Report on Policies, Measures, and Projections

Projections of Greenhouse Gas Emissions in Iceland until 2040

Submitted to the European Union under the bilateral agreement between Iceland and the EU regarding the second commitment period of the Kyoto Protocol

2022

DATA SHEET

Title
Report on Policies, Measures and Projections: Projections of Greenhouse gas emissions in Iceland until 2040.

Legal basis
Report pursuant to Articles 18(1) and 39 of Regulation (EU) No 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action (hereafter referred to as "the Governance Regulation"), and Articles 36, 37, and 38 of Commission Implementing Regulation (EU) 2020/1208 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 and repealing Commission Implementing Regulation (EU) No 749/2014.

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Contents

List of Figures

List of Tables

Abbreviations

AFF	Association of Fishmeal Factories
AR4	Assessment Report 4
AR5	Assessment Report 5
BAT	Best Available Techniques
BAU	Business as Usual
CF	Cultivated forest
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
EAI	Environment Agency of Iceland (*Umhverfisstofnun*)
EC	Energy Consumption
ECAC	European Civil Aviation Conference
ECAs	Emission Control Areas
EEA	European Environment Agency
ES	Energy Supply
ESR	Effort Sharing Regulation (EU) 2018/842
EU	European Union
EU ETS	European Union Emission Trading System
EVs	Electric Vehicles
FEE	Foundation for Environmental Education
F-gas	Fluorinated gas
FrF	Forest land remaining forest land
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GWP	Global Warming Potential
ICAO	International Civil Aviation Organization
IFS	Icelandic Forest Service
IPPU	Industrial Processes and Product Use
ISK	Icelandic króna
JCD	Joint Committee Decision (EEA) 269/2019
kt CO_2e	Kilotonnes carbon dioxide equivalent
LcF	Land converted to forest
LPG	Liquid Petroleum Gas
LULUCF	Land Use, Land-Use Change and Forestry
MAC	Mobile Air-Conditioning Systems
MCF	Methane Conversion Factor
MMR	Monitoring Mechanism Regulation (EU) 525/2013
NA	Not Applicable
NDC	Nationally Determined Contribution
NE	Not Estimated
NEA	National Energy Authority
NGO	Non-Governmental Organization
NIR	National Inventory Report
NO	Not Occurring
ODS	Ozone Depleting Substances
OECD	Organisation for Economic Co-operation and Development
PaMs	Policies and Measures
PFC	Perfluorocarbons
SCSI	Soil Conservation Service of Iceland
SECAs	Sulphur Emission Control Areas
SOC	Soil Organic Carbon

SWDS	Solid Waste Disposal Sites
WAM	With additional measures
WEM	With existing measures
WOM	Without measures
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

Iceland is submitting this report on greenhouse gas (GHG) policies and measures (PaMs) and projections for the third time in 2022 in line with the reporting obligations described in the **Sections 1**[1]. A list of improvements planned for the next submission is included in **Section 1.4**. Iceland's National System, including legal and institutional arrangements, main institutions and data providers, improvements undertaken or planned to the national system, and stakeholder engagement are described in **Section 3**.

The Ministry of the Environment, Energy, and Climate[2] published an updated Climate Action Plan in 2020, which forms the basis for the PaMs reported here. The Action Plan included 50 PaMs, all of which are described under the relevant chapters in this report. **Section 2.1** provides a brief introduction to the current (2020) and previous Action Plans. A Progress Report on the progress of the 2020 Action Plan was published in September 2021 and the PaMs reported here were updated accordingly.

Six further PaMs which have had- or are expected to have a significant impact on GHG emissions from Iceland have been included: the MAC Directive, best available techniques for ferrous metal production, industries and the manufacture of glass, a new gas and compost plant, a pay-as-you-throw system, and an extended manufacturer's warranty.

GHG emissions savings from the following PaMs have been quantified for this submission: electrical infrastructure in ports and electrification of fishmeal production plants (**Section 5.3.2**), energy transition of ferries (**Section 6.3.1**), regulation on F-gases (**Section 7.3.1**), improved use and handling of fertilisers (**Section 8.3.1**) ban on landfilling of organic waste and the new gas and composting plant (**Section 9.3.1**. In addition, three PaMs in Land use, land-use change, and forestry (LULUCF) were quantified (**Section 10.3**): enhanced action in forestry, expanding revegetation, and restorations of wetlands.

For this submission, Iceland has only included projections for the "with existing measures" (WEM) scenario. There is currently not enough data available to perform projections for a "with additional measures" (WAM) scenario for all sectors.

[1] According to Article 18 of the Governance Regulation, member states (MS) shall report information on GHG policies and measures and on projections to the Commission by 15 March 2021, and every two years thereafter. A MS shall, however, communicate to the Commisison any substantial changes to the information reported pursuant to paragraph 1 during the first year of the reporting period, by 15 March of the year following the previous report. This year, Iceland is communicating this report due to substantial changes, predominantly due to updated energy emissions projections based on new fuel projections published by the National Energy Authority (NEA) in October 2021.

[2] The new Governmental Agreement between the current government took force on 1 February 2022. Consequently, the title of the Ministry, previously called *The Ministry for the Environment and Natural Resources*, was changed to *The Ministry of the Environment, Energy and Climate*.

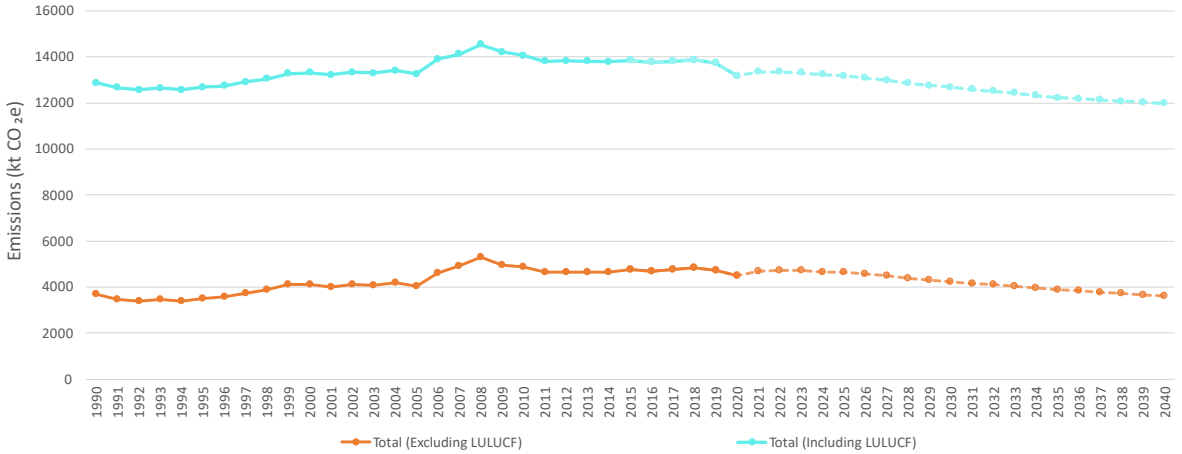

Figure ES.0.1 Total historical and projected GHG emissions, excluding and including LULUCF, in the WEM scenario 1990-2040, [kt CO_2e].

Based on the Environment Agency of Iceland's (EAI) calculations and assumptions, total emissions from Iceland excluding LULUCF are expected to increase slightly between 2020 and 2022, after which the total emissions begin to decrease until 2040 (see **Figure ES.0.1** and **Table ES.0.1**). The same trend is observed for total emissions including LULUCF.

Table ES.0.1 Total historical and projected GHG emissions, excluding and including LULUCF, in the WEM scenario 1990-2040, [kt CO2e].

	Emissions [kt CO_2e]						
Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Total exl. LULUCF	**3,674**	**4,746**	**4,511**	**4,630**	**4,241**	**3,876**	**3,620**
Total incl. LULUCF	**12,873**	**13,853**	**13,182**	**13,184**	**12,682**	**12,230**	**11,970**

1 Introduction

1.1 Legal basis for reporting obligations

For the second commitment period of the Kyoto Protocol (2013-2020), Iceland concluded a bilateral agreement[3] in 2015 with the European Union (EU) and its Member States concerning Iceland's participation in the Joint Fulfilment Agreement. Therein the Parties agreed to jointly fulfil their emission reduction commitments inscribed in the third column of Annex B to the Kyoto Protocol. According to Article 4 of the bilateral agreement the legal acts listed in Annex I shall be binding upon Iceland. This included Regulation (EU) No 525/2013, Commission Implementing Regulation (EU) No 749/2014 and other delegated and implementing acts based on Regulation (EU) No 525/2013.

For the Paris Agreement period, from 1 January 2021 to 31 December 2030, Iceland and Norway joined the EU in the commitment of a 40% reduction in greenhouse gas emissions, according to the EEA Joint Committee Decision (JCD) No 269/2019[4], that amends Protocol 31 to the EEA Agreement on cooperation in specific fields outside the four freedoms[5]. The JCD extends the cooperation on climate change by including GHG emissions and removals from LULUCF in the EEA Agreement. According to JCD 269/2019, Regulation (EU) 2018/842 (hereafter referred to as the Effort Sharing Regulation (ESR)[6]), Regulation (EU) 2018/841 (hereafter referred to as the LULUCF Regulation[7]), and relevant provisions of the Governance Regulation (all provisions replacing Regulation (EU) No 525/2013, which was repealed by the Governance Regulation by 1 January 2021) were incorporated to the EEA Agreement.

Work is underway to finalise the legal implementation of Iceland's joint commitment with the EU Member States and Norway under the Paris Agreement. Iceland has implemented the LULUCF Regulation and the ESR through the Climate Act No 70/2012 (*lög um loftslagsmál nr. 70/2012*)[8]. Commission Implementing Regulation (EU) 2020/1208 and Commission Delegated Regulation (EU) 2020/1044, are now incorporated into the EEA Agreement through the EEA Joint Committee Decision no 223/2021[9]. At the time of this writing, work is underway to write a new regulation aiming at implementing the JCD No 223/2021 into Icelandic legislation. The same regulation will also serve as a recast of Regulation No 520/2017, on data collection and information from institutions related to Iceland's inventory of greenhouse gas emissions and carbon removal, that implemented Regulation (EU) No 525/2013. This new regulation is expected to be published later this year.

Iceland is currently reporting under the aforementioned regulations, and in accordance, Iceland reports to the European Commission the greenhouse gas (GHG) emissions by sources or enhanced removals by sinks, the information on national systems, policies and measures (PaMs) regarding climate change mitigation, as well as national projections of anthropogenic GHG emissions by

[3] *Council of the European Union.* http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2010941%202014%20INIT

[4] *EFTA.* https://www.efta.int/sites/default/files/documents/legal-texts/eea/other-legal-documents/adopted-joint-committee-decisions/2019%20-%20English/269-2019.pdf

[5] *EFTA.* https://www.efta.int/EEA/Policy-Areas-2422

[6] Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013.

[7] Regulation (EU) 2018/841on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU.

[8] *Parliament (Alþingi)*. https://www.althingi.is/lagas/nuna/2012070.html

[9] *EFTA*. https://www.efta.int/media/documents/legal-texts/eea/other-legal-documents/adopted-joint-committee-decisions/2021%20-%20English/223-2021.pdf

sources and their removal by sinks for a sequence of four future years ending with zero or five immediately following the reporting year.

Table 1.1 Legal (EU) basis for the reporting on National Systems, Policies and measures and Projections

Reporting obligation	*Governance Regulation*	*Implementing Regulation (EU) 2020/1208*
National Systems for policies and measures and projections	Art. 39	Art. 36, Annex XXIII
National greenhouse gas policies and measures	Art. 18(1)(a)	Art. 37, Annex XXIV
National projections of anthropogenic greenhouse gases	Art. 18(1)(b)	Art. 38, Annex XXV

The report structure and provided information is pursuant to Commission Implementing Regulation (EU) 2020/1208 of 7 August 2020 on structure, format, submission processes and review of information reported by Member States pursuant to the Governance Regulation. The Articles and Annexes for the reporting are summarised in **For the** second commitment period of the Kyoto Protocol (2013-2020), Iceland concluded a bilateral agreement in 2015 with the European Union (EU) and its Member States concerning Iceland's participation in the Joint Fulfilment Agreement. Therein the Parties agreed to jointly fulfil their emission reduction commitments inscribed in the third column of Annex B to the Kyoto Protocol. According to Article 4 of the bilateral agreement the legal acts listed in Annex I shall be binding upon Iceland. This included Regulation (EU) No 525/2013, Commission Implementing Regulation (EU) No 749/2014 and other delegated and implementing acts based on Regulation (EU) No 525/2013.

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Iceland is currently reporting under the aforementioned regulations, and in accordance, Iceland reports to the European Commission the greenhouse gas (GHG) emissions by sources or enhanced removals by sinks, the information on national systems, policies and measures (PaMs) regarding climate change mitigation, as well as national projections of anthropogenic GHG emissions by sources and their removal by sinks for a sequence of four future years ending with zero or five immediately following the reporting year.

Table 1.1 above.

The legal basis for the national system for the GHG inventories, including the reporting on National Systems for PaMs and projections, national GHG PaMs and national projections of anthropogenic GHG emissions, is provided by the Icelandic Climate Act No 70/2012, which describes the roles and responsibilities of the relevant government agencies in this sector. The Act ensures that enough capacity is available for reporting.

1.2 About this report

This report presents information on Iceland's national system for reporting on climate mitigation PaMs, Iceland's GHG PaMs, as well as anthropogenic GHG emission projections until 2040 pursuant to Article 39, Article 18(1)(a) and Article 18(1)(b) of the Governance Regulation and under Article 36 (and Annex XIII), Article 37 (and Annex XXIV) and Article 38 (and Annex XXV) of Implementing Regulation (EU) 2020/1208 (see **For the** second commitment period of the Kyoto Protocol (2013-2020), Iceland concluded a bilateral agreement in 2015 with the European Union (EU) and its Member States concerning Iceland's participation in the Joint Fulfilment Agreement. Therein the Parties agreed to jointly fulfil their emission reduction commitments inscribed in the third column of Annex B to the Kyoto Protocol. According to Article 4 of the bilateral agreement the legal acts listed in Annex I shall be binding upon Iceland. This included Regulation (EU) No 525/2013, Commission Implementing Regulation (EU) No 749/2014 and other delegated and implementing acts based on Regulation (EU) No 525/2013.

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Table 1.1).

In accordance with these articles, this report contains the following items:

- Description of the legal basis and national system related to reporting on PaMs and projections.
- Description of climate mitigation PaMs that are implemented, adopted and planned.
- Projections of future anthropogenic GHG emissions for the following scenario:
    - With existing measures (WEM), the national base scenario that includes all measures implemented or adopted

According to Art. 18 of Regulation No 2018/1999, Member States are required to report on GHG policies and measures and projections every other year, on odd years. The same article states that member states shall inform about any substantial changes to the information reported on odd years in subsequent years. The current report presents an update of the information submitted in March 2021; the main change is due to the inclusion, in the GHG projections, of an update to the energy consumption projections which was published in September 2021. In addition, a few new PaMs have been added to the report and the PaMs reported in March 2021 have been updated in line with information published in the most recent Progress Report (2021).

According to Annex VII of the Governance Regulation, the report should include total GHG projections, as well as disaggregated projections by the scope of following regulations:

- Emissions falling under EU ETS Directive 2003/87/EC (which Iceland has incorporated; see also **Section 2.1.7**),
- Emissions falling under the ESR (Regulation 2018/842).

1.3 Emissions and removals under the LULUCF Regulation (Regulation 2018/841): Overview of reporting on emission projections

Iceland has completed WEM projections for the sectors: Energy (1), Industry (2), Agriculture (3), LULUCF (4) and Waste (5), as outlined in **Table 1.2.**

Table 1.2 Greenhouse gas source and sink categories for emission projections.

Sector	*CO_2*	*CH_4*	*N_2O*	*HFC*	*PFC*	*SF_6*	*NF_3*
Total excluding LULUCF	✓	✓	✓	✓	✓	✓	NE
Total including LULUCF	✓	✓	✓	✓	✓	✓	NE
1A1a Public electricity and heat production	✓	✓	✓	NA	NA	NA	NA
1A1b Petroleum refining	NO	NO	NO	NO	NO	NO	NO
1A1c Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
1A2 Manufacturing industries and construction	✓	✓	✓	NA	NA	NA	NA

Sector	*CO_2*	*CH_4*	*N_2O*	*HFC*	*PFC*	*SF_6*	*NF_3*
1A3a Domestic aviation	✓	✓	✓	NA	NA	NA	NA
1A3b Road transportation	✓	✓	✓	NA	NA	NA	NA
1A3c Railways	NO	NO	NO	NO	NO	NO	NO
1A3d Domestic navigation	✓	✓	✓	NA	NA	NA	NA
1A3e Other transportation	NO	NO	NO	NO	NO	NO	NO
1A4 Other sectors	✓	✓	✓	NA	NA	NA	NA
1A5 Other	NO	NO	NO	NO	NO	NO	NO
1B1 Solid fuels	NO	NO	NO	NO	NO	NO	NO
1B2 Oil and natural gas and other emissions from energy production	✓	✓	✓	NA	NA	NA	NA
1C CO_2 transport and storage	NA	NA	NA	NA	NA	NA	NA
2A Mineral Industry	✓	✓	✓	NA	NA	NA	NA
2B Chemical industry	NO	NO	NO	NO	NO	NO	NO
2C Metal industry	✓	✓	✓	NA	✓	NA	NA
2D Non-energy products from fuels and solvent use	✓	NA	NA	NA	NA	NA	NA
2E Electronics industry	NO	NO	NO	NO	NO	NO	NO
2F Product uses as substitutes for ODS(2)	NA	NA	NA	✓	✓	NA	NA
2G Other product manufacture and use	✓	✓	✓	NA	NA	✓	NA
2H Other (please specify)	NO	NO	NO	NO	NO	NO	NO
3A Enteric fermentation	NA	✓	NA	NA	NA	NA	NA
3B Manure Management	NA	✓	✓	NA	NA	NA	NA
3C Rice Cultivation	NO	NO	NO	NO	NO	NO	NO
3D Agricultural Soils	NA	NA	✓	NA	NA	NA	NA
3E Prescribed burning of savannahs	NO	NO	NO	NO	NO	NO	NO
3F Field burning	NO	NO	NO	NO	NO	NO	NO
3G Liming	✓	NA	NA	NA	NA	NA	NA
3H Urea application	✓	NA	NA	NA	NA	NA	NA
3I Other carbon-containing fertilisers	✓	NA	NA	NA	NA	NA	NA
3J Other (please specify)	NO	NO	NO	NO	NO	NO	NO
4A Forest land	✓	✓	✓	NA	NA	NA	NA
4B Cropland	✓	✓	NO, NA	NA	NA	NA	NA
4C Grassland	✓	✓	NA	NA	NA	NA	NA
4D Wetlands	✓	✓	NO, NE, NA	NA	NA	NA	NA
4E Settlements	✓	NE	NA	NA	NA	NA	NA
4F Other Land	NE, NA	NA	NA	NA	NA	NA	NA
4G Harvested wood products	✓	NA	NA	NA	NA	NA	NA
4H Other	IE	IE	IE	NA	NA	NA	NA
5A Solid Waste Disposal	NA	✓	NA	NA	NA	NA	NA
5B Biological treatment of solid waste	NA	✓	✓	NA	NA	NA	NA
5C Incineration and open burning of waste	✓	✓	✓	NA	NA	NA	NA
5D Wastewater treatment and discharge	NA	✓	✓	NA	NA	NA	NA
5E Other (please specify)	NA	NA	NA	NA	NA	NA	NA

Note: NO = not occurring, NA = not applicable, NE = not estimated

1.4 Improvement Actions

The 2022 submission is the third time Iceland is reporting on its GHG mitigation PaMs, Projections of anthropogenic GHG emissions, and National System under the Governance Regulation (previously under the MMR). Information on the improvements which were planned for this submission are listed in **Table 1.3** below. Not all the planned improvements were completed for this submission, and therefore, those improvements will remain on the improvement plan and be prioritised for the next submission.

Table 1.3 Improvement Actions for PaMs and Projections from the Improvement Plan.

Improvement ID	*Improvement Action*	*Priority*	*Status*
LULUCF projections	Include full LULUCF projections in collaboration with the Soil Conservation Service of Iceland and Icelandic Forest Service.	High	Completed
Agricultural projections	Collect country specific projections for the agriculture sector - livestock numbers, yields, MCF, nitrogen excretion, feed characteristics, manure management systems, area of arable land and fertiliser application.	High	Partially completed
Projections consistency with historical GHG inventory	There is a need to contact data providers to determine the causes/corrected projected activity data. Inconsistencies between the projected and historical activity data are causing step-changed in emissions between the base year and first year of projections.	High	Completed
Create WAM projections	Use quantified WAM PaMs to create a WAM GHG projections scenario	High	Not started
Road Transport projected activity data	Projections of road transport are currently available from different stakeholders. Facilitate discussions with stakeholders to determine the most appropriate activity data for the WEM and WAM scenario as well as the impact of PaMs on the projections.	Medium	Partially completed
LPG consumption projections	Iceland does not currently have any information on the future consumption of LPG within the energy sector. Stakeholder engagement is required to inform projections of LPG.	Medium	Not started
Quantifying more PaMs	Set a target for quantifying more PaMs for the 2022 GHG Projections submission.	High	Partially completed

Due to time and resource constraints, there are a number of additional areas which could still be improved. **Table 1.4** contains the key new improvement actions planned in each sector.

Table 1.4 New Improvement Actions for PaMs and Projections for the next submission.

Improvement ID	*Improvement Action*	*Priority*	*Status*
Energy (Other)	Acquire ex-post analysis of ongoing PaMs	Medium	Not started
	Increase number of ex-ante evaluated PaMs	High	Started
	Investigate CCS quantification possibilities	High	Started
Transport	Increase number of ex-ante evaluated PaMs	Medium	Started
	Expand ex-ante analysis to more ferries when more measures have been confirmed	Low	Not started
Waste	Improve wastewater projections	Medium	Not started
	Revise mass balance waste allocation and develop specific projection time series for all composting activities.	Medium	Not started

2 Policy Background

2.1 Iceland's Climate Action

2.1.1 Iceland's national emission reductions target

As stated in **Chapter 1.1**, Iceland, along with Norway, is part of a joint commitment with the EU Member States to reduce greenhouse gas emissions by 55%[10] by 2030 in comparison with 1990 levels under the Paris Agreement and will apply the key pieces of EU climate legislation accordingly.

Iceland submitted an updated Nationally Determined Contribution (NDC) under the Paris Agreement in February 2021. According to the NDC, Iceland is a part of a joint fulfilment of a -55% emissions target for 2030 (compared to 1990 emissions) with the European Union and its Member States. The intention to deliver the target in cooperation with the EU is stated in Iceland's latest NDC[11]. The cooperation entails that Iceland will take part in three key climate mitigation legislative frameworks:

a. Emissions Trading System (ETS), which includes emissions from the heavy industry and aviation sectors in Iceland;
b. Effort Sharing Regulation, which sets binding targets for non-ETS emissions determined by the same methodology as applied to EU Member States; and
c. LULUCF, which covers emissions and carbon removals from the Land Use, Land Use Change and Forestry sector.

The Effort Sharing target for Iceland within the collective target with the EU and Norway of 40% lower emissions in 2030 compared to 1990, had been set at -29% in 2030 compared to 2005, according to JCD No 269/2019. The target for Iceland within the updated collective delivery of -55% has not been set. The Icelandic Government has, furthermore, announced more ambitious targets than set forth for Iceland by the EU. In the 2018 and 2020 Climate Action Plans, the Government announced goals to achieve at least a 40% reduction in non-ETS emissions in 2030 compared to 2005 and of achieving carbon neutrality in 2040 (Law 95/2021 amending the Climate Act 70/2012)[12]. In November 2021, the then newly formed government announced an independent, more ambitious target of 55% reduction for ESR emissions in 2030 relative to 2005 in the Governmental agreement[13]. Furthermore, Iceland has implemented a national carbon neutrality target through law No 95/2021 on Climate Issues[14], stating that Iceland is to achieve carbon neutrality no later than 2040.

2.1.2 Past Action Plans

Iceland ratified the 1992 United Nations Framework Convention on Climate Change (UNFCCC) in 1993. In 1995 the government of Iceland adopted an implementation strategy based on the commitments of the Framework Convention. The domestic implementation strategy was revised in

[10] On 14 July 2021 the European Commission presented the Fit for 55 package, containing a set of legistlative proposals to make the EU's climate, energy, land use, transport and taxation policies fit for reaching the European Green Deal's objective of reducing net greenhouse gas emissions by at least 55% by 2030. The final text of the deal still needs ratification by the European Parliament and by EU ministers at the Council.
[11] Iceland's Intended Nationally Determined Contribution, Submission by Iceland to the ADP. *UNFCCC*. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Iceland%20First/Iceland_updated_NDC_Submission_Feb_2021.pdf
[12] Last April (2021) the Minister of the Environment, Energy and Climate submitted a bill for the Icelandic Parliament that proposes the enshrinement of the target of carbon neutrality in 2040 into law.
[13] *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/05-Rikisstjorn/Agreement2021.pdf
[14] *Parliament (Alþingi).* https://www.althingi.is/thingstorf/thingmalalistar-eftir-thingum/ferill/?ltg=151&mnr=711

2002, based on the commitments of the Kyoto Protocol and the provisions in the Marrakech Accords.

A new climate change strategy was adopted by the Icelandic government in February 2007 (Ministry for the Environment and Natural Resources, 2007). The Ministry of the Environment formulated the strategy in close collaboration with the ministries of Transport and Communications, Fisheries, Finance, Agriculture, Industry and Commerce, Foreign Affairs and the Prime Minister's Office. The long-term strategy was to reduce net GHG emissions in Iceland by 50 – 75% by 2050, compared to 1990 levels. In the shorter term, the strategy aimed to ensure that emissions of GHGs would not exceed Iceland's obligations under the Kyoto Protocol. In November 2010, the Icelandic government adopted a Climate Action Plan (Ministry for the Environment and Natural Resources, 2010) in order to execute the strategy. However, little funding followed the plan and its implementation was not entirely successful.

In 2012, the Climate Act No. 70/2012 introduced the legal requirement for a Climate Action Plan. In 2016, in light of the Paris Agreement and the ongoing second commitment period of the Kyoto Protocol, the government published a new Climate Action Plan (Ministry for the Environment and Natural Resources, 2016) presenting 16 climate-related projects, with eight projects specifically aimed at reducing GHG emissions. This plan included funding earmarked for specific projects.

2.1.3 The 2018 Climate Action Plan

In 2018, the government of Iceland published a new Climate Action Plan spanning the years 2018-2030 (Ministry for the Environment and Natural Resources, 2018[15]), this time in association with significant funding earmarked for the implementation of and follow-through on the actions. This plan was developed with the aim to achieve two major emission targets: Reaching Iceland's international 2030 target. At that time, the approximate non-ETS emission reduction target was a 29% reduction compared to emissions in the year 2005 (see also Section 1.1 on Iceland's commitment for 2030)) and reaching carbon neutrality by the year 2040.

The plan includes 34 actions across all sectors. The actions listed in the plan are mostly centred around two main strategies:

1. Electrification of the energy sector, by substituting fossil fuel combustion with the use of renewable electricity;
2. Enhanced carbon removal by better land use and increased efforts in afforestation/reforestation.

The Climate Action Plan (2018) was submitted to public consultation in the fall of 2018. It was consequently updated; taking into account results from the public consultation, further implementation work by the Climate Council, and the Interministerial steering committee for Climate Action, as well as results of the calculations shown in this report on Policies, Measures, and Projections, resulting in the publication of the 2020 Action Plan.

2.1.4 The 2020 Climate Action Plan

In 2020, the government of Iceland published an updated Climate Action Plan spanning the years 2020-2030 (Ministry for the Environment and Natural Resources, 2020[16]). This plan is Iceland's main instrument to reach the commitment in the Paris Agreement, specifically the emissions reduction

[15] *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/01--Frettatengt---myndir-og-skrar/UAR/100918%20A%C3%B0ger%C3%B0a%C3%A1%C3%A6tlun%20LOKA_%20-%20Copy%20(1).pdf

[16] *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/Adgerdaaetlun%20i%20loftslagsmalum%20onnur%20utgafa.pdf

goals for 2030. It is also the main instrument to reach Iceland's stated goal of carbon neutrality by 2040. Over a five-year period, from 2020 to 2024, the government will allocate a minimum of 46 billion ISK to climate mitigation measures. According to the government's latest Fiscal policy 2022-2026 (Ministry of Finance and Economic Affairs, 2021) funding for climate action will continue to increase. In addition to previously determined climate funding (Ministry of Finance and Economic Affairs, 2020), climate action will receive an additional one billion ISK per year of funding from 2022-2031.

The plan includes 48 measures across all sectors that aim to reduce GHG emissions and increase carbon sequestration. Fifteen measures have been added since the 2018 action plan. The main sectoral changes that are expected to impact Iceland's GHG emissions until 2030 are the phaseout of fossil fuels in transport and an increase in carbon sequestration in LULUCF, by restoration of woodlands and wetlands, revegetation and afforestation. As can be seen in **Figure 2.1** below emphasis is placed on immediate action and therefore 28 measures had already been started when the Action Plan was published.

2.1.5 The 2021 Progress Report

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 inter-ministerial 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 or not the development is in accordance with the Climate Plan. The first such progress report was published in September 2021 (Ministry for the Environment and Natural Resources, 2021[17]) to follow up on the progress of the 2020 Climate Action Plan. Besides the 48 PaMs put forth in the 2020 Climate Action Plan, two new GHG mitigation measures are introduced in the progress report: 1) energy change in the production sector; 2) increased knowledge and research to improve the LULUCF sector of the GHG inventory. According to the progress report, thirty PaMs (out of fifty in total) have currently been implemented, seventeen are in progress and three are in preparation stages.

[17] *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/St%c3%b6%c3%b0usk%c3%bdrsla%20a%c3%b0ger%c3%b0a%c3%a1%c3%a6tlunar%20%c3%ad%20loftslagsm%c3%a1lum%202021.pdf

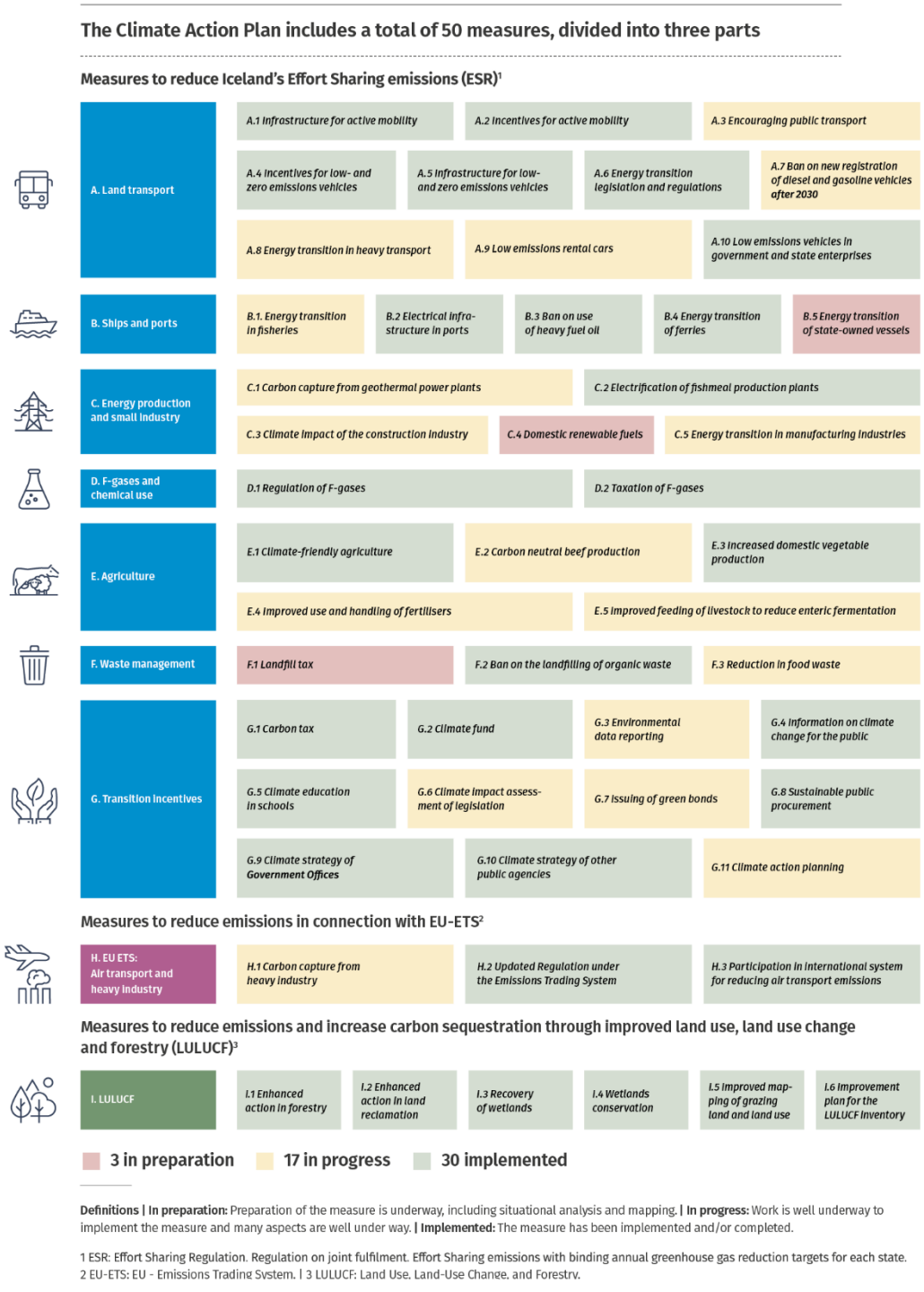


Figure 2.1 Summary of measures in Iceland's 2020 Climate Action Plan and 2021 Progress Report, indicating whether they are new and whether at the time of publication they were being implemented, in progress or in preparation.

