon stock changes in dead organic matter, as for vegetation other than trees, are available from the NFI data when sampling plots have been revisited and samples analysed.

The results from two separate research projects of carbon stock changes are used to estimate carbon stock changes 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 0.083 t C ha^{-1} 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 0.087-1.213 t C ha^{-1} 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 t C ha^{-1} 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 t C ha^{-1} yr^{-1}. New research from Southwest Iceland shows higher C accumulation in conifer plantations (0.22 t C ha^{-1} yr^{-1}) compared to native birch plantations (0.049 t C ha^{-1} 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 (0.3-0.9 t C ha^{-1} 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 g CO_2 m^{-2} 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 g CO_2 m^{-2} yr^{-1} for conifer plantations, and 235 g CO_2 m^{-2} 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 t C ha^{-1} 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). All these findings support the use of a country-specific removal factor of the dimension 0.51 t C ha^{-1} yr^{-1}, which is same removal factor as used for revegetation activities.

Table 6.16 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of Land converted to Forest Land, by land-use subcategory

Land Category	Pool	EF	t C $ha^{-1}yr^{-1}$	Reference
Grassland Converted to Forest Land				
Afforestation 1-50 years old – Cultivated Forest	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)

Land Category	Pool	EF	t C ha^{-1}yr^{-1}	Reference
	Biomass Losses	OTH	-0.02	Jóhannsdóttir Þ., 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	0.01	Estimated on the basis of biomass losses – see description above in this chapter
	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 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	CS	0.37	Bjarnadóttir, 2009
	Organic Soils	D	-0.37	Table 2.1 in the 2013 Wetlands Supplement
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 Þ., 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	0.01	Estimated on the basis of biomass losses – see description above in this chapter
	Litter	CS	0.14	Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008
	Mineral Soils	CS	0.51	Estimated by Soil conservation service (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	CS	0.51	Estimated by Soil conservation service (expert Jóhann Þórsson)

6.3.5 Uncertainty Assessment and Time-Series Consistency

The uncertainty assessment for Forest land use category for the period 1990–2023 have been assessed following 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 6.1.4 for more information.

6.3.7 Category-specific recalculations

As described above, the emission/removal estimate for Forest Land has been revised in comparison to previous 2024 submissions. Area-dependent sources, such as emissions from drained organic soil, have been changed in relation to changes in the area estimate for each category and each year. The main reason for area changes is inclusion of measurements plots from newly discovered cultivated forests. The C-stock changes in biomass in CF are based on direct stock measurements (Tier 3) as in last year's submission. They were recalculated for 2022 due to new data from NFI measurements in 2024. Figure 6.14 and Figure 6.15 show the difference between the estimates of area and net emission in 2024 and 2025 submissions.

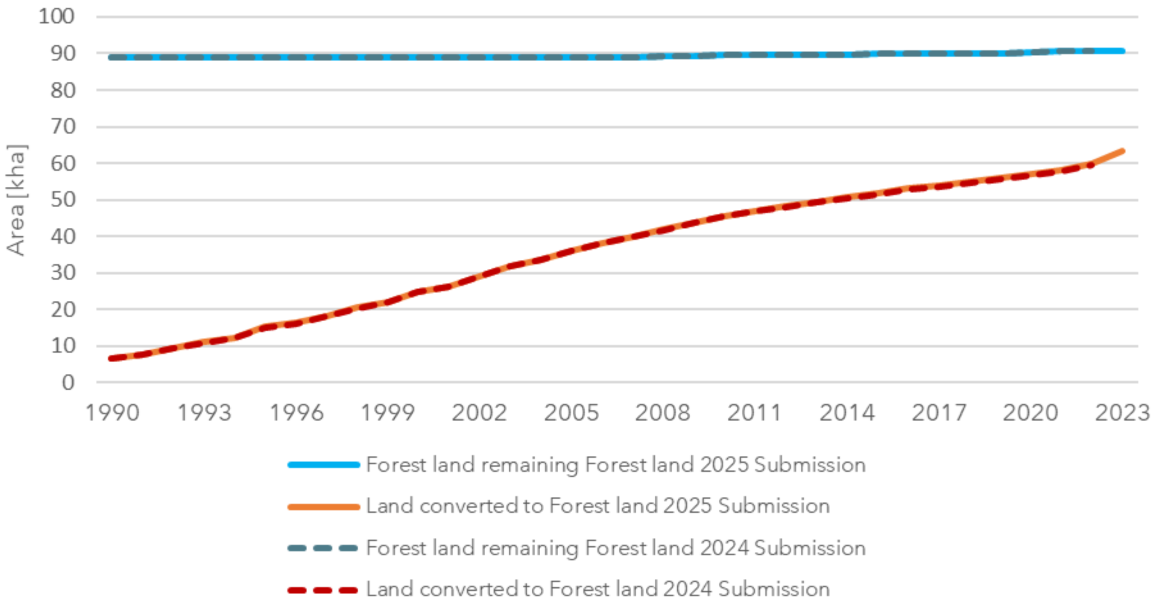


Figure 6.14 Recalculations to the activity data between the current (2025) and previous (2024) submission for Forest land

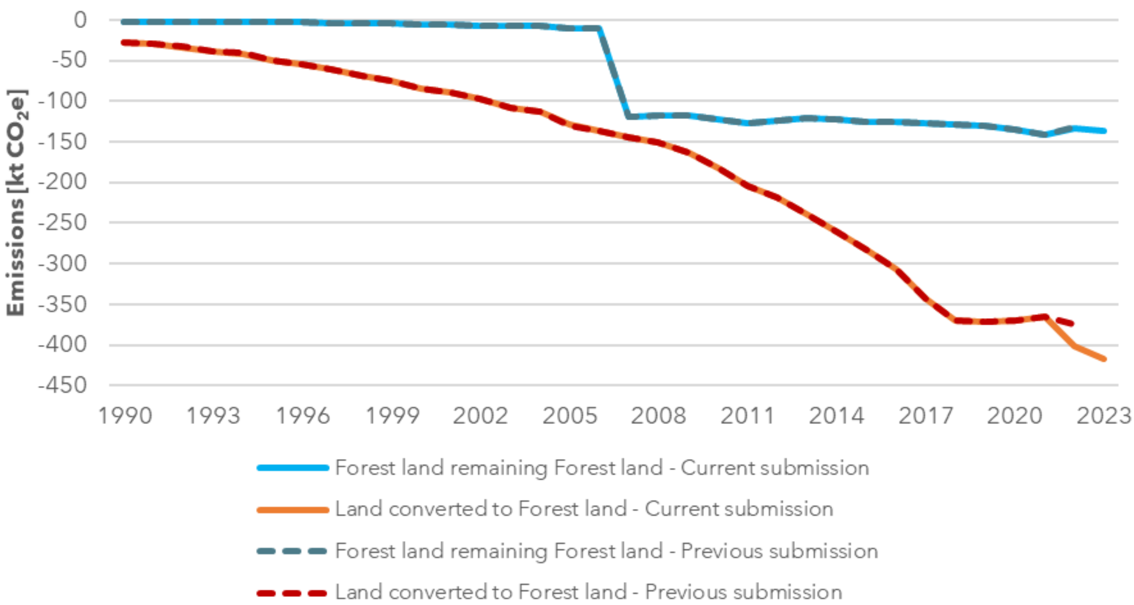


Figure 6.15 Recalculations to the emissions between the current (2024) and previous (2025) submission for Forest land

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 demonstrated a steady upward trend from 92.2 kha in 1990 to 110.5 kha in 2023, with significant changes in area starting from 2009 onward (Figure 6.16). Emissions were relatively constant over 1990 – 2008 period: from 1,448.9kt CO_2 in 1990 to 1,488.9kt CO_2 in 2008, however reached 1,790.0kt CO_2 in 2023 (Figure 6.17). Emissions from the cultivation of organic soils were the primary source of emissions for the two land use types in the cropland category.

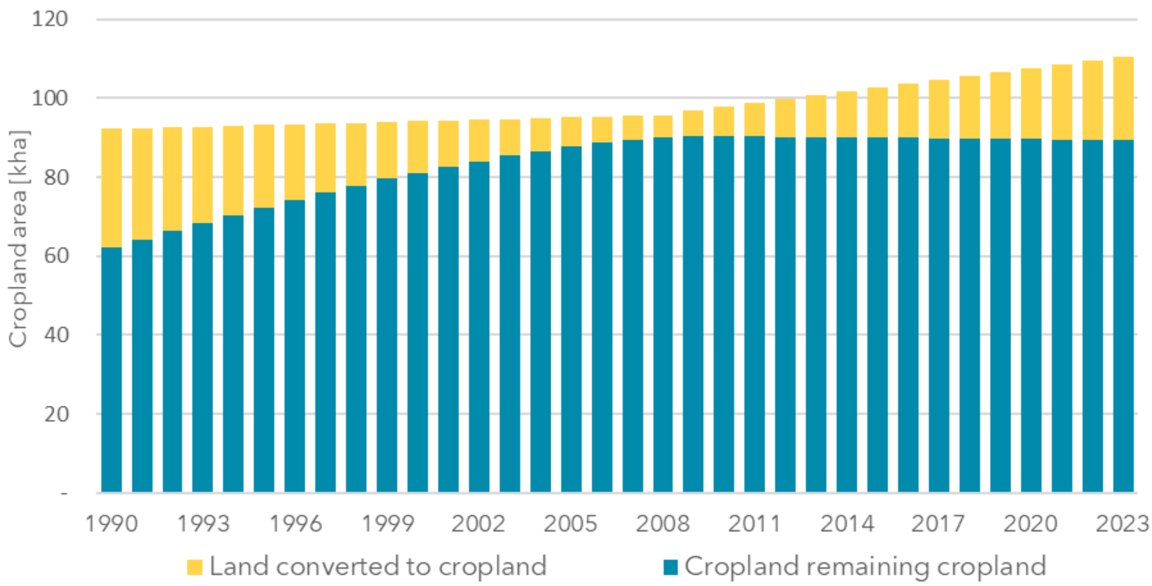


Figure 6.16 Cropland area (by category) in Iceland in 1990 – 2023 [kha].

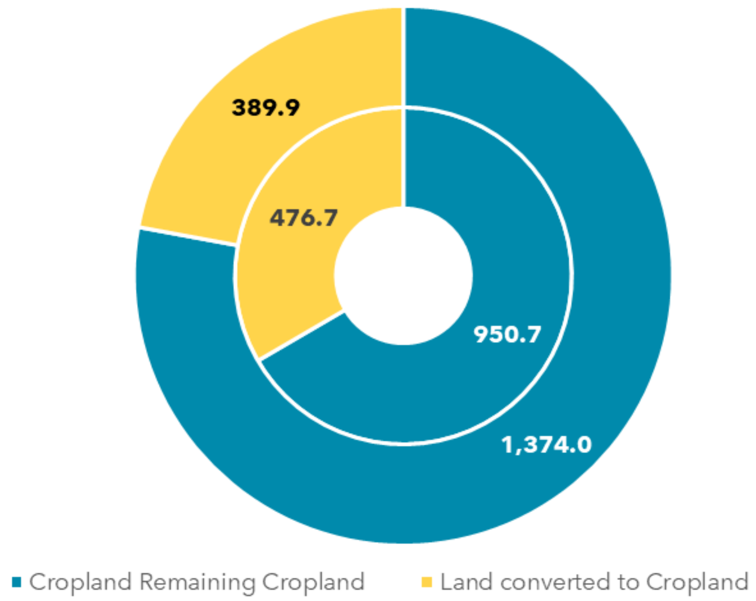


Figure 6.17 Emissions (+) resulting from Cropland remaining Cropland and Land converted to Cropland in Iceland in 1990 (inner cycle) and in 2023 (outer cycle) [kt CO_2].

6.4.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Cropland in Iceland consists mainly of cultivated hay- and barley fields, many of which are on drained organic soil, as well as cultivation of potatoes and vegetables. Cultivation of barley is still small but an increasing part of the category. The cropland category includes only actively cultivated crops. Due to lack of data on the age of cropland areas that are uncultivated for a short period, versus those completely abandoned, it is decided to report all uncultivated cropland areas (inactive) in the Grassland category, as Cropland abandoned for more than 20 years subcategory.

Table 6.17 Definitions of Cropland subcategories

LU category	Definition	LU subcategory	Definition	Allocation	Conversion period
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	Cropland active	This subcategory refers to all the cropland currently under cultivation.	CLrCL/LUC to CL	20 years

The land representation of Cropland comes from IGLUD map, where specialized layers regarding arable lands are incorporated. These refer to geographical layers on area of recently cultivated fields obtained from the Icelandic Agricultural Advisory Centre (IAAC) and Registers Iceland (RI). Since 2017, Iceland has adopted a payment system based on cultivated land areas. As a result, the digitization of cultivated land has progressed significantly, moving from identification using Landsat and SPOT imagery to more detailed aerial photography, resulting in accurate spatial mapping.

The geographical identification of the organic soils of arable land as they appear on the IGLUD maps is based on a preliminary analysis of the density of the ditch network.

The total Cropland area across the time series is determined using the 2023 IGLUD map data combined with estimates from a 2010 report by Snæbjörnsson et al., which set the total Cropland area for 2008 at 128.0 kha, including inactive cropland. To improve accuracy, the inactive cropland area is removed from the IGLUD time series (2023) and adjusted using historical data from IGLUD. Data on areas between 2008 and 2022 were interpolated and data between 1990 and 2007 was estimated with a linear decrease of 5 kha based on the estimate by Snæbjörnsson A., et al (2010). This adjustment results in two time series: Active Cropland, reported under the Cropland category, and Inactive Cropland, classified under Grassland as the Cropland abandoned for more than 20 years subcategory.

Table 6.18 Methodology and data sources for constructing the time series of Cropland category.

Land use category	Subcategory	1989	1990	...	2008	2009	...	2015	...	2022	2023
Cropland remaining cropland	Cropland active	Annual areas of new crops	Decrease of 5kha (annually)		2008 estimate	Linear interpolation					Annual IGLUD maps
Land converted to cropland	Forest land to cropland							2015 estimate			
	Grassland to cropland	Cropland active timeseries									
	Wetland to cropland										
Legend											
Samples or known areas	Maps	Expert judgement	Interpolation	Assumptions							

The total area of Cropland has an increasing trend over the time series. However, there is limited information where the conversions come from. The only known conversion comes from FL and has occurred only once across the reporting period (in 2015). The remaining land conversions are assumed to stem from Wetlands and Grassland. All conversions of organic soils from Wetlands to Cropland come from Intact mires – managed as cropland areas are assumed to come from these lower lying intact organic soils (below 200 meters altitude). All conversions of mineral soils to Cropland 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 are considered unlikely and thus reported as not occurring (NO). Conversions from Other land category is theoretically considered possible; thus they are reported as including elsewhere (IE), assuming that are reported in the figure of Grassland converted to Cropland.

6.4.3 Cropland Remaining Cropland (CRT 4B1)

6.4.3.1 Category Description

The total area of Cropland Remaining Cropland (i.e., Cropland active sub-category) was on a consistent upward trend over the entire period, starting at 62.2 kha in 1990 and reaching 89.4 kha in 2023. The overall increase is gradual, the growth rate remains relatively stable through the years, and there are no major ups or drops over reporting period (Figure 6.16).

While cultivation of organic soils resulted in emissions, management practices applied to mineral soils of cropland contributed to sequestration. This slightly reduced overall emissions from the Cropland Remaining Cropland (i.e., Cropland Active) category (Figure 6.18), however, the Cropland Active subcategory was a consistent net source throughout the entire reporting period.

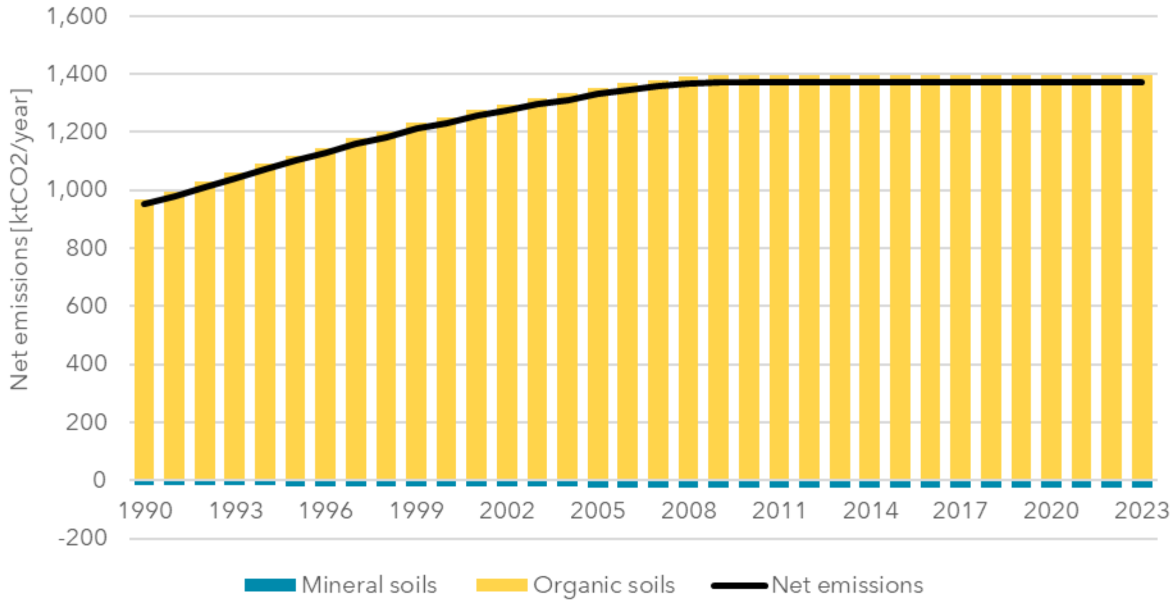


Figure 6.18 Emissions (+) and removals (-) from Cropland remaining Cropland by pools in Iceland in 1990 – 2023, kt CO_2

6.4.3.2 Methodology

Table 6.19 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 Cropland Remaining Cropland category and to report information in the relevant CRT table. More detail information is presented in textural format in the table below.

Table 6.19 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
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 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 dead organic matter. 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 6.20) 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 Sámsstaðir in Southern Iceland. The site is located on a freely drained, slightly sloping soil, and during the experiment period (1945-1973) the soil. The study detected that SOC content (in %) increased from 7.92% in 1945 to 9.14% in 1973. Additionally, to calculate carbon sequestration rate (in t C/ha) were applied the measured data on bulk density (BD) and cation exchange capacity (CEC) of soils. (Response to the recommendation FCCC/ARR/2022/ISL/L.14).

Organic soils

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 mineral and organic soils is reported in Table 6.20.

Table 6.20 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
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 areas converted to Cropland declined over the first two decades of the reporting period. However, since 2009, a steady increase has been observed to the 2023 inventory year. 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 6.19). The conversion of land to Cropland is a source of emissions for the entire reporting period, with emissions from organic soils remaining the most significant throughout the entire reporting period (Figure 6.20) demonstrates the data for 1990 and 2023.

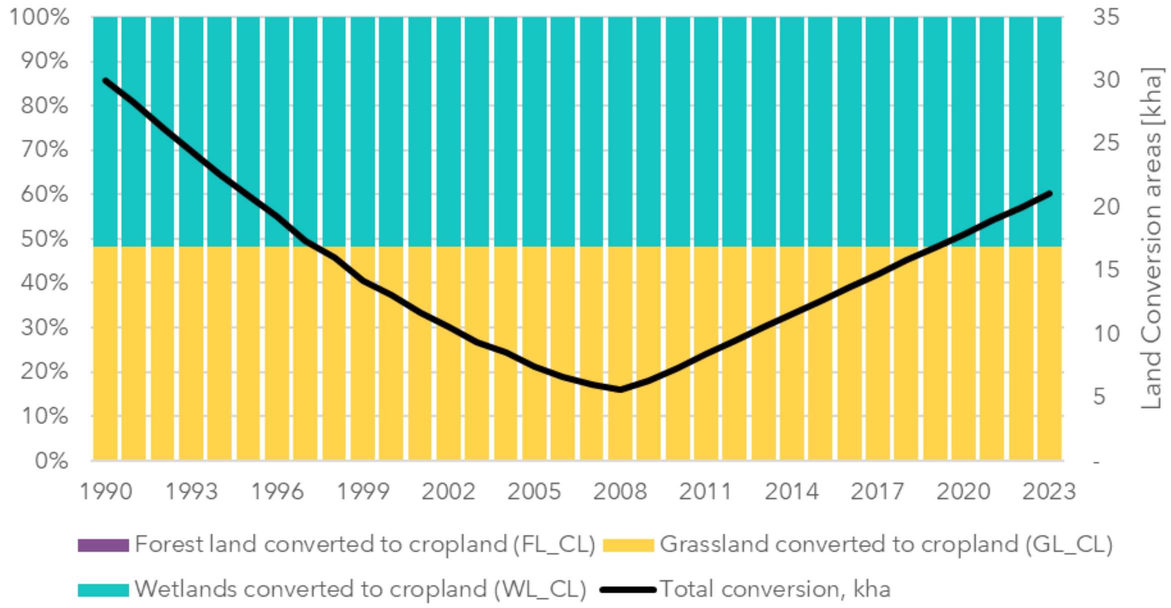


Figure 6.19 Relative shares of land conversion areas to Cropland (by subcategory), and the total area converted to Cropland (kha) in Iceland in 1990 – 2023

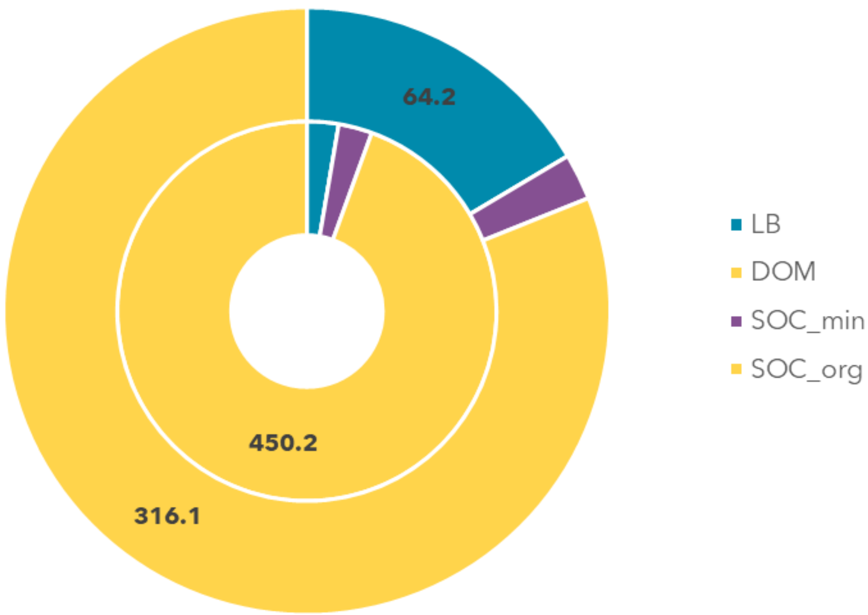


Figure 6.20. CO_2 emissions resulting from land conversion to cropland by pools in 1990 (inner circle) and 2023 (outer circle) in Iceland [kt].

6.4.4.2 Methodology

Table 6.21 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 Cropland category and to report information in the relevant CRT table. More detail information is presented in textural format below.

Table 6.21 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
Forest Land Converted to Cropland	NO (2015, T1)[6]	NO (2015, T3)[6]	NO	NO	T1 (D)
Grassland Converted to Cropland	T1 (D)	T2 (CS)	IE[2]	T2 (CS)	IE[5]
Wetlands Converted to Cropland	T1 (D)	T2 (CS)	IE[2]	NO[3]	T1 (D)
Settlements Converted to Cropland	NO	NO	NO	NO	NO
Other Land Converted to Cropland	IE[1]	IE[1]	IE[4]	IE[1]	NO

[1] Reported under Grassland converted Cropland. With regard to conversion of Other land to Cropland, organic soils are reported as "NO," as Other Land does not contain organic soil.

[2] See DOM section of the current chapter.

[3] It is assumed that all wetlands that are converted to croplands are on organic soils.

[4] Reported as aggregate number under CSC in DOM in Grassland converted to Cropland.

[5] Reported as aggregated number under organic soil in Wetlands converted to Cropland.

[6] The conversion of Forest Land to Cropland occurred in 2015 A tier 3 approach was applied to conduct the estimates.

Living biomass

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. Specifically, according to the Tier 1 method, it was assumed that 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 Grassland Converted to Cropland and Wetlands Converted to Cropland are estimated based on the year before the conversion and assuming biomass after one year of growth using a default EF (Table 6.20Table 6.21). Losses are estimated for the area converted in the year.

To estimate losses due carbon stock changes in living biomass due to conversion from Grassland and Wetlands to Cropland, the data from IGLUD field sampling (Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010) were applied. Based on that sampling, the average above-ground biomass 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[(32)] t C ha^{-1} yr^{-1}, and for Wetlands – 1.80 kg C m^{-2}, equivalent to 17.96 t C ha^{-1} yr^{-1}.

To estimate losses due carbon stock changes in living biomass due to conversion from Forest land to Cropland (only for 2015), the data from a measurement plot of the SSP-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 Forest Land converted to Settlement).

[32] Note that for GL the value of 12.68 tC/ha represents the stock of the above-ground biomass, including the litter and standing dead. It excludes the below-ground biomass.

DOM

CSCs from this pool in Grassland and Wetlands converted to Cropland are reported as aggregate values under Living biomass losses as 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.

Mineral soils

The calculation of the CS EF for C-stock change in mineral soils for Grassland Converted to Cropland is based on Equation 2.25 (Chapter 2 of the 2006 IPCC Guidelines) using a SC SOC_{REF} was evaluated in (Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010) and the IPCC default stock change factors (Table 6.22).

Table 6.22 Calculation of the country country-specific EF for C-stock change in mineral soils for Grassland Converted to Cropland.

SOC ref [CS] t C/ha	F_{LU} *	F_{MG} *	F_{I} *	Transition period [years]	Annual CSCF, t C/ha
90.5	1.00	0.82	1.15	20	-0.26

* Stock change factors are IPCC defaults taken from Table 5.5 from Chapter 5 – 2006 IPCC Guidelines: F_{LU} - Temperate/Boreal and Tropical – Moist/Wet, F_{MG} - No-till – Moist, and F_{I} – Medium – All – Dry and Moist/Wet

Organic soils

The default EF for drained in Boreal or Temperate Climate zones from the 2013 Wetlands Supplement was used in the estimates of emissions from organic soils for all categories (Table 6.23).

Table 6.23 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of Land converted to Cropland, by land-use subcategory for the entire reporting period

Land Category	Pool	EF	t C ha^{-1} yr^{-1}	Reference
Forest Land Converted to Cropland	Organic Soils	D	-7.9	Table 2.1 of the 2013 Wetlands Supplement
Grassland Converted to Cropland	Mineral Soils	CS	-0.26	See the text above
	Biomass Gains	D	2.1 (annual) 0.13 (ICSCEF* for 2023)	Table 5.9 (Temperate (all moisture regimes)) of the 2006 IPCC Guidelines
	Biomass Losses	CS	12.68 (-0.80 ICSCEF* for 2023)	Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010
Wetland Converted to Cropland	Organic Soils	D	-7.9	Table 2.1 in the 2013 Wetlands Supplement
	Biomass Gains	D	2.1 (annual) 0.13 (ICSCEF* for 2023)	Table 5.9 (Temperate (all moisture regimes)) of the 2006 IPCC Guidelines

Land Category	Pool	EF	t C ha^{-1} yr^{-1}	Reference
	Biomass Losses	CS	17.96 -1.13 (ICSCEF* for 2023)	Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010

* Implied CSC EF (ICSCEF) for 2023 reporting year were reported in the CRT

6.4.5 Uncertainty Assessment and Time-series Consistency

The uncertainty assessment for Cropland land use category for the period 1990–2023 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 are presented in Annex 2: Assessment of Uncertainty. 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 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 6.1.4 for more information.

6.4.7 Category-specific recalculations

The methodology for estimating cropland was revised in the 2025 submission. Areas transitioning from cropland to grassland (CL → GL) are now correctly included as cropland before conversion (Figure 6.21). Cropland mineral soils are estimated using the same bottom-up approach as organic soils, which accounts for all land-use conversions to and from cropland across the entire time series (beginning in 1882). This update leads to an increase in the estimated areas of organic soils due to the corrected allocation of CL → GL transitions. In contrast, there is a net decrease in mineral soils, as the bottom-up method reduces their estimates more significantly than any increases from corrected CL → GL allocations (Figure 6.22).

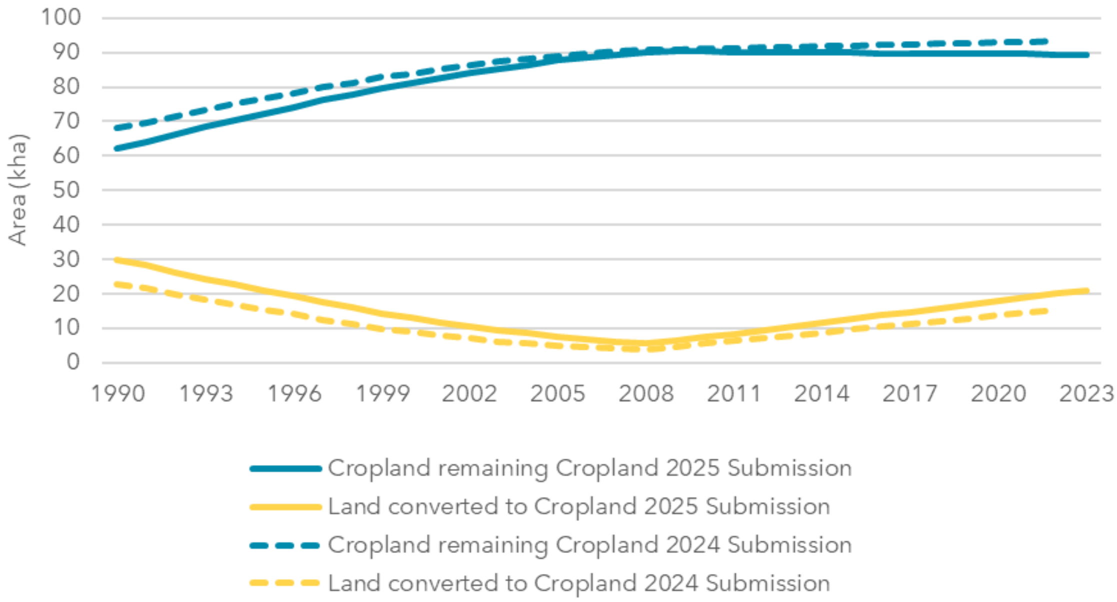


Figure 6.21 Recalculations to the activity data between the current (2025) and previous (2024) submission for Cropland

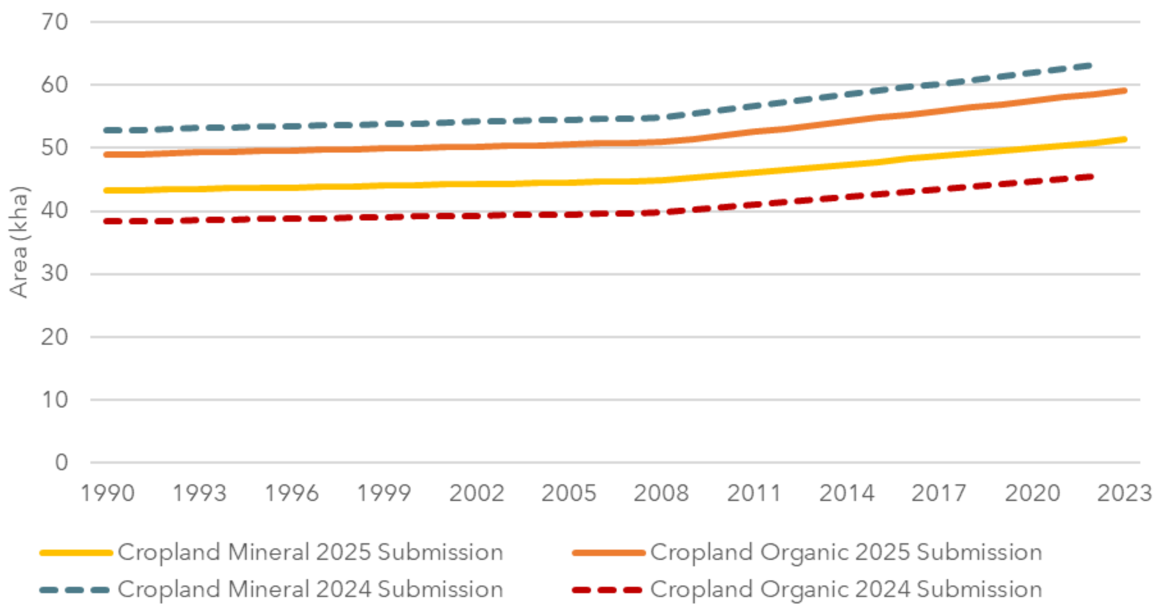


Figure 6.22 Recalculations to the activity data between the current and previous submission for Cropland mineral and organic soils

For this reason, emissions from Cropland organic soils increased in the current submission compared to the previous submission. Additionally, small recalculations result from an overall increase in cropland area reflected in the 2025 submission's IGLUD map.

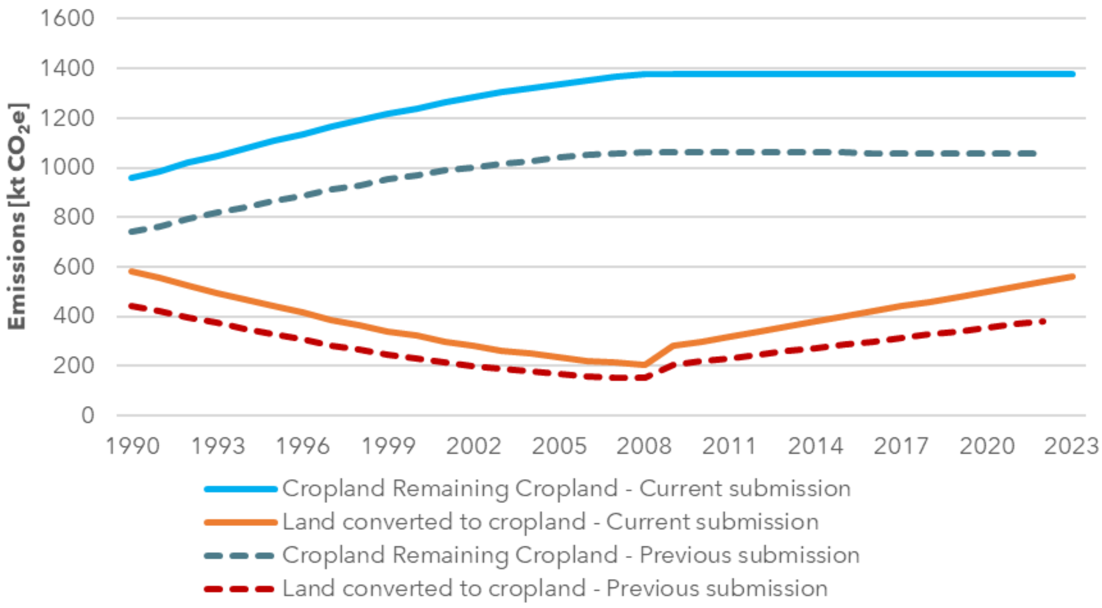


Figure 6.23 Recalculations to the emissions between the current (2025) and previous (2024) submission for Cropland

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 summer of 2024, with additional data collection planned for the summer of 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.

Land converted to Cropland: The category is being revised and the first improvements are included in this submission. The work is expected to be finalized in the 2026 submission.

6.5 Grassland (CRT 4C)

6.5.1 Category description

The total Grassland area demonstrated a stable, slight increase over the entire reporting period. Specifically, it increased from 5,954.3kha in 1990 to 6,000.1kha in 2005. Between 2006 and 2023, the area continued to rise, albeit at a slower rate, reaching 6,064.5kha in 2023 (Figure 6.24).

The Grassland land use category was a source of CO_2 emissions throughout the entire reporting period. Total CO_2 emissions fluctuated within a relatively narrow range, from 5,242.5kt CO_2 in 1990 to 5,310.13kt CO_2 in 2023. The slight growth in emissions from Grassland Remaining Grassland was offset by removals occurring within the Land Converted to Grassland subcategory since 2004 (Figure 6.25).

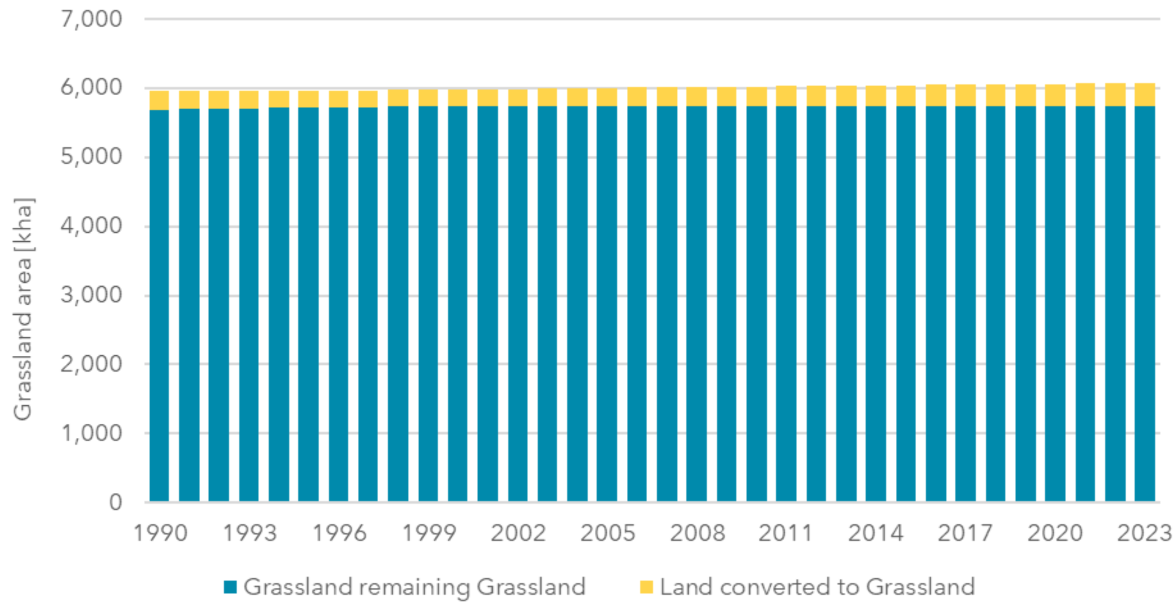


Figure 6.24 Grassland area (by category) in Iceland in 1990 – 2023 [kha].

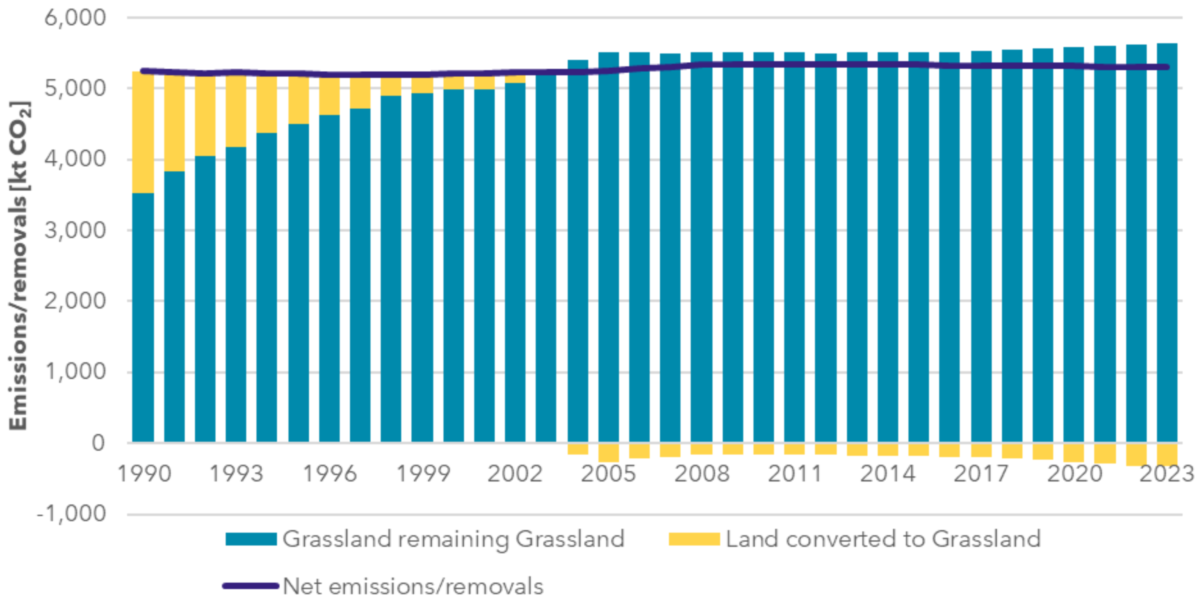


Figure 6.25 Emissions (+) and removals (-) from Grassland remaining Grassland and Land converted to Grassland in kt CO_2.

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 12 subcategories (Table 6.25). Land conversions into Grassland are identified for three categories: *Cropland Converted to Grassland, Wetland Converted to Grassland, and Other Land Converted to Grassland*.

The 2025 submission incorporates data from 44 map layers compiled within the IGLUD land-use map, of which 29 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 according to three primary time series of Cropland Converted to Grassland, Revegetation records, Wetland Converted to Grassland, and two independent time series for expansion of Birch Shrubland into Other Grassland and Other Land (Table 6.24 below).

The identification of the mineral and organic soils in the Grassland subcategories is based on information from the IGLUD map and Land and Forest (LaFI) Iceland together with some assumptions. The allocation of mineral and organic soils in Cropland inactive subcategory is based on a fixed ratio derived from the map areas. All the conversions from 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 (LaFI). All conversions from Wetlands to Grassland are assumed to come from Intact mires (managed <200 m a.s.l.) and are therefore reported under organic soils. All the revegetation activities are reported on Other land converted to Grassland and thus reporting as activities on mineral soils.

Table 6.24 Methodology and data sources for constructing the time series of Grassland category.

Land use category	Subcategory	1989	1990	-	2000		2008	-	2010	-	2022	2023
Grassland remaining grassland	Cropland abandoned for	Cropland timeseries										
	Natural birch shrublands	Natural birch forest timeseries										
	Organic soils drained for more than 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 converted to	Cropland timeseries										
	Revegetation (Other land converted to Grassland)	Recorded revegetation activities - NIRA database										
	Wetland converted 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 6.25 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 (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 other grassland	This subcategory represents Other Grassland 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 (Betula pubescens) 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 application of default 20 years conversion period of the subcategory Wetland converted to Grassland.	GLrGL	-
		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 costal land, heathlands with dwarf shrubs, shrubs other than birch (Betula pubescens), 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	-
		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 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.	LUC to GL	60
		Other land converted to natural birch shrubland	Originates from the ongoing expansion of Birch Shrubland noted in the NFI	LUC to GL	60

6.5.3 Grassland Remaining Grassland (CRT 4C1)

6.5.3.1 Category Description

Overall, it can be noted that the total area of Grassland Remaining Grassland demonstrated a slight increase (around 47 kha) throughout the period, rising from 5,682.7 kha in 1990 to 5,729.5 kha in 2023. The main subcategory contributing to the total area remains (Grazing areas) the largest throughout the entire period, although it shows a moderate decline, decreasing from 2,730.4 kha in 1990 to 2,692.5 kha in 2023. The second most significant subcategory has been and remains Grazing Areas on Other Land, which exhibits a steady decrease from 2,383.7kha in 1990 to 2,349.4 kha in 2023 (Figure 6.26).

Grassland Remaining Grassland was a source of emissions throughout the entire reporting period, with emissions increasing from 3,517.8kt CO_2 in 1990 to 5,637.0kt CO_2 in 2023. The primary source of emissions was the management of organic soils. These emissions were partially offset by sequestration occurring in mineral soils (Figure 6.27).

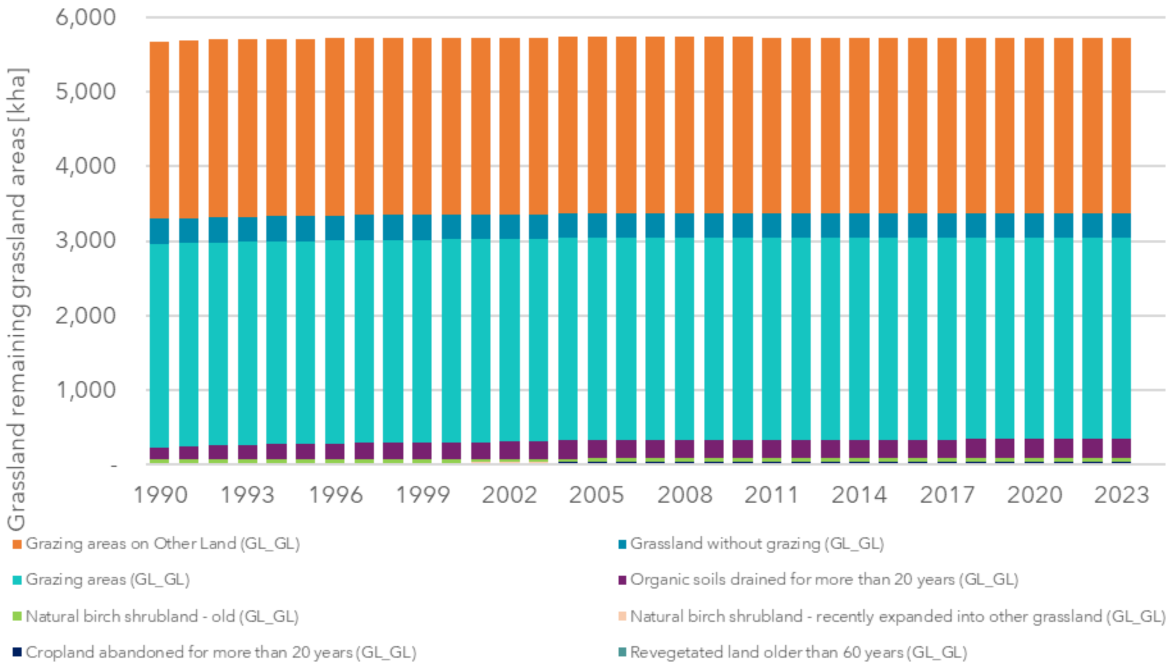


Figure 6.26 Area of Grassland remaining Grassland by subcategory in Iceland in 1990 – 2023 [kha].

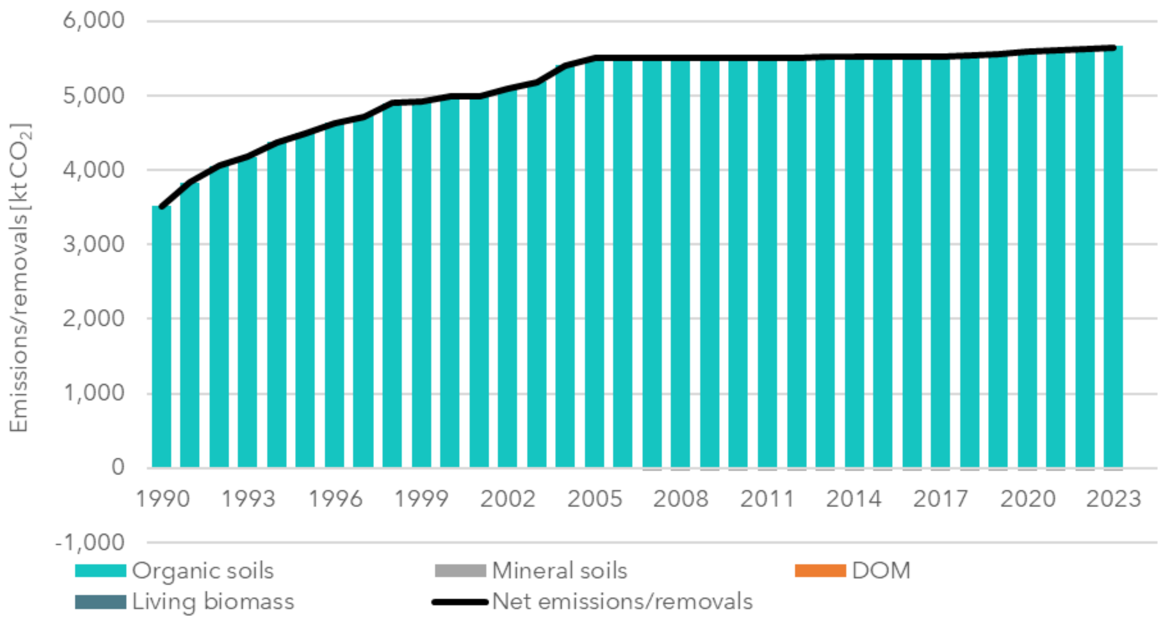


Figure 6.27 Emissions (+) and removals (-) from Land converted Grassland by pools in Iceland in 1990 – 2023 [kt CO_2].

6.5.3.2 Methodology

Table 6.26 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 6.26 Tier-level approaches, notation keys, and emission factors used for the Grassland Remaining Grassland category

Land-Use Category	Living Biomass		DOM	Soils	
	Gains	Losses		Min	Org
Revegetated Land older than 60 years	NA [T1]	NA [T1]	NA [T1]	NA[T1]	NO
Cropland Abandoned for more than 20 years	NA [T1]	NA [T1]	NA [T1]	NA[T1]	T1 (D)
Natural Birch Shrubland – recently expanded into Other Grassland	T2 (CS)	IE[1]	T2 (CS)	T2 (CS)	T1 (D)
Natural Birch Shrubland – old	T3 (OTH)	IE[1]	NA [T1]	NA [T1]	T1 (D)
Organic soils drained for more than 20 years	NA [T1]	NA [T1]	NA [T1]	IE[2]	T1 (D)
Grazing Areas	NA [T1]	NA [T1]	NA [T1]	NA [T1]	IE[3]
Grassland without Grazing	NA [T1]	NA [T1]	NA [T1]	NA [T1]	IE[3]
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] Estimation of CSC in mineral soils are reported as aggregated numbers in Grassland remaining Grassland - Grazing areas and Grassland without grazing.

[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 Natural Birch Shrubland – recently expanded into Other Grassland and Natural Birch Shrubland – old.

The changes in carbon stock of the subcategories Natural Birch Shrubland – Old and Natural Birch Shrubland – Recently Expanded into Other Grassland are estimated by LaFI based on NFI data and estimated in same manner as Natural Birch Forest – Old and Grassland converted to Natural Birch Forest respectively (See Sections 6.3.3.2 and 6.3.4.2 above).

DOM

The carbon stock changes of dead organic matter in the category Natural Birch Shrubland – Old are, as with Natural Birch Forest older than 50 years, assumed to be a slight sink and reported as NA based on a Tier 1 approach (Table 6.26).

The carbon stock changes in dead organic matter for Natural Birch Shrubland – Recently Expanded into Other Grassland are estimated by the same CS EFs as used for Grassland Converted to Forest Land (Table 6.16).

Mineral soils

The carbon stock changes in SOC of mineral soils under Natural Birch Shrubland – Recently Expanded to Other Grassland were estimated by the same CS EFs as used for Grassland Converted to Forest Land (Table 6.16).

Due to data constraints (lack availability) on carbon stock changes in mineral soils for these subcategories a Tier 1 approach was applied, assuming that the pool is in equilibrium.

Organic soils

A tier 1 approach along with the IPCC default values (Table 6.27) were used to estimate emissions due to use of organic soils.

Table 6.27 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
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)
Natural Birch Shrubland – Recently Expanded into Other Grassland	Mineral Soils	CS	0.37	Bjarnadóttir, 2009
	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
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.).
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 271.6 kha in 1990 to 335.0 kha in 2023 over the entire reporting period. The 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 153.4 kha in 2023, with a total decrease of 11.5 kha. The Wetlands Converted to Grassland (WL - GL) subcategory was the second most significant category in terms of initial area. However, it shows a substantial decline from 97.5 kha in 1990 to 14.5 kha in 2023, a total decrease of 83 kha. The Revegetation since 1990 - Protected from Grazing (OL - GL) subcategory demonstrated the most substantial growth, starting at 1.7 kha in 1990 and increasing to 118.5 kha in 2023, a total rise of 116.8 kha. On the other hand, the Wetlands Converted to Grassland (WL - GL) subcategory experienced the most dramatic decline, dropping by 83 kha over the period (Figure 6.28).

Land converted to Grassland changed from a source to a sink category over the reporting period, shifting from +1,724.7kt CO_2 in 1990 to -326.8kt CO_2 in 2023. Emissions due to the management of organic soils were the only source of emissions. However, this pool demonstrated a decline in emissions, from +2,093.5 kt CO_2 in 1990 to +348.4 kt CO_2 in 2023. All other pools were sinks, with the management of mineral soils becoming the largest sink and showing a steady increase in carbon sequestration, from -318.6 kt CO_2 in 1990 to -595.8 kt CO_2 in 2023. Living biomass also demonstrated an increase in seque–stration, starting at -50.2 kt CO_2 in 1990 and reaching -77.5 kt CO_2 in 2023 (Figure 6.28).

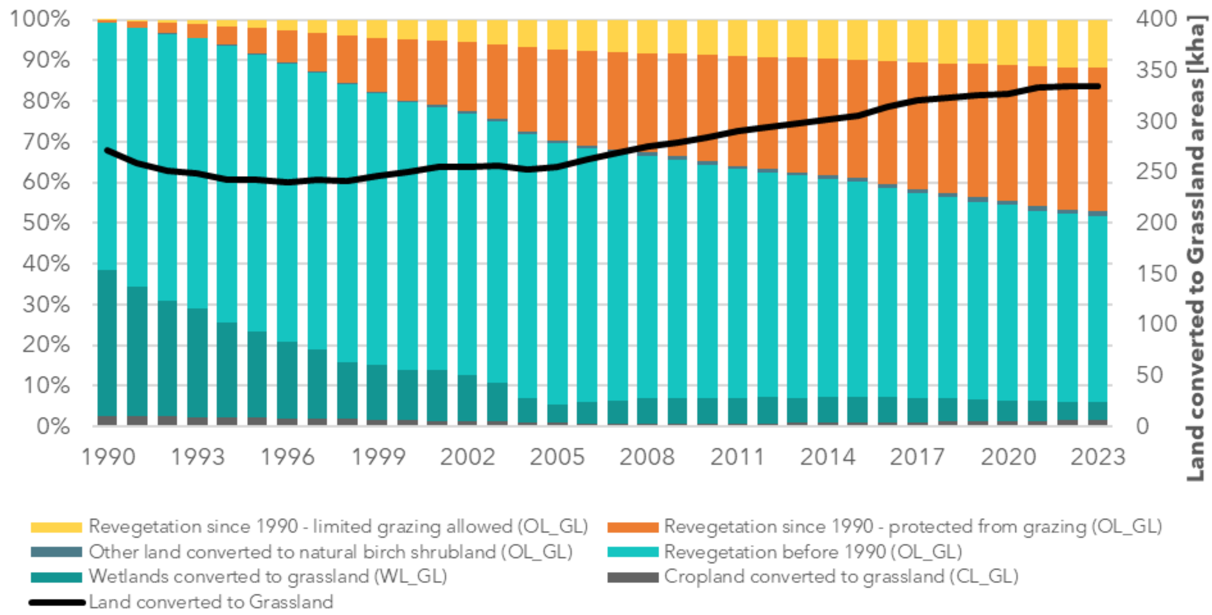


Figure 6.28 Relative shares of land converted to Grassland (by subcategory), and the total area converted to Grassland (kha) in Iceland in 1990 – 2023

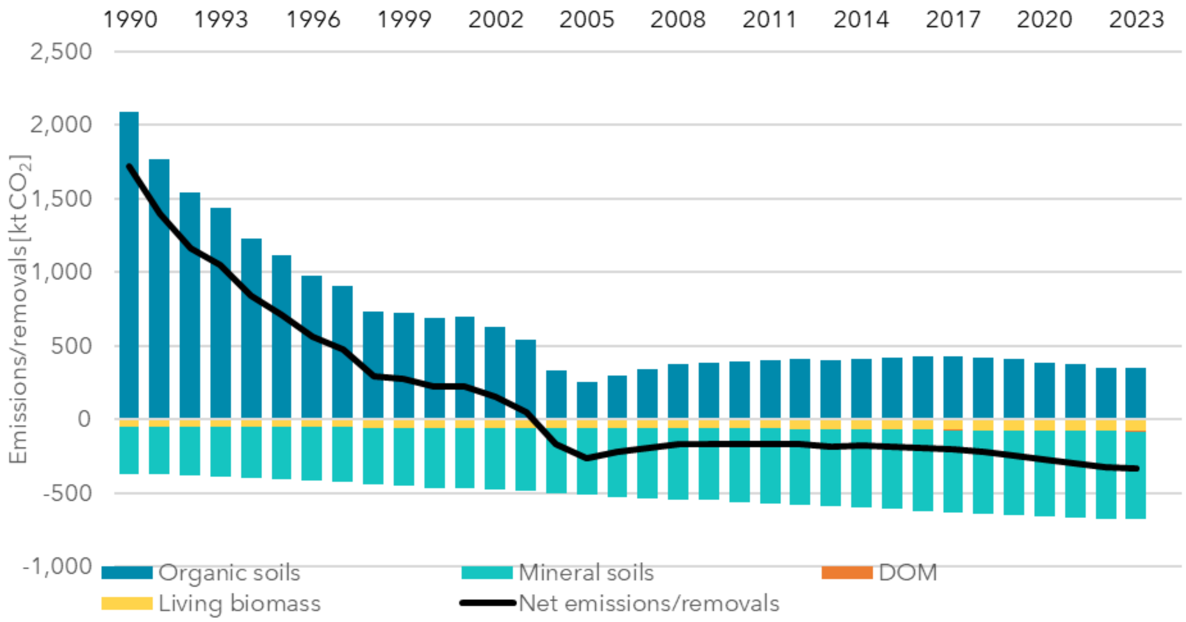


Figure 6.29 CO_2 emissions resulting from land conversion to Grassland by pools in Iceland in 1990 – 2023 [kt].

6.5.4.2 Methodology

Table 6.28 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 Grassland category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Table 6.28 Tier-level approaches, notation keys, and EFs used for Land converted to Grassland category

Land-Use Category		Living Biomass Gains	Living Biomass Losses	DOM	Soils Min	Soils Org
Forest Land Converted to Grassland		NO	NO	NO	NO	NO
Cropland Converted to Grassland		T2 (CS)	T1 (D)	IE[1]	T2 (CS)	T1 (D)
Wetlands Converted to Grassland		NA [T1]	NA [T1]	NA[5] [T1]	NO	T1 (D)
Settlements Converted to Grassland		NO	NO	NO	NO	NO
Other Land Converted to Grassland	*Revegetation before 1990*	T2 (CS)	IE[2]	IE[3]	T2 (CS)	NO
	Other Land Converted to Natural Birch Shrubland	T2 (CS)	IE[4]	T2 (CS)	T2 (CS)	NO
	Revegetation since 1990 – Protected from Grazing	T2 (CS)	IE[2]	IE[3]	T2 (CS)	NO
	Revegetation since 1990 – Limited Grazing Allowed	T2 (CS)	IE[2]	IE[3]	T2 (CS)	NO

[1] Reported as aggregate number under Living biomass Losses as the value of 12.68 tC/ha represents the stock of the above-ground biomass, including the litter and standing dead. It excludes the below-ground biomass.

[2] Reported as aggregate number under CSC in living biomass - Gains.

[3] A Tier 2 was applied to evaluate the CS changes (gains) in carbon within Living biomass, while Living biomass gains also includes changes in carbon for DOM (including litter and standing dead)

[4] 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.

[5] It is assumed that changes in C-stock in this C pool is likely to be in equilibrium based on a Tier 1 approach.

Living biomass

Carbon stock changes in living biomass were estimated for all categories of Land converted to Grassland where conversion is reported to occur (Table 6.29).

Cropland converted to Grassland: the explanation is provided in Table 6.29.

Other Land converted to Grassland: The stock changes in living biomass for this subcategory represents revegetation activities that reflect the increase in vegetation coverage and biomass. The changes in biomass are estimated as relative contribution (10%) of total C-stock increase (Aradóttir, Svavarsdóttir, Jónsson, & Guðbergsson, 2000).

DOM

The changes in DOM are included in C-stock changes in living biomass for the categories:

Cropland Converted to Grassland. 5.50Revegetation before 1990, Revegetation since 1990 – Protected from Grazing, and Revegetation since 1990 – Limited Grazing Allowed for Other land converted to Grassland (see information in the footnotes in Table 6.28) and (Aradóttir, Svavarsdóttir, Jónsson, & Guðbergsson, 2000).

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 6.3.4).

Mineral soils

Carbon stock changes reported in mineral soil of Cropland Converted to Grassland are assumed to be reversed changes estimated for Grassland Converted to Cropland (Chapter 6.4.4.2).