2.1.6 LULUCF Mitigation Plan

In July 2019 the Icelandic Government published a mitigation plan in the LULUCF sector (Government of Iceland, June 2019), outlining concrete measures and funding in accordance with the 2018 Climate Action Plan. The LULUCF mitigation plan outlines efforts to increase carbon sequestration and to decrease carbon emission from soils and vegetation.

Iceland is using land (ecosystem) restoration, reforestation, and afforestation as mitigation efforts against climate change. These efforts are carried out in collaboration with farmers and other landowners, NGO's and local authorities and include restoring native vegetation in degraded areas, restoring drained wetlands and afforestation to create a woodland resource.

The Icelandic Government has increased these efforts with the aim to restore ecosystems to conserve and enhance biological diversity, increase ecosystem resilience against natural disasters and increase the potential of rural societies -relying on these ecosystems to sustain their livelihoods.

2.1.7 Iceland's Long-Term Low Emission Development Strategy

Iceland communicated its first Long-Term Low Emission Development Strategy "On the Path to Climate Neutrality"[18] (hereafter called "Strategy"), based on the encouragements in the Paris Agreement, in October 2021. The Strategy declares that Iceland is committed to reducing its overall GHG emissions and reaching climate neutrality no later than 2040 and become fossil fuel free in 2050, which should set Iceland on a path to net negative emissions. The foundation and various milestones that have been reached on the path to climate neutrality are described in the Strategy. Key documents and policies are introduced, and insight is given into context and framing of overarching climate targets and commitments.

2.1.8 Updated ETS for Aviation and CORSIA

Iceland is part of the EU Emissions Trading System (EU ETS), through its commitments under the EEA agreement. The revised legal framework for the ETS Phase IV from 2021 to 2030 will be adopted in accordance with the Joint Commitment Decision No 112/2020. The ETS is an important tool for reducing GHG emissions cost-effectively and is designed to reduce European GHG emissions by 55%[19] by 2030 compared to 2005. In Iceland, it is mainly heavy industries and aviation which are covered by the EU ETS.

The regulations and implementation of the EU ETS in Iceland is being adjusted in accordance with the new period. Aviation in the EU ETS is in revision, since the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) takes place from 2021. The revision is to implement CORSIA by the EU in a way that it will be consistent with the EU's 2030 climate objectives. Initially, CORSIA is based on voluntary participation; Iceland is taking part in the system from the beginning and participated in the baseline period from 2019-2020 with all other European Civil Aviation Conference (ECAC)[20] states.

[18] *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/Iceland_LTS_2021.pdf

[19] *European Commission*.https://ec.europa.eu/clima/policies/eu-climate-action/2030_ctp_en

[20] The European Civil Aviation Conference (ECAC) is an intergovernmental organisation which was established by the International Civil Aviation Organization (ICAO) and the Council of Europe. The ECAC now totals 44 members, including all 27 EU members. ECAC promotes the continued development of a safe, efficient and sustainable European air transport system.

2.2 EU ETS vs. Effort Sharing Regulation ("ESR")

2.2.1 Note on Terminology

Iceland is part of the EU ETS, and the EU ETS Directive 2003/87/EC, establishing a system for GHG emission allowance trading within the Community, was incorporated into the EEA Agreement with EEA Joint Committee Decision No 146/2007. The EU ETS Directive was implemented into Icelandic legislation through the Climate Change Act No 70/2012, and the directive has been applied in Iceland since 2013.

For the EU Member States, emissions (outside of LULUCF) not falling under the EU ETS are referred to as ESR emissions, with reference to the Effort Sharing Regulation 2018/842.

2.2.2 Policy background

One of the actions listed in the Climate Action Plan (2020) includes the continuation of Iceland's participation in the ETS (measure **307**). Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018, that amends Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, was incorporated into the EEA Agreement with EEA Joint Committee Decision No 112/2020 and implemented into Icelandic legislation through amendments of the Climate Change Act No 70/2012. The Directive lays down the provisions for the fourth trading period in the EU ETS (phase IV).

Two other actions in the Climate Action Plan (2020) fall outside of the scope of ESR emissions: Carbon capture from heavy industry (measure **306**) and participation in the international system for mitigating emissions from aviation (ETS and CORSIA) (measure (**705**).

The rest of the actions cover ESR or LULUCF emissions.

2.2.3 Historical split between ETS and Joint Fulfilment

In recent years, the share of emissions falling under the scope of the EU ETS has been just below 40% of the total annual emissions excluding LULUCF and international bunkers, with just over 60% contributing to Iceland's emissions falling under the scope of the Joint Fulfilment Agreement with the EU.

Emissions from stationary operators falling under the scope of the EU ETS originate for the most part from metal production (primary aluminium, ferroalloys and silicon production). These emissions are largely dominated by process emissions from metal production, i.e., emissions related to the oxidation of carbon-containing fuels which in turn is linked to the reduction of raw materials into metal. Only a very small percentage belongs to emissions solely coming from fuel combustion.

In recent years, approximately two thirds of the emissions falling under the joint fulfilment agreement with the EU, originated from the energy sector. Half of the emissions from this sector were from road transport, while the fishing industry accounted for a large part of the rest. Approximately one fifth of the non-ETS emissions come from the agriculture sector, whereas F-gas emissions and solid waste disposal make up most of the rest of the emissions.

3 Information on National Systems for Policies and Measures and Projections

3.1 Legal Arrangements

The legal basis for the national system for the GHG inventories, including the reporting on National Systems for policies and measures and projections, national GHG policies and measures and national projections of anthropogenic GHG emissions, is provided by the Icelandic Climate Act No 70/2012, which describes the roles and responsibilities of the relevant government agencies in this area. The law ensures that enough capacity is available for reporting. The objectives of the Climate Act are the following:

- To reduce GHG emissions efficiently and effectively;
- To increase carbon sequestration from the atmosphere;
- To promote mitigation and adaptation to the consequences of climate change, and;
- To create conditions for the government to fulfil its international obligations regarding climate change.

The Climate Act establishes the national system for the estimation of GHG emissions by sources and removals by sinks, a national registry and the legal basis for installations and aviation operators participating in the EU ETS. It also serves as the legal basis for the development of national Climate Action Plans and Progress Reports.

Article 5 of the Climate Act describes the obligation of the Minister of the Environment, Energy and Climate to see to the production of a Climate Action Plan; it also establishes the Interministerial steering committee for Climate Action composed by members nominated by the Minister of the Environment, Energy and Climate as well as Ministers from other ministries.

Article 6 of the Climate Act addresses Iceland's GHG inventory. It states that the Environment Agency of Iceland (EAI) is the competent authority for the national accounting as well as for the inventory of emissions and removals of GHGs according to Iceland's international obligations. The Climate Act established the form of relations between the IEA and other bodies concerning data handling. This article also serves as the legal basis for Regulation No 520/2017 on data collection and information from institutions related to Iceland's inventory of greenhouse gases emissions and carbon removal. Regulation No 520/2017 is currently being revised in accordance with the new legislation for the Paris Agreement period.

Regulation No. 520/2017 serves both as the description of the EAI's and data providers' obligations related to the GHG inventory, and the implementation of Regulation (EU) No 525/2013. It specifies the obligations of the EAI in terms of reporting and information related to GHG emissions to other institutions, as well as listing the obligations of other agencies, institutions or other data providers to the EAI; in particular, it attributes the responsibility of the LULUCF sector to the Soil Conservation Service of Iceland and the Icelandic Forest Service (see below). In addition, it specifies the timelines for data collection and reporting to the EU and gives the EAI the right to request additional data from any stakeholder provided it is necessary to produce the GHG inventory. A summary of each article in Regulation No 520/2017 can be found in Chapter 13 of Iceland's 2021 National Inventory Report (NIR). A recast of this regulation is expected to be published later this year, and will be described in Iceland's 2023 submission.

Provisions on reporting on PaMs and projections were first included in the Climate Act in 2019 through law No 86/2019[21]. Another notable change is the legal establishment of Iceland's Climate Council and the definition of its role in advising the government regarding Iceland's Climate Action Plans. The Act was amended again in 2020 where ESR and LULUCF regulation were implemented. Consequently, Regulation No 520/2017 is also being revised in order to reflect the changes in the Act and spell out more specifically the data requirements linked to reporting on PaMs and projections. This updated regulation will also serve as the implementation of Implementing Regulation (EU) 2020/1208 and Delegated Regulation (EU) 2020/1044, as these two regulations have been incorporated into the EEA Agreement through JCD 233/2021. Any future delegated and implementing regulations based on Regulation (EU) 2018/1999 that will be incorporated into the EEA Agreement will also be implemented in Icelandic legislation.

3.2 Main institutions and data providers

The main institutions and organisations playing a major role in climate policy and international reporting include:

The Ministry of the Environment, Energy and Climate, which holds responsibility for activities related to the development and implementation of the national PaMs in climate change prevention.

The Environment Agency of Iceland (EAI), which is designated as the national entity with the overall responsibility for:

- The climate change policy evaluation and reporting on PaMs;
- The development and reporting on projections of anthropogenic GHG emissions;
- Reporting on national systems for policies and measures and projections.

The inventory team, which falls within the Department for Climate and the Circular Economy at the EAI, is also responsible for the submission of the national GHG Inventory for each year. The same experts complete the reporting on PaMs, projections of anthropogenic GHG emissions and the historical GHG inventory. This Team also performs the QA/QC and sensitivity analysis internally, with some external checks done by consultants from Aether ltd. The same team is also responsible for the air pollutant inventory, reported to the Convention on Long Range Transport of Atmospheric Pollutants (CLRTAP).

The Soil Conservation Service of Iceland (SCSI) and the *Icelandic Forest Service (IFS)* are responsible for reporting on PaMs and projections of Land-Use, Land-Use Change and Forestry (LULUCF). The SCSI and IFS report the information to the EAI, which submits everything together to the European Environment Agency (EEA). The same experts are also responsible for the LULUCF sector in the historical GHG inventory.

The main data providers include:

- The National Energy Authority (*Orkustofnun*) (NEA) provides energy use projections, including electricity use, fuel use, and geothermal heat use. To maintain consistency between the energy and GHG projections, the same GDP and population projections which are used by the NEA to produce the energy projections are used for the GHG projections;
- Statistics Iceland (*Hagstofa*), provides production statistics;
- EU ETS operators provide production data;

[21] Amendment to the Climate Act 70/2012. *Althingi*. https://www.althingi.is/altext/stjt/2019.086.html

- Various Ministries, companies and organisations have provided projected activity data.

All data providers are listed and described in the relevant chapters.

3.3 Institutional arrangements

The main institutions involved in the preparation of the PaMs & Projections reporting and responsible for the process of submission are:

- *Ministry of the Environment, Energy and Climate (MEEC)*
- *Environment Agency of Iceland (EAI)*
- *Soil Conservation Service of Iceland (SCSI)*
- *Icelandic Forest Service (IFS)*
- *Data Providers*

Figure 3.1 below shows a flow chart of the institutional arrangements in place for this year's submission of information on PaMs and projections.

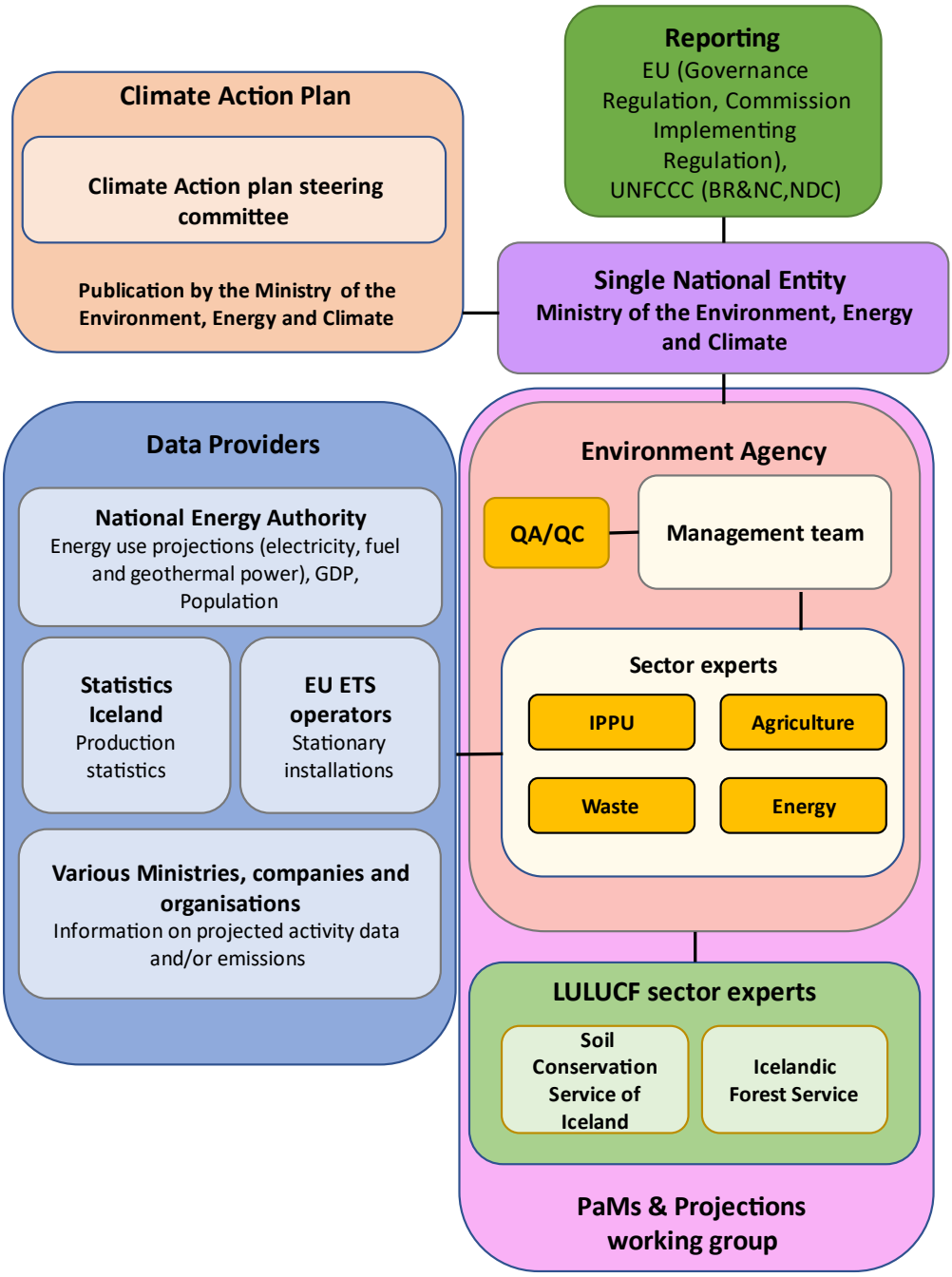


Figure 3.1 Information flow chart of institutional arrangements for PaMs and Projections reporting in Iceland.

Note: BR = Biennial Review, NC = National Communication, NDC = Nationally Determined Contribution

The Ministry of the Environment, Energy and Climate is responsible for implementation of national climate policy. However, climate policy is a cross-sectoral matter, in particular regarding measures for reducing emissions and adapting to climate change. This is acknowledged on a cross-sector level and reflected in the implementation of climate policy.

According to the Climate Act the *Minister of the Environment, Energy and Climate* is responsible for publishing a **Climate Action plan** with policies and measures to reduce anthropogenic greenhouse gas emissions and increase carbon sequestration, which shall be updated every four years at a minimum. The Minister of the Environment, Energy and Climate appoints an *Interministerial Steering*

Committee that formulates proposals for climate measures and oversees their implementation. The following Ministers nominate one representative each: The Minister in charge of governance in general and coordination within the Government of Iceland, the Minister in charge of public funding and finances, the Minister in charge of industry, the Minister in charge of education and the sciences, the Minister in charge of transport and the Minister in charge of fisheries and agriculture. The Association of Icelandic Local Authorities also has a representative in the Steering Committee.

The Steering Committee shall report annually to the Minister of the Environment and Natural Resources on the progress of the Climate Action Plan. The report shall review emissions trends and whether they are in accordance with plans and make recommendations for improvement.

The *Environment Agency of Iceland (EAI),* under the *Ministry of the Environment, Energy and Climate*, has the overall responsibility for the national system of GHG inventory preparation as well as of PaMs and projections reporting. Project management of the PaMs & Projections report is organised by National Inventory experts in the *Inventory Team* at the EAI. Those inventory experts form a PaMs & Projections working group with inventory experts at the *Soil Conservation Service of Iceland* and the *Icelandic Forest Service* to coordinate the reporting of all sectors. The EAI team is responsible for the overall coordination of the PaMs & GHG projections preparation process regarding the following:

- Collection of information from data providers on the currently adopted or planned policies and measures in different sectors (Energy, Industrial Processes and Product Use (IPPU), Agriculture and Waste) and preparation of the final report.
- Collecting projected relevant activity data from data providers.
- Preparing GHG emissions projections for different sectors (Energy, IPPU, Agriculture and Waste).
- Receiving an official consideration, QA and approval of the GHG emissions projections report by the Ministry of the Environment, Energy and Climate.
- Timely submission of the PaMs and GHG emission projections reports to the European Commission.
- Coordination of the process in Iceland during the QA procedure of the European Environmental Agency.
- Keeping of archive and publication of the official submissions to the European Commission.
- Informing of the responsible institutions on preparation process of PaMs and GHG emission projections and relevant requirements for the national system.

The *Soil Conservation Service of Iceland (SCSI) is* responsible for calculations of emissions and removals as well as estimating GHG emissions projections in the LULUCF (land use and land use change part) sector.

The *Icelandic Forest Service (IFS)* is responsible for calculations of emissions and removals as well as estimating GHG emissions projections in the LULUCF (forestry part) sector.

3.4 Procedural and administrative arrangements

The Environment Agency of Iceland (EAI) is responsible for ensuring the timeliness, transparency, accuracy, consistency, comparability and completeness of the information reported on policies and measures and projections.

A kick-off meeting between the PaMs and Projections working group members, including inventory experts from the EIA's *Inventory Team*, inventory experts *from the Soil Conservation Service of*

Iceland (SCSI) and *the Icelandic Forest Service (IFS),* is organised in September/October prior to the next 15 March submission date to launch the work. A date is set by which the PaMs and Projections working group members provide a list of their respective policies and measures to be included in the Reporting, along with a division between the projections scenarios to be included in the reporting (currently only the WEM scenario).

A month before the deadline of the Reporting, the PaMs and Projections working group members provide their respective information concerning the policies and measures and projections to the project manager of the working group, which compiles all the information into the reporting tools and a single paper report. This schedule leaves enough time to perform the remaining QA/QC activities.

The Reporting is prepared in a transparent manner. The Reporting is predominantly based on the latest version of Iceland's *Climate Action Plan*, which is updated no less frequently than every four years, and the latest *Progress Report*, which is published annually. Policy measures are described and published in the *Climate Action Plan,* including the entity responsible, a performance indicator (where available), funding (where available) and impact on emissions (where available). To classify policies and measures under the WEM and WAM scenarios, a cut-off date is agreed by the PaMs and Projections working group. Across the different sectors, the reported policies and measures that are implemented on or before the cut-off date belong to the WEM projection and those implemented after the cut-off date or being in planning phase to the WAM projection. It was not possible to include WAM projections in the current reporting cycle, and therefore, the policies and measures that would be included in a WAM scenario are not included in a projection scenario.

The reporting uses publicly available data to the extent possible, the main provider being the *National Energy Authority (NEA)*, which publishes energy (fuel/electricity/geothermal) projections on a regular basis. The same parameters (GDP, population, etc.) as the NEA uses for the energy projections, which are published in a separate *parameter report* by the NEA, are used for the GHG emissions projections to the extent possible. Not all data can be published, however, due to confidential reporting by companies. Out of the assumptions, methods and models used by the expert organizations (the EAI, SCSI, IFS and NEA) in evaluating policies and measures or used in making the projections, many are publicly available or have been described in public sources.

Accuracy is ensured through several measures. First, all the expert organizations preparing information are well-established. Second, the reporting uses publicly available data and assumptions to as large an extent as possible, and most of the methods and models have been used before in national and international reporting. Third, projections follow the greenhouse gas source and sink categorization recommended by the European Commission (based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and revised UNFCCC CRF tables for inventory reporting).

Consistency and comparability are ensured through several measures. The PaMs reported are primarily based on the **Climate Action Plan** and **Progress Report**. Inventory experts from the EAI are involved in the PaMs quantification and projections calculations for the **Climate Action Plan** and **Progress Reports** to a certain degree to facilitate the consistency and comparability with the **PaMs & Projections Report**.

The same inventory experts from the EAI, SCSI and IFS who prepare the historical GHG inventory, are involved in the PaMs and projections reporting, ensuring consistency and comparability between the historical and projected GHG emissions in each sector.

GHG emissions projections for Energy are based on the NEA's energy projections as much as possible to ensure consistency in national reporting. The NEA appoints experts from the NEA, the EIA, the *Federation of Icelandic Industries* and the *Federation of Trade and Services* to the energy projection working groups. Since 2020, the project manager of the PaMs working group and the main energy national inventory expert (both from the EIA) have been a part of the fuel projection working group. The aim of this is to streamline the projected activity data and projection scenarios for fuel combustion, which is one of the most significant causes of GHG emissions in Iceland, between the NEA and EIA.

In the case that the Reporting requires extending or updating assumptions affecting several sectors, the PaMs working group members agree on these together. Sector-specific assumptions are selected based on the expertise of the PaMs working group members or the expert organizations and rely on relevant plans and research reports as much as possible. Common parameters provided by the European Commission for the Reporting are used whenever applicable.

Monthly meetings between the *Ministry of the Environment, Energy and Climate* and the inventory experts at the EAI, as well as weekly meetings between the project manager of the PaMs working group and the project manager of the Climate Action Plan, ensure that both parties are kept up to date on developments and are in agreement on the PaMs & Projections reporting. Based on issues raised during these meetings, the Ministry of the Environment, Energy and Climate facilitates communications between other relevant ministries and the EAI where applicable. For example, experts on agriculture, from the *Ministry of Food, Agriculture and Fisheries*, provided expert judgment on the development of livestock numbers for the agriculture GHG emissions projections, after the EAI provided them with a few different projected activity data scenarios.

In order to ensure completeness, all the PaMs from Iceland's **Climate Action Plan (2020)** and **Progress Report (2021)** are included in the reporting. Other relevant PaMs may be approved by the PaMs working group and included if deemed appropriate. Furthermore, the projections follow the greenhouse gas source and sink categorization recommended by the European Commission (based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and revised UNFCCC CRF tables for inventory reporting) ensuring that all relevant categories are described in the reporting.

A month before the deadline of the Reporting, the PaMs and Projections working group members provide their respective information concerning the policies and measures and projections to the project manager of the working group, which compiles all the information into the reporting tools and a single paper report. This schedule leaves enough time to perform the remaining QA/QC activities.

3.5 Reporting process and QA/QC

Description of the information collection process

The base year for projections is the latest year for which there is a national GHG emission inventory (NIR). Because the historical and projected GHG emissions are prepared by the same inventory experts, the experts can prepare the calculations of both inventories in parallel. Therefore, for example, the 2022 PaMs & Projections have 2020 as a base year. Measures which have been introduced before the time of projection preparation are considered as existing measures. Measures expected to be implemented later are considered as additional and are currently not included in a projection scenario.

The policies and measures included in the report are predominantly based on the Government's most recent *Climate Action Plan* and *Progress Report*. According to the Climate Act No 70/2012 the

Government needs to update their Climate Action Plan, which includes national GHG mitigation policies and measures, no less frequently than every four years. The Progress Report is updated annually. Other significant policies and measures are included as much as capacity allows and where data is available before the time of projection preparation.

The projected general baseline activity data, such as population and GDP, is in line with the National Energy Authority's (NEA) latest Energy projections assumptions. The Environment Agency of Iceland (EIA) bases the **Energy** GHG emissions on the NEA's energy projections and, therefore, it is important that the same underlying baseline assumptions are used in proxy projections in other sectors to ensure consistency in the projections.

The emission estimates in the **IPPU** sector are based on various factors. For the mineral and metal industries, activity data is predominantly provided directly by the production companies. Where direct activity data is unavailable, historical trends are used. In the "non-energy products from fuels and solvent use" and "other product manufacture and use" categories, activity data is projected, using either historical trends or GDP or population as proxy. F-gas projections are based on the import quota legislation, which places a ceiling on F-gas imports.

The projections of GHG emissions in the **Agriculture** sector are based on trends in the activity data used in the emission inventory calculation. The most important activity data are animal population (particularly cattle and sheep population) and the amount of fertiliser applied to agricultural soils. The projections of animal numbers, fertiliser use, and crop production are based on historical trends. The animal number projections are approved by experts in the *Ministry of Food, Agriculture and Fisheries*. Livestock characterization parameters are the same used in the latest historical GHG inventory.

The **Waste** sector projection contains four source categories - emissions from landfills, emissions from wastewater handling and emissions from waste incineration and emissions from biological treatment of waste. The projections of GHG emissions in Waste are based on projections of the total waste amount generated, using population data as a proxy. The waste amount is then allocated to the various waste categories based on historical trends and operation permits of waste handling companies, while considering new policies which will impact waste allocation. Data on waste incineration is based on the operating licence of Iceland's only waste incinerator. Projections on landfill gas capture and methane production from landfill gas were received directly from the two companies capturing landfill gas.

The emission estimates in the **LULUCF** sector are to a large degree determined by development of land areas categorised by their use. Therefore, the LULUCF emission estimates and their projections must primarily methodologically solve the issue of land areas. The actual development of six major IPCC land use categories as reported in the latest emission inventory is used. The projections are based are on the observed trends and anticipation of increased soil reclamations and rewetting of wetlands. The soil reclamation and rewetting action areas of 2007 to 2023 were used for the projection of carbon sequestration from soil reclamation and rewetting of wetlands. including policies and measures defined in the Climate Action Plan (2020).

The projections related to forestry are prepared by the Icelandic Forest Service (IFS) based on a model projecting the development of C stock change in forest land. A sample plot statistic of the national forest inventory was used in a similar way as in the Icelandic National forestry Accounting Plan. Future harvesting was estimated by comparing wood production over the period 1996-2020 to potential harvesting of forest defined as available for wood supply.

Data for evaluation of PaMs are collected from projects and programs supported by various institutions, ministries, companies and associations. All PaMs which are evaluated are included in the reported WEM scenario. Some PaMs are assumed to be included the WEM scenario projections, although it was not possible to quantify them specifically.

Description of the alignment with the national inventory system

The same inventory experts from the Environment Agency of Iceland (EAI), Soil Conservation Service of Iceland (SCSI) and Icelandic Forest Service (IFS), who prepare the historical GHG inventory, are involved in the PaMs and projections reporting, ensuring consistency and comparability between the historical and projected GHG emissions in each sector. Data for policies and measures and projections is stored on the same drives as data for the historical GHG inventory.

Description of QA/QC procedures

All the expert organizations providing information for the reporting have their own quality assurance and quality control (QA/QC) procedures. The Environment Agency of Iceland (EAI) is responsible for collecting and combining all the information and for ensuring that further quality checks are performed. External QA/QC of the final draft submission is performed by the relevant Ministry or external consultants to increase the reliability and ensure the completeness of the reporting.

Sensitivity analyses for projections are carried out for factors being especially significant in terms of greenhouse gas emissions, and they are described in the report accompanying each round of the Reporting. For the reporting on projections, a sensitivity analysis was carried out for the following factors, namely the livestock population numbers of cattle and sheep and different levels of afforestation.

After the reporting tools and paper report have been compiled by the EIA, they are sent to the Ministry of the Environment, Energy and Climate for final approval.

Description of the process for selecting assumptions, methodologies and models for making projections of anthropogenic GHG emissions

Sector experts from the Environment Agency of Iceland (EAI), Soil Conservation Service of Iceland (SCSI) and Icelandic Forest Service (IFS) are responsible for selecting the assumptions, methods and models to use for the projections. The EAI's experts work closely and interact regularly with other key experts on in order to establish an appropriate set of assumptions and methods. The EAI, SCSI and IFS experts transparently document the data sources, methods and assumptions.

Description of procedures for the official consideration and approval of the Member States national system for policies and measures and projections

The Ministry of the Environment, Energy and Climate has tasked The Environment Agency of Iceland with the overall responsibility of the work related to the reporting on Policies and Measures and Projections in accordance with the EU legislations implemented by the decision of the EEA Joint Committee No 269/2019 and transposed into Icelandic law by an amendment to the Climate Act No 70/2012. The PaMs report is sent to the Ministry for approval before its submission to EU.

3.6 Description of the links to arrangements on integrated national energy and climate reports pursuant to Art. 17 of Regulation (EU) 2018/1999

According to the EEA Joint Committee Decision No 269/2019, Iceland implements only the provisions of the Governance Regulation relating to climate reporting. Art. 17 is not implemented,

but according to the Declaration on national plans[22], related to the EEA Joint Committee Decision No 269/2019[23], Iceland will, on a voluntary basis, develop a national plan describing how Iceland intends to fulfil the commitments undertaken in relation the implementation of Regulation (EU) 2018/841 and Regulation (EU) 2018/842. The first National Plan on Climate was published in 2020 (Government of Iceland, 2020).

According to the Declaration the plan has to contain following main elements:

- An executive summary of the plan;
- An overview of current national climate policies;
- A description of the national Effort Sharing target and LULUCF commitment;
- A description of the main existing and planned policies and measures foreseen to achieve the Effort Sharing target and LULUCF commitment;
- A description of the current national greenhouse gas emissions and removals as well as projections of the Effort Sharing target and LULUCF commitment based on already existing policies and measures;
- An assessment of impacts of the planned national policies and measures to meet the Effort Sharing target and LULUCF commitment, comparing with the projections based on existing policies and measures and describing interactions between existing and planned policies and measures.

Reporting on PaMs in the National Plan is based on the PaMs & Projections report, submitted by the EAI.

3.7 Information on relevant institutional administrative and procedural arrangements for domestic implementation of the EU's nationally determined contribution, or changes to such arrangements

According to the Climate Act the *Minister of the Environment, Energy and Climate* is responsible for publishing a **Climate Action plan** with policies and measures to reduce anthropogenic greenhouse gas emissions and increase carbon sequestration. The Plan shall be updated every four years at a minimum and consider international commitments and declared domestic goals. The Minister of the Environment, Energy and Climate appoints an *Interministerial Steering Committee* that formulates proposals for climate measures and oversees their implementation. The following Ministers nominate one representative each: The Minister in charge of governance in general and coordination within the Government of Iceland, the Minister in charge of public funding and finances, the Minister in charge of industry, the Minister in charge of education and the sciences, the Minister in charge of transport and the Minister in charge of fisheries and agriculture. The Association of Icelandic Local Authorities also has a representative in the Steering Committee. The preparation of the Climate Action plan is done in consultation with stakeholders and with public participation. The Steering Committee shall report annually to the Minister of the Environment, Energy and Climate on the progress of the Climate Action Plan and publish a Progress Report. The report shall review emissions trends and whether they are in accordance with plans and make recommendations for improvement.

[22] *EFTA*: https://www.efta.int/sites/default/files/documents/legal-texts/eea/other-legal-documents/adopted-joint-committee-decisions/2019%20-%20English/269-2019%20-declaration.pdf
[23] *EFTA*. https://www.efta.int/sites/default/files/documents/legal-texts/eea/other-legal-documents/adopted-joint-committee-decisions/2019%20-%20English/269-2019.pdf

3.8 Description of the stakeholder engagement undertaken in relation to the preparation of policies and measures and projections

After Iceland's first submission of the PaMs & Projections reporting in 2019, the Environment Agency of Iceland (EAI) organised expert review meetings for the sectors (Energy, IPPU, Agriculture and Waste) to get feedback and constructive criticism from external experts in order to improve future reporting. Consequently, the EAI gained some valuable insights and contacts that were maintained throughout the preparation stage of subsequent reporting.

After Iceland's first PaMs & Projections report was submitted, Energy experts from the EAI have strengthened the collaboration with the National Energy Authority. Since 2020, the project manager of the PaMs working group and the main energy national inventory expert (both from the EIA) have been a part of the fuel projection working group. The aim of this is to streamline the projected fuel activity data and projection scenarios for fuel combustion, which is one of the most significant causes of GHG emissions in Iceland, between the NEA and EIA. Updated fuel projections were published by the NEA in September 2021. The fuel projection working group held several stakeholder meetings throughout the development process of projections, i.e., with representatives from the fishing, transport and aviation industries.

The IPPU and F-gas experts from the EAI have been in contact with the main industry manufacturers in Iceland again to make the projections as accurate as possible. There was also regular collaboration with the Ministry of the Environment, Energy and Climate, which was updating the F-gas import quota regulation during this time. Experts from the EAI assisted the Ministry in the process of calculating the expected impacts of different import quotas, one of which was implemented in December 2020 with Icelandic Regulation No 1425/2020, which alters regulation No 1066/2019 on Fluorinated GHGs.

The Agriculture experts from the EAI presented draft agriculture projection scenarios to agriculture experts from the Ministry of Food, Agriculture and Fisheries. The experts from the Ministry reviewed the scenarios and in collaboration with the EAI the most appropriate projection scenarios were determined.

The Waste experts from the EAI had meetings with experts from the biggest waste provider in Iceland, Sorpa, who has recently opened the country's first gas and composting plant. Sorpa provided the EAI with projections for the future operations of the gas & composting plant which were used in the waste projections.

The EAI experts and the experts from the Soil Conservation Service of Iceland (SCSI) and Icelandic Forest Service (IFS) had a kick-off meeting to organise the Land-Use, Land-Use Change and Forestry (LULUCF) projections submission of 2021 in the autumn of 2020. A timeline for the 2022 submission was established in consultation with the LULUCF experts and collaboration has been maintained throughout the preparation period of the 2022 submission.

3.9 Improvements undertaken or planned to the national system

As mentioned in **Section 3.1**, changes are underway in the legislation to facilitate data acquisition for PaMs and projections reporting. Furthermore, improvements are being implemented in the archiving of information, documentation of decision-making processes, as well as the general work process. Since the first PaMs and Projections report produced by Iceland, the provisions of Regulation (EU) No 525/2013 have provided for the improvement of the process of information gathering, calculations and reporting in future submissions. Furthermore, the ever-increasing importance and visibility of climate change matters in Iceland is expected to lead to increased staff

capacity in the various teams participating in the compilation of future inventory- and PaMs and projections reports.

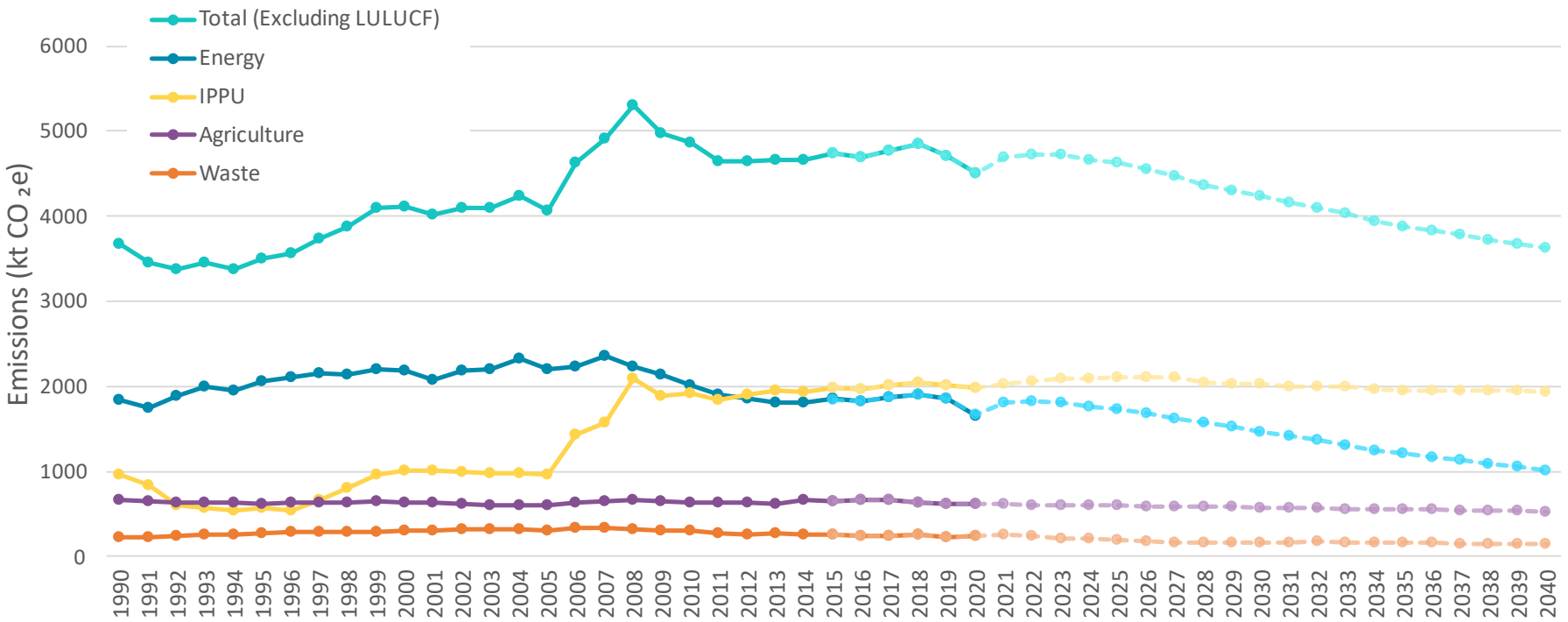
4 Summary of Projections

4.1 Total GHGs

Iceland's total historical and projected emissions of GHGs *excluding* LULUCF are presented in **Figure 4.1** below, for the WEM scenario. The total emissions are expected to have reached their peak in 2018 and to follow a downward trend until 2040. Iceland's GHG emissions will be 1% lower in 2040 than they were in 1990, but they will be 24% lower than they were in 2015.

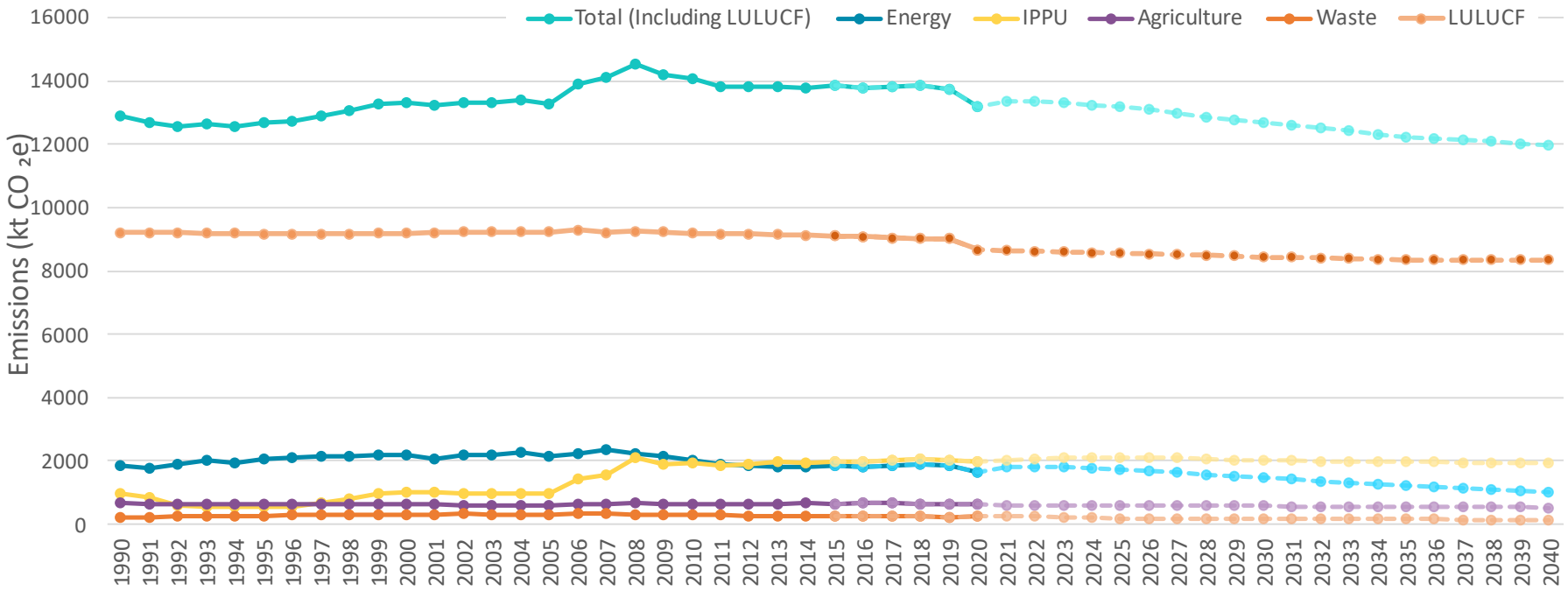
The main cause for the projected decrease in emissions from the energy sector is the impact of the energy transition in road transportation, which is changing rapidly from predominantly fossil fuel vehicles to electric vehicles, as well as a substantial decrease in emissions from fishing. IPPU will mainly change because of a projected decrease in emissions from F-gases due to the newly implemented F-gas regulation which limits the import of F-gases. Emissions reductions from IPPU will remain relatively low, however, due to an expected increase in emissions from the metal industry. Agriculture emissions will decrease because of a projected decrease in some livestock population numbers. Waste emissions are expected to peak in 2021 and decrease significantly due to better practices in solid waste disposal and the treatment of biological waste.

Iceland's total historical and projected emissions of GHGs *including* LULUCF emissions are presented in **Figure 4.2**. The total emissions incl. LULUCF are expected to have decreased by 8% in 2030 and 9% in 2040 compared to emissions in 1990. Carbon sequestration due to forest land has increased 17-fold in 2020 compared to 1990 levels and is expected to change from -510 kt CO_2 p.a. in 2020 to -794 kt CO_2 p.a. in 2040.



	Emissions [kt CO_2e]						
Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Energy	1,836	1,847	1,660	1,733	1,464	1,207	1,012
IPPU	958	1,983	1,986	2,112	2,035	1,957	1,937
Agriculture	662	655	618	595	574	551	529
Waste	219	261	247	191	168	160	141
Total excluding LULUCF	**3,674**	**4,746**	**4,511**	**4,630**	**4,241**	**3,876**	**3,620**

Figure 4.1 Total historical and projected GHG emissions (excluding LULUCF) in the WEM scenario 1990-2040, [kt CO_2e].



	Emissions [kt CO_2e]						
Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
LULUCF	9,199	9,107	8,672	8,553	8,441	8,354	8,351
Total excluding LULUCF	3,674	4,746	4,511	4,630	4,241	3,876	3,620
Total including LULUCF	**12,873**	**13,853**	**13,182**	**13,184**	**12,682**	**12,230**	**11,970**

Figure 4.2 Total historical and projected GHG emissions (including LULUCF) in the WEM scenario 1990-2040, [kt CO_2e].

4.1.1 Total Joint Fulfilment ("ESR") and ETS GHG Projections

Iceland's total historical and projected emissions, split into ETS and Joint Fulfilment ("ESR"), can be seen in **Figure 4.3** below for the WEM scenario. In Iceland, all emissions currently generated from the Production of Iron and Steel and Non-Ferrous Metals (1A2a and 1A2b) and industrial emissions from the Metal Industry (2C) are covered under the EU ETS.

As can be seen in **Figure 4.3**, emissions from ETS industry have remained reasonably steady from 2015. Based on the current projections, ETS emissions increase by almost a quarter between 2005 and 2040 (see **Table 4.1**). ESR emissions are, however, expected to decrease between 2005 and 2040 (see **Figure 4.3**).

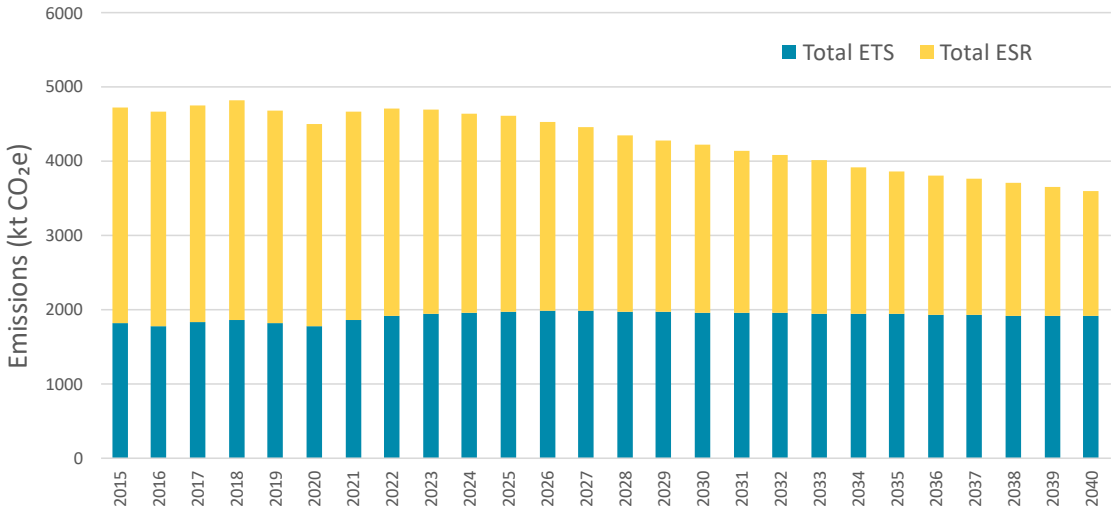


Figure 4.3 ETS and ESR GHG projections, WEM scenario, [kt CO_2e].

Table 4.1 ETS and ESR GHG projections, WEM scenario, [kt CO_2e].

	Emissions [kt CO_2e]						
Sector	**2005**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Total ETS	856	1,813	1,780	1,971	1,963	1,936	1,909
Total ESR	3,137	2,913	2,718	2,641	2,261	1,923	1,696

The projected ESR emissions for the year 2030 amount to approximately 2,261 kt CO_2e, which corresponds to 28% lower emissions than in 2005. Iceland's commitment for the year 2030 is -29% under the ESR.

ESR emission projections per sector can be seen in **Figure 4.3**. Most of the emission reduction until 2040 occurs in the Energy sector, and a proportionally high emission reduction can also be observed in the IPPU sector (the reduction is predominantly derived from reduced F-gas imports). Lower emission reductions occur in Agriculture and Waste.

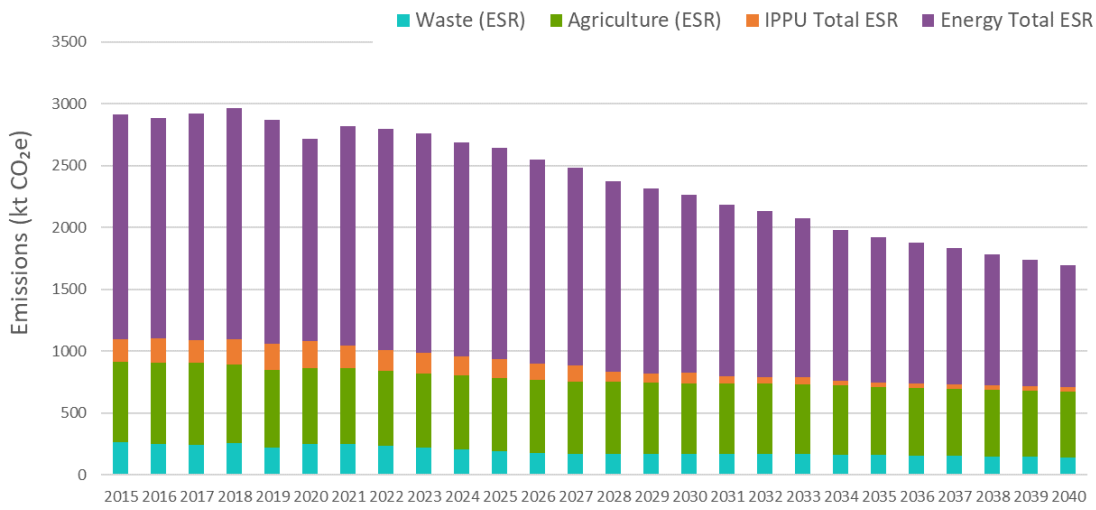


Figure 4.3 ESR emission projections split by sector, WEM scenario, [kt CO_2e].

4.2 Methodology Overview

The methodologies used to calculate GHG projections are consistent with Iceland's latest NIR. For information on the sectoral methods see the NIR (2022). Where methodologies are not described within the sectoral chapters the method from the NIR has been followed.

5 Energy (excluding Transport)

The Energy Sector (1) contains all emissions from fuel combustion, energy production, and distribution of fuels. Historically, transport has contributed to approximately one fifth of Iceland's GHG emissions (excl. LULUCF) and is therefore reported in a separate chapter. An overview of the historical and projected total emissions for the Energy sector within Iceland is given within **Table 5.1.**

Iceland almost exclusively uses renewable energy sources (hydropower, geothermal energy, and wind power) for electricity and heat production, and therefore emissions from Public Electricity and Heat Production (1A1) are low (< 1% of Iceland's emission from Energy) compared to other countries that utilise a higher share of fossil fuels.

The largest contributor of GHG emissions from the Energy Sector (excl. Transport) is Fishing (1A4c). Emissions from fishing ships have accounted for approximately a third of total emissions from the Energy Sector in recent years, however emissions have been steadily decreasing over the past years.

Manufacturing Industries and Construction (1A2) and Residential Stationary Combustion (1A4b) combined, account for approximately a third of emissions from the energy sector in Iceland in recent years.

The projections for the Energy sector are based on fuel projections until 2060 which were published by the National Energy Authority (NEA) 2021[24], except for geothermal projections which are based on unpublished projections by the NEA from 2021.

5.1 Emission trends

The historical and projected trend for the Energy Sector (excl. Transport) can be seen in **Figure 5.1.** Overall, emissions from the Energy Sector (excl. Transport) have declined by 31% between 1990 and 2020. Emissions are projected to decrease by 44% in 2040 compared to 1990.

Within the Energy sector (excl. Transport) the largest sources are Manufacturing Industries and Construction (1A2), Fishing (1A4c) and Geothermal Energy Production (1B2d), see **Table 5.1.**

Emissions from Fishing (1A4c) have been steadily decreasing since 1996, with some annual variations. Emissions are projected to have peaked in 2021, and to steadily decline from 2021 to 2040. No major changes are expected in the sector for the time period. Some emission savings are reported, however, due to an increased share of renewable energy used in fishing. In the projections, it is assumed that biodiesel is the most probable fuel to replace fossil fuels and the emissions have been calculated based on that assumption.

Emissions from Manufacturing Industries and Construction (1A2) have also been decreasing over the historical time series but are projected to remain relatively constant until 2040. Emissions from Geothermal Energy (Fugitive Emissions 1B) have historically been increasing but are projected decrease up until 2030 due to increased injections of CO_2 into basaltic rock[25]. Other sectors are also projected to remain relatively steady.

[24] *National Energy Authority (Orkustofnun).* https://orkustofnun.is/gogn/Skyrslur/OS-2021/OS-2021-02.pdf
[25] *Carbfix*. https://www.carbfix.com/

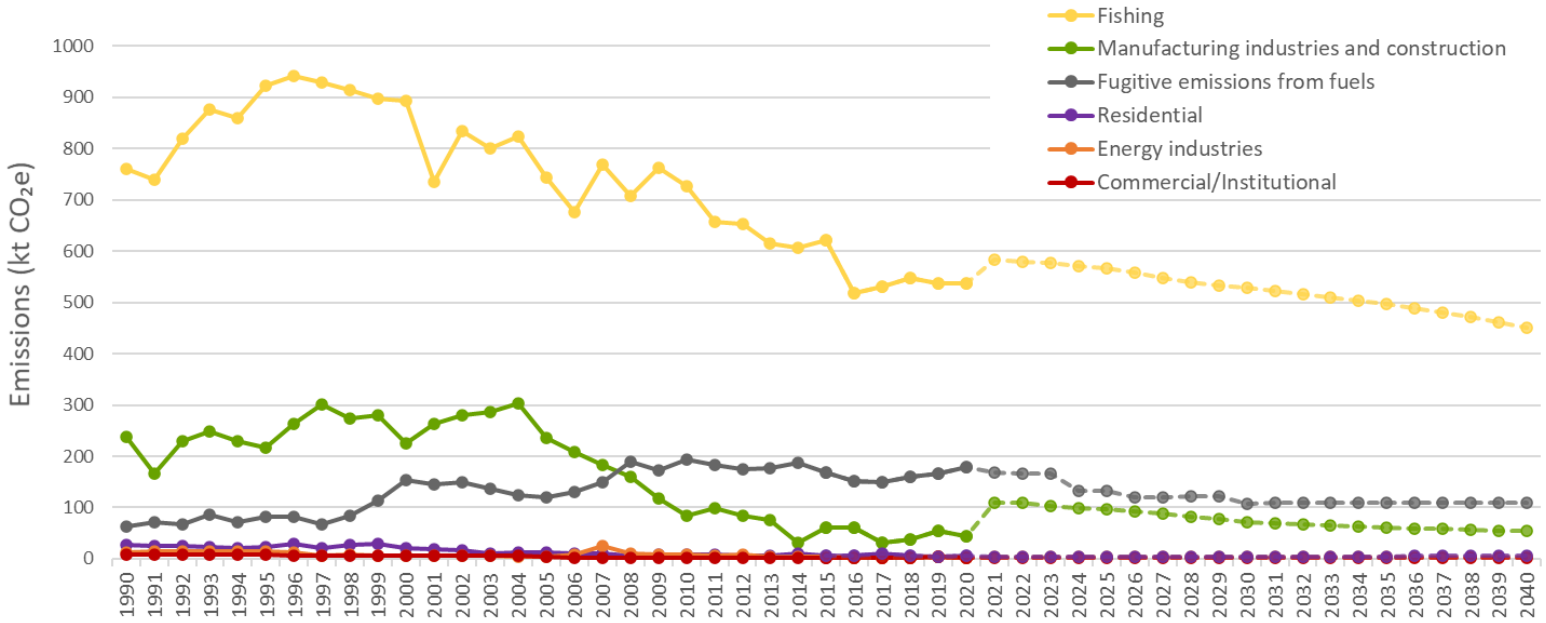


Figure 5.1 Energy (excluding Transport) Emissions of Total GHGs, WEM scenario, [kt CO_2e].

Table 5.1 Historical and projected emissions in the Energy sector, [kt CO_2e].

	Emissions [kt CO_2e]						
Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Energy industries (1A1)	14	4	2	3	3	3	3
Manufacturing industries and construction (1A2)	238	62	45	97	72	61	54
Commercial/Institutional (1A4a)	8	2	3	2	2	2	2
Residential (1A4b)	28	6	5	4	4	5	5
Fishing (1A4c)	761	622	537	566	528	497	450
Fugitive emissions from fuels (1B)	62	168	179	132	108	109	109
Energy excluding Transport (1A1,1A2,1A4,1B)	**1,111**	**863**	**771**	**805**	**718**	**677**	**624**

5.1.1 ESR vs EU ETS emissions in Energy

In Iceland, all emissions from the production of Iron and Steel and Non-Ferrous Metal (1A2a and 1A2b) are accounted for under the EU ETS, including emissions from fuel combustion for energy. Overall, this contributes to less than 1% of the total emissions from Energy (excl. Transport). The split between ESR and ETS emissions is projected to remain reasonably constant over the time series (**see Figure 5.2).**

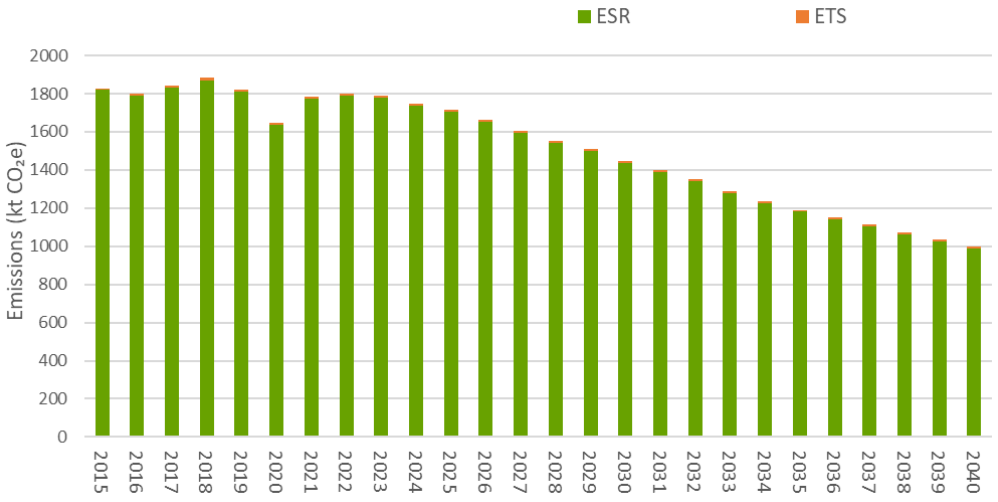


Figure 5.2 ETS and ESR GHG projections in the Energy Sector (excl. Transport), WEM scenario, [kt CO_2e].

5.2 PaMs

Nine energy consumption (EC) PaMs are currently implemented or adopted, with the objective of reducing GHG emissions (see **Table 5.2**). Currently there are no specific energy supply (ES) PaMs.

Table 5.2 Energy Policies and Measures.

PaM Name	*GHG(s)*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*Description*
Energy transition in fisheries (101)	CO_2, CH_4, N_2O	Economic, Planning, Regulatory, Research, Voluntary/ negotiated agreements	Planned	WEM	No	Emissions from the fisheries sector will be reduced through various incentives.
Electrical infrastructure in ports (102)	CO_2, CH_4, N_2O	Fiscal, Planning	Adopted	WEM	Yes	Further electrification of Icelandic ports will be supported through improving infrastructure.
Electrification of fishmeal production plants (103)	CO_2, CH_4, N_2O	Economic, Planning, Voluntary/ negotiated agreements	Imple-mented	WEM	Yes	Further electrification of fishmeal production plants will be supported.
Ban on use of heavy fuel oil (104)	CO_2, CH_4, N_2O	Regulatory	Adopted	WEM	No	A regulation will be issued tightening fuel requirements which effectively bans the use of heavy fuel oil in the territorial sea of Iceland.

PaM Name	*GHG(s)*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*Description*
Carbon capture from geothermal energy plants (105)	CO_2	Planning, Research	Imple-mented	WEM	No	CO_2 emissions from geothermal power plants will be reduced trough carbon capture, for example the CarbFix method.
Carbon tax (701)	CO_2	Fiscal	Imple-mented	WEM	No	The carbon tax will be increased to reduce fossil fuel use and the resulting CO_2 emissions.
Domestic renewable fuels (702)	CO_2, CH_4, N_2O	Planning, Research	Adopted	Not included in projection scenario	No	Domestic renewable fuel production will be reviewed for environmental benefit and cost effectiveness. Small-scale production is present now, including rapeseed oil and recycled cooking oil.
Climate impact of the construction industry (710)	CO_2	Planning, Regulatory	Adopted	Not included in projection scenario	No	CO_2 emissions from the construction industry will be reduced through various incentives.
Energy transition in manufacturing industries (106)	CO_2, CH_4, N_2O	Economic, Planning, Voluntary	Adopted	Not included in a projection scenario	No	Changing from fossil fuels in manufacturing industries by subsidising new equipment which uses renewable energy.

All of the PaMs described in **Table 5.2** above, that are included in the WEM scenario, will impact emissions. The two PaMs that are marked positively for ex-ante have been quantified; the impact of the electrical infrastructure in ports (**102**) and electrification of fishmeal production plants (**103**), are described in more detail in **Section 5.3.2**. Additional information on the PaMs is provided below. For more information on PaMs, see the Climate Action Plan (2020) and the Progress Report (2021).

Energy transition in fisheries (101)

Systematic measures will be undertaken to achieve an energy change in the fishing industry to reduce GHG emissions. The Icelandic fishing sector has already achieved significant results in reducing emissions in recent years, but there are still many opportunities for improvement. It is crucial to seize those opportunities in order for Iceland to reach its climate targets. Creating a defined framework for the sector to be able to do its part to reduce GHG emissions is a joint venture between the government and the fishing sector. A working group with representatives from five ministries, led by the Ministry of Finance and Economic Affairs, has been appointed to work towards this goal. This working group finished a report in 2021[26] proposing a target 50% decrease in emissions from fishing ships in 2030 compared to 2005.

Electrical infrastructure in ports (102)

Ports across the country will be further electrified systematically. In 2020 grants were distributed for infrastructure projects regarding electrical connection and connection to district heating whilst ships are at harbour, in order to reduce reliance on fossil fuels while ships are at harbour. This will be useful for medium sized ships, large trawlers, ferries, and service boats.

[26] *Green steps in fisheries (Græn skref í sjávarútvegi*) (2021). https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/Gr%c3%a6n%20skref%20%c3%ad%20sj%c3%a1var%c3%batvegi%20-%20sk%c3%bdrsla%20starfsh%c3%b3ps.pdf

Tourism companies will also have the opportunity to apply for grants as there are many possibilities for electrification in that sector. Whale watching boats and other smaller boats, which sail shorter distances with tourists, to and from the same port, could, for example, possibly be electrified. Unlike the larger fishing ships, tourism boats which do many trips a day, would need access to fast charging stations, which are currently not very common.

It has been proposed that projects regarding alterations to the ships and land-based infrastructure will also have the possibility to apply for grants. The grants will be up to 33% of the start-up costs. The goal is that electrical connections can meet the electrical demand to run the general operations of ships while at harbour by 2025.

Until now, the main focus for the electrification of ports has been to set up low voltage infrastructure, which most fishing ships and other small ships can use whilst at harbour. There is, however, not much infrastructure in place for ships with a power requirement above 500 kW, such as cruise ships. The possibilities for setting up high voltage infrastructure at ports need to be analysed, based on the cost and benefit potential of such infrastructure, because there is more uncertainty based around the cost efficiency of such projects. Furthermore, the cost-efficiency of reserve power to offset volatile demand needs to be analysed. Possibly, it could be met by hydrogen.

A report on the status of electrification of harbours and next steps was published in 2021[27]. It concluded that the status of electrification is generally good, but there are certain types of ships that cannot use electricity while at port. Future grants should focus on building infrastructure for those types of ships.

The measure is managed by the project management group on energy change in collaboration with municipalities and harbour management.

Electrification of fishmeal plants (103)

The energy change in fishmeal factories will be finalised in collaboration with the operators. In the past years, fishmeal factories have been quite successfully electrified at the operators' own initiative. It is important to complete this switch to electricity where it is technologically feasible. Emissions from fishmeal factories are volatile in nature, but the overall trend over the last few years is downward. In 1997, emissions from fishmeal factories were at their highest, at over 209 kt CO_2e. They had, however, been reduced to 5 kt CO_2e in 2020. It must be ensured that this development continues and does not suffer from any setbacks. The use of fossil fuels in fishmeal factories must be stopped completely.

One of the measures that will be taken is establishing how electricity security can be increased in the places where fishmeal factories are operating, how other technological hindrances can be overcome, and how it can be ensured that the electricity prices to fishmeal factories are cost-competitive compared to oil.

Ban on use of heavy fuel oil (104)

The requirements on fuels used in the Icelandic coastal zone will become stricter, to reduce the use of fuel oil. Fuel oil is a denominator for heavy oils with certain properties and can contain a high level of sulphur. Fuel oil is, among other fuels, used in shipping, and when it burns a high level of soot and air pollutants are released into the atmosphere.

[27] *Verkís*. "Electrification of harbours in Iceland" ("Rafvæðing hafna á Íslandi"). https://www.stjornarradid.is/library/01--Frettatengt---myndir-og-skrar/ANR/Orkustefna/Rafv%C3%A6%C3%B0ing%20hafna%20%C3%A1%20%C3%8Dslandi.pdf

The policy has been expanded since the first publication of the Climate Action Plan (2018). In December 2019, the Minister of the Environment, Energy and Climate signed a regulation on the sulphur content of particular liquid fuels. On 1 January 2020, a requirement came into force in the Icelandic Coastal Zone, which is a similar requirement as that which is in place in Emission Control Areas (ECAs)[28] in the Baltic and North seas, where the restrictions on fuel oil are some of the strictest. After these regulation changes, the permitted Sulphur content of marine fuel in Iceland is only 0.1% in the Icelandic coastal zone and internal waters. Previously, the Sulphur content was permitted to be up to 3.5%. This effectively prohibits the burning of fuel oil unless ships use approved methods to limit emissions of Sulphur dioxide[29]. The EAI has a monitoring role with this regulation and restrictions will be increased if it is deemed necessary. In 2020, no heavy fuel oil was imported to Iceland.

Carbon capture from geothermal energy plants (105)

Possibilities to further reduce GHG emissions from geothermal power plants will be investigated. Although fossil fuels are not used as an energy source in geothermal power plants, they still emit CO_2. In 2020, geothermal power plants were the source of 6.6% of Iceland's ESR emissions.

In the past years, emissions from geothermal power plants have decreased significantly due to measures by Orka náttúrunnar (ON) at the geothermal plant Hellisheiðarvirkjun. Reykjavík Energy (*Orkuveita Reykjavíkur*) developed the "CarbFix," or "gas-in-rock" method[30] in collaboration with the University of Iceland and foreign collaborators (see measure **306**: Carbon capture from heavy industry) and it has received widespread interest.

ON and the National Power Company of Iceland (*Landsvirkjun*), have shown a great deal of initiative in their plans to reduce emissions from their power plants. As well as reducing emissions through re-injecting CO_2 into the basaltic rock HS Orka has been exploring various other solutions and the possibilities to capture CO_2 and use it for producing fuel or in other types of industrial production. The companies are working on this measure on their own initiative, but the government will follow future developments and consult with them.

The goal is for emissions from geothermal power plants to be reduced by at least 47% by 2030 compared with 2005. This measure relates to measure **306** on carbon capture from heavy industry.