A tier 2 approach and the CS emission (removal) factor (Table 6.29) was used to calculate the changes in carbon stock in mineral soils for three subcategories of Other Land Converted to Grassland.

No mineral soils are included as Wetland Converted to Grassland.

Organic soils:

A tier 1 approach together with the IPCC default EF was used to estimate emissions from the use of organic soils (Table 6.29).

Table 6.29 EFs used to estimate emissions (-) and removals (+) resulting from changes in the carbon pools of Land converted to Grassland, by land-use subcategory for the entire reporting period

Land Category	Pool	EF	t C ha^{-1} yr^{-1}	Reference
Cropland Converted to Grassland	Mineral Soils	CS	0.26	Calculated based on SOCref= 90.5tC/ha (Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010), F_{LU} =0.93 (set aside); F_{MG} = 1.10 (no tillage); FI=1.0 (medium input) from Table 5.5the 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	0.63	Annual increase in above ground biomass, calculated as average sampled biomass from Grassland below 200m a.s.l. (12.68 t C ha^{-1}) divided for 20 years conversion period.
Wetlands Converted to Grassland	Organic Soils	D	-5.70	Table 2.1 in the 2013 IPCC Wetlands supplement (Grassland, Drained in Boreal Zone)
***Other Land* Converted to Grassland**				
Revegetation before 1990	Mineral Soils	CS	0.51	Estimated by Soil conservation service (expert Jóhann Þórsson)
	Biomass Gains	CS	0.06	Estimated by Soil conservation service (expert Jóhann Þórsson)
Other Land Converted to Natural Birch Shrubland	Mineral Soils	CS	0.51	Estimated by Soil conservation service (expert Jóhann Þórsson)
	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
Revegetation since 1990 – Protected from Grazing	Mineral Soils	CS	0.51	Estimated by Soil conservation service (expert Jóhann Þórsson)
	Biomass Gains	CS	0.06	Estimated by Soil conservation service (expert Jóhann Þórsson)
Revegetation since 1990 – Limited Controlled Grazing Allowed	Mineral Soils	CS	0.51	Estimated by Soil conservation service (expert Jóhann Þórsson)
	Biomass Gains	CS	0.06	Estimated by Soil conservation service (expert Jóhann Þórsson)

6.5.5 Uncertainty Assessment and Time-series Consistency

The uncertainty assessment for Grassland 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 presented in Annex 2: Assessment of Uncertainty. 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.

6.5.6 Category-specific QA/QC and verification

Please consult Section 1.5 and Section 6.1.4 for more information.

6.5.7 Category-specific recalculations

In the 2025 submission, the method for processing the activity data was revised to use annual land use transition matrixes to explicitly track changes in areas between land-use subcategories. This results in large recalculations in Grassland remaining Grassland and Other land (see area recalculations in Figure 6.30 and emission recalculation in Figure 6.32). Specifically, the new method identifies fewer conversions away from Grassland remaining Grassland and more conversions away from Other land.

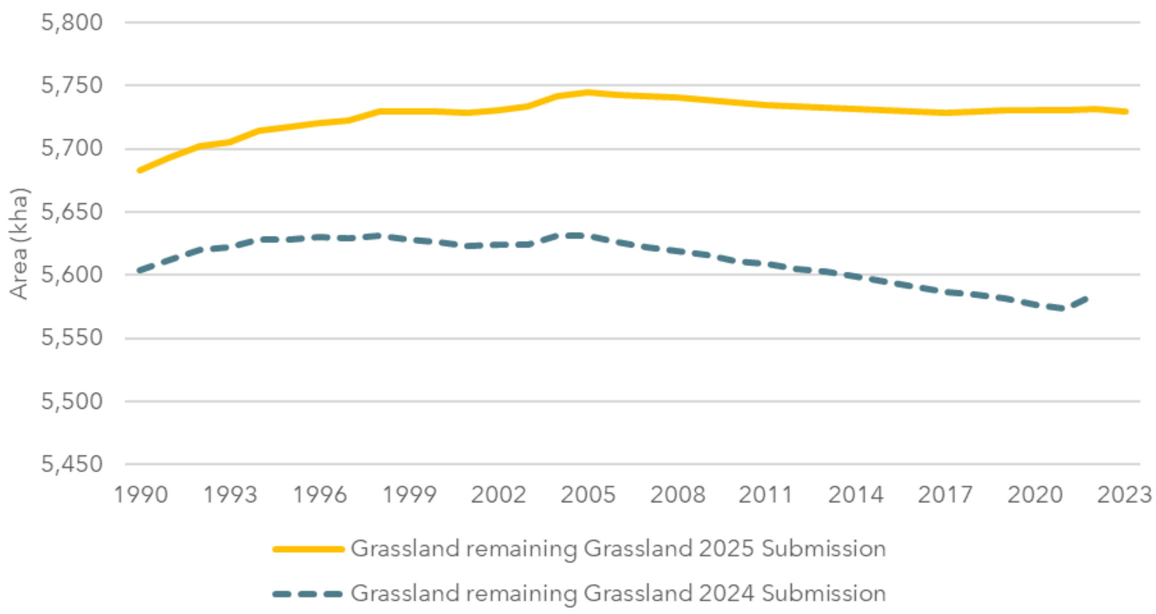


Figure 6.30 Recalculations to the activity data between the current and previous submission for Grassland remaining Grassland

There are small recalculations to the activity data and emissions to the Land converted to Grassland category as shown in Figure 6.31 and Figure 6.32 respectively.

There are minor recalculations to the Cropland converted to Grassland category due to the overall increase in cropland area reflected in the 2025 submission's IGLUD map.

There are minor revisions to Wetlands converted to Grassland (WL → GL) from 2009 onward. These revisions are due to the updated IGLUD map data, which now estimate areas of drained organic soils (WL → GL) explicitly, replacing the previous estimates based on expert judgment.

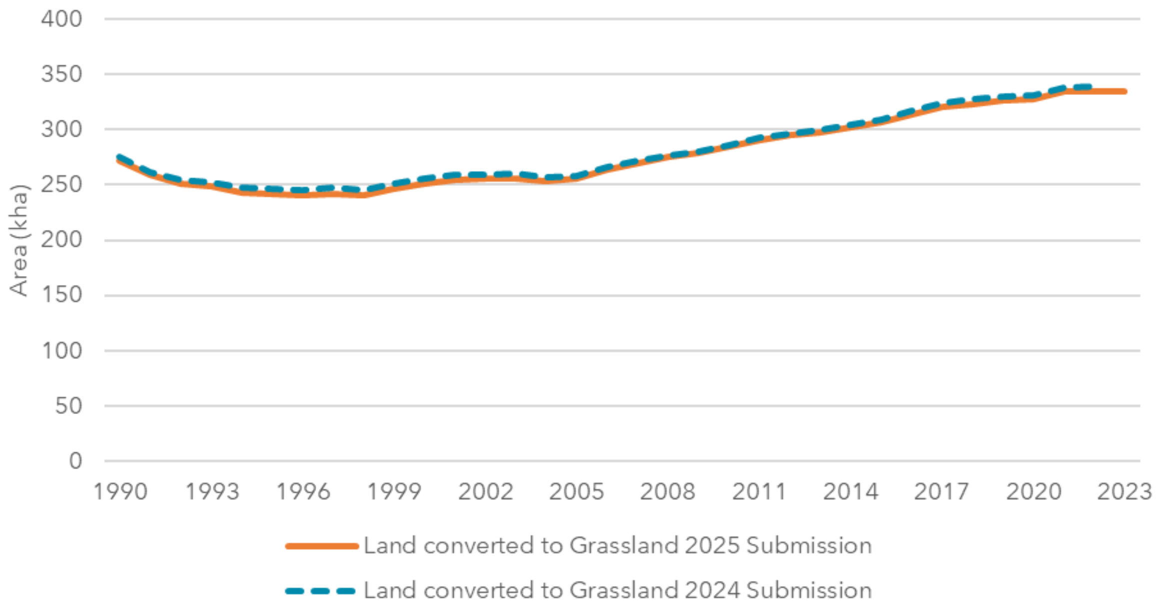


Figure 6.31 Recalculations to the activity data between the current (2025) and previous (2024) submission for Land converted to Grassland

Recalculations to emissions for grassland are mainly driven by changes to the activity data described above. Additionally, new country specific DOC emission factors result in a small decrease in CO_2 and CH_4 emissions from drained organic soils (Table 4(II)).

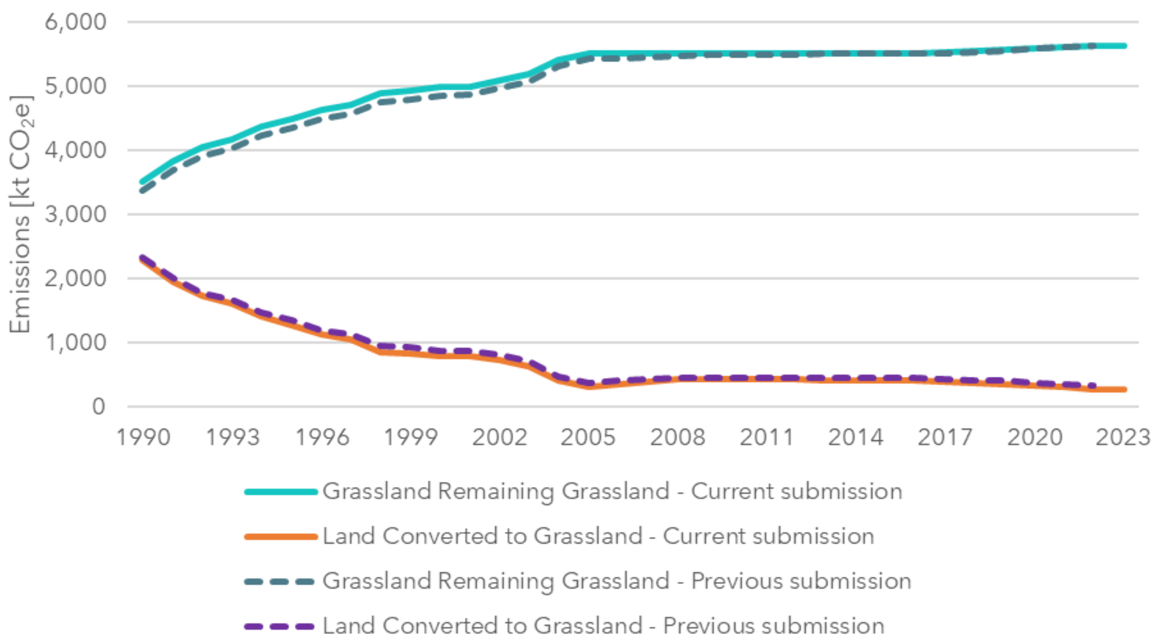


Figure 6.32 Recalculations to the emissions between the current and previous submission for Grassland

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 6.26). In 2023, Land and Forest Iceland launched a project focused on the "Grassland remaining Grassland" category. The initiative involves collecting soil samples and measuring gas flux data using portable units. Initial results are expected by late 2025 and will be utilized for the 2026 submission.

New map of ditches was released in 2021 and provide new estimates of changes in ditch network. Mapping of ditches is ongoing, now with emphasis on improving the timeseries. Data for dividing the drained area according to soil type drained has been collected for a part of the country. This work is ongoing and is planned to be finished in 2026.

The largest subcategory of Grassland, Other Grassland, is reported as two units: Grazing Areas and Grassland Without Grazing. Severely degraded soils are widespread in Iceland as a result of extensive erosion over a long period of time. 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 is pending. The processing of the IGLUD field data is expected to provide information connecting degradation severity, grazing intensity, and C-stocks. This data is also expected to enable the relative division of the area degradation and grazing intensity categories, including areas where vegetation is improving and degradation decreasing (Magnússon, et al., 2006).

One component pinpointed in this report is the effect of soil thickening on C-sequestration. The aeolian deposition of sand and dust on soil of Grassland, as well as other land-use categories, causes soil thickening. On vegetated land, this soil addition will accumulate carbon. The deposition rate of aeolian materials of different regions in Iceland has been estimated by Arnalds (2010). The rate and variability of C-sequestration following this deposition is still not estimated. This potential carbon sink needs to be quantified, and its variability mapped (in the latest submission, NA was used to report the changes in pool (Table 6.26). The potential of the soil samples, collected in the IGLUD survey, to estimate this component will be explored.

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.

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 steadily from 278.6 kha in 1990 to a peak of 285.5kha in 1998. After 1998, the total area began to decline slightly and by 2023, the total area was 262.8 kha, reflecting a general decline over the long term. Wetlands remaining wetlands has been the main CO_2 sink over the report period. The removals trend follows the changes in area: from -477.8 kt CO_2 in 1990 to -409.28 kt CO_2 in 2023 (Figure 6.34).

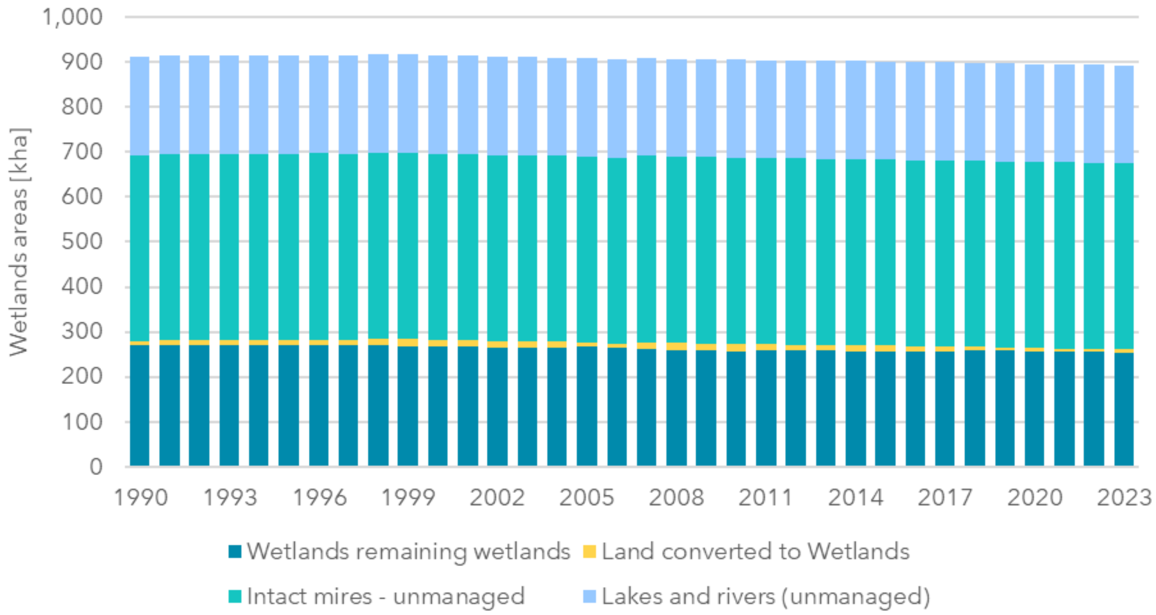


Figure 6.33 Area of Wetlands by category in Iceland in 1990 – 2023, kha (The areas of unmanaged Wetlands areas are shown for transparency. The data were not used in the estimates).

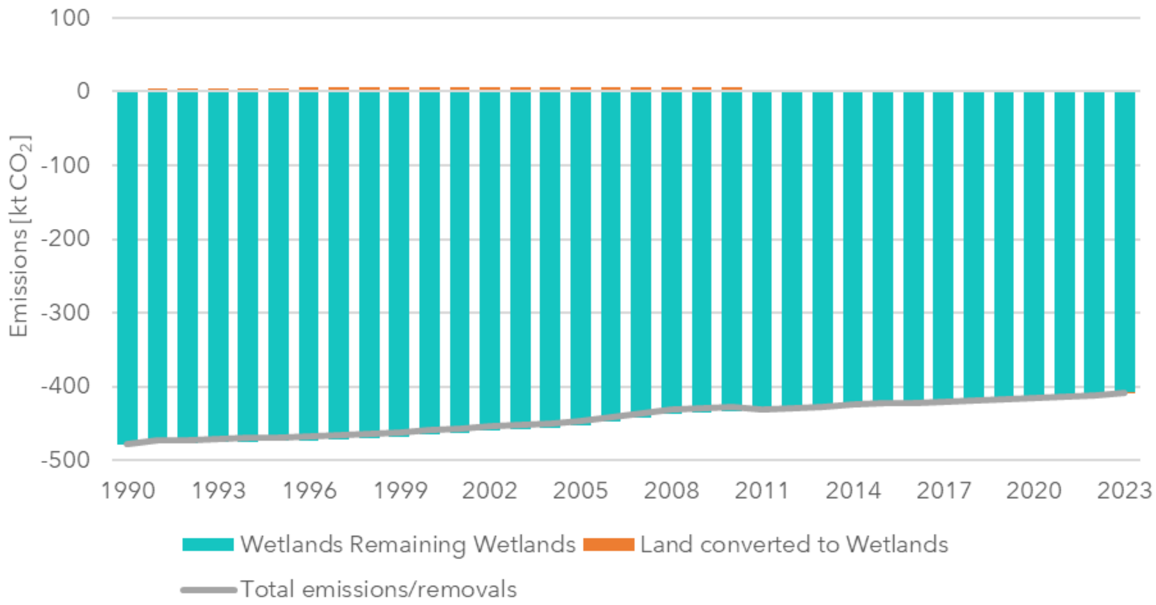


Figure 6.34 CO_2 emissions resulting from Wetlands (by category) in Iceland in 1990 – 2023 [kt].

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, rewetted mires, and fens below 200 meters elevation, which are part of rangelands grazed by livestock. The largest subcategory, Intact mires, is considered managed only in areas below 200 meters in elevation where grazing occurs. This subcategory acts as CO_2 sinks.

The category consists of 10 subcategories summarized in the Table 6.30 below.

Table 6.30 Definitions of Wetlands subcategories

LU category	Definition	LU subcategory	Definition	Allocation	Conversion period
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**			
		Intact mires converted to reservoirs	This subcategory includes land areas with high organic carbon content (>50 kgC/m2) that have been inundated, changing their natural state. Due to the altered ecosystem function from flooding, these areas are now classified as "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	-
		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 6.32) 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	-
		Medium SOC to reservoirs	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
		Low SOC to reservoirs	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 have 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			
		Lakes and rivers	This subcategory includes areas of **unmanaged land** reported as Lakes and rivers which has been converted to reservoirs.	WLrWL	-
		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
		Intact Mires - unmanaged	**Unmanaged** mires are intact wetlands located above 200m elevation, where minimal grazing occurs due to low stocking rates and sheep preference for other vegetation types. About 64% of intact mires fall within this elevation, experiencing negligible grazing pressure based on data from the GróLind Monitoring Program and past grazing trials.	WLrWL	-
		Intact Mires - managed	This subcategory includes intact mires below 200m classified as managed land based on inclusion under land used for livestock grazing.	WLrWL	-
		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 "Organic soils drained for more than 20 years" and areas of mineral soils are assumed to be converted from the mineral Grassland category "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
		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 "Cropland abandoned for more than 20 years" as these areas are known to be historically intensively managed.	WLrWL/LUC to WL	20 years

The data for the Wetlands category is derived from various sources, including:

- Land and Forest Iceland (LaFI)
- 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 6.31).

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 wetlands, were reclassified recently into managed and unmanaged subcategories. The revised series assumes that no drainage of histosols occurs above 200 meters, resulting in a constant unmanaged area across all years except for 1991, when 500 hectares were flooded and reclassified as "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 6.31 Methodology and data sources for constructing the time series of Wetlands category.

Land use category		Subcategory	1989	1990	....	2019	....	2023
Wetlands remaining Wetlands	Flooded land remaining Flooded land	Intact Mires converted to reservoirs	Agricultural Research Institute					
		Intact Mires converted to reservoirs >20 years						
		Medium SOC to reservoirs >20 years						
		Low SOC to reservoirs >20 years						
	Other wetlands remaining other wetlands	Lakes and rivers (unmanaged)	The National Power Company of Iceland			Annual IGLUD maps		
		Lakes and rivers converted to reservoirs						
		Intact mires (unmanaged)	Cropland active timeseries and ditches timeseries					
		Intact mires (managed)						
		Rewetted wetland soils >20 years	Recorded areas converted					
		Refilled lakes and ponds >20 years						
Land converted to Wetlands	Grassland to Flooded land	Grassland converted to flooded land (Medium SOC to reservoirs)	Agricultural Research Institute					
	Other land to Flooded land	Other land converted to flooded land (Low SOC to reservoirs)						
	Grassland to Other Wetlands	Rewetted wetland soils	Recorded areas converted					
		Refilled lakes and ponds						
Legend								
Samples or known areas	Maps	Expert judgement	Interpolation	Assumptions				

Categories to be consistent with those listed in table 6.29 and 6.32 and to have the same type of sentence as for GL.

6.6.3 Wetlands Remaining Wetlands (CRT 4D1)

6.6.3.1 Category Description

The area of Wetlands remaining Wetlands showed a consistent decrease over the period, declining from 269.6 kha in 1990 to 254.5 kha in 2023. Within this category, the area of Intact Mires - Managed subcategory constituted the largest share. This subcategory exhibited a steady decline throughout the period, with a total loss of 35.2kha over 33 years, dropping from 237.2 kha in 1990 to 202.0kha in 2023. 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 2023 (Figure 6.35).

Regarding the magnitude of emissions/removals, Wetlands remaining Wetlands remained a sink throughout the entire reporting period. Removals directly followed the changes in the area. Organic soils were the sole sink over the entire period (Figure 6.36). For more information on the estimates of changes in carbon pools, see Table 6.33.

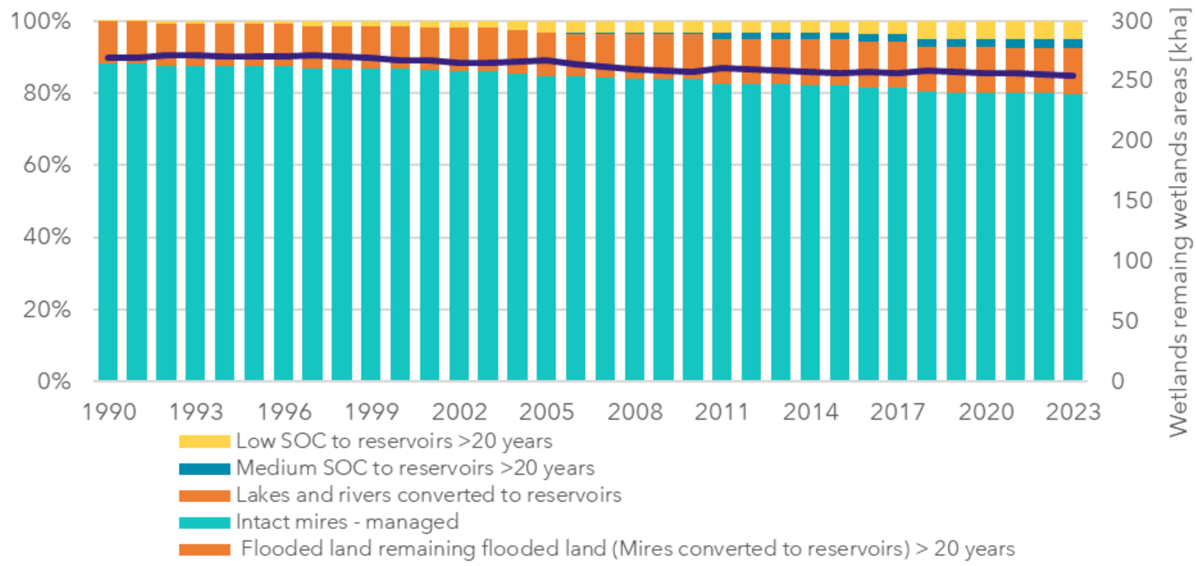


Figure 6.35 The total area (kha) and relative shares (%) of Wetlands remaining Wetlands (by subcategory) in Iceland in 1990 – 2023

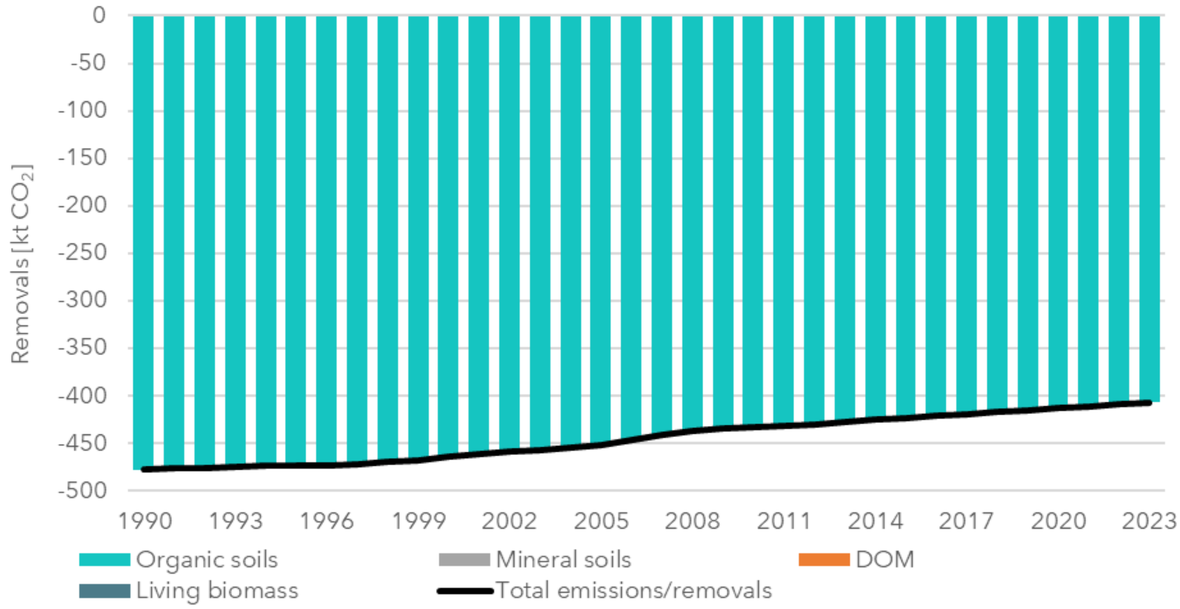


Figure 6.36 Emissions (+) and removals (-) from Wetlands remaining Wetlands by pools in Iceland in 1990 – 2023, kt CO_2.

6.6.3.2 Methodology

Table 6.31 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 Wetlands remaining Wetlands category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Table 6.32 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
Peat Extraction Remaining Peat Extraction	NO	NO	NO	NO	NO
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[5]
Low SOC to reservoirs older than 20 years	NA[1]	NA[1]	NA[1]	NA[1]	NO[5]
Other Wetlands Remaining Other Wetlands					
Intact Mires - managed	IE[2]	IE[2]	IE[2]	NO	T1(D)
Lakes and Rivers Converted to Reservoirs	NA[3]	NA[3]	NA[3]	NA[3]	NO
Refilled lakes and ponds older than 20 years	NA[3]	NA[3]	NA[3]	NO	IE[6]
Rewetted wetland soils	IE[4]	IE[4]	IE[4]	NO	T1(D)

[1] According to the 2019 Refinement to the 2006 IPCC Guidelines, no CO_2 emissions are reported for Land converted to Flooded land for more than 20 years.

[2] Section 3.2.1 of in the 2013 WL supplement to the IPCC 2006 GL states: "Since the default CO_2-C EFs in this chapter are all derived from flux measurements (see Annex 3A.1), the CO_2-Ccomposite results from the net flux, emissions or removals, from the soil and non-tree vegetation taken together." Hence, it was assumed that CSCs in living biomass for gains and losses, and DOM are included as aggregated values in organic soils under this subcategory.

[3] LB and DOM are reported as NA because no vegetation removal occurred before flooding the area.

[4] 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 CO_2-C EFs in this chapter are all derived from flux measurements (see Annex 3A.1), the CO_2-Ccomposite 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.

[5] 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.

[6] Reported as aggregate values under organic soils in "Rewetted mires"

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 6.32 for each relevant category.

Organic soils: Intact mire converted to Reservoirs, Medium SOC to reservoirs older than 20 years and Low SOC to reservoirs older than 20 years

CO_2 emissions from organic soils were estimated for Intact mires converted to reservoirs up until the 2011 reporting year. However, starting from the 2012 reporting year, CO_2 from Intact mires converted to reservoirs are no longer estimated and reported as NO because these areas are no longer defined as Intact mires converted to reservoirs, but rather as Intact mires converted to reservoirs more than 20 years. Consequently, all relevant emissions/removals are reported under the respective land-use subcategory.

Organic soils: Other wetlands remaining other wetlands

The CSCs in organic soils of the category Intact mires – managed, and Rewetted mires were estimated according to a Tier 1 by applying Equation 3.4 and the IPCC default EF (Table 6.33).

Table 6.33 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
Rewetted mires Intact mires - managed	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 8.9 kha in 1990, peaking at 16.4 kha in 2010, and then declining to 9.5 kha in 2023. Meanwhile, the Other Land Converted to Flooded Land (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 2023. The Grassland Converted to Flooded Land (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 (Figure 6.36).

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 CO_2 in 1990 to 6.1kt CO_2 in 1996 and moved to net removals in 2017, reaching -1.5 kt CO_2 in 2023. Management of mineral soils consistently showed emissions throughout the reporting period. The management of organic soils was a net source (Figure 6.38).

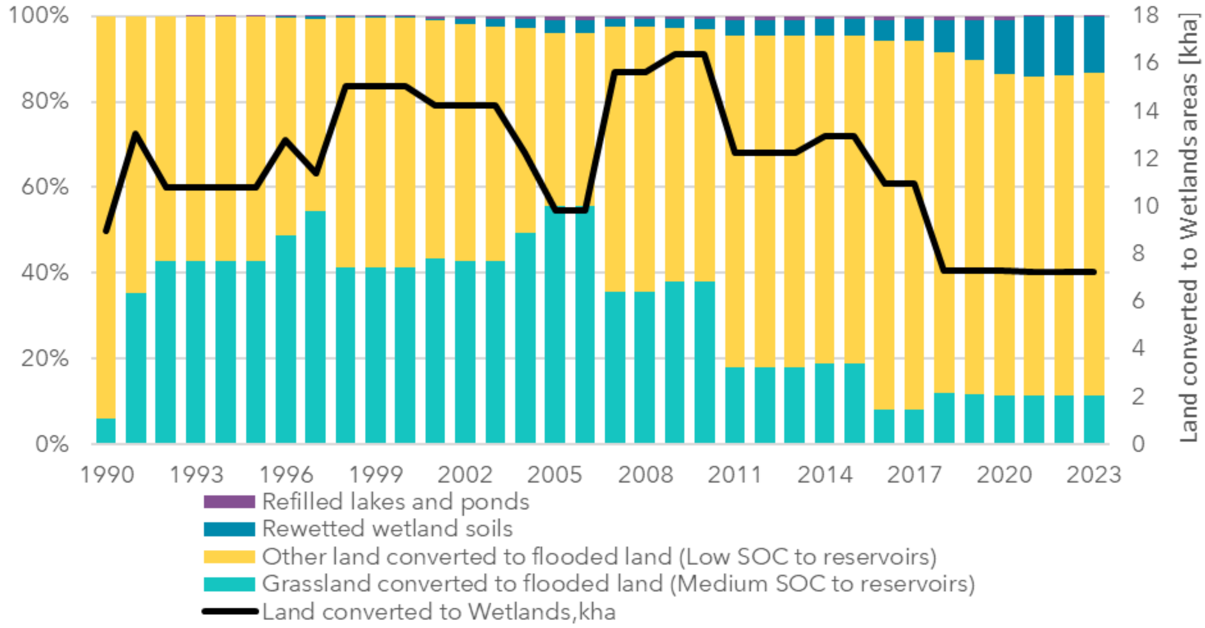


Figure 6.37 The total area (kha) and relative shares (%) of subcategories within Land converted to Wetlands in Iceland in 1990 – 2023

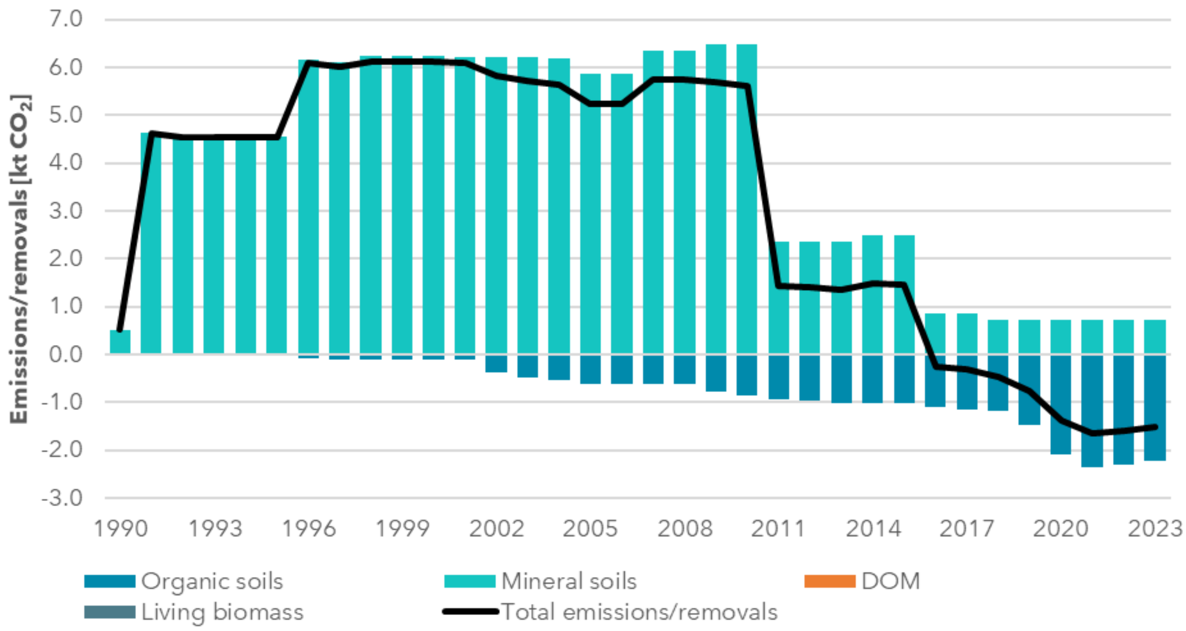


Figure 6.38 Emissions (+) and removals (-) by pools from Land converted to Wetlands in Iceland in 1990 – 2023, kt CO_2

6.6.4.2 Methodology

Table 6.19 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 textural format below.

Table 6.34 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
Land Converted to Peat Extraction	NO	NO	NO	NO	NO
Grassland Converted to Flooded Land					
Medium SOC to Reservoirs	NA[1]	NA[1]	NA[1]	T2 (CS)	NO
Other Land Converted to Flooded Land					
Low SOC to Reservoirs	NA[1]	NA[1]	NA[1]	T2 (CS)	NO
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 CO_2- C EFs in this chapter are all derived from flux measurements (see Annex 3A.1), the CO_2-Ccomposite 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 CO_2 and CH_4, and bubble emissions. In total, 10 reservoirs were examined in the studies for which EFs were evaluated (Table 6.35): 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 (Chapter 6.6.3.1). The IEFs for Low SOC and Medium SOC to Reservoirs is reported in Table 6.35.

Table 6.35 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_Hálslón	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 6.36).

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 6.36), developed for estimating emissions from organic soils, was used to calculate emissions from mineral soils.

Table 6.36 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	EF	t C ha^{-1} yr^{-1}	Reference
Grassland Converted to Flooded Land Medium SOC to Reservoirs	Mineral soils	CS	-0.06	Reported as IEF, the CS EFs and the calculation approach is reported in the text above
Other Land Converted to Flooded Land Low SOC to Reservoirs	Mineral soils	CS	-0.02	Reported as IEF, the CS EFs and the calculation approach is reported in the text above
Grassland Converted to Other Wetlands Rewetted Wetland Soils	Mineral soils	D	0.55	See explanation in the text above
	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 1990–2023 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. 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 6.1.4 for more information.

6.6.7 Category-specific recalculations

The 2025 submission includes revisions to the methodology for Wetlands organic soils activity data (see Figure 6.40). These revisions specifically impact the "Intact mires - managed" and "Intact mires - unmanaged" categories.

The "Intact mires - unmanaged" areas are now fixed across the timeseries, except for a single recorded conversion to a reservoir in 1991. Consequently, all changes in the overall Intact mires timeseries are reflected in the "Intact mires - managed" category, leading to a larger decrease in this category across the timeseries.

Additionally, the use of annual land-use transition matrices to explicitly track area changes between land-use subcategories has identified more conversions away from "Intact mires - managed," resulting in a minor further decrease in this category.

These recalculations impact the areas and emissions reported under Wetlands remaining Wetlands (see area recalculations in Figure 6.39 and emission recalculation in Figure 6.42.

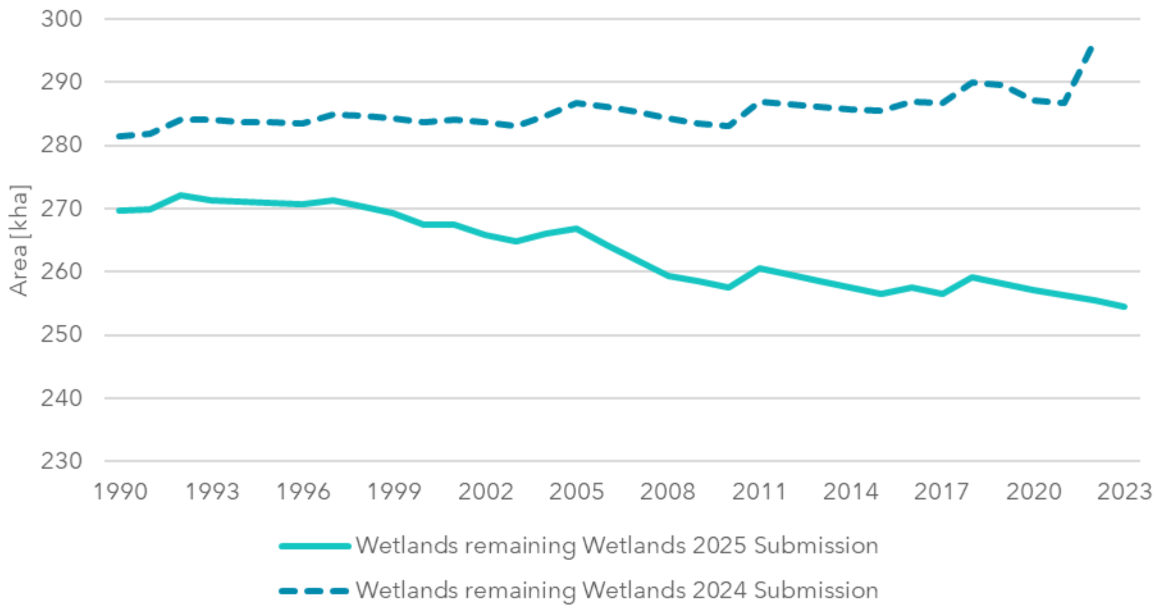


Figure 6.39 Recalculations to the activity data between the current (2025) and previous submission for Wetlands remaining Wetlands. Note this graph does not include unmanaged wetlands.

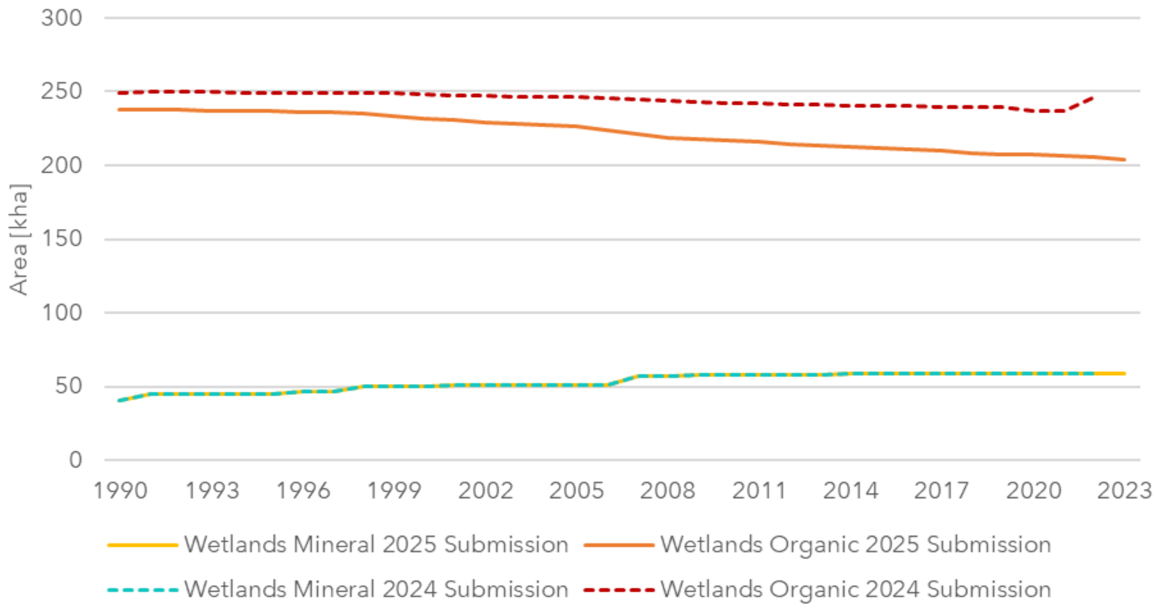


Figure 6.40 Recalculations to the activity data between the current and previous submission for Wetlands mineral and organic soils

There are no revisions to Land converted to Wetlands (see Figure 6.41).

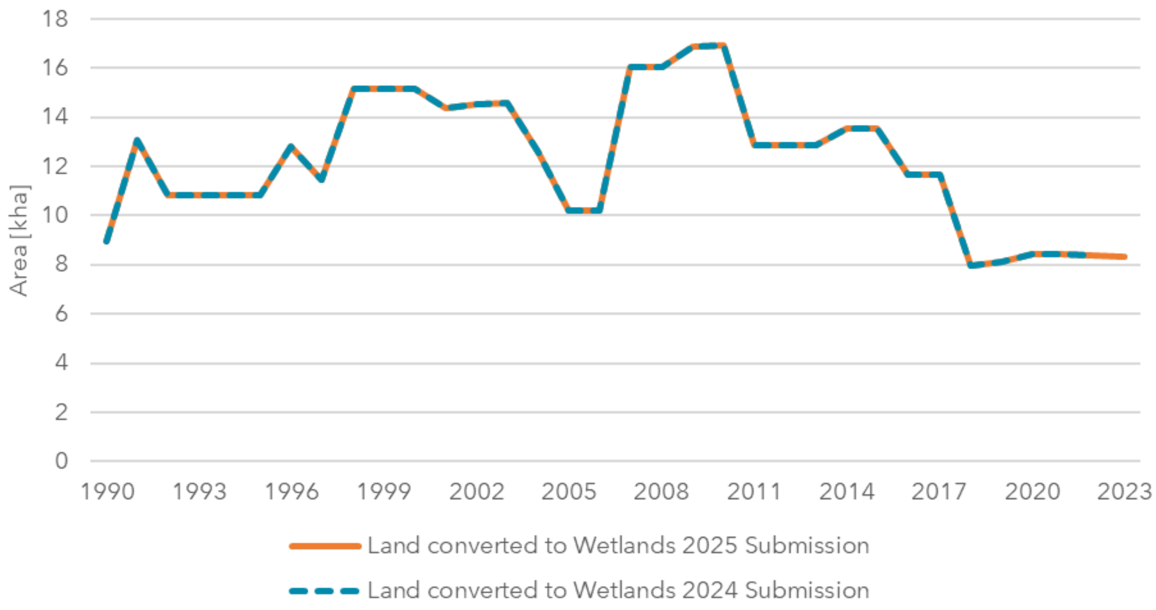


Figure 6.41 Recalculations to the activity data between the current and previous submission for Land converted to Wetlands

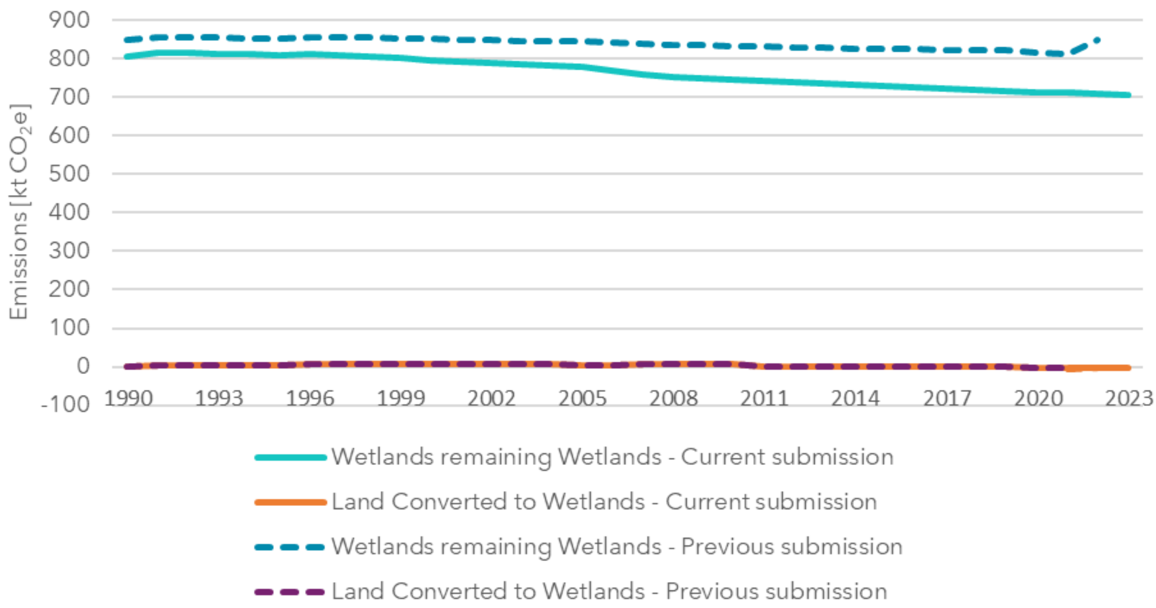


Figure 6.42 Recalculations to the emissions between the current and previous submission for Wetlands

6.6.8 Category-specific planned improvements

Wetlands remaining Wetlands: In the latest submissions, all drained grasslands are reported under one category, independent of age. Time series for ditches are now planned to be completed in 2026. With that data, possibilities of analysing, finding patterns and then being able to evaluate age in drained grassland will give us a different geographical stamp on how these areas are affected in terms of emission from these areas.

Wetlands below 200 m are classified as being managed due to grazing. Planned improvements of grazing density will improve that mapping, which will most likely lead to a reduction of area of managed land because existing data shows that even below 200m, not all areas of wetlands are impacted by grazing.

Land converted to Wetlands: Improvements regarding information on reservoir area and type of land flooded are planned. Efforts will be made to map existing reservoirs but many of them are not included in the present inventory. Introduction of reservoir-specific emission factors for more reservoirs is to be expected as information on land flooded is improved. Compiling information on the ice-free period for individual reservoirs or regions is planned. Applying reservoir specific ice-free periods will decrease the uncertainty of emission estimates. Information on how EFs change with the age of reservoirs is needed, but no plans have been made at present to conduct this research.

The planned revisions of the map of drainage ditches and deducted map layer of drained soils are especially likely to affect the estimate of wetland area.

Mapping of wetland restoration activities is available in printed form, but digitisation of those maps is pending and will be included in the compilation of the IGLUD land-use map, when available.

Separation of regions, soil classes, and drainage categories, as well as adoption of different emission factors is planned.

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 28.4 kha in 1990 to 42.7 kha in 2023. The share of the Settlements remaining Settlements category dominated the overall Settlements area throughout the entire reporting period (Figure 6.43). 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).

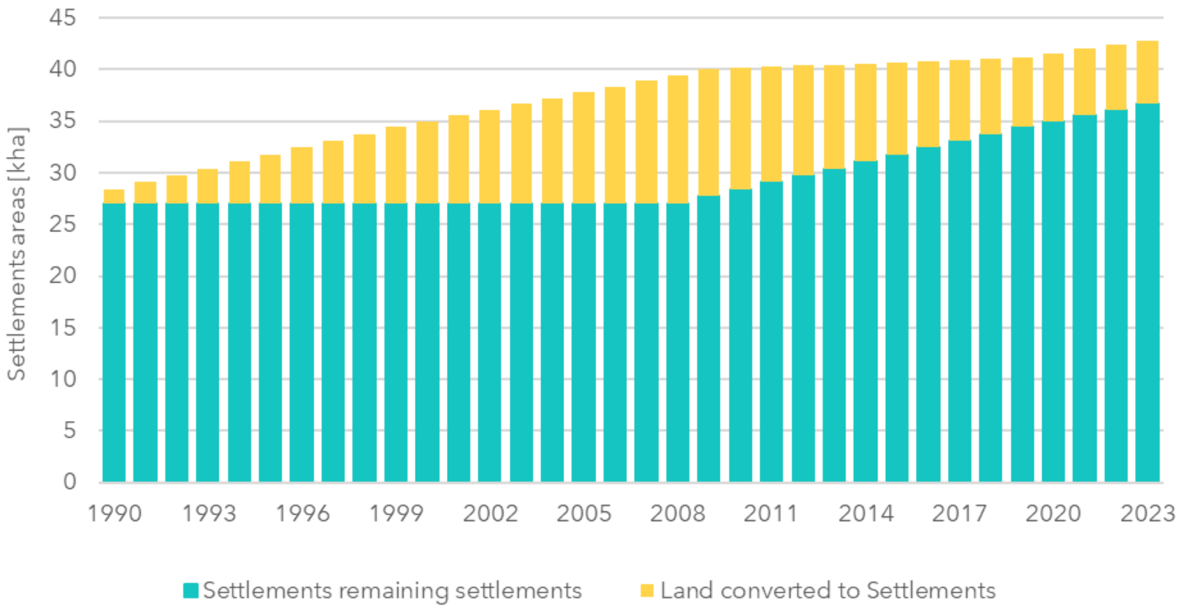


Figure 6.43 Settlements area (by category) in Iceland in 1990 – 2023, kha

6.7.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Areas designated for human habitation and associated infrastructure such as towns, villages and roads are included in the Settlements category. The category does not include subdivisions but has two main components: Towns and villages and Other Settlements (Roads) as represented in the IGLUD Land Use Map. Towns and villages must have a minimum population of 200, while *roads* are defined with buffer zones of 2.5-15.0 meters from the centre line.

Table 6.37 Definitions of Settlements subcategories

LU category	Definition	LU subcategory	Allocation	Conversion period
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 centres with fewer than 200 inhabitants are therefore not considered urban/settlement.	Settlements	SMrSM/LUC to SM	20 years

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 (LaFI) has compiled new urban area maps for 1990, 2000, 2010 and since 2020. These maps were developed using Maxar satellite imagery and aerial photographs from the National Land Survey of Iceland (NLSI) and Loftmyndir ehf[33].

The total Settlements area across the time series is estimated by combining spatial data from LaFI maps and interpolation. The time series for *Towns and Villages* and *Other Settlements (Roads)* are constructed using interpolation between LaFI map areas for 1990, 2000, 2010, and the most recent maps since 2020 (Table 6.38). 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 6.38 Methodology and data sources for constructing the time series of Settlements category

<table>
<tr><th>Land use category</th><th>Subcategory</th><th>1989</th><th>1990</th><th>1991</th><th>...</th><th>1999</th><th>2000</th><th>2001</th><th>....</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>....</th><th>2019</th><th>2020</th><th>....</th><th>2023</th></tr>
<tr><td>Settlements remaining settlements</td><td>Settlements remaining settlements</td><td></td><td>SCSI urban map</td><td colspan="3">Linear interpolation</td><td>SCSI urban map</td><td colspan="3">Linear interpolation</td><td>SCSI urban map</td><td colspan="4">Linear interpolation</td><td colspan="3">SCSI urban map</td></tr>
<tr><td rowspan="3">Land converted to settlements</td><td>Forest land converted to settlements</td><td colspan="17">Deforestation reported to LaFI</td></tr>
<tr><td>Natural birch shrubland converted to Settlement</td><td>1987-1991 map</td><td colspan="10">Linear interpolation</td><td>2010-2014 map</td><td colspan="5">Linear extrapolation</td></tr>
<tr><td>All other Grassland subcategories converted to Settlement</td><td colspan="17">Other grassland timeseries</td></tr>
<tr><td colspan="19">Legend</td></tr>
<tr><td>Samples or known areas</td><td>Maps</td><td>Expert judgement</td><td>Interpolation</td><td>Assumptions</td><td colspan="14"></td></tr>
</table>

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 LaFI 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 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 All other Grassland converted to Settlements. These conversions are assumed to occur proportionally from all mineral Grassland categories 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 All other Grassland 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 6.43. 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 6.19 summarizes tier-level approaches, notation keys [in square brackets], and emission factors (in parentheses) are used to estimate changes in relevant carbon stocks in

[33] https://loftmyndir.is

the Settlements remaining Settlements category and to report information in the relevant CRT table. More detail information is presented in textual format below.

Table 6.39 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
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.

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 1.4 kha in 1990 to a peak of 12.4 kha in 2008. However, from 2009 onward, the trend reverses, with the area gradually decreasing to 6.1 kha by 2023. The dominant subcategory converted to Settlements was 'All other Grassland,' while the conversion of other land-use categories remained insignificant throughout the reporting period (Figure 6.44). 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 and mineral soils (Figure 6.45). In certain years, emissions occurred due to changes in the DOM carbon pool; for more details, see Table 6.40.

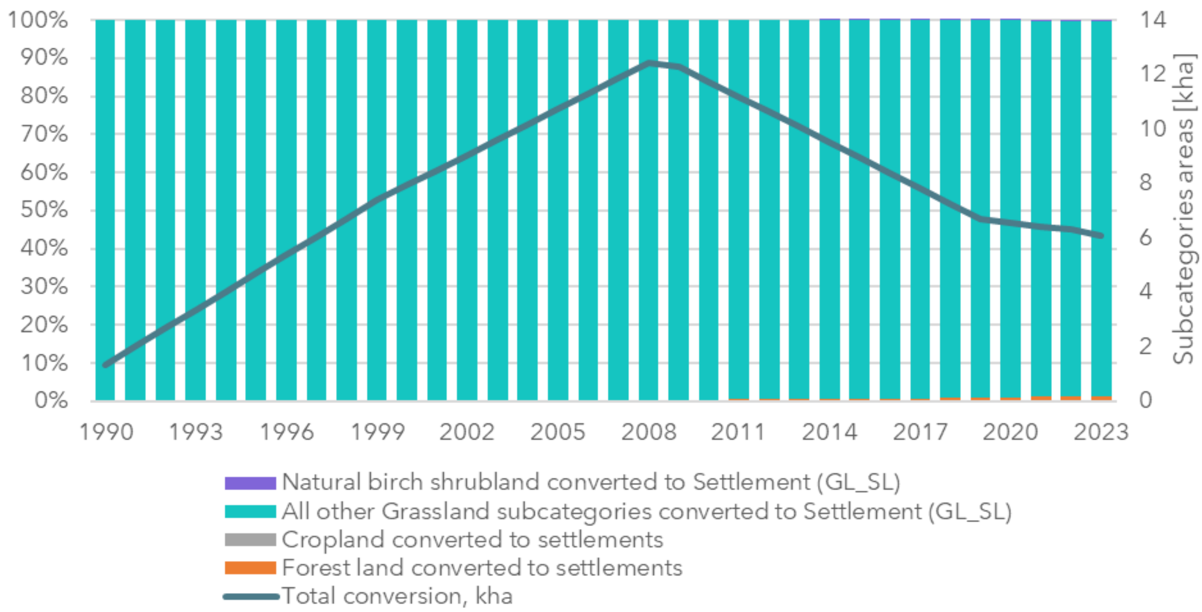


Figure 6.44 The total area (kha) and relative shares (%) of Land converted to Settlements (by subcategory) in Iceland in 1990 – 2023

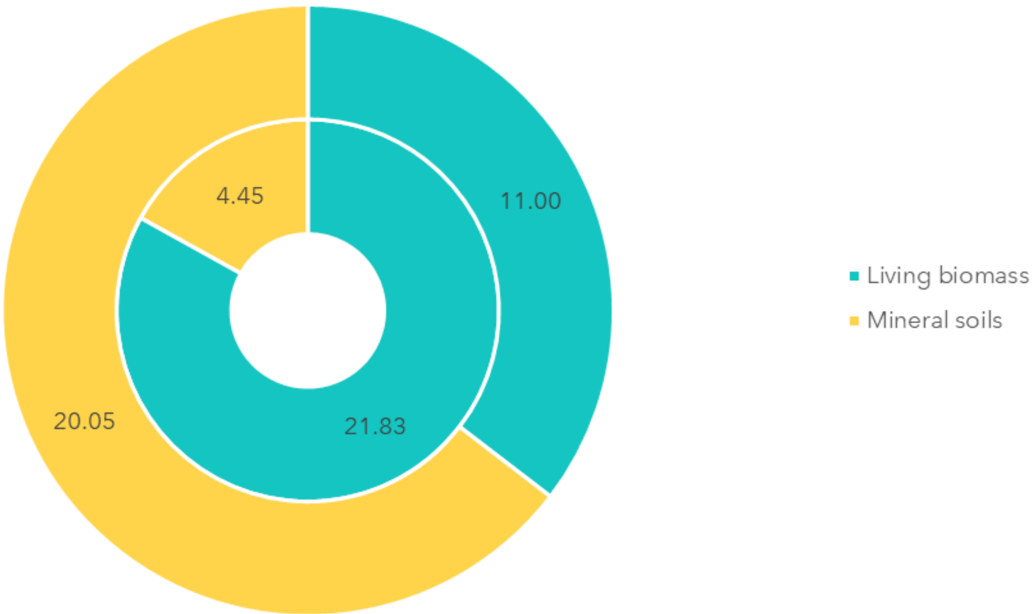


Figure 6.45 CO_2 emissions resulting from Land converted to Settlements by pool in 1990 (inner circle) and 2023 (outer circle) in Iceland, kt.

6.7.4.2 Methodology

Table 6.40 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 6.40 Tier-level approaches, notation keys, and EFs used for the Land converted to Settlements category in 2023

Land-Use Category	Living Biomass		DOM	Soils	
	Gains	Losses		Min	Org
Forest Land Converted to Settlements[4]	NO	NO	NO	T1 (D)	NO
Cropland Converted to Settlements	IE[1]	IE[1]	IE[1]	IE[1]	IE[2]
Grassland Converted to Settlements					
Natural Birch Shrubland Converted to Settlements	NO	NO [T3 (CS)[5]]	NO [T2 (CS)[5]]	T2 (CS)	NO
All Other Grassland sub-categories Converted to Settlements	NA	T2(CS)	IE[3]	T2 (CS)	IE[2]
Wetlands Converted to Settlements	IE[1]	IE[1]	IE[1]	IE[1]	IE[2]
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 All Other Grassland subcategories converted to Settlements.

[2] Reported as aggregated value under organic soils in 4.C Grassland.

[3] Reported as aggregate number under Living biomass Losses as the value of 12.68 tC/ha represents the stock of the above-ground biomass (see sections 6.4.4.2 Methodology), including the litter and standing dead. It excludes the below-ground biomass.

[4] No deforestation is reported in the year 2023 so gains and losses in living biomass and DOM are not occurring.

[5] The changes in Living biomass-losses and DOM pool were estimated for 2014, 2015, 2019, 2021.

Living biomass

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 above ground biomass of All other Grassland subcategories converted to Settlements subcategory was based on average carbon stock of IGLUD field sampling points on land below 200 m a.s.l. categorised to the Grassland category, and the assumption that 70% of the original vegetation cover is removed in the conversion as the value of 12.68 tC/ha represents the stock of the above-ground biomass (see section 6.4.4.2 Methodology), including the litter and standing dead. It excludes the below-ground biomass. The estimation of the ratio of vegetation cover removed is based on correspondence with planning authorities of several towns in Iceland.

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 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 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}.

Mineral soils

Until the 2024 submission, the changes in the mineral soils pool in the subcategory All other Grassland categories converted to Settlements were reported using the notation key “NE”. However, in the 2025 submission a CS CSC factor for this pool has been calculated to perform the estimates. The annual changes in mineral soils SOC were determined using the same CS SOC_{ref} (90.50 t C/ha) as for Grassland converted to Cropland (see section 6.4.4.2). Furthermore, the SOC stock was calculated multiplying the SOCref by attributed a soil stock change factors and by a coefficient of 0.8[34]. Using a 20-year conversion period, the annual emissions from SOC are estimated to be -0.91 t C ha^{-1} (Table 6.41).

The EFs used in the estimates were summarised in Table 6.42.

Table 6.41 Summary of the annual CSC factor calculation for mineral soils in All other Grassland subcategories converted to Settlements.

CS SOCref (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)
90.5*	0.8	72.4	20	-0.91

* SOCref (90.50 t C/ha) as for Grassland converted to Cropland (see section 6.4.4.2).

Table 6.42 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
Forest land converted to Settlement	Mineral Soils	CS/D	-0.67	Snorrason et al. 2002
Grassland converted to Settlement				
All Other Subcategories Converted to Settlements	Biomass losses	CS	-8.88	Study compiled by the Forest Instirute
	Mineral Soils	CS	-0.91	Described above
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

[34] For the proportion of the settlement area that is paved over, assume product of F_{LU}, F_{MG} and F_I is 0.8 times the corresponding product for the previous land use (Chapter 8 of the 2006 IPCC Guidelines)

EFs is reported in Annex 6. It is 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 6.1.4 for more information.

6.7.7 Category-specific recalculations

In the 2025 submission, the methodology for "Land converted to Settlements" was corrected. Specifically, a 20-year transition period was introduced for the "All other grassland subcategories converted to settlements" category, replacing the previous 1-year transition period. As a result, land remains classified as "Land converted to Settlements" for a longer duration compared to prior submissions (see area recalculations in Figure 6.46). This activity data recalculation does not impact the living biomass emissions estimates.

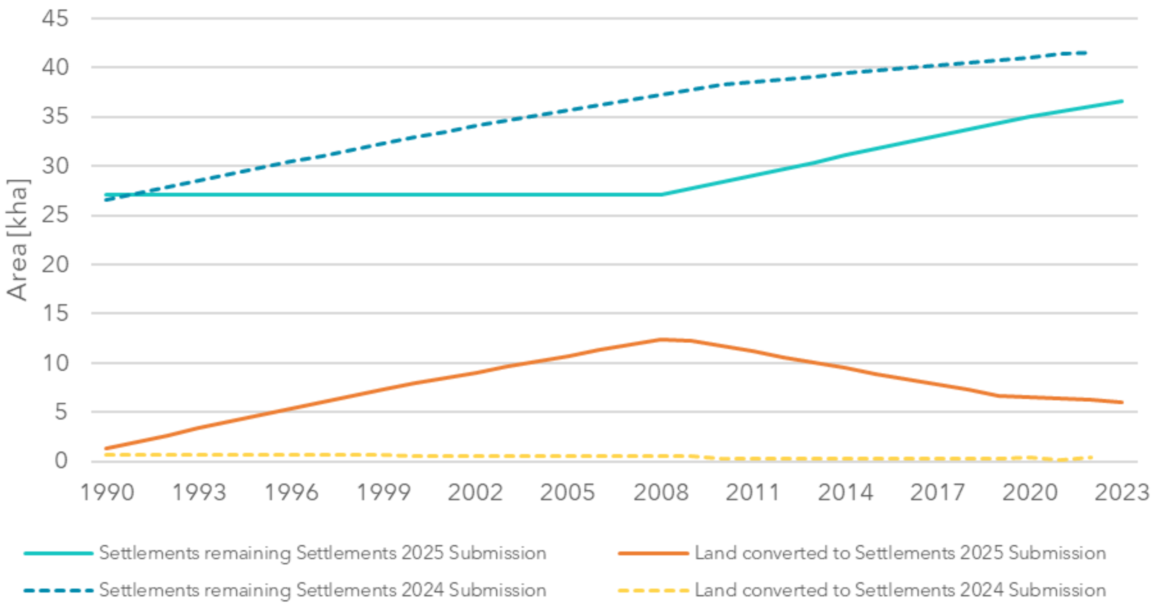


Figure 6.46 Recalculations to the activity data between the current (2025) and previous (2024) submission for Settlements

There were also minor recalculations to the 2021 and 2022 settlements activity data to ensure timeseries consistency with the newest settlements map. This resulted in minor recalculations to the living biomass emissions estimates.

Emissions for the mineral soil pool were estimated for the first time in the 2025 submission (see emission recalculations in Figure 6.47). A new carbon stock change factor was used for the mineral soil pool for the category "All other grassland subcategories converted to settlements". This results in a recalculation to the Land converted to Settlements emissions estimates.

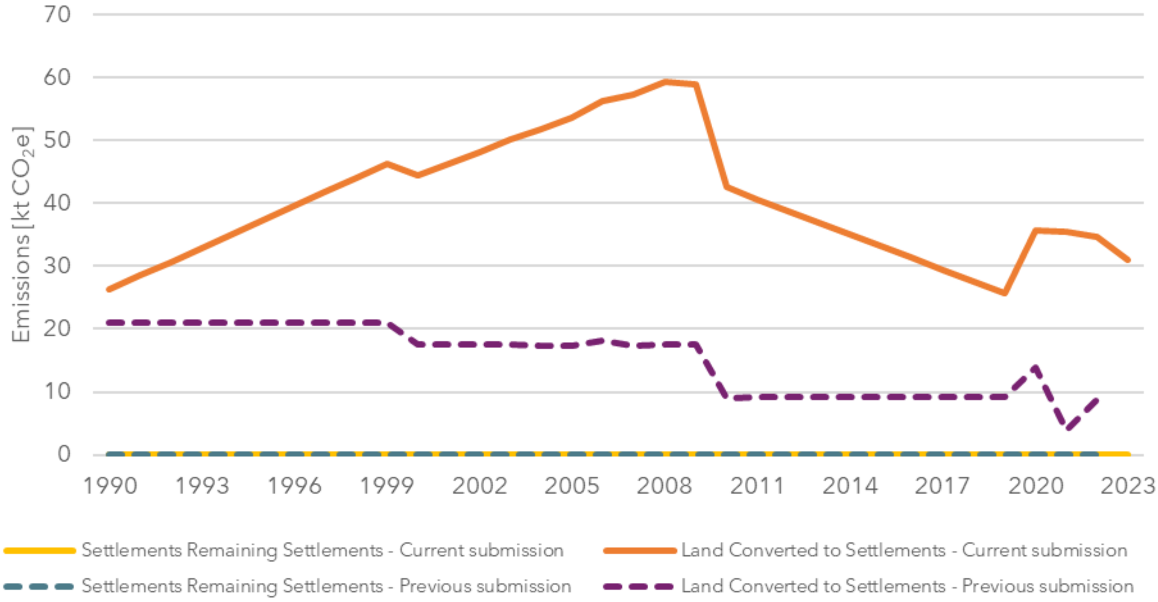


Figure 6.47 Recalculations to the emissions between the current (2025) and previous (2024) submission for Settlements

6.7.8 Category-specific Planned Improvements

There are no category-specific planned improvements for this category.

6.8 Other Land (CRT 4F)

6.8.1 Other Land Remaining Other Land (CRT 4F1) and Other Land Converted to Other Land (CRT 4F2)

6.8.1.1 Category Description

The area reported for Other Land was the area estimated in IGLUD. Other Land in IGLUD is recognised as the area of the map layer included in the category remaining after the compilation process. The map layers included in the category Other Land are areas with vascular vegetation cover <20%. During the 2020 submission, the Other Land area decreases significantly.

The total area of Other Land has slightly declined over the reporting period: from 3,157.0 kha in 1990 to 2,972.6 kha in 2023 (Figure 6.48).

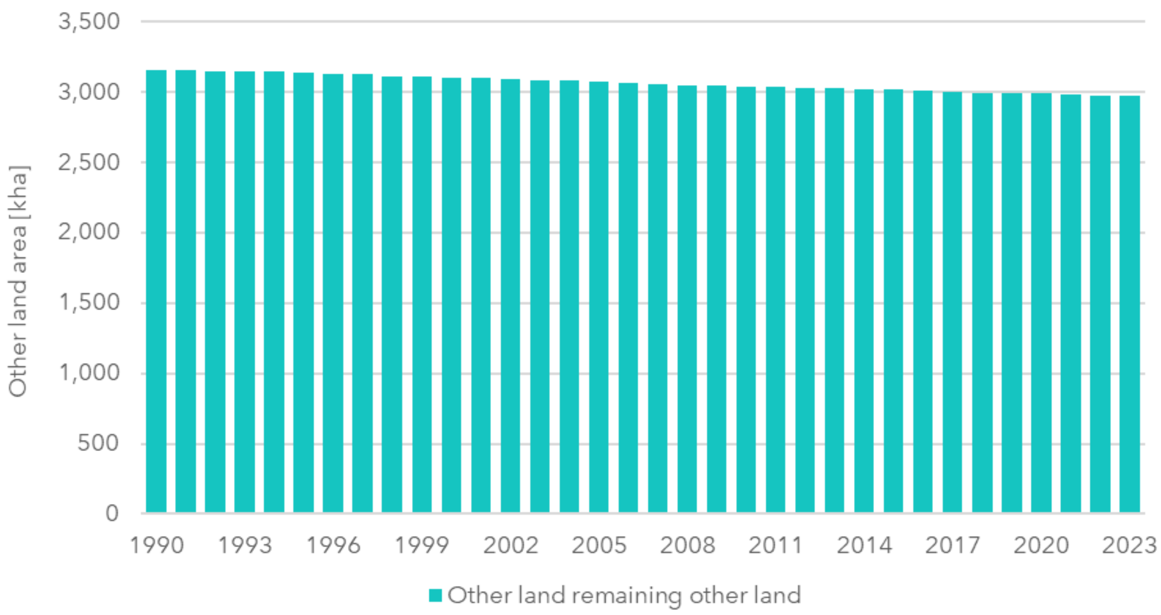


Figure 6.48 The total area of Other land [kha].

6.8.1.2 Methodology

No emissions are estimated or reported from this land-use category.

Table 6.43 summarizes notation keys used to report emissions from the Other land category.

Table 6.43 Notation keys used for the Other Land category in 2023

Land-Use Category	Living Biomass		DOM	Soils	
	Gains	Losses		Min	Org
Other Land remaining Other Land	NO	NO	NO	NO	NO
Forest Land Converted to Other Land	NO	NO	NO	NO	NO
Cropland Converted to Other Land	NO	NO	NO	NO	NO
Grassland Converted to Other Land	NO	NO	NO	NO	NO
Wetlands Converted to Other Land	NO	NO	NO	NO	NO
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 6.1.4 for more information.

6.8.4 Category-specific Recalculations

In the 2025 submission, the method for processing the activity data was revised to use annual land use transition matrixes to explicitly track changes in areas between land-use subcategories. This results in large recalculations in Grassland remaining Grassland and Other land. Specifically, the new method identifies are fewer conversions away from Grassland remaining Grassland and more conversions away from Other land (Figure 6.49). Note that as an unmanaged category, no emissions are estimated from Other land.

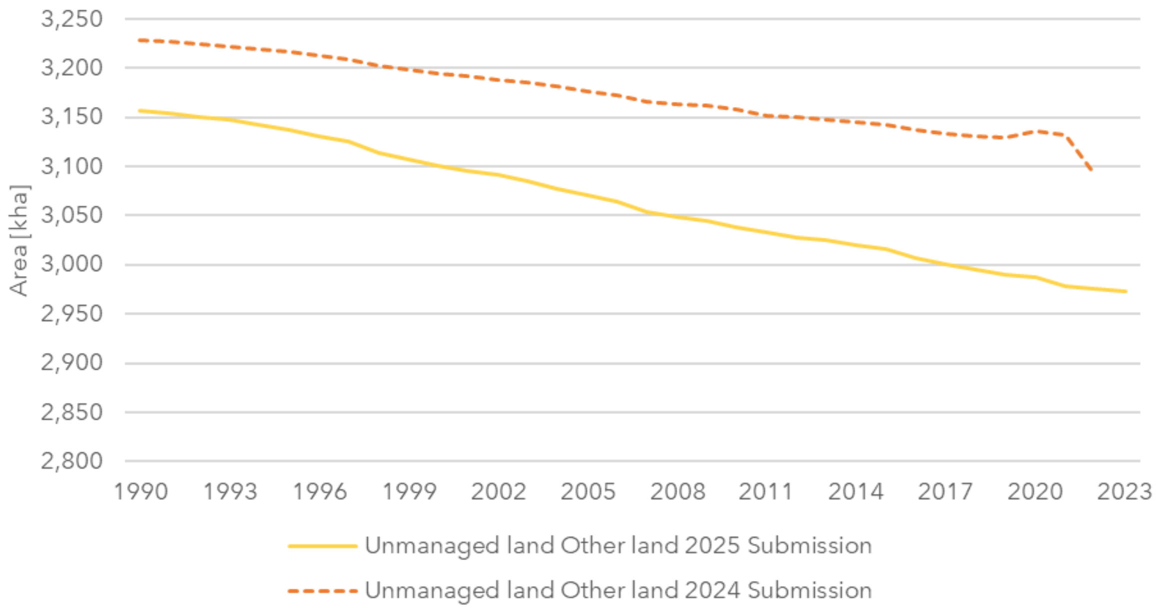


Figure 6.49 Recalculations to the activity data between the current (2025) and previous (2024) submission for Other land

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 HWPs. 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 data[35], the annual unofficial report of the Iceland Forest Association contains data about sawnwood production from domestic harvested wood for 1996 to 2023 (see Table 6.44.); (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).

[35] http://faostat3.fao.org/download/F/FO/E

Table 6.44. Annual wood production (in m^3 on bark) and sawnwood production (in m^3) in 1996 to 2023.

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
2023	2,451	296

These data were used to estimate C-stock changes in HWP. Sawnwood is only a small fragment of commercial wood removal. Other HWP than sawnwood are not produced from domestic wood. To convert sawnwood volume (m^3) 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 sawnwood 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 N_2O Emissions from N Inputs to Managed Soils (CRT 4(I))

6.10.1 Category description and methodology

Direct: N_2O 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 inorganic fertilisers applied to Forest Land are negligible.

Activity data for 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 Þ., 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 N_2O emissions from N input (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 6.1.4 for more information.

6.10.4 Category-specific recalculations

No recalculations conducted for this category.

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 reported in Table 6.51, whereas the organic soils under wetlands contribute the most significant share to the total area. The area of ditches within each land-use category is presented in Figure 6.51, whereas the forest land category has the largest area among all land-use categories.

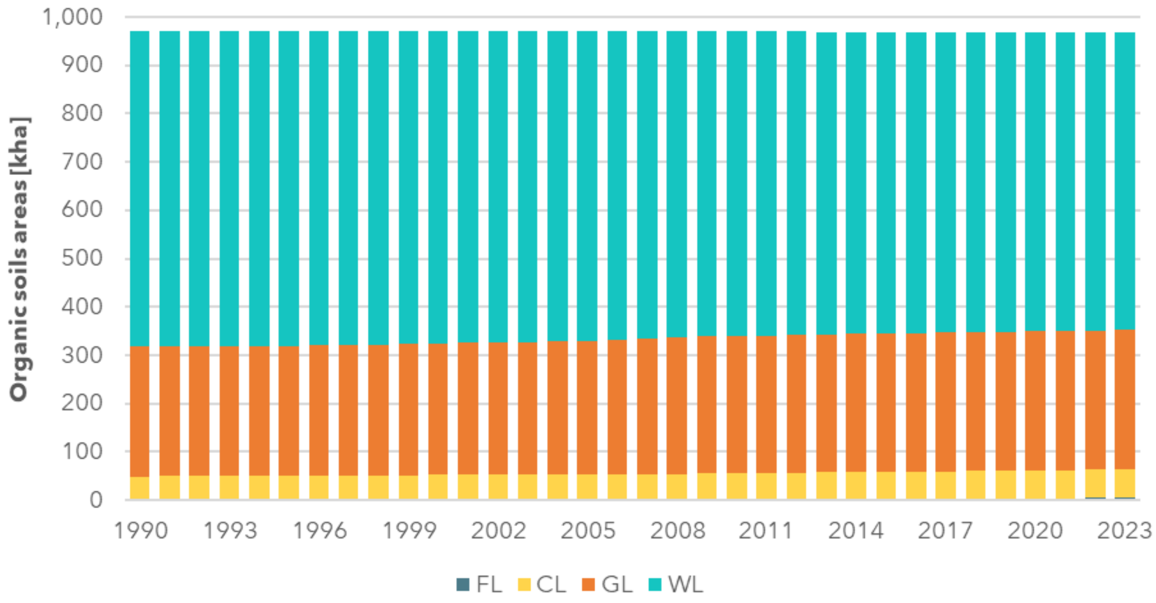


Figure 6.50 Area of organic soils by land-use category in Iceland in 1990 – 2023, kha.

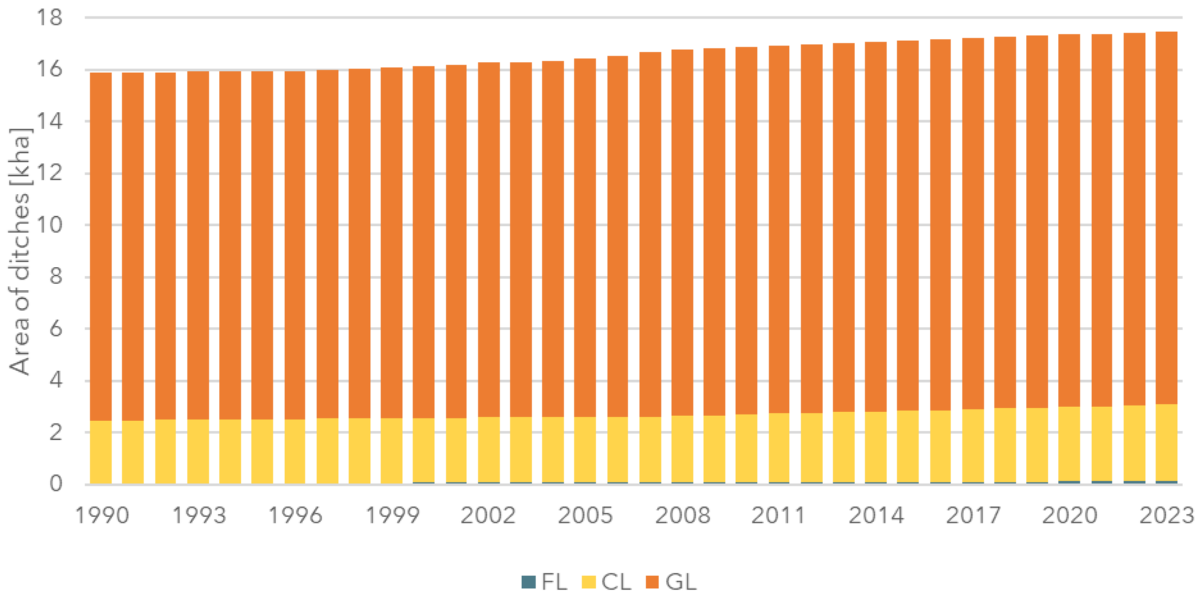


Figure 6.51 Areas of ditches within land-use categories in Iceland in 1990 – 2023, kha

The emissions from organic soils and ditches show a stable trend over the reporting period, whereas emissions from wetlands contribute the most significant share (Figure 6.52).

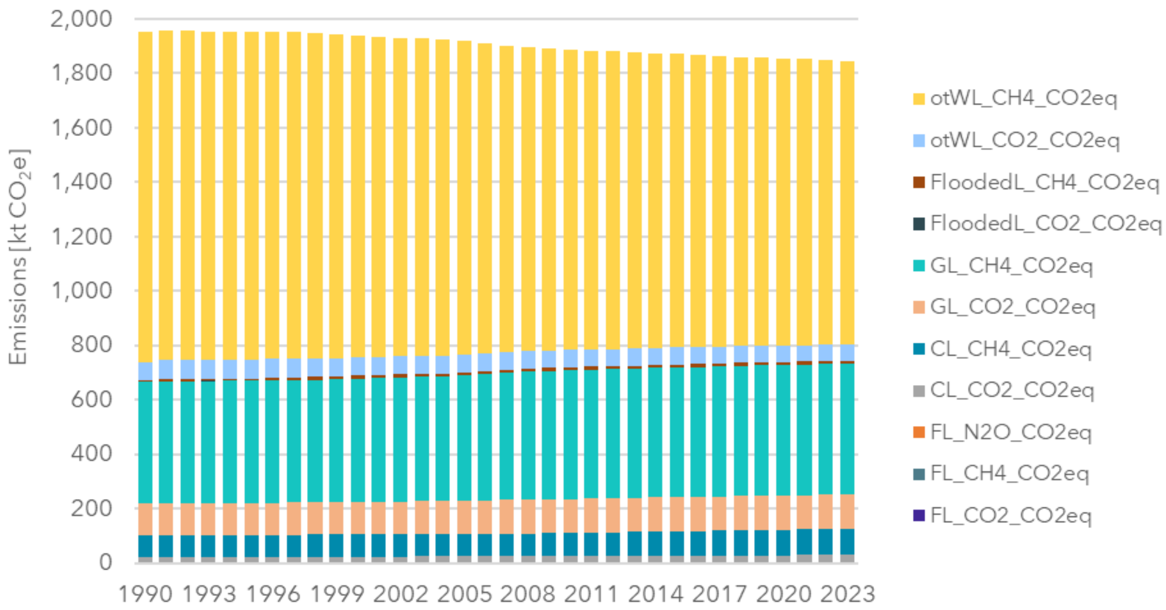


Figure 6.52 Non-CO_2 emissions from the organic soils and ditch areas in Iceland in 1990 – 2023, in kt CO_2eq

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 6.53, areas of organic soils in Forest land in Figure 6.54. The EFs used to estimate the emissions and tier-level approaches applied are briefly described below and reported in Table 6.45.

Table 6.45 Tier-level approaches, notation keys, and emission factors used for the Forest Land category

Land-use category	CO_2	N_2O	CH_4
Forest land remaining Forest land			
Total organic soils			
Drained organic soils	T2 (CS)	T2 (CS)	T1 (D)
Total mineral soils	NA	NA	NA
Grassland converted to Forest land			
Total organic soils			
Drained organic soils	T2 (CS)	T2 (CS)	T1 (D)
Total mineral soils	NA	NA	NA

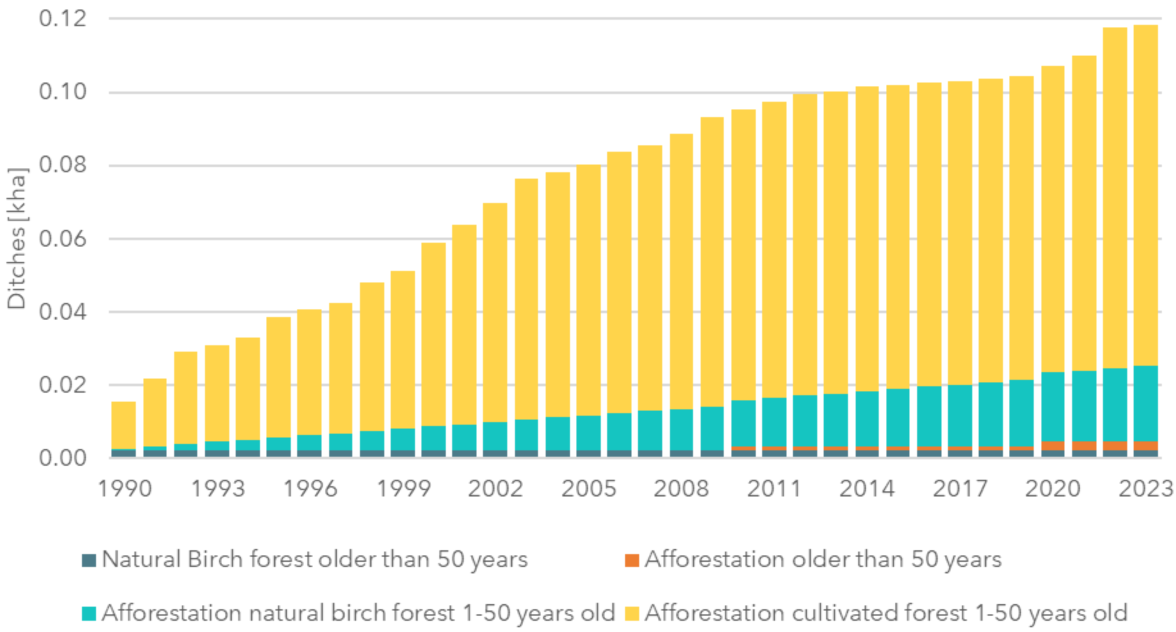


Figure 6.53 Ditches areas, total for Forest land remaining Forest land and Land converted to Forest land in Iceland in 1990 – 2023, kha.

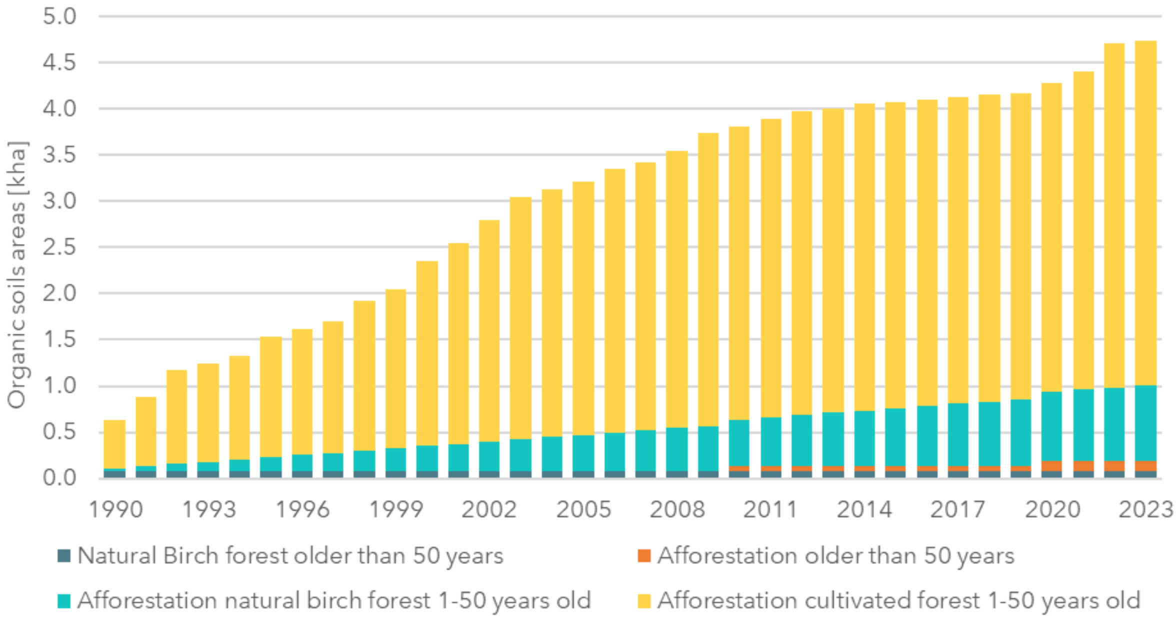


Figure 6.54 Areas of organic soils in Forest land remaining Forest land and Land converted to Forest land in Iceland in 1990 – 2023, kha

Indirect CO_2 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 CO_2 fluxes in 23-25-year-old Black Cottonwood plantation on drained peatland in South Iceland, offsite CO_2 was measured simultaneously (Bjarnadóttir B., 2021). Waterborne carbon losses were measured at 0.04 t C ha^{-1} yr^{-1}, which represents ⅓ of the default value stated in the 2013 Wetlands Supplement.

CH_4 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%). CH_4 EFs applied are 2.0 kg CH_4 ha^{-1} yr^{-1} for drained land categorised as 'Forest Land, Drained, Nutrient-rich, Boreal' (Table 2.3) and 217 kg CH_4 ha^{-1} yr^{-1} for ditches under 'Boreal/Temperate-Drained Forest Land/Drained Wetlands' from Table 2.4 in the 2013 Wetlands Supplement (Table 6.46).

N_2O 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 N_2O-N ha^{-1} yr^{-1} (see further description in Chapter 5.7.2.6).

Table 6.46 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_2O/ha/yr
Forest Land Remaining Forest Land				
Afforestation more than 50 Years Old	147	2	217	1.98
Forest Land Remaining Forest Land – Natural Birch Forest older than 50 Years	147	2	217	1.98
Land Converted to Forest Land				
Grassland Converted to Forest Land – Natural Birch Forest 1 to 50 Years Old	147	2	217	1.98
Grassland Converted to Forest Land – Afforestation 1 to 50 Years Old	147	2	217	1.98

Cropland

Areas of ditches are reported in Figure 6.55, areas of organic soils in Cropland in Figure 6.56. The EFs used to estimate the emissions and tier-level approaches applied are briefly described below and reported in Table 6.47 and Table 6.48.

The CH_4 EFs were used from the 2013 Wetlands Supplement (EFCH4_laNd = 0 and EFCH4_ditCH = 1,165 CH_4 ha^{-1} yr^{-1} from Table 2.3 and 2.4 in, respectively (Table 6.43).

Table 6.47 Tier-level approaches, notation keys, and emission factors used for the Cropland category

Land-use category	CO_2	N_2O	CH_4
Cropland remaining Cropland			
Total organic soils			
Drained organic soils	T1 (D)	-	T1 (D)
Total mineral soils	NA	-	NA
Forest land converted to Cropland			
Total organic soils			
Drained organic soils	T1 (D)	IE*	T1 (D)
Total mineral soils	NA	NA	NA
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

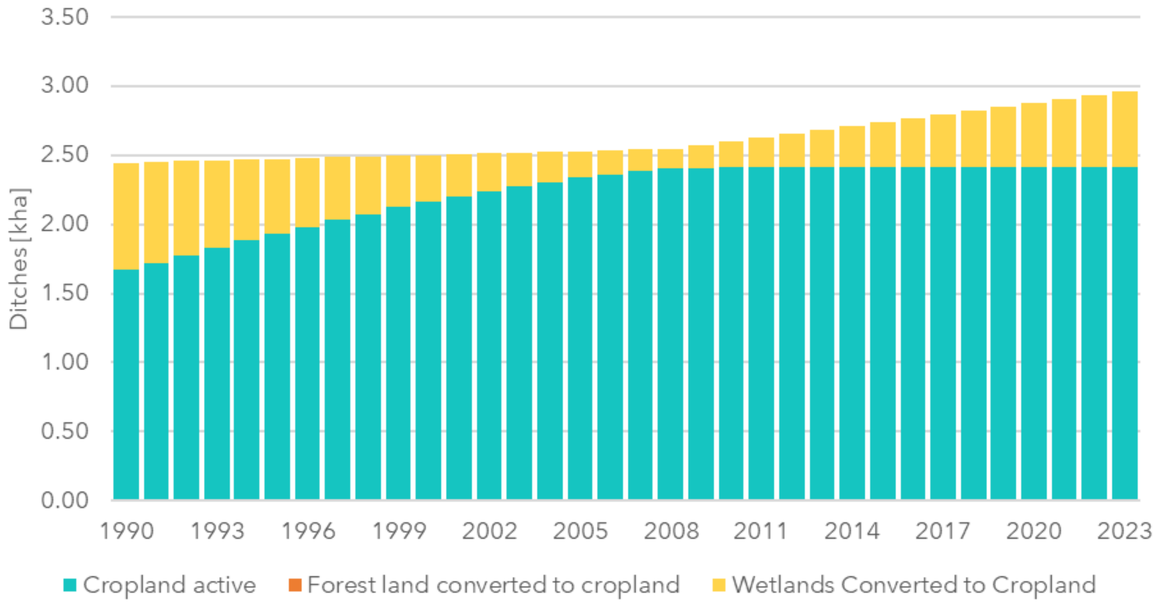


Figure 6.55 Ditches areas, total for Cropland remaining Cropland and Land converted to Cropland in Iceland in 1990 – 2023, kha.

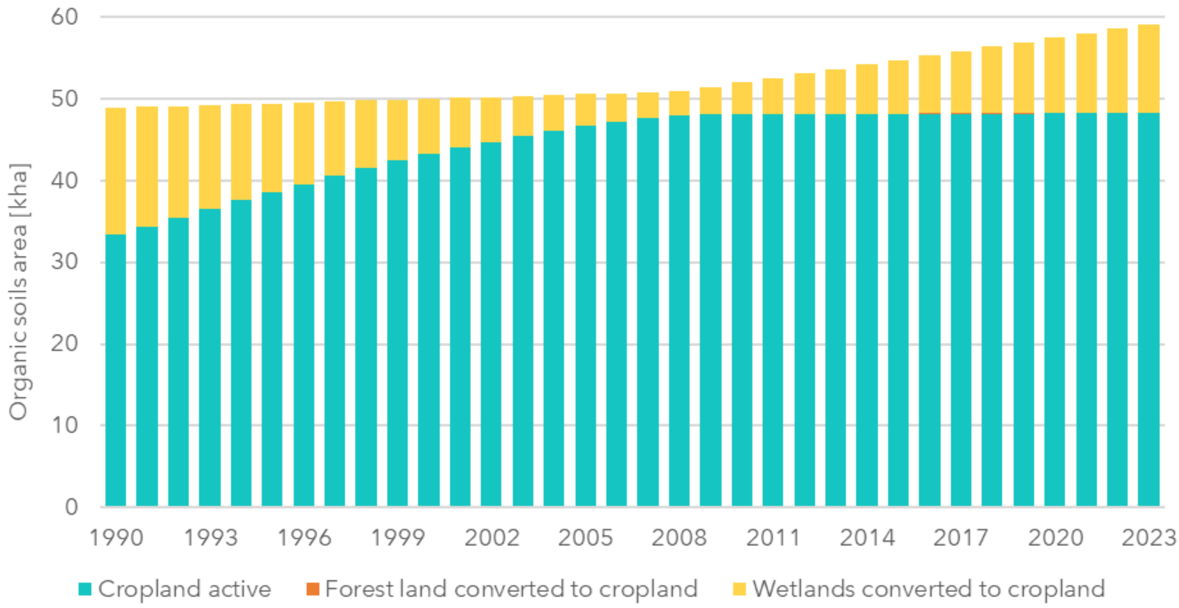


Figure 6.56 Areas of organic soils in Cropland remaining Cropland and Land converted to Cropland in Iceland in 1990 – 2023, kha.

Off-site CO_2 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 (0.12 C $ha^{-1}yr^{-1}$ or 440 kg CO_2/ha/yr) (Table 6.48).

CH_4 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 CH_4 EFs were used from the 2013 Wetlands Supplement (EFCH4_laNd = 0 and EFCH4_ditCH = 1,165 kg CH_4 ha^{-1} yr^{-1} from Tables 2.3 and 2.4 in, respectively (Table 6.48).

Table 6.48 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]
Cropland Remaining Cropland			
Cropland Active	440	0	1,165
Land Converted to Cropland			
Wetlands Converted to Cropland	440	0	1,165
Forest Land Converted to Cropland	440	0	1,165

Grassland

Areas of ditches and organic soils in Grassland are reported in Figure 6.57 and Figure 6.58. The EFs used to estimate the emissions and tier-level approaches applied are briefly described below and reported in Table 6.49 and Table 6.50.

Table 6.49 Tier-level approaches, notation keys, and emission factors used for the Grassland category

Land-use category	CO_2	N_2O	CH_4
Grassland remaining grassland			
Total organic soils			
Drained organic soils	T1 (D) – T2 (CS)	-	T1 (D)
Total mineral soils	NA	-	NA
Cropland converted to grassland			
Total organic soils			
Drained organic soils	T1 (D)	IE*	T1 (D)
Total mineral soils	NA	NA	NA
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

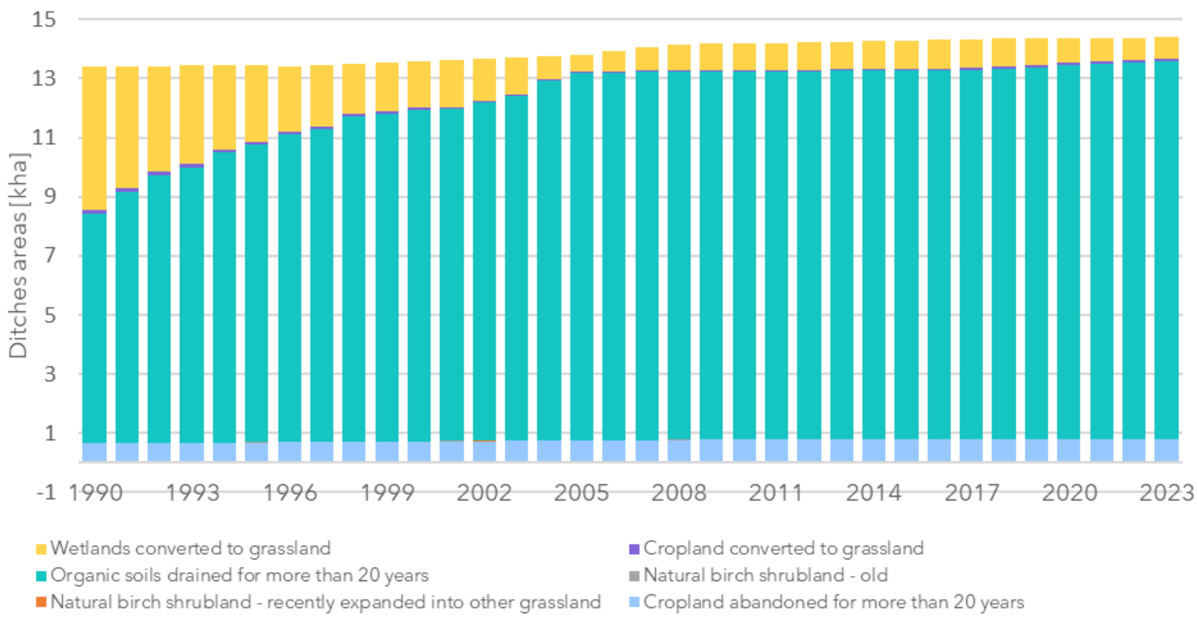


Figure 6.57 Ditches areas, total for Grassland remaining Grassland and Land converted to Grassland in Iceland in 1990 – 2023 [kha].

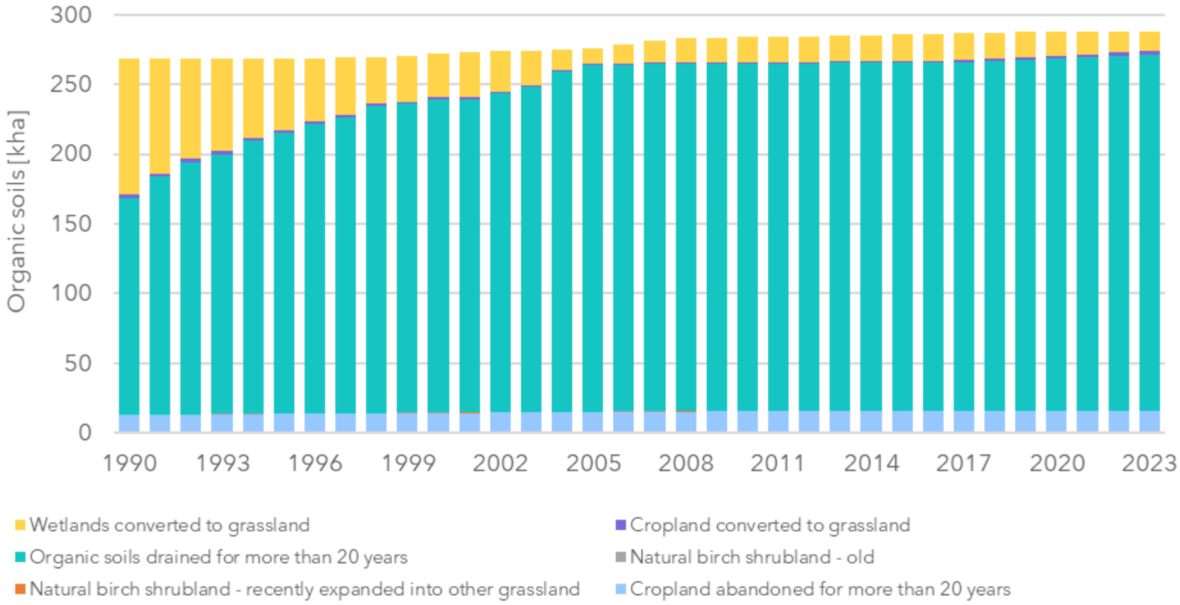


Figure 6.58 Areas of organic soils in Grassland remaining Grassland and Land converted to Grassland in Iceland in 1990 – 2023 [kha].

Two sources of emissions are reported for Grassland: off-site CO_2 emissions via waterborne losses from drained inland soils, and CH_4 emissions from drained inland soils and ditches.

The off-site emissions of CO_2 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).

CH_4 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. CH_4 emissions from drained Grassland were calculated according to Tier 1 by applying EFCH4_land = 1.4 and EFCH4_ditCH = 1,165 kg CH_4 ha^{-1} yr^{-1} from Tables 2.3 and 2.4 in the 2013 Wetlands Supplement, respectively.

Table 6.50 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]
Grassland Remaining Grassland			
Cropland Abandoned for more than 20 Years	440	1.4	1,165
Natural Birch Shrubland (NBS) – Old	147	2	217
NBS – Recently Expanded into Other Grassland	147	2	217
Organic soils drained for more than 20 Years	440	1.4	1,165
Land Converted to Grassland			
Cropland Converted to Grassland	440	1.4	1,165
Wetlands Converted to Grassland	440	1.4	1,165

Wetlands

Areas of organic soils in Wetlands are reported in Figure 6.59. The EFs used to estimate the emissions and tier-level approaches applied are briefly described below and reported in Table 6.51 and Table 6.52.

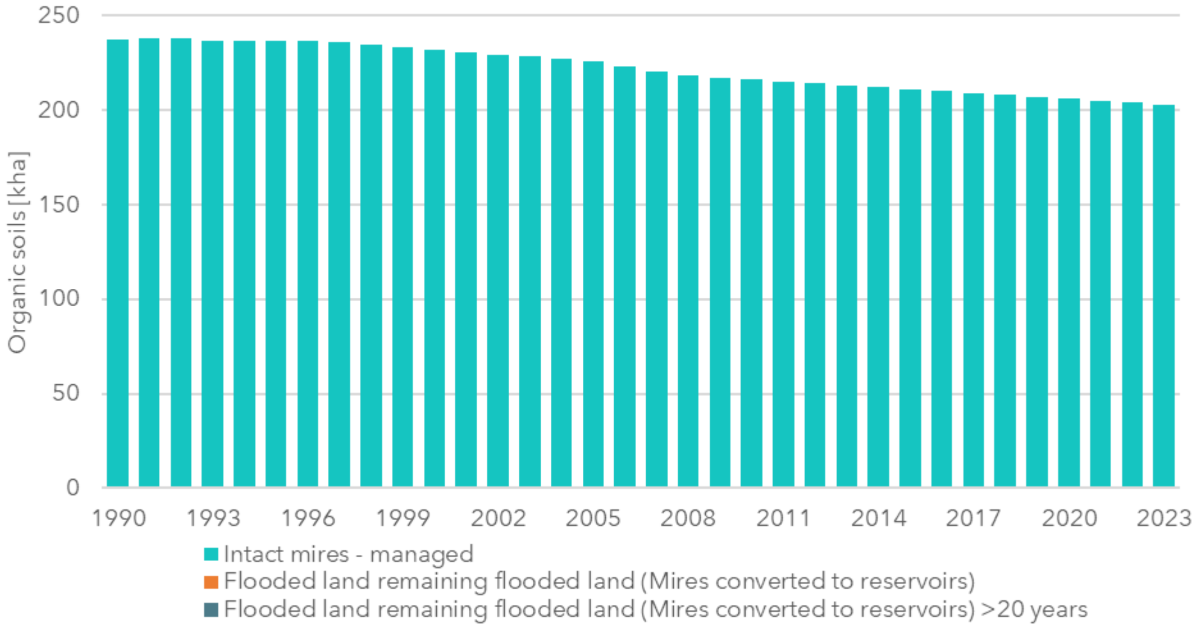


Figure 6.59 Areas of organic soils in Wetlands remaining wetlands and Land converted to Wetlands in Iceland in 1990 – 2023 [kha].

Table 6.51 Tier-level approaches, notation keys, and emission factors used for the Wetlands category

Land-use category	CO_2	N_2O	CH_4
Wetlands remaining wetlands			
Peat extraction remaining peat extraction			
Total organic soils	NO	NO	NO
Total mineral soils	NO	NO	NO
Flooded land remaining flooded land			
Total organic soils			
Intact mires converted to reservoirs - High SOC to reservoirs	NO	NO	NO
Intact mires converted to reservoirs - High SOC to reservoirs older than 20 years	NA	NO	T1 (D)[1]
Total mineral soils	NA	NO	T1 (D)
Grassland converted to flooded land - Medium SOC to reservoirs older than 20 years	NA	NO	T2 (CS)
Other land converted to flooded land - Low SOC to reservoirs older than 20 years	NA	NO	T2 (CS)
Other wetlands remaining other wetlands			
Total organic soils			
Rewetted mires	T1 (D)	NO	T1 (D)
Intact mires - managed	T1 (D)	NO	T1 (D)
Total mineral soils			
Refilled lakes and ponds older than 20 years	NA	NA	T1 (D)
Grassland converted to flooded land			
Total organic soils	NA	NA	NA
Total mineral soils			
Medium SOC to reservoirs	NA	NO	T2 (CS)
Other land converted to flooded land			
Total organic soils	NA	NA	NA
Total mineral soils			
Low SOC to reservoirs	NA	NO	T2 (CS)
Grassland converted to other wetlands			
Total organic soils			
Rewetted wetland soils	T1 (D)	NO	T1 (D)
Total mineral soils			
Refilled lakes and ponds	T1 (D)	NA	T1 (D)

[1] To estimate CH_4 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 CO_2 emissions via waterborne losses from wet organic soils are reported for four wetland subcategories:

- Intact Mires – managed,
- Rewetted mires (of Wetland Remaining Wetland),
- Refilled Lakes and Ponds, and
- Rewetted Wetland Soils (of 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 CO_2 emissions via waterborne losses from Mires Converted to Reservoirs, Intact Mires, Refilled Lakes and Ponds, and Rewetted Wetland Soils are calculated according to Tier 1 using EF = 0.08 t CO_2-C ha^{-1} yr^{-1} from Table 3.2 in the 2013 Wetlands Supplement.

Emissions of CH_4 from reservoirs were estimated by applying a comparative method for CO_2 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.

CH_4 emissions from wet soils in the Intact Mires, Refilled Lakes and Ponds, and 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: 137 kg CH_4-C ha^{-1} yr^{-1} from Table 3.3 in 2013 Wetlands Supplement.

N_2O emissions from reservoirs are considered as not occurring.

Zero emissions were measured in a recent Icelandic study on which the emission estimates of CO_2 and CH_4 for reservoirs were based (Óskarsson & Guðmundsson, 2008).

The Tier 1 approach of the 2013 Wetlands Supplement for emissions of N_2O is considered negligible for Rewetted Wetland Soils and the same is assumed here to apply to Intact Mires.

Table 6.52 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]
Wetlands Remaining Wetlands		
Intact Mires - managed	293	183
Refilled lakes and ponds older than 20 years	-	183
Rewetted mires	293	183
Land Converted to Wetlands		
Rewetted Wetland Soils	293	183
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 1990–2023 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.

6.11.4 Category-specific QA/QC and Verification

Please consult Chapter 1.5 and section 6.1.4 for more information.

6.11.5 Category-specific Recalculations

Changes in values between the 2024 and 2025 Submissions are related to new areas emerged from the new map layers through the IGLUD process and new area results from NFI data sampled in 2023.

Recalculation of indirect emissions CO_2 and emission of N_2O from Natural Birch Forest and Shrubland has been conducted as new CS EF are used for the first time in the 2025 submission.

6.11.6 Category-specific Planned Improvements

There are no specific improvements planned for this category.

6.12 Direct and indirect N_2O Emissions from N Mineralisation and Immobilisation (CRT 4(III))

6.12.1 Category Description and methodology

Direct N_2O emissions from N mineralisation and immobilisation are reported for Cropland Converted to Grassland and Forest Land Converted to Settlements. A tier 1 and a Tier 2 approach, respectively, was used to estimate direct N_2O emissions.

Conversion of Cropland on mineral soils to Grassland, and Forest Land 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 N_2O (kg N_2O-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 Grassland to Wetlands and Grassland to Settlements because despite activity data the emissions are not yet estimated since the Party has prioritized the estimation of emissions from other land uses. However, Iceland will strive to estimate the emissions using IPCC default EFs.

Direct and indirect N_2O emissions due to mineralization associated with carbon losses from the conversion of Other Land to Wetlands were reported as NA, as the 2006 IPCC Guidelines do not provide default values.

Indirect N_2O 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 6.1.4 for more information.

6.12.4 Category-specific Recalculations

No recalculations conducted for this category.

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 IINH 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 2023 is shown in Figure 6.60. No wildfires were recorded for the period between 1990 and 2005.

One forest fire was reported in 2021, which burned on 4 May 2021 in Southwest Iceland. According to an expert knowledge from IINH, 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 2023.

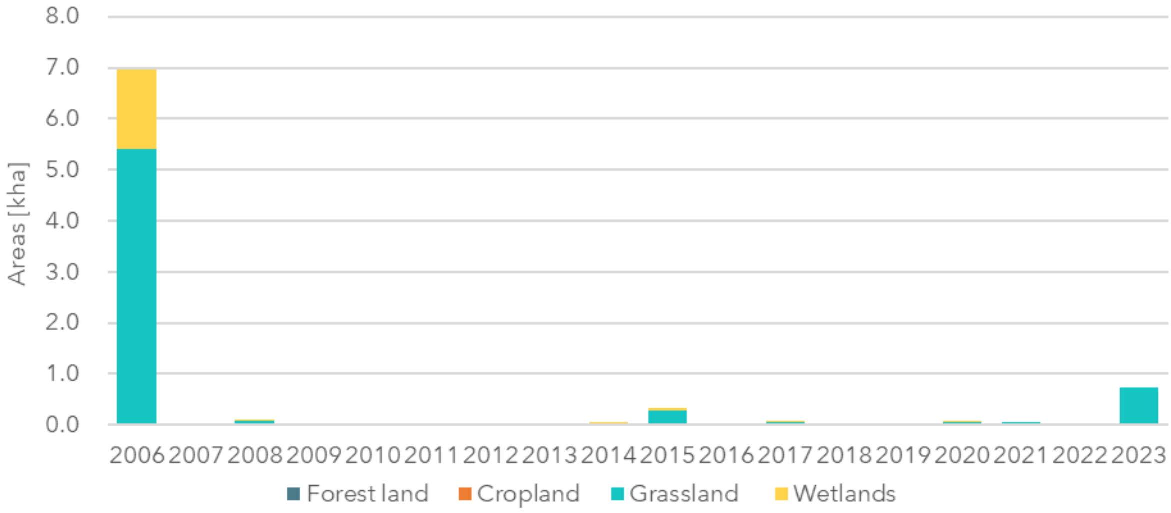


Figure 6.60 Areas affected by wildfires (by category) in Iceland in 2006 – 2023 [kha].

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 6.60). Since March 19, 2021, 10 eruption events have occurred in the same area. Non-CO_2 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-CO_2 emissions and removals are not estimated.

6.13.2 Methodology

Emissions of CH_4 and N_2O 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 CO_2 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, has an average above-ground biomass of 11.9 Mgha^{-1} (Snorrason et. al. 2019) was used to conduct the estimates for 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 6.53).

Table 6.53 Mass of fuel available by land category / soil type

Land use category		Soil type / Land-use subcategory	kg FM / m²
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 Cf 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 Gef for Savanna and Grassland were taken from Table 2.5 in 2006 IPCC Guidelines.

Controlled burning is not allowed in Iceland. This management regime was banned with the entry into force of Law 61/1992 on fires and fire management (Lög um sinubrennur og meðferð elds á víðavangi number 61, 1992). 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. Moreover, this assumption can be confirmed as no wildfires occurred during this period.

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 6.1.4 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 (CRF 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 CH_4 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. The emissions from the biogas production at the plant are reported under Anaerobic Digestion at Biogas Facilities (5B2).

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 CO_2e].

CRT			1990	1995	2000	2005	2010	2015	2020	2022	2023
5A	Solid Waste Disposal	CH_4	173	225	263	284	280	234	229	215	201
5B	Biological Treatment of Solid Waste	CH_4	NO	0.22	0.22	0.56	1.7	2.4	3.6	2.0	2.3
		N_2O	NO	0.13	0.13	0.32	1.0	1.4	2.0	0.70	0.77
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_2O	1.5	1.0	0.63	0.27	0.22	0.29	0.23	0.30	0.33
		CO_2	7.3	4.9	2.7	4.8	6.1	6.9	6.4	6.5	6.1
5D	Wastewater Treatment and Discharge	CH_4	15	15	18	15	11	14	12	16	16
		N_2O	4.3	4.3	4.3	4.5	4.9	5.1	5.4	5.7	5.9
5E	Other		NO	NO	NO	NO	NO	NO	NO	NO	NO
5	**Waste**	**Total**	**207**	**255**	**293**	**309**	**306**	**264**	**259**	**247**	**233**

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)[36], and the rather difficult road transportation network, especially during the first half of the 20th

[36] The Worldbank, population density, accessed 22/11/2024

https://data.worldbank.org/indicator/EN.POP.DNST?end=2021&locations=IS&start=1970

century. Further information can be found in the National Plan on Waste Treatment 2004-2016 (2004)[37], the National Plan on Waste Treatment 2013-2024 (2013)[38] and Towards a Circular Economy (2021)[39], 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.

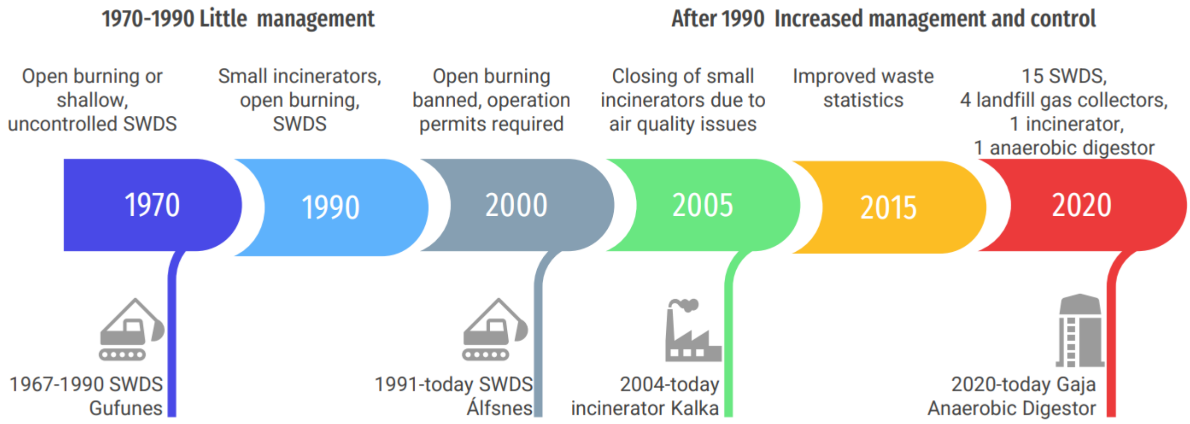


Figure 7.1 Timeline of the most important developments in waste management in Iceland since 1970.

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*,

[37] The National Plan on Waste Treatment 2004-2016, available at https://ust.is/library/Skrar/Atvinnulif/urgangur/Landsaatlun_2004-2016_VEF.pdf

[38] 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

[39] Towards a Circular Economy, available at https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/UAR_stefnal_att_ad_hringrasarhagkerfi.pdf.

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, landfilling[40] 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 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.

[40] Regulation No 738/2003 on landfilling of waste.

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_2O	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_2O	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_2O	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	D
5D1	Domestic Wastewater	N_2O	Tier 1	D
5D2	Industrial Wastewater	CH_4	Tier 1	D
5D2	Industrial Wastewater	N_2O	Tier 1	D
5E	**Other**	/	/	/

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 2023	Trend
Waste (CRT sector 5)					
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 2023	Trend
Waste (CRT sector 5)					
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 CO_2	Direct GHG CH_4	Direct GHG N_2O	Indirect GHG NO_x	Indirect GHG CO	Indirect GHG NMVOC
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	IE[4]	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 (CRF 5B1b) 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.

4 Included in Domestic Wastewater (CRT 5D1).

N_2O emissions from Solid Waste Disposal Sites (5A1 and 5A2) are not applicable since the 2006 IPCC Guidelines consider N_2O emissions to be insignificant and the 2019 Refinements do not provide clear guidelines on how to estimate these emissions. CO_2 emissions from the same categories are also not applicable, because CO_2 emissions from the decomposition of organic material, derived from biomass sources, are of biogenic origin and, therefore, accounted for under the AFOLU sector. CO_2 emissions from Composting (5B1) are also not applicable since 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/m^3 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, CH_4 production data is obtained directly from the only such plant in Iceland. This data is combined with the default 5% CH_4 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 CH_4 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 2006 IPCC Guidelines. Data about the recovery of CH_4 is collected from the single operators running CH_4 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 CH_4 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 CH_4 and (biogenic) CO_2 emissions.

No methodology is given in the 2019 Refinements for the estimation of N_2O emissions from Solid Waste Disposal Sites and these have not been estimated. CO_2 emissions from this category are also not applicable, because CO_2 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 CH_4 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:

$$\text{Waste amount generated (t)} = 0.0003 \times \text{GDP index}^3 - 0.0443 \times \text{GDP index}^2 + 6.6191 \times \text{GDP index}$$

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.

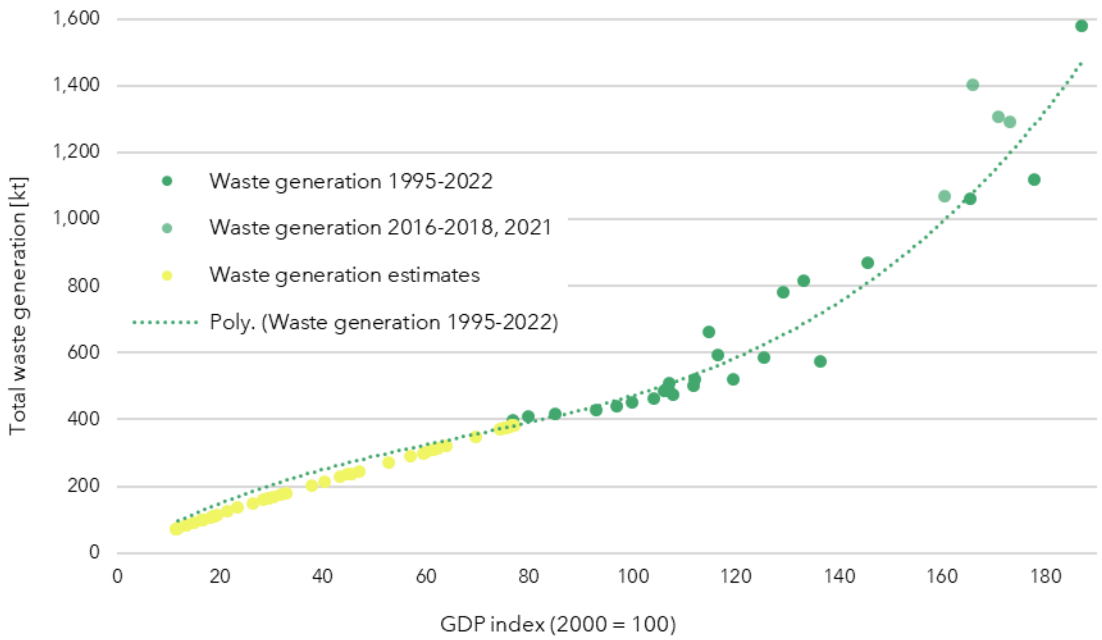


Figure 7.2 Correlation between waste generation and GDP index in Iceland used for waste generation estimates before 1995. Three years were not used for the prediction because of unusually much soil of total waste amount those years.

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 biggest 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.

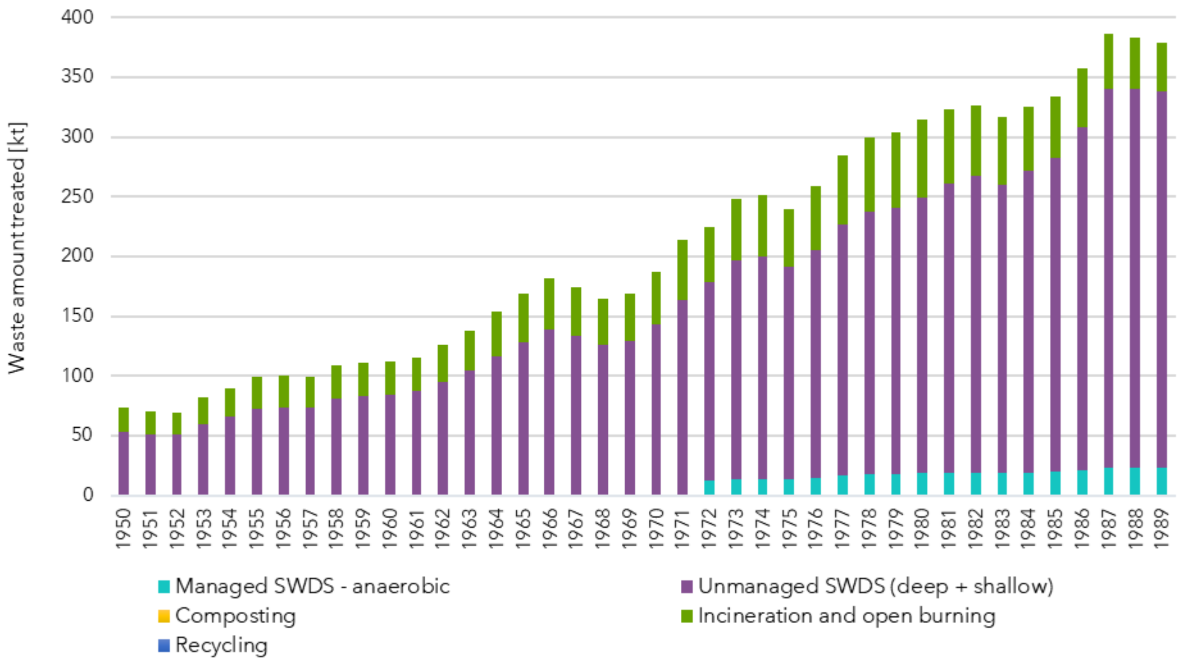


Figure 7.3 Waste amount and allocation to incineration/open burning, solid waste disposal, recycling, and composting 1950-1989.