Carbon tax (701)

There has been a carbon tax in place in Iceland since 1 January 2010, after the implementation of Law No 129/2009 on Environmental- and Natural Resource taxes[31]. The carbon tax amount, per ton CO_2, can be seen for different fuel types in **Table 5.3** below.

Table 5.3 The carbon tax amount per ton CO_2 for different fuel types [32]

Carbon tax [ISK/ton CO_2]	*2010*	*2015*	*2020*
Petrol	1,504	2,503	4,359
Gas and diesel oil	1,499	2,561	4,460
Residual Fuel oil	1,486	2,533	4,388

[28] Emission Control Areas (ECAs) or Sulphur Emission Control Areas (SECAs) are sea areas in which stricter controls were established to minimise airborne emissions from ships as defined by Annex VI of the 1997 MARPOL Protocol.
[29] Incorporated into Icelandic law in December 2019 through an update to Regulation No 124/2015 on the Sulphur content of certain liquid fuels. https://island.is/reglugerdir/nr/0124-2015
[30] *Carbfix*. https://www.carbfix.com/
[31] *Parliament (Althingi).* Law No 129/2009 on Environmental- and Resource Taxes. https://www.althingi.is/lagas/nuna/2009129.html
[32] Overview of Carbon tax from 2010 to 2021. *Parliament (Althingi).* https://www.althingi.is/altext/151/s/1220.html

As can be seen in **Table 5.3** the carbon tax has been increasing over the past decade. Carbon taxes tackle carbon emissions from fossil fuels, both from transport and other sources, comprehensively. At the beginning of 2018 carbon taxes were raised by 50%, and in line with the government's fiscal plan for 2019 to 2023, it was raised again by 10% in January 2019, and again by another 10% in 2020.

The Institute of Economic Studies (*Hagfræðistofnun*), at the University of Iceland, published an analysis of the impact of a carbon tax on the fossil fuel use of Icelandic homes and businesses in 2020, at the request of the Ministry of the Environment, Energy and Climate[33]. The analysis indicates that it is possible to reduce the consumption of fossil fuels, and thereby GHG emissions from fossil fuel consumption, by imposing a carbon tax. According to the analysis, homes reduce their fossil fuel consumption by approximately 0.35% when the price increases by 1%. The tax results in homes using 1 to 2% less fossil fuels. Businesses reduce their fossil fuel consumption by approximately 0.3% when the price increases by 1%.

Domestic renewable fuels (702)

An assessment will be undertaken of the cost-effectiveness and environmental benefits of domestic fuel production. In the cost-benefit analysis, an emphasis will be placed on ensuring that all EU requirements on such production, including lower GHG emissions, will be fulfilled. Hydrogen, methane, methanol, ethanol, and biodiesel are among the possibilities which will be explored.

The report on domestic fuel production by the Minister of Industries and Innovation, which was mentioned in the first edition of the Climate Action Plan (2018), was submitted to parliament in April 2019. It contains an overview of domestic fuel production and knowledge of the industry, and the possibilities for domestic production until 2030 were assessed[34]. In 2021, a report was published which analysed the feasibility of the production of e-fuels in Iceland[35]. An additional analysis to determine the cost-efficiency of domestic fuel production and map the obstacles to utilising it will be undertaken. The results will be used to build a foundation for a guide to sustainable fuels in Iceland, i.e., which fuels are most cost-effective to use in which industry/operation, such as heavy transport and in ships, and to determine where more research is necessary. The project management team on energy change will receive the analysis and propose the next steps.

General climate measures such as a higher fossil fuel prices because of the carbon tax and concessions for climate friendly vehicles are in part aimed to increase the demand for sustainable fuels, and in that way, support the domestic production of sustainable fuels. In measure **101** on the energy transition in the fisheries, it will be mapped out whether requiring a mixture of sustainable fuels and other fuels to be used on ships would be possible, and whether it would be possible to use domestically produced sustainable fuels for this. A measure from the first Climate Action Plan (2018), "a special effort to use methane from landfill sites as fuel" has been combined in this measure.

Climate impact of the construction industry (710)

In September 2020, a joint project between the government and the business sector was launched, called "Building a Greener Future" *("byggjum grænni framtíð")*[36]. The project involves the creation of a roadmap to environmentally friendly construction until 2030. It estimates the emissions from the

[33] *The Institute of Economic Studies*. "The impact of a carbon tax on the fossil fuel use of homes and businesses" ("Áhrif kolefnisgjalds á eldsneytisnotkun"). https://ioes.hi.is/files/2021-04/Ahrif_kolefnisgjalds_a_eldsneytisnotkun.pdf
[34] *Parliament (Althingi).* https://www.althingi.is/altext/pdf/149/s/2043.pdf
[35] *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/efst-a-baugi/frettir/stok-frett/2021/06/23/Skyrsla-um-fysileika-thess-ad-framleida-rafeldsneyti-a-Islandi/
[36] *Building a Greener Future (Byggjum grænni framtíð).* https://byggjumgraenniframtid.is/

construction industry and sets goals for reducing GHG emissions and other environmental impacts of the construction sector. Furthermore, actions will be defined to achieve those goals.

A great emphasis has been placed on the project being carried out in broad collaboration between companies from the construction industry and the government. Considering this, a project group was set up, the members of which were appointed by representatives from the Federation of Icelandic Industries (*Samtök Iðnaðarins*), the Green Building Council of Iceland (*Grænni byggð*), the EAI, the Icelandic Road and Coastal Administration (*Vegagerðin*), the Icelandic Association of Local Authorities (*Samband íslenskra sveitarfélaga*), the Ministry of Culture and Business Affairs. The purpose of the group is to manage the "Building a Greener Future" project. Results from the project will be published early in 2022.

Energy transition in manufacturing industries (106)

There are many opportunities for energy transition from fossil fuel to renewable fuel in different sectors of manufacturing industries, such as food production and industries linked to fisheries. In 2021 the Energy fund provided grants and many of the projects that were funded were for manufacturing industries[37].

5.2.1 Quantified PaMs & Interlinkages with Projections

The projections performed for the sector include only a WEM scenario. There is currently not enough data available to perform projections for a WAM scenario.

The impact of six PaMs (**101, 102, 103, 104, 105, & 701**) in the energy sector are represented in the WEM scenario produced by the Fuel Projection Working Group and the Energy Projection Working Group. These results are represented as the WEM scenario for the Energy sector in this report. The PaMs were not quantified separately due to difficulties in isolating them from the large number of other smaller actions undertaken by individual organisations, companies, and individuals.

Measures on the production of renewable fuel (**702**) in Iceland as well as measures relating to the climate impact of the construction industry (**710**) have been adopted. However, since very limited data is available on the effectiveness of such measures in Iceland, its potential impact on emissions has not been estimated nor included in the WEM scenario projections.

Two PaMs (**102 & 103**) were quantified individually due to the availability of data on specific developments within the relevant sectors. These data sets were acquired from the relevant companies and associations, which formed the foundation for the analysis of these sectors.

Each PaM is integrated into the projections as follows:

- PaM **101**, Energy transition in fisheries, is accounted for in the WEM scenario of the Fuel Projection Working Group.
- PaM **102**, Electrical infrastructure in ports, is quantified individually. Therefore, a BAU scenario has been estimated to represent the development of emissions excluding the effects of PaM **102**. The quantification of the BAU scenario is based on recent development of vessel port visits and the difference in time spent at bay between ship types, see **Chapter 5.3.1**.
- PaM **103**, Electrification of fishmeal production, is quantified individually. Therefore, a BAU scenario has been estimated to represent the development of emissions excluding the

[37] *Energy fund (Orkusjóður).* https://orkustofnun.is/orkustofnun/rad-og-nefndir/orkusjodur/verkefni-styrkt-af-orkusjodi/verkefni-2021

effects of PaM **103**. The quantification of the BAU scenario is based on the recent developments in the fishmeal industry, i.e., developments in fuel utilisation change in the years 2010-2020, see **Chapter 5.3.1**.

- PaM **104**, Ban on use of heavy fuel oil, is accounted for in the WEM scenario of the Fuel Projection Working Group.
- PaM **105**, Carbon capture from geothermal plants, is accounted for in the WEM scenario of the Energy Projection Working Group.
- PaM **701**, Carbon tax, is accounted for in the WEM scenario of the Fuel Projection Working Group.
- PaM **702**, Domestic renewable fuels, is accounted for in the WEM scenario of the Fuel Projection Working Group.
- PaM **710**, Climate impact of the construction industry, is accounted for in the WEM scenario of the Fuel Projection Working Group.

5.2.2 Stakeholder Engagement

After the submission of the PaMs & Projections reporting in 2019, the EAI organised an expert review meeting for the Energy sector to get feedback and constructive criticism from external experts in order to improve future reporting. Consequently, the EIA gained some valuable insights and contacts that were maintained throughout the preparation stage of the reporting.

Since Iceland's first PaMs & Projections report was submitted in 2019, Energy experts from the EAI have strengthened the collaboration with the National Energy Authority. Since 2020, the project manager of the PaMs working group and the main energy national inventory expert (both from the EIA) have been a part of the fuel projection working group. The aim of this is to streamline the projected fuel activity data and projection scenarios for fuel combustion, which is one of the most significant causes of GHG emissions in Iceland, between the NEA and EIA. The fuel projection working group held several stakeholder meetings throughout the development process of the fuel projections, for example with representatives from the fishing, transport, and aviation industries.

5.3 Methodology of projections

The methodology used to generate projections for the Energy Sector (excluding Transport) are based on the historical inventory, see NIR (2022) and fuel projections from the Fuel Projection Working Group (2021)[38]

5.3.1 Data & Assumptions

An overview of the data and assumptions used as a basis for the energy projections is presented in **Table 5.4**. A further description is provided below.

Table 5.4 Activity data basis for energy projections

Energy	**Basis for projections**
1.A.1 Energy industries	Fuel projections (2021)
1.A.2 Manufacturing industries and construction	Fuel projections (2021)
1.A.4 Other sectors	Fuel projections (2021)
1.B.1 Solid Fuels	Not relevant in Iceland
1.B.2 Oil and gas and other emissions from energy	Emission projections from all operators of geothermal power plants in Iceland

[38] *National Energy Authority (Orkustofnun).* https://orkustofnun.is/gogn/Skyrslur/OS-2021/OS-2021-02.pdf

Projections for the energy sector are based on fuel projections generated by the ***Fuel Projection Working Group*** and the ***Energy Projection Working Group***, except for emission projections for geothermal power which were obtained from the ***Geothermal Projection Working Group***. Fuel projections were available by fuel type and activity.

Certain policies listed in **Chapter 5.2.1** above have been assumed to be included in the fuel projections generated by the ***Fuel Projection Working Group (2021*)** and consequently are responsible for some of the reductions in the projected fuel use. The results of quantified PaMs are represented in a BAU scenario. BAU scenario was calculated for the quantified measures (**102 & 103**) and fuel savings from the policies were estimated by subtracting the WEM scenario from the fuel projections from the BAU scenario.

5.3.2 Quantified PaMs

This chapter entails all quantified PaMs in the energy sector and the methodology, data sets, and assumptions that form the BAU scenarios.

Electrical infrastructure in ports (102)

This policy aims to increase the electricity supply and improve the infrastructure for ships in harbours, in order to reduce fossil fuel use by ships. The goal is to complete electrical connections which meet the electricity demands of all general ship operations in harbours by 2025 (Hafið & INE, 2018). A special action plan on energy change in harbours will be prepared with support from the government and in cooperation with relevant stakeholders.

The number of ships by ship type and tons of CO_2 emissions per ship type in 2015 were obtained from a report on energy change by Landsnet (2016). In the BAU scenario, the number of ships were projected using Organisation for Economic Co-operation and Development (OECD) GDP as a proxy, whilst emissions per ship during time at harbour were kept constant. In the WEM scenario, the number of ships were projected using the same GDP proxy, but the emissions at harbour were reduced linearly, for general ship operations, from the start of the policy to 2025. This reflects the goal of the PaM to meet electricity demands of all general ship operations in harbours by 2025. Moreover, general ships are defined as all ships except cruise ships and cargo ships, as there are no high-voltage (>1,000V) connections in Icelandic harbours. However, PaM **102** is expected to have a significant effect on higher utilisation rates of existing infrastructure, i.e., 400V connections, which are present. Therefore, cruise ships and cargo ships are expected, in both the WEM scenario and the BAU scenario, to utilise oil in harbours, while all other ships are expected to phase out fuel use in harbours linearly, ending at full electricity utilisation in 2025, see **Figure 5.3**.

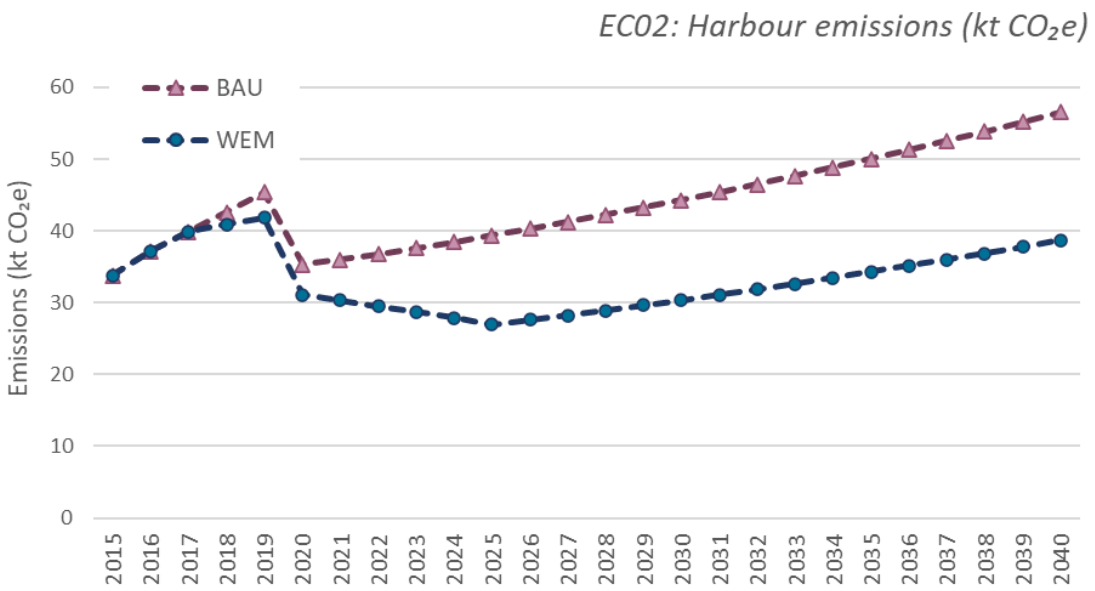


Figure 5.3 Quantified ex-ante emission impact of PaM 102: electrical infrastructure in ports [kt CO_2e].

The fuel use by vessel type is calculated by dividing the tons of CO_2 emissions by the default gas/diesel oil CO_2 emission factor (IPCC, 2006). From this, default 2006 IPCC emission factors for gas/diesel oil for CH_4 and N_2O are applied, along with AR4 GWPs to estimate GHG emissions by vessel type by year in kt CO_2e.

The allocation of vessel types to IPCC sectors is in **Table 5.5** below.

Table 5.5 Allocation of vessel types to IPCC sectors.

Vessel type	IPCC Sector
Cargo ships	1A3di(i)
Oil and product tankers	1A3di(i)
Cruise ships	1A3di(i)
Fishing vessels and trawlers	1A4ciii
Research and coast guard ships	1A3dii

Electrification of fishmeal production plants (103)

One of the quantified PaMs (**103**), fall into the IPCC subsector 1A2, fishmeal production. This PaM aims to ensure, to the extent possible, that it will be economically beneficial for fishmeal factories to use electricity instead of fossil fuels for its processes. Furthermore, the PaM aims to facilitate infrastructure support to ensure technical availability for electrification. The goal is to complete the electrification of fishmeal factories and ensure that a no setbacks occur. Strategies to facilitate this switch must be discussed by the government, power companies, and the fishmeal producers. This measure corresponds with the parliamentary resolution on energy change, which was approved in Parliament in 2017.

Projections of total oil use in fishmeal factories for the years 2020 to 2030 are obtained from the energy projections made by the Fuel Projections Working Group. This projection forms the WEM scenario, which entails all efforts that have been made towards electrification of fishmeal factories in recent decades, and is influenced by measure **103**, which was included in the Climate Action Plan.

Significant development in terms of electrification of fishmeal factories has been ongoing before the existence of the Climate Action Plan, where measure **103** is introduced. Electrification of fishmeal factories has been an ongoing effort, initiated by the National Power Company (*Landsvirkjun*) and the fishmeal factories, for over a decade. In 2017, the National Power Company and the Association for Fishmeal Factories (AFF) signed a letter of intent to make it economically feasible to utilise electricity for fishmeal factories. Consequently, the WEM case regarding fuel use of fishmeal factories is based upon the main assumption that fishmeal factories were somewhat on a trajectory towards electrification before the Climate Action Plan's efforts were announced. Moreover, the WEM trajectory is partly due to measure **103**, but also due to the abovementioned cooperation between the National Power Company and the AFF. Finally, the WEM scenario is based upon the calculations from the Working Group on Fuel Projections of the National Energy Authority.

A "without measures" (WOM) scenario has been created to contrast all measures, actions, and plans associated with the electrification of fishmeal factories. This scenario is based upon the main assumption that without all measures, both governmental and non-governmental, regarding electrification of fishmeal factories, no electricity would have been utilised throughout the timeline. To estimate the amount of fuel used in this scenario, information and data were gathered from the AFF regarding the number of fish received for processing every year since 2010. Furthermore, the AFF provided data on the amount of electricity and oil utilised to process the fish. Subsequently, the energy used to process one unit of fish was calculated for both oil and electricity. Energy intensity was assumed to be commensurable between plants utilising electricity and those utilising oil. This assumption could be improved, however, only a few plants have run their operations purely on electricity for an entire year, and therefore, energy losses due to different energy carriers and technologies could not be analysed for this assessment. The average energy intensity over a 16-year period was 526 kWh/t of processed fish, with a standard deviation of 31 kWh/t. Subsequently, the number of fish were assumed to be processed with fossil fuels only, while the energy intensity of 526 kWh/t was used as a proxy for estimating the potential fuel use in the WOM scenario.

A hypothetical WAM scenario was created where the main assumption was that best available technology would be reached in 2025, i.e., full electrification of all fishmeal factories. This scenario was created to reflect technologically viable possibilities. However, this scenario would require significant infrastructure investments. Adequate power lines would need to be constructed to fishmeal factories that have yet to be connected to the power grid for their operations.

In December 2021, The National Power Company announced that all fishmeal operations utilising interruptible electricity would cease to receive energy for and undecided amount of time. The prospect of this actuality seems to have influenced the WEM scenario, as the increase in emissions in 2022 does not reflect the emission levels of previous five years. However, the amount of fish processing aligns relatively well with those years. Therefore, the increase of emissions in 2022 in the WEM scenario does adequately reflect this situation, where interruptible electricity is not sold to buyers in the first half of 2022. Moreover, the slow levelling-off of emissions in the WEM scenario between 2023 and 2030 reflects the possibility of some interruption in electricity supply during the timeline, and/or slow infrastructure development in the realm of power lines where they are needed.

The results of the WOM and WEM scenarios show that with all current existing measures (WEM scenario) total CO_2e savings amounted to 13 to 77 kt CO_2e p.a. throughout the timeline 2010 to 2040, when compared to the WOM scenario (**Figure 5.4**). Furthermore, cumulative abatement during the Paris Agreement period (2021-2030) amounts to approximately 600 kt CO_2e.

The Ex-ante emission reduction impact (orange area in **Figure 5.4**) of the WAM scenario compared to the WEM scenario is approximately 0-16 kt CO_2e p.a. Cumulative possible abatement during the Paris Agreement timeframe amounts to approximately 107 kt CO_2e. However, this abatement would rely on significant investment costs, and not only on availability of cost-competitive electricity as a few of the fishmeal factories have yet to receive sufficient electrical infrastructure.

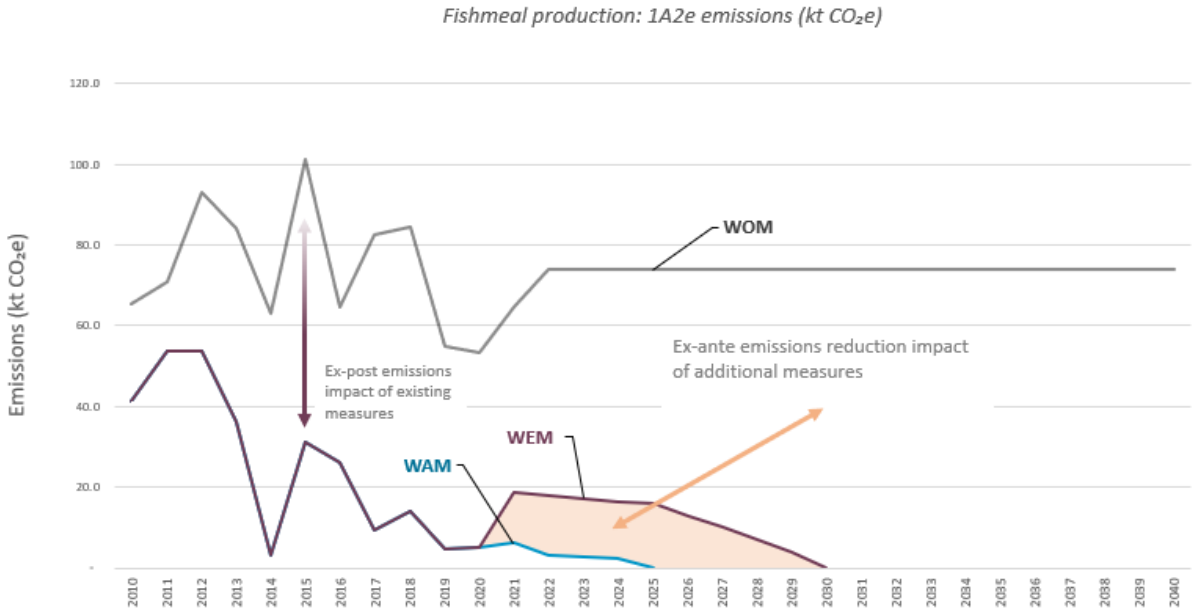


Figure 5.4 Quantified ex-ante and ex-post emissions impact of a group of measures, including measure 103: the electrification of fishmeal factories [kt CO_2e]. Results of the WEM scenario from 2021 onwards are acquired from the Working Group on Fuel Projections, the WOM scenario from different parameters and assumptions discussed in the chapter and the WAM scenario as the best technologically viable option.

6 Transport

The Transport Sector (1A3) in Iceland includes road transport, domestic aviation and domestic navigation. There are no railways in Iceland, and therefore, these are reported as not occurring (NO). Emissions from international aviation and navigation are accounted for but they do not count towards the national total.

Emissions from the transport sector have accounted for approximately half of the energy sector's total GHG emissions in Iceland in recent years and road transport has historically accounted for approximately 95% of the emissions in the transport sector.

There is a link between Waste PaMs and the Transport Sector; PaMs described in section 9.2 include increased methane recovery, which in Iceland is primarily utilised as a vehicle fuel. Increased use of methane as vehicle fuel is reported in road transport projections.

The projections for the Energy sector are based on fuel projections until 2060 which were published by the National Energy Authority (NEA) 2021[39].

6.1 Emission Trends

Figure 6.1 presents an overview of the historical and projected emissions from Transport. The trend in Transport emissions is dominated by the increase in road transport emission between 1990 and 2007. This is followed by a decrease in road transport emissions because of the financial crisis in 2008. After 2014 there is a significant increase in emissions from road transport, mainly due to increased tourism. The effect of increased tourism can also be seen in the emissions from international aviation.

Emissions projections from international bunkers (aviation and navigation), in comparison with emissions from other transport subsectors, can also be seen in **Figure 6.1.** As stated before, emissions from international bunkers are not included in the national total.

Historical emissions from road transport decreased significantly in 2020, partly due to the COVID-19 pandemic. In the WEM scenario, emissions from the transport sector are projected to drop below 1990 levels by 2034. This reduction in emissions is due to the rapid electrification of the vehicle fleet since 2015. It is predicted that in 15 years, the proportion of electric vehicles (EVs) will rise from 4% in 2020 to 60% in 2035.

A slight decline in fuel use in domestic navigation and domestic aviation has been projected between 2020 and 2040. However, the projections presented in **Figure 6.1** consider additional reductions in fuel use in domestic navigation due to one policy in the WEM scenario (see section 6.3):

- The electrification for ferries (PaM 208, see section 6.3.1)

[39] *National Energy Authority (Orkustofnun).* https://orkustofnun.is/gogn/Skyrslur/OS-2021/OS-2021-02.pdf

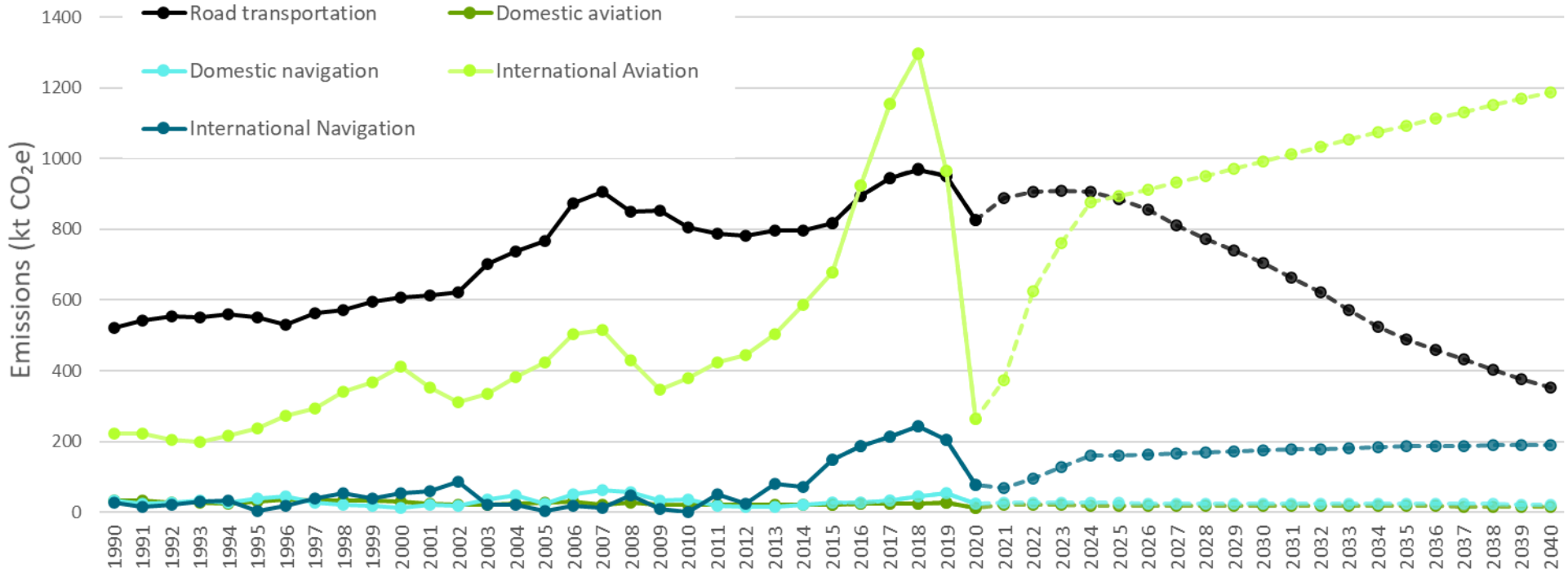


Figure 6.1 and Table 6.1; Transport Emissions (including international bunkers), Total GHGs, WEM scenario, [kt CO_2e).

	Emissions [kt CO_2e]						
Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Domestic aviation (1A3a)	34	21	13	19	18	17	15
Road transportation (1A3b)	523	819	826	884	704	490	353
Domestic navigation (1A3d)	33	27	25	25	25	24	20
Transport (1A3)	**724**	**984**	**888**	**928**	**746**	**531**	**388**
International Aviation (memo)	221	680	264	895	992	1,094	1,188
International Navigation (memo)	28	149	78	161	174	185	191

6.2 PaMs

Thirteen transport PaMs are currently implemented or planned with the objective of reducing GHG emissions. They are summarised in **Table 6.2** below. Seven PaMs are related to the electrification or fuel change of the car fleet, three are to do with promoting public transport, cycling or walking, two are on the electrification of ferries and the final one has to do with mitigation of emissions from aviation.

Table 6.2 Transport Policies and Measures.

PaM Name	*GHG(s)*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*Description*
Participation in an international system for mitigating emissions from aviation (ETS and CORSIA) (705)	CO_2	Economic, Regulatory	Imple-mented	WEM	No	Iceland will partake in CORSIA, an emission mitigation approach for the global airline industry, developed by the International Civil Aviation Organization.
Incentives for low- and zero emission vehicles (201)	CO_2, CH_4, N_2O	Economic, Fiscal, Voluntary/ negotiated agreements, Regulatory, Planning	Imple-mented	WEM	No	Tax incentives will be continued and expanded as necessary to increase low- and zero emission vehicle use in Iceland. Incentives have proved to be an effective catalyst for low emission vehicles in Iceland since the adoption of these incentives in 2012.
Infrastructure for low- and zero emission vehicles (202)	CO_2, CH_4, N_2O	Economic, Fiscal, Voluntary/ negotiated agreements, Regulatory, Planning	Imple-mented	WEM	No	Infrastructure will be increased for low- and zero emission vehicles. Investment grants have been allocated for high power recharging points widely around the country, near tourist accommodation, among other incentives.
Legislation and regulations for clean energy transition (203)	CO_2, CH_4, N_2O	Regulatory, planning	Imple-mented	WEM	No	The goal of this measure to ensure that legislation supports energy transition. Diverse measures have recently been taken in this regard, including a requirement that all new buildings supply EV-charging stations, and regulations facilitating setting up EV-charging stations in apartment buildings. Further measures will be adopted.
Ban on new registration of	CO_2, CH_4, N_2O	Regulatory	Planned	WAM	No	Registration of new diesel and gasoline vehicles will be banned after 2030. Some

PaM Name	*GHG(s)*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*Description*
diesel and gasoline vehicles after 2030 (204)						exceptions are expected, taking into account harsh climate and safety issues.
Infrastructure for active mobility (205)	CO_2, CH_4, N_2O	Fiscal, Planning	Imple-mented	WEM	No	Tax incentives will be adopted to encourage active mobility, such as cycling and walking.
Encouraging public transport (206)	CO_2, CH_4, N_2O	Economic, Regulatory, planning	Imple-mented	WEM	No	Public transport will be encouraged with a better public transport system in the capital area. Public transport between population centres in regional Iceland will be supported.
Low emission vehicles in government and state enterprises (207)	CO_2, CH_4, N_2O	Fiscal, Regulatory, planning	Imple-mented	WEM	No	Government agencies will be obliged to buy low emission and electric vehicles when renewing their vehicle fleet.
Energy transition of ferries (208)	CO_2, CH_4, N_2O	Fiscal, Planning	Imple-mented	WEM	Yes, 1A3d	Ferries that are a regular part of the transport system will be required to use fossil free fuel.
Incentives for active mobility (209)	CO_2, CH_4, N_2O	Economic, Information, Planning	Imple-mented	WEM	No	Tax incentives will be adopted to encourage active mobility, such as cycling and walking.
Energy transition in heavy transport (210)	CO_2, CH_4, N_2O	Fiscal, Planning	Adopted	WEM	No	A task force that aims towards accelerating energy transition in heavy vehicle transport has been formed. Around 15% of total land transport can be traced to heavy vehicle use.
Low emission rental cars (211)	CO_2, CH_4, N_2O	Economic, Fiscal, Planning	Adopted	WEM	No	The action aims at increasing the availability of low emission and electric rental cars. A large part of new vehicles in Iceland are imported for car rentals and addressing the issue is therefore crucial for energy transition of the car fleet.
Energy transition of state-owned vessels (212)	CO_2, CH_4, N_2O	Fiscal, planning	Adopted	WEM	No	The action aims to reduce the use of fossil fuel in state owned vessels other than ferries.

Measures from **Table 6.2** above will impact emissions from the Transport sector. The policy that has been quantified; the electrification / fuel change of ferries (**208**), is described in more detail in **Chapter 6.3.1**. Additional information on PaMs that have not been quantified is provided below. For more information on PaMs, see the Climate Action Plan (2020) and the Progress Report (2021).

Electrification or fuel change of the vehicle fleet (201-204, 207, 210, 211)

The accelerated uptake of electric vehicles or vehicles fuelled by renewable fuels has the possibility to significantly reduce Iceland's GHG emissions due to the country's heavy dependency on cars for transport. The seven PaMs that are to do with the electrification or energy change of the vehicle fleet in the 2020 Action Plan are the following: **201-204, 207, 210, 211**. All except **203** and **204** are considered to fall under the WEM scenario and to contribute to the accelerated projected uptake of electric cars in the WEM scenario projections for transport. The impact of these PaMs was, however, not quantified as a group due to difficulties in isolating them from the large number of other smaller actions undertaken by individual organisations, companies and individuals to accelerate the electrification / fuel change of the vehicle fleet.