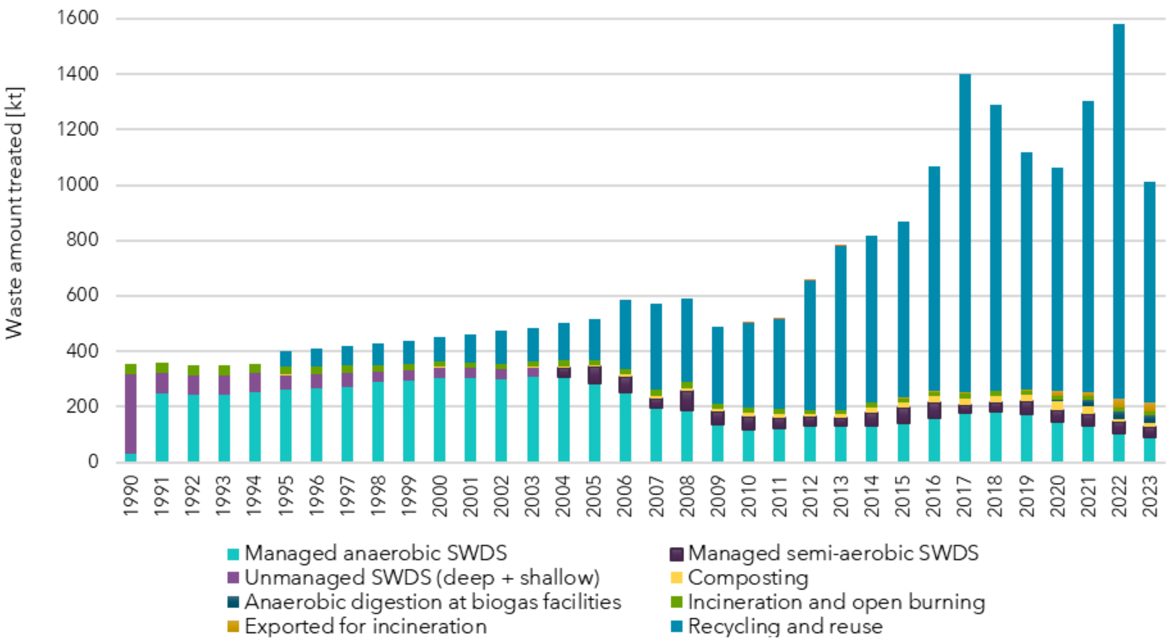


Figure 7.4 Waste amount and allocation to incineration/open burning, solid waste disposal, recycling, and composting, since 1990.

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 Álfsnes* started serving the capital and all surrounding municipalities. *Álfsnes* 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 Álfsnes 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.

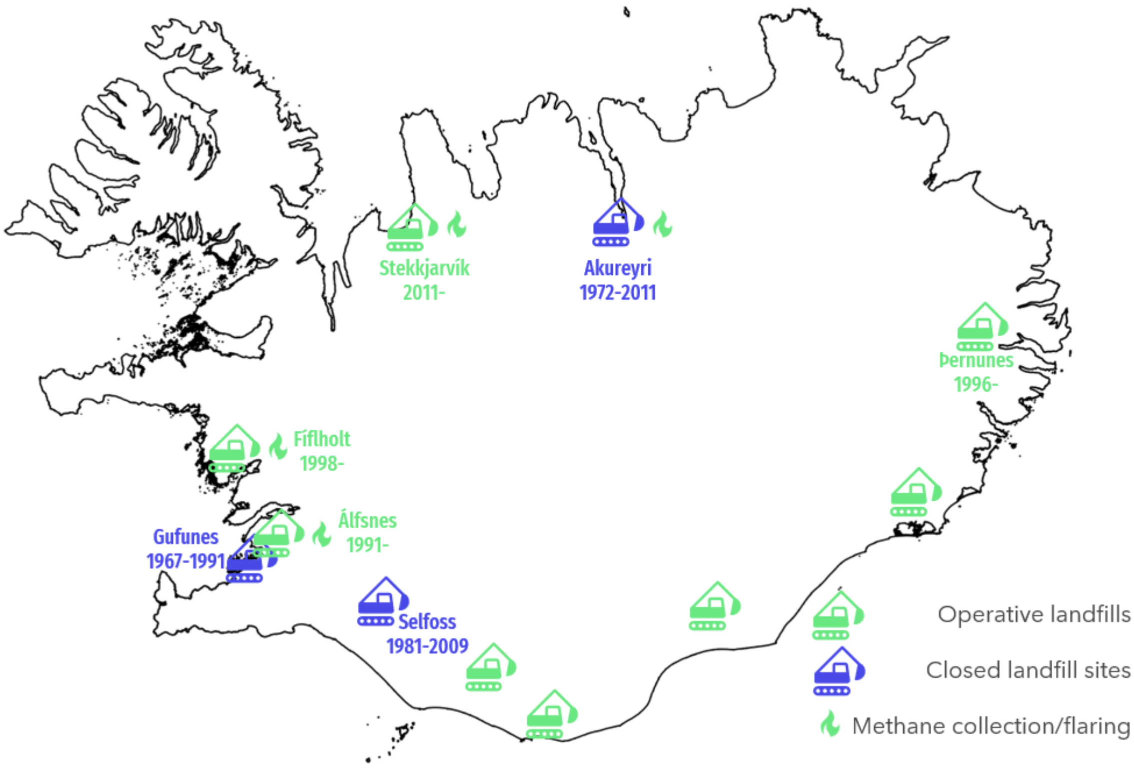


Figure 7.5 Main SWD sites in Iceland, operative (green) and closed sites (blue). There are several other smaller sites which are still operative or dismissed.

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.

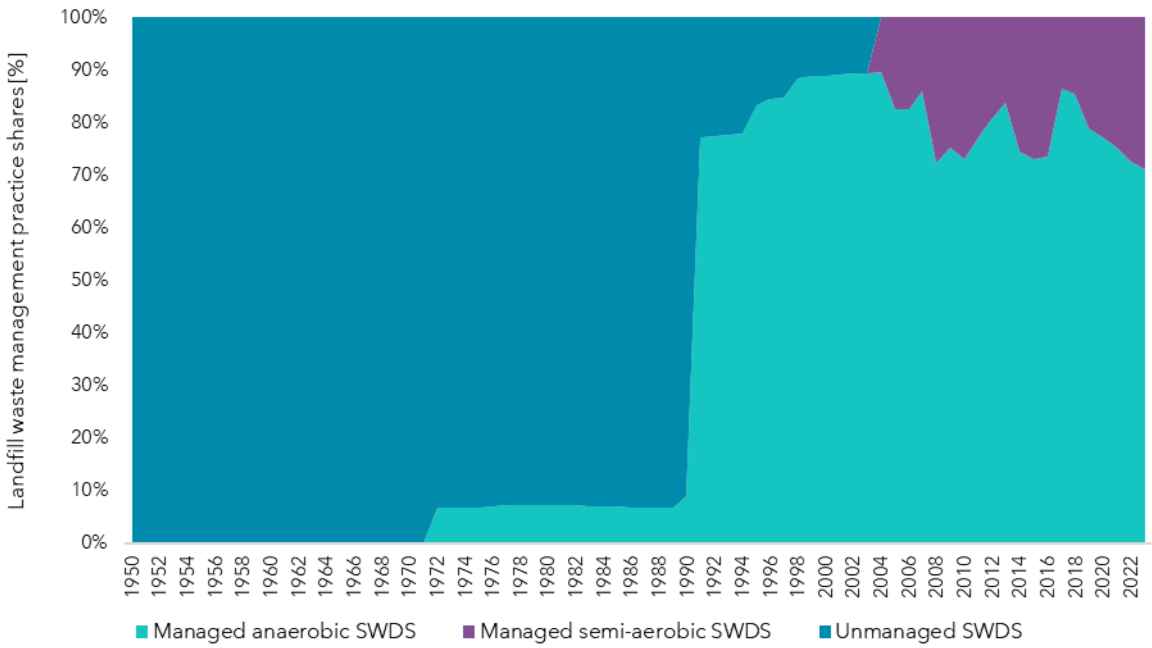


Figure 7.6 Waste management practice shares of total waste disposed of in managed and unmanaged SWDS.

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 CH_4 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 *Álfsnes*. 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 *Sorpa Ltd.*

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

CH_4 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 CH_4 recovered is discussed in chapter 7.2.4.1. To calculate CH_4 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 CH_4 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), CH_4 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 *Álfsnes* SWDS since 2014. According to the environmental manager at *Sorpa* Ltd. (which owns and runs *Álfsnes*), 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 (DDOCm).

The default MCFs 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) and (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 MCFs and MCFs 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 biggest 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 CH_4 since 2019. Figure 7.5 shows the location of the SWDS with CH_4 collection.

Data on the amount of landfill gas recovered from *Álfsnes* stems from the operator *Sorpa Ltd.*, either through e-mail request or though 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 CH_4 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*. CH_4 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 CH_4 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 CH_4 volume, a CH_4 fraction, based on regularly performed measurements, is used to estimate the CH_4 volume. CH_4 volume is converted to CH_4 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 CH_4 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 CH_4 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 CH_4 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 IEEA will continue to harmonise the data for the period 2011-2015.

As can be seen in Figure 7.7, CH_4 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 CH_4 decreased, and the collection amount was reduced again in 2020 (information from *Sorpa Ltd.*, e-mail).

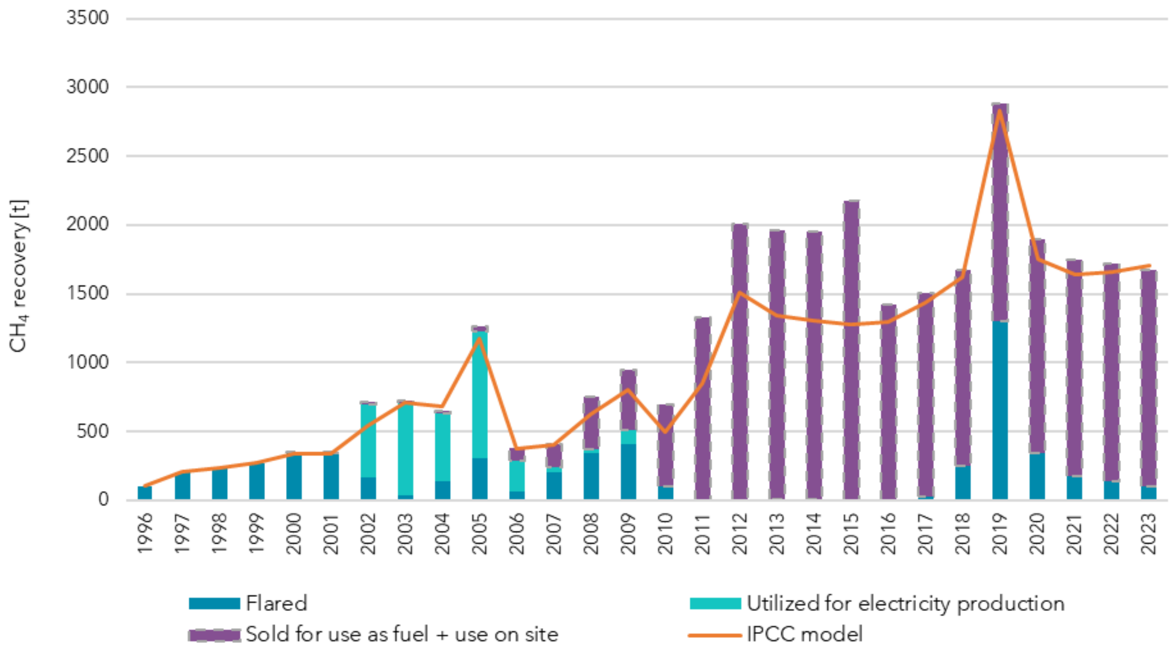


Figure 7.7 Methane recovery (5A1a) at Álfsnes, Glerárdalur, Stekkjarvík, and Fíflholt SWDSs (the last two started CH_4 recovery in 2019) [t CH_4].

7.2.4.2 Methane Emissions

CH_4 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 CH_4 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 CH_4 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 CH_4.

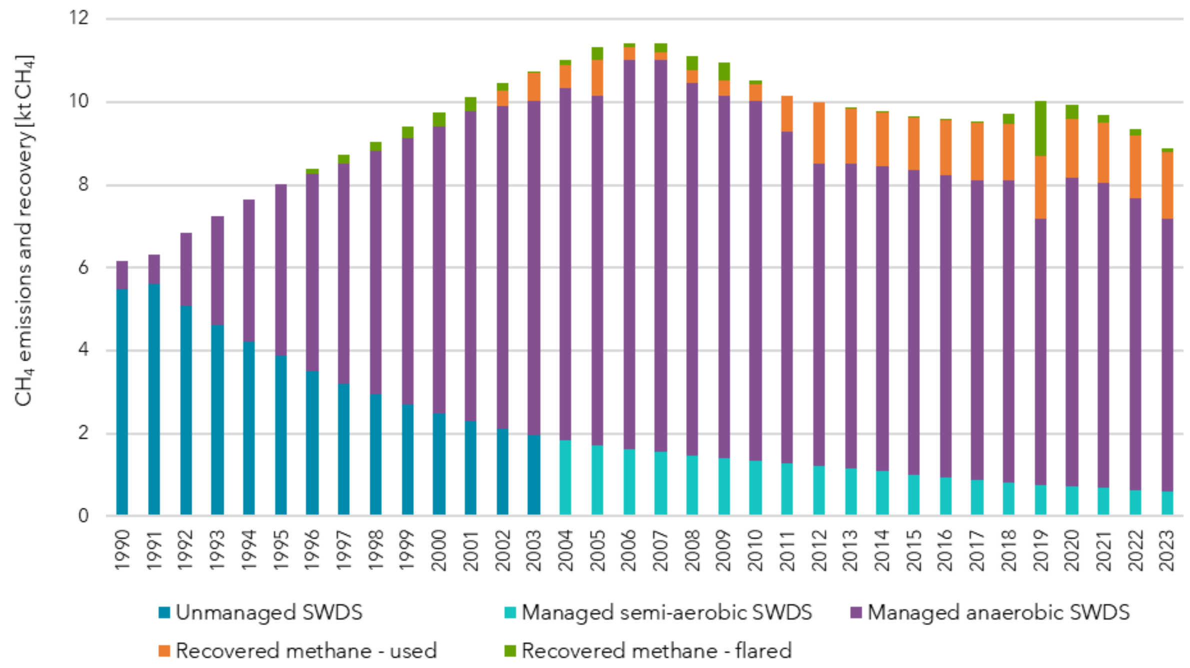


Figure 7.8 Methane generation estimates from SWDS since 1990.

Table 7.10 Methane emission estimates and recovery from SWDS since 1990.

CH_4 emissions [kt CO_2e]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Unmanaged SWDS	154	108	69	NO	NO	NO	NO	NO	NO
Managed Well – Semi-Aerobic SWDS	NO	NO	NO	48	37	28	20	18	17
Managed Anaerobic SWDS	19	116	194	236	243	205	209	197	184
Total CH_4 emissions	**173**	**225**	**263**	**284**	**280**	**234**	**229**	**215**	**201**
Relative change from 1990		30%	53%	65%	63%	35%	33%	24%	17%
Recovered CH_4 (flared and used)	NO	NO	10	33	14	36	49	47	48

7.2.5 Uncertainties

Activity data uncertainties are based on expert judgement within the IEEA on the uncertainty of total waste amount going to SWDS (10%) and composition uncertainty (20-25%, for 5A1a and 5A1b 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 49% for managed anaerobic SWDS and 51% for managed semi-aerobic SWDS and unmanaged SWDS.

The combined uncertainty for activity data and emission factor is 54% for managed, anaerobic SWDS (5A1a) and 58% 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 for the 2025 Submission

Recalculations were made for the years 2015-2022 due to updated activity data on the composition of mixed waste from households and commercial operators. The percentages that had previously been used, were showing the composition of landfilled waste, i.e. from both mixed and separately collected waste, instead of only the composition of mixed waste. Both the previously- and currently used studies are conducted by *Sorpa* Ltd.

The effect of changing the mixed waste composition for the years 2014-2022 can be seen in Table 7.11 and Table 7.12. The effects of changing the composition in 2014 are first seen in 2015. There are also small changes for the year 2022 due to updated waste amount data arriving after Iceland's NID was submitted in 2024.

Table 7.11 Recalculation in sector 5A1a due to a new mixed waste composition.

CRT 5A1a	2015	2016	2017	2018	2019	2020	2021	2022
2024 v1 submission [kt CO_2e]	206	205	202	199	168	193	190	182
2025 submission [kt CO_2e]	205	205	202	204	180	209	206	197
Change relative to the 2024 submission [kt CO_2e]	-0.08	-0.18	-0.24	4.70	11.80	15.77	15.49	14.35
Change relative to the 2024 submission [%]	-0.04%	-0.09%	-0.12%	2.4%	7.0%	8.2%	8.1%	7.9%

Table 7.12 Recalculation in sector 5A1b due to a new mixed waste composition.

CRT 5A1b	2015	2016	2017	2018	2019	2020	2021	2022
2024 v1 submission [kt CO_2e]	28.2	26.3	24.5	22.9	21.4	20.1	19.0	17.9
2025 submission [kt CO_2e]	28.2	26.3	24.5	22.9	21.5	20.3	19.2	18.1
Change relative to the 2024 submission [kt CO_2e]	-0.001	-0.003	-0.003	0.04	0.12	0.13	0.16	0.16
Change relative to the 2024 submission [%]	-0.004%	-0.011%	-0.014%	0.19%	0.57%	0.87%	1.0%	1.1%

Recalculations for the 2024 Submission

Recalculations were made for the years 1990-2021 due to updated activity data, error fixing and updated methodology.

For the 2024 submission, the methodology from the 2019 Refinements was used for the first time to calculate emissions from landfilling. Because of the proportion of waste categories landfilled in Iceland, transitioning to using the waste model from the 2019 Refinements led to an overall increase in emissions from solid waste disposal. Generally, there is an increase in emissions from the managed – anaerobic SWDS and a decrease from the other SWDS types.

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 didn't 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 to reclassify the small SWDS from 5A2 to 5A1b from the year 2004 and onwards. Since a country specific methane correction factor was already in use for these sites, that was obtained using measurements on sites fitting the 5A1b criteria, the same MCF is in use before and after the change. The change for the inventory is though large since all 5A2 emissions are moved over to 5A1 in the year 2004.

Updated activity data on methane recovery and flaring was obtained for the years 2013-2021 from *Sorpa Ltd.*, the waste management company servicing the capital area and operating the SWDS Álfsnes. The methane recovery is, on average, 7% lower in the new dataset. The methane recovery data for the years 1996-2012, had also been incorrectly assumed to be mass values but was in fact volume numbers. An average of the 2014-2022 methane gas purity values was used for the years 1990-2013 since no data on gas purity was available for those years and no clear trend could be seen in the 2014-2022 data. The resulting methane recovery values for the years 1990-2012 are, therefore, 32% lower than in last submission.

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.

A new anaerobic digestion facility (gas and composting plant), *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 municipal solid waste from households from the entire capital area, which contains around two thirds of Iceland's population. It can process 30 to 40 kt of organic waste every year and produce 10 to 12 kt of compost and 3 million Nm^3 of CH_4 each year, which will be utilised for downstream energy/heat.

7.3.1 Methodology

Estimation of CH_4 and N_2O 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. CO_2 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 the anaerobic digestor. 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 CH_4 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 CH_4 generated. In the absence of further information, the default value of 5% is used for the CH_4 emissions (IPCC, 2006). Based on this information, emissions from the anaerobic digestion facility were estimated based on the following equation:

Equation

Emissions from anaerobic *digestion* at biogas facilities

$$CH_{4,\mathrm{leakage}} = CH_{4,\mathrm{production}} \times C \times \mathrm{Frac}_{\mathrm{leakage}}$$

Where:

- $CH_{4,\mathrm{leakage}}$: emissions from anaerobic digestion, [Nm^3]
- $CH_{4,\mathrm{production}}$: CH_4 production at the biogas plant, [Nm^3]
- C: CH_4 density conversion factor, [0.716 kg/Nm^3]
- $\mathrm{Frac}_{\mathrm{leakage}}$: 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. Since 2005, this amount has increased steadily, as can be seen in Table 7.13.

Table 7.13 Waste amounts composted since 1990 as dry matter weight.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Waste amount composted [kt DM]	NO	0.80	0.80	2.00	6.10	8.52	12.68	4.43	4.87

Anaerobic digestion at biogas facilities 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, sludge, and manure. Biogas production is received directly from facility data (Table 7.14).

Table 7.14 Activity data for anaerobic digestion of organic waste since 2020.

	2020	2021	2022	2023
Waste amount sent to anaerobic digestion at biogas facilities [kt wet waste]	3.08	22.6	26.9	29.4
CH4 production [Nm3]	35,000	641,036	697,084	845,772

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 7.15.

Table 7.15 Tier 1 emission factors for CH_4 and N_2O from the 2006 IPCC Guidelines.

	Gas	Emission Factors [g/kg waste treated]
Wet weight	CH_4	4
	N_2O	0.24

CH_4 emissions from anaerobic digestion at biogas facilities are calculated by multiplying the volume of CH_4 produced at the biogas facility with the CH_4 density conversion factor [0.716 kg/Nm^3] and the fraction of leakage expected, which is 5% (IPCC Guidelines, 2006), see the Equation above.

7.3.4 Emissions

Emissions from Composting are shown in Figure 7.9, as well as the mass of waste composted. Emissions, both from Composting and Anaerobic Digestion at Biogas Facilities, are shown in Table 7.16

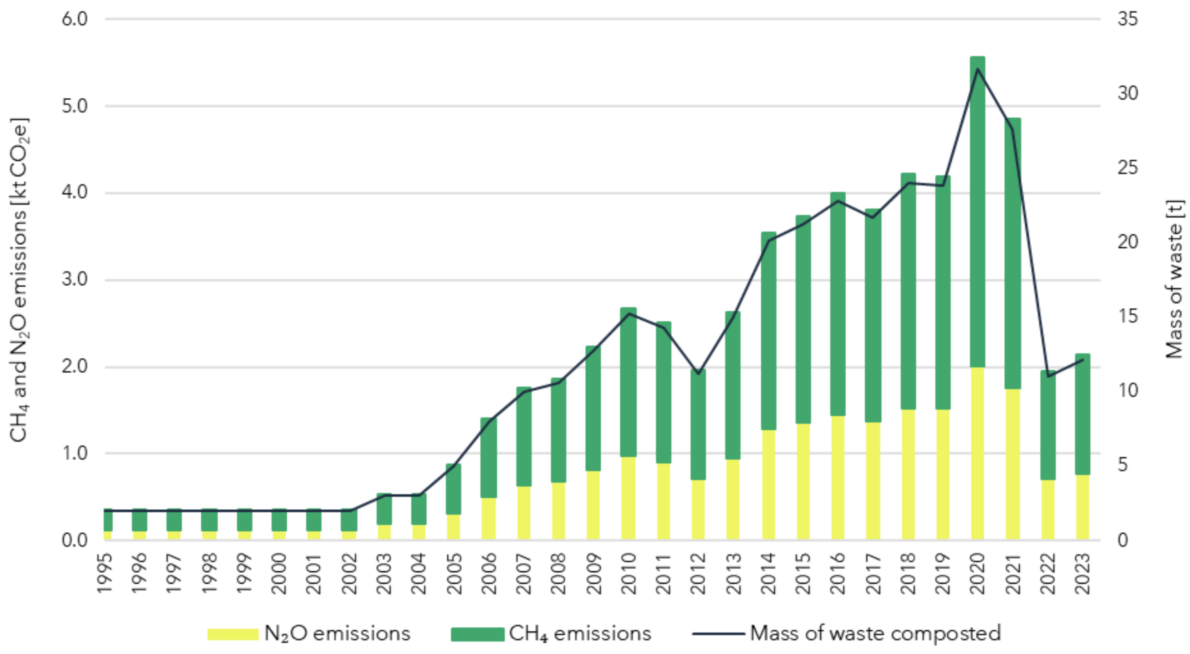


Figure 7.9 Mass of waste composted and estimated CH_4 and N_2O emissions.

CH_4 emissions from Anaerobic Digestion at Biogas Facilities can also be seen in Table 7.16. Emissions reported here are the estimated CH_4 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 / CH_4 produced (Table 7.14) acts as activity data for the energy sector where it is utilised rather than being released directly.

Table 7.16 Emissions from composting and anaerobic digestion at biogas facilities since 1990.

Emissions [kt CO_2e]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Composting CH_4	NO	0.22	0.22	0.56	1.71	2.39	3.55	1.24	1.36
Composting N_2O	NO	0.13	0.13	0.32	0.97	1.35	2.02	0.70	0.77
Composting Total	**NO**	**0.35**	**0.35**	**0.88**	**2.68**	**3.74**	**5.57**	**1.94**	**2.14**
Anaerobic digestion CH_4	NO	NO	NO	NO	NO	NO	0.037	0.736	0.892
Anaerobic digestion N_2O	NO	NO	NO	NO	NO	NO	NA	NA	NA
Anaerobic digestion Total	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.037**	**0.736**	**0.892**

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 100% for the CH_4 emission factor and 150% for the N_2O EF. The CH_4 emission factor uncertainty for anaerobic digestion is based on data from the anaerobic digestor GAJA and is estimated as 69%. N_2O emissions are considered negligible for anaerobic digestion. The uncertainty of CH_4 emissions from biological treatment of solid waste is estimated to be 59% and the N_2O uncertainty as 151%. The complete uncertainty analysis is shown in Annex 2: Assessment of Uncertainty.

7.3.6 Recalculations

Recalculations for the 2025 Submission

New data was obtained on the amount of waste composted in 2022 leading to recalculations for that year, see Table 7.17.

There are recalculations for the years 2020-2022 due to changes in how methane leakage is calculated. In earlier submissions, the leakage had been taken as 5% of the methane recovered from the anaerobic digestion plant. To obtain the leakage from the production, it is assumed that the methane recovered is 95% of the methane produced and that the rest was lost due to leakage. The effects of these recalculations can be seen in Table 7.18.

Table 7.17 Recalculations in sector 5B1 Composting due to updated waste amount composted in 2022.

CRT 5B1	2022
2024 v1 submission [kt CO_2e]	3.27
2025 submission [kt CO_2e]	1.94
Change relative to the 2024 submission [kt CO_2e]	-1.32
Change relative to the 2024 Submission [%]	-41%

Table 7.18 Recalculations in sector 5B2 due to changes to how methane leakage is calculated.

CRT 5B2	2020	2021	2022
2024 v1 submission [kt CO_2e]	0.035	0.643	0.699
2025 submission [kt CO_2e]	0.037	0.676	0.736
Change relative to the 2024 submission [kt CO_2e]	0.002	0.034	0.037
Change relative to the 2024 submission [%]	5.3%	5.3%	5.3%

Recalculations for the 2024 Submission

No recalculations were done for the 2024 Submission for biological treatment of solid waste.

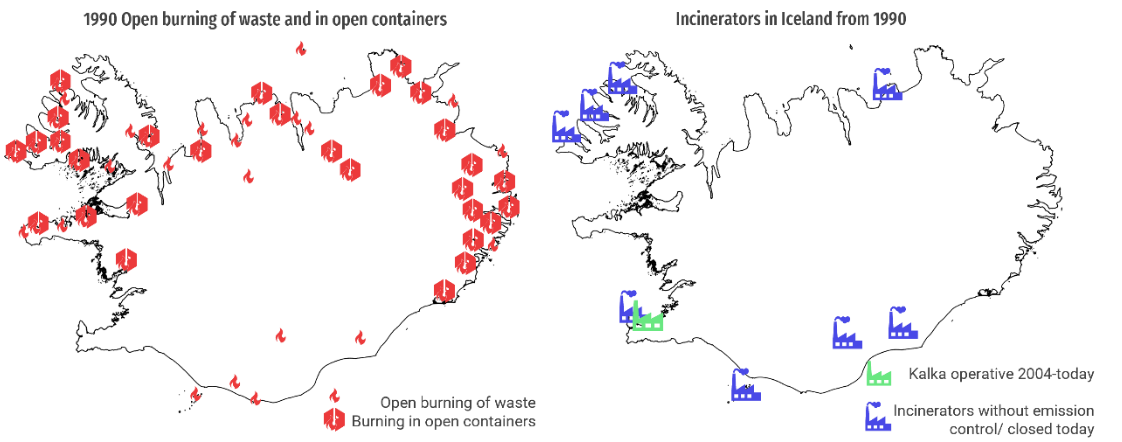
7.3.7 Planned Improvements

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.

7.4 Waste Incineration and Open Burning of Waste (CRT 5C)

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 (4-6m^3-20m^3) 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.

This category calculates emissions from incineration and open burning of waste for CH_4, N_2O and CO_2. Consistent with the 2006 IPCC Guidelines, only CO_2 emissions deriving from the burning of waste from fossil origin are taken into consideration. Burning of biomass materials (paper, food, wood) leads to biogenic CO_2 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 CO_2 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 CO_2, 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 CO_2 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.

CH_4 and N_2O emissions are calculated using the Tier 1 method of the 2006 IPCC Guidelines.

NO_x, CO, NMVOC, and SO_2 emissions are estimated in accordance with the 2023 EMEP/EEA Guidebook (EEA, 2023).

Kalka conducts continuous measurements for NOx, 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 7.10.

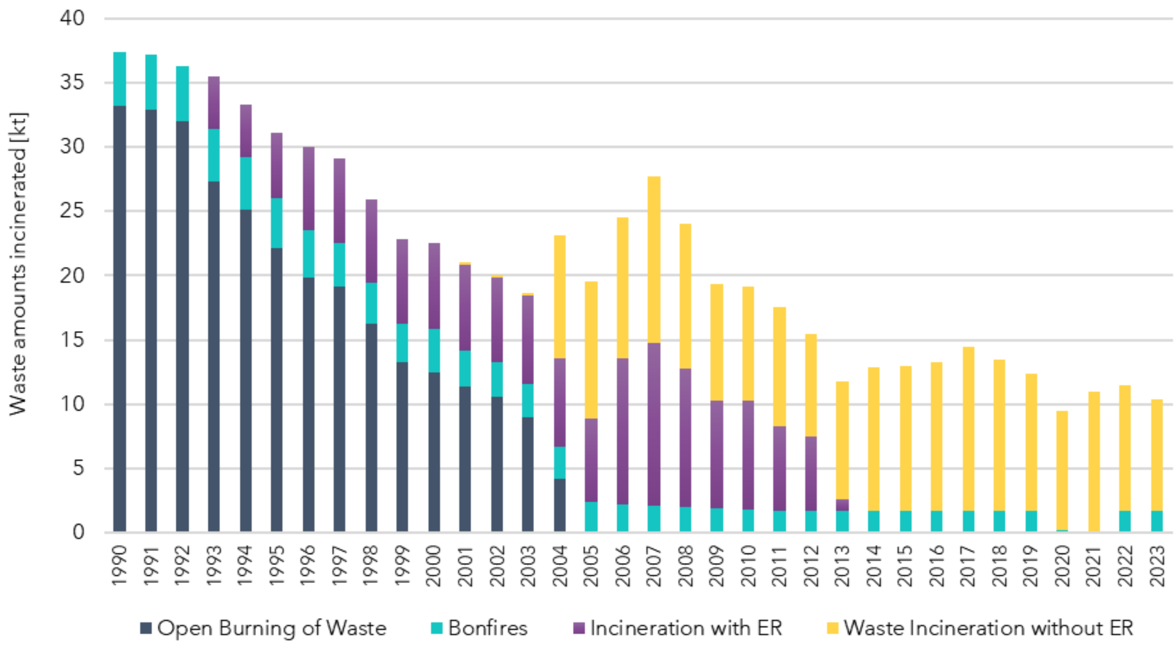


Figure 7.10 Amounts of MSW waste incinerated with and without energy recovery, burned openly and amount of wood burned in bonfires since 1990.

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 or 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 7.10).

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 CO_2 Emission Factors

CO_2 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 CO_2. This is shown for this year's submission in Table 7.19.

Table 7.19 Calculation of non-biogenic CO_2 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	1,736	0.15	0.90	0.46	0.01	7	26
Textiles	425	0.04	0.80	0.50	0.20	34	125
Wood	87	0.01	0.85	0.50	0	0	0
Garden	150	0.01	0.40	0.49	0	0	0
Diapers	1,047	0.09	0.40	0.70	0.10	29	108
Food	2,727	0.23	0.40	0.38	0	0	0
Inert	1,055	0.09	0.90	0.03	1.00	28	104
Plastics	1,404	0.12	1.00	0.75	1.00	1,053	3,861
Hazardous	1,345	0.11	0.50	NA	0.275[1]	370	1,356[2]
Clinical	557	0.05	0.65	NA	0.25[1]	139	511[2]
Rubber	NO	NO	0.84	0.67	0.20	0	0
Sludge plus manure	175	0.01	0.40	0.45	0	0	0
Industrial solid waste	1,239	0.10	0.40	0.38	0	0	0
Total	**11,946**					**1,661**	**6,090**

[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 CO_2.

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 CO_2 emissions from bonfires are reported.

7.4.3.2 CH_4, N_2O, NO_x, CO, NMVOC, and SO_x Emission Factors

In contrast to CO_2 emission factors, which are applied to the fossil carbon content of waste incinerated, the emission factors for CH_4, N_2O, NO_x, CO, NMVOC, and SO_2 are applied to the total waste amount incinerated. Emission factors for CH_4 and N_2O 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 SO_2 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 7.20.

Table 7.20 Emission factors for Incineration and Open Burning of Waste. All values are in g/tonne wet waste except were indicated otherwise.

	CH_4	N_2O		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 7.11 and Table 7.21. 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 CO_2 emission. CH_4 and N_2O emissions have been reduced significantly from 1990 due to a transition from open burning facilities towards waste incineration in waste incineration plants.

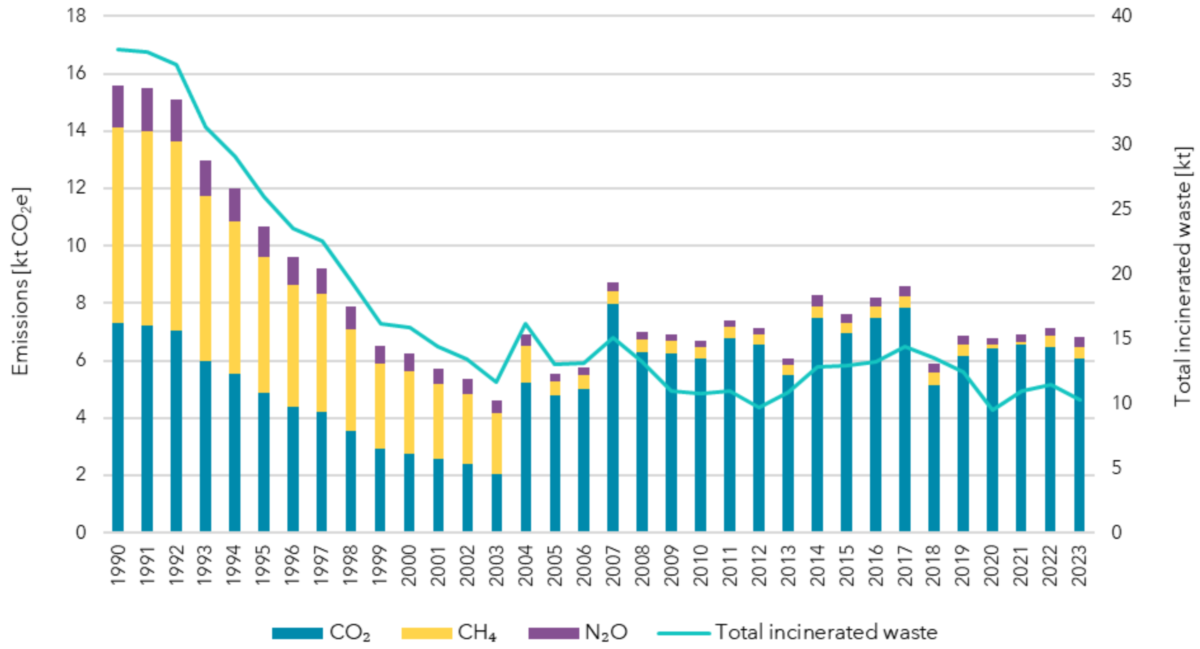


Figure 7.11 Emission estimates from incineration and open burning of waste since 1990.

Table 7.21 Emissions from Incineration and Open Burning of Waste (CRT 5C) since 1990.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
CO_2 emissions [kt CO_2e]	7.3	4.9	2.7	4.8	6.1	6.9	6.4	6.5	6.1
CH_4 emissions [kt CO_2e]	6.8	4.7	2.9	0.50	0.39	0.39	0.12	0.39	0.39
N_2O emissions [kt CO_2e]	1.5	1.0	0.63	0.27	0.22	0.29	0.23	0.30	0.33
Total	**16**	**11**	**6.3**	**5.6**	**6.7**	**7.6**	**6.8**	**7.1**	**6.8**
Relative change since 1990		-32%	-60%	-64%	-57%	-51%	-57%	-54%	-56%

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 uncerntainty in waste composition (25%). 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 42%.

Uncertainties associated with CO_2 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 CO_2. A default value of ± 40% was used to estimate the emission factor uncertainty for CO_2 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 CO_2 emissions from incineration and open burning of waste is therefore 58%.

Default values were also used to estimate the uncertainties associated with N_2O and CH_4 emissions. The total combined uncertainty for N_2O and CH_4 emissions was estimated to be 108% (100% for the emission factors and 42% for the activity data). The complete uncertainty analysis is shown in Annex 2: Assessment of Uncertainty.

7.4.6 Recalculations

Recalculations for the 2025 Submission

Recalculations were made for the years 2014-2022 due to updated activity data on the composition of mixed waste from households and commercial operators, affecting emissions from MSW and hazardous waste. The percentages previously used were found to represent the composition of both mixed and separately collected landfilled waste, rather than exclusively mixed waste. Both studies were conducted by *Sorpa* Ltd. The impact of revising the mixed waste composition for 2014-2022 is shown in Table 7.22 and Table 7.23. There are also minor changes for the year 2022 due to updated waste amount data arriving after Iceland's NID was submitted in 2024.

Table 7.22 Recalculation in sector 5C12a Municipal Solid Waste Incineration due to a new mixed waste composition.

CRT 5C12a	2014	2015	2016	2017	2018	2019	2020	2021	2022
2024 v1 submission [kt CO_2e]	6.83	6.14	6.17	6.48	5.55	7.90	5.24	7.16	8.36
2025 submission [kt CO_2e]	6.87	6.18	6.21	6.49	4.05	6.60	4.89	5.72	4.94
Change relative to the 2024 submission [kt CO_2e]	0.05	0.05	0.05	0.01	-1.50	-3.19	-0.36	-1.45	-3.41
Change relative to the 2024 Submission [%]	0.70%	0.78%	0.76%	0.13%	-27%	-16%	-6.8%	-20%	-41%

Table 7.23 Recalculation in sector 5C12bii Hazardous Waste Incineration due to a new mixed waste composition.

CRT 5C12bii	2014	2015	2016	2017	2018	2019	2020	2021	2022
2024 v1 Submission [kt CO_2e]	0.63	0.76	1.25	1.35	1.31	1.31	1.26	0.54	0.44
2025 Submission [kt CO_2e]	0.63	0.77	1.25	1.38	1.11	1.42	1.42	0.75	1.32
Change relative to the 2024 submission [kt CO_2e]	0.003	0.002	0.004	0.03	-0.19	0.07	0.15	0.20	0.88
Change relative to the 2024 Submission [%]	0.46%	0.25%	0.28%	2.5%	-15%	8.7%	12%	38%	197%

Recalculations for the 2024 Submission

Recalculations were made due to updated activity data, which affected the 2021 emissions from waste incineration. The fraction of hazardous and clinical waste incinerated of biogenic origin was also updated for the entire time series.

Chapter 5.4.1.2 in the 2006 IPCC Guidelines states that the carbon in hazardous waste is usually of fossil origin. Therefore, the biogenic fraction of hazardous waste is now assumed to be zero. For the clinical waste, the fraction of total carbon in waste is 40% and the fraction of fossil carbon in waste is 25%. Consequently, the fraction of biogenic carbon in clinical waste is 15%.

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. A small percentage was collected in septic systems. The share of septic systems, which are mostly used in rural areas and smaller villages, has increased slightly 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 treatment. Basic treatment includes at least filtering the wastewater through 3 mm wide grids. In the capital area the wastewater discharge is pumped 4 km away from the coastline, but in smaller municipalities the sewage outlets are not as far from the coast. Since basic treatment filters next to no organic material from the wastewater, it is categorised as no treatment here. Since 2002, some smaller municipalities 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 below 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 CH_4 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 N_2O emissions from the wastewater.

7.5.1 Methodology

The calculation of greenhouse gas emissions from wastewater treatment in Iceland is based on the Tier 1 methodologies in the 2006 IPCC Guidelines.

7.5.2 Activity Data

7.5.2.1 Methane Emissions from Wastewater

Domestic Wastewater

Activity data for emissions from domestic wastewater treatment and discharge consists of the annual amount of total organics in wastewater (TOW). TOW is calculated using Equation 6.3 from Ch. 6, Vol. 5 of the 2006 IPCC Guidelines. In the equation, the annual amount of TOW is a product of population, amount of biochemical oxygen demand (BOD) (in kg per head per year) and a correction factor for additional industrial BOD discharged into sewers. The correction factor, I, is set to 1 for the pathways "not known and septic tanks", while for all collected wastewater, treated and untreated, I is set to 1.25, to account for industrial wastewater discharge such as commercial activities, accommodation services, restaurants and shops, which are commonly discharged in the municipal sewer system. The default BOD_5 value for Canada, Europe, Russia, and Oceania was used, 60 g per person per day (Table 6.4).

Data on overnight stays associated with foreign visitors to Iceland is calculated into population equivalents (PE) and used to adjust the total population and, hence, include the additional emissions from Wastewater Treatment and Discharge associated with foreign visitors to Iceland.

Table 7.24 and Table 7.25 provide information on activity data used to estimate CH_4 emissions from Domestic Wastewater Treatment and Discharge in Iceland.

Table 7.24 Information on total population (incl. PE from foreign visitors) and total organic matter in domestic wastewater since 1990.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Population [n]	255,368	269,332	282,178	297,824	323,505	338,260	359,050	382,941	395,923
Total organic matter[1] [kt BOD/yr]	5.6	5.9	6.2	6.5	7.1	7.4	7.9	8.4	8.7

[1] This is TOW divided by the correction factor I, i.e., excluding the correction factor for additional industrial BOD discharge into sewers.

Six known wastewater discharge pathways exist in Iceland. In addition, some wastewater goes to unknown pathways. Information about the shares of different treatment pathways comes from status reports on wastewater treatment, which are prepared by the IEEA. These are shown in Table 7.25 along with respective shares of total wastewater discharge.

Table 7.25 Proportions of different domestic wastewater discharge pathways in Iceland since 1990.

		I-factor	1990	1995	2000	2005	2010	2015	2020	2022	2023
Not known		1.00	0	0	0	0	0.010	0.018	0.017	0.017	0.017
Collected - untreated systems	Not known into sea, river, lake	1.25	0	0	0	0	0	0.015	0	0	0
	No treatment	1.25	0.96	0.94	0.94	0.89	0.90	0.89	0.90	0.85	0.85
Collected - treated systems	Primary treatment	1.25	0	0	0	0	0	0.0019	0.0070	0.058	0.058
	Secondary treatment	1.25	0	0	0	0.010	0.010	0.015	0.019	0.019	0.019
	Tertiary treatment	1.25	0	0	0	0.0050	0.010	0.0058	0	0	0
Uncollected	Septic tank	1.00	0.040	0.060	0.060	0.10	0.070	0.059	0.055	0.055	0.055

Industrial Wastewater

The biggest industry in Iceland, which produces organic wastewater, is fish processing. It is currently the only industry included separately in the inventory. Information about wastewater treatment in fish processing is based on expert judgement by specialists in the Ocean and Water Unit at the IEEA. Emissions from Industrial Wastewater are calculated from total organics in wastewater (TOW_i), using Equation 6.6 in Vol. 5 in the 2006 IPCC Guidelines. In the equation, the annual amount of TOW_i is a product of the total industrial product for industrial sector i, wastewater generated and chemical oxygen demand (COD_i) in the wastewater.

The default COD_i and W_i values for fish processing were used; 2.5 kg/m^3 and 13 m^3/t product, respectively (2006 IPCC Guidelines, Volume 5, Table 6.9). 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 7.26.

Table 7.26 Information on fish processing and organic matter in industrial wastewater since 1990.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Processed Fish [kt]	1,371	1,376	1,705	1,243	729	1,104	845	1,268	1,238
TOW_i [kt COD/yr]	44.6	44.7	55.4	40.4	23.7	35.9	27.5	41.2	40.2

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 basic or no wastewater treatment (i.e., no removal of small organic particles).

7.5.2.2 Nitrous Oxide Emissions from Wastewater

The activity data needed to estimate N_2O emissions is the total amount of nitrogen in the wastewater effluent ($N_{EFFLUENT}$). $N_{EFFLUENT}$ is calculated using Equation 6.8 in Volume 5 from the 2006 IPCC Guidelines:

Default values from the 2006 IPCC Guidelines are used for the fraction of nitrogen in protein, factor for non-consumed protein added to wastewater, and factor for industrial and commercial co-discharged protein, and are shown in Table 7.27.

Table 7.27 Default parameters used to calculate the amount of nitrogen in the wastewater effluent.

Parameter	Default value	Range	Remark
F_{NPR}	0.16	0.15-0.17	Default value used
$F_{NON\text{-}CON}$	1.1	1-1.5	The default value of 1.1 for countries with no garbage disposal was selected.
$F_{IND\text{-}COM}$	1.25	1-1.5	Default value used

Other parameters influencing the nitrogen amount in wastewater are 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, Eysteindsdóttir, & 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.

The amount of sludge removed for landfilling and incineration, or to use as a fertiliser for land reclamation is used alongside the protein consumption to obtain the amount of nitrogen in effluent. For the sewage sludge landfilled or incinerated, the default value for nitrogen amount in domestic sewage treated sludge, from the 2019 Refinements, is used (4.2% N/dry matter sludge). The N-content of sewage sludge used as a fertilizer is obtained from a 2022 report from the Soil Conservation Service (Jóhannsson & Valdimarsdóttir, 2022).

Table 7.28 provides information on activity data used to estimate nitrous dioxide emissions from Wastewater Treatment and Discharge in Iceland.

Table 7.28 Activity data used to estimate N_2O emissions from Wastewater Treatment and Discharge in Iceland; Protein consumption, amount of sludge removed and N in effluent.

	1990	1995	2000	2005	2010	2015	2020	2022	2023
Protein consumption [kg/person/yr]	37.2	35.4	33.6	32.9	32.9	32.9	33.0	33.0	33.0
Sludge removed [kt DC]	6.01	5.5	6.0	4.9	3.9	3.3	3.3	7.1	8.4
N in effluent [kt N/year]	2.1	2.1	2.1	2.1	2.3	2.4	2.6	2.7	2.8

7.5.3 Emission Factors

7.5.3.1 Domestic Wastewater

The CH_4 emission factor for domestic wastewater treatment and discharge pathway and system is a function of the maximum CH_4 producing potential (B_O) and the methane correction factor (MCF), from Equation 6.2 in Volume 5 of the 2006 IPCC Guidelines.

The default B_o for domestic wastewater, 0.6 kg CH_4/kg BOD, was applied (Table 6.2 of the 2006 IPCC Guidelines).

In the 2006 IPCC Guidelines, the default Tier 1 MCF value is explained this way: "Rivers with high organics loadings can turn anaerobic". This does not describe the condition in Iceland. Iceland is sparsely populated, with two thirds of the population living in the capital area, and mainly habited along the coastline. Both rivers and the ocean contain cold, fast running water. Hence, the default Tier 1 MCF for wastewater discharge in the 2006 IPCC Guidelines is not considered appropriate here.

Most of the wastewater is discharged into the ocean, which around the capital area, has an average max temperature of 12°C (in August)[41]. According to the 2019 Refinements, CH_4 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 CH_4 production from wastewater were found (Auðunsson, 2006; Auðunsson, 2015; Auðunsson, 2009; 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 CH_4 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; Auðunsson, 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 CH_4 production based on environmental research on the riverbed (Jónsson, Gunnarsson, Skúladóttir, & Árnason, 2020). However, expert judgement 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). Hence, she determined that CH_4 emissions from wastewater discharges were unlikely in Iceland and a lower MCF would be appropriate.

Therefore, it has been concluded that the Tier 2 MCF value, 0.035, from Table 6.3 (updated) in the 2019 Refinements, for discharge to aquatic environments other than reservoirs, lakes and estuaries, is the best option for the Icelandic inventory. Since this value applies to discharge from treated and untreated systems, it is applied to all collected wastewater in the inventory.

Unfortunately, the data required to be able to transition all wastewater calculations to the 2019 Refinements is currently not available. Efforts to collect data on sludge, which is necessary to complete the transition, are ongoing. Since most wastewater goes through little or no treatment, most sludge, which is collected, is discharged directly into the ocean around Iceland.

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

[41] https://seatemperature.net/current/iceland/reykjavik-sea-temperature

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.

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 7.12 adapted from Figure 20 in (Petersen & Berber, Jarðvegshitamælingar á Íslandi: Staða núverandi kerfis og framtíðarsýn, 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."*[42]

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 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 2006 IPCC Guidelines 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 CH_4 emission factors for domestic wastewater are, therefore, 0.021 kg CH_4/kg BOD for all collected wastewater treatment systems, while septic tanks and unknown treatment have the emission factor 0.025 kg CH_4/kg BOD. Total CH_4 emissions from domestic wastewater were calculated with Equation 6.1 in Volume 5 from the 2006 IPCC Guidelines.

The parameter S has not been estimated for Iceland and is set to zero. The parameter R is set to zero as well as no CH_4 from wastewater is recovered in Iceland.

[42] EAI (2004). https://ust.is/library/Skrar/utgefid-efni/Annad/UST_Rotthraer_og_siturlagnir.pdf, p. 16.

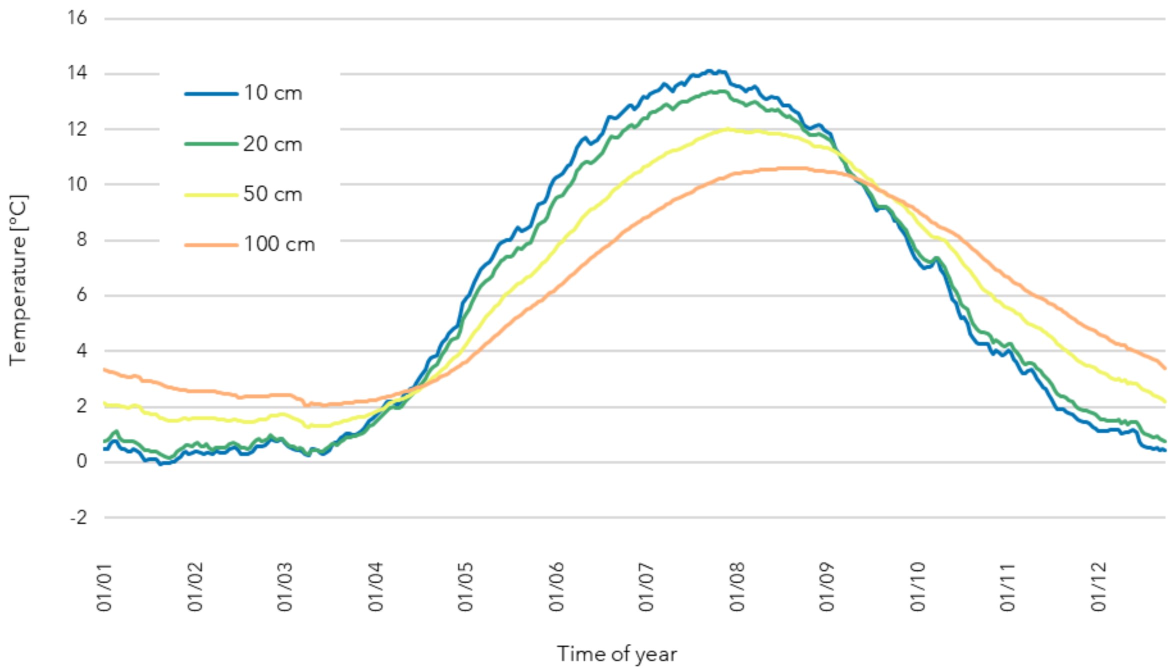


Figure 7.12 Monthly average soil temperature in Reykjavík, 2007-2017, adjusted from Figure 20 in (Petersen & Berber, Jarðvegshitamælingar á Íslandi: Staða núverandi kerfis og framtíðarsýn, 2018).

7.5.3.2 Industrial Wastewater

The CH_4 emission factor for industrial wastewater is a function of Bo and the MCF, from Equation 6.5 in Volume 5 of the 2006 IPCC Guidelines. The default B_O for industrial wastewater, 0.25 kg CH_4/kg COD, was applied (2006 IPCC Guidelines). Since CH_4 emissions from industrial wastewater are only estimated for fish processing, the only pathway for industrial waste in the inventory is no treatment, with the MCF 0.035, as explained for the domestic wastewater, and the resulting emission factor is 0.009 kg CH_4/kg COD.

Total CH_4 emissions from industrial wastewater are calculated with Equation 6.4 in Volume 5 from the 2006 IPCC Guidelines.

Treatment of wastewater from fish processing is basic, hence, S_i and R_i are set to zero.

7.5.3.3 N_2O emissions

Total N_2O emissions from wastewater are calculated with Equation 6.7, Volume 5 from the 2006 IPCC Guidelines.

The 2006 IPCC Guidelines emission factor for N_2O emissions from wastewater is 0.005 kg N_2O-N/kg N.

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 7.29 and Figure 7.13. CH_4 and N_2O 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. CH_4 emissions from industrial wastewater were at their highest in 1997 but have decreased since then due to less domestic fish processing.

Table 7.29 Emissions from wastewater treatment and discharge since 1990.

Emissions [kt CO_2e]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Domestic Wastewater CH_4	4.10	4.32	4.53	4.77	5.19	5.42	5.76	6.14	6.35
Industrial Wastewater CH_4	10.9	11.0	13.6	9.9	5.8	8.8	6.7	10.1	9.9
Domestic and Industrial Wastewater N_2O	4.33	4.34	4.32	4.47	4.86	5.09	5.39	5.72	5.87
Total	**19.3**	**19.6**	**22.4**	**19.1**	**15.9**	**19.3**	**17.9**	**22.0**	**22.1**
Relative change from 1990		1.5%	15.9%	-1.1%	-18.0%	-0.2%	-7.6%	13.5%	14.1%

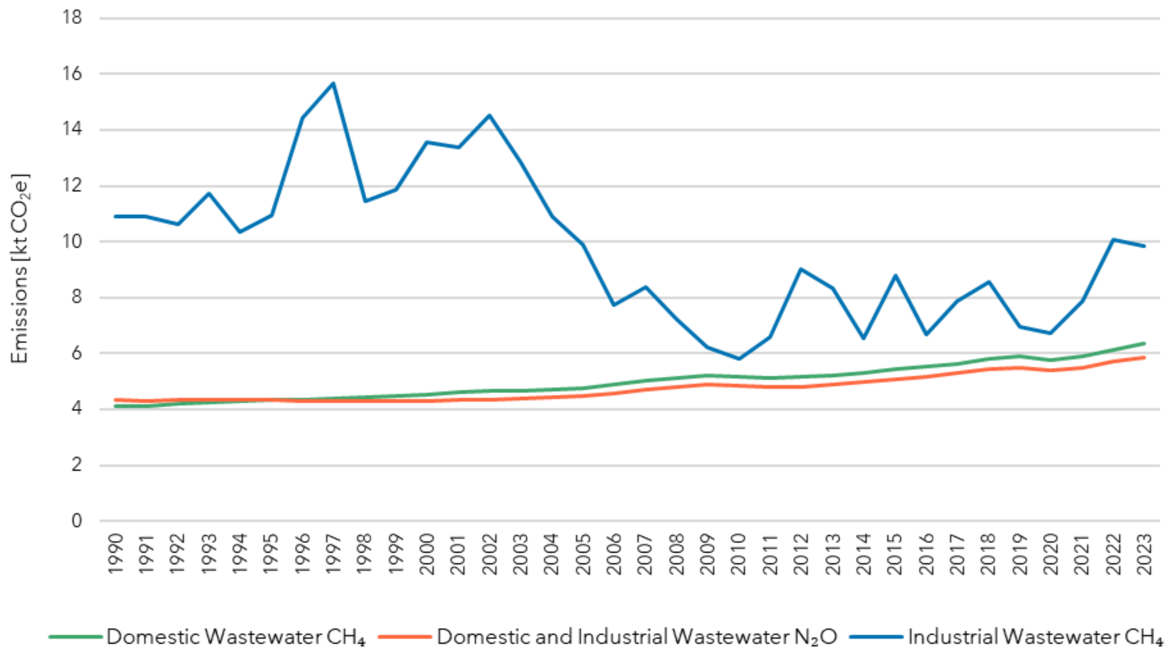


Figure 7.13 Emissions from Wastewater Treatment and Discharge (CRT 5D) since 1990.

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 38% and 103% for CH_4 emissions for domestic and industrial wastewater, respectively. The emission factor uncertainty for both domestic and industrial wastewater is 58% based on values from Table 6.7 of the 2006 IPCC Guidelines (Volume 5, chapter 6). The combined uncertainties for CH_4 emissions from domestic and industrial wastewater are, therefore, 69% and 118%, respectively.

The activity data uncertainty of domestic wastewater for N_2O emissions is based on values from the 2006 IPCC Guidelines and is 44% while the emission factor uncertainty is 30% based on Table 6.13, Vol. 5, in the 2019 refinements, giving a combined uncertainty of 53%. The N_2O emissions from industrial are included in the domestic wastewater emissions and present therefore the same uncertainties mentioned above. The complete uncertainty analysis is shown in Annex 2: Assessment of Uncertainty.

7.5.6 Recalculations

Recalculations for the 2025 Submission

A few changes were made for the 2025 submission which required recalculations. The largest effect on emissions from domestic wastewater is due to updated population numbers for the years 2011-2022. The correction of the interpolation of protein consumption between the years 2012-2019 and a small update of treatment system utilisation fractions for 2014 have a smaller effect. The overall effect on emissions from domestic wastewater can be seen in Table 7.30.

There are recalculations for the industrial wastewater due to updated data on domestic fish processing for the whole time series 1990-2022. The change is small for all years except 2022, but preliminary data had to be used for the newest historical year for the last submission, see Table 7.31.

Table 7.30 Recalculations of total emissions in sector 5D1 Domestic Wastewater due to updated population numbers for the years 2011-2022.

CRT 5D1	2011	2013	2015	2017	2019	2021	2022
2024 submission [kt CO_2e]	10.1	10.3	10.7	11.1	11.7	11.7	12.2
2025 submission [kt CO_2e]	9.9	10.1	10.5	11.0	11.4	11.4	11.9
Change relative to the 2024 submission [kt CO_2e]	-021	-0.19	-0.18	-0.17	-0.31	-0.33	-0.35
Change relative to the 2024 submission [%]	-2.0%	-1.8%	-1.7%	-1.5%	-2.0%	-2.8%	-2.9%

Table 7.31 Recalculations in sector 5D2 Industrial Wastewater due to updated data on domestic fish processing for the whole time series 1990-2022.

CRT 5D2	1990	1995	2000	2005	2010	2015	2020	2021	2022
2024 submission [kt CO_2e]	10.9	11.0	13.6	10.0	5.8	8.8	6.8	8.0	7.5
2025 submission [kt CO_2e]	10.9	11.0	13.6	9.9	5.8	8.8	6.7	7.9	10.1
Change relative to the 2024 submission [kt CO_2e]	-2.0E-06	-	-1.1E-04	-0.084	8.0E-06	-5.1E-03	-0.11	-0.10	2.6
Change relative to the 2024 submission [%]	-0.0%	-	-0.0%	-0.84%	0.0%	-0.06%	-1.7%	-1.3%	35%

Recalculations for the 2024 Submission

For the 2024 submission, recalculations were made in Sector 5D1 and 5D2 due to substantial changes in activity data on the shares of different treatment pathways and due to changed methane correction factors used for all wastewater treatment and discharge pathways. The changes and the effects they had on emissions from the 5D sector are explained below.

A specialist from the Ocean and Water Unit at the IEEA was consulted on the shares of different wastewater treatment pathways in Iceland. That consultation confirmed that the share of septic tanks had been overestimated over the entire time series. More accurate data on treatment pathways in Iceland is now used and the share of septic tanks in the inventory has gone down significantly. This change had a large effect on the emissions from septic tanks, since the share of this pathway decreased considerably.

It had been assumed that the *coarse cleaning* applied to most wastewater in Iceland was similar to primary treatment. However, it has now been clarified that it more resembles no treatment. The shares of different treatment pathways have been updated accordingly. With this change, the amount of domestic wastewater with no treatment went from 10% to 90% for the year 2020, and the shares between pathways are not in accordance with the latest status report on wastewater treatment in Iceland[43]. This change did, however, not affect the overall emissions estimates from wastewater since, to be conservative, the MCF from the 2006 IPCC Guidelines for no treatment for this coarse cleaning was already used. This change, therefore, only affects the terminology used.

Since fish processing is the only industry reported under 5D2 Industrial Wastewater, only the treatment pathways used in fish processing is used in the inventory for industrial wastewater. Part of the industrial wastewater had been incorrectly assigned to septic tanks for the years 1990-2013, which has now been updated. As a result of this, all wastewater reported under 5D2 is assigned to no treatment for now. As other industries will be added to the inventory that will change.

For the last few years, the default Tier 1 MCF of 0.1 from the 2006 IPCC Guidelines has been used. Previous reviews have highlighted that there might be an over-estimate of emissions above the threshold of significance because of the MCF used. After researching this issue, the MCF was changed to 0.035 for all collected wastewater discharge, in accordance with the 2019 Refinements. The reason for the change is given in Section 7.5.3 on emission factors.

Furthermore, the Tier 1 MCF for septic tanks from the 2006 IPCC Guidelines is no longer used. Instead, the methodology that Ireland has applied for the last few years is followed. Hence, the MCF for septic tanks changed from 0.5 to 0.042 for this submission, for the whole time series. The reason for the change is given in Section 7.5.3 on emission factors.

The PE from overnight stays was also incorporated for the first time for this submission. It affects both CH_4 and N_2O emissions from domestic wastewater. Additionally, protein intake data was interpolated over the years between dietary survey publications which affects N_2O emissions from wastewater.

7.5.7 Planned Improvements

The Industrial Wastewater category is currently only calculated for fish processing on land. For future submissions it is planned to add more industries. Preliminary work on mapping the missing data has begun and is ongoing. Completing the data set for the main industries for the whole time series is a considerable project that will take a few years.

[43] https://ust.is/library/sida/haf-og-vatn/Stoduskyrsla_fraveitumala_2020

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 CO_2 from the atmosphere; the captured CO_2 is then injected into the subsurface in the *CarbFix* well, where CO_2 mineralises to form calcite ($CaCO_3$). More about *Climeworks* can be found here: www.climeworks.com.

9 Indirect CO_2 and N_2O Emissions

9.1 Indirect CO_2 Emissions

The only indirect CO_2 emissions estimated in Iceland's greenhouse gas tnventory 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, CO_2 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 CO_2 emissions related to this are included in the national totals.

9.2 Indirect N_2O Emissions

Indirect N_2O 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 N_2O 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 2025 greenhouse gas emission inventory was recalculated for several sources. 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 2025 Submission and the 2024 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 2025 Submission compared to the 2024 Submission, [kt CO_2e] - without LULUCF.

Inventory Year	2024 Submission	2025 Submission	Change [kt]	Change [%]
1990	3645	3707	62	1.7%
1995	3504	3591	87	2.5%
2000	4107	4201	95	2.3%
2005	4022	4129	107	2.6%
2010	4868	4976	108	2.2%
2015	4734	4845	110	2.3%
2020	4495	4605	110	2.4%
2021	4631	4729	98	2.1%
2022	4666	4782	116	2.5%

Table 10.2 Total emissions according to the 2025 Submission compared to the 2024 Submission, [kt CO_2e] - with LULUCF.

Inventory Year	2024 Submission	2025 Submission	Change [kt]	Change [%]
1990	11377	11850	473	4.2%
1995	11219	11702	483	4.3%
2000	11830	12296	467	3.9%
2005	11768	12221	452	3.8%
2010	12635	13064	429	3.4%
2015	12474	12884	411	3.3%
2020	12197	12605	408	3.3%
2021	12330	12733	402	3.3%
2022	12423	12767	344	2.8%

10.2 Most Recent Reviews

10.2.1 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.

10.2.2 UNFCCC Review 2023

No UNFCCC review took place for Iceland's inventory submitted in 2023.

10.2.3 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.

10.2.4 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 submission[44] 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 2024 and the 2025 submissions amounting to -12.3 kt CO_2e for 2022, +0.034 kt CO_2e for 2005, and +0.0199 kt CO_2e 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 3 (Energy). There are various reasons that caused these recalculations:

- Most subsectors: A more precise NCV for diesel was obtained for the years 2021 and 2022 resulting in recalculations in N_2O and CH_4 for these two years. Also, the C and H content of diesel for 2022 was updated.
- 1A1ai Electricity Generation: Updated AD for biomethane for the years 2002-2009 which caused recalculations in N_2O and CH_4 for these years.
- 1A4bi Residential Stationary: The AD on charcoal for the year 2022 was updated and the AD for the years 1990-2018 for charcoals was added (was NE).
- 1A3b Road Transport: With the latest version of COPERT some methodological changes were done based on new data and measurements.

[44] https://unfccc.int/sites/default/files/resource/arr2022_ISL.pdf

- 1B2d Geothermal Energy: Recalculations were performed for CH_4 and CO_2 emission. For 2021 and 2022 emission number were updated based on error in the calculations.
- 1B2av Fugitive Emissions from Fuels: In the previous submissions, the activity data was the total imported fuel. It is now the total fuel sold which is considered to be more representative of oil distributed. This caused recalculations for the whole timeline.
- 1D1a International Aviation: Updated activity data for jet kerosene for 2021-2022 resulted in recalculations for these two years.

10.3.2 Industrial Processes and Products Use (CRT Sector 2)

Recalculations were performed for the IPPU sector for this submission, leading to a difference in greenhouse gas emissions between the 2024 and the 2025 Submission amounting to -0.632 kt CO_2e for 2022, -0.510 kt CO_2e for 2005, and -0.3674 kt CO_2e 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:

- 2C3 Aluminium production: An updated slope factor was used to estimate the CF_4 and C_2F_6 emissions of a plant using the "slope method" for PFC emission estimation, resulting in recalculations of CF_4 and C_2F_6 emissions for the years 2019, 2020, and 2021.
- 2D1 Lubricant use: Recalculations were done for 2002-2022 due to updated import/export data from Statistics Iceland.
- 2D2 Paraffin wax use: Recalculations were done for 1995-2021 due to updated import/export data of candles from Statistics Iceland.
- 2D3 Other non-energy products from fuels and solvent use: Recalculations were done for the whole timeline due to tier change and updated import/export data of candles from Statistics Iceland.
- 2F4 Aerosols: Recalculations were done for 1990-2002 due to changes in population statistics and for 2021-2022 due to updated activity data from the Icelandic Medicines Agency.
- 2G3 N_2O from Product Use: Recalculations were done for 2011-2022 due to changes in population statistics.
- 2G4 Tobacco: Recalculations were done for 2005, 2007-2010 and 2020-2022 due to updated import/export data from Statistics Iceland.
- 2G4 Fireworks: Recalculations were done for 2007, 2009-2010, 2012, 2016, 2018 and 2020 due to updated import/export data from Statistics Iceland.
- 2H2, Food and Beverages: Recalculations were done for the whole timeline due to changes in method in calculating emissions from beer and malt. Recalculations were also due to updated import/export data from Statistics Iceland.

10.3.3 Agriculture (CRT Sector 3)

Recalculations were performed in the Agriculture sector for this submission, leading to an increase in greenhouse gas emissions between the 2024 and 2025 submission amounting to 116 kt CO_2e for 2022, 107 kt CO_2e for 2005, and 63 kt CO_2e 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:

- Updated livestock population numbers for most animal categories for one or more years due to livestock census numbers being fetched for the whole timeline at once, instead of just updating the newest years. For the latest historical years there are also some updates in livestock numbers due to farmers late registration of livestock to MFAF. Most were the changes for Sheep, Horses, Ducks/Geese and Turkeys, other categories mostly had changes for one or two years.
- Broilers chickens, which are bred for meat production, were previously categorised as Chicken but are now under the category Broiler, resulting in recalculations.
- A correction was made to the number of pullets for the whole timeline. The number for pullets in the livestock census data is the AAP number but had been believed to be the number of animals produced annually.
- The body weight gain for pregnant heifers was updated from 0.5 kg/day to 0.443 kg/day based on data from the IAAC.
- The gender ratios in the category Young bulls and non-inseminated heifers was changed from 71% young bulls to 42% young bulls based on 2022 data from the IAAC, and in the Calves category from 46% male to 45% on average.
- The 2019 Refinements methodology is now applied for Tier 1 animal categories, which results in recalculations for emissions from enteric fermentation in horses and goats. The new methodology allows for emission factor scaling by weight, which was applied to horses and goats.
- The 2019 Refinements methodology is now applied for Tier 1 animal categories for emissions from manure management, which results in recalculations for all groups. The largest absolute changes in CH_4 emissions are an increase for pigs and decrease for horses and poultry. This methodology change also affects N_2O emissions, mainly from goats and poultry.
- The animal weight of some of the Tier 1 animals was updated, which also affected both CH_4 and N_2O emissions.
- An error was found in the fractions of slurry with and without crust in the N_2O calculation sheet, causing recalculations for all Cattle subcategories.
- For adult cattle categories the protein content in milk was used instead of the milk fat content in the nitrogen retention calculations, which affected the Nex rate for these categories, and hence, the direct and indirect N_2O emissions.
- The largest change in emissions from Agricultural Soils between submissions occurred in the subsector Cultivation of Organic Soils. This change is due to the publication of a peer-reviewed paper in 2024, which introduced updated emissions factors. These emission factors are based on the same research as previous ones, originally derived from a report published after the research concluded. In the newly published paper, the statistical analysis was revisited, resulting in higher emission factors. The factor for cropland increased from 0.99 kg N_2O-N/ha/yr to 2.24 kg N_2O-N/ha/yr and the factor for grassland increased from 0.44 kg N_2O-N/ha/yr to 1.26 kg N_2O-N/ha/yr.
- A double counting-issue was solved for 3G1 Limestone, resulting in recalculations for the years 2012-2022 for limestone.

- Activity data on fertiliser types was revisited with a fertiliser expert in the spring of 2024 resulting in some recalculations for 3G1 Limestone, 3G2 Dolomite, 3H Urea application and 3I Other Carbon-containing Ferilisers.

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 the 2025 and 2024 submissions, kt CO_2e

Inventory Year	2024 Submission	2025 Submission	Difference [kt CO_2e]	Difference [%]
1990	7732	8142	410	5.3%
1995	7715	8111	396	5.1%
2000	7723	8095	372	4.8%
2005	7746	8092	346	4.5%
2010	7767	8088	321	4.1%
2015	7739	8039	300	3.9%
2020	7702	8000	298	3.9%
2021	7699	8003	304	4.0%
2022	7757	7986	229	2.9%

Forest Land (CRT 4A)

The emission/removal estimates for Forest land-use category have been revised in comparison to previous 2024 submissions. Specifically:

- Area-dependent sources, such as emissions from drained organic soil, have been changed in relation to changes in the area estimate for each category and each year. The main reason for area changes is inclusion of measurements plots from newly discovered cultivated forests.

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/removal estimates for Cropland land-use category have been revised in comparison to previous 2024 submissions. Specifically:

- The methodology for estimating cropland areas (including mineral and organic soils areas) was revised in the 2025 submission.

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 2024 submissions. Specifically:

- The method for processing the activity data was revised to use annual land use transition matrixes to explicitly track changes in areas between land-use subcategories.
- There are small recalculations to the activity data and emissions to the Land converted to Grassland category.
- There are minor recalculations to the Cropland converted to Grassland category due to the overall increase in cropland area reflected in the 2025 submission's IGLUD map.
- There are minor revisions to Wetlands converted to Grassland (WL → GL) from 2009 onward due to the updated IGLUD map data.

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 2024 submissions. Specifically:

- The methodology for Wetlands organic soils activity data was revised. The revisions impacted the "Intact mires - managed" and "Intact mires - unmanaged" categories.
- The use of annual land-use transition matrices to explicitly track area changes between land-use subcategories has identified more conversions away from "Intact mires - managed," resulting in a minor further decrease in this category.

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)

The emission/removal estimates for Settlements land-use category have been revised in comparison to previous 2024 submissions. Specifically:

- The methodology for "Land converted to Settlements" was corrected. Specifically, a 20-year transition period was introduced for the "All other grassland subcategories converted to settlements" category, replacing the previous 1-year transition period.
- There were also minor recalculations to the 2021 and 2022 settlements activity data to ensure timeseries consistency with the newest settlements map.
- Emissions for the mineral soil pool were estimated for the first time in the 2025 submission.

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 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 N_2O Emissions from N Inputs to Managed Soils (CRT 4(I))

No recalculations conducted for this category.

Emissions and Removals from Drainage and Rewetting and Other Management of Organic and Mineral Soils (CRT 4(II))

New CS EF for indirect emission of CO_2 on drained organic soils was introduced in Forest land and Shrubland categories. New CS EF for N_2O emission on drained organic soils was introduced in Forest land categories.

Direct and Indirect N_2O Emissions from N Mineralisation and Immobilisation (CRT 4(III))

Indirect N_2O Emissions from mineralization of Managed Soils was reported in Forest land converted to Settlement for the first time in 2025 submission.

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 2024 and 2025 submissions amounting to +13 kt CO_2e for 2022, -0.084 kt CO_2e for 2005, and $-2.0 \cdot 10^{-6}$ kt CO_2e 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 the years 2015-2022 due to updated activity data on the composition of mixed waste from households and commercial operators. The percentages that had previously been used, were showing the composition of landfilled waste, i.e. from both mixed and separately collected waste, instead of only the composition of mixed waste. Both the previously- and currently used studies are conducted by *Sorpa* Ltd. The effects of changing the composition in 2014 are first seen in 2015. There are also small changes for the year 2022 due to updated waste amount data arriving after Iceland's NID was submitted in 2024.
- 5B1 Composting, new data was obtained on the amount of waste composted in 2022 leading to recalculations for that year.
- 5B2 Anaerobic Digestion, recalculations for the years 2020-2022 due to changes in how methane leakage is calculated. In earlier submissions, the leakage had been taken as 5% of the methane recovered from the anaerobic digestion plant. To obtain the leakage from the production, it is assumed that the methane recovered is 95% of the methane produced and that the rest was lost due to leakage.

- 5C1 Waste Incineration, recalculations were made for the years 2014-2022 due to updated activity data on the composition of mixed waste from households and commercial operators, affecting emissions from MSW and hazardous waste. The percentages previously used were found to represent the composition of both mixed and separately collected landfilled waste, rather than exclusively mixed waste. Both studies were conducted by *Sorpa* Ltd. There are also minor changes for the year 2022 due to updated waste amount data arriving after Iceland's NID was submitted in 2024.
- 5D1 Domestic Wastewater, the largest effect on emissions is due to updated population numbers for the years 2011-2022. The correction of the interpolation of protein consumption between the years 2012-2019 and a small update of treatment system utilisation fractions for 2014 have a smaller effect.
- 5D2 Industrial Wastewater, recalculations were made for the whole timeline due to updated activity data on domestic fish processing. The change is small for all years except 2022, but preliminary data had to be used for the newest historical year for the last submission.

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 increase the total emissions with LULUCF by 4.2% for the year 1990 and 2.8% for the year 2022, 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.

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-implementation	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/2022/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 far 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/2022/ISL/G.2	Solved during review.		n/a

CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	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 Inventory Compiler in obtaining data from data providers and to provide an update on progress with the planned revision to Regulation 520/2017.	FCCC/ARR/2022/ISL/G.6	Implemented.		Chapter 1.2.3 and Chapter 12

CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
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.		Chapter 1.2.2
Annual submission	Iceland did not report national total emission estimates with and without indirect CO_2 in the CRF 1ables 10.1-10.6. The ERT notes that Decision 24/CP.19, paragraph 29 states that "for Parties that decide to report indirect CO_2 the national totals shall be presented with and without indirect CO_2". During the review, the Party provided a spreadsheet with tthe total national emissions with and without indirect CO_2 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 CO_2 in CRF tables 10.1-10.6. The ERT notes that this can be done by including the indirect CO_2 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 NCV and C and H content for diesel was updated the most recent years. Charcoals were added for the years 1990-2018. The activity data for 1B2av Fugitive Emissions was changed from total imported fuel to the total fuel sold. 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).

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		

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/IS L/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 table1.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/IS L/E.5	In progress		
Feedstocks, reductants and other non-energy use of fuels - liquid fuels - CO_2 (E.9, 2021) (E.30, 2019) Convention reporting adherence	(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 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	FCCC/ARR/2022/IS L/E.6	Implemented.		

CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	from this category. Total emissions under category 1.A.2.f reduced by 0.07 – 0.13 kt CO_2e 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 does not address the increase in the CO_2 EF for gasoline between 1990-2016, considering constant values of the c-content and NCV.	FCCC/ARR/2022/ISL/E.7	Partially implemented. Still need to investigate further he increase in the CO_2 EF for gasoline between 1990-2016.		Chapter 3

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 - 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_2O (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 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	FCCC/ARR/2022/ISL/E.9	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
	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_2O (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_2O (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
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 CO_2 emissions. Explain in the NIR how the CO_2 EF was derived, including values and assumption for NCVs and carbon content and how the bioethanol is considered in the calculation of the CO_2 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 CO_2 emissions for road transportation. The Party applied constant NCVs and constant measured carbon	FCCC/ARR/2022/ISL/E.12	Implemented.		Chapter 3.3.3

CRF Category/ Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	content for 1990–2016 and the CO_2 EF varied in this period from 69,96–70,15 t CO_2/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 CO_2, 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 CO_2 EF from gasoline considering the blended bioethanol, there is probably an overestimation in the CO_2 emissions in the energy sector. This should be clarified by the Party.				
1.A.3.b.i Cars – gasoline – CH4 and N2O (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 CH_4 and N_2O 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 drop from 0.034 kt N2O in 2005 to 0.016 kt N2O in 2006, which is not addressed and explained in the NIR.	FCCC/ARR/2022/IS L/E.13	Implemented.		Chapter 3
1.A.3.b.i Cars – biomass – CO_2, CH_4 and N_2O (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_2O 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/IS L/E.14	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
1.A.3.e Other transportation – liquid fuels – CO_2, CH_4 and N_2O (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 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.	FCCC/ARR/2022/IS L/E.15	Implemented.		Chapter 3
1.A.4 Other sectors – liquid fuels – CO_2, CH_4 and N_2O (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	FCCC/ARR/2022/IS L/E.16	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
	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".				
1.A.4 Other sectors – biomass – CO_2, CH_4 and N_2O (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_2eq per year, which is well below the significance threshold of around 2.35 kt CO_2eq. 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.	FCCC/ARR/2022/IS L/E.17	Implemented.		Chapter 3.2.3
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/IS L/E.18	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
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/IS L/E.19	Implemented.		Chapter 3
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 CO_2 emissions from diesel oil in other categories such as in stationary combustion and categories 1.A.2.g.vii, 1.A.3.e.ii 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.e.ii The corrected emissions in 1.A.3.e.ii were 1.01 kt CO_2e and 1.04 kt CO_2e lower than the originally reported values for 2017 and 2018,	FCCC/ARR/2022/IS L/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
	respectively. In 2019, the corrected emissions were 0.64 kt CO_2e lower than the originally reported value, as totaled for all three referenced categories. In 2020, the corrected emissions were 0.17 kt CO_2e 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 CO_2eq and that Iceland has therefore not included the emissions in the inventory at this 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- CH4, N2O	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	FCCC/ARR/2022/IS L/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
	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 NIR to justify and verify the inter-annual diesel oil and gasoline EFs variations for CH4, and N2O 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 this submission, the main change was a tier change in 2D3a, Other Solvent Use Including Fungicides and changes in method in calculating NMVOC emissions from beer and malt in 2H2, Food and Beverage Industry. 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.

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 Table2(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 notations keys in CRF table 2(II) were not uploaded due to a technical problem with CRF Reporter.	FCCC/ARR/2022/ISL/I.1	Clarified during review.		Chapter 4
2.C.2 Ferroalloys production – CO2 (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 CH4 totalizing 418.35 kt CO_2eq. Emission reported in the NIR in table 4.4 is 418 kt CO_2 eq and these number are consistent.	FCCC/ARR/2022/ISL/I.2	Implemented.		Chapter 4
2.D.2 Paraffin wax use – CO2 (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/2022/ISL/I.3	Implemented.		Chapter 4.5.2

10.5.3 Agriculture (CRT Sector 3)

For the 2025 submission the calculations were updated to the 2019 IPCC Refinements methodology wherever possible. The 2019 IPCC Refinements are now applied in the 3A and 3B subsectors, where Tier 1 methodology and corresponding emission factors are used for emission calculations. Plans are underway to collect the necessary data and information to evaluate how to incorporate the 2019 Refinements into the calculations where Tier 2 methodology is applied in 3A and 3B, as well as for all calculations in 3D Agricultural Soils.

Research was launched in the end of 2024 with the aim to establish country specific B_0 and methane conversion factors (MCFs) from slurry and pit storage in cattle and sheep farming. Results, expected in 2026, will be incorporated in the 2027 submission.

Preliminary steps will be undertaken to define a country specific FracLeachMS based on a 2021 UNFCCC review recommendation. Furthermore, the activity data on CAN fertilisers is expected to improve over the next few years, as more detailed data recording is planned.

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) - CH4 and N2O (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 5.2.1.1
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 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	FCCC/ARR/ 2022/ISL/A. 2	Implemented. Explanations of horse population numbers have been improved in chapter 5.2.1 and a footnote has been added to Table 5.8.		Chapter 5.2.1 and Chapter 5.2.1.1

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-impleme ntation	Chapter/ Section in the NIR
	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.		Furthermore, a detailed explanation on the calculation of of the foal population has been added to chapter 5.2.1.1.		
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 5.2.1.1.		Chapter 5.2.1.1
3.A.1 Cattle - CH4 (A.8, 2021) (A.30, 2019) Accuracy	Justify the appropriateness of the current parameters and/or update the input parameters and consequently the CH4 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 have been updated for this submission.		Chapter 5.2.2
3.A.1 Cattle - CH4 (A.11, 2021) (A.33, 2019) Transparency	Revise the explanation of CH4 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 CH4 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 CH4 IEF is between the default IPCC Range (90-128 kg CH4/head/year) for the entire time series.	FCCC/ARR/ 2022/ISL/A. 5	Implemented. The Cfi value is included in Table 5.16.		Chapter 5.2.2
3.D Direct and indirect N2O emissions from agricultural soils - N2O (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 NH3 and NOx 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 NH3 and NOx 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

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 – N2O (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 volatised 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/ 2022/ISL/A. 7	Implemented. The Nitrogen fluxes are demonstated in Figure 5.3.		Chapter 5.2
3.F Field burning of agricultural residues – CH4 and N2O (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/ 2022/ISL/A. 8	Implemented. Detailed information on the non-occurrence has been included in the NIR.		Chapter 5.10
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 CO_2 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 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	FCCC/ARR/ 2022/ISL/A. 9	Implemented. The notation key has been corrected.		Chapter 5.11

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	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 5.11
3.D.a.6 Cultivation of organic soils (i.e. histosols) – N2O	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. An explanation of the difference in areas has been added to the NIR.		Chapter 5.7.2.6

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-impleme ntation	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 5.11

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. As mentioned before improvements in forest inventories will also improve uncertainty estimates both on area and stock changes.

10.5.4.2 Cropland (4B)

Cropland Remaining Cropland:

The map of cultivated land has been improved from last submission. The party will continue with these improvements and expects them to be finished by the 2026 submission.

Land Converted to Cropland:

The category is being revised and the first improvements are included in this submission. The work is expected to be finalized in the 2026 submission.

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 6.26). Improvements in emission estimates for the Grassland and other categories to adopt higher tiers will be included in future submissions.

New map of ditches was released in 2021 and provide new estimates of changes in ditch network. Mapping of ditches is ongoing, now with emphasis on improving the timeseries. Data for dividing the drained area according to soil type drained has been collected for a part of the country. This work is ongoing and is planned to be finished in 2026.

Considering the amount of emissions from this category, it is important to move to higher tier levels in general and define relevant disaggregation to land-use categories and management regimes. That disaggregation is one of the main objectives of the IGLUD project and it is expected that analyses of the data already sampled will enable some steps in that direction.

The largest subcategory of Grassland, Other Grassland, is reported as two units: Grazing Areas and Grassland Without Grazing. Severely degraded soils are widespread in Iceland as a result of extensive erosion over a long period of time. 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 is pending. The processing of the IGLUD field data is expected to provide information connecting degradation severity, grazing intensity, and C-stocks. This data is also expected to enable the relative division of the area degradation and grazing intensity categories, including areas where vegetation is improving and degradation decreasing (Magnússon, et al., 2006).

One component pinpointed in this report is the effect of soil thickening on C-sequestration. The aeolian deposition of sand and dust on soil of Grassland, as well as other land-use categories, causes soil thickening. On vegetated land, this soil addition will accumulate carbon. The deposition rate of aeolian materials of different regions in Iceland has been estimated by Arnalds (2010). The rate and variability of C-sequestration following this deposition is still not estimated. This potential carbon sink needs to be quantified, and its variability mapped (in the latest submission, NA was used to report the changes in pool (Table 6.26). The potential of the soil samples, collected in the IGLUD survey, to estimate this component will be explored.

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 the latest submissions, all drained grasslands are reported under one category, independent of age. Time series for ditches are now planned to be completed in 2026. With that data, possibilities of analysing, finding patterns and then being able to evaluate age in drained grassland will give us a different geographical stamp on how these areas are affected in terms of emission from these areas.

Wetlands below 200 m are classified as being managed due to grazing. Planned improvements of grazing density will improve that mapping, which will most likely lead to a reduction of area of managed land because existing data shows that even below 200m, not all areas of wetlands are impacted by grazing.

Land Converted to Wetlands:

Improvements regarding information on reservoir area and type of land flooded are planned. Efforts will be made to map existing reservoirs but many of them are not included in the present inventory. Introduction of reservoir-specific emission factors for more reservoirs is to be expected as information on land flooded is improved. Compiling information on the ice-free period for individual reservoirs or regions is planned. Applying reservoir specific ice-free periods will decrease the uncertainty of emission estimates. Information on how EFs change with the age of reservoirs is needed, but no plans have been made at present to conduct this research.

The planned revisions of the map of drainage ditches and deducted map layer of drained soils are especially likely to affect the estimate of wetland area.

Mapping of wetland restoration activities is available in printed form, but digitisation of those maps is pending and will be included in the compilation of the IGLUD land-use map, when available.

Separation of regions, soil classes, and drainage categories, as well as adoption of different emission factors is planned.

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 N_2O 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 N_2O 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.

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	Implemented		Chapter 6
4. General (LULUCF) - CO_2, CH4 and N2O (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	Implemented		Chapter 6
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 6
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 regarding the use of the notation key "IE" where areas have been accounted for elsewhere in the 2023 Submission.	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.		Chapter 6

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
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
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 6.4

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
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 6.6.1.2 and 6.6.2.2
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 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.	FCCC/ARR /2022/ISL/ L.9	Resolved in 2022 and 2023 Submission		Chapter 6.6.1.2 and 6.6.2.2

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
4.A Forest land - CO2 (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 6.6.1.2 and 6.6.2.2
4.A.2 Land converted to forest land - CO2 (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 6.6.1.2 and 6.6.2.2
4.A.2 Land converted to forest land - CO2 (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 6.6.1.2 and 6.6.2.2
4.B.1 Cropland remaining cropland - CO2 (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 it 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 6.7.1.2

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 - CO2 (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 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 6.7.1.2
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 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.		Chapter 6

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
			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 – CO2 (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 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		Chapter 6

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
			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 recomendation provided in 2017 should be considered as Resolved.		
4.C Grassland – CO2 (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		Chapter 6

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
			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. 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.		

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
4.C.1 Grassland remaining grassland - CO2 (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.		Chapter 6.8.1.
4.C.1 Grassland remaining grassland - CO2 (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 6.8.1.
4.C.2 Land converted to grassland - CO2 (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	FCCC/ARR /2022/ISL/ L.20	Resolved in 2022 Submission.		Chapter 6.6.2.2 and 6.8.1.1.

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	biomass, litter and soil for all land categories (p. 200, 205, 209, 212, 218, 224, 228, 230 and 235).				
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 the it is working to improve this issue for future submissions.	FCCC/ARR /2022/ISL/ L.21	Not resolved. The Party is working to develop CS methodology only for significant pool which in this case is the Organic soils pool under the CRT subcategory Intact mires - managed.		Chapter 6
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		Chapter 6.9.11
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 6.9.2

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
4.E.2 Land converted to settlements - CO2 (L.28, 2021) (L.20, 2019) (L.12, 2017) (L.14, 2016) (L.14, 2015) Completeness	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 Grassland subcategories converted to Settlements".		Chapter 6
4(I) Direct N2O emissions from N input to managed soils - N2O (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
4(II) Emissions/removals from drainage and rewetting and other management of organic/mineral soils - CH4 (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
4(III) Direct N2O emissions from N	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.	FCCC/ARR /2022/ISL/ L.27	Resolved in the 2022 Submission. Additional information were added in NIR 2022 in section		Chapter 6.7.1.2 and 6.7.2.2

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
mineralization/immobilization - N2O (L.31, 2021) (L.40, 2019) Transparency	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). 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.		6.6.1.2 for Cropland remaining Cropland and in section 6.6.2.2 for Land converted to Cropland.		
4(V) Biomass burning - CO2, CH4 and N2O (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
4(V) Biomass burning - CO2, CH4 and N2O (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 6.17.1
4.A.2 Land converted to forest land - CO2	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 Betula pubescens 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		Chapter 6.6.2.2.

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 - CO2	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	Partially resolved in the 2022 resubmission. Resolved in the 2023 Submission		Chapter 6.6.2.2.
General (KP-LULUCF) - CO2, CH4 and N2O (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/ KL.1	Resolved in the 2022 Submission		Chapter 11.4
General (KP-LULUCF) - CO2, CH4 and N2O (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/ KL.2	Resolved in the 2022 Submission		Chapter 11.5
General (KP-LULUCF) - CO2, CH4 and N2O (KL.3, 2021) (KL.4, 2019)	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	FCCC/ARR /2022/ISL/ KL.3	Resolved in the 2022 Submission		Chapter 11

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
(KL.7, 2017) Transparency	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				
General (KP-LULUCF) - CO2, CH4 and N2O (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/ KL.4	Resolved in the 2022 Submission		Chapter 11.4
AR - CO2, CH4 and N2O (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. Iceland provided additional description of the process by which CSC and associated emissions and removals are estimated. 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/ KL.5	Resolved in the 2022 Submission		Chapter 6.6.1.2 and 6.6.2.2
AR - CO2 (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/ KL.6	Resolved in the 2022 Submission		Chapter 6 and 11
AR - CO2 (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	FCCC/ARR /2022/ISL/ KL.7	Resolved in the 2022 Submission		Chapter 6.6.1.2 and 6.6.2.2

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	Party explained that the separate research projects used to estimate the CS average EF include both introduced tree species and the native Betula pubescens 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.				
Deforestation - CO_2, CH_4 and N_2O (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/KL.8	Resolved in the 2023 Submission. Forest land converted to grassland has never been reported.		Chapter 6 and 11
Deforestation - CO_2 and N_2O (KL.10, 2021) (KL.18, 2019) Completeness	Report the AD, CSC and related N_2O 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 N_2O 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, N_2O 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. 345) 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, 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.	FCCC/ARR/2022/ISL/KL.9	Resolved in the 2022 Submission		Chapter 6 and 11
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	FCCC/ARR/2022/ISL/KL.10	Partially resolved in the 2022 resubmission. Resolved in the 2023 Submission		Chapter 6.6.2.2.

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	for FM during the commitment period (2013-2020) of 6.634 kt CO2 eq. The ERT checked the resubmitted values in CRF table 4(KP-I)B.1 and concluded that the issue is now resolved.				
FM - CO2 (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/ KL.11	Resolved in the 2022 Submission		Chapter 6 and 11
FM - CO2 (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/ KL.12	Resolved in the 2022 Submission		Chapter 6 and 11
FM - CO2 (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 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)."	FCCC/ARR /2022/ISL/ KL.13	Resolved in the 2022 Submission		Chapter 6 and 11
FM - CO2 (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	FCCC/ARR /2022/ISL/ KL.14	Resolved in the 2022 resubmission		Chapter 11.5.3

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	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.				
RV - CO2 (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 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	FCCC/ARR /2022/ISL/ KL.15	Resolved in the 2022 resubmission		Chapter 6 and 11

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	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/ KL.16	Resolved in the 2022 Submission		Chapter 11.6
Direct and indirect N2O emissions from N fertilization - N2O	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	FCCC/ARR /2022/ISL/ KL.17	Resolved in the 2022 resubmission		Chapter 6 and 11

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	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).				
FM - CO2, N2O, CH4	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 (-19.941 kt CO2e/ 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.	FCCC/ARR /2022/ISL/ KL.18	Resolved in the 2022 resubmission		Chapter 6 and 11
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/ KL.19	Resolved in the 2022 resubmission		Chapter 6 and 11

10.5.5 Waste (CRT Sector 5)

The inconsistency between the reporting of landfill gas, between the Energy and the Waste sectors were partially fixed for the 2025 submission. The remaining issues 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 Industrial Wastewater category is currently only calculated for fish processing on land. Effort was put into adding the other major industries in Iceland to the inventory. The missing data was mapped out for various industries for the whole times series. However, collecting the missing data was too large a project to finish for the 2025 submission. This project is expected to take a few years.

Comments and suggestions received during the 2023 reviews have been partially addressed, mainly with better explanations in the NID waste chapter and will be tackled further in future submissions.

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 - CH4 (W.1, 2021) (W.12, 2019) Transparency	Document and provide in the NIR all the parameters used in the estimation of CH4 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/ARR/2022/ISL/W.1	Implemented.		Chapter 7.2 and Annex 7
5.A Solid waste disposal on land - CH4 (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/ARR/2022/ISL/W.2	Implemented.		Chapter 7.2
5.A Solid waste disposal on land - CH4 (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/ARR/2022/ISL/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, 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	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
				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 – CO2, CH4 and N2O (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 investigating 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/ARR/2022/ISL/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 – CH4 and N2O (W.8, 2021) Convention reporting adherence	(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 7.10, 14 kt dm. The party also continues to report the CH4 and N2O EFs in wet weight in the NIR table 7.12 (p. 266), i.e 4 g CH4/kg waste and 0.24 g N2O/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	FCCC/ARR/2022/ISL/W.5	Resolved in the 2023 Submission.		Chapter 7.3

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
	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 - CH4 and N2O (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 N2O 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 - CH4 and N2O (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 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."	FCCC/AR R/2022/I SL/W.7	Implemented.		Chapter 7.5
5.D Wastewater treatment and discharge - CH4 and	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	FCCC/AR R/2022/I SL/W.8	Resolved for the 2024 submissions. Now the total population equivalents used to calculate wastewater emissions is adjusted to		Chapter 7

CRF Category/Issue	Review Recommendation	Review Report/ Paragraph	MS Response / Status of Implementation	Reason for Non-implementation	Chapter/ Section in the NIR
N2O (W.9, 2021) Completeness	of a category or subcategory in accordance with footnote 7 of the UNFCCC Annex I reporting guidelines.		include overnight stays from foreign nationals.		
5.D Wastewater treatment and discharge - NOX, CO, NMVOCs (W.10, 2021) Transparency	Update the notation key to “NA” for NOX 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 NOX 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 NOx 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 arty did not provide in CRF table 9 the reasons for reporting “NE” for NMVOCs under domestic and industrial wastewater.	FCCC/ARR/2022/ISL/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

National (all 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"

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 Icelands accounting of greenhouse gas emissions and carbon sequestration from the atmosphere"

Other

Alm, J., Saario, S., Nykänen, H., Silvola, J., & Martikainen, P. J. (1999). Winter CO2, CH4, and N2O fluxes on some natural and drained boreal peatlands. *Biogeochemistry, 44*, 163-186.

Alþingi. (2019). *Lög um skóga og skógrækt.* Alþingi. Alþingi. Retrieved January 10, 2020, from https://www.althingi.is/lagas/149c/2019033.html

Aradóttir, Ó., Svavarsdóttir, K., Jónsson, T., & Guðbergsson, G. (2000). Carbon accumulation in vegetation and soils by reclamation of degraded areas. *Icelandic Agricultural Science, 13*, 99-113.

Arnalds, O. (2015). Vegetation and Ecosystems. In *The Soils of Iceland. World Soils Book Series.* Dordrecht: Springer. doi:https://doi.org/10.1007/978-94-017-9621-7_4

Arnalds, O., Gudmundsson, J., Oskarsson, H., Brink, S. H., & Gísladóttir, F. O. (2016). Icelandic Inland Wetlands: Characteristics and Extent of Draining. *Wetlands, 36*, 759-769. doi:https://doi.org/10.1007/s13157-016-0784-1

Arnalds, O., Orradottir, B., & Aradottir, A. (2013). Carbon accumulation in Icelandic desert Andosols during early stages of restoration. *Geodema*, 172-179.

Arnalds, Ó. (2010). Dust sources and deposition of aeolian materials in Iceland. *Icelandic Agricultural Science, 23*, 3-21.

Arnalds, Ó., & Óskarsson, H. (2009). Íslenskt Jarðvegskort. *Náttúrufræðingurinn, 78*(3-4), 107-121.

Arnalds, Ó., Óskarsson, H., Gísladóttir, F., & Grétarsson, E. (2009). Íslenskt Jarðvegskort. Landbúnaðarháskóli Íslands.

ASHRAE. (1992). *Standard 34-1992 Number Designation and Safety Classification of Refrigerants.* ATLANTA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, INC. Retrieved 2019, from ashrae.iwrapper.com/ViewOnline/Standard_34-1992

Auðunsson, G. A. (2006). *Summary and evaluation of environmental impact studies on the recipient of sewage from the STP at Ánanaust, Reykjavík.* Work for Reykjavík Energy (Orkuveita Reikjavíkur).

Auðunsson, G. A. (2009). *Viðtaki fráveituvatns frá Borgarnesi. Greinargerð vegna skilgreiningar.* Work for Reykjavík Energy (Orkuveita Reykjavíkur).

Auðunsson, G. A. (2015). *Viðtakarannsóknir 2011: Setgildrur, kræklingur og sjór.* Work for Reykjavík Energy (Orkuveitu Reykjavíkur). Retrieved from https://reykjavik.is/sites/default/files/vidtakaskyrsla_samsett_2015.pdf

Baldvinsson, Í., Þórisdóttir, Þ. H., & Ketilsson, J. (2011). *Gaslosun jarðvarmavirkjana á Íslandi 1970-2009.* Orkustofnun.

Bjarnadóttir B., A. S. (2021). Carbon and water balance of an afforested shallow drained peatland in Iceland. *Forest Ecology and Management*, 118861. Retrieved from http://www.sciencedirect.com/science/article/pii/S0378112720316303

Bjarnadóttir, B. (2009). Carbon stocks and fluxes in a young Siberian larch (Larix sibirica) plantation in Iceland. 62. Lund, Sweden: Lunds Universitet.

Brynleifsdóttir, S. J., & Jóhannsdóttir, Þ. (2021). Skógræktarárið 2020. *Skógræktarritið 2021*, 85-95.

Carbon Recycling International. (2018). *Carbon Recycling International*. Retrieved from https://www.carbonrecycling.is/

Dalsgaard, L., Astrup, R., Antón-Fernández, C., Kynding Borgen, S., Breidenbach, J., Lange, H., . . . Liski, J. (2016). Modeling Soil Carbon Dynamics in Northern Forests: Effects of Spatial and Temporal Aggregation of Climatic Input Data. *PLoS ONE, 11*(2), 22. Retrieved from https://doi.org/10.1371/journal.pone.0149902

Dämmgen, U., Amon, B., Gyldenkærne, S., Hutchings, N., Kleine Klausing, H., Haenel, H.-D., & Rösemann, C. (2011). Reassessment of the calculation procedure for the volatile solids excretion rates of cattle and pigs in the Austrian, Danish and German agricultural emission inventories. *Agriculture and Forestry Research 2, 61*, 115-126.

Danish Centre for Environment and Energy. (2018). *Denmark's National Inventory Report 2018. Emission Inventories 1990-2016.* Aarhus University, Danish Centre for Environment and Energy. Danish Centre for Environment and Energy. Retrieved from https://dce2.au.dk/pub/SR272.pdf

EAI. (2022). *Stöðuskýrsla fráveitumála 2020.* Reykjavík: The Environment Agency of Iceland.

EEA. (2019). *EMEP/EEA air pollutant emission inventory guidebook - 2019.* European Environment Agency.

EEA. (2023). *EMEP/EEA Air Pollutant Emission Inventory Guidebook - 2019.* European Environment Agency.

EEA. (2023). *EMEP/EEA air pollutant emission inventory guidebook - 2023.* European Environment Agency.

EEA. (2023). *EMEP/EEA air pollutant emission inventory guidebook - 2023.* European Environment Agency.

Elefsen, S., & Brynleifsdóttir, S. (2020). *Skógræktarritið 2020 1.: Skógræktarárið 2018.*

Embætti Landlæknis. (1990). *Könnun á mataræði Íslendinga.* Rannsóknir manneldisráðs Íslands III.

Embætti Landlæknis. (2002). *Hvað borða Íslendingar? Könnun á mataræði Íslendinga 2002.* Rannsóknir Manneldisráðs Íslands.

Embætti Landlæknis. (2011). *Hvað borða Íslendingar? Könnun á mataræði Íslendinga 2010-2011.* Embætti Landlæknis, Matvælastofnun og Rannsóknarstofa í næringarfræði.

Embætti landlæknis. (2022). *Hvað borða Íslendingar? Könnun á mataræði Íslendinga 2019-2021.* Embættis landlæknis og Rannsóknastofa í næringarfræði.

Embætti Landlæknis. (2022). *Könnun á mataræði Íslendinga 2019–2021.* Reykjavík: Embætti landlæknis. Retrieved from https://www.landlaeknir.is/servlet/file/store93/item49171/Hvadbordaislendingar_vefur_lok.pdf

FAO. (2011). *Global Food Losses and Food Waste - Extent, causes and prevention.* Rome: Food and Agriculture Organization of the United Nations. Retrieved from https://www.fao.org/3/i2697e/i2697e.pdf

Fridriksson Th, M. A. (2016). *Greenhouse gases from geothermal power production.* Energy Sector Managment Assistance Program, The World Bank.

Gísladóttir, F. Ó., Metúsalemsson, S., & Óskarsson, H. (2007). Áhrifasvæði skurða: Greining með fjarkönnunaraðferðum. *Fræðaþing landbúnaðarins.* Reykjavík.

Guðmundsson, J. (2009). *Vísinda og tæknilega lokaskýrsla: Verkefni: Losun hláturgass og annarra gróðurhúsalofttegunda úr lífrænum jarðvegi við msimunandi landnotkun.* Hvanneyri: Landbúnaðarháskóli Ísland.

Guðmundsson, J. (2016). *Greining á losun gróðurhúsalofttegunda frá íslenskum landbúnaði.* Ministry for the Environment and Natural Resources. Retrieved from https://www.umhverfisraduneyti.is/media/PDF_skrar/Greining-a-losun-grodurhusa-vegna-landbunadar_161012JG_okt.pdf

Guðmundsson, J., & Óskarsson, H. (2014). Carbon dioxide emission from drained organic soils in West-Iceland. *Soil carbon sequestration for climate food security and ecosystem services* (pp. 155-159). Reykjavík: JRC Science and Policy Report.

Guðmundsson, J., Brink, S. H., & Gísladóttir, F. (2013). Preparation of a LULUCF land-use map for Iceland: Developement of the Grassland layer and subcategories. *Grassland Science in Europe*, 105-108.

Guðmundsson, J., Gísladóttir, F. Ó., Brink, S. H., & Óskarsson, H. (2010). The Icelandic Geographic Land Use Database (IGLUD). *Mapping and monitoring of Nordic Vegetation and landscapes.* Hveragerði: Norsk Insitute for Skog og landskap.

Guðmundsson, J., Óskarsson, H., Jansen, E., Kristinsson, S. Þ., Kjeld, A., & Gíslason, E. M. (2024). Low nitrous oxide fluxes from mineral affected peatland soils in Iceland. *Agriculture, Ecosystems & Environment, 376*, 109247.

Guðmundsson, Ó. (1987). *Átgeta búfjár og nýting beitar.* Ráðunautafundur 1987.

Guðmundsson, Ó., & Eiríksson, T. (1995). Breyting á orkumatskerfi fyrir jórturdýr. *Ráðunautafundur*, (pp. 39-45).

Gunnarsdóttir, I., Eysteindsdóttir, T., & Þórsdóttir, I. (2008). *Hvað borða íslensk börn á leikskólaaldri? Könnun á mataræði 3ja og 5ára barna 2007.* Research institute on nutrition - Rannsóknastofa í næringafræði. Retrieved from www.landlaeknir.is: http://www.landlaeknir.is/servlet/file/store93/item14897/version2/3ja_og_5_ara_skyrsla_181208.pdf

Gunnarsson, E. (2010). Skógræktarárið 2009. *Skógræktarritið 2010, 2*, 90-95.

Gunnarsson, E. (2011). Skógræktarárið 2010. *Skógræktarritið 2011, 2*, 96-101.

Gunnarsson, E. (2012). Skógræktarárið 2011. *Skógræktarritið 2012, 2*, 90-95.

Gunnarsson, E. (2013). Skógræktarárið 2012. *Skógræktarritið 2013, 2*, 84-89.

Gunnarsson, E. (2014). Skógræktarárið 2013. *Skógræktarritið 2014*, 88-91.

Gunnarsson, E. (2015). Skógræktarárið 2014. *Skógræktarritið 2015*.

Gunnarsson, E. (2016). Skógræktarárið 2015. *Skógræktarritið, 2*, 91-99.

Gunnarsson, E., & Brynleifsdóttir, S. (2017). Skógræktarárið 2016. *Skógræktarritið*(2), 86-96.

Gunnarsson, E., & Brynleifsdóttir, S. (2019). Skógræktarárið 2017. *Skógræktarritið*, 113-122.

Hagstofa Íslands (Statistics Iceland). (1997). *Hagskinna.* Reykjavík: Hagstofa Íslands.

Hararuk, O., Kurz, W. A., & Didion, M. (2020). Dynamics of dead wood decay in Swiss forests. *Forest Ecosystems*, 36. doi:10.1186/s40663-020-00248-x

Harðarson, G., Þórkelsson, E., & Sveinbjörnsson, J. (2007). *Uppeldi kálfa: Áhrif kjarnfóðurs með mismiklu tréni á vöxt og heilbrigði kálfa.* Fræðaþing landbúnaðarins 2007.

Helgason, A., Þórðarson, S., & Eiríksson, Þ. (2002). *Athugun á skólpmengun við sjö þéttbýlisstaði.* . Náttúrustofa Vestfjarða.

Helgason, B. (1975). Breytingar á jarðvegi af völdum ólíkra tegunda köfnunarefnisáburðar. Samanburður þriggja tegunda köfnunarefnisáburðar. *Íslenskar landbúnaðarrannsóknir, 7*(1-2), 11.

IAAC. (2022). *Agricultural Data for the Icelandic National Inventory Report.* Reykjavik: The Icelandic Agricultural Advisory Centre.

Icelandic Recycling Fund - Úrvinnslusjóður. (2018). *Annual report - Ársskýrsla 2016*. Retrieved from http://www.urvinnslusjodur.is/media/arsskyrslur/Arsskyrsla-2016.pdf

IPCC. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories.* (H. Eggleston, L. Buendia, K. Miwa, T. Ngara, & K. Tanabe, Eds.) IGES, Japan. Retrieved from 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

IPCC. (2006). *IPCC Guidelines for National Greehouse Gas Inventories. Volume 4: Agriculture, Forestry and Other Land Use (AFOLU).* Hayama: Institute for Global Environmental Strategies.

IPCC. (2014). *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol.* (T. Hiraishi, T. Krug, K. Tanabe, N. Srivastava, J. Baasansuren, M. Fukuda, & T. Troxler, Eds.) IPCC, Switzerland.

IPCC. (2014). *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands.* (T. Hiraishi, T. Krug, K. Tanabe, N. Srivastava, J. Baasansuren, M. Fukuda, & T. Troxler, Eds.) IPCC, Switzerland.

Jóhannesdóttir Þ., B. S. (2020). *Skógræktarritið 2020 2.: Skógræktarárið 2019.*

Jóhannsdóttir Þ., B. S. (2020). *Skógræktarritið 2020 2.: Skógræktarárið 2019.*

Jóhannsdóttir, Jóhannesdóttir, & Snorrason. (2024). Skógræktarárið 2023. *Skógræktarritið 2023 2.tbl.*

Jóhannsdóttir, Þ., Jóhannesdóttir, H., & Snorrason, A. (2023). Skógræktarárið 2022. *Skógræktarritið*(2), 89-105.

Jóhannsson, M. H., & Valdimarsdóttir, A. S. (2022). *Seyra til uppgræðslu á Hrunamannaafrétti 2012-2022.*

Jón Guðmundsson, H. Ó. (2024). Low nitrous oxide fluxes from mineral affected peatland soils in Iceland. *Agriculture, Ecosystems and Environment*, 1-14.

Jónsdóttir, S., & Jóhannsson, M. H. (2016). *Seyra til uppgræðslu á Hrunamannaafrét.* Hella: Landgræðsla ríkisins.

Jónsson, J. Á., Gunnarsson, F. K., Skúladóttir, S. S., & Árnason, B. (2020). *Hreinsistöð fráveitu á Selfossi. Matsskýrsla.* Árborg municipality.

Jónsson, T. H. (2004). Stature of Sub-arctic Birch in Relation to Growth Rate, Lifespan and Tree Form. *Annals of Botany, 94*, 753-762.

Jónsson, T. H., & Snorrason, A. (2018). Single tree aboveground biomass models for native birch in Iceland. *Icelandic Agricultural Sciences*, 65-80.

Júlíusson, A. G. (2011). *Hauggasrannsóknir á urðunarstöðum á Íslandi.* M.Sc. Thesis, Umhverfis- og byggingarverkfræðideild, University of Iceland.

Kamsma, R., & Meyles, C. (2003). *Landfill Gas Formation in Iceland.* Environmental and Food Agency.

Klemedtsson, L., Klemedtsson A., K., Escala, M., & Kulmala, A. (1999). Inventory of N2O emission from farmed European peatlands. In *Freibauer, A. and Kaltschmitt, M. (eds.), Approaches to Greenhouse Gas Inventories of Biogenic Sources in Agriculture* (pp. 79-91). Proc. Workshop at Lökeberg, Sweden, 9-10 July 1998.

Klemedtsson, L., Von Arnold, K., Weslien, P., & Gundersen, P. (2005). Soil CN ratio as a scalar parameter to predict nitrous oxide emissions. *Global Change Biology, 11*(7), 1142–1147. doi:https://doi.org/10.1111/j.1365-2486.2005.00973.x

Kolka-Jónsson. (2011). *CarbBirch (Kolbjörk): Carbon sequestration and soil development under mountain birch (Betula pubescens) in rehabilitated areas in southern Iceland.* Ohio State University.

Kristofersson, D. M., Eythorsdottir, E., Harðarson, G. H., & Jonsson, M. B. (2007). Samanburður á rekstrarhagkvæmni mjólkurframleiðslu með íslenskum kúm og fjórum erlendum kúakynjum – niðurstöður starfshóps. *Rit Lbhí 15*, 58.

Laine, J., Silvola, J., Tolonen, K., Alm, J., Nykänen, H., Vasander, H., . . . Martikainen, P. (1996). Effect of water-level drawdown on global climatic warming--northern peatlands. *Ambio, 25*, 179-184.

Liimatainen, M., Voigt, C., Martikainen, P. J., Hytönen, J., Regina, K., Óskarsson, H., & Maljanen, M. (2018). Factors controlling nitrous oxide emissions from managed northern peat soils with low carbon to nitrogen ratio. *Soil Biology and Biochemistry, 122*, 186-195. doi:https://doi.org/10.1016/j.soilbio.2018.04.006

Lillesand, T., Kiefer, R., & Chipmann, J. (2004). *Remote Sensing and Image Interpretation.* Wiley.

Linke, T., & Gislason, S. R. (2018). Stability of iron minerals in Icelandic peat areas and transport of heavy metals and nutrients across oxidation and salinity gradients - A modelling approach. *Energy Procedia, 146*, 30-37. doi:https://doi.org/10.1016/j.egypro.2018.07.005

Magnússon, B., Barkarson, B., Guðleifsson, B., Maronsson, B., Heiðmarsson, S., Guðmundsson, G., . . . Jónsdóttir, S. (2006). Vöktun á ástandi og líffræðilegri fjölbreytni úthaga 2005. *Fræðaþing Landbúnaðarins.* Reykjavík.

Martikainen, P., Nykänen, H., Alm, J., & Silvola, J. (1995). Change in fluxes of carbon dioxide, methane, and nitrous oxide due to forest drainage of mire sites of different trophy. *Plant and Soil, 169*, 571-577.

Matter, J., Stute, M., Snæbjörnsdottir, S., Oelkers, E., Gislason, S., Aradottir, E., . . . Broecker, W. (2016). Rapid carbon mineralization for permanent disposal of anthropogenic carbon dioxide emissions. *Science, 352*(6291), 1312-1314.

McFarland, M. (2000). *Biosolids Engineering.* New York: McGrawHill.

Ministry for the Environment (Umhverfisráðuneytið). (2007). *Vernd og endurheimt íslenskra birkiskóga. Skýrsla og tillögur nefndar.* Reykjavík: Umhverfisráðuneytið.

Minkkinen, K., Korhonen, R., S. I., & Laine, J. (2002). Carbon balance and radiative forcing of Finnish peatlands 1990-2100 the impact of forestry drainage. *Global Change Biology, 8*, 785-799.

Molta. (2020). *molta.is*. Retrieved from molta.is/naeringarinnihald-kraftmoltu

Orkustofnun. (2019). *Primary Energy Use in Iceland 1940-2018.* Reykjavík: Orkustofnun. Retrieved from https://orkustofnun.is/gogn/Talnaefni/OS-2018-T009-01.pdf

Ottósson, J. G., Sveinsdóttir, A., & Harðardóttir, M. (2016). Vistgerðir í Íslandi. *Fjölrit Náttúrufræðistofnunar, 54*, 299.

Owona, J. C. (2019). Changes in carbon-stock and soil properties following afforestation in SW Iceland. 97. Agricultural University of Iceland. Retrieved from https://skemman.is/bitstream/1946/34470/1/Joel%27s%20thesis_%20AUI_final.pdf

Óskarsson, H. (1998). Wetland draining in Western Iceland. In J. Ólafsson (Ed.), *Icelandic Wetlands: exploitation and conservation* (pp. 121-129). University of Iceland Press.

Óskarsson, H., & Guðmundsson, J. (2001). *Mat á gróðurhúsaáhrifum fyrirhugaðs Hálslóns.* RALA. Reykjavík: Landsvirkjun.

Óskarsson, H., & Guðmundsson, J. (2008). *Gróðurhúsaáhrif uppistöðulóna; Rannsóknir við Gilsárlón 2003-2006.* Reykjavík: Landsvirkjun.

Petersen, G. N., & Berber, D. (2018). *Jarðvegshitamælingar á Íslandi Staða núverandi kerfis og framtíðarsýn.* Icelandic Meteorological Office (Veðurstofa Íslands).

Petersen, G. N., & Berber, D. (2018). *Jarðvegshitamælingar á Íslandi: Staða núverandi kerfis og framtíðarsýn.* Icelandic Meteorological Office (Veðurstofa Íslands).

Regina, K., Nykänen, H., Silvola, J., & Martikainen, P. (1996). Fluxes of nitrous oxide from boreal peatlands as affected by peatland type, water table level and nitrification capacity. *Biogeochemistry, 35*, 401-418.

Schwarz, W., Gschrey, B., Leisewitz, A., Herold, A., Gores, S., Papst, I., . . . Lindborg, A. (2012). *Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases.* European Union.

Sigurdsson, B., & Snorrason, A. (2000). Carbon sequestration by afforestation and revegetation as a means of limiting net-CO2 emissions in Iceland. *Biotechnologie, Agronomie Société et Environnement, 4*(4), 303-307.

Sigurðsson, B., Elmarsdóttir, Á., Bjarnadóttir, B., & Magnússon, B. (2008). Mælingar á kolefnisbindingu mismunandi skógargerða. *Fræðaþing Landbúnaðarins*, (pp. 301-308). Reykjavík.

Sigurðsson, B., Magnússon, B., Elmarsdóttir, A., & Bjarnadóttir, B. (2005). Biomass and composition of understory vegetation and the forest floor carbon stock across Siberian larch and mountain birch chronosequences in Iceland. *Annals of Forest Sciences, 62*(8), 881-888.

Skógræktin, & Skipulagsstofnun. (2017). *Skógrækt í skipulagsáætlunum sveitarfélaga II útgáfa. 2017.* Retrieved from http://www.skogur.is/media/ymislegt/Skograektogskipurlag_2017_lores.pdf

Snorrason, A. (2010). National Forest Inventories reports: Iceland. In E. G. Tomppo, *National Forest Inventories - Pathways for Common Reporting.* Springer.

Snorrason, A. (2011). *Prediction of Reference Level for the Period 2013-2020 for Forest Management in Iceland.* Reykjavík: Icelandic Forest Research. Retrieved from https://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/awgkp_iceland_2011.pdf

Snorrason, A., & Einarsson, S. (2006). Single-tree biomass and stem volume functions for eleven tree species used in Icelandic forestry. *Icelandic Agricultural Sciences*, 15-24.

Snorrason, A., & Kjartansson, B. (2004). Towards a general woodland and forestry inventory for Iceland.

Snorrason, A., Brynleifsdóttir, S., & Jóhannsdóttir, Þ. (2022). Skógræktarárið 2021. *Skógræktarritið*(2), 101-112.

Snorrason, A., Jónsson, Þ. H., & Eggertsson, Ó. (2019). Aboveground woody biomass of natural birch woodland in Iceland – Comparison of two inventories 1987-1988 and 2005-2011. *Icelandic Agricultural Sciences*, 21-29. doi:doi.org/10.16886/IAS.2019.03

Snorrason, A., Jónsson, Þ., Svavarsdóttir, K., Guðbergsson, G., & Traustason, T. (2000). Rannsóknir á kolefnisbindingu ræktaðra skóga á Íslandi. *Ársrit Skógræktarfélags Íslands*(1), 71-89.

Snorrason, A., Kjartansson, B. Þ., & Traustason, B. (2020). *Forest Reference Level 2021-2025: Iceland National forestry accounting plan.* Icelandic Forest Service, Icelandic Forest Research. Reykjavík: Icelandic Forest Service. Retrieved from https://www.skogur.is/static/files/utgafa/nfap_iceland_october_2020.pdf

Snorrason, A., Sigurðsson, B., Guðbergsson, G., Svavarsdóttir, K., & Jónsson, Þ. (2002). Carbon sequestration in forest plantations in Iceland. *Icelandic Agricultural Sciences, 15*, 81-93.

Snorrason, A., Traustason, B., Kjartansson, B., Heiðarsson, L., Ísleifsson, R., & Eggertsson, Ó. (2016). Náttúrulegt birki á Íslandi - ný úttekt á útbreiðslu þess og ástandi. *Náttúrufræðingurinn, 86*(3-4), 37-51.