Promoting alternative methods of transportation (205, 206, 209)

Alongside electrification or fuel change of the vehicle fleet, there will be a parallel effort to promote alternative methods of transportation, such as public transportation, cycling and walking. Biking- and walking paths will be improved systematically, to increase the share of active modes of transportation and enable more people to choose that option. Support for building paths will be increased, both in urban areas and to connect urban areas. In the capital area the transportation agreement between the government and six municipalities, which was signed in September 2019[40], will be followed. The agreement includes, inter alia, a substantial effort to build new biking paths in the capital area (approximately 70 to 100 km of paths), as well as new walking bridges and underpasses. Simultaneously, work on bike paths between urban areas will be continued according to the Transport Plan (*Samgönguáætlun*) 2020-2034 and in cooperation with the relevant municipalities[41].

Temporary tax subsidies which encourage people to use active modes of transportation, such as biking and walking, will be used to change people's commuting behaviour. Laws have already been updated and VAT on all bikes, electric bikes and electric scooters has been cancelled. The changes went through on 1 January 2020. The updated law states that all types of bikes should be subsidised if they will promote increased outdoor activity, improve public health and reduce road transport.

The government and six municipalities in the capital signed a treaty in September 2019 with an ambitious plan to build up transport infrastructure and public transportation in the capital area in the next 15 years.[42] The treaty contains the most extensive transportation construction plan in the history of Iceland. The goal is to greatly boost public transport, improve transport for all modes of transportation, reduce GHG emissions to reach the government's and municipalities' climate goals, reduce traffic jams etc. *Borgarlínan*, a new public transportation system in the Capital Area, is a part of the agreement and the preparations for construction are currently underway (COWI 2017).

[40] *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/Samgongusattmali_undirritadur.pdf

[41] Transport Plan for the next 15 years 2020-2034 (Samgönguáætlun til fimmtán ára 2020-2034). *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/verkefni/samgongur-og-fjarskipti/samgonguaaetlun/samgonguaaetlun-2020-2034/

[42] A Treaty on Transport in the Capital Area (Sáttmáli um samgöngur á höfuðborgarsvæðinu). *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/verkefni/samgongur-og-fjarskipti/samgonguaaetlun/sattmali-um-samgongur-a-hofudborgarsvaedinu/

Participation in an international system for mitigating emissions from aviation (ETS and CORSIA) (705)
Iceland will participate in a new international system, CORSIA (e. Carbon Offsetting and Reduction Scheme for International Aviation), by the International Civil Aviation Organization (ICAO), which is meant to reduce greenhouse gas emissions from aviation. The goal of CORSIA is to achieve a carbon neutral growth in international aviation from 2020 with carbon offsetting through certain project certifications. The scope of CORSIA encompasses flight operators which emit more than 10 kt CO_2 from international aviation from aircrafts, with a maximum take of weight of over 5.700 kg.

CORSIA will be implemented in a few steps. To start with, participation is voluntary, and Iceland will participate from the beginning along with other countries that are a part of the ECAC (e. European Civil Aviation Conference). First, emissions from 2019 will be used as a baseline for emissions, and it will be mandatory to carbon offset all emissions that are in excess of the baseline in the following years. Then two three-year periods begin (2021-2026) when all countries can participate voluntarily before participation becomes binding. Currently, 88 countries have committed themselves to participate voluntarily from 2021 to 2026. From the start of 2019, flight operators from these countries have been monitoring CO_2 emissions from international aviation. The CORSIA system will be implemented in Iceland through the ETS with changes in legislation on climate issues.

Energy transition of state-owned vessels (212)
The aim of this measure is to reduce fossil fuel use by state owned ships, other than ferries. The use of fossil fuels in state owned ships will be systematically reduced and ways to make them more sustainable will be evaluated. The possibilities for energy change in the patrol ship Þór, from the Icelandic Coast Guard (*Landhelgisgæsla Íslands*), are already being analysed. The analysis consists of looking at possible alterations to the equipment, so that the electricity production of the ship can be used to power its sailing. The goal of this is to change the patrol ship to a hybrid. The share of sustainable fuels, such as biodiesel will also be increased.

Furthermore, a decision has been taken on building a new marine research ship and the tender for its build is currently being prepared. An emphasis was put on saving energy and limiting the environmental impact in the design process, among others, by designing the ship in the most favourable length- and width proportions and checking which other sources of energy than fossil fuels can be considered for the ship. Other energy saving methods in ships will also be used. It is also assumed that the ship will be equipped with engines which can be powered not only by fossil-fuels, but also by biofuels and possibly methanol. It will, however, be decided through the development process of a four-speed engine of the size required by the ship, whether it will be possible to equip it with such an engine. It is also being reviewed how the propulsion equipment can be designed so that it will be relatively simple to equip the ship with batteries in the future. Land electricity will, furthermore, be used at harbour. It is expected that heat exchangers will be set up at the ships home harbour for the ship to be able to be heated with water from district heating. A plan will be prepared on energy change in other state-owned ships. The measure is split between Ministries, because the Iceland Coast Guard falls under the Ministry of Justice and the Marine and Freshwater Research Institute falls under the Ministry of Food, Agriculture and Fisheries.

Electrification of ferries (208)
The aim of this measure is to achieve an energy change in ferries which are in regular operation and which are categorised as a part of the national highway system. Energy sources in ferries which are in regular operation will be switched out for more sustainable non-fossil fuelled options where technological development allows it.

There are five ferries currently in operation in Iceland, three of those are state owned:

- Herjólfur, the Westman Island ferry. The new Herjólfur is a hybrid, and it is expected that the ship will sail completely on electricity from the Icelandic coast to the Westman Islands. The first journey running completely on electricity was undertaken on 22 August 2020.
- Sævar, the ferry to Hrísey. The ferry will be renewed as an electric ferry. It is expected that the design process can begin late in 2024.
- Sæfari, the ferry to Grímsey. When the ferry needs to be renewed alternative energy sources than fossil fuels will be considered.

Two ferries are privately owned:

- The ferry in Mjóifjörður. This is a small ferry which the owner is interested in electrifying.
- Baldur, the ferry in Breiðafjörður. This is a ferry owned by the company Eimskip/Sæferðir. The ferry trips across Breiðafjörður are supported by government funding nine months of the year, but during the summertime Baldur sails under market conditions. When the next description for tender for the sailing of the ferry will be made, energy change will be encouraged.

Herjólfur, the biggest ferry in Iceland, is operated between Landeyjarhöfn and Vestmannaeyjar. In certain weather conditions, the ferry needs to be diverted to Þorlákshöfn instead of Landeyjarhöfn, which is a considerably longer journey. The impact of the electrification of the Herjólfur ferry has been considered in the fuel projections of domestic navigation (1A3d) in the WEM scenario.

6.2.1 Quantified PaMs & Interlinkages with Projections

The projections performed for the sector include only a WEM scenario. There is currently not enough data available to perform projections for a WAM scenario.

The impact of the seven PaMs that are to do with the electrification or energy change of the vehicle fleet **(201-204, 207, 210, 211**) were not quantified due to difficulties in isolating them from the large number of other smaller actions undertaken by individual organisations, companies and individuals to accelerate the electrification / fuel change of the vehicle fleet.

Three measures on alternative modes of transport have been implemented (**205, 206, 209**). However, since very limited data is available on the effectiveness of such measures in Iceland, their potential impact on emissions has not been estimated nor included in the WEM scenario projections.

The measures on the energy transition of state-owned vessels (**212**) and participation in an international system for mitigating emissions from aviation (ETS and CORSIA) (**705**) have also not been quantified, due to a lack of available data.

There is one quantifiable measure included in the transport sector, which is the electrification of the Herjólfur ferry (**208**). A new ferry was constructed and started sailing regular trips between Vestmannaeyjar and the coast of Iceland (Landeyjarhöfn) in 2019. In 2020 the construction of charging stations at each port (Vestmannaeyjar and Landeyjarhöfn) was finished and the ferry could begin regular journey using only electricity for fuel. However, during wintertime, the ferry is not able to sail to Landeyjarhöfn due to weather conditions and the ferry needs to sail to a different port, Þorlákshöfn. The trip to Þorlákshöfn is significantly longer (3 hours, compared to 45 minutes to Landeyjarhöfn) and during those trips the ferry needs to run the hybrid engine on diesel.

For the quantification of this measure (**208**) data was obtained from the operator of Herjólfur, both historical fuel use, from before the ferry started using electricity, and future projections of fuel use.

6.2.2 Stakeholder Engagement

After the submission of the PaMs & Projections reporting in 2019 expert review meetings were organised to get feedback and constructive criticism from external experts in order to improve future reporting. Consequently, the EA gained some valuable insights and contacts that were maintained throughout the preparation stage of the reporting.

The Transport experts from the EA had meetings with stakeholder in the transport sector, including experts from the Ministry of Infrastructure, the National Energy Authority and the Road Transport Authority. The stakeholders had a chance to review and discuss the 2019 submission of the Policies, Measures and Projections report and the EA gained some valuable insights from the experts.

6.3 Methodology of Projections

The methodology used to calculate projected emissions from transport are based on fuel projections from the Fuel Projection Working Group (2021). In addition to the Fuel Projection, data from sibyl baseline[43] was purchased to run COPERT 5.5.1 (same methodology as historical emission calculations, see 2022 NIR)

6.3.1 Data & Assumptions

An overview of the data and assumptions used as a basis for the transport projections can be found in **Table 6.3**. A further description is provided below.

Table 6.3 Basis for Transport projections.

Transport	**Basis for projections**
1.A.3.a Domestic Aviation	Fuel projections (2021)
1.A.3.b Road transportation	Fuel projections (2021), sybil baseline data
1.A.3.c Railways	NA
1.A.3.d Domestic Navigation	Fuel projections (2021)
1.A.3.e Other transportation	Fuel projections (2021)
Memo items: international bunkers	
M. IB International Aviation	Fuel projections (2021)
M. IB International Navigation	Fuel projections (2021)

Projections for aviation and navigation are based on fuel projections generated by the National Energy Authority and the Fuel Projection Working Group. Fuel projections were available by fuel type and activity. The fuel projections generated by the National Energy Authority for domestic navigation have considered the implementation of related quantified policies (see **Section 6.2.1**). Therefore, the BAU scenario was calculated for the quantified measure (**208**) and fuel savings from the policy were estimated by subtracting the WEM scenario from the fuel projections from the BAU scenario.

Electrification of Herjólfur ferry (208)

To estimate the emission savings from the electrification of Herjólfur ferry, data was obtained from the operator of the ferry with historical and projected fuel use. The historical data for 2011-2018 represent the fuel used on the old Herjólfur ferry, which was not electric/hybrid. In 2019 the new ferry started operating but did not start using electricity until 2020. In 2019 it used diesel fuel to

[43] *Emisia.* https://www.emisia.com/utilities/sibyl-baseline/

power the hybrid engines. From 2022 (WEM scenario) and onwards it is expected to use some amount of diesel annually, due to regular trips to Þorlákshöfn.

Historical data on the old Herjólfur ferry's fuel use from 2011 was used to calculate the BAU scenario to 2040. Fuel use was projected to increase linearly to 2031 when it would reach the maximum possible fuel usage. The maximum possible fuel usage was calculated based on the maximum number of trips that the ferry could possibly make. Emissions from ferry trips running on gas/diesel oil were calculated following the Tier 1 IPCC (2006) methodology as is applied in the historical and projected GHG inventory. The impact of this policy on emissions from the Herjólfur ferry is presented in **Figure 6.2**. Emissions are projected to increase across the time series as the number of trips has been assumed to increase until it reaches a maximum in 2031.

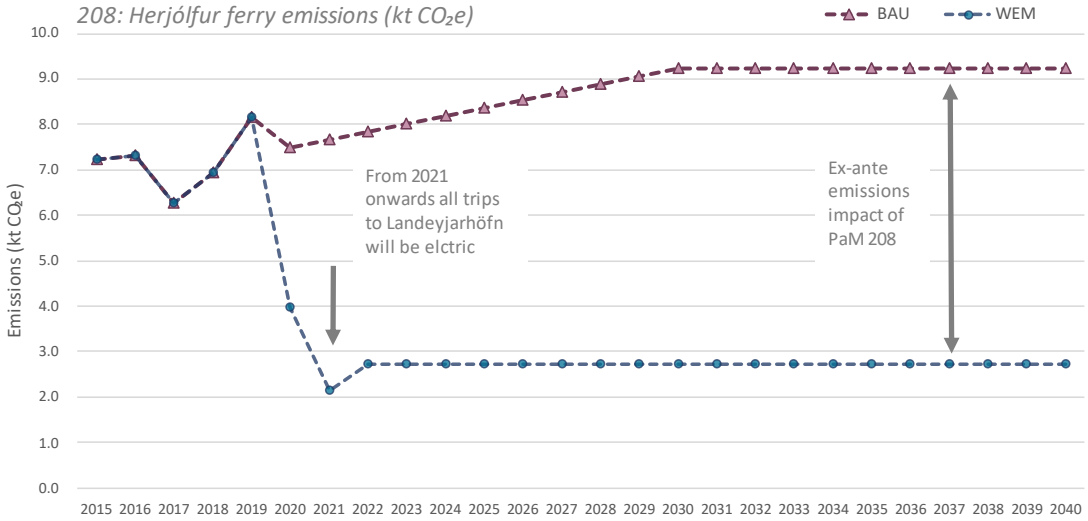


Figure 6.2 Quantified ex-ante emissions impact of PaM 208: the electrification of ferries (kt CO_2e.)

Emission savings in CO_2e and % from BAU can be seen in Table 6.4. Emissions for the WEM scenario for 2020 and 2021 are based on data received from the operator of Herjólfur, and it shows that the emissions savings in 2021 were 5.5 kt CO_2e.

Table 6.4 Quantified ex-ante emissions impact of measure 208 with emissions savings [kt CO_2e].

Transport	*2020*	*2021*	*2022*	*2025*	*2030*	*2035*	*2040*
BAU	7.5	7.7	7.8	8.4	9.2	9.2	9.2
WEM	4.0	2.2	2.7	2.7	2.7	2.7	2.7
Emission savings	3.5	5.5	5.1	5.6	6.5	6.5	6.5
% from BAU	-47%	-72%	-65%	-68%	-71%	-71%	-71%

The plan is to switch all ferries which are operated by the government to electricity or renewable fuels by the next renewal of the fleet. Based on information received from the Icelandic Road and Coastal Administration (*Vegagerðin*) it is, however, still unknown when the other ferries which are operated will be renewed. Therefore, the calculation of this measure currently only considers the electrification of Herjólfur.

7 Industrial Processes and Product Use (PPU)

Emissions, including projected emissions, from IPPU are dominated by the Metal industry (2C), specifically ferroalloys and aluminium production. The use of fluorinated gases (F-gases) in products as substitutes for Ozone Depleting Substances (ODS, 2F), mostly in the fishing industry, industrial refrigeration and commercial refrigeration, also contributes significantly to emissions from the IPPU sector. An overview of the historical and projected total emissions for the IPPU sector within Iceland can be found in **Table 7.1**. There is no Electronics industry (2E) in Iceland and therefore this is reported as NO.

This chapter describes and explains the observed trends in projected emissions for the IPPU sector, details relevant Policies and Measures (PaMs), including their interlinkages with projections, and documents the assumptions and methodologies.

7.1 Emission trends

The historical and projected emissions trend in IPPU is presented in **Table 7.1** and **Figure 7.2**.

Emissions from the **Metal Industry (2C)** have increased considerably during the past 30 years due to the expansion of existing aluminium smelters and the addition of new smelter facilities. Currently, there are two ferroalloy plants and three aluminium smelters operating in Iceland. It has been assumed that the number of aluminium and ferroalloy plants remains at current levels for the projected years. Permits for more plants have been released, but due to a lack of information on whether or when these plants will begin operating and due to the current worldwide economic situation, they are not included in the WEM projections. For more information on other possible GHG emissions projections scenarios for the heavy industry sector, including a scenario considering the addition of two more ferrosilicon plants and the expansion of existing aluminium plants, see the University of Iceland's report *Iceland and climate issues* (Hagfræðistofnun, 2017).

The most recent aluminium smelter started operating in 2007 and CO_2 emissions **from Aluminium production** increased in a strong correlation with production. In contrast, perfluorocarbon (PFC) emissions occur mostly during the first years of operation, causing the spike in emissions in 2008. They also occur in case of increased voltage in the production line (anode effect). Two aluminium facilities are already producing close to the maximal operating allowance. The projections show only a slight increase in emissions compared to 2020 emissions and relatively constant PFC emissions, since a prediction of PFC emissions is difficult to achieve. The aluminium smelters in Iceland are currently operating using the best available technology, following the best practices set out in the Directive 2006/21/EC (BAT Directive). They do, therefore, not foresee any possibilities to reduce emissions until there is a change in technology. The ELYSIS technology, developed through a partnership between aluminium industry giants Alcoa and Rio Tinto, has the potential to drastically reduce GHG emissions from the aluminium industry worldwide. This technology is, however, still in the development stage. The aim is to scale-up the process and demonstrate the technology commercially in 2023[44].

The **Ferroalloys** industry currently has two operating plants which produce ferrosilicon and silicon metal. One plant has been in operation since 1979, but the other one started operation in 2018. There is a silicon metal plant which is currently not operating, and it is unclear whether operations are to be resumed. Due to this uncertainty, this plant is excluded from the projections. The

[44] *ELYSIS*. https://www.elysis.com/en

ferroalloys industry shows a decrease in emissions, primarily due to the efforts of one company who plans to become carbon neutral by 2040[45].

F-gases are mostly used for refrigeration and air conditioning in Iceland. The biggest source in F-gas emissions derives from the fishing fleet, which relies on HFCs for the cooling and freezing systems on board. Trends in projected emissions from ODS are presented in **Figure 7.2**. As can be seen from the graph the emissions show some variation which can be explained by the nature of the calculation method. All 2F1 subcategories have different lifetimes, so the emissions occur a certain number of years after the import of the gases. The calculation is also based on the import amounts of one calendar year. If a shipment is coming late in the year, the F-gases might be stockpiled and not used immediately in the same year, even though it appears so from the calculation method. Regulation (EU) 517/2004 is implemented into Icelandic legislation with Regulation No 1066/2019, defining a quota system on the amount of F-gases to be imported each year and steps for phasing it out. This quota system was revised in 2020, and revised Regulation No 1066/2019 defines a new quota with a quicker phase out of these compounds. A comparison between the two scenarios, the older import quota according to Regulation No 1279/2018 (BAU) and the newer import quota according to Regulation No 1425/2020 (WEM), was calculated and is reported in section 7.2.1.

The **Mineral industry (2A)** has seen a big drop in emissions as the only cement production plant in Iceland closed in 2011. The projections are based on a single facility producing mineral wool, which is having a fairly constant production target (based on communication from the facility), and therefore, constant emissions over time. The **Chemical industry (2B)** is insignificant in the Icelandic inventory, with no emissions reported under this sector since 2005. In the past, there were a fertiliser production plant, which stopped production in 2001, and a diatomite production plant, which stopped production in 2004. There is no information on plans of opening new production facilities in these two sectors and the historical and projected emissions (for the Mineral industry only) can be seen in **Figure 7.2**.

Table 7.1 Historical and projected emissions (kt CO_2e) in the IPPU sector

Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mineral Industry (2A)	52	0.7	0.9	0.9	0.9	0.9	0.9
Chemical industry (2B)	47	NO	NO	NO	NO	NO	NO
Metal industry (2C)	844	1,807	1,775	1,964	1,957	1,930	1,903
Non-energy products from fuels and solvent use (2D)	7.1	6.1	6.2	5.9	5.6	5.2	5.1
Electronics industry (2E)	NO	NO	NO	NO	NO	NO	NO
Product use as substitutes for ODS (2F)	0	163	198	136	68	16	23
Other product manufacture and use (2G)	7.2	4.9	6.0	4.9	4.7	4.5	4.3
Other (please specify) (2H)	NO	NO	NO	NO	NO	NO	NO
IPPU (2)	**958**	**1,983**	**1,986**	**2,112**	**2,035**	**1,957**	**1,937**

[45] *Elkem* (2019). https://www.elkem.is/frettir/elkem-island-fagnar-40-ara-afmali/

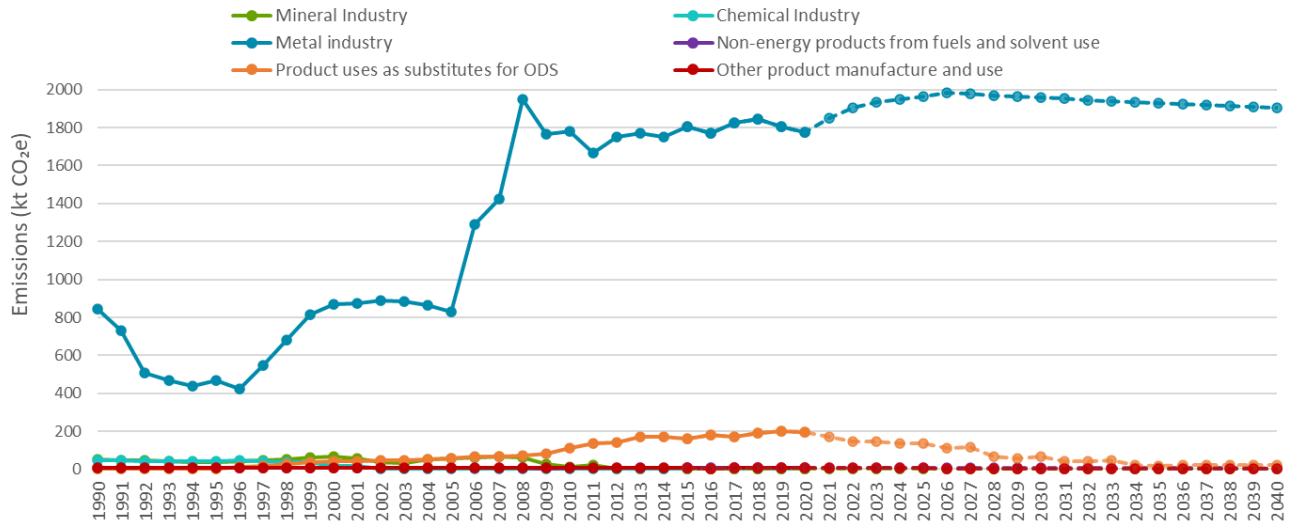


Figure 7.1 IPPU Emissions Total GHGs [kt CO_2e], WEM scenario. Unbroken lines represent historical emissions, broken lines projected emissions.

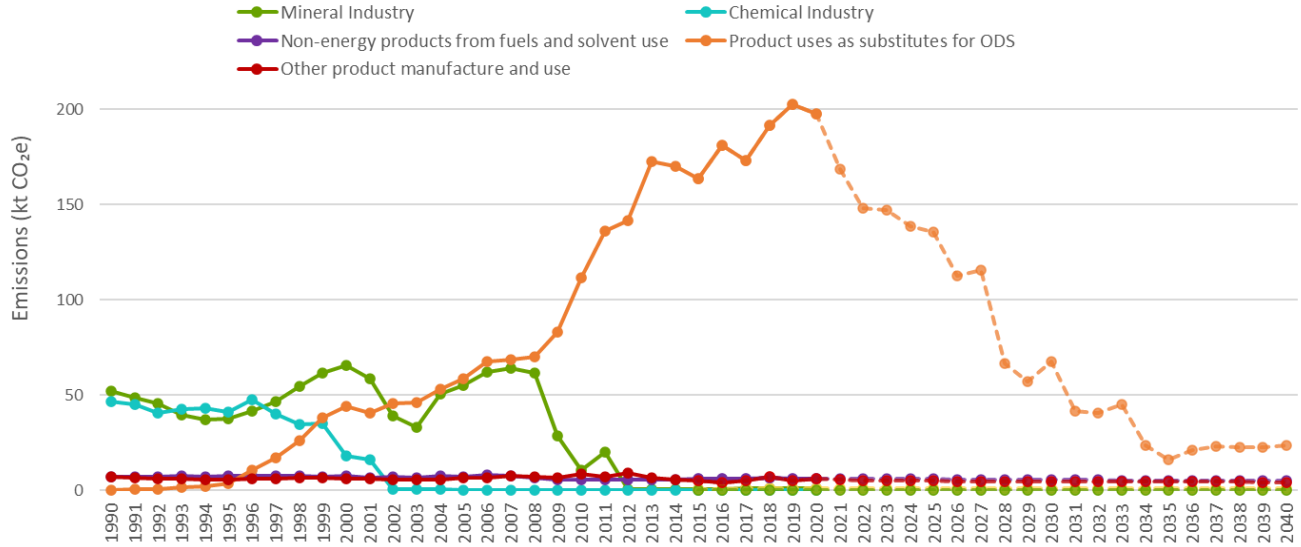


Figure 7.2 IPPU Emissions without the metal sector (2C) [kt CO_2e], WEM scenario. Broken lines represent projected emissions.

7.1.1 ESR vs EU ETS emissions in Industry

In Iceland, process emissions from the 2C Metal Industry, that is ferroalloys and aluminium production are accounted for under the EU ETS (Directive 2003/87/EC). Overall and historically, this contributes to approximately 90% of the total emissions from the Industry sector. The projections under the WEM scenario show that the EU ETS contribution will increase up to 98% as the emissions for the Metal sector (2C) are fairly constant while the ESR part, especially the F-gases (2F) are expected to decrease substantially (**Figure 7.3)**.

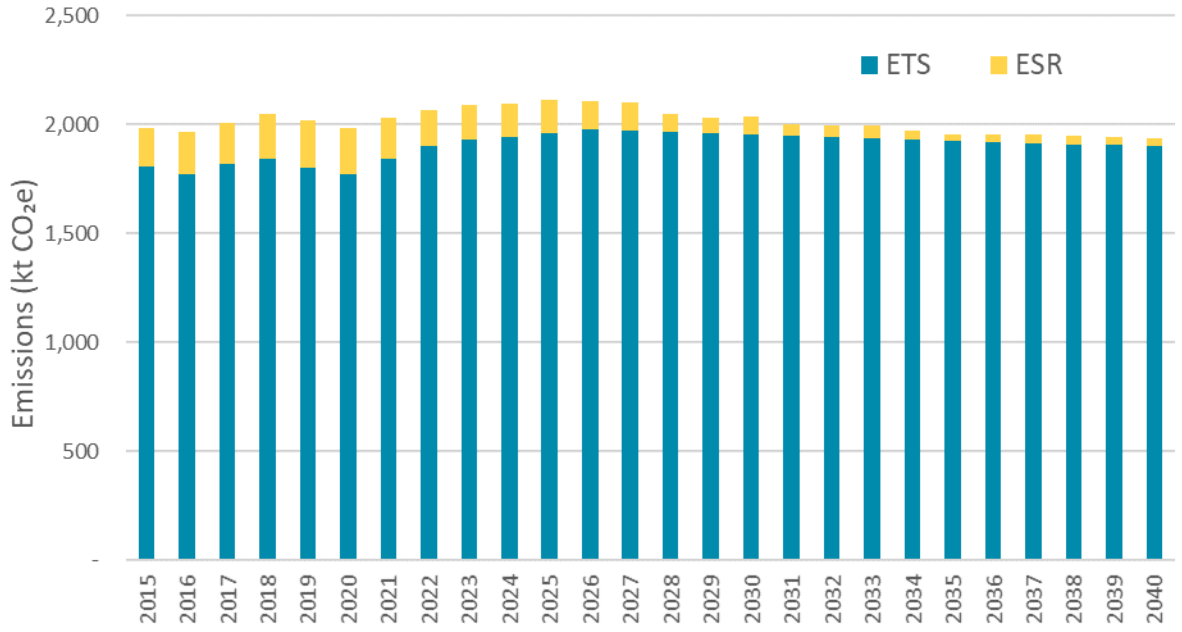


Figure 7.3 ETS and ESR GHG projections in the Industry sector, WEM scenario, [kt CO_2e].

7.2 PaMs

PaMs with the objective of reducing GHG emissions relevant for the IPPU sector, both implemented and adopted, are summarised in **Table 7.2**.

Table 7.2 IPPU Policies and Measures.

PaM Name	*GHG*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*CRF code*	*Description*
Regulation on F-gases (301)	HFC, PFC	Economic, Regulatory	Imple-mented	WEM	Yes	2F	A regulation on F-gases implements Regulation (EU) No 517/2014 which contains provisions that stipulate for, i.e., import quota on F-gases.
MAC Directive 2006/40/EC (302)	HFC, PFC	Regulatory	Imple-mented	WEM	No	2F1e	Gradual ban of F-gases in passenger cars by enforcing the use of gases with a GWP lower than 150. Implemented in Icelandic legislation with Regulation No 822/2004.

PaM Name	*GHG*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*CRF code*	*Description*
BAT for Non-Ferrous Metals Industries (303)	GHGs	Regulatory	Imple-mented	WEM	No	2C	Operating permits for non-ferrous metals industries are required to include the Best Available Techniques (BAT) Reference Document (Art. 31(1) of the Directive 2010/75/EU on industrial emissions).
BAT for Manufactur e of Glass (304)	GHGs	Regulatory	Imple-mented	WEM	No	2A	Operating permits for the manufacture of glass are required to include the BAT Reference Document (Art. 31(1) of the Directive 2010/75/EU on industrial emissions).
Taxation of F-gases (305)	HFC, PFC	Fiscal	Imple-mented	Not included in a projectio n scenario	No	2F	F-gases will be taxed to reduce further the use of F-gases. (Art. 13 implemented in Icelandic legislation with Act No 129/2009 on Environmental and Resource Taxes in 2020).
Carbon capture from heavy industry (306)	CO_2	Regulatory	Imple-mented	Not included in a projectio n scenario	No	2	CO_2 emissions from heavy industry will be reduced through carbon capture, for example using the Carbfix method.
Updated Regulation under the Emission Trading System (ETS) (307)	CO_2, PFC	Regulatory	Imple-mented	WEM	No	2C	Updated regulation for the EU ETS was adopted for the fourth trading period.
Environment al data reporting (708)	GHGs	Regulatory	Adopted	Not included in a projectio n scenario	No		Regulation will be issued for better environmental data reporting, on, e.g., material use, GHG emissions among other pollutants.

The PaMs on reducing GHG emissions from IPPU in the 2020 Action Plan and 2021 Progress Report are predominantly focused on achieving the phasing out of F-gases.

Iceland adopted Regulation (EU) No 517/2014 on fluorinated greenhouse gases (F-gas Regulation) in December 2018, in line with the 2018 Action Plan. This regulation limits the total amount of the

most significant F-gases which can be sold, banning the use of F-gases in many new types of equipment where less harmful alternatives are available, and preventing emissions of F-gases from existing equipment. The F-gas regulation is adapted to Icelandic conditions and the import quota differs from the values stated in the Annex V of the Regulation. A stricter quota was adopted in December 2020 through amendment (Regulation 1425/2020) to Regulation 1066/2019 on F-gases which took effect in January 2021, further accelerating the decrease in F-gas emissions in Iceland.

Further measures to reduce the use of F-gases are the implementation of a taxation system based on the GWP of the F-gases imported in bulk. This was implemented into Icelandic legislation with an amendment (Act No 135/2019) to Act No 129/2009 on Environmental and Resource Taxes. The effect of the taxation, however, has not been calculated in the projections.

Regulation on F-gases (301)

This measure has been expanded since the first Climate Action Plan (2018) and has become a separate measure. The goal was the implementation of EU Regulation No 517/2014 on F-gases with import quotas to reduce gradually the amount of F-gases coming to the country until 2036. The first regulation was adopted in December 2018 (Icelandic Regulation No 1279/2018) and repealed in 2020 with Icelandic Regulation No 1045/2020 which applies a quicker phase out of imported F-gases as can be seen in **Table 7.3**. Certain other provisions are made in the regulation which aim to further reduce F-gas emissions, such as limits on their marketing and use. Refilling big systems with F-gases which have a very high global warming potential (maximum 2,500 GWP) will be banned. This regulation is an important step in reducing GHG emissions from the use of F-gases in Iceland. The EAI is in charge of monitoring the regulation in line with provisions in the chemical law. Restrictions will be further increased if deemed necessary.

Table 7.3 Comparison between steps in phasing out the bulk import of F-gases between Regulation No 1279/2018 and Regulation No 1045/2020.

	Regulation No 1279/2018 (repealed)			***Regulation No 1045/2020 (in force)***		
Steps	**Years**	**Percentage compared to baseline**	**kt CO_2e**	**Years**	**Percentage compared to baseline**	**kt CO_2e**
1 step	2019-23	90%	243.9	2019-20	90%	243.9
2 step	2024-28	60%	162.6	2021-23	35%	94.9
3 step	2029-33	30%	81.3	2024-26	24%	65.0
4 step	2034-35	20%	54.2	2027-29	19%	51.5
Final/ 5 step	2036	15%	40.6	2030-35	17%	46
Final				2036	12%	32.5
Baseline			271			271

MAC Directive 2006/40/EC (302)

Gradual ban on F-gases in passenger cars by enforcing the use of gases with a GWP lower than 150. It is implemented into Icelandic Regulation with Regulation No 822/2004.

BAT for Non-Ferrous Metals Industries (303)

Operating permits for non-ferrous metals industries are required to consider the Best Available Techniques (BAT) Reference Document (Art. 31(1) of the Directive 2010/75/EU on industrial emissions).

BAT for Manufacture of Glass (304)

Operating permits for the manufacture of glass are required to consider the Best Available Techniques (BAT) Reference Document (Art. 31(1) of the Directive 2010/75/EU on industrial emissions).