Snæbjörnsson, A., Hjartardóttir, D., Blöndal, E., Pétursson, J., Eggertsson, Ó., & Halldórsson, Þ. (2010). *Skýrsla nefndar um landnotkun. Athugun á notkun og varðveislu ræktanlegs lands.* Reykjavík: Sjávarútvegs- og landbúnaðarráðuneytið.

Statistics Iceland. (2019). *Hagstofa Íslands*. Retrieved from http://px.hagstofa.is/pxis/pxweb/is

Statistics Iceland. (2020). *Úrgangstölfræði*. Retrieved from https://hagstofa.is/talnaefni/umhverfi/efnisflaedi/urgangur/

Statistics Iceland. (2024). *Hagstofa Íslands*. Retrieved from http://px.hagstofa.is/pxis/pxweb/is

Statistics Norway. (2019). *Nationa Inventory report.* Statistics Norway.

Stefánsdóttir, G. (2015). *Physiological response to exercise in the Icelandic horse.*

Steingrímsdóttir, L., Þorgeirsdóttir, H., & Ólafsdóttir, A. (2002). *Hvað borða Íslandingar? Könnun á mataræði Íslendinga.* Icelandic Director of healt report. Retrieved from https://www.landlaeknir.is/servlet/file/store93/item11603/skyrsla.pdf

Sveinbjörnsson, J. (2013). Fóðrun og fóðurþarfir sauðfjár. In *Sauðfjárrækt á Íslandi.* Uppheimar.

Sveinbjörnsson, J. (2013). Fóðuröflun og beit á ræktað land. In *Sauðfjárrækt á Íslandi.* Uppheimar.

Sveinbjörnsson, J., & Harðarson, G. (2008). *Þungi og átgeta íslenskra mjólkurkúa.* Fræðaþing landbúnaðarins.

Sveinbjörnsson, J., & Ólafsson, B. L. (1999). *Orkuþarfir sauðfjár og nautgripa í vexti með hliðsjón af mjólkurfóðureiningakerfi.* Ráðunautafundur 1999.

Sveinbjörnsson, J., Eyþórsdóttir, E., & Örnóflsson, E. K. (2018). "Misjafn er sauður í mörgu fé" greining á áhrifaþáttum haustþunga lamba í gagnasafni Hestbúsins 2002-2013. *Rit LbhÍ*.

Sveinsdóttir, H. E., & Dýrmundsson, O. R. (1994). The Icelandic goat breed. *Icel. Agric. Sci.*, 93-97.

Thordarson, T., & Höskuldsson, Á. (2002). *Iceland* (4th ed.). Edinburgh: Dunedin Academic Press.

Thordarson, T., & Larsen, G. (2007). Volcanism in Iceland in historical time: Volcano types, eruption styles and eruptive history. *Journal of Geodynamics, 43*(1), 118-152. doi:https://doi.org/10.1016/j.jog.2006.09.005

Thorsteinsson, S., & Thorgeirsson, S. (1989). Winterfeeding, housing and management. In *Reproduction, nutrition and growth in sheep* (pp. 113-145). Iceland: Agricultural Research Institute and Agricultural Society.

Traustason, B., & Snorrason, A. (2008). Spatial distribution of forests and woodlands in Iceland in accordance with the CORINE land cover classification. *Icelandic Agricultural Sciences, 21*, 39-47.

Volden, H. (Ed.). (2011). *NorFor- the Nordic feed evaluation system. EAAP publication no. 130.* Wageningen Academic Publishers.

Wang, M., Hu, R., Zhao, J., Kuzyakov, Y., & Liu, S. (2016). Iron oxidation affects nitrous oxide emissions via donating electrons to denitrification in paddy soils. *Geoderma, 271*, 173–180. doi:https://doi.org/10.1016/j.geoderma.2016.02.022

Þorgeirsdóttir, H., Valgeirsdóttir, H., Gunnarsdóttir, I., Gísladóttir, E., Gunnarsdóttir, B. E., Þórsdóttir, I., . . . Steingrímsdóttir, L. (2012). *Hvað borða Íslendingar? Könnun á mataræði Íslendinga 2010-2011.* Icelandic directorate of Health. Retrieved from https://www.landlaeknir.is/servlet/file/store93/item14901/Hva

Þorvaldsson, G. (1994). Gróðurfar og nýting túna. *Fjölrit RALA*, 3-28.

Þórsdóttir, I., & Gunnarsdóttir, I. (2006). *Hvað borða íslensk börn og unglingar? Könnun á mataræði og 15 ára barna og unglinga 2003-2004. [The Diet of Icelandic 9- and 15-year-old children and adolescents]*. Rannsóknastofa í næringarfræði við Háskóla Íslands og Landspítla-Háskólasjúkrahús & Lýðheilsustöð.

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, 2023 level and 1990-2023 trend assessment without LULUCF, and Table A1.4, A1.5, and A1.6 show the 1990 level, 2023 level and 1990-2023 trend assessment with LULUCF. All categories are listed in decreasing order of level or trend % contribution. All emission figures are reported in kt CO_2e, with CO_2 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 CO_2e].

IPCC Code	IPCC Category	Gas	1990 Emissions [kt CO_2e]	Level Assessment [%]	Cumulative Total of Level [%]
1A4c	Agriculture/Forestry/Fishing	CO_2	794.9	21.44%	21.4%
1A3b	Road Transport	CO_2	519.8	14.02%	35.5%
2C3	Metal Production: Aluminium	PFC	444.8	12.00%	47.5%
1A2	Manufacturing and Construction	CO_2	298.9	8.06%	55.5%
3D1	Agricultural Soils	N_2O	249.5	6.73%	62.3%
3A2	Enteric Fermentation: Sheep	CH_4	209.4	5.65%	67.9%
2C2	Metal Production: Ferroalloys	CO_2	208.8	5.63%	73.5%
5A2	Unmanaged Waste Disposal Sites	CH_4	153.6	4.14%	77.7%
3A1	Enteric Fermentation: Cattle	CH_4	140.2	3.78%	81.5%
2C3	Metal Production: Aluminium	CO_2	139.2	3.75%	85.2%
1B2d	Fugitive Emissions	CO_2	61.4	1.65%	86.9%
2A1	Mineral Products: Cement	CO_2	51.6	1.39%	88.3%
3B1	Manure Management: Cattle	CH_4	47.3	1.28%	89.5%
2B10	Other	N_2O	41.3	1.12%	90.7%
3D2	Agricultural Soils: Indirect	N_2O	35.8	0.967%	91.6%
1A3a	Domestic Aviation	CO_2	33.3	0.899%	92.5%
1A3d	Domestic Navigation	CO_2	32.6	0.879%	93.4%
1A4b	Residential Stationary	CO_2	27.9	0.754%	94.2%
3A4	Enteric Fermentation: Other	CH_4	27.7	0.747%	94.9%
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH_4	18.9	0.509%	95.4%

Table A1.2 Key category analysis approach 1 level for 2023, excluding LULUCF, [kt CO_2e].

IPCC code	IPCC category	Gas	2023 Emissions [kt CO_2e]	Level Assessment [%]	Cumulative Total of Level [%]
2C3	Metal Production: Aluminium	CO_2	1334.6	28.72%	28.72%
1A3b	Road Transport	CO_2	913.4	19.66%	48.38%
1A4c	Agriculture/Forestry/Fishing	CO_2	500.5	10.77%	59.16%
2C2	Metal Production: Ferroalloys	CO_2	404.4	8.70%	67.86%
3D1	Agricultural Soils: Direct	N_2O	287.8	6.19%	74.05%
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH_4	184.3	3.97%	78.02%
1B2d	Fugitive Emissions	CO_2	172.2	3.71%	81.73%
3A1	Enteric Fermentation: Cattle	CH_4	138.7	2.98%	84.71%
3A2	Enteric Fermentation: Sheep	CH_4	130.0	2.80%	87.51%
2F1	Refrigeration and Air Conditioning	HFC	123.5	2.66%	90.17%
1A2	Manufacturing and Construction	CO_2	104.3	2.25%	92.41%
2C3	Metal Production: Aluminium	PFC	68.1	1.47%	93.88%
3B1	Manure Management: Cattle	CH_4	38.2	0.823%	94.70%
3D2	Agricultural Soils: Indirect	N_2O	28.8	0.620%	95.32%

Table A1. 3 Key category analysis approach 1 1990-2023 trend assessment, excluding LULUCF, [kt CO_2e].

IPCC code	IPCC Category	Gas	Base Year (1990) Estimate $E_{x,0}$ [kt CO_2e]	Current Year (2023) Estimate $E_{x,t}$ [kt CO_2e]	Trend Assessment $T_{x,t}$	Contribution to Trend [%]	Cumulative Total of trend [%]
2C3	Metal Production: Aluminium	CO_2	139.2	1334.6	31.29%	30.33%	30.33%
1A4c	Agriculture/Forestry/Fishing	CO_2	794.9	500.5	13.38%	12.96%	43.29%
2C3	Metal Production: Aluminium	PFC	444.8	68.1	13.20%	12.79%	56.08%
1A2	Manufacturing and Construction	CO_2	298.9	104.3	7.29%	7.06%	63.14%
1A3b	Road Transport	CO_2	519.8	913.4	7.06%	6.85%	69.99%
5A2	Unmanaged Waste Disposal Sites	CH_4	153.6	0.0	5.19%	5.03%	75.03%
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH_4	18.9	184.3	4.33%	4.20%	79.22%
2C2	Metal Production: Ferroalloys	CO_2	208.8	404.4	3.85%	3.73%	82.95%
3A2	Enteric Fermentation: Sheep	CH_4	209.4	130.0	3.57%	3.46%	86.42%
1B2d	Fugitive Emissions	CO_2	61.4	172.2	2.57%	2.49%	88.91%
2A1	Mineral Products: Cement	CO_2	51.6	0.0	1.74%	1.69%	90.60%
2B10	Other	N_2O	41.3	0.0	1.40%	1.35%	91.95%
3A1	Enteric Fermentation: Cattle	CH_4	140.2	138.7	1.00%	0.97%	92.92%
1A4b	Residential Stationary	CO_2	27.9	4.2	0.83%	0.81%	93.72%
3D1	Agricultural Soils	N_2O	249.5	287.8	0.67%	0.65%	94.37%
1A3d	Domestic Navigation	CO_2	32.6	16.7	0.65%	0.63%	95.01%

Table A1. 4 Key Category analysis approach 1 Level Assessment for 1990, including LULUCF, [kt CO_2e].

IPCC code	IPCC Category	Gas	1990 Emissions / Removals [kt CO_2e]	Level Assessment [%]	Cumulative Total of Level [%]
4C1	Grassland Remaining Grassland	CO_2	3517.8	27.34%	27.34%
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	1743.1	13.55%	40.89%
4C2	Land Converted to Grassland	CO_2	1724.7	13.40%	54.29%
4B1	Cropland Remaining Cropland	CO_2	950.7	7.39%	61.68%
1A4c	Agriculture/Forestry/Fishing	CO_2	794.9	6.18%	67.86%
1A3b	Road Transport	CO_2	519.8	4.04%	71.90%
4D1	Wetlands remaining wetlands	CO_2	-478.3	3.72%	75.62%
4B2	Land Converted to Cropland	CO_2	476.7	3.70%	79.32%
2C3	Metal Production: Aluminium	PFC	444.8	3.46%	82.78%
1A2	Manufacturing and Construction	CO_2	298.9	2.32%	85.10%
3D1	Agricultural Soils: Direct	N_2O	249.5	1.94%	87.04%
3A2	Enteric Fermentation: Sheep	CH_4	209.4	1.63%	88.67%
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO_2	209.4	1.63%	90.30%
2C2	Metal Production: Ferroalloys	CO_2	208.8	1.62%	91.92%
5A2	Unmanaged waste disposal sites	CH_4	153.6	1.19%	93.11%
3A1	Enteric Fermentation: Cattle	CH_4	140.2	1.09%	94.20%
2C3	Metal Production: Aluminium	CO_2	139.2	1.08%	95.28%

Table A1. 5 Key category analysis approach 1 level for 2023, including LULUCF, [kt CO_2e].

IPCC Code	IPCC Category	Gas	2023 Emissions/ Removals [kt CO_2e]	Level Assessment [%]	Cumulative Total of Level [%]
4C1	Grassland Remaining Grassland	CO_2	5637.0	37.04%	37.04%
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	1629.3	10.71%	47.74%
4B1	Cropland Remaining Cropland	CO_2	1374.0	9.03%	56.77%
2C3	Metal Production: Aluminium	CO_2	1334.6	8.77%	65.54%
1A3b	Road Transport	CO_2	913.4	6.00%	71.54%
1A4c	Agriculture/Forestry/Fishing	CO_2	500.5	3.29%	74.83%
4A2	Land Converted to Forest Land	CO_2	-422.3	2.77%	77.60%
4D1	Wetlands remaining wetlands	CO_2	-407.8	2.68%	80.28%
2C2	Metal Production: Ferroalloys	CO_2	404.4	2.66%	82.94%
4B2	Land Converted to Cropland	CO_2	389.9	2.56%	85.50%
4C2	Land Converted to Grassland	CO_2	-326.8	2.15%	87.65%
3D1	Agricultural Soils: Direct	N_2O	287.8	1.89%	89.54%
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO_2	213.0	1.40%	90.94%
5A1a	Managed Waste Disposal Sites (Anaerobic)	CH_4	184.3	1.21%	92.15%
1B2d	Fugitive Emissions	CO_2	172.2	1.13%	93.28%
3A1	Enteric Fermentation: Cattle	CH_4	138.7	0.911%	94.19%
4A1	Forest land remaining forest land	CO_2	-135.9	0.893%	95.08%

Table A1. 6 Key category analysis approach 1 - 1990-2023 trend assessment, including LULUCF, [kt CO_2e].

IPCC Code	IPCC Category	Gas	Base Year (1990) Estimate $E_{x,0}$ [kt CO_2e]	Current Year (2023) Estimate $E_{x,t}$ [kt CO_2e]	Trend Assessment $T_{x,t}$	Contribution to Trend [%]	Cumulative Total of trend [%]
4C2	Land Converted to Grassland	CO_2	1724.7	-326.8	18.40%	25.95%	25.95%
4C1	Grassland Remaining Grassland	CO_2	3517.8	5637.0	11.47%	16.18%	42.13%
2C3	Metal Production: Aluminium	CO_2	139.2	1334.6	9.09%	12.83%	54.96%
2C3	Metal Production: Aluminium	PFC	444.8	68.1	3.56%	5.02%	59.98%
1A4c	Agriculture/ Forestry/ Fishing	CO_2	794.9	500.5	3.42%	4.82%	64.80%
4(II)	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	1743.1	1629.3	3.36%	4.74%	69.55%
4A2	Land Converted to Forest Land	CO_2	-28.3	-422.3	3.02%	4.26%	73.81%
1A3b	Road Transport	CO_2	519.8	913.4	2.32%	3.27%	77.08%
4B1	Cropland Remaining Cropland	CO_2	950.7	1374.0	1.94%	2.73%	79.82%
1A2	Manufacturing and Construction	CO_2	298.9	104.3	1.94%	2.73%	82.55%
5A2	Unmanaged waste disposal sites	CH_4	153.6	0.0	1.41%	1.99%	84.54%
4B2	Land converted to cropland	CO_2	476.7	389.9	1.35%	1.91%	86.45%
5A1a	Managed waste disposal sites (Anaerobic)	CH_4	18.9	184.3	1.26%	1.78%	88.22%
4D1	Wetland remaining wetland	CO_2	-478.3	-407.8	1.23%	1.73%	89.96%
2C2	Metal Production: Ferroalloys	CO_2	208.8	404.4	1.22%	1.73%	91.68%
4A1	Forest Land Remaining Forest Land	CO_2	-1.86	-135.9	1.04%	1.47%	93.15%
3A2	Enteric Fermentation: Sheep	CH_4	209.4	130.0	0.91%	1.29%	94.44%
1B2d	Fugitive Emissions	CO_2	61.4	172.2	0.77%	1.09%	95.53%

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 19.7%, whereas the uncertainty in total inventory is 32.2%. When looking at the uncertainty analysis without LULUCF, the trend uncertainty is 6.0%, and the uncertainty in total inventory is 4.9%.

Table A2.1 and Table A2.2 show the complete uncertainty assessment, with and without LULUCF, respectively.

Table A2.1 Uncertainty Analysis including LULUCF.

IPCC Category		Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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	6.38	5%	5%	7%	1.3E-09	0.0008%	0.0038%	0.0000%
1A1aiii	Public Electricity and Heat Production (Heat Plants)	CO_2	9.34	4.54	5%	5%	7%	6.5E-10	0.0023%	0.0027%	0.0000%
1A2a	Iron and Steel	CO_2	0.35	1.28	2%	5%	5%	2.8E-11	0.0004%	0.0002%	0.0000%
1A2b	Non-Ferrous Metals	CO_2	13.50	4.19	2%	5%	5%	3.0E-10	0.0043%	0.0007%	0.0000%
1A2c	Chemicals	CO_2	7.43	0.00	5%	5%	7%	0.0E+00	0.0033%	0.0000%	0.0000%
1A2e	Food Processing, Beverages, and Tobacco	CO_2	128.24	42.18	5%	5%	7%	5.6E-08	0.0399%	0.0252%	0.0000%
1A2f	Non-metallic Minerals	CO_2	47.42	0.44	5%	5%	7%	6.0E-12	0.0211%	0.0003%	0.0000%
1A2g	Other Manufacturing Industries and Constructions	CO_2	101.94	56.22	5%	5%	7%	9.9E-08	0.0221%	0.0335%	0.0000%
1A3a	Domestic Aviation	CO_2	33.34	22.34	5%	5%	7%	1.6E-08	0.0056%	0.0133%	0.0000%
1A3b	Road Transport	CO_2	519.80	913.38	5%	3%	6%	1.7E-05	0.0850%	0.5450%	0.0030%
1A3d	Domestic Water-borne Navigation	CO_2	32.59	16.68	5%	5%	7%	8.7E-09	0.0076%	0.0100%	0.0000%
1A3e	Mobile Machinery - Other	CO_2	16.78	0.07	5%	5%	7%	1.5E-13	0.0075%	0.0000%	0.0000%
1A4a	Commercial/Institutional	CO_2	8.02	2.28	5%	5%	7%	1.6E-10	0.0026%	0.0014%	0.0000%
1A4b	Residential	CO_2	27.94	4.21	5%	5%	7%	5.5E-10	0.0108%	0.0025%	0.0000%
1A4c	Agriculture/Fishing	CO_2	794.91	500.48	5%	5%	7%	7.9E-06	0.1463%	0.2987%	0.0011%
1A5a	Other - Stationary	CO_2	0.12	1.77	5%	5%	7%	9.8E-11	0.0007%	0.0011%	0.0000%
1B2a5	Oil - Distribution of Oil Products	CO_2	0.00	0.01	5%	5%	7%	8.3E-16	0.0000%	0.0000%	0.0000%
1B2d	Other Emissions from Energy Production	CO_2	61.36	172.18	10%	10%	14%	3.7E-06	0.0901%	0.2055%	0.0005%
2A1	Cement Production	CO_2	51.56	0.00	2%	30%	30%	0.0E+00	0.1391%	0.0000%	0.0002%

IPCC Category		Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
2A4d	Other: Mineral Wool Production	CO_2	0.70	0.97	2%	2%	3%	4.3E-12	0.0000%	0.0003%	0.0000%
2B10a	Other: Silica Production	CO_2	0.36	0.00	5%	10%	11%	0.0E+00	0.0003%	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	404.35	2%	2%	2%	4.6E-07	0.0230%	0.0724%	0.0001%
2C3	Metal Production – Aluminium Production	CO_2	139.21	1334.56	2%	2%	2%	5.0E-06	0.1501%	0.2389%	0.0008%
2D1	Lubricants	CO_2	4.06	2.04	5%	50%	50%	6.6E-09	0.0097%	0.0012%	0.0000%
2D2	Paraffin Wax Use	CO_2	0.17	0.28	5%	100%	100%	4.8E-10	0.0008%	0.0002%	0.0000%
2D3a	Domestic Solvent Use Including Fungicide	CO_2	1.00	1.49	2%	67%	67%	6.2E-09	0.0023%	0.0004%	0.0000%
2D3b	Other (please specify) Road Paving with Asphalt	CO_2	0.01	0.01	2%	303%	303%	4.0E-12	0.0001%	0.0000%	0.0000%
2D3d	Coating Applications	CO_2	1.12	0.77	2%	43%	44%	7.0E-10	0.0015%	0.0002%	0.0000%
2D3e	Degreasing	CO_2	0.17	0.12	2%	74%	74%	5.2E-11	0.0003%	0.0000%	0.0000%
2D3f	Dry Cleaning	CO_2	0.00	0.00	2%	496%	496%	3.6E-12	0.0001%	0.0000%	0.0000%
2D3g	Chemical Products	CO_2	0.03	0.01	2%	36%	36%	3.3E-14	0.0001%	0.0000%	0.0000%
2D3h	Printing	CO_2	0.17	0.10	2%	207%	207%	2.6E-10	0.0015%	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	0.07	2%	5%	6%	9.7E-14	0.0000%	0.0000%	0.0000%
2D3ic	De-icing	CO_2	0.08	0.14	30%	75%	80%	7.4E-11	0.0003%	0.0005%	0.0000%
2D3urea	Urea-based Catalysts	CO_2	0.00	0.73	2%	5%	5%	9.7E-12	0.0003%	0.0002%	0.0000%
2G4fw	Other: Fireworks	CO_2	0.00	0.02	2%	50%	50%	5.8E-13	0.0001%	0.0000%	0.0000%
3G	Liming	CO_2	0.02	4.91	50%	50%	71%	7.5E-08	0.0206%	0.0293%	0.0000%
3H	Urea Application	CO_2	0.00	1.83	20%	50%	54%	6.1E-09	0.0077%	0.0044%	0.0000%
3I	Other Carbon Containing Fertilisers	CO_2	0.00	1.14	50%	50%	71%	4.1E-09	0.0048%	0.0068%	0.0000%

IPCC Category		Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
4(II)	Cropland	CO_2	21.52	26.02	18%	42%	45%	8.7E-07	0.0109%	0.0545%	0.0000%
4(II)	Forest Land	CO_2	0.09	0.69	3%	48%	48%	6.9E-10	0.0024%	0.0003%	0.0000%
4(II)	Grasslands	CO_2	118.17	126.69	19%	45%	48%	2.3E-05	0.0027%	0.2826%	0.0008%
4(II)	Wetlands	CO_2	69.57	59.64	29%	37%	47%	4.9E-06	0.0456%	0.2050%	0.0004%
4(IV)	Biomass Burning	CO_2	0.00	0.00	100%	0%	100%	0.0E+00	0.0000%	0.0000%	0.0000%
4A1	Forest Land Remaining Forest Land	CO_2	-1.86	-135.87	3%	27%	28%	8.9E-06	0.3103%	0.0534%	0.0010%
4A2	Land Converted to Forest Land	CO_2	-28.28	-422.26	3%	7%	7%	5.5E-06	0.2160%	0.1279%	0.0006%
4B1	Cropland Remaining Cropland	CO_2	950.68	1374.01	21%	19%	29%	9.9E-04	0.5920%	3.5018%	0.1261%
4B2	Land Converted to Cropland	CO_2	476.70	389.94	17%	19%	25%	6.1E-05	0.1852%	0.8034%	0.0068%
4C1	Grassland Remaining Grassland	CO_2	3517.81	5636.96	20%	49%	53%	5.5E-02	7.7429%	13.4017%	2.3956%
4C2	Land Converted to Grassland	CO_2	1724.65	-326.83	40%	51%	65%	2.8E-04	9.3103%	1.5464%	0.8907%
4D1	Wetlands Remaining Wetlands	CO_2	-478.33	-407.78	29%	40%	49%	2.5E-04	0.3448%	1.4114%	0.0211%
4D2	Land Converted to Wetlands	CO_2	0.51	-1.50	45%	79%	90%	1.2E-08	0.0136%	0.0080%	0.0000%
4E2	Land Converted to Settlements	CO_2	26.28	31.05	4%	30%	31%	5.6E-07	0.0078%	0.0135%	0.0000%
4G	Harvested Wood Products	CO_2	0.00	-0.22	10%	50%	51%	7.9E-11	0.0009%	0.0003%	0.0000%
5C	Incineration and Open Burning of waste	CO_2	7.30	6.09	42%	40%	58%	7.8E-08	0.0057%	0.0304%	0.0000%
1A1ai	Public electricity and heat production (electricity generation)	CH_4	0.00	0.01	5%	100%	100%	3.3E-13	0.0000%	0.0000%	0.0000%
1A1aiii	Public electricity and heat production (heat plants)	CH_4	0.01	0.01	5%	100%	100%	1.7E-13	0.0000%	0.0000%	0.0000%

IPCC Category		Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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	CH_4	0.00	0.00	2%	100%	100%	7.0E-15	0.0000%	0.0000%	0.0000%
1A2b	Non-Ferrous Metals	CH_4	0.01	0.00	2%	100%	100%	2.9E-14	0.0001%	0.0000%	0.0000%
1A2c	Chemicals	CH_4	0.01	0.00	5%	100%	100%	0.0E+00	0.0001%	0.0000%	0.0000%
1A2e	Food Processing, Beverages, and Tobacco	CH_4	0.14	0.17	5%	100%	100%	1.9E-10	0.0002%	0.0001%	0.0000%
1A2f	Non-metallic Minerals	CH_4	0.14	0.00	5%	100%	100%	1.6E-15	0.0012%	0.0000%	0.0000%
1A2g	Other Manufacturing Industries and Constructions	CH_4	0.14	0.08	5%	100%	100%	4.5E-11	0.0006%	0.0001%	0.0000%
1A3a	Domestic Aviation	CH_4	0.01	0.00	5%	100%	100%	1.2E-13	0.0000%	0.0000%	0.0000%
1A3b	Road Transport	CH_4	6.24	0.79	5%	236%	236%	2.2E-08	0.1168%	0.0005%	0.0001%
1A3d	Domestic Water-borne Navigation	CH_4	0.09	0.04	5%	50%	50%	3.1E-12	0.0002%	0.0000%	0.0000%
1A3e	Mobile machinery - Other	CH_4	0.03	0.00	5%	100%	100%	7.6E-17	0.0002%	0.0000%	0.0000%
1A4a	Commercial/Institutional	CH_4	0.03	0.01	5%	100%	100%	2.0E-13	0.0002%	0.0000%	0.0000%
1A4b	Residential	CH_4	0.14	0.05	5%	100%	100%	1.5E-11	0.0008%	0.0000%	0.0000%
1A4c	Agriculture/Fishing	CH_4	2.06	1.31	5%	50%	50%	2.7E-09	0.0037%	0.0008%	0.0000%
1A5a	Other - Stationary	CH_4	0.00	0.00	5%	100%	100%	3.4E-14	0.0000%	0.0000%	0.0000%
1B2a5	Oil - Distribution of Oil Products	CH_4	0.52	0.76	5%	100%	100%	3.7E-09	0.0018%	0.0005%	0.0000%
1B2d	Other emission from Energy Production	CH_4	0.22	4.51	10%	25%	27%	9.3E-09	0.0090%	0.0054%	0.0000%
2C2	Metal Production - Ferroalloys	CH_4	1.76	3.85	2%	10%	10%	9.5E-10	0.0017%	0.0007%	0.0000%
2G4tob	Other - Tobacco	CH_4	0.05	0.01	2%	50%	50%	3.2E-13	0.0002%	0.0000%	0.0000%
2G4fw	Other - Fireworks use	CH_4	0.00	0.01	2%	50%	50%	1.7E-13	0.0000%	0.0000%	0.0000%
3A1	Enteric Fermentation - Cattle	CH_4	140.21	138.66	5%	40%	40%	2.0E-05	0.0364%	0.0827%	0.0001%
3A2	Enteric Fermentation - Sheep	CH_4	209.44	130.03	5%	40%	40%	1.7E-05	0.3146%	0.0776%	0.0011%

IPCC Category		Gas	1990 Emissions [kt CO2e]	2023 Emissions [kt CO2e]	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 [%]
3A3	Enteric Fermentation - Swine	CH_4	1.23	1.60	5%	40%	40%	2.6E-09	0.0010%	0.0010%	0.0000%
3A4 rabbit	Enteric Fermentation - Rabbit	CH_4	0.01	0.00	5%	40%	40%	2.9E-17	0.0000%	0.0000%	0.0000%
3A4 fur-bearing	Enteric Fermentation - Fur-bearing	CH_4	0.13	0.01	5%	40%	40%	2.1E-13	0.0004%	0.0000%	0.0000%
3A4 poultry	Enteric Fermentation - Poultry	CH_4	0.38	0.47	5%	40%	40%	2.3E-10	0.0002%	0.0003%	0.0000%
3A4 horses	Enteric Fermentation - Horses	CH_4	27.09	25.15	10%	40%	41%	6.7E-07	0.0126%	0.0300%	0.0000%
3A4 goats	Enteric Fermentation - Goats	CH_4	0.10	0.55	5%	40%	40%	3.0E-10	0.0015%	0.0003%	0.0000%
3B11	Manure Management - Cattle	CH_4	47.35	38.22	23%	20%	31%	8.7E-07	0.0207%	0.1070%	0.0001%
3B12	Manure Management - Sheep	CH_4	18.66	10.33	54%	20%	58%	2.2E-07	0.0161%	0.0670%	0.0000%
3B13	Manure Management - Swine	CH_4	6.41	8.23	59%	30%	67%	1.9E-07	0.0035%	0.0583%	0.0000%
3B14 rabbit	Manure Management - Rabbit	CH_4	0.00	0.00	59%	30%	67%	5.0E-17	0.0000%	0.0000%	0.0000%
3B14 fur-bearing	Manure Management - Fur-bearing	CH_4	0.91	0.10	59%	30%	67%	2.7E-11	0.0022%	0.0007%	0.0000%
3B14 poultry	Manure Management - Poultry	CH_4	4.60	1.00	59%	30%	67%	2.8E-09	0.0099%	0.0071%	0.0000%
3B14 horses	Manure Management - Horses	CH_4	1.22	1.15	60%	30%	67%	3.7E-09	0.0004%	0.0082%	0.0000%
3B14 goats	Manure Management - Goats	CH_4	0.00	0.01	59%	30%	67%	5.2E-13	0.0000%	0.0001%	0.0000%
4(II)	Cropland	CH_4	79.79	96.46	4%	60%	60%	2.1E-05	0.0574%	0.0481%	0.0001%
4(II)	Forest Land	CH_4	0.13	0.98	3%	65%	65%	2.6E-09	0.0046%	0.0004%	0.0000%
4(II)	Grassland	CH_4	447.94	480.15	4%	63%	64%	5.8E-04	0.0143%	0.2551%	0.0007%
4(II)	Wetlands	CH_4	1215.28	1051.72	28%	255%	257%	4.6E-02	5.2436%	3.5753%	0.4028%

IPCC Category		Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
4(IV)	Biomass Burning	CH_4	0.00	0.79	100%	78%	127%	6.4E-09	0.0052%	0.0095%	0.0000%
5A1a	Managed Waste Disposal Sites - Anaerobic	CH_4	18.89	184.26	22%	49%	54%	6.1E-05	0.6757%	0.4917%	0.0070%
5A1b	Managed Waste Disposal Sites - Semi-anaerobic	CH_4	0.00	17.00	27%	51%	58%	6.1E-07	0.0734%	0.0546%	0.0001%
5A2	Unmanaged Waste Disposal Sites	CH_4	153.65	0.00	27%	51%	58%	0.0E+00	0.7073%	0.0000%	0.0050%
5B	Biological Treatment of Solid Waste	CH_4	0.00	2.26	16%	57%	59%	1.1E-08	0.0108%	0.0043%	0.0000%
5C	Incineration and Open Burning of Waste	CH_4	6.82	0.39	42%	100%	108%	1.1E-09	0.0580%	0.0019%	0.0000%
5D1	Wastewater Treatment and Discharge Domestic Wastewater	CH_4	4.10	6.35	38%	58%	69%	1.2E-07	0.0097%	0.0286%	0.0000%
5D2	Wastewater Treatment and Discharge Industrial Wastewater	CH_4	10.92	9.86	103%	58%	118%	8.5E-07	0.0088%	0.1212%	0.0001%
1A1ai	Public electricity and heat production (electricity generation)	N_2O	0.01	0.01	5%	100%	100%	1.2E-12	0.0000%	0.0000%	0.0000%
1A1aiii	Public electricity and heat production (heat plants)	N_2O	0.02	0.01	5%	100%	100%	6.0E-13	0.0001%	0.0000%	0.0000%
1A2a	Iron and Steel	N_2O	0.00	0.00	2%	100%	100%	1.9E-14	0.0000%	0.0000%	0.0000%
1A2b	Non-ferrous Metals	N_2O	0.03	0.00	2%	100%	100%	3.9E-14	0.0002%	0.0000%	0.0000%
1A2c	Chemicals	N_2O	0.02	0.00	5%	100%	100%	0.0E+00	0.0001%	0.0000%	0.0000%
1A2e	Food Processing, Beverages, and Tobacco	N_2O	0.26	0.24	5%	100%	100%	3.7E-10	0.0003%	0.0001%	0.0000%
1A2f	Non-metallic Minerals	N_2O	0.19	0.00	5%	100%	100%	5.6E-15	0.0017%	0.0000%	0.0000%
1A2g	Other Manufacturing Industries and Construction	N_2O	6.42	4.93	5%	100%	100%	1.5E-07	0.0162%	0.0029%	0.0000%
1A3a	Domestic Aviation	N_2O	0.25	0.17	5%	150%	150%	3.9E-10	0.0012%	0.0001%	0.0000%

IPCC Category		Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
1A3b	Road Transport	N_2O	4.67	7.12	5%	192%	192%	1.2E-06	0.0347%	0.0042%	0.0000%
1A3d	Domestic Water-borne Navigation	N_2O	0.23	0.12	5%	140%	140%	1.8E-10	0.0015%	0.0001%	0.0000%
1A3e	Mobile Machinery – Other	N_2O	1.73	0.01	5%	250%	250%	2.0E-12	0.0387%	0.0000%	0.0000%
1A4a	Commercial/Institutional	N_2O	0.01	0.00	5%	100%	100%	1.7E-14	0.0001%	0.0000%	0.0000%
1A4b	Residential	N_2O	0.06	0.01	5%	100%	100%	2.1E-13	0.0005%	0.0000%	0.0000%
1A4c	Agriculture/Fishing	N_2O	9.69	5.50	5%	140%	140%	3.7E-07	0.0571%	0.0033%	0.0000%
1A5a	Other – Stationary	N_2O	0.00	0.00	5%	100%	100%	9.5E-14	0.0000%	0.0000%	0.0000%
1B2a5	Oil – Distribution of Oil Products	N_2O	0.00	0.00	5%	0%	5%	0.0E+00	0.0000%	0.0000%	0.0000%
2B10b	Other – Fertiliser Production	N_2O	41.34	0.00	5%	40%	40%	0.0E+00	0.1487%	0.0000%	0.0002%
2G3a	N_2O from Product Uses: Medical Applications	N_2O	4.71	1.21	6%	5%	8%	5.7E-11	0.0016%	0.0009%	0.0000%
2G3b	N_2O from Product Uses: Other	N_2O	0.64	0.39	6%	5%	8%	5.9E-12	0.0001%	0.0003%	0.0000%
2G4tob	Other – Tobacco	N_2O	0.01	0.00	2%	50%	50%	1.2E-14	0.0000%	0.0000%	0.0000%
2G4fw	Other – Fireworks	N_2O	0.06	0.23	2%	50%	50%	8.2E-11	0.0007%	0.0001%	0.0000%
3B21	Manure Management – Cattle	N_2O	0.32	1.76	40%	100%	108%	2.2E-08	0.0120%	0.0083%	0.0000%
3B22	Manure Management – Sheep	N_2O	4.58	2.80	56%	100%	115%	6.5E-08	0.0175%	0.0189%	0.0000%
3B24 rabbit	Manure Management – Rabbit	N_2O	0.01	0.00	55%	100%	114%	6.6E-16	0.0001%	0.0000%	0.0000%
3B24 fur-bearing	Manure Management – Fur-bearing	N_2O	0.15	0.01	55%	100%	114%	1.6E-12	0.0012%	0.0001%	0.0000%
3B24 poultry	Manure Management – Poultry	N_2O	0.05	0.20	61%	100%	117%	3.5E-10	0.0013%	0.0015%	0.0000%
3B24 horses	Manure Management – Horses	N_2O	0.54	0.52	51%	100%	112%	2.1E-09	0.0005%	0.0031%	0.0000%

IPCC Category		Gas	1990 Emissions [kt CO₂e]	2023 Emissions [kt CO₂e]	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 [%]
3B24 goats	Manure Management - Goats	N_2O	0.00	0.02	50%	100%	112%	2.3E-12	0.0001%	0.0001%	0.0000%
3B25	Manure Management - Indirect	N_2O	8.27	7.03	208%	400%	451%	6.3E-06	0.0603%	0.1749%	0.0003%
3D1.1	Inorganic N Fertilisers	N_2O	51.93	37.62	5%	200%	200%	3.6E-05	0.2993%	0.0224%	0.0009%
3D1.2a	Organic N Fertilisers	N_2O	26.90	22.38	61%	200%	209%	1.4E-05	0.1062%	0.1620%	0.0004%
3D1.2b	Organic N Fertilisers	N_2O	0.00	0.18	10%	200%	200%	8.2E-10	0.0030%	0.0002%	0.0000%
3D1.2c	Organic N Fertilisers	N_2O	0.00	1.26	20%	200%	201%	4.0E-08	0.0213%	0.0030%	0.0000%
3D1.3	Urine and Dung Deposited by Grazing Animals	N_2O	36.32	28.22	71%	200%	212%	2.3E-05	0.1771%	0.2406%	0.0009%
3D1.4	Crop Residues	N_2O	0.26	0.47	200%	200%	283%	1.1E-08	0.0033%	0.0113%	0.0000%
3D1.6	Cultivation of Organic Soils	N_2O	134.08	197.68	17%	43%	46%	5.3E-05	0.2002%	0.3903%	0.0019%
3D2.1	Indirect N_2O Emissions	N_2O	10.80	9.35	200%	400%	447%	1.1E-05	0.0730%	0.2232%	0.0006%
3D2.2	Nitrogen Leaching and Run-off	N_2O	25.04	19.47	27%	287%	288%	2.0E-05	0.1748%	0.0629%	0.0003%
4(I)	Direct and Indirect nitrous oxide (N_2O) emissions from nitrogen (N) inputs to managed soils	N_2O	0.02	0.28	4%	164%	164%	1.3E-09	0.0036%	0.0001%	0.0000%
4(II)	Forest Land	N_2O	0.33	2.48	3%	41%	41%	6.5E-09	0.0074%	0.0010%	0.0000%
4(III)	Direct N_2O emissions from N Mineralization/Immobilization	N_2O	1.27	0.91	17%	166%	167%	1.4E-08	0.0062%	0.0019%	0.0000%
4(IV)	Biomass Burning	N_2O	0.00	0.69	100%	95%	138%	5.6E-09	0.0055%	0.0082%	0.0000%
5B	Biological Treatment of Solid Waste	N_2O	0.00	0.77	16%	150%	151%	8.5E-09	0.0098%	0.0015%	0.0000%
5C	Incineration and Open Burning of Waste	N_2O	1.49	0.33	42%	100%	108%	8.0E-10	0.0106%	0.0016%	0.0000%

IPCC Category		Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
5D1	Wastewater Treatment and Discharge Domestic Wastewater	N_2O	4.33	5.87	44%	30%	53%	6.2E-08	0.0032%	0.0310%	0.0000%
2F1	Refrigeration and Air Conditioning	HFC	0.00	123.52	0%	0%	45%	1.9E-05	0.0000%	0.0000%	0.0000%
2F4	Aerosols	HFC	0.32	1.02	5%	5%	7%	3.2E-11	0.0003%	0.0006%	0.0000%
2C3	Metal Production – Aluminium Production	PFC	444.82	68.09	2%	15%	15%	6.6E-07	0.5138%	0.0122%	0.0026%
2F1	Refrigeration and Air Conditioning	PFC	0.00	0.08	0%	0%	45%	7.2E-12	0.0000%	0.0000%	0.0000%
2G1	Electrical Equipment	SF_6	1.13	1.94	30%	30%	42%	4.2E-09	0.0019%	0.0069%	0.0000%
2G2b	Accelerators	SF_6	0.00	0.00	2%	30%	30%	4.1E-17	0.0000%	0.0000%	0.0000%
Total Emissions			11849.61	12631.06							
Total Uncertainties		% Uncertainty in total inventory (including LULUCF):							32.2%	Trend uncertainty:	19.7%

Table A2.2 Uncertainty Analysis excluding LULUCF.

IPCC Category		Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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	6.38	5%	5%	7%	9.4E-09	0.0016%	0.0122%	0.0000%
1A1aiii	Public Electricity and Heat Production (Heat Plants)	CO_2	9.34	4.54	5%	5%	7%	4.8E-09	0.0097%	0.0087%	0.0000%
1A2a	Iron and Steel	CO_2	0.35	1.28	2%	5%	5%	2.1E-10	0.0011%	0.0007%	0.0000%

	IPCC Category	Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
1A2b	Non-Ferrous Metals	CO_2	13.50	4.19	2%	5%	5%	2.2E-09	0.0172%	0.0024%	0.0000%
1A2c	Chemicals	CO_2	7.43	0.00	5%	5%	7%	0.0E+00	0.0126%	0.0000%	0.0000%
1A2e	Food Processing, Beverages, and Tobacco	CO_2	128.24	42.18	5%	5%	7%	4.1E-07	0.1598%	0.0804%	0.0003%
1A2f	Non-metallic Minerals	CO_2	47.42	0.44	5%	5%	7%	4.5E-11	0.0795%	0.0008%	0.0001%
1A2g	Other Manufacturing Industries and Constructions	CO_2	101.94	56.22	5%	5%	7%	7.3E-07	0.0964%	0.1072%	0.0002%
1A3a	Domestic Aviation	CO_2	33.34	22.34	5%	5%	7%	1.2E-07	0.0262%	0.0426%	0.0000%
1A3b	Road Transport	CO_2	519.80	913.38	5%	3%	6%	1.3E-04	0.1978%	1.7421%	0.0307%
1A3d	Domestic Water-borne Navigation	CO_2	32.59	16.68	5%	5%	7%	6.4E-08	0.0326%	0.0318%	0.0000%
1A3e	Mobile Machinery - Other	CO_2	16.78	0.07	5%	5%	7%	1.1E-12	0.0283%	0.0001%	0.0000%
1A4a	Commercial/Institutional	CO_2	8.02	2.28	5%	5%	7%	1.2E-09	0.0105%	0.0043%	0.0000%
1A4b	Residential	CO_2	27.94	4.21	5%	5%	7%	4.1E-09	0.0415%	0.0080%	0.0000%
1A4c	Agriculture/Fishing	CO_2	794.91	500.48	5%	5%	7%	5.8E-05	0.6671%	0.9546%	0.0136%
1A5a	Other - Stationary	CO_2	0.12	1.77	5%	5%	7%	7.3E-10	0.0022%	0.0034%	0.0000%
1B2a5	Oil - Distribution of Oil Products	CO_2	0.00	0.01	5%	5%	7%	6.1E-15	0.0000%	0.0000%	0.0000%
1B2d	Other Emissions from Energy Production	CO_2	61.36	172.18	10%	10%	14%	2.7E-05	0.2570%	0.6568%	0.0050%
2A1	Cement Production	CO_2	51.56	0.00	2%	30%	30%	0.0E+00	0.5228%	0.0000%	0.0027%
2A4d	Other: Mineral Wool Production	CO_2	0.70	0.97	2%	2%	3%	3.2E-11	0.0000%	0.0008%	0.0000%
2B10a	Other: Silica Production	CO_2	0.36	0.00	5%	10%	11%	0.0E+00	0.0012%	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	404.35	2%	2%	2%	3.4E-06	0.0577%	0.2314%	0.0006%
2C3	Metal Production - Aluminium Production	CO_2	139.21	1334.56	2%	2%	2%	3.7E-05	0.4692%	0.7636%	0.0080%
2D1	Lubricants	CO_2	4.06	2.04	5%	50%	50%	4.9E-08	0.0412%	0.0039%	0.0000%
2D2	Paraffin Wax Use	CO_2	0.17	0.28	5%	100%	100%	3.6E-09	0.0016%	0.0005%	0.0000%

IPCC Category		Gas	1990 Emissions [kt CO₂e]	2023 Emissions [kt CO₂e]	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 [%]
2D3a	Domestic Solvent Use Including fungicide	CO_2	1.00	1.49	2%	67%	67%	4.5E-08	0.0041%	0.0011%	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	0.77	2%	43%	44%	5.2E-09	0.0074%	0.0006%	0.0000%
2D3e	Degreasing	CO_2	0.17	0.12	2%	74%	74%	3.8E-10	0.0017%	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%	2.4E-13	0.0004%	0.0000%	0.0000%
2D3h	Printing	CO_2	0.17	0.10	2%	207%	207%	1.9E-09	0.0064%	0.0001%	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	0.07	2%	5%	6%	7.2E-13	0.0001%	0.0001%	0.0000%
2D3ic	De-icing	CO_2	0.08	0.14	30%	75%	80%	5.5E-10	0.0007%	0.0015%	0.0000%
2D3urea	Urea-based Catalysts	CO_2	0.00	0.73	2%	5%	5%	7.2E-11	0.0010%	0.0006%	0.0000%
2G4fw	Other – Fireworks	CO_2	0.00	0.02	2%	50%	50%	4.3E-12	0.0002%	0.0000%	0.0000%
3G	Liming	CO_2	0.02	4.91	50%	50%	71%	5.6E-07	0.0658%	0.0936%	0.0001%
3H	Urea Application	CO_2	0.00	1.83	20%	50%	54%	4.5E-08	0.0246%	0.0139%	0.0000%
3I	Other Carbon Containing Fertilisers	CO_2	0.00	1.14	50%	50%	71%	3.0E-08	0.0154%	0.0218%	0.0000%
5C	Incineration and Open Burning of Waste	CO_2	7.30	6.09	42%	40%	58%	5.8E-07	0.0329%	0.0972%	0.0001%
1A1ai	Public Electricity and Heat Production (Electricity Generation)	CH_4	0.00	0.01	5%	100%	100%	2.5E-12	0.0000%	0.0000%	0.0000%
1A1aiii	Public Electricity and Heat Production (Heat Plants)	CH_4	0.01	0.01	5%	100%	100%	1.2E-12	0.0002%	0.0000%	0.0000%
1A2a	Iron and Steel	CH_4	0.00	0.00	2%	100%	100%	5.2E-14	0.0000%	0.0000%	0.0000%
1A2b	Non-ferrous Metals	CH_4	0.01	0.00	2%	100%	100%	2.2E-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%

	IPCC Category	Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
1A2e	Food Processing, Beverages, and Tobacco	CH_4	0.14	0.17	5%	100%	100%	1.4E-09	0.0000%	0.0003%	0.0000%
1A2f	Non-metallic Minerals	CH_4	0.14	0.00	5%	100%	100%	1.2E-14	0.0046%	0.0000%	0.0000%
1A2g	Other Manufacturing Industries and Construction	CH_4	0.14	0.08	5%	100%	100%	3.3E-10	0.0025%	0.0002%	0.0000%
1A3a	Domestic Aviation	CH_4	0.01	0.00	5%	100%	100%	8.9E-13	0.0001%	0.0000%	0.0000%
1A3b	Road Transport	CH_4	6.24	0.79	5%	236%	236%	1.6E-07	0.4476%	0.0015%	0.0020%
1A3d	Domestic Water-borne Navigation	CH_4	0.09	0.04	5%	50%	50%	2.3E-11	0.0008%	0.0001%	0.0000%
1A3e	Mobile machinery - Other	CH_4	0.03	0.00	5%	100%	100%	5.6E-16	0.0009%	0.0000%	0.0000%
1A4a	Commercial/Institutional	CH_4	0.03	0.01	5%	100%	100%	1.5E-12	0.0008%	0.0000%	0.0000%
1A4b	Residential	CH_4	0.14	0.05	5%	100%	100%	1.1E-10	0.0034%	0.0001%	0.0000%
1A4c	Agriculture/Fishing	CH_4	2.06	1.31	5%	50%	50%	2.0E-08	0.0171%	0.0025%	0.0000%
1A5a	Other - Stationary	CH_4	0.00	0.00	5%	100%	100%	2.5E-13	0.0001%	0.0000%	0.0000%
1B2a5	Oil - Distribution of Oil Products	CH_4	0.52	0.76	5%	100%	100%	2.7E-08	0.0031%	0.0015%	0.0000%
1B2d	Other emissions from Energy Production	CH_4	0.22	4.51	10%	25%	27%	6.8E-08	0.0286%	0.0172%	0.0000%
2C2	Metal Production - Ferroalloys	CH_4	1.76	3.85	2%	10%	10%	7.0E-09	0.0044%	0.0022%	0.0000%
2G4tob	Other - Tobacco	CH_4	0.05	0.01	2%	50%	50%	2.4E-12	0.0007%	0.0000%	0.0000%
2G4fw	Other - Fireworks	CH_4	0.00	0.01	2%	50%	50%	1.2E-12	0.0001%	0.0000%	0.0000%
3A1	Enteric Fermentation - Cattle	CH_4	140.21	138.66	5%	40%	40%	1.4E-04	0.3996%	0.2645%	0.0023%
3A2	Enteric Fermentation - Sheep	CH_4	209.44	130.03	5%	40%	40%	1.3E-04	1.4281%	0.2480%	0.0210%
3A3	Enteric Fermentation - Swine	CH_4	1.23	1.60	5%	40%	40%	1.9E-08	0.0006%	0.0031%	0.0000%
3A4 rabbit	Enteric Fermentation - Rabbit	CH_4	0.01	0.00	5%	40%	40%	2.1E-16	0.0001%	0.0000%	0.0000%
3A4 fur-bearing	Enteric Fermentation - Fur-bearing	CH_4	0.13	0.01	5%	40%	40%	1.6E-12	0.0017%	0.0000%	0.0000%
3A4 poultry	Enteric Fermentation - Poultry	CH_4	0.38	0.47	5%	40%	40%	1.7E-09	0.0000%	0.0009%	0.0000%
3A4 horses	Enteric Fermentation - Horses	CH_4	27.09	25.15	10%	40%	41%	5.0E-06	0.0950%	0.0959%	0.0002%

IPCC Category		Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
3A4 goats	Enteric Fermentation – Goats	CH_4	0.10	0.55	5%	40%	40%	2.2E-09	0.0046%	0.0010%	0.0000%
3B11	Manure Management – Cattle	CH_4	47.35	38.22	23%	20%	31%	6.4E-06	0.1139%	0.3419%	0.0013%
3B12	Manure Management – Sheep	CH_4	18.66	10.33	54%	20%	58%	1.7E-06	0.0704%	0.2141%	0.0005%
3B13	Manure Management – Swine	CH_4	6.41	8.23	59%	30%	67%	1.4E-06	0.0016%	0.1863%	0.0003%
3B14 rabbit	Manure Management – Rabbit	CH_4	0.00	0.00	59%	30%	67%	3.7E-16	0.0000%	0.0000%	0.0000%
3B14 fur-bearing	Manure Management – Fur-bearing	CH_4	0.91	0.10	59%	30%	67%	2.0E-10	0.0084%	0.0022%	0.0000%
3B14 poultry	Manure Management – Poultry	CH_4	4.60	1.00	59%	30%	67%	2.1E-08	0.0385%	0.0227%	0.0000%
3B14 horses	Manure Management – Horses	CH_4	1.22	1.15	60%	30%	67%	2.8E-08	0.0031%	0.0264%	0.0000%
3B14 goats	Manure Management – Goats	CH_4	0.00	0.01	59%	30%	67%	3.9E-12	0.0001%	0.0003%	0.0000%
5A1a	Managed Waste Disposal Sites - Anaerobic	CH_4	18.89	184.26	22%	49%	54%	4.5E-04	2.1130%	1.5717%	0.0693%
5A1b	Managed Waste Disposal Sites - Semi-anaerobic	CH_4	0.00	17.00	27%	51%	58%	4.5E-06	0.2348%	0.1747%	0.0009%
5A2	Unmanaged waste disposal sites	CH_4	153.65	0.00	27%	51%	58%	0.0E+00	2.6571%	0.0000%	0.0706%
5B	Biological treatment of solid waste	CH_4	0.00	2.26	16%	57%	59%	8.2E-08	0.0345%	0.0136%	0.0000%
5C	Incineration and Open Burning of waste	CH_4	6.82	0.39	42%	100%	108%	8.2E-09	0.2199%	0.0062%	0.0005%
5D1	Wastewater Treatment and Discharge Domestic Wastewater	CH_4	4.10	6.35	38%	58%	69%	9.0E-07	0.0190%	0.0915%	0.0001%
5D2	Wastewater Treatment and Discharge Industrial Wastewater	CH_4	10.92	9.86	103%	58%	118%	6.3E-06	0.0602%	0.3875%	0.0015%
1A1ai	Public Electricity and Heat Production (Electricity Generation)	N_2O	0.01	0.01	5%	100%	100%	8.8E-12	0.0001%	0.0000%	0.0000%
1A1aiii	Public Electricity and Heat Production (Heat Plants)	N_2O	0.02	0.01	5%	100%	100%	4.5E-12	0.0004%	0.0000%	0.0000%
1A2a	Iron and Steel	N_2O	0.00	0.00	2%	100%	100%	1.4E-13	0.0000%	0.0000%	0.0000%
1A2b	Non-ferrous Metals	N_2O	0.03	0.00	2%	100%	100%	2.9E-13	0.0008%	0.0000%	0.0000%

	IPCC Category	Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
1A2c	Chemicals	N_2O	0.02	0.00	5%	100%	100%	0.0E+00	0.0005%	0.0000%	0.0000%
1A2e	Food Processing, Beverages, and Tobacco	N_2O	0.26	0.24	5%	100%	100%	2.7E-09	0.0024%	0.0005%	0.0000%
1A2f	Non-metallic Minerals	N_2O	0.19	0.00	5%	100%	100%	4.2E-14	0.0066%	0.0000%	0.0000%
1A2g	Other Manufacturing Industries and Construction	N_2O	6.42	4.93	5%	100%	100%	1.1E-06	0.0842%	0.0094%	0.0001%
1A3a	Domestic Aviation	N_2O	0.25	0.17	5%	150%	150%	2.9E-09	0.0059%	0.0003%	0.0000%
1A3b	Road Transport	N_2O	4.67	7.12	5%	192%	192%	8.6E-06	0.0657%	0.0136%	0.0000%
1A3d	Domestic Water-borne Navigation	N_2O	0.23	0.12	5%	140%	140%	1.3E-09	0.0064%	0.0002%	0.0000%
1A3e	Mobile Machinery – Other	N_2O	1.73	0.01	5%	250%	250%	1.5E-11	0.1456%	0.0000%	0.0002%
1A4a	Commercial/Institutional	N_2O	0.01	0.00	5%	100%	100%	1.2E-13	0.0004%	0.0000%	0.0000%
1A4b	Residential	N_2O	0.06	0.01	5%	100%	100%	1.6E-12	0.0019%	0.0000%	0.0000%
1A4c	Agriculture/Fishing	N_2O	9.69	5.50	5%	140%	140%	2.7E-06	0.2512%	0.0105%	0.0006%
1A5a	Other – Stationary	N_2O	0.00	0.00	5%	100%	100%	7.1E-13	0.0001%	0.0000%	0.0000%
1B2a5	Oil – Distribution of Oil Products	N_2O	0.00	0.00	5%	0%	5%	0.0E+00	0.0000%	0.0000%	0.0000%
2B10b	Other – Fertiliser Production	N_2O	41.34	0.00	5%	40%	40%	0.0E+00	0.5589%	0.0000%	0.0031%
2G3a	N_2O from Product Uses – Medical Applications	N_2O	4.71	1.21	6%	5%	8%	4.2E-10	0.0063%	0.0028%	0.0000%
2G3b	N_2O from Product Uses – Other	N_2O	0.64	0.39	6%	5%	8%	4.4E-11	0.0006%	0.0009%	0.0000%
2G4tob	Other – Tobacco	N_2O	0.01	0.00	2%	50%	50%	8.6E-14	0.0001%	0.0000%	0.0000%
2G4fw	Other – Fireworks	N_2O	0.06	0.23	2%	50%	50%	6.0E-10	0.0021%	0.0002%	0.0000%
3B21	Manure Management – Cattle	N_2O	0.32	1.76	40%	100%	108%	1.7E-07	0.0367%	0.0267%	0.0000%
3B22	Manure Management – Sheep	N_2O	4.58	2.80	56%	100%	115%	4.8E-07	0.0791%	0.0603%	0.0001%
3B24 rabbit	Manure Management – Rabbit	N_2O	0.01	0.00	55%	100%	114%	4.9E-15	0.0003%	0.0000%	0.0000%
3B24 fur-bearing	Manure Management – Fur-bearing	N_2O	0.15	0.01	55%	100%	114%	1.2E-11	0.0047%	0.0003%	0.0000%

	IPCC Category	Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
3B24 poultry	Manure Management – Poultry	N_2O	0.05	0.20	61%	100%	117%	2.6E-09	0.0038%	0.0047%	0.0000%
3B24 horses	Manure Management – Horses	N_2O	0.54	0.52	51%	100%	112%	1.6E-08	0.0044%	0.0100%	0.0000%
3B24 goats	Manure Management – Goats	N_2O	0.00	0.02	50%	100%	112%	1.7E-11	0.0004%	0.0003%	0.0000%
3B25	Manure Management – Indirect	N_2O	8.27	7.03	208%	400%	451%	4.7E-05	0.3598%	0.5589%	0.0044%
3D1.1	Inorganic N fertilisers	N_2O	51.93	37.62	5%	200%	200%	2.6E-04	1.4812%	0.0718%	0.0220%
3D1.2a	Animal Manure Applied to Soils	N_2O	26.90	22.38	61%	200%	209%	1.0E-04	0.6111%	0.5178%	0.0064%
3D1.2b	Animal Manure Applied to Soils	N_2O	0.00	0.18	10%	200%	200%	6.1E-09	0.0097%	0.0007%	0.0000%
3D1.2c	Animal Manure Applied to Soils	N_2O	0.00	1.26	20%	200%	201%	3.0E-07	0.0679%	0.0096%	0.0000%
3D1.3	Urine and Dung Deposited by Grazing Animals	N_2O	36.32	28.22	71%	200%	212%	1.7E-04	0.9331%	0.7689%	0.0146%
3D1.4	Crop Residues	N_2O	0.26	0.47	200%	200%	283%	8.3E-08	0.0080%	0.0360%	0.0000%
3D1.6	Cultivation of Organic Soils (e.g., histosols)	N_2O	134.08	197.68	17%	43%	46%	3.9E-04	0.3464%	1.2476%	0.0168%
3D2.1	Atmospheric Deposition	N_2O	10.80	9.35	200%	400%	447%	8.1E-05	0.4514%	0.7134%	0.0071%
3D2.2	Nitrogen Leaching and Run-off	N_2O	25.04	19.47	27%	287%	288%	1.5E-04	0.9213%	0.2010%	0.0089%
5B	Biological Treatment of Solid Waste	N_2O	0.00	0.77	16%	150%	151%	6.3E-08	0.0313%	0.0047%	0.0000%
5C	Incineration and Open Burning of Waste	N_2O	1.49	0.33	42%	100%	108%	5.9E-09	0.0414%	0.0053%	0.0000%
5D1	Wastewater Treatment and Discharge Domestic Wastewater	N_2O	4.33	5.87	44%	30%	53%	4.6E-07	0.0036%	0.0992%	0.0001%
2F1	Refrigeration and Air Conditioning	HFC	0.00	123.52			45%	1.4E-04			
2F4	Aerosols	HFC	0.32	1.02	5%	5%	7%	2.4E-10	0.0008%	0.0019%	0.0000%
2C3	Metal Production – Aluminium Production	PFC	444.82	68.09	2%	15%	15%	4.9E-06	1.9775%	0.0390%	0.0391%
2F1	Refrigeration and Air Conditioning	PFC	0.00	0.08			45%	5.3E-11			
2G1	Electrical Equipment	SF_6	1.13	1.94	30%	30%	42%	3.1E-08	0.0042%	0.0221%	0.0000%

IPCC Category		Gas	1990 Emissions [kt CO_2e]	2023 Emissions [kt CO_2e]	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 [%]
2G2b	Accelerators	SF_6	0.00	0.00	2%	30%	30%	3.0E-16	0.0000%	0.0000%	0.0000%
Total Emissions			3707.3	4646.0							
Total Uncertainties		% Uncertainty in total inventory (excluding LULUCF):						4.9%	Trend uncertainty:		6.0%

Annex 3: National Energy Balance for 2023

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 1078 TJ, which is 5.0% of the total final energy consumption in Iceland in 2023. The biggest discrepancies in fuel use are in jet kerosene. This discrepancy will be further analysed with the agencies that provide the data.