Taxation of F-gases (305)

The policy has been expanded since the first publication of the Climate Action Plan (2018) and has become a separate measure. The goal of this measure it to accelerate the process of phasing out F-gases by taxing imports of F-gases. The taxation was implemented into Icelandic legislation with Act on environmental and resource taxes in 2020. The tax is based on the polluter pays principle which stipulates that those who are responsible for pollution pay for the consequences of it. A similar approach is used in Iceland as has been used in Denmark, where a certain price is added per kilogram of F-gases for every tonne CO_2e that it emits, up to a price ceiling of 10,000 ISK per kilogram. A taxation on F-gases can have a significant impact in a short span of time because more sustainable solutions are already available and it is fairly simple to phase out F-gases, technologically.

Carbon capture from heavy industry (306)

Explore whether heavy industry in Iceland can systematically capture CO_2 from their operations. The "Carbfix," or "gas-to-rock" method[46] will be explored further, to determine whether it is a realistic option to capture CO_2 emissions from heavy industry in Iceland. Reykjavík Energy (*Orkuveita Reykjavíkur*) has developed the method in collaboration with the University of Iceland and foreign stakeholders and it has received widespread attention around the world. The method involves capturing CO_2 from geothermal emissions. The CO_2 dissolves in water under pressure and the water is subsequently pumped to a depth of 500-800 meters into the basalt strata, where the CO_2 is permanently mineralised. The gas is, in this way, turned into rock. ON, a subsidiary of Reykjavík Energy, has used the method for the last years to reduce emissions from Hellisheiði Geothermal Power Plant with good results.

According to a declaration of intent[47], which was signed in 2019 by Reykjavík Energy, Elkem, Alcoa Fjarðaál, Rio Tinto Iceland, Norðurál, PCC Bakki and the government, an analysis of the possibilities to use the same method in heavy industries in Iceland will be undertaken to see if it is possible for them to capture CO_2 directly from their processes and pump it into basalt strata. The project is very extensive and will span five to ten years. It is planned to develop methods to separate the density of CO_2 in emissions from heavy industry, so that similar cleaning measures can be used as in the Hellisheiði Geothermal Power Plant. Equipment to experiment with the filtering and pumping down of CO_2 from heavy industry must be designed and built, and consequently real full-scale equipment must be made. Recently Iceland implemented in the Icelandic law (No 12 from 18 March 2021) an Icelandic adaptation of Directive 2009/31/EC (the CCS Directive) with the aim to enable the EU ETS industry in Iceland to utilise the Carbfix method within the CCS.

Updated regulation under the Emission Trading System (EU ETS) for the fourth trading period (307)

Iceland will continue to participate in the ETS. New regulations have taken effect when the fourth period (2021-2030) of the system started in 2021. The stricter rules are designed to return a 43% decrease in emissions within the ETS in 2030 compared to 2005, start of the EU ETS. The trading

[46] *Carbfix*. https://www.carbfix.com/

[47] Declaration of intent by the Government, the heavy industry sector and Reykjavík Energy on carbon sequestration (Viljayfirlýsing stjórnvalda, stóriðjunnar og OR um hreinsun og bindingu kolefnis). *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/01--Frettatengt---myndir-og-skrar/FOR/Fylgiskjol-i-frett/VIljayfirl%c3%bdsing%20undirritu%c3%b0.pdf

system is the EU's main instrument in climate issues and is meant to create an economic incentive to reduce GHG emissions.

The ETS is based on making certain operations in the European Economic Area (EEA) dependent on emission allowances. A certain limited total of emission allowances is allocated to the whole EEA per year, and the total allowances decrease each year. Emission allowances are in part allocated to operators and flight operators for free, and in part auctioned off. If operators and flight operators have managed to reduce their emissions to the extent that they have more emission allowances than they need, they can sell the excess allowances on the market. In the same way they have to buy emission allowances if their emissions exceed their allocated free emission allowances. In this manner, the trading system creates a financial incentive to reduce GHG emissions from operations, for example by investing in more environmentally friendly technology or optimizing operations in other ways.

Since the ETS was set afoot, it has been expanded every few years so that more sectors are included in the system and the rules have become stricter. The third period of the ETS came to an end by the end of 2020 and the fourth period, which covers the next 10 years, has taken over. With Act No 35/2021 the relevant changes on the Climate Act No 70/2012 were made to implement the appropriate EU regulations regarding the fourth period.

Environmental data reporting (708)

The measure has been expanded since the first edition of the Climate Action Plan (2018). The aim of this measure is to improve reporting on environmental data and information by operators in Iceland, including data on the use of raw materials, air pollutant- and greenhouse gas emissions. A regulation on the reporting of environmental data will be developed to coordinate information and simplify the reporting process for operators. In 2019, Act No 7/1998 on Public Health and Pollution Prevention was amended; an obligation to report a special "green account" (*grænt bókhald*), is planned to be cancelled and instead operators have to report certain environmental data. This environmental data includes similar information as was previously reported through the "green accounting", such as emissions of polluting substances and resource use. The work on this regulation has already begun. The goal with this amendment is to receive more detailed data from the operators that are bound to report environmental data, to have better information on resource use and pollution in Iceland.

A regulation on "emissions accounts" (*útstreymisbókhald*), Regulation No 990/2008, will build on the same base as the Regulation on Green Accounts No 851/2002 and weave in further provisions to ensure that all data that the EAI needs to fulfil its legal obligations, such as reporting to EFTA's regulatory agency and the UNFCCC, is gathered and reported. The reporting obligation contained within the Regulation on Environmental Data is expected to apply to businesses that currently fall under the Act on Public Health and Pollution Prevention. This includes metal production, chemical industry, energy industry, fish-meal factories, asphalt plants, oil warehouses, power plants, sewage treatment plants, poultry and pig farming and smaller operations, such as dry cleaners and gas stations, are also included. The plan is that the draft on the Regulation on Environmental Information reporting to be presented in the Government's consultation portal by the end of 2020. This measure has not been finalised yet.

Other ongoing initiatives

Besides the abovementioned PaMs, there are other smaller initiatives being prepared or already underway that may reduce greenhouse gas emissions from the industry sector in the future. Among them it is worth mentioning that a report about Nordic criteria of Green Public Procurement (GPP) for the refrigeration and air conditioning sector has been published. Aim of the publication, funded

by the Nordic Council of Ministers is to provide resources and guidance for the public administration to avoid the purchase or to find alternatives to appliances containing F-gases with high GWP[48].

7.2.1 Quantified PaMs & Interlinkages with Projections

The measure **301** was quantified individually and a comparison between the import quota according to Regulation No 1279/2018 (BAU) and import quota according to Regulation No 1425/2020 (WEM) was calculated and is presented below.

The Mobile Air-Conditioning Systems (MAC) Directive (**302**) has been in force since 2008 and is therefore considered to be part of the WEM projections scenario. Data collected directly from the main car importers carried out in 2020 showed that since R-134a has been replaced by lower GWP HFOs (Haloolefines) if the cars are aimed for the European market, a development which started in 2016. However, some cars are imported to Iceland from non-EU countries, so a small percentage of cars using F-gases (3% of yearly new registrations) are still considered in both historical and projected emission calculations. This measure has not been quantified separately.

303 and **304**, that is the application of BAT for the non-ferrous metal industry and the glass industry, are part of the WEM scenario, as the best available techniques are part of the current operation permits. **307**, that is being part of the European Emission Trading System (ETS) is also estimated in the WEM scenario, as all main industrial emitters fall into the ETS system. Within the whole ETS system, emissions from installations declined by about 35% between 2005 and 2019[49]. Currently, no significant decrease is occurring within the EU ETS Industry in Iceland and in general the emissions are quite steady. The reason is i.e., the start-up of two new installation during the time Iceland has participated in the EU ETS and the fact that most of the emissions comes from the industrial processes themselves but not the burning of fossil fuels. The possibilities that the operators in EU ETS industry must decrease emissions lies within the use of renewable energy/biofuels but first and foremost in the permanent removal of emitted CO_2 from the source streams.
Since the technology to reduce emissions within the industrial processes themselves is not available, the possibilities to reduce emissions from EU ETS industry in Iceland lies mostly within carbon capture and storage (CCS), measure **306**. Recently, Iceland implemented into Icelandic legislation, Act No 12/2021, an Icelandic adaptation of Directive 2009/31/EC (the CCS Directive), with amendment to Climate Act No 70/2012 and Act No. 7/1998, with the aim to enable the EU ETS industry in Iceland to utilise the Carbfix method within the CCS. Although the utilization of this technique within the industry is still in a developmental stage it is of great relevance to speed up the process since a large part of Iceland's emissions are from this sector.

The recently adopted F-gas Regulation, Regulation (EU) No 517/2014 (implemented into Icelandic legislation with Regulation No 1066/2019), is the measure (**301**) which causes the biggest shift in the trend of emissions in the non-ETS IPPU emissions (see **Figure 7.4**). The quantification of this measure is however difficult, as the import of F-gases has been varying greatly over time and the emissions deriving from F-gases extend over the whole lifetime of the installation using F-gases. A description of the calculation can be found in **chapter 7.3.1**.

7.2.2 Stakeholder Engagement

The stakeholder workshop on IPPU, organised by the EA in May 2018, was well attended by representatives from the industrial sector in Iceland. The largest industrial plants (aluminium and ferroalloy) all fall under the EU ETS have strong incentives to minimise their GHG emissions. The

[48] *Nordic criteria for Green Public Procurement for alternatives to high GWP HFCs in refrigeration, air conditioning and heat pump products*. https://pub.norden.org/temanord2020-512/#
[49] *European Commission*. https://ec.europa.eu/clima/policies/ets_en

majority of companies have set environmental and or climate strategies, which will be included in the future as more information on direct actions to be undertaken becomes available.

After the completion of the first PaMs and Projections report, the environmental managers of the main industrial facilities (metal sector), representatives from the Ministry of Environment and Natural Resources and from other departments within the Environment Agency, were invited to a meeting, during which the report was presented, calculation methods explained, and collaboration consolidated. The meeting was held at the Environment Agency in October 2019 and was well attended and there was a fruitful exchange between the participants.

There was also regular collaboration with the Ministry for the Environment and Natural Resources, which was updating the F-gas import quota regulation during this reporting cycle. Experts from the EAI assisted the Ministry in the process of calculating the expected impacts of different import quotas, one of which was implemented in Icelandic legislation in December 2020 with Icelandic Regulation No 1425/2020 which amended Regulation No 1066/2019 on fluorinated greenhouse gases.

7.3 Methodology of projections

The methodology used to generate WEM projections for the IPPU sector are based on the historical inventory. Please refer to the latest edition of the National Inventory Report where information about activity data and emission factors is collected. Only a WEM scenario has been calculated for the entire IPPU sector, as no data was available to calculate a WAM or WOM scenario. Only for the sector 2F a comparison between BAU and WEM was carried out (**Figure 7.4**).

7.3.1 Data & Assumptions:

An overview of the activity data and assumptions used as a basis for the IPPU projections can be found in **Table 7.4**. The emission factors are calculated following the methodology in the historical inventory. Where the application of default or Tier 3 facility specific emission factors was not possible due to the lack of data, averages of historical data were used to provide implied emission factors. A further description is provided below.

Table 7.4 Activity data basis for IPPU projections.

IPPU	**Basis for projections**
2.A Mineral Industry	Activity data provided by the stakeholders, maximal production allowance according to operation permits
2.B Chemical Industry	Not relevant in Iceland
2.C Metal Industry	Activity/emission data provided by the stakeholders, trends over the past years, maximal production allowance according to operation permits
2.D Non-energy products from fuels and solvent use	GDP, population and fuel projection
2.E Electronics Industry	Not relevant in Iceland
2.F Product uses as substitutes for ODS	Legislation (import quota), mass balance to allocate imported amounts to different sectors.
2.G Other product manufacture and use	GDP and population projection, trends over the past years

2.A Mineral Industry and 2.C Metal Industry

The main companies (mineral wool, ferroalloys, and aluminium) were asked to provide a production and emission estimate or to confirm or reject the calculated emission estimates based on historical

inventory data for the previous PaMs and Projection report. This data has been used. No big changes are expected in these subsectors.

According to the Icelandic Ministry of Higher Education, Science and Innovation, and the Department of Energy, Industry, and Business affairs, there are currently no plans for adding new aluminium smelters, ferroalloys plants, or for resuming production of cement, fertiliser, diatomite, or steel[50]. Therefore, the projections are based on the current production and the production amounts communicated by the individual companies, also taking into account the maximal permitted allowance according to the operation permits. The quantification of the effects of the EU-Emission Trading System (**307**) and the Carbon Capture and Storage (**306**) were not considered. The ETS aspires to an emission reduction for the whole European region, by giving emission allowances to companies. In case of higher emissions, the companies can trade for other emission allowances, so overall the emissions are reduced but this cannot be quantified for the Icelandic companies separately. Provisions on The Carbon Capture and Storage (306) was implemented into Icelandic legislation (amendment to Climate Act No 70/2012 and Act No. 7/1998) by adapting Directive 2009/31/EC (the CCS Directive) with the aim to enable the EU ETS industry in Iceland to utilise the Carbfix method within the CCS. The utilisation of this technique within the industry is still in a developmental stage.

2.F Product uses as substitutes for ODS

The projected emissions deriving from F-gases (sector 2F1) are based on the maximum allowed import quota for each year starting with 2021. Both scenarios (import quota according to Regulations No 1066/2019 – BAU and No 1425/2020 – WEM, see **Table 7.3**) have been calculated using the following assumptions:

A) As it cannot be predicted which blends will be imported in the future, also in light of quick developments in this sector (low GWP drop-ins and replacements), the average of 2011-2020 of all imported blends was calculated and the allowed import quota distributed accordingly; the import quota is expressed as CO_2e and no further indications are given. The quota applied to the historical usage proportions/splits creates a deficit for MAC that will probably be filled through a quicker phase out of large installations F-gas usage, but this fact cannot be considered in the calculation model.
B) The methodology for the calculation of the greenhouse gas emissions is the same as applied for the historical emissions as explained in the most recent edition of the NIR.

Figure 7.4 shows the comparison between the two scenarios and clearly illustrates that a rapid phasing out of F-gases, achieved by Regulation No 1425/2020 amending Regulation No 1066/2019, will drive further emission reductions from this category. Under both scenarios, some increase is still expected in certain years, due to the import fluctuations in the past and different lifetime of equipment. **Table 7.5** reports the emission amounts and the difference between both scenarios. With the new import quota regulation of 2020 emissions decrease by 59% in 2030 compared to 2015 and by 86% in 2040 compared to 2015.

[50] [E-mail communication from 05/02/2019, Director General, Department of Energy, Industry and Business Affairs, Ministry of Industries and Innovation]

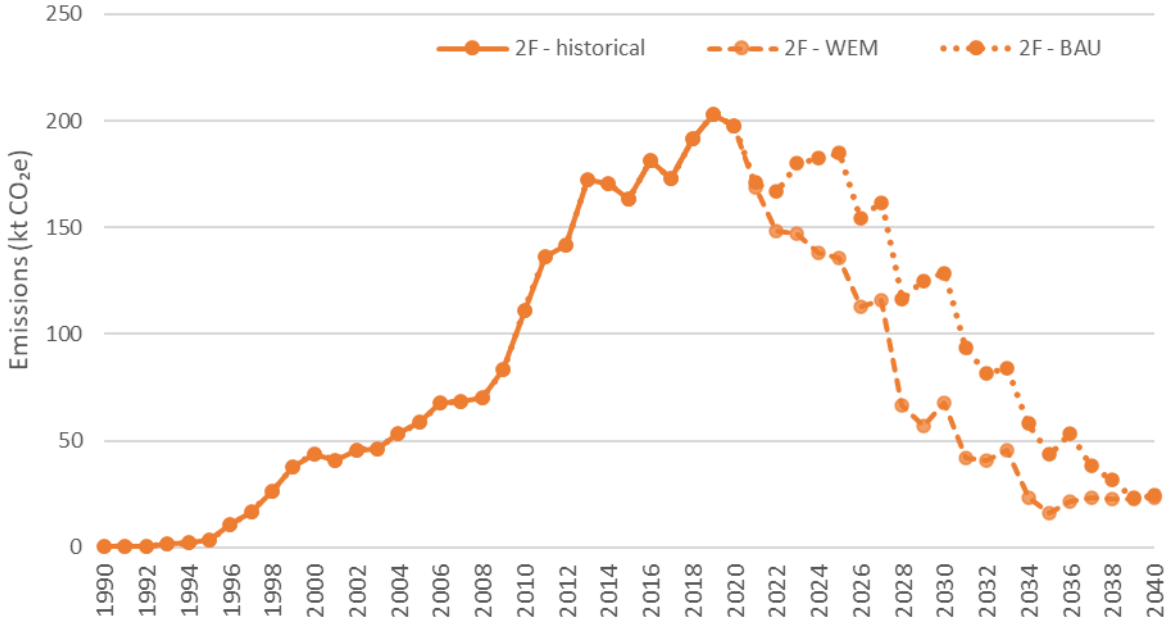


Figure 7.4 GHGs emissions from Product Uses as Substitutes for ODS (2F) due to the use of F-gases, WEM scenario compared to BAU scenario.

Table 7.5 Comparison of emissions for 2F1 Refrigeration and Air Conditioning, BAU and WEM scenario.

	Emissions (kt CO_2e)					
Sector	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
2F1 Refrigeration and Air Conditioning - BAU	163	198	185	129	44	24
2F1 Refrigeration and Air Conditioning - WEM	163	198	136	68	16	23
Difference WEM-BAU	0	0	49	61	27	1
% Difference	0%	0%	-26%	-47%	-62%	-4%

8 Agriculture

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, i.e., dairy cattle, sheep, horses, and goats, which are all of an ancient Nordic origin, one breed for each species. These animals are generally smaller than the breeds common elsewhere in Europe, and therefore, the calculated emissions from these breeds, based on default IPCC (2006) emission factors, might be slightly overestimated. 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, although potatoes, barley, beets and carrots are grown on limited acreage. The projections encompass emissions from enteric fermentation (3A), manure management (3B), agricultural soils (3D), liming (3G), urea (3H), and other carbon-containing fertilisers (3I). A number of agriculture categories are not occurring in Iceland and have therefore not been included in the projections, e.g., rice cultivation (3C), prescribed burning of savannas (3E) and field burning of agricultural residues (3F).

The total GHG emissions from Agriculture in the latest year were 7% below the 1990 level. The main sources of GHG emissions in Agriculture are CH_4 emissions from enteric fermentation and manure management, and N_2O emissions from manure management and agricultural soils. Emissions of CH_4 and N_2O have historically accounted for over 99% of the total emissions from agriculture in Iceland, with less than 1% arising from CO_2. In 2020, 84% of CH_4 emissions were caused by enteric fermentation, the rest by manure management. In the same year, 94% of N_2O emissions were caused by agricultural soils, the rest by manure management, i.e., storage of manure.

8.1 Trends

Historically the biggest source of GHG emissions from the agriculture sector in Iceland is enteric fermentation, although manure management and agricultural soils are also significant sources. The decrease of GHG emissions since 1990 is mainly due to a decrease in the sheep livestock population, reducing methane emissions from enteric fermentation, and reduced fertiliser application, reducing N_2O emissions from agricultural soils. The historical and projected trend can be seen in **Figure 8.1**. Emissions from agriculture are projected to decrease by 19% (126 kt CO_2e) in 2040 compared to the 2015 level. This is due to a projected decrease in livestock numbers, mostly sheep and dairy cattle, which are key categories in methane emissions from enteric fermentation and nitrous oxide emissions from manure management.

CH_4 emissions from enteric fermentation are projected to decrease by 26% in 2040 compared to 2015, while the total CH_4 and N_2O from manure management are projected to decrease by 16%. Emissions from the category agricultural soils are projected to decrease by 12%. Projections for liming and urea were based on the historical emissions 1990-2020 interpolated linearly to reach 2040. These emissions are predicted to increase by 31% in 2040 compared to 2015 (

Table 8.1).

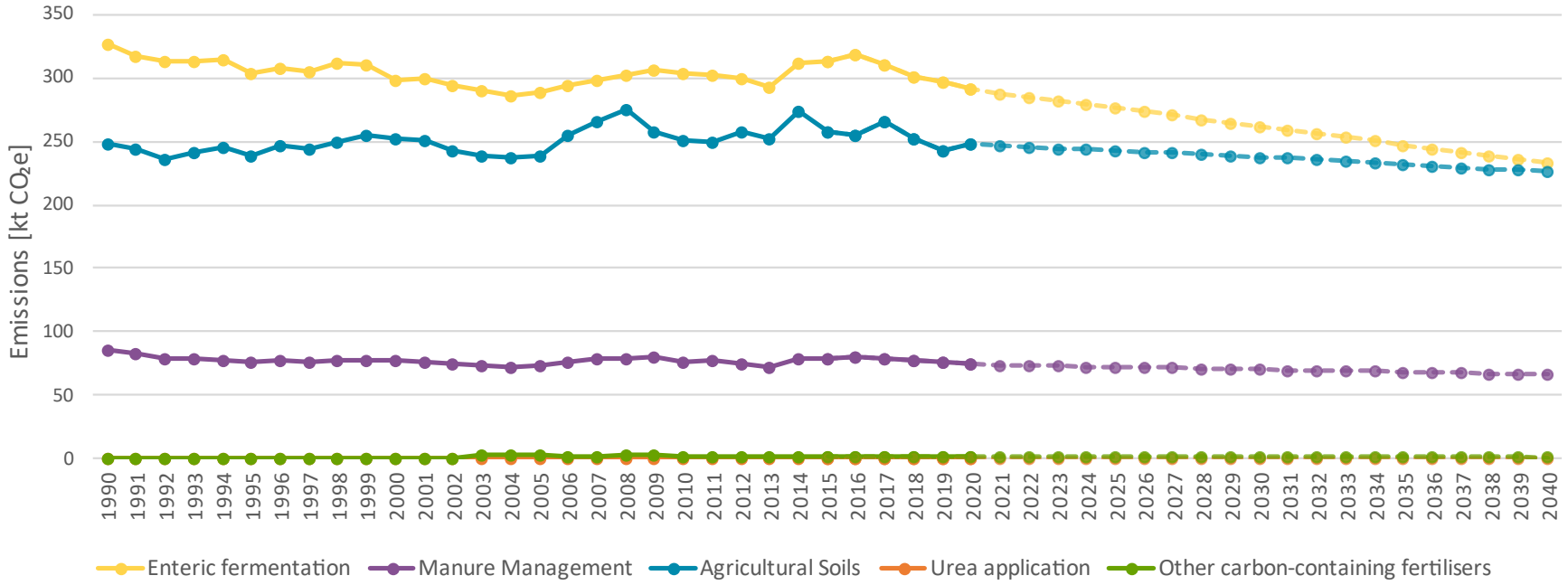


Figure 8.1 Agriculture Emissions Total GHGs [kt CO_2e], WEM scenario. Unbroken lines represent historical emissions, broken lines projected emissions.

Table 8.1 Historical and projected emissions [kt CO_2e] in the Agriculture sector.

	Emissions [kt CO_2e]						
Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Enteric fermentation (3A)	326	314	291	277	262	247	233
Manure Management (3B)	86	79	74	72	70	68	66
Agricultural Soils (3D)	248	258	248	243	238	232	226
Liming (3G)	0.5	2.0	4.0	2.0	2.0	3.0	3.0
Urea application (3H)	0.1	0.2	0.2	0.1	0.2	0.2	0.2
Other carbon-containing fertilisers	0.0	1.2	1.4	1.2	1.1	1.0	0.9
Total	**662**	**655**	**618**	**595**	**574**	**551**	**529**

8.2 PaMs

Five Agriculture (AG) PaMs are currently planned with the objective of reducing GHG emissions, summarised in Table 8.2.

Table 8.2 Agriculture Policies and Measures.

PaM Name	GHG	Instrument type	Status	Scenario	Ex-ante	Description
Climate-friendly agriculture (401)	CO_2, CH_4, N_2O	Information, Education, Planning	Adopted	not included in a projection scenario	No	Information on climate-friendly agricultural practices will be made accessible for farmers.
Improved feeding of livestock to reduce enteric fermentation (402)	CO_2, CH_4, N_2O	Research	In progress	not included in a projection scenario	No	Research shows that supplements can reduce enteric fermentation in livestock, that results in methane emissions; these possibilities will be explored in the Icelandic context.
Improved use and handling of fertilisers (403)	CO_2, CH_4, N_2O	Education, Planning, Regulatory	In progress	WEM	Yes, 3D	Information on manure and synthetic fertiliser use and handling and their effect on GHG emissions will be made accessible for farmers.
Carbon-neutral beef production (404)	CO_2, CH_4, N_2O	Education, Planning, Regulatory	In progress	not included in a projection scenario	No	Emissions arising from beef production will be reduced and carbon sequestration enhanced to aim for carbon neutral beef production in 2040.
Increased domestic vegetable production (405)	CO_2, CH_4, N_2O	Planning, Regulatory	Adopted	not included in a projection scenario	No	Domestic vegetable production will be increased and the objective of carbon neutral vegetable production set for 2040.

The PaMs described in the table above are all from the Climate Action Plan (2020) and the Progress Report (2021).

Climate-friendly agriculture (401)

The measure has been expanded since the first Climate Action Plan (2018), where it was called "Collaboration with sheep farmers on carbon sequestration"/ "Carbon neutral sheep". The aim of this measure is to provide farmers with comprehensive counselling and education on how they can reduce their GHG emissions and increase carbon sequestration on their farms and land through a project called "Climate friendly farming" (*Loftslagsvænni landbúnaður*). The goal is to reduce GHG emissions from farming and land use and increase carbon sequestration in soils and vegetation. In the first edition of the Climate Action Plan (2018) a collaboration project with sheep farmers, with the goal to reduce GHG emissions and increase carbon sequestration in farming and land use, was described. The preparation of the project has been managed by the Icelandic Agricultural Advisory Centre (RML), the Icelandic Forestry Association and the Soil Conservation Service of Iceland, in collaboration with the Icelandic Sheep Farmers Association (*Landssamtök sauðfjárbænda*), the

Icelandic Farmers Association (*Bændasamtök Íslands*), the Ministry of the Environment, Energy, and Climate and the Ministry of Food, Agriculture, and Fisheries. Courses, that will be open to all farmers, will be held with the aim of increasing farmers' knowledge and interest in climate issues. The project began in February 2020 with an open meeting for all farmers. Voluntary participants receive guidance on future planning, that focuses on reducing the carbon footprint of their farms and is based on data from each individual farm. In 2020, thirteen sheep farmers participated in the project. In 2021 this had expanded to forty-three participants, including fifteen cattle farmers. One of the aims of the project is to include different types of farms and around 100 farms are expected to participate in 2023.

Improved feeding of livestock to reduce enteric fermentation (402)

Reduced emissions from the enteric fermentation of ruminants will be achieved by improved feeding practices, which will be carefully monitored. Enteric fermentation is the process that causes methane emissions from the digestive system of livestock. It is the main source of GHG emissions from livestock and animal husbandry. When the livestock chew and process food they belch out methane. Research, that has been conducted abroad, indicates that it is possible to reduce methane production in the digestive system of livestock in various ways, such as through using substances made from algae. Whether it is possible to reduce emissions from enteric fermentation in Iceland through such means will be explored, and domestic research and development will be supported. The implementation of this policy is aligned with policy **401** on Climate-friendly agriculture and policy 404 on Carbon-neutral beef production, part of which is to assess the status and development of research on enteric fermentation. The project management team on the progress of climate action in agriculture will consequently be in charge of monitoring developments in this field and recommending measures that are suitable for Icelandic conditions when appropriate.

Improved use and handling of fertilisers (403)

The policy has been expanded since the first edition of the Climate Action Plan (2018). The policies "Reduced use of non-organic fertiliser" and "Improved manure management" have been combined in one policy. Emissions from fertiliser use in farming will be reduced by improving manure management practices and reducing the use of inorganic fertilisers. An emphasis will be placed on increasing farmers' knowledge and access to information on how best to reduce greenhouse gas emissions (CH_4 and N_2O) from agriculture. An important aspect of this effort is to enforce the regulation on protection against water pollution due to nitrogen compounds (NO_x) from agriculture and other operations (Icelandic regulation No. 796/1999). According to the regulation the size of a manure storage should be based on a holding a capacity of at least six months of manure, or the possibility of using the manure in a reasonable manner as organic fertiliser on soil. The policy scope includes the fertiliser use of all farmers, but it will begin with cattle- and sheep farmers since measures in those fields have already begun (see policies 401 and 402). Through those measures farmers will, among other things, be provided with advice that aims to improve the use of manure, and it will be researched systematically how farmers use their manure. Knowledge and experience from this work will highlight the possibilities that exist to reduce GHG emissions with improved fertiliser use and lay a foundation for increased training and information sharing to other farming sectors. Consequently, it will be the responsibility of the project management group on climate action in agriculture to implement the policy for all farmers. A milestone report is due to be released in 2022. It will make proposals on:

1) How to reduce the use of non-organic fertilisers and how the government and farmers can support this.
2) How to improve the use of organic fertilisers, such as with methane production, and how the government and farmers can support this.
3) 3) Whether organic matter and compost can be used more in agriculture and how best to facilitate this.
4) 4) How training for farmers can be organised best and who is best qualified to provide this.

Carbon-neutral beef production (404)

GHG emissions from cattle breeding will be reduced and carbon sequestration at cattle farms will be increased. Efforts will be made to reach the target of making cattle farming carbon neutral no later than 2040. An emphasis will be placed on both reducing GHG emissions and increasing carbon sequestration. To reach the target, research, counselling and education for farmers will be increased. First, cattle farmers' knowledge on carbon emissions and sequestration, improved feeding and manure management techniques, will be built up. The foundation will be knowing the possibilities of each plot of farmland and to build up a transparent and certified framework for the project. The preparation for this project is ongoing and a management group with representatives from the Ministry of Food, Agriculture and Fisheries, the Ministry of the Environment, Energy and Climate and the Farmers Association of Iceland (*Bændasamtök Íslands*) has proposed a variety of measures, in consultation with RML, The University of Agriculture, Matís (Icelandic Food and Biotech R&D) and more. The group handed in their recommendations in May 2020. It was proposed that part of the projects that will be undertaken now will, on one hand, improve the data that lays the foundation for the carbon inventory for cattle farming and, on the other hand, increase training and education for farmers on the possibilities to reduce their GHG emissions. The goal is for these projects to be concluded by the end of 2022. Proposals on direct measures in farms will be implemented in parallel, which will be useful when the agricultural contracts (*búvörusamningar*) are reviewed in 2023. The project management team on the agricultural contracts will follow through on the projects.

Increased domestic vegetable production (405)

The aim of this measure is to increase vegetable production in Iceland and promote carbon neutrality in horticulture. Production of Icelandic vegetables will be increased by 25% in the next three years. Organic vegetable production will receive increased financial support and efforts will be made for Icelandic horticulture to become carbon neutral no later than 2040. This was agreed upon when the contract for the operation conditions of horticulture production (horticulture contract)[51] was reviewed in May 2020. To support carbon neutrality in Icelandic horticulture by the year 2040, a part of the funding for the horticulture contract will be spent specifically on climate action. Knowledge on carbon emissions and sequestration will be increased, the treatment and use of resources and fertilisers will be improved, waste will be reduced, and an emphasis will be placed on effective agriculture, increased sustainability, and other actions that support reaching the target of carbon neutral farming. A holistic approach will be undertaken, focusing on policy strategy in climate-, energy-, employment-, and regional affairs, among other significant issues. Farmers' knowledge on climate issues, and possibilities to reduce carbon emissions and increase carbon sequestration, will be improved further. This will be achieved, partly by increasing farmers' access to direct council and education. The emphasis will be on knowing the possibilities of each individual

[51] *Government of Iceland (Stjornarráð Íslands).* https://www.stjornarradid.is/library/01--Frettatengt---myndir-og-skrar/ANR/Landbunadur/r04siol_22.5.2020_08-43-29.pdfv

horticultural farm directly, and to build up a transparent and certified framework for the project. At the end of 2020, the Ministry of Food, Agriculture, and Fisheries and the Icelandic Association of Horticulture Producers (*Samband garðyrkjubænda*) decided to fund two specific projects that the Icelandic Association of Horticulture Producers will manage. The projects are vegetation in the city and carbon sequestration. They will focus on increasing knowledge, public interest and participation in cultivation in order to increase carbon sequestration.

8.2.1 Quantified PaMs & Interlinkages with Projections

The projections performed for the Agricultural sector include only a WEM scenario. There is currently not enough data available to perform projections for a WAM scenario. The PaMs in this sector, as proposed by the Climate Action Plan (2020), are mostly regarding education for farmers to reduce their greenhouse gas emissions within their daily farming activities and/or through carbon sequestration (**401**, **404**). Therefore, a quantification in terms of emissions, as calculated in the historical inventory, is difficult and any efforts of carbon sequestration by rewetting drained wetlands or increase afforested areas on farmland would fall into the LULUCF sector. Nevertheless, the Ministry of the Environment, Energy and Climate plans to measure the effects of these educational policies with the number of participating farmers.

Measure **402** proposes to look into innovative feeding systems to reduce methane emissions from enteric fermentation from ruminants, e.g., with the use of seaweed. This is only on an experimental level and not included in any projections. Matís is participating in one research project SeaCH4NGE[52], financed by EIT food, but no results are yet available, and the project would need to be upscaled to real life conditions.

The measure **405** – Increased domestic vegetable production – has not been quantified, as greenhouses for vegetable farming do not produce any GHG emissions (except for very low fugitive emissions from geothermal power production) according to the National Inventory Report. Greenhouses in Iceland are heated by geothermal heat and the electricity derives from renewable sources, that is hydropower plants and geothermal power plants. It can be supposed that fertiliser use might increase slightly but compared to the animal farming sector, the vegetable production in Iceland is very small and should not lead to significant increase of greenhouse gas emissions. On an international level, increased domestic vegetable production in Iceland may reduce emissions caused by the international transportation of goods to Iceland.

The only quantified PaM is **403** – Improved use and handling of fertilisers. This policy has been quantified in the current WEM scenario and according to the Climate Action Plan (2020), it is aimed to reduce the use of inorganic N-fertiliser by 10% in the year 2030 compared to a BAU scenario. Details on the calculations can be found in section 8.3.1

8.2.2 Stakeholder Engagement

After the submission of the PaMs & Projections reporting in 2019, the Environment Agency of Iceland (EA) organised expert review meetings for the Agriculture sector to get feedback and constructive criticism from external experts in order to improve future reporting. Experts from the Agricultural Advisory Centre were invited to the Agency in order to discuss the 2019 report and discuss possible synergies and collaboration. Also with both Ministries, the Ministry of the Environment, Energy and Climate, and the Ministry of Food, Agriculture and Fisheries, collaboration and exchange of information and ideas increased and consolidated over the past years. A meeting

[52] Seaweed supplementation to mitigate methane (CH_4) emissions by cattle (SeaCH4NGE) *EitFood*. https://www.eitfood.eu/projects/seaweed-supplementation-to-mitigate-methane-ch4-emissions-by-cattle-seach4nge

was held during spring 2020 with experts from both ministries, as well as from the Icelandic Farmers association to discuss measure 404 – climate friendly beef production.

Experts from the Ministry of Food, Agriculture and Fisheries provided livestock scenarios for the projection calculation. In collaboration with the EAI, they reviewed the scenarios and determined the most appropriate projection scenarios.

8.3 Methodology of projections

The methodology used to generate projections for the Agriculture Sector is based on the historical inventory. For more detail, refer to the latest edition of the National Inventory Report where information about activity data and emission factors is collected. Only a WEM scenario has been calculated for the entire Agriculture sector, no data was available to calculate a WAM or WOM scenario. Only for the sector 3D1 Inorganic N-fertilisers, a comparison between BAU and WEM was carried out (Figure 8.2).

8.3.1 Data & Assumptions

The projections on how the agriculture sector will develop in Iceland are based on historical trends and expert judgement.

An overview of the activity data and assumptions used as a basis for the Agriculture projections can be found in **Table 8.3**. All parameters necessary for livestock characterisation (such as pregnancy rates, days on pasture/in housing, feed digestibility, weight) were kept constant over the projected time series and correspond to the values used in the 2022 NIR submission. The milk yield per dairy cow was slightly raised to reach 6,500 kg per year and then kept constant as it is not known how the development of feeding practices translates into milk yield. The emission factors are the same as are used in the historical inventory and could not be projected due to a lack of data and their high uncertainty.

Table 8.3 Basis for Agriculture projections.

Agriculture	**Basis for projections**
3.A Enteric fermentation	Linear extrapolation of historical trends
3.B Manure management	Linear extrapolation of historical trends
3.C Rice cultivation	Not relevant in Iceland
3.D Agricultural soils	Linear extrapolation of historical trends, quantification of AG03
3.E Prescribed burning of savannahs	Not relevant in Iceland
3.F Field burning	Not relevant in Iceland
3.G Liming	Linear extrapolation of historical trends
3.H Urea application	Linear extrapolation of historical trends
3.I Other carbon-containing fertilisers	Linear extrapolation of historical trends

The trend in livestock populations has been predicted by extrapolation to 2040 based on the available historical data. The historical data is collected from the Ministry of Food, Agriculture and Fisheries and are the same numbers as are used for agriculture calculations in the latest NIR.

To assess the best possible trends considering the variability of the historical data, experts from the Ministry of Food, Agriculture and Fisheries, which has responsibility for the agricultural sector, were consulted. Those experts determined the most representative projections for each livestock

category, based on their expectation of future developments in each agricultural sector. Impacts of agricultural contracts, consumer behaviour and the level of imports of agricultural goods were also considered. The agricultural contracts will be reviewed again in 2023 and renegotiated in 2026, at which point the projections in each livestock category may change.

The conclusion was that livestock numbers for cattle were linearly projected based on the timeseries 1980-2020 and the composition of this category (dairy cattle, other mature cattle, growing cattle) was calculated based on the average of the years 2016-2020. Horses were also extrapolated using the available historical data (1990-2020), as were fur animals including minks and rabbits. In the category sheep (mature ewes, other mature sheep, animals for replacement, lambs) the livestock numbers were projected using a 10-year trend (2010-2020) as the more recent years reflect the actual development in sheep farming better. Swine, goats, and poultry are also calculated using the 10-year (2010-2020) trend.

Table 8.4 Livestock number projections [number] and milk yield per dairy cow [kg/year].

Category	2015	2020	2025	2030	2035	2040	% change '15-'40
Dairy Cattle	27,441	25,763	22,508	21,286	20,064	18,842	-31%
Milk yield	5,851	6,384	6,500	6,500	6,500	6,500	11%
Cattle	78,776	80,643	77,780	78,893	80,006	81,120	3%
Sheep	745,832	609,419	582,492	524,787	467,083	409,379	-45%
Goats	1,476	2,367	3,028	3,730	4,432	5,134	248%
Horses	79,429	73,584	75,901	75,522	75,143	74,764	-6%
Swine	42,542	39,253	44,742	46,917	49,092	51,268	21%
Poultry	718,935	839,296	995,259	1,103,048	1,210,866	1,318,705	83%

The livestock projections in **Table 8.4** show that the number of dairy cattle is projected to decrease by 31% from 2015 until 2040, while the average annual milk yield per dairy cow is projected to increase by 11%. While the number of dairy cattle decreases, the number of growing cattle or other mature cattle for meat production increases so that the total amount of cattle increases by 3%. Sheep numbers decrease by 45% and horses by 6%. Goats, if linearly projected into the future show a 248% increase in numbers, i.e., they increase from around 1,500 animals to approximately 5,000. This trend does not have a big impact on GHG emissions, as the numbers of goats are still low. This projected increase can be explained by government subsidies for goat farming established in recent years. In fact, before 2010 the number of goats did not reach 1,000. Poultry populations also increase substantially, or by 83%.

Other sources of emissions, such as the use of organic and inorganic N-fertilisers, liming, and the use of urea are predicted by linear interpolation of historical trends. The areas in hectares [ha] for the calculations of N_2O emissions from drained organic soils are communicated from the Soil Conservation Service of Iceland, which calculates projections for the LULUCF sector.

The quantification of measure **403** allows a comparison of the BAU and the WEM scenarios for the use of inorganic N-fertilisers. For the BAU scenario, the amount of N-fertilisers used in Iceland, as reported in the NIR (1990-2020), was used to predict its usage until 2040. The historical data shows a high yearly variability due to the nature of the import system which registers imports during one calendar year, i.e., stockpiling can occur in case of shipments arriving late in the year. In addition, as all inorganic fertilisers are imported, the international value of the local currency contributes to the

fluctuations. For the WEM scenario, a 10% reduction of fertiliser use in 2030 is expected, compared to the BAU scenario. From 2030 to 2040, the linear decrease is projected to continue, as this action also includes an education/training programme. Therefore, it is expected that the action will be rolled out gradually and reach more and more farmers with time, resulting in a 16% reduction of fertiliser use by 2040 compared to 2015. **Figure 8.2** shows the difference between the two scenarios resulting in a decrease of 9 kt CO_2e in 2040 between WEM and BAU (**Table 8.5**).

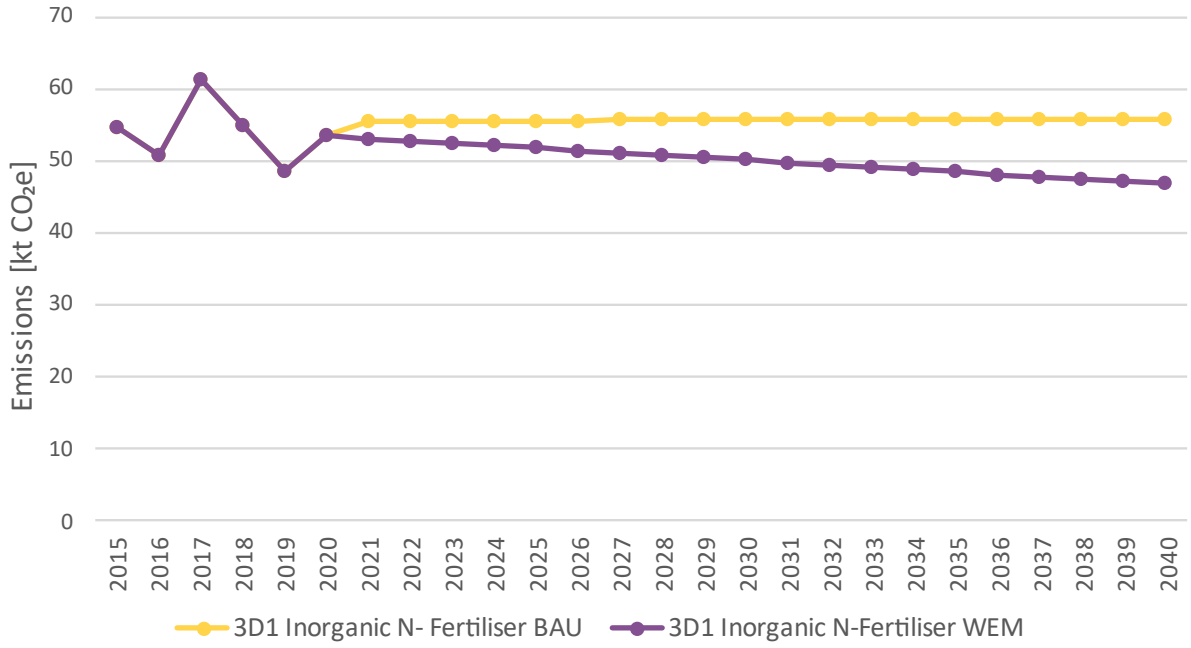


Figure 8.2 Comparison of emissions deriving from inorganic N-fertilisers (CRF category 3D1) between BAU (yellow) and WEM (purple) scenario, [kt CO_2e].

Table 8.5 Comparison of emissions for inorganic N-fertilisers BAU and WEM scenario.

	Emissions [kt CO_2e]					
Sector	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
3D1 Inorganic N-fertilisers - BAU	55	53	56	56	56	56
3D1 Inorganic N-fertilisers - WEM	55	53	52	50	48	47
Difference WEM-BAU	0	0	-4	-6	-8	-9
% Difference	0%	0%	-7%	-10%	-14%	-16%

9 Waste

This sector includes emission projections from Solid Waste Disposal (5A), Biological Treatment of Solid Waste (5B), Incineration and Open Burning of Waste (5C) and Wastewater Treatment and Discharge (5D).

For most of the 20th century Solid Waste Disposal Sites (SWDS) in Iceland were numerous, small, and located close to the locations of waste generation. In 1991, the SWDS Álfsnes was opened, which is currently the biggest SWDS in Iceland and is serving the capital and all surrounding municipalities, where approximately two thirds of the population of Iceland lives. A new biogas and composting plant called GAJA has been built at Álfsnes and started operating in the second half of 2020. According to the operation permit[53] issued by the Environment Agency of Iceland, the plant is expected to turn up to 30-40 kt of waste into compost and methane gas annually. The methane will mostly be used as fuel for vehicles, and therefore the emissions from methane produced in GAJA is included in the Road transport sector (see **Section 6**). There was a trial to produce electricity from the recovered methane, but this could not compete with the cheaper electricity production from geothermal or hydropower plants, so the methane is mostly used for vehicle fuel. Other plans to utilise the methane produced in GAJA[54] include asphalt production, where it would be replacing diesel oil, and coffee roasting, where it would be replacing propane gas.

Until the 1970s, the most common form of waste management outside the capital area was open burning of waste. However, this practice was banned in 1999 and is non-existent today. In the beginning of 2012, a total of four waste incinerators were operating. However, by the end of 2012 all incineration plants except one (Kalka) had closed; therefore, emissions from the single plant are reported from 2013. Kalka mostly handles mixed general waste from the four municipalities that own it and from Iceland's main international airport. To a smaller extent it handles clinical waste, hazardous waste, slaughterhouse waste and other waste categories.

Recycling and biological treatment of waste started on a larger scale in the beginning of the 1990s. Their share of total waste management has increased since then, slowly but steadily.

Wastewater treatment in Iceland consists mainly of basic treatment with subsequent discharge into the sea. In recent years, more advanced wastewater treatments have been commissioned in some smaller municipalities, but their share of total wastewater treatment systems in Iceland does not exceed 2%.

9.1 Trends

Historically 80 – 90% of GHG emissions from the waste sector in Iceland have come from Solid Waste Disposal (5A). In recent years the emissions from SWDS have been decreasing due to reduced landfilling and increased methane collection. The projected total emissions from the waste sector show a strong decrease in 2040 (-46% compared to 2015 emissions), predominantly due to two major policies and measures which have been quantified in the current report (**501,504**). The historical and projected emissions are reported in **Table 9.1**.

Figure 9.1 reports the emission trends for all waste subsectors. The emissions from Solid Waste Disposal (5A) are projected to decrease until 2030, after which they will remain fairly steady until 2035, when they will start to decrease again. The decrease until 2030 is due to the addition of the

[53] *EAI*. https://ust.is/library/sida/atvinnulif/starfsleyfi-og-eftirlitsskyrslur/Starfsleyfi%20undirrita%c3%b0.pdf, in Icelandic
[54] *Sorpa*. https://www.sorpa.is/frettir/malbikstodin-og-sorpa-undirrita-viljayfirlysingu-um-kaup-a-metani, https://www.sorpa.is/frettir/sorpa-og-te---kaffi-undirrita-samning-um-kaup-a-metani, in Icelandic

new gas and composting plant and the subsequent ban of landfilling organic and decomposable waste (see PaMs **501** and **504**). Both of these PaMs decrease the amount of waste that is landfilled. During that time, there is also a steady methane recovery from the landfill sites. These two factors (less waste and high methane recovery) coupled together cause the decrease in emissions from solid waste disposal over the projected timeseries.

After 2030, emissions are projected to remain fairly steady until 2035. During this time, the methane recovery rapidly decreases due to less methane being produced in the landfills, which is the reason emission remain steady. From 2035 and onwards, the emissions decrease again because at that time there have been low amounts of waste landfilled for a significant amount of time.

Figure 9.2 shows historical and projected emissions from the waste sector, excluding emissions from Solid Waste Disposal (5A). Emissions from Biological Treatment of Waste (5B) are projected to increase due to the addition of the gas and composting plant, GAJA, and a slight increase in composting. The small step change between 2019 and 2020 is due to the start of the gas and composting plant, which began operating at a small scale in the second half of 2020. The plant was unable to operate fully in 2021 and consequently the expected step wise increase in its operational scale was delayed slightly. The plant is expected to operate at 75% capacity from 2023 onwards, turning 30 kt of waste into compost and methane gas annually.

In Iceland, only one incineration plant is operative, and it is expected that no additional plants will be added. Therefore, it is expected that the emissions in the subcategory Incineration and Open Burning of Waste (5C) will increase slightly in order to reach the full capacity of the incineration plant as declared in its operation permit. The emissions of Wastewater Treatment and Discharge (5D) are projected to slightly increase in accordance with the expected increase in population.

Table 9.1 Historical and projected emissions [kt CO_2e] in the Waste sector.

	Emissions [kt CO_2e]						
Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Solid Waste Disposal (5A)	150	200	187	112	88	80	60
Biological treatment of solid waste (5B)	0	4	5	11	11	11	11
Incineration and open burning of waste (5C)	15	7	6	14	14	14	14
Wastewater treatment and discharge (5D)	55	50	48	53	54	55	56
Other (please specify) (5E)	NO	NO	NO	NO	NO	NO	NO
Waste (5)	**219**	**261**	**247**	**191**	**168**	**160**	**141**

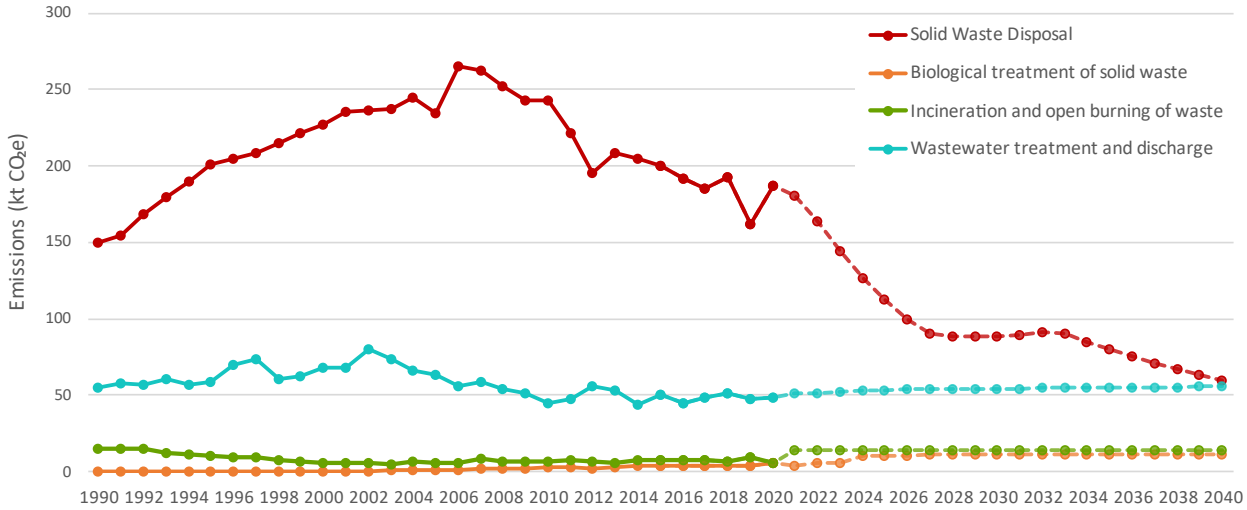


Figure 9.1 Waste Emissions Total GHGs [kt CO_2e], WEM scenario. Unbroken lines represent historical emissions, broken lines projected emissions.

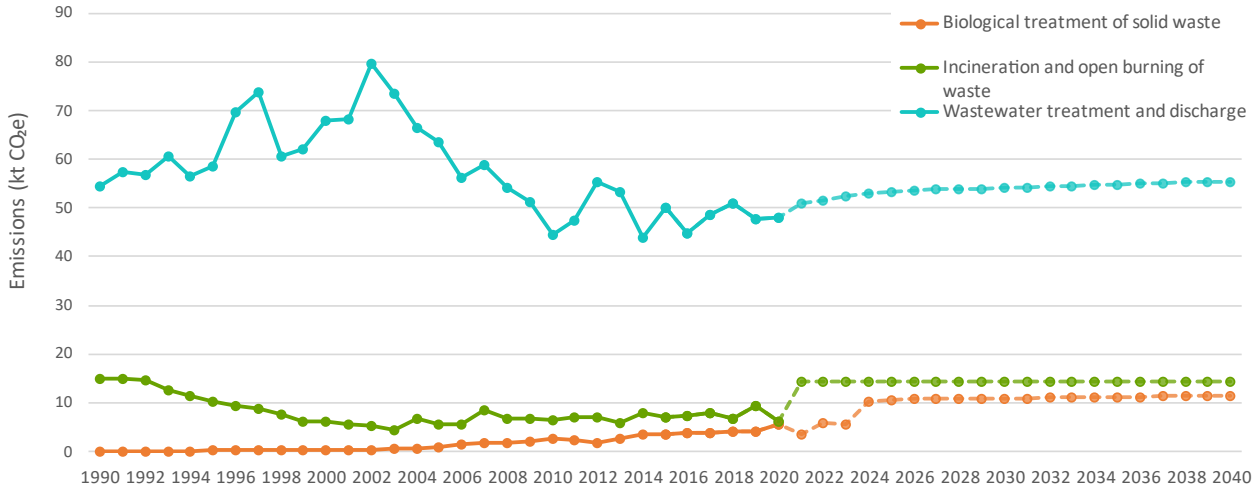


Figure 9.2 Waste Emissions excluding 5A Solid Waste Disposal Sites, total GHGs [kt CO_2e]. Broken lines represent projected emissions.

9.2 PaMs

Four waste management PaMs are currently implemented or planned with the objective of reducing GHG emissions and are summarised in **Table 9.2**

Table 9.2 Waste Policies and Measures.

PaM Name	*GHG*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*CRF*	*Description*
Ban on landfilling of organic waste (501)	CH_4	Regulatory	Adopted	WEM	Yes	5A	Landfilling of organic waste will be banned from 2021 and landfilling biodegradable waste will be banned from 2023.[55]
Landfill tax (502)	CH_4	Economic, Regulatory	Planned	Not included	No		Greenhouse gas emissions from landfills will be reduced with the application of a tax on landfilling.
Reduction in food waste (503)	CH_4	Fiscal	Adopted	Not included	No		Various projects will be conducted with the aim of reducing food waste.
Gas and compost plant (504)	CH_4	Other	Imple-mented	WEM	Yes	5B	A new gas and composting plant is being built and will start operating at Iceland's largest landfill site in 2020.
Pay-as-you-throw system (505)	CH_4	Economic, Regulatory	Adopted	Not included	No		Local authorities are obliged to collect a fee as close as possible to the actual cost of waste treatment.
Extended manufacturer's warranty (506)	CO_2, CH_4	Economic, Regulatory	Adopted	Not included	No		Extended manufacturer's warranty on all packaging and many plastic products.

Three PaMs are from the 2020 Action Plan (**501, 502 and 503**) and two are from the Ministry of the Environment, Energy and Climate's waste strategy, *Towards a circular economy*, from 2021[56] (**505 and 506**). The measures listed here from the Action Plan, and many others, are also included in the waste strategy. Twelve measures from the waste strategy were incorporated into legislation in 2021 with an amendment to Act No 55/2003 on Waste Management [57]. Most of them aim to decrease waste production and improve sorting, which will in turn decrease greenhouse gas emissions.

[55] The original policy aimed to ban the landfilling of organic waste in two steps as described in Table 9.2 above. The ban has, however, been combined and now both organic and biodegradable waste will be banned from 2023. This was implemented into law with an amendment in 2021 to Act No 7/1998 on Public Health and Pollution Control. Our calculations of the impact of the measure still follow the two-step ban, which means emissions from 5A will be slightly underestimated between 2021 and 2022.

[56] Towards a circular economy (Í átt að hringrásarhagkerfi). *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/UAR_stefnaI_att_ad_hringrasarhagkerfi.pdf

[57] *Parliament (Alþingi).* https://www.althingi.is/lagas/nuna/2003055.html

The gas and compost plant **(504**) and the ban on landfilling of organic waste (**501**) are included in the projected WEM scenario for the Waste Sector.

Currently, methane is processed at two landfill sites in Iceland, by Sorpa and Norðurorka, and the resulting fuel is mainly used for passenger cars. There is, however, a significant potential to process more methane at the landfill sites as well as from agricultural waste and use the resulting fuel to fuel more cars and other vehicles. More detailed descriptions of these planned PaMs can be found in the sections below, in the Climate Action Plan (Ministry for the Environment and Natural Resources, 2020), the Progress Report (Ministry for the Environment and Natural Resources, 2021) and in Towards a circular economy (Ministry for the Environment and Natural Resources, 2021).

Ban on landfilling of organic waste (501)

The measure has been expanded upon since the first edition of the Climate Action Plan (2018) and is now an individual measure. The measure is twofold. The first part declares that landfilling bio and biological waste will be banned in Iceland as a main rule. The second part announces a ban on landfilling any waste that has been collected specially. These bans will be in place from 1 January 2023, according to an amendment in 2021 to Act No 7/1998 on Public Health and Pollution Control and Act No 55/2003 on the Treatment of Waste[58]Provisions in the bill specify that a special collection of bio and biological waste shall be set afoot and that landfilling this waste will be prohibited. Bio waste contains food-, kitchen- and garden waste which can biodegrade. This is a change in the legislation and the goal of the law is, among other things, to create conditions that support a circular economy. The provisions are meant to lead to the sorting of bio waste from other waste in the whole country and it being prepared for reuse or recycling, in line with how the treatment of waste is prioritised. In the capital area, bio waste will be partly diverted to the gas- and composting plant of Sorpa, but in the countryside it is more likely that bio waste will be used for composting as a rule. The measure also includes banning the landfilling of biodegradable waste starting from the year 2023. Biodegradable waste contains all waste that can decompose through the agency of microorganisms, such as waste from slaughterhouses, fishing, breweries, domestic animals, timber, fish oil, paper, sewage, and bio waste. Local authorities will also be obliged to set up a special collection of household waste, which shall cover at least paper and cardboard, metals, plastics, glass, organic waste, textiles and hazardous waste. Individuals and legal entities will be required to sort household waste. A general prohibition will be on landfilling or incineration of the types of waste that have been collected separately, except for waste residues that are not suitable for reuse or recycling.

Landfill tax (502)

This measure has been expanded since the previous Climate Action Plan (2018) and defined as an individual measure. Waste to be sent to landfills will be taxed to direct it to other treatment pathways which release less GHG emissions. The purpose of the tax is to encourage a decrease in the amount of waste that is currently sent to landfill in Iceland. The aim of the tax is to decrease total waste generation as well as encourage sorting. It is proposed that the tax be 15 ISK/kg of landfilled general waste, with the exception of inert waste for which 0.5 ISK/kg of landfilled waste is proposed. The Ministry of Finance and Economic Affairs is currently collaborating with the Ministry of the Environment, Energy and Climate on a bill to change the law on environmental- and resource taxes, where the tax on landfilling waste will be legislated. The coalition of Icelandic municipalities will be consulted on the issue. Partly due to the COVID-19 pandemic, this tax was not implemented as planned in 2020 and is, therefore, not included in the WEM projections scenario.

[58] *Parliament (Alþingi)*. https://www.althingi.is/altext/stjt/2021.103.html

Reduction in food waste (503)

The goal of this measure is to systematically reduce food waste by encouraging several short term and long term projects. In the past years, several projects have been undertaken by the government, NGOs, and companies to reduce food waste, such as the creation of various educational material, the organization of events to raise public awareness, school projects and discount systems in stores for food products that are nearing the expiration date, innovation in using by-products from food production, a defined government policy, and courses on the better use of food products.
Until 2023, the Environmental Agency of Iceland will continue to raise awareness on how much food is currently going to waste, education on food waste will receive 15 million ISK per year in funding. The continued running of the Icelandic website on food waste[59] will be ensured and an analysis will be undertaken of possible unnecessary regulatory requirements on food products that have no impact on food safety but may be causing food waste. A survey on Icelanders' attitudes towards food waste has already been undertaken to track changes in local public opinion.

The Minister of the Environment, Energy, and Climate formed a project team on food waste to create a holistic plan for the next years on effective measures against food waste. The team (which consists of representatives from consumers, the business sector, NGOs, young people, and the government) submitted a report including 24 proposed food waste reduction measures in June 2020[60]. Out of the propositions, the government will be responsible for implementing 14 of the measures and the business sector will be responsible for the remainder. The goal is to reduce food waste, throughout the entire value chain, by 30% in 2025 and by 50% in 2030.

Gas and compost plant (504)

A new gas and composting plant, GAJA, started operating at a small scale in the second half of 2020[61]. It is the first plant of its kind in Iceland, and it will process municipal solid waste from households from the entire capital area, which contains around two thirds of Iceland's population. It is planned to process 30 kt of organic waste every year (max capacity: 40 kt) and produce 10 to 12 kt of compost and 3,000,000 Nm3 of CH_4 each year. The plant was unable to operate fully in 2021, and consequently, the expected step wise increase in its operational scale was delayed slightly. The plant is expected to operate at 75% capacity from 2023 onwards, turning 30 kt of waste into compost and methane gas annually.

Pay-as-you-throw system (505)

Local authorities will be obliged to collect a fee for waste treatment as close as possible to the actual cost of the service in question, e.g., by targeting the amount of waste, type of waste, frequency of discharge, waste disposal or other factors affecting the cost of waste treatment. It will be possible to deviate from the principle in exceptional cases, e.g., if it is impossible to base the fee on real costs. At the same time, municipalities will be allowed to transfer real costs between waste categories in order to promote a circular economy. In this way, municipalities could encourage increased recycling by transferring the costs of collection and other treatment of recyclables to charging for the treatment of mixed waste. If a waste holder reduces his waste volume or sorts it properly, it will lead to a lower cost for him. This measure is included in an amendment in 2021 to Act No 7/1998 on Public Health and Pollution Control and will take effect in January 2023.

[59] *Food Waste (Matarsóun).* https://samangegnsoun.is/matarsoun/
[60] Proposals for actions against food waste ("Tillögur um aðgerðir gegn matarsóun"). *Food Waste (Matarsóun)*. http://matarsoun.is/default.aspx?pageid=10e38685-0300-11e6-a224-00505695691b
[61] *GAJA*. https://sorpa.is/um-sorpu/gas-og-jardgerdarstod

Extended manufacturer's warranty (506)

In January 2023, an extended manufacturer's warranty will be introduced to all packaging that is not already under extended manufacturer's warranty, as well as on many other plastic products. These new items are, e.g., glass and metal packaging not intended for beverages, all timber packaging, and single-use plastics.

Other ongoing initiatives

Besides the abovementioned PaMs, there are several other smaller initiatives being prepared or already underway that may reduce greenhouse gas emissions from the waste sector in the future. A few of these initiatives are outlined in **Table 9.3**.

Table 9.3 Other initiatives that may impact GHG emissions from the Waste sector.

Initiative	*Description*
The Green Steps Program[62]	This program is developed for government agencies in Iceland with the overall aim of minimising the environmental impact of daily operations in the public sector. The program was established in 2014 and the EAI oversees it and assists and guides government agencies in its implementation. Waste sorting and waste reduction is one category of this program.
Together against waste[63]	This initiative has been run by the EAI since 2016 with the goal of prioritising a circular economy. It focuses on better efficiency, creating less waste as well as increasing education to prevent waste generation. Every couple of years the focus is on a particular waste category such as: food, plastic, textiles, electronics, construction or paper.
Bokashi experiment in the Rangárvellir municipality	In 2020, Jarðgerðarfélagið, the Rangárvallasýsla waste processing plant and the Soil Conservation Service of Iceland started working on an experimental project to see if Bokashi composting can work on a municipal level. The compost created from the process can subsequently be used to fertilise plants and in soil conservation efforts. If this experiment is successful, other municipalities may follow suit.
Decreased GHG emissions with increased treatment of wastewater [64]	In 2021, the Environment Agency of Iceland had an analysis done on the scope of emissions from wastewater in Iceland and the possibilities of decreasing those emissions. The results showed that there are opportunities in increased wastewater treatment and the use of sludge for land reclamation and restoration.
Other measures in Towards a Circular Economy	Funds were allocated by the Ministry of the Environment, Energy and Climate to a number of other initiatives, i.e., for the development of necessary infrastructure that can contribute to the implementation of a circular economy in Iceland, the promotion of domestic waste recycling, support for home composting, the strengthening of repair and maintenance services, abolition of VAT on the resale of used goods, improved waste statistics, support for infrastructure development for waste incineration and more. Some of these measures have already begun while others are still in planning.

[62] *Green Steps Program ("Græn skref").* https://graenskref.is/english/
[63] *Together against waste ("Saman gegn sóun").* https://samangegnsoun.is/
[64] *EAI*. https://ust.is/library/sida/haf-og-vatn/Greinarger%c3%b0%20um%20aukna%20s%c3%b6fnun%20seyru%20og%20losun%20GHL%20161220%20-%20Copy%20(1).pdf, in Icelandic

9.2.1 Quantified PaMs & Interlinkages with Projections

The projections performed for the sector include only a WEM scenario. There is currently not enough data available to perform projections for a WAM scenario. The landfill tax (**502**) measure has not been implemented yet in the legislative system due to delays and is also not quantifiable due to a lack of data.

The measures to reduce food waste (**503**), the pay-as-you-throw system **(505)**, and the extended manufacturer's warranty **(506)** have been adopted. However, since very limited data is available on the effectiveness of such measures in Iceland, their potential impacts on emissions have not been estimated nor included in the WEM scenario projections.

There are two quantifiable PaMs included in the waste sector which are the new biogas and composting plant (**504**) and the ban on landfilling of organic waste (**501**). As these two PaMs are linked, e.g., organic waste which cannot be landfilled anymore due to the ban needs to go to the anaerobic digester, the effect of both measures was calculated together. The biogas and composting plant started operating at a small scale in the second half of 2020 and is located at the largest landfilling site in Iceland. Data on the plant was received from Sorpa. The plant's full capacity is to process 40 kt/year of general waste according to the operation permit and the company has provided data about a stepwise increase in the amount of waste processed. The plant was unable to operate fully in 2021, and consequently the expected step wise increase in its operational scale was delayed slightly. The plant is expected to operate at 75% capacity from 2023 onwards, turning 30 kt of waste into compost and methane gas annually

9.2.2 Stakeholder Engagement

After the first submission of the PaMs & Projections reporting in 2019, expert review meetings were organised to get feedback and constructive criticism from external experts in order to improve future reporting. Consequently, the EAI gained some valuable insights and contacts that were maintained throughout the preparation stage of the current reporting.