A comparison of CO_2 emissions [kt] between the sectoral approach and the reference approach are shown in Table A3.2.

Table A3.1: National Energy Balance for 2023 [TJ]

2023	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	–	–	–	–	–	–	–	–	–	–	–	–	–	82	82.2	0.000
Imports	4345	14632	20854	247	139	793	141	344	32	3462	232	16	661	–	45898	45237
Exports	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
International Bunkers	–	13431	4207	252	–	–	–	–	–	–	–	–	–	–	17890	17890
Stock Change	25.4	88	-30	-251	-6.86	–	–	–	–	–	–	–	-1.5	–	-175	-174
Primary Energy Supply	4320	1112	16677	246	146	793	141	344	32	3462	232	16	663	82	28266	27521
Non-Energy Use of Fuels						793	139	344	32	3462	232	16			5018	5018
Available Final Energy Consumption [TJ	**4320**	**1112**	**16677**	**246**	**146**	**0**	**1.6**	**0**	**0**	**0**	**0**	**0**	**663**	**82**	**23248**	**22503**
1A1ai Electricity generation	–	–	86.6	–	–	–	–	–	–	–	–	–	–	–	87	87
1A1aiii Heat Plants	–	–	61.62	–	–	–	–	–	–	–	–	–	–	–	61.6	61.6
1A2a Iron and Steel	–	–	9.56	–	9.1	–	–	–	–	–	–	–	–	–	18.7	18.7
1A2b Non-Ferrous Metals	–	–	5.8	–	59.7	–	–	–	–	–	–	–	–	–	65.5	65.5
1A2c Chemicals	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1A2e Food Processing, Beverage and Tobacco	–	–	324	245	–	–	–	–	–	–	–	–	–	–	569	569
1A2f Non-Metallic Minerals	–	–	5.95	–	–	–	–	–	–	–	–	–	–	–	5.95	5.95
1A2gvii Off-Road Vehicles and Mobile Machinery	–	–	648	–	–	–	–	–	–	–	–	–	–	–	648	648
1A2gviii Other industry	–	–	103.2	–	11.7	–	–	–	–	–	–	–	–	–	115	115
1A3a Domestic Aviation	7.53	305	–	–	-	–	–	–	–	–	–	–	–	–	313	313
1A3b Road Transport	4092	–	8307	–	–	–	–	–	–	–	–	–	639	79.1	13116	12399

2023	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
1A3dii Domestic Navigation	–	–	226	–	–	–	–	–	–	–	–	–	–	–	226	226
1A3eii Other Mobile Machinery	–	0.96	–	–	–	–	–	–	–	–	–	–	–	–	1.0	1.0
1A4ai Commercial/Institutional: Stationary Combustion	–	–	5.20	–	30.0	–	–	–	–	–	–	–	–	–	35.2	35.2
1A4bi Residential: Stationary Combustion	–	–	17.8	–	45.9	–	–	–	–	–	–	–	–	–	63.7	63.7
1A4ci Stationary Agriculture	–	–	–	–	0.189	–	–	–	–	–	–	–	–	–	0.189	0.189
1A4cii Off Road in Agriculture	–	–	269	–	–	–	–	–	–	–	–	–	–	–	269	269
1A4ciii Fishing	–	–	6524	–	–	–	–	–	–	–	–	–	–	–	6524	6524
1A5 Other	–	1.36	22.50	–	0.241	–	–	–	–	–	–	–	0.618	–	24.7	24.1
Final Energy Consumption [TJ]	**4099**	**307**	**16616**	**245.2**	**157**	–	–	–	–	–	–	–	**639**	**79.1**	**22144**	**21425**
Statistical Differences [TJ]	**221**	**804**	**61**	**0.79**	**-10.7**	–	–	–	–	–	–	–	**23.5**	**3.1**	**1104**	**1078**
Difference [%]	**5.4%**	**262%**	**0.4%**	**0.32%**	**-6.8%**	–	–	–	–	–	–	–	**3.7%**	**4%**	**5.0%**	**5.0%**

Table A3.2: A comparison of CO_2 emissions [kt] between the sectoral approach and the reference approach.

CO_2 emissions [kt]		1990	1995	2000	2005	2010	2015	2020	2021	2022
Liquid fuels	Reference Approach	1735	1738	1763	1804	1587	1652	1482	1683	1642
	Sectoral Approach	1700	1898	1932	1961	1786	1656	1465	1595	1564
	Difference [kt]	35	-159	-170	-156	-199	-3.5	16.4	88	78
	Difference [%]	2.1%	-8.4%	-8.8%	-8.0%	-11%	-0.21%	1.1%	5.5%	5.0%
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	1.50	1.95	1.92	3.27	NO	NO	NO	NO
	Sectoral Approach	NO	16.9	20.7	8.21	9.38	4.70	1.10	13.7	12.3
	Difference [kt]	–	-15.4	-18.7	-6.28	-6.11	-4.70	-1.10	-13.7	-12.3
	Difference [%]	–	-91%	-91%	-77%	-65%	–	–	–	–
Total	**Reference Approach**	**1767**	**1757**	**1799**	**1840**	**1600**	**1652**	**1482**	**1683**	**1642**
	Sectoral Approach	**1746**	**1936**	**1985**	**1993**	**1804**	**1661**	**1466**	**1609**	**1576**
	Difference [kt]	**21.3**	**-179**	**-187**	**-153**	**-204**	**-8.24**	**15.3**	**74.3**	**65.9**
	Difference [%]	**1.2%**	**-9.2%**	**-9.4%**	**-7.7%**	**-11%**	**-0.50%**	**1.0%**	**4.6%**	**4.2%**

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 CO_2e, with CO_2 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.

		Total Emissions (CO_2e)			
Category[(1)]	**Gas**	**GHG inventory emissions [kt CO_2e]**[(3)]	**Verified emissions under Directive 2003/87/EC [kt CO_2e]**[(3)]	**Ratio in % (Verified emissions/ inventory emissions)**[(3)]	**Comment**[(2)]
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	4,623.7	1,812.5	39.2%	
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	3,485.9	1,744.4	50.0%	

For footnotes, see under Table A4. 4 below.

Table A4. 2 Total GHG inventory CO_2 emissions vs. emissions verified under the EU ETS, by CRT sector.

CO_2 Emissions					
Category[1]	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]	Comment[2]
1.A Fuel combustion activities, total	CO_2	1,576.4	5.5	0.4%	
1.A Fuel combustion activities, stationary combustion	CO_2	117.5	5.5	4.7%	
1.A.1 Energy industries	CO_2	10.9	NO		Not verified emissions under Directive 2003/87/EC
1.A.1.a Public electricity and heat production	CO_2	10.9	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	405.6	405.6	100.0%	
1.A.2. Manufacturing industries and construction	CO_2	104.3	5.5	5.3%	
1.A.2.a Iron and steel	CO_2	1.3	1.3	100.2%	Differences due to slightly different NCV values used by ETS companies vs. inventory
1.A.2.b Non-ferrous metals	CO_2	4.2	4.2	99.9%	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	42.2	NO		Not verified emissions under Directive 2003/87/EC
1.A.2.f Non-metallic minerals	CO_2	0.44	NO		Not verified emissions under Directive 2003/87/EC
1.A.2.g Other	CO_2	56.2	0.1	0.1%	One company is included in ETS, others are not
1.A.3. Transport	CO_2	952.5	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	507.0	NO		Not verified emissions under Directive 2003/87/EC

Category[1]	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]	Comment[2]
CO_2 Emissions					
1.A.4.a Commercial / Institutional	CO_2	2.3	NO		Not verified emissions under Directive 2003/87/EC
1.A.4.c Agriculture/ Forestry / Fisheries	CO_2	500.5	NO		Not verified emissions under Directive 2003/87/EC
1.B Fugitive Emissions from Fuels	CO_2	172.2	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	CO_2	1.0	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	1.0	NO		Not verified emissions under Directive 2003/87/EC
2.B Chemical Industry	CO_2	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	CO_2	1,738.9	1,738.9	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	404.4	404.4	100.0%	
2.C.3 Aluminium Production	CO_2	1,334.6	1,334.6	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

CO_2 Emissions					
Category[(1)]	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)]	Comment[(2)]
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 N_2O emissions vs. emissions verified under the EU ETS, by CRT sector [kt CO_2e].

N_2O Emissions					
Category[1]	Gas	GHG inventory emissions [kt CO_2e][3]	Verified emissions under Directive 2003/87/EC [kt CO_2e][3]	Ratio in % (Verified emissions/ inventory emissions)[3]	Comment[2]
2.B.2. Nitric Acid Production	N_2O	NO	NO		Does not occur in Iceland
2.B.3. Adipic Acid Production	N_2O	NO	NO		Does not occur in Iceland
2.B.4. Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	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 CO_2e].

PFC Emissions					
Category[1]	Gas	GHG inventory emissions [kt CO_2e][3]	Verified emissions under Directive 2003/87/EC [kt CO_2e][3]	Ratio in % (Verified emissions/ inventory emissions)[3]	Comment[2]
2.C.3 Aluminium Production	PFC	68.1	68.1	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 Feed: Mature Dairy Cattle.

1. Dairy Cattle, stallfed, lactation period		1990	1995	2000	2005	2010	2015	2020	2022	2023
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	0.00	0.17	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Feed intake [kg/day]	Concentrate	2.0	2.1	2.5	3.7	4.2	4.8	5.2	5.2	5.2
Dry matter digestibility [%]	Hay	68.0	69.3	71.2	72.0	71.0	74.1	76.0	74.0	74.0
Dry matter digestibility [%]	Barley	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0
Dry 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	7.4	7.8	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	8.0	8.6	9.0	9.0	9.0
Crude protein content (of dry matter) [%]	Hay	14.1	14.9	15.9	16.0	15.8	15.9	15.5	15.7	15.7
Crude protein content (of dry matter) [%]	Barley	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Crude protein content (of dry matter) [%]	Concentrate	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Weighted average dry matter digestibility [%]		70.8	72.2	74.2	75.7	75.4	77.8	79.2	77.9	77.9
Weighted average ash content [%]		7.2	7.1	7.1	7.2	7.2	7.6	7.9	8.1	8.1
Weighted average CP [%]		14.6	15.2	16.1	16.2	16.1	16.2	15.9	16.1	16.1
Time in feeding situation [days]		230	233	235	238	241	244	246	247	247
2. Dairy Cattle, stallfed, non-lactation		**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2022**	**2023**
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
Dry matter digestibility [%]	Hay	67.0	68.1	69.2	70.0	70.0	70.0	70.0	70.0	70.0
Dry 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
Crude protein content (of dry matter) [%]	Hay	14.1	14.9	15.7	16.0	15.8	14.5	13.7	12.8	12.8
Crude protein content (of dry matter) [%]	Concentrate	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0

2. Dairy Cattle, stallfed, non-lactation		1990	1995	2000	2005	2010	2015	2020	2022	2023
Weighted average dry matter digestibility [%]		67.0	68.1	69.2	70.0	70.0	70.0	70.0	70.0	70.0
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.3	7.5	7.2	7.2
Weighted average CP [%]		14.1	14.9	15.7	16.0	15.8	14.5	13.7	12.8	12.8
Time in feeding situation [days]		35	38	40	43	46	49	51	52	52

3. Dairy Cattle, pasture, lactation period		1990	1995	2000	2005	2010	2015	2020	2022	2023
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
Dry matter digestibility [%]	Hay	72.0	72.0	72.0	72.0	72.0	75.1	77.0	77.0	77.0
Dry 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	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Crude protein content (of dry matter) [%]	Hay	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Crude protein content (of dry matter) [%]	Concentrate	17.0	17.0	17.0	17.0	17.0	17.6	18.0	18.0	18.0
Weighted average dry matter digestibility [%]		73.9	74.0	74.3	75.2	75.5	77.9	79.3	79.3	79.3
Weighted average ash content [%]		7.6	7.6	7.7	7.8	7.8	7.8	7.9	7.9	7.9
Weighted average CP [%]		17.9	17.8	17.8	17.8	17.7	17.9	18.0	18.0	18.0
Time in feeding situation [days]		65	62	60	57	54	51	49	48	48

4. Dairy Cattle, pasture, non-lactation		1990	1995	2000	2005	2010	2015	2020	2022	2023
Feed intake [kg/day]	Hay	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Dry matter digestibility [%]	Hay	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Ash content [%]	Hay	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Crude protein content (of dry matter) [%]	Hay	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Weighted average dry matter digestibility [%]		72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Weighted average ash content [%]		7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Weighted average CP [%]		13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Time in feeding situation [days]		25	22	20	17	14	11	9	8	8

Conversion of dry matter digestibility to digestible energy % of gross energy intake[45]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Digestible organic matter per kg of dry matter	630	639	653	665	663	683	694	685	685
Metabolizable energy per gram dry matter	15	15	15	15	15	15	15	15	15
Metabolizable energy per kg dry matter	9,451	9,588	9,796	9,976	9,947	10,238	10,407	10,278	10,278
Ratio of metabolizable to digestible energy	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy per kg dry matter	11,668	11,837	12,094	12,317	12,281	12,639	12,848	12,689	12,689
Gross energy per kg dry matter	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500
Digestible % of gross energy intake	63.1	64.0	65.4	66.6	66.4	68.3	69.4	68.6	68.6

Table A5.2 Values used in Calculation of Digestible Energy of Feed: Other Mature Cattle.

1. Other Mature Cattle, stallfed		1990	1995	2000	2005	2010	2015	2020	2022	2023
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
Dry matter digestibility [%]	Hay	66.0	67.6	68.8	70.0	69.0	69.6	70.0	70.0	70.0
Dry 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
Crude protein content (of dry matter) [%]	Hay	14.0	14.6	15.3	16.0	15.5	14.7	14.0	13.0	13.0
Crude protein content (of dry matter) [%]	Concentrate	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Weighted average dry matter digestibility [%]		66.2	67.7	69.0	70.1	69.3	69.9	70.4	70.4	70.4
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.3	7.5	7.3	7.3
Weighted average CP [%]		14.0	14.6	15.3	16.0	15.5	14.7	14.1	13.1	13.1
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	2022	2023
Feed intake [kg/day]	Hay	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Feed intake [kg/day]	Grass (grazing)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0

[45] Breyting á orkumatskerfi fyrir jórturdýr (Guðmundsson & Eiríksson, 1995)

Dry matter digestibility [%]	Hay	66.0	67.6	68.8	70.0	69.0	69.6	70.0	70.0	70.0
Dry 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	7.0
Ash content [%]	Grass (grazing)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Crude protein content (of dry matter) [%]	Hay	14.0	14.6	15.3	16.0	15.5	14.7	14.0	13.0	13.0
Crude protein content (of dry matter) [%]	Grass (grazing)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Weighted average dry matter digestibility [%]		74.4	75.0	75.5	76.0	75.6	75.8	76.0	76.0	76.0
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Weighted average CP [%]		15.5	15.7	16.0	16.3	16.1	15.7	15.5	15.1	15.1
Time in feeding situation [days]		335	335	335	335	335	335	335	335	335

Conversion of dry matter digestibility to digestible energy % of gross energy intake[46]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Digestible organic matter per kg of dry matter	675	681	687	692	688	690	692	692	692
Metabolizable energy per gram dry matter	15	15	15	15	15	15	15	15	15
Metabolizable energy per kg dry matter	10,118	10,221	10,302	10,381	10,317	10,355	10,385	10,385	10,385
Ratio of metabolizable to digestible energy	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy per kg dry matter	12,491	12,618	12,719	12,816	12,737	12,784	12,821	12,821	12,821
Gross energy per kg dry matter	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500
Digestible % of gross energy intake	67.5	68.2	68.7	69.3	68.9	69.1	69.3	69.3	69.3

[46] Breyting á orkumatskerfi fyrir jórturdýr (Guðmundsson & Eiríksson, 1995)

Table A5.3 Values used in Calculation of Digestible Energy of Feed: Pregnant Heifers.

1. Pregnant Heifers, stallfed		1990	1995	2000	2005	2010	2015	2020	2022	2023
Feed intake [kg/day]	Hay	5.0	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0
Feed intake [kg/day]	Concentrate	0.20	0.20	0.21	0.25	0.30	0.41	0.50	0.50	0.50
Dry matter digestibility [%]	Hay	66.0	67.6	68.8	70.0	69.0	70.7	72.0	72.0	72.0
Dry 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	7.5	7.5
Ash content [%]	Concentrate	8.0	8.0	8.0	8.0	8.0	8.6	9.0	9.0	9.0
Crude protein content (of dry matter) [%]	Hay	14.0	14.6	15.3	16.0	15.5	15.2	15.0	15.0	15.0
Crude protein content (of dry matter) [%]	Concentrate	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Weighted average dry matter digestibility [%]		66.7	68.2	69.5	70.7	69.9	71.8	73.0	73.0	73.0
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.1	7.4	7.6	7.6	7.6
Weighted average CP [%]		14.1	14.7	15.4	16.0	15.6	15.4	15.2	15.2	15.2
Time in feeding situation [days]		245	245	245	245	245	245	245	245	245

2. Pregnant Heifers, pasture		1990	1995	2000	2005	2010	2015	2020	2022	2023
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)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Dry matter digestibility [%]	Hay	66.0	67.6	68.8	70.0	69.0	70.7	72.0	72.0	72.0
Dry 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	7.3	7.5	7.5	7.5
Ash content [%]	Grass (grazing)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Crude protein content (of dry matter) [%]	Hay	14.0	14.6	15.3	16.0	15.5	15.2	15.0	15.0	15.0
Crude protein content (of dry matter) [%]	Grass (grazing)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Weighted average dry matter digestibility [%]		77.8	78.1	78.3	78.5	78.3	78.6	78.8	78.8	78.8
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.1
Weighted average CP [%]		16.1	16.2	16.3	16.4	16.3	16.3	16.2	16.2	16.2
Time in feeding situation [days]		120	120	120	120	120	120	120	120	120

Conversion of dry matter digestibility to digestible energy % of gross energy intake[47]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Digestible organic matter per kg of dry matter	642	652	661	670	664	677	686	686	686
Metabolizable energy per gram dry matter	15	15	15	15	15	15	15	15	15
Metabolizable energy per kg dry matter	9,627	9,786	9,916	10,051	9,962	10,157	10,290	10,290	10,290
Ratio of metabolizable to digestible energy	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy per kg dry matter	11,885	12,082	12,242	12,408	12,299	12,540	12,703	12,703	12,703
Gross energy per kg dry matter	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500
Digestible % of gross energy intake	64.2	65.3	66.2	67.1	66.5	67.8	68.7	68.7	68.7

Table A5.4 Values used in Calculation of Digestible Energy of Feed: Steers and Non-inseminated Heifers.

1. Steers and Uninseminated Heifers, stallfed		1990	1995	2000	2005	2010	2015	2020	2022	2023
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]	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
Dry matter digestibility [%]	Hay	66.0	67.6	68.8	70.0	69.0	71.2	73.0	73.0	73.0
Dry matter digestibility [%]	Barley	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0
Dry 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
Crude protein content (of dry matter) [%]	Hay	14.0	14.6	15.3	16.0	15.5	15.2	15.0	15.0	15.0
Crude protein content (of dry matter) [%]	Barley	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Crude protein content (of dry matter) [%]	Concentrate	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Weighted average dry matter digestibility [%]		67.7	69.8	71.8	72.9	72.2	74.0	75.2	75.2	75.2
Weighted average ash content [%]		7.1	7.0	6.8	6.8	6.8	7.1	7.3	7.1	7.1
Weighted average CP [%]		14.0	14.5	14.9	15.5	15.0	14.8	14.7	14.7	14.7

[47] Breyting á orkumatskerfi fyrir jórturdýr (Guðmundsson & Eiríksson, 1995)

1. Steers and Uninseminated Heifers, stallfed		1990	1995	2000	2005	2010	2015	2020	2022	2023
Time in feeding situation [days]		307	307	307	307	307	307	307	307	307

2. Steers and Uninseminated Heifers, pasture		1990	1995	2000	2005	2010	2015	2020	2022	2023
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
Dry matter digestibility [%]	Hay	66.0	67.6	68.8	70.0	69.0	70.9	72.0	72.0	72.0
Dry 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
Crude protein content (of dry matter) [%]	Hay	14.0	14.6	15.3	16.0	15.0	15.4	15.0	15.0	15.0
Crude protein content (of dry matter) [%]	Grass (grazing)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Weighted average dry matter digestibility [%]		75.8	76.1	76.3	76.5	76.4	76.2	76.1	76.1	76.1
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.0	7.0
Weighted average CP [%]		16.0	16.1	16.2	16.4	16.2	16.3	16.2	16.2	16.2
Time in feeding situation [days]		58	58	58	58	58	58	58	58	58

Conversion of dry matter digestibility to digestible energy % of gross energy intake[48]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Digestible organic matter per kg of dry matter	628	646	663	672	666	680	691	691	691
Metabolizable energy per gram dry matter	15	15	15	15	15	15	15	15	15
Metabolizable energy per kg dry matter	9,425	9,692	9,941	10,080	9,988	10,205	10,358	10,358	10,358
Ratio of metabolizable to digestible energy	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy per kg dry matter	11,636	11,966	12,273	12,444	12,331	12,599	12,788	12,788	12,788
Gross energy per kg dry matter	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500
Digestible % of gross energy intake	62.9	64.7	66.3	67.3	66.7	68.1	69.1	69.1	69.1

[48] Breyting á orkumatskerfi fyrir jórturdýr (Guðmundsson & Eiríksson, 1995)

Table A5.5 Values used in Calculation of Digestible Energy of Feed: Calves

1. Calves, first 90 days		1990	1995	2000	2005	2010	2015	2020	2022	2023
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
Dry matter digestibility [%]	Milk/formula	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0
Dry matter digestibility [%]	Hay	68.0	69.6	70.8	72.0	71.0	73.2	75.0	75.0	75.0
Dry 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	7.5	7.5
Ash content [%]	Concentrate	8.0	8.0	8.0	8.0	8.0	8.6	9.0	9.0	9.0
Crude protein content (of dry matter) [%]	Hay	14.1	14.9	15.8	16.0	15.8	15.5	15.5	15.5	15.5
Crude protein content (of dry matter) [%]	Concentrate	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Weighted average dry matter digestibility [%]		89.4	89.5	89.6	89.4	89.0	88.9	89.7	89.7	89.7
Weighted average ash content [%]		8.7	8.7	8.7	8.7	8.6	8.8	8.9	8.9	8.9
Weighted average CP [%]		18.0	18.3	18.6	18.9	19.0	19.0	19.1	19.1	19.1
Time in feeding situation [days]		90	90	90	90	90	90	90	90	90

2. Calves, days 91-365		1990	1995	2000	2005	2010	2015	2020	2022	2023
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
Dry matter digestibility [%]	Hay	68.0	69.6	70.8	72.0	71.0	72.1	73.0	73.0	73.0
Dry 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
Crude protein content (of dry matter) [%]	Hay	14.1	14.9	15.8	16.0	15.8	15.5	15.5	15.5	15.5
Crude protein content (of dry matter) [%]	Concentrate	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Weighted average dry matter digestibility [%]		70.8	71.9	72.8	73.7	72.8	73.6	74.8	74.8	74.8
Weighted average ash content [%]		7.2	7.2	7.2	7.2	7.2	7.4	7.6	7.6	7.6

Weighted average CP [%]	15.1	15.7	16.4	16.5	16.3	16.1	16.0	16.0	16.0
Time in feeding situation [days]	275	275	275	275	275	275	275	275	275

Conversion of dry matter digestibility to digestible energy % of gross energy intake[49]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Digestible organic matter per kg of dry matter	691	699	706	712	704	710	721	721	721
Metabolizable energy per gram dry matter	15	15	15	15	15	15	15	15	15
Metabolizable energy per kg dry matter	10,361	10,488	10,590	10,681	10,565	10,656	10,811	10,811	10,811
Ratio of metabolizable to digestible energy	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy per kg dry matter	12,792	12,948	13,074	13,186	13,043	13,156	13,346	13,346	13,346
Gross energy per kg dry matter	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500
Digestible % of gross energy intake	69.1	70.0	70.7	71.3	70.5	71.1	72.1	72.1	72.1

Table A5.6 Values used in Calculation of Digestible Energy of Feed: Sheep

1. Sheep, stallfed		1990	1995	2000	2005	2010	2015	2020	2022	2023
Feed intake [kg/day]	Hay	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Feed intake [kg/day]	Concentrate	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Dry matter digestibility [%]	Hay	65.0	66.6	67.8	69.0	68.0	70.8	73.0	71.0	71.0
Dry 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
Crude protein content (of dry matter) [%]	Hay	13.3	14.1	14.9	15.2	15.0	14.7	14.6	14.6	14.6
Crude protein content (of dry matter) [%]	Concentrate	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Weighted average dry matter digestibility [%]		65.1	66.7	67.9	69.1	68.1	70.9	73.1	71.1	71.1
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.2	7.4	7.8	7.8
Weighted average CP [%]		13.3	14.2	14.9	15.2	15.0	14.7	14.6	14.6	14.6
Time in feeding situation [days]		200	200	200	200	200	200	200	200	200

[49] Breyting á orkumatskerfi fyrir jórturdýr (Guðmundsson & Eiríksson, 1995)

2. Sheep, pasture		1990	1995	2000	2005	2010	2015	2020	2022	2023
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
Dry matter digestibility [%]	Hay	68.0	69.6	70.8	72.0	71.0	73.2	75.0	75.0	75.0
Dry 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
Crude protein content (of dry matter) [%]	Hay	14.1	14.9	15.7	16.0	15.8	15.5	15.5	15.7	15.7
Crude protein content (of dry matter) [%]	Grass (grazing)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Weighted average dry matter digestibility [%]		77.0	77.4	77.7	78.0	77.8	78.3	78.8	78.8	78.8
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.2	7.2
Weighted average CP [%]		15.9	16.1	16.3	16.3	16.3	16.2	16.2	16.3	16.3
Time in feeding situation [days]		60	60	60	60	60	60	60	60	60

3. Sheep, range		1990	1995	2000	2005	2010	2015	2020	2022	2023
Feed intake [kg/day]	Grass (grazing)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Dry matter digestibility [%]	Grass (grazing)	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0
Ash content [%]	Grass (grazing)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Crude protein content (of dry matter) [%]	Grass (grazing)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Weighted average dry matter digestibility [%]		70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0
Weighted average ash content [%]		7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Weighted average CP [%]		16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Time in feeding situation [days]		105	105	105	105	105	105	105	105	105

Conversion of dry matter digestibility to digestible energy % of gross energy intake[50]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Digestible organic matter per kg of dry matter	623	632	639	646	640	656	669	658	658

[50] Breyting á orkumatskerfi fyrir jórturdýr (Guðmundsson & Eiríksson, 1995)

Conversion of dry matter digestibility to digestible energy % of gross energy intake[50]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Metabolizable energy per gram dry matter	15	15	15	15	15	15	15	15	15
Metabolizable energy per kg dry matter	9,346	9,481	9,587	9,691	9,605	9,840	10,029	9,869	9,869
Ratio of metabolizable to digestible energy	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy per kg dry matter	11,539	11,705	11,836	11,964	11,858	12,149	12,382	12,184	12,184
Gross energy per kg dry matter	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500
Digestible % of gross energy intake	62.4	63.3	64.0	64.7	64.1	65.7	66.9	65.9	65.9

Table A5.7 Values used in Calculation of Digestible Energy of Feed: Lambs

1. Lambs, pre-weaning		1990	1995	2000	2005	2010	2015	2020	2022	2023
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
Dry matter digestibility [%]	Grass (grazing)	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0
Dry 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
Crude protein content (of dry matter) [%]	Grass (grazing)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Crude protein content (of dry matter) [%]	Milk	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Weighted average dry matter digestibility [%]		79.9	79.9	79.9	79.9	79.9	79.9	79.9	79.9	79.9
Weighted average ash content [%]		6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Weighted average CP [%]		16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
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	2022	2023
Feed intake [kg/day]	Grass (grazing)	0.70	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	0.10
Feed intake [kg/day]	Milk	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Dry matter digestibility [%]	Grass (grazing)	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0

2. Lambs, after-weaning		1990	1995	2000	2005	2010	2015	2020	2022	2023
Dry matter digestibility [%]	Rape/rye grass etc.	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.0
Dry 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)	8.0	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	9.0
Ash content [%]	Milk	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Crude protein content (of dry matter) [%]	Grass (grazing)	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Crude protein content (of dry matter) [%]	Rape/rye grass etc.	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Crude protein content (of dry matter) [%]	Milk	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Weighted average dry matter digestibility [%]		79.4	79.4	79.4	79.4	79.4	79.4	79.4	79.4	79.4
Weighted average ash content [%]		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Weighted average CP [%]		16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Time in feeding situation [days]		70	70	70	70	70	70	70	70	70

Conversion of dry matter digestibility to digestible energy % of gross energy intake[51]	1990	1995	2000	2005	2010	2015	2020	2022	2023
Digestible organic matter per kg of dry matter	704	704	704	704	704	704	704	704	704
Metabolizable energy per gram dry matter	15	15	15	15	15	15	15	15	15
Metabolizable energy per kg dry matter	10,553	10,553	10,553	10,553	10,553	10,553	10,553	10,553	10,553
Ratio of metabolizable to digestible energy	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Digestible energy per kg dry matter	13,029	13,029	13,029	13,029	13,029	13,029	13,029	13,029	13,029
Gross energy per kg dry matter	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500	18,500
Digestible % of gross energy intake	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4

[51] Breyting á orkumatskerfi fyrir jórturdýr (Guðmundsson & Eiríksson, 1995)

Table A5.8 Conversion of DMD into DE

2022	Dry matter digestibility	Organic matter digestibility	Metabolizable energy	Digestible energy
Calculations	DMD [%] cf. A-G	OMD [g/kg] (0.98·DMD-4.8)·10	ME [kJ/kg dm] 15·OMD	DE [%] $\frac{\mathrm{ME}}{0.81 \cdot 18500} \cdot 100$
Dairy Cattle	74.82	685.20	10,278	**68.59**
Other Mature Cattle	75.54	692.32	10,385	**69.30**
Pregnant Heifers	74.90	685.99	10,290	**68.67**
Steers and Non-inseminated Heifers	75.36	690.54	10,358	**69.12**
Young Cattle	78.44	720.70	10,811	**72.14**
Sheep	72.03	657.93	9,869	**65.86**
Lambs	76.69	703.56	10,553	**70.43**

Annex 6: Uncertainty rates associated with activity data and emission factors used in the LULUCF sector estimates

Table A6.9 Uncertainty rates associated with Forest Land use category

Category	Uncertainty rate	Reference
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 1,778 plots in the sample area, 1,012 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.).
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 2020-2024 (n=958), which are paired with measurements taken in 2015-2019, is based on calculations using raw data from September 2024. In addition, the measurements in research projects (Snorrason, Sigurðsson, Guðbergsson, Svavarsdóttir, & Jónsson, 2002; Sigurðsson, Elmarsdóttir, Bjarnadóttir, & Magnússon, 2008) were consulted.
Afforestation older than 50 years Plantations in natural birch forest	±9%	
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.
Afforestation older than 50 years Plantations in natural birch forest	±10%	
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.
Afforestation older than 50 years Plantations in natural birch forest	±10%	
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.
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		Error calculation (relative 95% Confidense interval) on CSC of the 2020-2024 NFI systematic sample plots (n=958, paired with measurments in 2015-2019). (Build on calculation on raw data in September 2024).
Afforestation 1-50 years old - Cultivated forest Afforestation 1-50 years old	±9%	

Category	Uncertainty rate	Reference
Grassland converted to Forest land - Afforestation natural birch forest 1-50 years old Other Land 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.
Living biomass: Losses		
Afforestation 1-50 years old -Cultivated forest Afforestation 1-50 years old	±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.
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:		
Grassland converted to Forest land - Afforestation natural birch forest 1-50 years old Grassland converted to Forest land - Afforestation 1-50 years old - Cultivated forest	±23%	The average of the relative 95% CIs from research results used to estimate carbon stock change in deep, well-developed soils on rangelands. (Bjarnadóttir, 2009; table 8 on page 42).
Other Land Converted to Forest land - Afforestation 1-50 years old Other Land Converted to Forest land - Afforestation natural birch forest 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.
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.

Table A6.10 Uncertainty rates associated with Cropland and Grassland land use categories

Category	Uncertainty rate	Reference
Cropland remaining Cropland **Land converted to Cropland**		
Area		
Area (Cropland remaining Cropland)	±21%	See the explanation below the table.
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		
Forest land converted to Cropland	±75%	Table 5.9 of the 2006 IPCC Guidelines
Grassland converted to Cropland	±75%	Table 5.9 of the 2006 IPCC Guidelines
Wetlands converted to Cropland	±75%	Table 5.9 (Temperate climate) of the 2006 IPCC Guidelines
Living biomass: Losses		
Forest land converted to Cropland	50%	Biomass on one plot at the area deforested. Variation in biomass density assumed to be 50%
Grassland converted to Cropland	±75%	Guðmundsson, Gísladóttir, Brink, & Óskarsson, 2010
Wetlands converted to Cropland	±75%	Table 5.9 (Temperate climate) of the 2006 IPCC Guidelines
SOC, mineral soils, EFs		
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.
Grassland converted to Cropland	±17%	Table 5.5 (Flu-Temperate/Boreal-Moist) of the 2006 IPCC Guidelines
Organic soils, EFs		
Cropland remaining Cropland	-18% ...+ 19%	Table 2.1 (Cropland, drained - Boreal and Temperate) of the 2013 Wetlands Supplement
Forest land converted to Cropland	-18%...19%	Table 2.1 (Cropland, drained - Boreal and Temperate) of the Wetlands Supplement
Wetlands converted to Cropland	-18%...+19%	Table 2.1 (Drained inland organic soils) of the Wetlands Supplement
Grassland remaining Grassland		
Area		
Cropland abandoned for more than 20 years	±21%	Assumed the same value as for Cropland remaining Cropland
Organic soils drained for more than 20 years	±21%	

Category	Uncertainty rate	Reference
Natural birch shrubland - recently expanded into other grassland	±4%	Minera soils: area estimates of Natural Birch Shrubland are identical to the area estimates of Natural Birch Forest.
Natural birch shrubland – old	±4%	
Living biomass: Gains/Losses		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.
Natural birch shrubland - recently expanded into other grassland	±47%	
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		
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		
Natural birch shrubland - recently expanded into other grassland	±23%	EF was evaluated as a result of the comprehensive research (Bjarnadóttir 2009, Table 42). Average relative accuracy of 11 different treatments where 23% (95% CI).
Organic soils, EFs		
Cropland abandoned for more than 20 years		
Natural birch shrubland - recently expanded into other grassland	-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
Natural birch shrubland - old		
Organic soils drained for more than 20 years	-49%...+51%	Table 2.1 (Grassland, drained; Boreal) of the Wetlands Supplement
Land converted to Grassland		
Area		
Cropland converted to Grassland	±21%	The reference and extensive explanation is provided below.
Revegetation before 1990		
Revegetation since 1990 - protected from grazing	±30%	Assessment of land restoration areas conducted between 2007 and 2011 (Umpublished data – Jóhann Thorsson)
Revegetation since 1990 - limited grazing allowed		

Category	Uncertainty rate	Reference
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		
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, C stock change (Other land converted to natural birch shrubland)	±18%	The arithmetic average of the 95% CI was evaluated based on two research results conduced to estimate CSC in litter. Bjarnadóttir (2009) and Snorrason et al. (2000; 2002).
SOC, mineral soils, EFs:		
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_{lu} 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 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 A6.11 Uncertainty rates associated with Wetlands and Settlements land use categories

Category	Uncertainty rate	Reference
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.
Rewetted mires - organic soils, EF	-40%…-38%...	Table 3.1 (Boreal, Rich) of the 2013 Wetlands Supplement
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**)
Low SOC – EFs	-53%...142%	The uncertainty range is evaluated based on the data developed within Óskarsson and Guðmundsson 2001, Óskarsson and Guðmundsson, 2008.
Medium SOC – EFs	-53%...142%	The uncertainty range is evaluated based on the data developed within Óskarsson and Guðmundsson 2001, Óskarsson and Guðmundsson, 2008.
Rewetted wetland Soils: Organic/Mineral soils – EFs	-38%...40%	Table 3.1 (Boreal, Rich) of the 2013 Wetlands Supplements

Category	Uncertainty rate	Reference
Land converted to Settlements		
Area		
Forest land converted to Settlements Grassland converted to Settlements – Natural birch shrubland 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.
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		
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.
SOC, mineral soils, EFs		
Forest land converted to settlements Natural birch shrubland converted to Settlements All other Grassland subcategories converted to Settlement	±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.

Table A6.12 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 (N_2O) emissions from nitrogen (N) inputs to managed soils		
Amount of synthetic fertilizers applied	±5%	See chapter 5.7.6 of the NID.
EF1 for N additions from mineral fertilisers	-70%...200%	Table 11.1 of Chapter 11 of the 2006 IPCC Guidelines

Category	Uncertainty rate	Reference
EF4 [N volatilisation and re-deposition], kg N_2O–N EF5 [leaching/runoff], kg N_2O–N (kg N leaching/runoff)	-80%...400% -93%...233%	Table 11.3 of Chapter 11 of the 2006 IPCC Guidelines
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.
Forest land remaining Forest Land, Land converted to Forest Land CO_2 EF N_2O EF CH_4 EF	 ±58% ±51% ±81%	 Country specific EF for forest land on drained organic soils. Bjarnardottir et al. (2021) Country specific EF for uncultivated drained organic soils. Guðmundsson et al. (2024) Table 2.4 (Boreal/Temperate, Drained Forest Land) of the 2013 Wetlands Supplement
Cropland remaining Cropland, Land converted to Cropland CO_2 EF CH_4 EF	 -42%...50% ±71%	 Table 2.2 (Boreal) of the 2013 Wetlands Supplement Table 2.4 (Boreal/Temperate, Deep drained Grassland/Cropland) of the 2013 Wetlands Supplement
Grassland remaining Grassland, Land converted to Grassland CO_2 EF Cropland abandoned for more than 20 years Organic soils drained for more than 20 years	 -42%...50% ±58%	As two EFs were applied to estimate CO_2 emissions from various sub-categories, two uncertainty rates are reported and referenced here: Table 2.2 (Boreal) of the 2013 Wetlands Supplement

Category	Uncertainty rate	Reference
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:
Cropland abandoned for more than 20 years	±71%	Table 2.4 (Boreal/Temperate, Deep-drained Grassland) of the 2013 Wetlands Supplement
Organic soils drained for more than 20 years Natural birch shrubland - recently expanded into other grassland Natural birch shrubland - old	±81%	Table 2.4 (Boreal/Temperate, Drained Forest Land) of the 2013 Wetlands Supplement
Wetlands remaining wetlands Land converted to flooded land (all subcategories) CO_2 EF	-25%...38%	Table 3.2, Boreal of the 2013 Wetlands Supplement.
CH_4 EF Intact mires converted to reservoirs more than 20 years	-100%...260%	Table 3.3 (Boreal, Rich) of the 2013 Wetlands Supplement
Low SOC to reservoirs more than 20 years	-64%...98%	Lower and upper 95% CI of the range EF values for reservoirs.
Medium SOC to reservoirs more than 20 years Grassland converted to flooded land (Medium SOC to reservoirs)	-63%...121%	Lower and upper 95% CI of the range EF values for reservoirs.
Intact mires (managed) Refilled lakes and ponds >20 years Rewetted mires	-100%...260%	Table 3.3 (Boreal, Rich) of the 2013 Wetlands Supplement
Other land converted to flooded land (Low SOC to reservoirs)	-54%...143%	Lower and upper 95% CI of the range EF values for reservoirs.

Category	Uncertainty rate	Reference
CRF 4(III) Direct and indirect nitrous oxide (N_2O) 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_2O–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:		Table 2.5 of the 2006 IPCC Guidelines
CH_4	±81%	
N_2O	±54%	
EFs, Other LU categories:		Table 2.5 of the 2006 IPCC Guidelines
CH_4	±78%	
N_2O	±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 A.7.1 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	0.2
		MCF Managed well – Semi-aerobic	0.2
		MCF Unmanaged Deep	0.8
Starting year	1972	Starting year	1950

Table A.7.2 Amounts Deposited in Managed anaerobic SWDS (CRT 5A1a).

Year	Population [millions]	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	0.207	4.9	0.4	1.7	0.4	0.3	0.0	0.2	2.9	0.7	NO	**11.4**
1973	0.211	5.4	0.4	1.9	0.4	0.3	0.0	0.2	3.3	0.7	NO	**12.6**
1974	0.214	5.4	0.4	1.9	0.4	0.3	0.0	0.2	3.3	0.7	NO	**12.8**
1975	0.217	5.2	0.4	1.9	0.4	0.3	0.0	0.2	3.3	0.7	NO	**12.4**
1976	0.219	5.6	0.5	2.1	0.5	0.3	0.0	0.2	3.6	0.8	NO	**13.6**
1977	0.221	6.2	0.5	2.4	0.5	0.4	0.0	0.3	4.1	0.9	NO	**15.4**
1978	0.223	1.9	0.2	0.7	0.2	0.1	0.0	0.1	1.3	0.3	NO	**4.7**
1979	0.225	6.6	0.6	2.7	0.6	0.4	0.0	0.3	4.6	1.0	NO	**16.7**
1980	0.227	6.8	0.6	2.9	0.6	0.4	0.0	0.3	4.9	1.0	NO	**17.5**
1981	0.229	6.8	0.6	3.0	0.6	0.5	0.1	0.3	5.2	1.0	NO	**18.1**
1982	0.232	6.5	0.6	3.1	0.6	0.5	0.2	0.3	5.4	1.0	NO	**18.3**
1983	0.236	6.0	0.6	3.0	0.6	0.4	0.2	0.3	5.4	1.0	NO	**17.5**
1984	0.238	5.8	0.6	3.1	0.6	0.4	0.3	0.3	5.6	1.0	NO	**17.8**
1985	0.241	5.7	0.6	3.2	0.6	0.5	0.4	0.3	5.9	1.0	NO	**18.2**
1986	0.242	5.8	0.7	3.5	0.7	0.5	0.5	0.3	6.5	1.1	NO	**19.6**
1987	0.244	6.0	0.7	3.9	0.7	0.5	0.6	0.4	7.4	1.2	NO	**21.5**

Year	Population [millions]	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Nappies [kt]	Sludge [kt]	Inert [kt]	Industrial [kt]	Recovery [kt]	Total [kt]
1988	0.248	5.6	0.7	3.9	0.7	0.5	0.7	0.4	7.4	1.2	NO	**21.1**
1989	0.252	5.2	0.7	3.8	0.7	0.5	0.8	0.4	7.5	1.2	NO	**20.8**
1990	0.254	6.6	1.0	5.4	1.0	0.7	1.2	0.5	10.6	1.6	NO	**28.6**
1991	0.256	57.7	8.4	46.6	8.3	6.3	10.3	4.4	92.2	14.2	NO	**248.2**
1992	0.260	56.1	8.2	45.3	8.1	6.1	10.0	4.2	89.7	13.9	NO	**241.6**
1993	0.262	56.4	8.2	45.5	8.1	6.1	10.0	4.3	90.1	13.9	NO	**242.6**
1994	0.265	58.4	8.5	47.2	8.4	6.3	10.4	4.4	93.4	14.4	NO	**251.5**
1995	0.267	60.8	8.8	49.1	8.7	6.6	10.8	4.6	97.1	15.0	NO	**261.6**
1996	0.268	62.0	9.0	50.1	8.9	6.7	11.0	4.7	99.1	15.3	0.1	**267.0**
1997	0.270	63.5	9.2	51.2	9.1	6.9	11.3	4.8	101.4	15.7	0.2	**273.1**
1998	0.272	66.8	9.7	53.9	9.6	7.3	11.9	5.1	106.7	16.5	0.2	**287.4**
1999	0.276	68.0	9.9	54.9	9.8	7.4	12.1	5.1	108.7	16.8	0.3	**292.8**
2000	0.279	70.7	10.3	57.0	10.2	7.7	12.6	5.3	112.9	17.4	0.3	**304.0**
2001	0.283	70.2	10.2	56.7	10.1	7.6	12.5	5.3	112.3	17.3	0.3	**302.3**
2002	0.287	69.5	10.1	56.1	10.0	7.6	12.4	5.3	111.1	17.2	0.5	**299.2**
2003	0.288	71.1	10.3	57.4	10.2	7.7	12.6	5.4	113.6	17.5	0.7	**305.8**
2004	0.291	71.1	10.3	57.4	10.2	7.7	12.6	5.4	113.7	17.6	0.7	**306.1**
2005	0.294	66.4	9.7	53.6	9.5	7.2	11.8	5.0	106.1	16.4	1.2	**285.8**
2006	0.300	58.9	8.6	47.6	8.5	6.4	10.5	4.5	94.2	14.5	0.4	**253.6**
2007	0.308	32.7	12.1	39.8	13.1	5.8	7.1	5.0	61.8	19.5	0.4	**197.0**
2008	0.315	43.1	2.7	44.6	6.5	7.1	8.2	3.1	69.3	1.6	0.6	**186.4**
2009	0.319	40.1	2.0	17.2	4.8	7.1	9.0	2.8	52.4	1.2	0.8	**136.5**
2010	0.318	32.1	1.2	25.6	1.5	2.5	8.6	1.8	46.6	0.2	0.5	**120.2**
2011	0.312	46.5	1.6	25.7	2.3	3.1	8.7	1.9	29.7	4.1	0.9	**123.7**
2012	0.313	51.4	4.5	23.1	2.7	2.8	7.3	1.6	36.4	2.2	1.5	**132.1**
2013	0.316	63.6	4.5	9.3	3.6	3.7	9.5	2.0	36.1	0.8	1.3	**133.2**
2014	0.320	61.9	0.8	13.4	1.2	3.3	8.2	2.2	38.0	4.1	1.3	**133.0**
2015	0.323	65.8	2.4	13.5	3.5	4.6	8.2	2.9	39.8	2.4	1.3	**143.2**
2016	0.326	68.5	2.4	17.3	5.1	5.8	8.5	2.5	44.7	3.7	1.3	**158.4**
2017	0.333	87.9	2.1	16.3	6.5	5.3	8.0	2.4	47.0	4.5	1.4	**180.0**
2018	0.342	92.3	1.8	15.2	7.7	4.6	10.5	2.4	44.3	6.3	1.6	**185.1**
2019	0.349	86.4	1.1	13.3	8.7	5.1	9.2	1.3	42.2	5.2	2.8	**172.5**
2020	0.354	61.7	1.4	10.8	15.4	4.7	10.2	2.0	37.0	2.8	1.8	**146.1**
2021	0.358	47.3	1.8	11.0	10.1	5.2	12.9	2.8	34.1	6.1	1.6	**131.4**
2022	0.365	37.3	1.5	8.9	6.5	4.2	10.3	5.8	28.9	2.4	1.7	**105.9**
2023	0.375	32.1	1.2	7.2	5.6	3.4	8.4	5.2	24.7	2.7	1.7	**90.5**

Table A.7.3 Amounts Deposited in Managed well – Semi-aerobic (CRT 5A1b).

Year	Population [millions]	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Nappies [kt]	Sludge [kt]	Inert [kt]	Industrial [kt]	Recovery [kt]	Total [kt]
Before 2004 these sites were categorised as unmanaged SWDS												
2004	0.291	8.3	1.2	6.7	1.2	0.9	1.5	0.6	13.3	2.1	NO	**35.9**
2005	0.294	14.0	2.0	11.3	2.0	1.5	2.5	1.1	22.4	3.5	NO	**60.2**
2006	0.300	12.4	1.8	10.0	1.8	1.3	2.2	0.9	19.8	3.1	NO	**53.4**
2007	0.308	11.9	0.7	3.3	0.3	0.3	0.6	0.1	13.5	1.3	NO	**32.0**
2008	0.315	16.0	10.0	5.8	1.1	0.8	1.0	3.5	28.5	4.9	NO	**71.7**
2009	0.319	14.2	4.6	2.1	0.5	0.7	1.1	1.2	16.9	3.7	NO	**45.0**

Year	Population [millions]	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Nappies [kt]	Sludge [kt]	Inert [kt]	Industrial [kt]	Recovery [kt]	Total [kt]
2010	0.318	11.7	2.3	2.9	0.9	0.5	1.0	0.5	21.9	2.9	NO	**44.6**
2011	0.312	14.2	2.7	3.2	0.8	0.5	1.1	0.7	9.3	3.8	NO	**36.4**
2012	0.313	13.0	0.2	2.4	1.7	0.4	0.8	0.9	10.7	1.6	NO	**31.7**
2013	0.316	11.4	0.8	1.0	1.2	0.5	1.0	1.0	6.9	2.1	NO	**25.9**
2014	0.320	5.6	0.1	0.8	0.3	0.2	0.5	0.4	37.0	0.9	NO	**45.8**
2015	0.323	5.0	0.3	1.0	0.3	0.3	0.6	0.3	43.9	1.1	NO	**52.6**
2016	0.326	3.9	0.1	1.0	0.5	0.3	0.5	0.2	49.0	1.3	NO	**56.8**
2017	0.333	4.2	0.1	0.7	0.4	0.2	0.3	0.4	20.4	1.5	NO	**28.3**
2018	0.342	5.0	0.1	0.7	0.5	0.2	0.5	1.1	22.1	1.2	NO	**31.5**
2019	0.349	4.6	0.1	0.6	7.7	0.2	0.4	1.0	29.4	2.3	NO	**46.3**
2020	0.354	5.5	0.3	0.8	1.0	0.4	0.8	0.5	31.4	2.4	NO	**43.1**
2021	0.358	4.3	0.3	0.9	1.1	0.4	1.0	0.3	33.9	1.0	NO	**43.3**
2022	0.365	3.5	0.3	0.8	2.6	0.6	0.9	0.1	30.6	0.8	NO	**40.3**
2023	0.375	2.5	0.1	0.5	1.0	0.5	0.6	0.4	30.6	0.4	NO	**36.7**

Table A.7.4 Amounts Deposited in Unmanaged SWDS (CRT 5A2).

Year	Population [millions]	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Nappies [kt]	Sludge [kt]	Inert [kt]	Industrial [kt]	Recovery [kt]	Total [kt]
1950	0.141	29.6	1.8	5.0	1.8	1.4	0.0	0.9	10.0	3.1	NO	**53.6**
1951	0.144	28.3	1.7	5.0	1.7	1.3	0.0	0.9	9.8	3.0	NO	**51.7**
1952	0.147	27.9	1.7	5.1	1.7	1.3	0.0	0.9	9.9	3.0	NO	**51.5**
1953	0.149	32.2	2.0	6.1	2.0	1.5	0.0	1.1	11.8	3.5	NO	**60.2**
1954	0.153	35.2	2.2	6.9	2.2	1.7	0.0	1.2	13.2	3.8	NO	**66.4**
1955	0.156	38.2	2.5	7.7	2.4	1.8	0.0	1.3	14.7	4.2	NO	**72.8**
1956	0.159	38.4	2.5	8.0	2.5	1.9	0.0	1.3	15.2	4.2	NO	**73.9**
1957	0.163	37.7	2.5	8.1	2.5	1.9	0.0	1.3	15.3	4.2	NO	**73.4**
1958	0.167	41.0	2.7	9.1	2.7	2.0	0.0	1.4	17.0	4.6	NO	**80.5**
1959	0.170	41.5	2.8	9.5	2.8	2.1	0.0	1.4	17.7	4.7	NO	**82.5**
1960	0.174	41.7	2.8	9.8	2.8	2.1	0.0	1.5	18.2	4.8	NO	**83.7**
1961	0.177	42.5	2.9	10.3	2.9	2.2	0.0	1.5	19.0	5.0	NO	**86.3**
1962	0.181	45.5	3.2	11.4	3.1	2.4	0.0	1.6	20.9	5.4	NO	**93.4**
1963	0.184	49.2	3.5	12.7	3.4	2.6	0.0	1.8	23.1	5.9	NO	**102.1**
1964	0.187	54.0	3.8	14.3	3.8	2.9	0.0	2.0	26.0	6.5	NO	**113.3**
1965	0.191	58.4	4.2	16.0	4.1	3.1	0.0	2.2	28.9	7.1	NO	**124.0**
1966	0.194	62.1	4.5	17.5	4.5	3.4	0.0	2.3	31.5	7.7	NO	**133.5**
1967	0.197	59.2	4.3	17.2	4.3	3.2	0.0	2.3	30.7	7.4	NO	**128.6**
1968	0.200	55.5	4.1	16.6	4.1	3.1	0.0	2.1	29.5	7.0	NO	**122.0**
1969	0.203	56.1	4.2	17.3	4.2	3.2	0.0	2.2	30.6	7.2	NO	**125.0**
1970	0.204	61.2	4.7	19.4	4.6	3.5	0.0	2.4	34.2	7.9	NO	**138.0**
1971	0.205	68.5	5.3	22.3	5.2	3.9	0.0	2.7	39.3	9.0	NO	**156.3**
1972	0.207	68.8	5.4	23.1	5.3	4.0	0.0	2.8	40.4	9.1	NO	**158.8**
1973	0.211	74.4	5.9	25.7	5.8	4.4	0.0	3.1	44.8	10.0	NO	**174.0**
1974	0.214	74.5	6.0	26.5	5.9	4.5	0.0	3.1	46.0	10.1	NO	**176.4**
1975	0.217	70.3	5.7	25.7	5.6	4.3	0.0	3.0	44.5	9.7	NO	**168.7**
1976	0.219	74.5	6.1	28.0	6.1	4.6	0.0	3.2	48.3	10.4	NO	**181.2**
1977	0.221	80.9	6.7	31.3	6.7	5.0	0.0	3.5	53.8	11.4	NO	**199.4**

Year	Population [millions]	Food [kt]	Garden [kt]	Paper [kt]	Wood [kt]	Textile [kt]	Nappies [kt]	Sludge [kt]	Inert [kt]	Industrial [kt]	Recovery [kt]	Total [kt]
1978	0.223	24.0	2.0	9.6	2.0	1.5	0.0	1.1	16.4	3.4	NO	**60.0**
1979	0.225	83.8	7.2	34.3	7.1	5.4	0.0	3.7	58.6	12.2	NO	**212.3**
1980	0.227	85.8	7.4	36.2	7.4	5.6	0.0	3.9	61.5	12.6	NO	**220.3**
1981	0.229	87.0	7.9	38.7	7.8	5.9	1.0	4.1	67.1	13.3	NO	**232.7**
1982	0.232	84.6	8.0	39.9	7.9	6.0	2.0	4.2	70.2	13.5	NO	**236.1**
1983	0.236	78.4	7.7	39.2	7.6	5.8	2.8	4.0	70.2	13.1	NO	**228.9**
1984	0.238	77.4	8.0	41.1	7.9	6.0	3.9	4.2	74.8	13.6	NO	**236.8**
1985	0.241	75.8	8.2	42.9	8.1	6.2	5.0	4.3	79.3	14.0	NO	**243.8**
1986	0.242	78.3	9.0	47.2	8.9	6.7	6.6	4.7	88.7	15.2	NO	**265.1**
1987	0.244	82.2	9.9	53.1	9.8	7.4	8.5	5.2	101.1	16.9	NO	**294.2**
1988	0.248	77.3	9.9	53.6	9.8	7.4	9.7	5.1	103.3	16.8	NO	**292.8**
1989	0.252	71.6	9.8	53.5	9.6	7.3	10.7	5.1	104.5	16.6	NO	**288.7**
1990	0.254	66.7	9.7	53.9	9.6	7.2	11.9	5.0	106.7	16.5	NO	**287.2**
1991	0.256	17.1	2.5	13.8	2.5	1.9	3.0	1.3	27.4	4.2	NO	**73.7**
1992	0.260	16.4	2.4	13.3	2.4	1.8	2.9	1.2	26.2	4.1	NO	**70.7**
1993	0.262	16.3	2.4	13.1	2.3	1.8	2.9	1.2	26.0	4.0	NO	**70.1**
1994	0.265	16.6	2.4	13.4	2.4	1.8	3.0	1.3	26.6	4.1	NO	**71.5**
1995	0.267	12.2	1.8	9.8	1.8	1.3	2.2	0.9	19.5	3.0	NO	**52.4**
1996	0.268	11.4	1.7	9.2	1.6	1.2	2.0	0.9	18.2	2.8	NO	**49.0**
1997	0.270	11.4	1.7	9.2	1.6	1.2	2.0	0.9	18.2	2.8	NO	**48.9**
1998	0.272	8.7	1.3	7.0	1.3	0.9	1.6	0.7	13.9	2.2	NO	**37.6**
1999	0.276	8.7	1.3	7.0	1.2	0.9	1.5	0.7	13.8	2.1	NO	**37.2**
2000	0.279	8.8	1.3	7.1	1.3	1.0	1.6	0.7	14.1	2.2	NO	**38.0**
2001	0.283	8.5	1.2	6.9	1.2	0.9	1.5	0.6	13.6	2.1	NO	**36.7**
2002	0.287	8.3	1.2	6.7	1.2	0.9	1.5	0.6	13.3	2.1	NO	**35.8**
2003	0.288	8.4	1.2	6.8	1.2	0.9	1.5	0.6	13.4	2.1	NO	**36.2**
2004 - present						**No landfilling in unmanaged SWDS**						

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_2e]	2022 emissions [kt CO_2e]	2023 emissions [kt CO_2e]
Total greenhouse gas emissions without LULUCF	4,729.16	4,781.72	4,646.05
Total verified emissions from stationary installations under Directive 2003/87/EC	1,828.02	1,875.08	1,812.53
CO_2 emissions from 1.A.3.a civil aviation	20.74	24.09	22.34
Total ESR emissions (= C-D-E)	**2,880.41**	**2,882.56**	**2,811.18**

Annex 9: CRT (Common Reporting Table) Summary 2 Tables for 1990-2023 (GWP from AR5)

1990

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
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1990
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**8,619.50**	**2,406.82**	**377.03**	**0.32**	**444.82**	**NO**	**1.13**	**NO**	**11,849.61**
1. Energy	**1,807.19**	**9.77**	**23.59**						**1,840.56**
1.A. Fuel combustion	1,745.84	9.03	23.59						1,778.46
1.A.1. Energy industries	13.46	0.01	0.03						13.50
1.A.2. Manufacturing industries and construction	298.88	0.44	6.92						306.24
1.A.3. Transport	602.50	6.36	6.87						615.73
1.A.4. Other sectors	830.87	2.22	9.77						842.86
1.A.5. Other	0.12	0.00	0.00						0.12
1.B. Fugitive emissions from fuels	61.36	0.74	NO						62.09
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	61.36	0.74	NO						62.09
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**407.47**	**1.81**	**46.76**	**0.32**	**444.82**	**NO**	**1.13**	**NO**	**902.30**
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	6.84	NA,NO	NA,NO						6.84
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				0.32	NO	NO		NO	0.32
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**	**457.74**	**299.26**						**757.02**
3.A. Enteric fermentation		378.59							378.59
3.B. Manure management		79.15	13.92						93.07
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	285.34						285.34
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)]	**6,397.52**	**1,743.14**	**1.61**						**8,142.27**
4.A. Forest land	-30.05	0.13	0.34						-29.58
4.B. Cropland	1,448.91	79.79	1.27						1,529.96
4.C. Grassland	5,360.63	447.94	IE,NA,NO						5,808.57
4.D. Wetlands	-408.24	1,215.28	NA,NE,NO						807.04
4.E. Settlements	26.28	NA	IE,NA,NE,NO						26.28
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**	**194.37**	**5.81**						**207.48**
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		15.02	4.33						19.35
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	247.24	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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	2.39								2.39
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						

Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**3,707.35**
Total CO_2 equivalent emissions with LULUCF	**11,849.61**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**3,707.35**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**11,849.61**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**8,499.05**	**2,401.47**	**377.95**	**0.63**	**369.25**	**NO**	**1.28**	**NO**	**11,649.63**
1. Energy	**1,722.76**	**9.71**	**22.95**						**1,755.41**
1.A. Fuel combustion	1,652.81	9.01	22.95						1,684.77
1.A.1. Energy industries	15.05	0.02	0.03						15.10
1.A.2. Manufacturing industries and construction	225.11	0.35	6.48						231.93
1.A.3. Transport	608.62	6.50	7.05						622.18
1.A.4. Other sectors	803.89	2.14	9.39						815.42
1.A.5. Other	0.14	0.00	0.00						0.14
1.B. Fugitive emissions from fuels	69.95	0.70	NO						70.65
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	69.95	0.70	NO						70.65
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**373.06**	**1.46**	**44.94**	**0.63**	**369.25**	**NO**	**1.28**	**NO**	**790.62**
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	6.69	NA,NO	NA,NO						6.69
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**	**442.73**	**302.58**						**745.32**
3.A. Enteric fermentation		366.00							366.00
3.B. Manure management		76.73	13.46						90.19
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	289.12						289.12
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]	**6,395.99**	**1,748.57**	**1.68**						**8,146.23**
4.A. Forest land	-31.59	0.18	0.48						-30.93
4.B. Cropland	1,450.88	79.97	1.19						1,532.04
4.C. Grassland	5,350.56	447.55	IE,NA,NO						5,798.11
4.D. Wetlands	-402.36	1,220.87	NA,NE,NO						818.51
4.E. Settlements	28.50	NA	IE,NA,NE,NO						28.50
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**	**199.00**	**5.80**						**212.03**
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		15.05	4.32						19.37
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	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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	2.39								2.39
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						

Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**3,503.40**
Total CO_2 equivalent emissions with LULUCF	**11,649.63**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**3,503.40**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**11,649.63**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**8,631.78**	**2,404.00**	**371.01**	**0.64**	**164.60**	**NO**	**1.28**	**NO**	**11,573.31**
1. Energy	**1,865.93**	**10.00**	**23.24**						**1,899.17**
1.A. Fuel combustion	1,798.31	9.29	23.24						1,830.85
1.A.1. Energy industries	14.06	0.02	0.03						14.10
1.A.2. Manufacturing industries and construction	284.26	0.41	6.19						290.86
1.A.3. Transport	619.67	6.52	7.35						633.55
1.A.4. Other sectors	879.53	2.34	9.67						891.54
1.A.5. Other	0.79	0.00	0.00						0.80
1.B. Fugitive emissions from fuels	67.62	0.71	NO						68.32
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	67.62	0.71	NO						68.32
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**376.32**	**1.58**	**40.21**	**0.64**	**164.60**	**NO**	**1.28**	**NO**	**584.63**
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	6.84	NA,NO	NA,NO						6.84
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**	**432.00**	**300.03**						**732.07**
3.A. Enteric fermentation		358.51							358.51
3.B. Manure management		73.50	13.02						86.51
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	287.01						287.01
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)]	**6,382.46**	**1,747.65**	**1.75**						**8,131.86**
4.A. Forest land	-36.56	0.24	0.64						-35.68
4.B. Cropland	1,452.64	80.15	1.11						1,533.89
4.C. Grassland	5,337.85	447.09	IE,NA,NO						5,784.95
4.D. Wetlands	-402.20	1,220.17	NA,NE,NO						817.97
4.E. Settlements	30.73	NA	IE,NA,NE,NO						30.73
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**	**212.76**	**5.79**						**225.59**
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		14.82	4.35						19.16
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	2.39								2.39
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**3,441.46**
Total CO_2 equivalent emissions with LULUCF	**11,573.31**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**3,441.46**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**11,573.31**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**8,791.99**	**2,410.33**	**380.36**	**1.44**	**79.35**	**NO**	**1.28**	**NO**	**11,664.76**
1. Energy	**1,968.86**	**10.00**	**25.04**						**2,003.90**
1.A. Fuel combustion	1,883.48	9.25	25.04						1,917.77
1.A.1. Energy industries	14.42	0.04	0.08						14.54
1.A.2. Manufacturing industries and construction	307.31	0.44	6.68						314.43
1.A.3. Transport	622.53	6.27	7.88						636.68
1.A.4. Other sectors	937.78	2.50	10.39						950.67
1.A.5. Other	1.44	0.00	0.00						1.44
1.B. Fugitive emissions from fuels	85.38	0.75	NO						86.12
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	85.38	0.75	NO						86.12
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**425.26**	**1.94**	**42.00**	**1.44**	**79.35**	**NO**	**1.28**	**NO**	**551.27**
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	7.09	NA,NO	NA,NO						7.09
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**	**428.97**	**306.02**						**735.01**
3.A. Enteric fermentation		356.29							356.29
3.B. Manure management		72.67	13.08						85.76
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	292.94						292.94
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)]	**6,391.85**	**1,744.62**	**1.71**						**8,138.18**
4.A. Forest land	-41.71	0.26	0.67						-40.78
4.B. Cropland	1,454.50	80.33	1.03						1,535.86
4.C. Grassland	5,346.84	448.20	IE,NA,NO						5,795.04
4.D. Wetlands	-400.73	1,215.84	NA,NE,NO						815.10
4.E. Settlements	32.95	NA	IE,NA,NE,NO						32.95
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**	**224.81**	**5.60**						**236.41**
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		15.99	4.35						20.34
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	5.52								5.52
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**3,526.58**
Total CO_2 equivalent emissions with LULUCF	**11,664.76**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**3,526.58**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**11,664.76**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**8,732.58**	**2,418.41**	**388.84**	**1.85**	**47.24**	**NO**	**1.28**	**NO**	**11,590.21**
1. Energy	**1,917.39**	**9.77**	**25.63**						**1,952.79**
1.A. Fuel combustion	1,847.27	9.03	25.63						1,881.92
1.A.1. Energy industries	14.28	0.04	0.08						14.40
1.A.2. Manufacturing industries and construction	287.95	0.45	6.79						295.18
1.A.3. Transport	623.58	6.09	8.41						638.07
1.A.4. Other sectors	921.36	2.45	10.35						934.16
1.A.5. Other	0.10	0.00	0.00						0.10
1.B. Fugitive emissions from fuels	70.12	0.75	NO						70.87
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	70.12	0.75	NO						70.87
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**426.35**	**1.90**	**41.87**	**1.85**	**47.24**	**NO**	**1.28**	**NO**	**520.50**
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	7.00	NA,NO	NA,NO						7.00
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**	**428.91**	**314.15**						**743.08**
3.A. Enteric fermentation		357.08							357.08
3.B. Manure management		71.83	13.17						85.00
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	300.98						300.98
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]	**6,383.30**	**1,744.04**	**1.67**						**8,129.01**
4.A. Forest land	-44.80	0.27	0.71						-43.82
4.B. Cropland	1,456.40	80.51	0.95						1,537.86
4.C. Grassland	5,337.03	448.10	IE,NA,NO						5,785.13
4.D. Wetlands	-400.50	1,215.16	NA,NE,NO						814.66
4.E. Settlements	35.18	NA	IE,NA,NE,NO						35.18
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**	**233.79**	**5.51**						**244.83**
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		14.64	4.35						18.99
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*						**NO**		**NO**	**NO**

	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	5.52								5.52
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**3,461.20**
Total CO_2 equivalent emissions with LULUCF	**11,590.21**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**3,461.20**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**11,590.21**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**8,835.12**	**2,412.12**	**387.77**	**3.15**	**62.38**	**NO**	**1.28**	**NO**	**11,701.82**
1. Energy	**2,017.88**	**9.80**	**29.91**						**2,057.59**
1.A. Fuel combustion	1,935.65	9.01	29.91						1,974.56
1.A.1. Energy industries	15.10	0.05	0.10						15.24
1.A.2. Manufacturing industries and construction	291.56	0.55	8.47						300.58
1.A.3. Transport	633.50	5.78	9.45						648.73
1.A.4. Other sectors	993.88	2.63	11.88						1,008.39
1.A.5. Other	1.61	0.00	0.00						1.62
1.B. Fugitive emissions from fuels	82.24	0.79	NO						83.03
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	82.24	0.79	NO						83.03
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**443.75**	**2.05**	**40.03**	**3.15**	**62.38**	**NO**	**1.28**	**NO**	**552.64**
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	7.52	NA,NO	NA,NO						7.52
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**	**412.45**	**310.62**						**725.51**
3.A. Enteric fermentation		342.23							342.23
3.B. Manure management		70.22	12.72						82.94
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	297.90						297.90
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]	**6,366.18**	**1,742.78**	**1.71**						**8,110.67**
4.A. Forest land	-54.59	0.32	0.83						-53.44
4.B. Cropland	1,458.33	80.69	0.88						1,539.90
4.C. Grassland	5,325.07	447.98	IE,NA,NO						5,773.05
4.D. Wetlands	-400.04	1,213.80	NA,NE,NO						813.76
4.E. Settlements	37.40	NA	IE,NA,NE,NO						37.40
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**	**245.04**	**5.51**						**255.42**
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		15.28	4.34						19.63
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	6.29								6.29
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**3,591.16**
Total CO_2 equivalent emissions with LULUCF	**11,701.82**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**3,591.16**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**11,701.82**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**8,880.51**	**2,426.95**	**405.33**	**10.09**	**26.66**	**NO**	**1.28**	**NO**	**11,750.82**
1. Energy	**2,072.87**	**9.69**	**30.48**						**2,113.05**
1.A. Fuel combustion	1,991.60	8.83	30.48						2,030.92
1.A.1. Energy industries	12.11	0.05	0.12						12.28
1.A.2. Manufacturing industries and construction	336.24	0.60	8.34						345.19
1.A.3. Transport	623.84	5.46	10.13						639.44
1.A.4. Other sectors	1,019.02	2.71	11.89						1,033.62
1.A.5. Other	0.38	0.00	0.00						0.39
1.B. Fugitive emissions from fuels	81.27	0.86	NO						82.13
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	81.27	0.86	NO						82.13
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**443.11**	**2.08**	**46.50**	**10.09**	**26.66**	**NO**	**1.28**	**NO**	**529.73**
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	7.47	NA,NO	NA,NO						7.47
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**	**416.20**	**321.29**						**740.13**
3.A. Enteric fermentation		345.91							345.91
3.B. Manure management		70.29	13.06						83.35
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	308.23						308.23
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]	**6,357.51**	**1,743.95**	**1.68**						**8,103.14**
4.A. Forest land	-58.80	0.33	0.87						-57.60
4.B. Cropland	1,460.40	80.87	0.81						1,542.08
4.C. Grassland	5,314.43	447.91	IE,NA,NO						5,762.34
4.D. Wetlands	-398.15	1,214.84	NA,NE,NO						816.69
4.E. Settlements	39.63	NA	IE,NA,NE,NO						39.63
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**	**255.02**	**5.38**						**264.77**
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		18.79	4.32						23.11
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	7.36								7.36
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						

Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**3,647.68**
Total CO_2 equivalent emissions with LULUCF	**11,750.82**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**3,647.68**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**11,750.82**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**8,971.06**	**2,426.77**	**400.91**	**16.14**	**87.30**	**NO**	**1.28**	**NO**	**11,903.46**
1. Energy	**2,109.29**	**9.43**	**34.19**						**2,152.91**
1.A. Fuel combustion	2,042.44	8.52	34.19						2,085.16
1.A.1. Energy industries	7.00	0.05	0.11						7.15
1.A.2. Manufacturing industries and construction	389.41	0.65	9.95						400.02
1.A.3. Transport	639.30	5.16	11.30						655.76
1.A.4. Other sectors	1,006.70	2.66	12.84						1,022.19
1.A.5. Other	0.04	0.00	0.00						0.04
1.B. Fugitive emissions from fuels	66.85	0.91	NO						67.76
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	66.85	0.91	NO						67.76
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**502.32**	**2.05**	**39.52**	**16.14**	**87.30**	**NO**	**1.28**	**NO**	**648.62**
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	7.36	NA,NO	NA,NO						7.36
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**	**410.75**	**320.22**						**733.53**
3.A. Enteric fermentation		342.43							342.43
3.B. Manure management		68.32	13.33						81.65
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	306.89						306.89
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]	**6,352.68**	**1,741.81**	**1.64**						**8,096.13**
4.A. Forest land	-66.00	0.35	0.91						-64.74
4.B. Cropland	1,462.23	81.05	0.73						1,544.01
4.C. Grassland	5,311.78	448.58	IE,NA,NO						5,760.36
4.D. Wetlands	-397.17	1,211.83	NA,NE,NO						814.65
4.E. Settlements	41.85	NA	IE,NA,NE,NO						41.85
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**	**262.73**	**5.33**						**272.27**
5.A. Solid waste disposal		238.37							238.37
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		20.03	4.31						24.33
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	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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	7.36								7.36
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**3,807.33**
Total CO_2 equivalent emissions with LULUCF	**11,903.46**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**3,807.33**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**11,903.46**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**8,989.66**	**2,435.06**	**404.91**	**25.46**	**190.94**	**NO**	**1.28**	**NO**	**12,047.31**
1. Energy	**2,102.00**	**9.33**	**35.20**						**2,146.54**
1.A. Fuel combustion	2,018.29	8.20	35.20						2,061.69
1.A.1. Energy industries	9.03	0.05	0.11						9.19
1.A.2. Manufacturing industries and construction	361.20	0.66	10.03						371.89
1.A.3. Transport	642.95	4.84	12.23						660.02
1.A.4. Other sectors	1,000.15	2.65	12.82						1,015.61
1.A.5. Other	4.97	0.01	0.01						4.99
1.B. Fugitive emissions from fuels	83.72	1.13	NO						84.85
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	83.72	1.13	NO						84.85
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**530.16**	**1.80**	**35.15**	**25.46**	**190.94**	**NO**	**1.28**	**NO**	**784.80**
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	7.50	NA,NO	NA,NO						7.50
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**	**419.52**	**327.64**						**749.71**
3.A. Enteric fermentation		349.59							349.59
3.B. Manure management		69.93	13.82						83.75
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	313.82						313.82
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)]	**6,351.38**	**1,738.12**	**1.71**						**8,091.21**
4.A. Forest land	-74.35	0.40	1.03						-72.92
4.B. Cropland	1,464.43	81.23	0.68						1,546.34
4.C. Grassland	5,312.50	449.72	IE,NA,NO						5,762.21
4.D. Wetlands	-395.28	1,206.78	NA,NE,NO						811.50
4.E. Settlements	44.08	NA	IE,NA,NE,NO						44.08
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**	**266.29**	**5.20**						**275.06**
5.A. Solid waste disposal		246.67							246.67
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		15.86	4.30						20.16
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	7.36								7.36
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						

Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**3,956.10**
Total CO_2 equivalent emissions with LULUCF	**12,047.31**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**3,956.10**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,047.31**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,199.44**	**2,433.28**	**412.20**	**36.99**	**183.61**	**NO**	**1.28**	**NO**	**12,266.80**
1. Energy	**2,156.23**	**9.54**	**37.24**						**2,203.01**
1.A. Fuel combustion	2,044.96	8.02	37.24						2,090.21
1.A.1. Energy industries	6.68	0.04	0.10						6.83
1.A.2. Manufacturing industries and construction	376.93	0.71	10.97						388.61
1.A.3. Transport	666.82	4.63	12.83						684.28
1.A.4. Other sectors	990.16	2.63	13.33						1,006.12
1.A.5. Other	4.36	0.00	0.01						4.38
1.B. Fugitive emissions from fuels	111.27	1.52	NO						112.79
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	111.27	1.52	NO						112.79
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**679.04**	**2.08**	**35.58**	**36.99**	**183.61**	**NO**	**1.28**	**NO**	**938.57**
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	7.05	NA,NO	NA,NO						7.05
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**	**412.62**	**332.60**						**747.99**
3.A. Enteric fermentation		344.78							344.78
3.B. Manure management		67.84	13.71						81.55
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	318.89						318.89
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]	**6,358.50**	**1,733.91**	**1.69**						**8,094.10**
4.A. Forest land	-80.59	0.42	1.09						-79.08
4.B. Cropland	1,466.34	81.41	0.60						1,548.35
4.C. Grassland	5,319.71	451.28	IE,NA,NO						5,770.99
4.D. Wetlands	-393.27	1,200.80	NA,NE,NO						807.53
4.E. Settlements	46.30	NA	IE,NA,NE,NO						46.30
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**	**275.13**	**5.09**						**283.13**
5.A. Solid waste disposal		255.64							255.64
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		16.32	4.31						20.63
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	7.46								7.46
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						

Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,172.70**
Total CO_2 equivalent emissions with LULUCF	**12,266.80**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,172.70**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,266.80**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**9,298.22**	**2,422.68**	**396.48**	**42.97**	**134.79**	**NO**	**1.35**	**NO**	**12,296.49**
1. Energy	**2,138.39**	**9.25**	**37.55**						**2,185.19**
1.A. Fuel combustion	1,985.24	7.59	37.55						2,030.38
1.A.1. Energy industries	6.38	0.04	0.10						6.53
1.A.2. Manufacturing industries and construction	325.41	0.65	11.08						337.13
1.A.3. Transport	669.81	4.31	12.93						687.05
1.A.4. Other sectors	979.04	2.58	13.42						995.05
1.A.5. Other	4.60	0.01	0.01						4.61
1.B. Fugitive emissions from fuels	153.15	1.66	NO						154.81
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	153.15	1.66	NO						154.81
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**788.85**	**3.09**	**20.31**	**42.97**	**134.79**	**NO**	**1.35**	**NO**	**991.37**
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	7.42	NA,NO	NA,NO						7.42
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**	**397.98**	**331.67**						**732.42**
3.A. Enteric fermentation		331.57							331.57
3.B. Manure management		66.41	13.42						79.83
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	318.25						318.25
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)]	**6,365.48**	**1,727.66**	**1.87**						**8,095.01**
4.A. Forest land	-91.74	0.49	1.32						-89.94
4.B. Cropland	1,468.75	81.59	0.55						1,550.90
4.C. Grassland	5,334.31	453.36	IE,NA,NO						5,787.67
4.D. Wetlands	-390.38	1,192.23	NA,NE,NO						801.85
4.E. Settlements	44.53	NA	IE,NA,NE,NO						44.53
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**	**284.69**	**5.08**						**292.51**
5.A. Solid waste disposal		263.47							263.47
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		18.10	4.32						22.42
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*						**NO**		**NO**	**NO**

	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	7.46								7.46
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,201.48**
Total CO_2 equivalent emissions with LULUCF	**12,296.49**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,201.48**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,296.49**

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,239.01**	**2,429.44**	**393.53**	**39.80**	**97.16**	**NO**	**1.35**	**NO**	**12,200.29**
1. Energy	**2,028.65**	**8.68**	**36.56**						**2,073.89**
1.A. Fuel combustion	1,884.88	6.96	36.56						1,928.40
1.A.1. Energy industries	5.97	0.04	0.10						6.12
1.A.2. Manufacturing industries and construction	360.11	0.65	10.88						371.64
1.A.3. Transport	680.01	4.09	13.39						697.49
1.A.4. Other sectors	819.03	2.16	12.15						833.33
1.A.5. Other	19.75	0.02	0.04						19.81
1.B. Fugitive emissions from fuels	143.77	1.72	NO						145.49
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	143.77	1.72	NO						145.49
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**831.07**	**3.21**	**17.97**	**39.80**	**97.16**	**NO**	**1.35**	**NO**	**990.56**
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	6.52	NA,NO	NA,NO						6.52
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**	**399.12**	**332.06**						**733.87**
3.A. Enteric fermentation		331.97							331.97
3.B. Manure management		67.15	13.68						80.84
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	318.37						318.37
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]	**6,374.02**	**1,724.06**	**1.91**						**8,099.98**
4.A. Forest land	-97.39	0.53	1.41						-95.45
4.B. Cropland	1,470.91	81.77	0.49						1,553.17
4.C. Grassland	5,342.64	454.63	IE,NA,NO						5,797.27
4.D. Wetlands	-388.53	1,187.13	NA,NE,NO						798.61
4.E. Settlements	46.39	NA	IE,NA,NE,NO						46.39
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	**2.58**	**294.37**	**5.04**						**301.99**
5.A. Solid waste disposal		273.58							273.58
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		17.98	4.34						22.32
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	7.46								7.46
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,100.30**
Total CO_2 equivalent emissions with LULUCF	**12,200.29**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,100.30**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,200.29**

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,380.75**	**2,419.29**	**373.39**	**44.62**	**76.90**	**NO**	**1.35**	**NO**	**12,296.30**
1. Energy	**2,138.81**	**8.65**	**36.35**						**2,183.81**
1.A. Fuel combustion	1,991.39	6.92	36.35						2,034.66
1.A.1. Energy industries	6.85	0.05	0.11						7.00
1.A.2. Manufacturing industries and construction	369.98	0.62	10.24						380.84
1.A.3. Transport	682.00	3.82	13.54						699.36
1.A.4. Other sectors	909.96	2.40	12.41						924.78
1.A.5. Other	22.60	0.02	0.05						22.67
1.B. Fugitive emissions from fuels	147.41	1.73	NO						149.14
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	147.41	1.73	NO						149.14
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**848.37**	**3.38**	**3.88**	**44.62**	**76.90**	**NO**	**1.35**	**NO**	**978.50**
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	6.76	NA,NO	NA,NO						6.76
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**	**389.49**	**326.16**						**718.06**
3.A. Enteric fermentation		324.80							324.80
3.B. Manure management		64.69	13.49						78.18
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	312.67						312.67
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]	**6,388.76**	**1,718.54**	**2.00**						**8,109.30**
4.A. Forest land	-106.29	0.58	1.56						-104.15
4.B. Cropland	1,473.30	81.95	0.45						1,555.69
4.C. Grassland	5,359.46	456.52	IE,NA,NO						5,815.98
4.D. Wetlands	-385.95	1,179.49	NA,NE,NO						793.54
4.E. Settlements	48.24	NA	IE,NA,NE,NO						48.24
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**	**299.23**	**5.00**						**306.64**
5.A. Solid waste disposal		277.43							277.43
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		19.17	4.34						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	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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	8.91								8.91
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,187.00**
Total CO_2 equivalent emissions with LULUCF	**12,296.30**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,187.00**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,296.30**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,367.89**	**2,410.14**	**370.06**	**45.10**	**63.38**	**NO**	**1.35**	**NO**	**12,257.92**
1. Energy	**2,129.47**	**8.30**	**34.99**						**2,172.76**
1.A. Fuel combustion	1,993.12	6.59	34.99						2,034.71
1.A.1. Energy industries	4.99	0.04	0.10						5.14
1.A.2. Manufacturing industries and construction	340.81	0.48	9.28						350.57
1.A.3. Transport	774.02	3.77	13.97						791.76
1.A.4. Other sectors	866.02	2.29	11.63						879.94
1.A.5. Other	7.28	0.01	0.02						7.31
1.B. Fugitive emissions from fuels	136.34	1.71	NO						138.05
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	136.34	1.71	NO						138.05
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**849.24**	**3.38**	**3.84**	**45.10**	**63.38**	**NO**	**1.35**	**NO**	**966.29**
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	6.43	NA,NO	NA,NO						6.43
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				45.10	0.01	NO		NO	45.11
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**	**382.41**	**324.11**						**711.19**
3.A. Enteric fermentation		319.80							319.80
3.B. Manure management		62.61	13.47						76.08
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	310.65						310.65
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]	**6,382.46**	**1,715.33**	**2.08**						**8,099.86**
4.A. Forest land	-117.01	0.63	1.69						-114.70
4.B. Cropland	1,475.60	82.13	0.39						1,558.13
4.C. Grassland	5,358.32	457.25	IE,NA,NO						5,815.57
4.D. Wetlands	-384.55	1,175.32	NA,NE,NO						790.77
4.E. Settlements	50.10	NA	IE,NA,NE,NO						50.10
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**	**300.73**	**5.03**						**307.82**
5.A. Solid waste disposal		280.72							280.72
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		17.57	4.38						21.95
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	9.52								9.52
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,158.06**
Total CO_2 equivalent emissions with LULUCF	**12,257.92**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,158.06**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,257.92**

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,489.51**	**2,405.50**	**377.46**	**52.14**	**40.90**	**NO**	**1.36**	**NO**	**12,366.86**
1. Energy	**2,224.18**	**8.46**	**38.95**						**2,271.59**
1.A. Fuel combustion	2,101.28	6.66	38.95						2,146.89
1.A.1. Energy industries	3.16	0.04	0.10						3.30
1.A.2. Manufacturing industries and construction	339.60	0.53	11.02						351.15
1.A.3. Transport	830.89	3.68	14.80						849.38
1.A.4. Other sectors	901.44	2.37	12.97						916.77
1.A.5. Other	26.20	0.03	0.06						26.29
1.B. Fugitive emissions from fuels	122.90	1.80	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	122.90	1.80	NO						124.70
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**872.98**	**3.37**	**3.60**	**52.14**	**40.90**	**NO**	**1.36**	**NO**	**974.34**
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	7.21	NA,NO	NA,NO						7.21
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**	**375.01**	**327.77**						**707.56**
3.A. Enteric fermentation		313.97							313.97
3.B. Manure management		61.04	13.74						74.78
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	314.03						314.03
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]	**6,382.34**	**1,712.09**	**2.10**						**8,096.53**
4.A. Forest land	-123.40	0.65	1.74						-121.01
4.B. Cropland	1,478.24	82.31	0.36						1,560.92
4.C. Grassland	5,358.70	458.42	IE,NA,NO						5,817.13
4.D. Wetlands	-383.03	1,170.71	NA,NE,NO						787.68
4.E. Settlements	51.82	NA	0.00						51.82
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**	**306.58**	**5.03**						**316.83**
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		15.60	4.41						20.02
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	9.06								9.06
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						

Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,270.32**
Total CO_2 equivalent emissions with LULUCF	**12,366.86**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,270.32**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,366.86**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**9,358.78**	**2,396.18**	**378.17**	**57.20**	**27.66**	**NO**	**2.60**	**NO**	**12,220.58**
1. Energy	**2,111.12**	**8.06**	**39.33**						**2,158.51**
1.A. Fuel combustion	1,992.96	6.15	39.33						2,038.44
1.A.1. Energy industries	3.26	0.04	0.10						3.40
1.A.2. Manufacturing industries and construction	294.14	0.47	11.80						306.41
1.A.3. Transport	839.12	3.44	14.38						856.95
1.A.4. Other sectors	827.69	2.16	12.99						842.84
1.A.5. Other	28.75	0.03	0.06						28.84
1.B. Fugitive emissions from fuels	118.16	1.91	NO						120.07
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	118.16	1.91	NO						120.07
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**855.92**	**3.16**	**3.45**	**57.20**	**27.66**	**NO**	**2.60**	**NO**	**949.98**
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	6.92	NA,NO	NA,NO						6.92
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				57.20	0.00	NO		NO	57.20
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**	**378.13**	**328.24**						**710.91**
3.A. Enteric fermentation		316.01							316.01
3.B. Manure management		62.13	13.30						75.42
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	314.94						314.94
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)]	**6,382.42**	**1,707.21**	**2.10**						**8,091.73**
4.A. Forest land	-142.72	0.66	1.78						-140.28
4.B. Cropland	1,480.64	82.49	0.31						1,563.44
4.C. Grassland	5,371.80	460.39	IE,NA,NO						5,832.19
4.D. Wetlands	-380.96	1,163.67	NA,NE,NO						782.71
4.E. Settlements	53.67	NA	0.00						53.67
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**	**299.61**	**5.05**						**309.46**
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		14.67	4.47						19.14
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	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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	10.02								10.02
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,128.85**
Total CO_2 equivalent emissions with LULUCF	**12,220.58**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,128.85**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,220.58**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,578.94**	**2,426.70**	**394.07**	**66.27**	**353.22**	**NO**	**2.69**	**NO**	**12,821.89**
1. Energy	**2,180.04**	**8.74**	**33.02**						**2,221.79**
1.A. Fuel combustion	2,052.61	6.03	33.02						2,091.66
1.A.1. Energy industries	9.03	0.08	0.18						9.29
1.A.2. Manufacturing industries and construction	287.83	0.42	10.68						298.93
1.A.3. Transport	979.43	3.56	10.33						993.31
1.A.4. Other sectors	749.67	1.95	11.77						763.39
1.A.5. Other	26.65	0.03	0.06						26.74
1.B. Fugitive emissions from fuels	127.43	2.71	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	127.43	2.71	NO						130.13
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**964.93**	**3.10**	**3.67**	**66.27**	**353.22**	**NO**	**2.69**	**NO**	**1,393.88**
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	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				66.27	0.00	NO		NO	66.27
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**	**388.55**	**345.00**						**737.98**
3.A. Enteric fermentation		323.17							323.17
3.B. Manure management		65.38	14.19						79.58
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	330.81						330.81
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]	**6,424.56**	**1,703.58**	**7.03**						**8,135.17**
4.A. Forest land	-149.36	0.69	1.86						-146.82
4.B. Cropland	1,483.26	82.69	0.29						1,566.24
4.C. Grassland	5,410.83	468.84	3.87						5,883.54
4.D. Wetlands	-376.42	1,151.36	1.00						775.94
4.E. Settlements	56.26	NA	0.01						56.26
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**	**322.73**	**5.35**						**333.08**
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		12.62	4.57						17.19
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	11.80								11.80
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,686.72**
Total CO_2 equivalent emissions with LULUCF	**12,821.89**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,686.72**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,821.89**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**9,833.48**	**2,421.14**	**400.47**	**66.94**	**298.01**	**NO**	**2.98**	**NO**	**13,023.02**
1. Energy	**2,319.58**	**9.65**	**33.86**						**2,363.09**
1.A. Fuel combustion	2,172.20	6.19	33.86						2,212.25
1.A.1. Energy industries	24.94	0.10	0.23						25.27
1.A.2. Manufacturing industries and construction	282.79	0.54	10.87						294.19
1.A.3. Transport	1,015.44	3.36	10.31						1,029.11
1.A.4. Other sectors	842.24	2.18	12.44						856.86
1.A.5. Other	6.80	0.01	0.01						6.82
1.B. Fugitive emissions from fuels	147.37	3.47	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	147.37	3.47	NO						150.84
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**1,162.72**	**3.26**	**4.08**	**66.94**	**298.01**	**NO**	**2.98**	**NO**	**1,537.99**
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	7.21	NA,NO	NA,NO						7.21
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				66.94	0.00	NO		NO	66.94
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**	**396.11**	**354.72**						**754.89**
3.A. Enteric fermentation		328.81							328.81
3.B. Manure management		67.30	14.40						81.70
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	340.31						340.31
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)]	**6,339.16**	**1,689.11**	**2.18**						**8,030.45**
4.A. Forest land	-267.10	0.71	1.91						-264.48
4.B. Cropland	1,486.03	82.85	0.25						1,569.14
4.C. Grassland	5,434.20	468.52	0.01						5,902.73
4.D. Wetlands	-371.31	1,137.03	NA,NE,NO						765.72
4.E. Settlements	57.35	NA	0.01						57.36
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**	**323.01**	**5.63**						**336.60**
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		13.39	4.69						18.08
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	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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	13.08								13.08
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						

Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,992.56**
Total CO_2 equivalent emissions with LULUCF	**13,023.02**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,992.56**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**13,023.02**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**10,194.26**	**2,400.03**	**406.78**	**65.62**	**369.94**	**NO**	**3.10**	**NO**	**13,439.72**
1. Energy	**2,193.79**	**9.09**	**32.10**						**2,234.98**
1.A. Fuel combustion	2,007.85	5.59	32.10						2,045.54
1.A.1. Energy industries	10.16	0.07	0.17						10.40
1.A.2. Manufacturing industries and construction	255.36	0.49	10.36						266.22
1.A.3. Transport	961.73	3.01	9.86						974.59
1.A.4. Other sectors	773.52	2.00	11.69						787.21
1.A.5. Other	7.09	0.01	0.02						7.11
1.B. Fugitive emissions from fuels	185.94	3.50	NO						189.44
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	185.94	3.50	NO						189.44
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**1,604.38**	**2.75**	**3.64**	**65.62**	**369.94**	**NO**	**3.10**	**NO**	**2,049.42**
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	6.46	NA	NA						6.46
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				65.62	0.00	NO		NO	65.62
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**	**400.56**	**363.00**						**770.58**
3.A. Enteric fermentation		332.82							332.82
3.B. Manure management		67.74	14.29						82.03
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	348.71						348.71
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]	**6,382.77**	**1,680.62**	**2.28**						**8,065.67**
4.A. Forest land	-270.77	0.73	1.95						-268.09
4.B. Cropland	1,488.89	83.03	0.23						1,572.15
4.C. Grassland	5,472.45	472.24	0.06						5,944.75
4.D. Wetlands	-367.12	1,124.61	0.02						757.52
4.E. Settlements	59.33	NA	0.01						59.34
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**	**307.02**	**5.75**						**319.08**
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		12.37	4.81						17.18
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	11.31								11.31
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**5,374.06**
Total CO_2 equivalent emissions with LULUCF	**13,439.72**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**5,374.06**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**13,439.72**

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**10,168.38**	**2,391.95**	**384.61**	**78.81**	**161.91**	**NO**	**3.13**	**NO**	**13,188.79**
1. Energy	**2,102.67**	**8.46**	**25.95**						**2,137.08**
1.A. Fuel combustion	1,932.56	5.29	25.95						1,963.80
1.A.1. Energy industries	7.75	0.06	0.13						7.94
1.A.2. Manufacturing industries and construction	182.05	0.30	7.11						189.46
1.A.3. Transport	927.56	2.81	8.70						939.07
1.A.4. Other sectors	810.39	2.12	10.00						822.50
1.A.5. Other	4.81	0.01	0.01						4.83
1.B. Fugitive emissions from fuels	170.11	3.18	NO						173.29
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	170.11	3.18	NO						173.29
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**1,615.80**	**2.79**	**3.20**	**78.81**	**161.91**	**NO**	**3.13**	**NO**	**1,865.64**
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	4.99	NA	NA						4.99
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				78.81	0.00	NO		NO	78.82
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**	**406.57**	**347.20**						**759.49**
3.A. Enteric fermentation		338.61							338.61
3.B. Manure management		67.95	14.32						82.28
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	332.88						332.88
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]	**6,437.93**	**1,677.10**	**2.34**						**8,117.37**
4.A. Forest land	-283.71	0.77	2.06						-280.88
4.B. Cropland	1,556.78	83.93	0.27						1,640.97
4.C. Grassland	5,471.30	472.50	0.00						5,943.80
4.D. Wetlands	-365.37	1,119.90	NA,NE,NO						754.54
4.E. Settlements	58.96	NA	0.01						58.97
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**	**297.03**	**5.92**						**309.21**
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		11.44	4.88						16.32
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	9.24								9.24
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**5,071.42**
Total CO_2 equivalent emissions with LULUCF	**13,188.79**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**5,071.42**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**13,188.79**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**10,038.84**	**2,383.86**	**375.75**	**106.64**	**154.37**	**NO**	**4.81**	**NO**	**13,064.26**
1. Energy	**1,993.77**	**10.49**	**22.54**						**2,026.81**
1.A. Fuel combustion	1,804.13	4.79	22.54						1,831.47
1.A.1. Energy industries	8.36	0.06	0.14						8.55
1.A.2. Manufacturing industries and construction	136.21	0.23	5.62						142.06
1.A.3. Transport	880.45	2.48	7.98						890.91
1.A.4. Other sectors	765.23	2.01	8.78						776.02
1.A.5. Other	13.88	0.02	0.03						13.92
1.B. Fugitive emissions from fuels	189.64	5.70	NO						195.35
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	189.64	5.70	NO						195.35
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**1,622.89**	**2.90**	**3.45**	**106.64**	**154.37**	**NO**	**4.81**	**NO**	**1,895.05**
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	5.21	NA	NA						5.21
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				106.64	0.00	NO		NO	106.64
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	**3.90**	**403.35**	**341.28**						**748.54**
3.A. Enteric fermentation		338.22							338.22
3.B. Manure management		65.14	14.38						79.52
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	326.90						326.90
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	2.05								2.05
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [(1)]	**6,412.20**	**1,673.56**	**2.42**						**8,088.18**
4.A. Forest land	-306.58	0.79	2.10						-303.69
4.B. Cropland	1,573.49	84.83	0.31						1,658.63
4.C. Grassland	5,466.49	473.08	0.00						5,939.58
4.D. Wetlands	-363.67	1,114.86	0.00						751.19
4.E. Settlements	42.50	NA	0.01						42.51
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**	**293.55**	**6.05**						**305.68**
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		11.00	4.86						15.85
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	9.69								9.69
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,976.08**
Total CO_2 equivalent emissions with LULUCF	**13,064.26**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,976.08**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**13,064.26**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,894.39**	**2,357.99**	**372.40**	**131.33**	**67.01**	**NO**	**3.14**	**NO**	**12,826.26**
1. Energy	**1,875.52**	**8.85**	**20.77**						**1,905.14**
1.A. Fuel combustion	1,696.01	4.36	20.77						1,721.14
1.A.1. Energy industries	6.42	0.04	0.11						6.57
1.A.2. Manufacturing industries and construction	143.05	0.25	4.90						148.20
1.A.3. Transport	848.63	2.24	7.98						858.85
1.A.4. Other sectors	691.02	1.82	7.77						700.62
1.A.5. Other	6.88	0.01	0.01						6.90
1.B. Fugitive emissions from fuels	179.51	4.49	NO						184.00
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	179.51	4.49	NO						184.00
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**1,617.35**	**2.99**	**3.54**	**131.33**	**67.01**	**NO**	**3.14**	**NO**	**1,825.36**
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	5.41	NA,NO	NA,NO						5.41
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				131.33	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	**3.83**	**402.48**	**339.63**						**745.94**
3.A. Enteric fermentation		336.61							336.61
3.B. Manure management		65.86	14.29						80.15
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	325.35						325.35
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	1.91								1.91
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**6,390.91**	**1,670.05**	**2.52**						**8,063.48**
4.A. Forest land	-333.81	0.80	2.16						-330.85
4.B. Cropland	1,590.19	85.73	0.36						1,676.27
4.C. Grassland	5,461.58	473.66	IE,NA,NO						5,935.25
4.D. Wetlands	-367.61	1,109.86	NA,NE,NO						742.25
4.E. Settlements	40.61	NA	0.01						40.62
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**	**273.63**	**5.92**						**286.33**
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		11.71	4.79						16.50
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	11.04								11.04
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,762.78**
Total CO_2 equivalent emissions with LULUCF	**12,826.26**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,762.78**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,826.26**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,894.71**	**2,321.73**	**375.57**	**136.51**	**84.53**	**NO**	**5.51**	**NO**	**12,818.57**
1. Energy	**1,828.14**	**7.77**	**20.01**						**1,855.92**
1.A. Fuel combustion	1,656.09	4.10	20.01						1,680.20
1.A.1. Energy industries	7.71	0.04	0.10						7.85
1.A.2. Manufacturing industries and construction	130.76	0.20	5.10						136.06
1.A.3. Transport	831.18	2.05	6.88						840.10
1.A.4. Other sectors	686.36	1.81	7.93						696.10
1.A.5. Other	0.09	0.00	0.00						0.09
1.B. Fugitive emissions from fuels	172.05	3.67	NO						175.72
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	172.05	3.67	NO						175.72
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,660.23**	**3.36**	**3.46**	**136.51**	**84.53**	**NO**	**5.51**	**NO**	**1,893.60**
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	5.36	NA,NO	NA,NO						5.36
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				136.51	0.00	NO		NO	136.52
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	**4.24**	**390.44**	**343.81**						**738.49**
3.A. Enteric fermentation		329.32							329.32
3.B. Manure management		61.12	13.83						74.95
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	329.98						329.98
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	2.45								2.45
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**6,395.56**	**1,666.42**	**2.56**						**8,064.54**
4.A. Forest land	-345.18	0.82	2.14						-342.21
4.B. Cropland	1,606.89	86.62	0.40						1,693.91
4.C. Grassland	5,461.01	474.30	0.01						5,935.31
4.D. Wetlands	-365.86	1,104.68	NA,NE,NO						738.81
4.E. Settlements	38.77	NA	0.01						38.78
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**	**253.75**	**5.73**						**266.03**
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		14.16	4.82						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	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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	12.33								12.33
1.D.4. CO_2 captured	-0.06								-0.06
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,754.03**
Total CO_2 equivalent emissions with LULUCF	**12,818.57**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,754.03**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,818.57**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,884.90**	**2,310.98**	**374.22**	**166.67**	**79.28**	**NO**	**3.32**	**NO**	**12,819.38**
1. Energy	**1,792.88**	**8.39**	**19.30**						**1,820.57**
1.A. Fuel combustion	1,619.74	3.92	19.30						1,642.95
1.A.1. Energy industries	4.37	0.01	0.02						4.41
1.A.2. Manufacturing industries and construction	120.01	0.22	4.93						125.16
1.A.3. Transport	845.96	1.98	6.80						854.75
1.A.4. Other sectors	648.64	1.71	7.53						657.88
1.A.5. Other	0.76	0.00	0.00						0.76
1.B. Fugitive emissions from fuels	173.14	4.48	NO						177.61
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	173.14	4.48	NO						177.61
1.C. CO_2 transport and storage	NA,NO								NA,NO
2. Industrial processes and product use	**1,686.22**	**3.38**	**3.06**	**166.67**	**79.28**	**NO**	**3.32**	**NO**	**1,941.94**
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	5.30	NA,NO	NA,NO						5.30
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				166.67	0.00	NO		NO	166.67
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	**4.20**	**382.43**	**343.12**						**729.75**
3.A. Enteric fermentation		322.93							322.93
3.B. Manure management		59.49	13.71						73.20
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	329.42						329.42
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	2.31								2.31
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**6,396.10**	**1,662.98**	**2.69**						**8,061.78**
4.A. Forest land	-362.90	0.83	2.16						-359.92
4.B. Cropland	1,623.57	87.52	0.44						1,711.54
4.C. Grassland	5,462.73	475.07	0.08						5,937.88
4.D. Wetlands	-364.14	1,099.56	NA,NE,NO						735.42
4.E. Settlements	36.91	NA	0.01						36.92
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**	**253.79**	**6.05**						**265.34**
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		13.56	4.88						18.44
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	15.58								15.58
1.D.4. CO_2 captured	NO								NO
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,757.60**
Total CO_2 equivalent emissions with LULUCF	**12,819.38**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,757.60**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,819.38**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**9,834.84**	**2,327.24**	**395.25**	**164.48**	**89.05**	**NO**	**2.46**	**NO**	**12,813.32**
1. Energy	**1,779.34**	**8.90**	**20.73**						**1,808.97**
1.A. Fuel combustion	1,596.39	3.80	20.73						1,620.92
1.A.1. Energy industries	5.10	0.01	0.01						5.12
1.A.2. Manufacturing industries and construction	85.93	0.14	5.67						91.75
1.A.3. Transport	852.27	1.94	6.97						861.18
1.A.4. Other sectors	650.44	1.71	8.07						660.22
1.A.5. Other	2.65	0.01	0.01						2.67
1.B. Fugitive emissions from fuels	182.95	5.10	NO						188.05
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	182.95	5.10	NO						188.05
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,654.71**	**3.06**	**2.83**	**164.48**	**89.05**	**NO**	**2.46**	**NO**	**1,916.58**
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	5.37	NA,NO	NA,NO						5.37
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				164.48	0.00	NO		NO	164.48
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	**3.73**	**404.59**	**362.33**						**770.64**
3.A. Enteric fermentation		340.76							340.76
3.B. Manure management		63.83	14.42						78.25
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	347.90						347.90
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	2.11								2.11
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [(1)]	**6,389.56**	**1,659.42**	**2.70**						**8,051.68**
4.A. Forest land	-386.53	0.84	2.16						-383.53
4.B. Cropland	1,640.25	88.42	0.49						1,729.16
4.C. Grassland	5,463.17	475.70	0.04						5,938.91
4.D. Wetlands	-362.26	1,094.47	0.01						732.21
4.E. Settlements	35.04	NA	0.01						35.05
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**	**251.27**	**6.66**						**265.43**
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		11.87	4.99						16.86
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	20.50								20.50
1.D.4. CO_2 captured	-2.38								-2.38
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,761.63**
Total CO_2 equivalent emissions with LULUCF	**12,813.32**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,761.63**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,813.32**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**9,921.37**	**2,328.65**	**382.50**	**156.82**	**93.25**	**NO**	**1.63**	**NO**	**12,884.23**
1. Energy	**1,823.67**	**8.96**	**21.11**						**1,853.75**
1.A. Fuel combustion	1,660.54	3.88	21.11						1,685.53
1.A.1. Energy industries	4.18	0.00	0.01						4.19
1.A.2. Manufacturing industries and construction	115.02	0.20	5.70						120.92
1.A.3. Transport	881.49	1.94	7.26						890.70
1.A.4. Other sectors	659.66	1.73	8.14						669.53
1.A.5. Other	0.19	0.00	0.00						0.19
1.B. Fugitive emissions from fuels	163.13	5.08	NO						168.22
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	163.13	5.08	NO						168.22
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,707.27**	**3.34**	**2.87**	**156.82**	**93.25**	**NO**	**1.63**	**NO**	**1,965.18**
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	5.70	NA,NO	NA,NO						5.70
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				156.82	0.01	NO		NO	156.83
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	**3.14**	**409.56**	**348.85**						**761.55**
3.A. Enteric fermentation		343.58							343.58
3.B. Manure management		65.98	14.54						80.52
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	334.31						334.31
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	1.79								1.79
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [(1)]	**6,380.36**	**1,656.10**	**2.94**						**8,039.40**
4.A. Forest land	-411.58	0.84	2.20						-408.54
4.B. Cropland	1,656.81	89.31	0.53						1,746.66
4.C. Grassland	5,462.50	476.56	0.16						5,939.22
4.D. Wetlands	-360.53	1,089.39	0.04						728.89
4.E. Settlements	33.20	NA	0.01						33.21
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**	**250.69**	**6.73**						**264.36**
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		14.22	5.09						19.30
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	45.55								45.55
1.D.4. CO_2 captured	-3.91								-3.91
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,844.84**
Total CO_2 equivalent emissions with LULUCF	**12,884.23**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,844.84**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,884.23**

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,856.74**	**2,320.90**	**380.32**	**173.65**	**82.56**	**NO**	**1.39**	**NO**	**12,815.56**
1. Energy	**1,798.74**	**7.43**	**22.77**						**1,828.95**
1.A. Fuel combustion	1,649.78	3.51	22.77						1,676.06
1.A.1. Energy industries	2.36	0.00	0.01						2.37
1.A.2. Manufacturing industries and construction	122.16	0.19	6.62						128.97
1.A.3. Transport	961.46	1.83	8.05						971.34
1.A.4. Other sectors	563.65	1.48	8.09						573.22
1.A.5. Other	0.16	0.00	0.00						0.16
1.B. Fugitive emissions from fuels	148.96	3.93	NO						152.89
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	148.96	3.93	NO						152.89
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,683.90**	**3.39**	**2.32**	**173.65**	**82.56**	**NO**	**1.39**	**NO**	**1,947.20**
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	5.79	NA,NO	NA,NO						5.79
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				173.65	0.02	NO		NO	173.67
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	**3.54**	**411.47**	**345.53**						**760.54**
3.A. Enteric fermentation		345.65							345.65
3.B. Manure management		65.83	14.50						80.33
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	331.03						331.03
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	1.90								1.90
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**6,363.08**	**1,652.54**	**2.75**						**8,018.38**
4.A. Forest land	-435.64	0.85	2.16						-432.63
4.B. Cropland	1,673.58	90.21	0.58						1,764.36
4.C. Grassland	5,454.43	477.00	IE,NA,NO						5,931.43
4.D. Wetlands	-360.52	1,084.49	NA,NE,NO						723.97
4.E. Settlements	31.33	NA	0.01						31.34
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**	**246.06**	**6.95**						**260.50**
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		12.19	5.18						17.37
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	1,101.38	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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	47.56								47.56
1.D.4. CO_2 captured	-6.64								-6.64
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,797.18**
Total CO_2 equivalent emissions with LULUCF	**12,815.56**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,797.18**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,815.56**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,946.26**	**2,305.96**	**391.42**	**164.60**	**61.12**	**NO**	**2.81**	**NO**	**12,872.17**
1. Energy	**1,839.53**	**7.05**	**23.56**						**1,870.15**
1.A. Fuel combustion	1,693.05	3.32	23.56						1,719.93
1.A.1. Energy industries	2.31	0.00	0.01						2.32
1.A.2. Manufacturing industries and construction	95.05	0.17	6.70						101.92
1.A.3. Transport	1,015.36	1.62	8.60						1,025.58
1.A.4. Other sectors	580.16	1.52	8.26						589.95
1.A.5. Other	0.17	0.00	0.00						0.17
1.B. Fugitive emissions from fuels	146.48	3.73	NO						150.21
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	146.48	3.73	NO						150.21
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,759.32**	**3.54**	**2.14**	**164.60**	**61.12**	**NO**	**2.81**	**NO**	**1,993.52**
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	5.61	NA,NO	NA,NO						5.61
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				164.60	0.01	NO		NO	164.61
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	**4.25**	**403.14**	**355.53**						**762.92**
3.A. Enteric fermentation		338.32							338.32
3.B. Manure management		64.82	14.33						79.15
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	341.20						341.20
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	1.99								1.99
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**6,335.31**	**1,649.11**	**3.16**						**7,987.58**
4.A. Forest land	-473.91	0.85	2.49						-470.57
4.B. Cropland	1,690.23	91.10	0.62						1,781.96
4.C. Grassland	5,448.50	477.72	0.03						5,926.24
4.D. Wetlands	-358.83	1,079.44	0.01						720.63
4.E. Settlements	29.46	NA	0.01						29.47
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**	**243.12**	**7.03**						**258.00**
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		13.52	5.30						18.82
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	1,357.98	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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	51.92								51.92
1.D.4. CO_2 captured	-10.17								-10.17
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						

Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,884.58**
Total CO_2 equivalent emissions with LULUCF	**12,872.17**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,884.58**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,872.17**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,988.81**	**2,291.38**	**380.47**	**182.46**	**68.70**	**NO**	**4.03**	**NO**	**12,915.84**
1. Energy	**1,882.55**	**6.94**	**21.51**						**1,911.00**
1.A. Fuel combustion	1,726.09	3.24	21.51						1,750.84
1.A.1. Energy industries	2.35	0.00	0.01						2.36
1.A.2. Manufacturing industries and construction	88.58	0.16	5.39						94.13
1.A.3. Transport	1,050.38	1.54	8.64						1,060.56
1.A.4. Other sectors	584.25	1.54	7.47						593.27
1.A.5. Other	0.52	0.00	0.00						0.53
1.B. Fugitive emissions from fuels	156.46	3.70	NO						160.16
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	156.46	3.70	NO						160.16
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,773.29**	**3.57**	**2.60**	**182.46**	**68.70**	**NO**	**4.03**	**NO**	**2,034.65**
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	6.24	NA,NO	NA,NO						6.24
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				182.46	0.04	NO		NO	182.49
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	**4.35**	**391.18**	**346.02**						**741.55**
3.A. Enteric fermentation		328.41							328.41
3.B. Manure management		62.77	13.79						76.56
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	332.22						332.22
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	1.81								1.81
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**6,323.45**	**1,645.56**	**3.05**						**7,972.06**
4.A. Forest land	-503.36	0.86	2.38						-500.13
4.B. Cropland	1,706.88	92.00	0.67						1,799.54
4.C. Grassland	5,449.63	478.38	IE,NA,NO						5,928.02
4.D. Wetlands	-357.23	1,074.32	NA,NE,NO						717.09
4.E. Settlements	27.61	NA	0.01						27.62
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**	**244.13**	**7.29**						**256.58**
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		14.39	5.45						19.84
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	60.86								60.86
1.D.4. CO_2 captured	-12.20								-12.20
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,943.79**
Total CO_2 equivalent emissions with LULUCF	**12,915.84**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,943.79**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,915.84**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**9,889.49**	**2,249.68**	**370.77**	**194.36**	**72.34**	**NO**	**2.34**	**NO**	**12,779.00**
1. Energy	**1,827.29**	**7.03**	**19.39**						**1,853.71**
1.A. Fuel combustion	1,664.19	2.76	19.39						1,686.33
1.A.1. Energy industries	4.95	0.01	0.01						4.97
1.A.2. Manufacturing industries and construction	67.41	0.11	4.10						71.62
1.A.3. Transport	1,051.57	1.20	9.82						1,062.58
1.A.4. Other sectors	538.58	1.44	5.45						545.48
1.A.5. Other	1.68	0.00	0.00						1.68
1.B. Fugitive emissions from fuels	163.11	4.27	NO						167.38
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	163.11	4.27	NO						167.38
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,711.44**	**3.64**	**2.49**	**194.36**	**72.34**	**NO**	**2.34**	**NO**	**1,986.62**
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	5.61	NA,NO	NA,NO						5.61
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				194.36	0.05	NO		NO	194.41
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	**7.74**	**379.52**	**338.43**						**725.68**
3.A. Enteric fermentation		317.85							317.85
3.B. Manure management		61.66	13.27						74.93
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	325.16						325.16
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	2.30								2.30
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [(1)]	**6,336.85**	**1,642.45**	**3.13**						**7,982.44**
4.A. Forest land	-504.56	0.86	2.41						-501.29
4.B. Cropland	1,723.51	92.89	0.71						1,817.11
4.C. Grassland	5,447.90	478.88	IE,NA,NO						5,926.78
4.D. Wetlands	-355.72	1,069.82	NA,NE,NO						714.10
4.E. Settlements	25.76	NA	0.01						25.77
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**	**217.04**	**7.33**						**230.55**
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		12.86	5.51						18.37
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	1,159.90	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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	60.45								60.45
1.D.4. CO_2 captured	-9.70								-9.70
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,796.56**
Total CO_2 equivalent emissions with LULUCF	**12,779.00**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,796.56**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,779.00**

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	CO_2 equivalents (kt) [(2)]								
Total (net emissions) [(1)]	**9,695.83**	**2,268.33**	**371.91**	**198.11**	**67.61**	**NO**	**3.25**	**NO**	**12,605.04**
1. Energy	**1,641.10**	**7.18**	**16.03**						**1,664.31**
1.A. Fuel combustion	1,466.23	2.38	16.03						1,484.64
1.A.1. Energy industries	2.61	0.00	0.01						2.62
1.A.2. Manufacturing industries and construction	52.23	0.08	2.15						54.46
1.A.3. Transport	874.16	0.87	7.80						882.83
1.A.4. Other sectors	536.87	1.42	6.07						544.36
1.A.5. Other	0.36	0.00	0.00						0.36
1.B. Fugitive emissions from fuels	174.87	4.80	NO						179.67
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	174.87	4.80	NO						179.67
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,683.26**	**3.44**	**2.51**	**198.11**	**67.61**	**NO**	**3.25**	**NO**	**1,958.17**
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	5.74	NA,NO	NA,NO						5.74
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				198.11	0.06	NO		NO	198.17
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	**8.11**	**372.57**	**342.59**						**723.27**
3.A. Enteric fermentation		312.13							312.13
3.B. Manure management		60.44	12.99						73.42
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	329.60						329.60
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		NO	NO						NO
3.G. Liming	3.57								3.57
3.H. Urea application	3.07								3.07
3.I. Other carbon-containing fertilizers	1.47								1.47
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [(1)]	**6,356.93**	**1,639.85**	**3.15**						**7,999.93**
4.A. Forest land	-507.93	0.89	2.35						-504.69
4.B. Cropland	1,740.14	93.81	0.78						1,834.72
4.C. Grassland	5,443.62	479.00	0.02						5,922.64
4.D. Wetlands	-354.48	1,066.15	0.00						711.67
4.E. Settlements	35.61	NA	0.01						35.63
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**	**245.30**	**7.63**						**259.36**
5.A. Solid waste disposal		229.11							229.11
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		12.49	5.39						17.87
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	64.10								64.10
1.D.4. CO_2 captured	-11.70								-11.70
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						

Indirect CO_2 [(4)]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,605.11**
Total CO_2 equivalent emissions with LULUCF	**12,605.04**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,605.11**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,605.04**

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	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,854.05**	**2,262.46**	**377.16**	**162.41**	**73.38**	**NO**	**3.08**	**NO**	**12,732.55**
1. Energy	**1,726.31**	**7.11**	**16.94**						**1,750.37**
1.A. Fuel combustion	1,563.86	2.59	16.94						1,583.40
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	892.52	0.82	7.39						900.73
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	162.45	4.53	NO						166.97
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	162.45	4.53	NO						166.97
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,750.99**	**4.01**	**1.87**	**162.41**	**73.38**	**NO**	**3.08**	**NO**	**1,995.74**
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	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				162.41	0.06	NO		NO	162.48
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	**6.77**	**372.12**	**347.47**						**726.36**
3.A. Enteric fermentation		311.10							311.10
3.B. Manure management		61.01	12.97						73.99
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	334.49						334.49
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	1.87								1.87
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**6,363.42**	**1,636.58**	**3.39**						**8,003.38**
4.A. Forest land	-508.81	0.95	2.56						-505.30
4.B. Cropland	1,756.76	94.68	0.80						1,852.23
4.C. Grassland	5,432.89	479.34	0.01						5,912.24
4.D. Wetlands	-352.97	1,061.61	NA,NE,NO						708.64
4.E. Settlements	35.56	NA	0.02						35.58
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**	**242.64**	**7.49**						**256.69**
5.A. Solid waste disposal		225.02							225.02
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		13.75	5.50						19.25
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	89.30								89.30
1.D.4. CO_2 captured	-13.31								-13.31
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						

Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	4,729.16
Total CO_2 equivalent emissions with LULUCF	12,732.55
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	4,729.16
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	12,732.55

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	CO_2 equivalents (kt) (2)								
Total (net emissions) (1)	**9,947.04**	**2,242.36**	**370.90**	**133.20**	**71.81**	**NO**	**2.10**	**NO**	**12,767.42**
1. Energy	**1,782.69**	**7.49**	**16.87**						**1,807.05**
1.A. Fuel combustion	1,608.77	2.53	16.87						1,628.17
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	967.52	0.86	7.65						976.03
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	173.92	4.96	NO						178.88
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	173.92	4.96	NO						178.88
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,802.55**	**4.49**	**2.01**	**133.20**	**71.81**	**NO**	**2.10**	**NO**	**2,016.16**
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	5.87	NA,NO	NA,NO						5.87
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				133.20	0.06	NO		NO	133.26
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	**5.99**	**364.16**	**341.82**						**711.97**
3.A. Enteric fermentation		303.99							303.99
3.B. Manure management		60.18	12.69						72.87
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	329.13						329.13
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	1.50								1.50
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry (1)	**6,349.36**	**1,632.87**	**3.47**						**7,985.70**
4.A. Forest land	-537.56	0.97	2.61						-533.98
4.B. Cropland	1,773.37	95.57	0.84						1,869.78
4.C. Grassland	5,430.44	479.43	IE,NA,NO						5,909.87
4.D. Wetlands	-351.39	1,056.90	NA,NE,NO						705.52
4.E. Settlements	34.59	NA	0.02						34.61
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**	**233.35**	**6.73**						**246.53**
5.A. Solid waste disposal		214.75							214.75
5.B. Biological treatment of solid waste		1.98	0.70						2.68
5.C. Incineration and open burning of waste	6.46	0.39	0.30						7.15
5.D. Waste water treatment and discharge		16.24	5.72						21.96
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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	58.51								58.51
1.D.4. CO_2 captured	-12.11								-12.11
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 (4)	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,781.72**
Total CO_2 equivalent emissions with LULUCF	**12,767.42**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,781.72**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,767.42**

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SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
Total (net emissions) [1]	**9,858.79**	**2,217.37**	**360.26**	**124.54**	**68.17**	**NO**	**1.94**	**NO**	**12,631.06**
1. Energy	**1,748.62**	**7.75**	**18.12**						**1,774.50**
1.A. Fuel combustion	1,576.44	2.48	18.12						1,597.03
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	952.47	0.84	7.41						960.72
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	172.19	5.28	NO						177.46
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	172.19	5.28	NO						177.46
1.C. CO_2 transport and storage	NA,NE,NO								NA,NE,NO
2. Industrial processes and product use	**1,745.64**	**3.88**	**1.84**	**124.54**	**68.17**	**NO**	**1.94**	**NO**	**1,946.00**
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	5.75	NA,NO	NA,NO						5.75
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				124.54	0.08	NO		NO	124.61
2.G. Other product manufacture and use	0.02	0.02	1.84		NO		1.94	NO	3.82
2.H. Other	NA	NA	NA					NO	NA,NO
3. Agriculture	**7.88**	**355.52**	**328.98**						**692.38**
3.A. Enteric fermentation		296.47							296.47
3.B. Manure management		59.05	12.35						71.40
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NA	316.63						316.63
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	1.14								1.14
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**6,350.55**	**1,630.11**	**4.35**						**7,985.01**
4.A. Forest land	-557.43	0.98	2.76						-553.70
4.B. Cropland	1,789.97	96.46	0.89						1,887.32
4.C. Grassland	5,436.82	480.95	0.69						5,918.46
4.D. Wetlands	-349.64	1,051.72	NA,NE,NO						702.08
4.E. Settlements	31.05	NA	0.02						31.07
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**	**220.11**	**6.97**						**233.17**
5.A. Solid waste disposal		201.26							201.26
5.B. Biological treatment of solid waste		2.26	0.77						3.03
5.C. Incineration and open burning of waste	6.09	0.39	0.33						6.81
5.D. Waste water treatment and discharge		16.21	5.87						22.08
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*								**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	NO	NO	NO						NO
1.D.3. CO_2 emissions from biomass	54.85								54.85
1.D.4. CO_2 captured	-12.26								-12.26
5.F.1. Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NA,NE						
Indirect CO_2 [4]	NA,NE								

Total CO_2 equivalent emissions without LULUCF	**4,646.05**
Total CO_2 equivalent emissions with LULUCF	**12,631.06**
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	**4,646.05**
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	**12,631.06**