The Waste experts from the EAI had meetings with experts from the biggest waste provider in Iceland, Sorpa, who has recently opened the country's first gas and composting plant. Sorpa provided the EAI with projections for the future operations of the gas and composting plant which were used in the waste projections.

9.3 Methodology of projections

The methodology used to generate projections for the waste sector is based on the historical inventory. Please refer to the latest edition of the National Inventory Report where information about activity data and emission factors is collected. Only a WEM scenario has been calculated for the entire Waste sector, no data was available to calculate a WAM or WOM scenario. Only for the sectors 5A and 5B a comparison between BAU and WEM was carried out (**Figure 9.4**).

9.3.1 Data & Assumptions:

An overview of the data and assumptions used as a basis for the Waste projections can be found in **Table 9.4**. A further description is provided below.

Table 9.4 Basis for Waste projections.

Waste	Basis for projections
5.A Solid Waste Disposal	Population projections, methane recovery projections from stakeholders, operation permits for landfilling sites; allocation based on mass balance and average past allocations.
5.B Biological treatment of solid waste	Mass balance allocation, data from the first year of operation (2020) of the gas and composting plant GAJA, methane collection communicated by operating company
5.C Incineration and open burning of waste	Operation permit of incinerator
5.D Wastewater treatment and discharge	Population projections (Statistics Iceland)
5.E Other (please specify)	Not relevant in Iceland

The projections in the waste sector, for the subcategories 5A, 5B and 5C are based on the same principle of a mass balance of yearly produced waste, projected in correlation with population numbers. This projected yearly waste amount was consequently allocated to the three subcategories, considering the existing policies and operation permits of waste handling companies. The category 5D wastewater is solely based on the projection of population numbers. The same approach is used for both calculated scenarios, BAU and WEM, and the approach can be summarised as follows:

A) Calculation of overall waste generation until 2040 by correlating historical waste generation data as reported in the NIR (1990-2020) with population. A population forecast until the year 2040 was made available by the Energy Authority.
B) A graphical representation for the WEM scenario waste allocation is given in **Figure 9.3**. Allocation of generated waste to the subcategories as reported in **Table 9.5**.
C) Application of greenhouse calculations according to the approach described in the latest National Inventory Report; the same parameters and emission factors are applied throughout the whole time series 2020-2040.

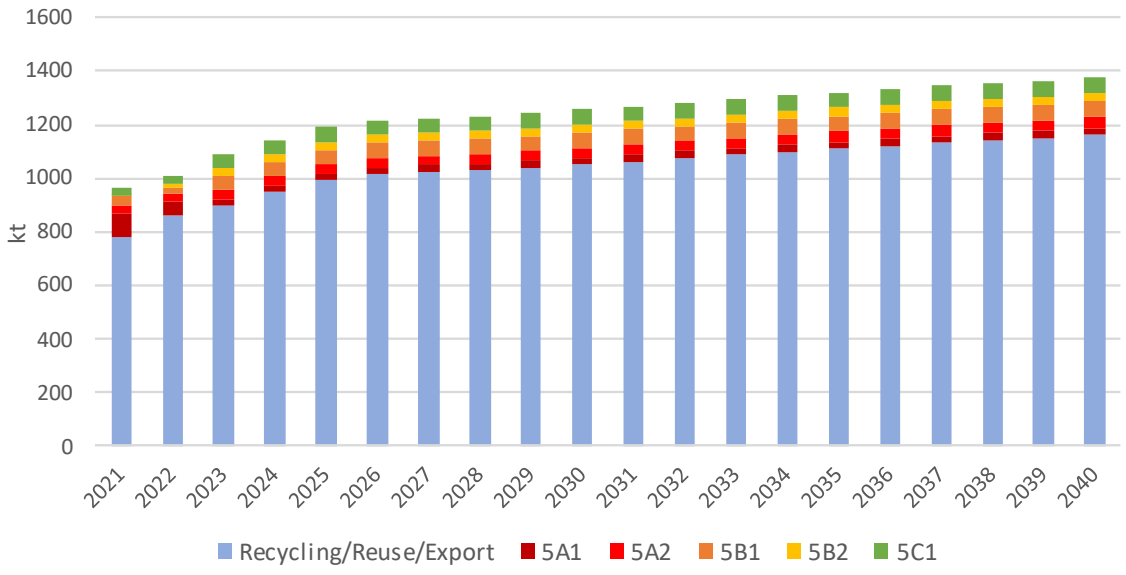


Figure 9.3 Waste allocation following the mass balance starting from total waste generation projected with population increase for the WEM scenario, [kt].

Table 9.5 Waste allocation applying a mass balance starting from total waste generation projected with population increase.

	BAU	WEM
5.A 1 Solid Waste Disposal Managed	• 15% of total waste produced (average 2016-2020) from (A) • Communication of expected methane generation from operators.	• 78% of total waste sent to landfil between 2017 & 2019 was from Sorpa, the largest waste provider in Iceland. This share is assumed to continue throughout the projected timeseries. The total amount of landfilled waste is estimated from the operation permit of Sorpa, which will be reducing the amount of waste landfilled drastically[65]. • Action **501** is taken into account and no organic waste can be sent to any landfill in the country (managed or unmanaged) in 2021, and no biodegradable waste (IPCC categories Garden, Paper, Wood, Sludge) from 2023. The so created difference in amount is allocated to 5B. • Communication of expected methane generation from operators.
5.A 2 Solid Waste Disposal Unmanaged	• 4% of total waste produced (average 2016-2020) from (A)	• 4% of total waste produced (average 2016-2020) from (A) • Action **501** is taken into account and no organic waste can be sent to landfill in 2021, and no compostable waste from 2023. The so created difference in amount is allocated to 5B.
5.B 1 Composting	• Assumed 2% of total waste produced (average 2016-2020) from (A)	• Compost rate is increased from 2% to accommodate the waste which cannot be landfilled anymore in 5A1 and 5A2 and reaches 4% at its maximum.
5.B 2 Anaerobic biodigester	• Not included	• Start of operations in the second half of 2020 according to operation permit[66] (action **504**) which contains data of stepwise increase of allocated waste; communication of methane generation from operator
5.C Incineration and open burning of waste	• Use of total capacity of the only incinerator present in the country according to operation permit[67]	• Same as BAU scenario
Recycling/Reuse/Export	• Assumed average share (2016-2020) of 78% of total waste produced.	• Applying a mass balance of all allocations above the recycling/reuse and export increased from 75% to 87% over 20 years.

[65] *Sorpa*. http://sorpa.dccweb.net/media/2/sorpa---undirritad.pdf
[66] *EAI*. https://www.ust.is/atvinnulif/mengandi-starfsemi/starfsleyfi/urgangur-og-efnamottaka/hofudborgarsvaedid/gas-og-jardgerdarstod-sorpu-alfsnesi-gaja/ (in Icelandic)
[67] *EAI*. https://www.ust.is/atvinnulif/mengandi-starfsemi/starfsleyfi/urgangur-og-efnamottaka/sudurnes/kalka-sorpeydingarstod-adur-sorpeydingarstod-sudurnesja/

For projected waste streams that are based on assumptions (such as additional WEM allocation to composting), we will develop a specific projected timeseries for all composting activities in Iceland working with our data providers where possible. Where results challenge our existing mass balance of waste handling, we may need to revise:

i) Our BAU waste generation projections; or
ii) Our other solid waste handling projections.

At all times we will make sure that projections are in harmony with the mass balance and treatment pathway / plant capacities. Country specific data is used to quantify emissions from the anaerobic digestor GAJA, despite the very limited amount of data (5 months of operations) available.

Regarding the waste allocation to 5C Incineration, it is expected that the amount of waste going to the only operative incinerator, Kalka, will increase until it reaches the full capacity according to its current operation permit in order to allocate the waste which partly cannot be sent to landfill (5A) anymore.

The comparison between the BAU and WEM scenario is best seen in **Figure 9.4**, where the changes for category 5A Solid Waste Disposal Sites and 5B Biological Treatment of waste is reported in separate graphs. While the emissions in 5A show an important decrease by 2040 (-181 kt CO_2 when compared with the BAU scenario), the emissions in 5B increase, due to an increased composting rate (from 2% to 4%) and the addition of a new waste handling facility, the gas and composting plant. The increase in this category, however, is rather limited (+7 kt CO_2e by 2040 when compared with the BAU scenario). **Table 9.6** reports the emission decrease and increases for both categories over the projected time series.

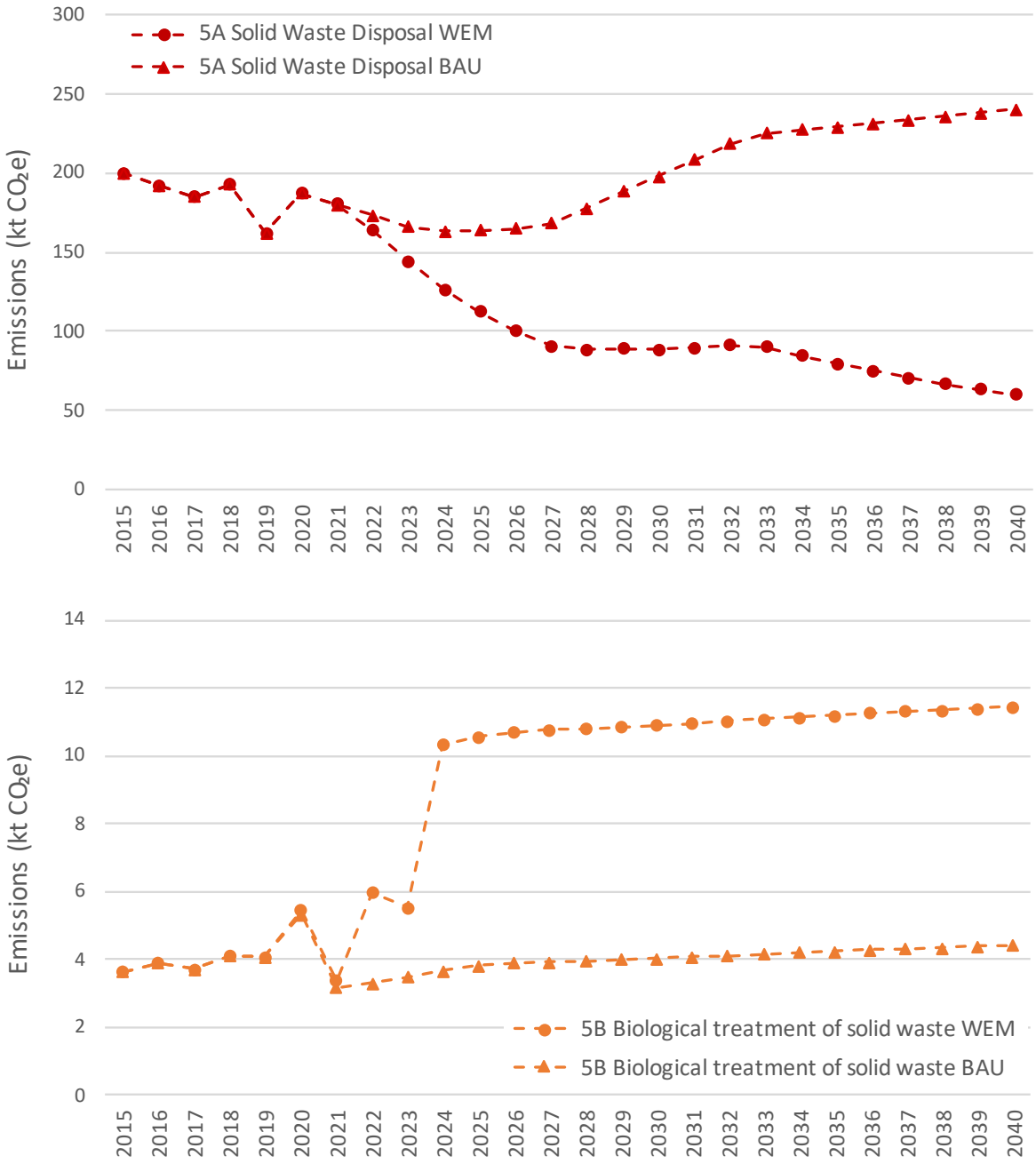


Figure 9.4 Quantified ex-ante impact of PaM 504 and 501 on GHG emissions from Solid Waste Disposal Sites (5A) on top and Biological Treatment of Waste (5B, bottom) [kt CO_2e].

Table 9.6 Comparison of emissions for 5A – Solid Waste Disposal sites and 5B – Biological treatment of solid waste, BAU and WEM scenario.

	Emissions [kt CO_2e]					
Sector	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
5A Solid Waste Disposal BAU	200	187	164	198	229	240
5A Solid Waste Disposal - WEM	200	187	112	88	80	60
Difference WEM-BAU	-	-	-51	-110	-150	-181
% Difference	0%	0%	-31%	-55%	-65%	-75%
5B Biological treatment of solid waste - BAU	4	5	4	4	4	4
5B Biological treatment of solid waste - WEM	4	5	11	11	11	11
Difference WEM-BAU	-	0.1	7	7	7	7
% Difference	0%	2%	176%	170%	164%	159%
5A, 5B – BAU	204	192	168	202	234	245
5A, 5B – WEM	204	193	123	99	91	71
Difference WEM-BAU	0	0.1	-45	-103	-143	-174
% Difference	0%	0.1%	-27%	-51%	-61%	-71%

10 Land Use, Land-Use Change, and Forestry (LULUCF)

In this sector emissions and removals related to land use, land use change and forestry (LULUCF), are reported. The categorization of land use is according to the 2006 IPCC guidelines (IPCC, 2006). This defines six main land use categories and conversions between them. Emissions and removals of GHGs are reported for all managed lands within these categories according to guidelines given in Volume 4: Agriculture, Forestry and Other Land Use of the 2006 Guidelines (IPCC, 2006), hereafter named AFOLU Guidelines, and the 2013 Supplement to the 2006 Guidelines: Wetlands (IPCC, 2014), hereafter named 2013 Wetland Supplement. The Soil Conservation Service of Iceland (SCSI) and the Icelandic Forest Service (IFS) are responsible for preparing the inventory for this sector.

Almost 90% of the total area of Iceland is included in two land use categories i.e. Other land and Grassland. Land categories have been changed considerably in the 2021 submission, as part of the Other land category is now under Grassland (See also Chapter 6.7 Grassland (CRF 4C) of NIR 2022 (Environment Agency of Iceland, 2022)). This change is due to new data available for this year's submission. **Figure 10.1** shows the relative division of the area of Iceland to the six main land use categories reported.

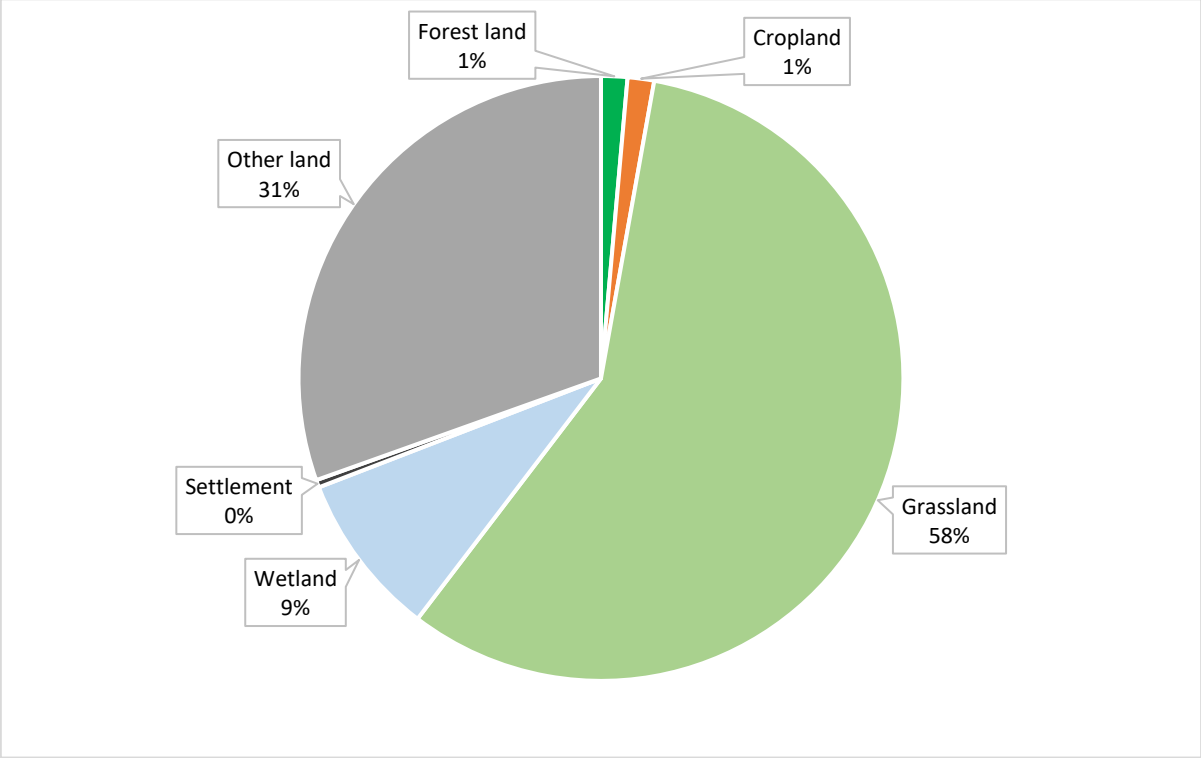


Figure 10.1 Relative size of land use categories in Iceland according to IGLUD land use map 2020 and other land use estimates available for the reporting.

Both emissions from sources and removals by sinks are reported for this sector. The net contribution of the main land use categories is summarised in **Figure 10.2.** More information on historical emissions and removals of the land use categories is reported in the NIR 2022.

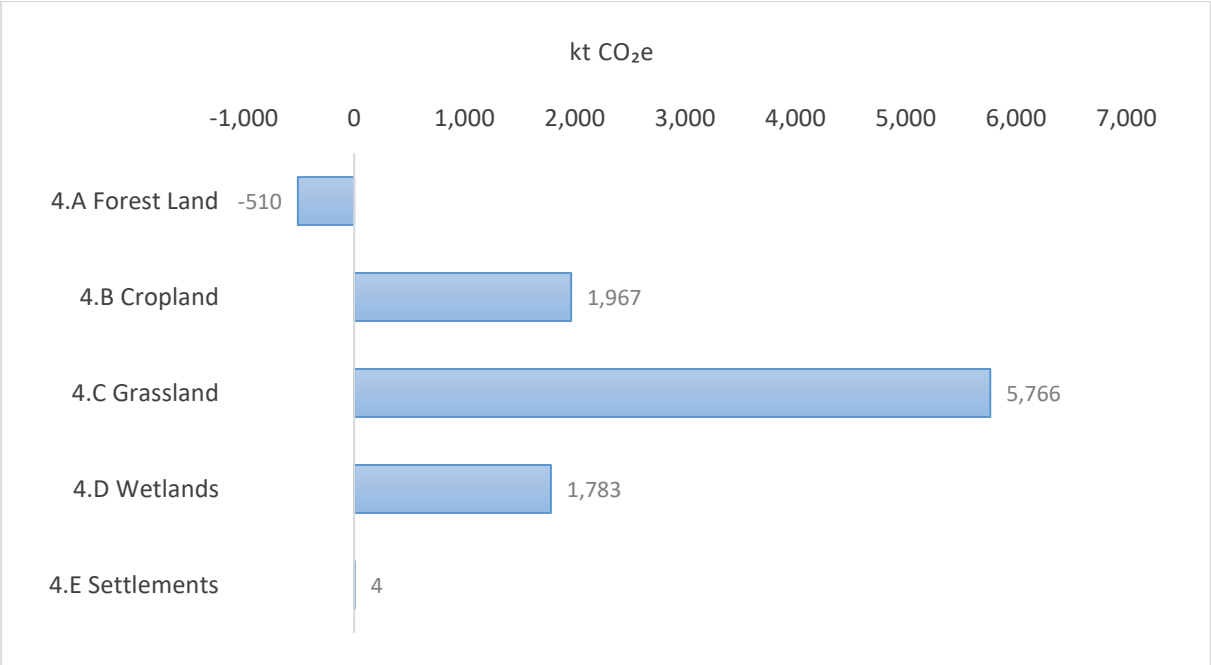


Figure 10.2 The net emissions/removals of land use categories [kt CO_2e] in 2020. Emissions from Other land (4F) are not included in this graph. Since 2020 submission, the N_2O emission from Cropland management of organic soils is reported under the Agricultural sector and not included here.

A large part of the government's Climate Action Plan, published in 2020 (Ministry for the Environment and Natural Resources, 2020), concerns LULUCF. Sustainable management practices in the LULUCF sector can contribute to climate change mitigation in several ways, by reducing emissions and maintaining and enhancing sinks and carbon stocks. Furthermore, the government has expressed the goal to reach carbon neutrality by the year 2040; this underlines the importance of enhanced carbon sequestration action.

10.1 Trends

The historical and projected emissions trend in LULUCF is presented in **Table 10.1** and **Figure 10.3** below. Overall emissions from the LULUCF sector have decreased slightly during the last decade. However, both historical and projected emissions in Grassland show an increasing trend. The upward trend observed in Grassland is nevertheless not attributable to incrementation of land use activity or/and expansion of degraded land areas, but mostly to the decrease in areas of land reclaimed more than 60 years ago, which implies a reduction in soil carbon storage capacity, and to the increase in areas of drained organic soils of sub-categories "Wetlands drained for more than 20 years" and "Abandoned crops for more than 20 years", which implies a decrease of carbon stocks in the soil (**Figure 10.3**). In contrast, the historical and projected trends of emissions from the land categories Cropland and Wetland decrease mostly due to a transition over time of areas of Cropland and Wetlands to Grassland.

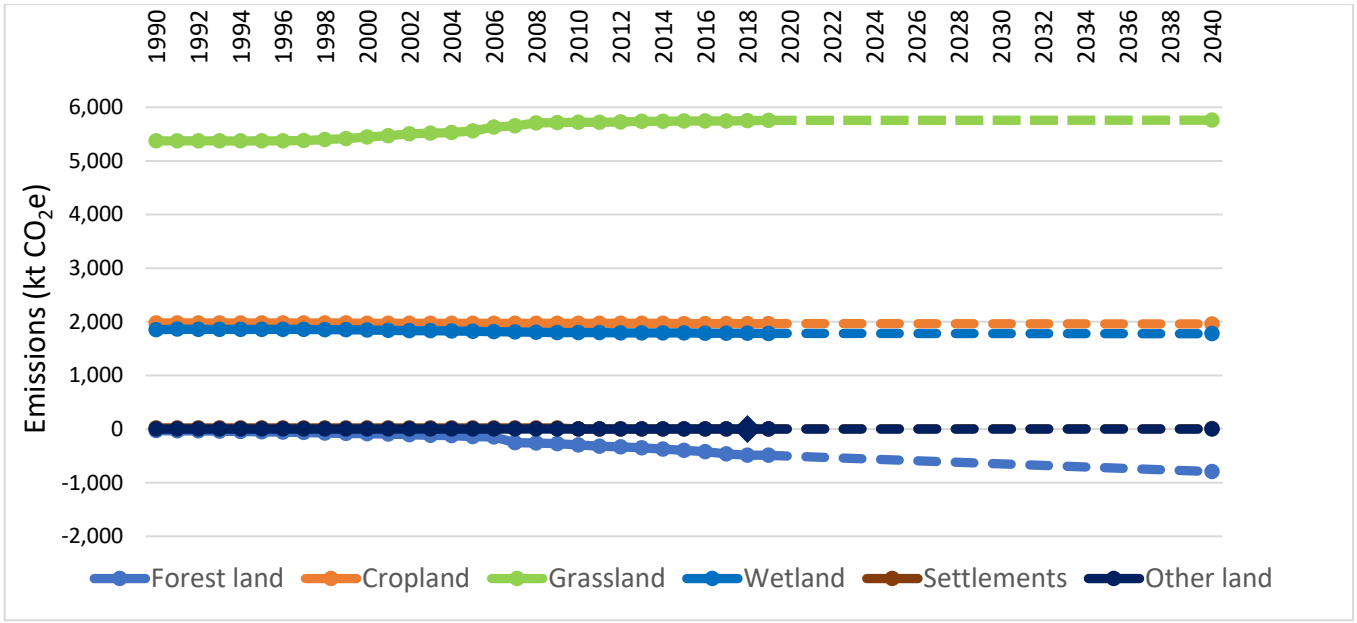


Figure 10.3 LULUCF Emissions Total GHGs [kt CO_2e], WEM scenario.

Table 10.1 Historical and projected emissions [kt CO_2e] in the LULUCF sector.

	Emissions [kt CO_2e]					
Categories	**1990**	**2020**	**2025**	**2030**	**2035**	**2040**
Forest land (4.A)	-30	-510	-580	-648	-714	-794
Cropland (4.B)	1,979	1,967	1,965	1,963	1,961	1,959
Grassland (4.C)	5,375	5,766	5,733	5,694	5,679	5,760
Wetlands (4.D)	1,852	1,783	1,781	1,780	1,779	1,778
Settlements (4.E)	22	4	4	4	4	4
Other Land (4.F)	0	0	0	0	0	0
Total LULUCF	**9,199**	**9,010**	**8,902**	**8,792**	**8,708**	**8,707**

10.2 PaMs

Six LULUCF PaMs are currently planned with the objective of reducing GHG emissions and increasing removals and are summarised in **Table 10.2.** The PaMs on reducing GHG emissions from LULUCF in the 2020 Climate Action Plan are predominantly focused on enhancing carbon sequestration by forestry, land reclamation and reduction in carbon emissions through recovery and conservation of wetlands.

Table 10.2 LULUCF Policies and Measures.

PaM Name	*GHG(s)*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*Description*
Enhanced action in forestry (601)	CO_2, CH_4	Fiscal	Imple-mented	WEM	Yes (4.A.)	Efforts in forestry will be enhanced leading to increased carbon sequestration and reducing emissions
Expanding revegetation (602)	CO_2, CH_4	Fiscal	Imple-mented	WEM	Yes (4.C.2.5)	Revegetation efforts will be increased for increased carbon sequestration. Efforts will also be made to halt and reverse land degradation and decrease emissions from degraded land.
Wetlands Conservation (603)	CO_2, CH_4	Fiscal, Planning, Regulatory	Imple-mented	WEM	Yes (4.D.1)	*Increased efforts will be made for wetland conservation making sure existing wetlands are not drained and degraded.*
Restoration of wetlands (604)	CO_2, CH_4	Research, Planning, Fiscal, Other	Imple-mented	WEM	Yes (4.D.2.3.3)	Efforts in wetland restoration will be increased as well as research on the effect of such measures on carbon emissions.
Improved mapping of grazing land and land use (605)	CO_2, CH_4	Information, Research, Planning	Imple-mented	WEM	No	The state of grazing land will be mapped and used for grazing management
Improvement plan for the LULUCF inventory (606)	Not applicable	Research	Imple-mented	Not occurring in projections scenario	No	Increased capacity in the LULUCF inventory and increased research to improve the foundation for estimating emissions and sequestration from the LULUCF sector.

All of the PaMs in **Table 10.2** will impact emissions and removals due to land-use. Three of the PaMs; Enhanced action in forestry (**601**), Expanding revegetation (**602**), and have been quantified and Restoration of wetlands (**604**) are described in more detail in **Section 10.3**. Additional information on the PaMs that have not been quantified; on Wetland Conservation (**603**), Improved mapping of grazing land and land use (**605**), and the Improvement plan for the LULUCF inventory (**606**) is provided below. For more information, see the Climate Action Plan (2020) or the Progress Report (2021).

Wetlands Conservation (603)

Law provisions on the protection of wetlands will be adhered to more strictly and monitoring of new draining will be increased further by requiring a construction permit from municipalities. The measure will be a collaboration project between farmers, landowners, municipalities, NGOs, companies, and others. Wetlands are protected by the law. At the same time as there is a major focus on reclaiming wetlands in Iceland, it is vital to prevent further draining of wetlands unless absolutely necessary. Collaboration between farmer's associations, municipalities, and government organisations needs to be improved in order to ensure that the protection of wetlands is organised properly and that it will become the main rule that wetlands are protected instead of disturbed. The soil Conservation Service of Iceland and the Environment Agency of Iceland have been given the responsibility of proposing policies and measures to improve processes regarding this matter. Furthermore, the organisations will make proposals on how best to improve monitoring and data collection because of the measures which will be undertaken.

Improved mapping of grazing land and land use (605)

Map the condition of grazing land and its use holistically in order to evaluate the sustainability of current land use. The condition of the flora and soils on grazing land have been mapped out. The goal was to do such a complete mapping of the condition of grazing land regularly and develop sustainability indicators for the utilization of the flora- and soil resources of the country. The goal is for the result to be useful to direct grazing of land so that it ensures the protection of carbon in soils and flora and encourages increased carbon sequestration where carbon has been lost. The mapping occurs based on the project *Grólind*. The first part of the project has been to set up monitoring systems for the vegetation cover of land. Pastures have among others been mapped and a first edition of the mapping of grazing land was published in June 2020[68]. A draft report on the status of soils and flora in Iceland was published at the same time[69]

The project is based on the collaboration between the Soil Conservation Service of Iceland, the Sheep Farmers' Association, the Farmers' Association of Iceland, and the Ministry of Food, Agriculture and Fisheries. It is financed through agricultural contracts, although the Soil Conservation Service of Iceland takes care of its execution. The purpose is among others to better support the science behind grazing management to ensure that grazing remains sustainable into the future. Knowledge gained from this effort will be useful as a basis for the future strategic planning efforts in farming and farming land use, as well as other work that relates to land use. Changed land use can be a significant measure to improve the condition of the land.

[68] *Grólind*. https://grolind.is/wp-content/uploads/2020/06/Kortlagning-beitilanda-2020.pdf
[69] *Grólind*. https://grolind.is/wp-content/uploads/2020/06/GroLind_stodumat_18_06_2020.pdf

Improvement plan for the LULUCF inventory (606)

The aim of this measure is to improve the capacity in the LULUCF inventory and increased research to improve the foundation for estimating emissions and sequestration from the LULUCF sector. An improvement plan from 2020 to 2023, containing 20 improvement actions, has already been published[70]. The goal of the plan is to strengthen the National Inventory and to ensure that Iceland fulfils its obligations to the UNFCCC and EU.

Stakeholder Engagement

The Environment Agency of Iceland organised an open workshop on LULUCF PaMs & Projections in 2018 to connect with stakeholders and other interested parties, gather ideas on PaMs which exist or are in development and discover available projections data. The interest at this workshop demonstrated that there is a high level of public interest and a clear intention by government, companies, organisations, and individuals to undertake action to increase carbon sequestration in this sector, to reduce their carbon footprints and to prepare for the Icelandic government's goal of reaching carbon neutrality by 2040.

10.3 Quantified PaMs & Interlinkages with Projections

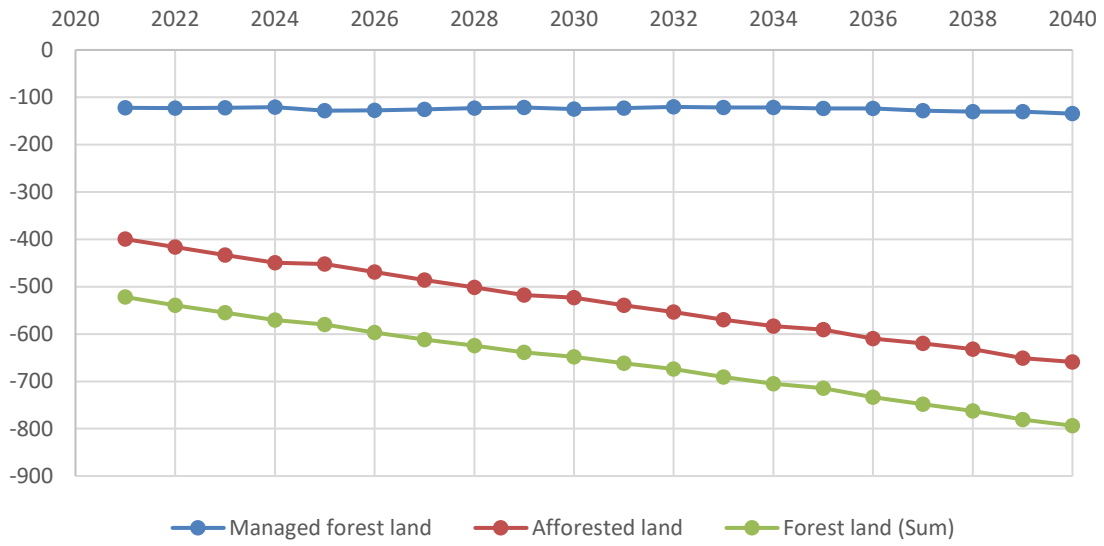
10.3.1 Enhanced Action in Forestry (601)

In the government's updated Climate Action Plan (2020) there is a great emphasis on increasing carbon capture and storage in forests through afforestation. Forestry and afforestation are reinforced through increased government funding. A plan on afforestation has been prepared on behalf of the government in line with the increased flexibilities afforded by higher financial contributions. Particular consideration will be given to how sheep farmers and other farmers can be included in the afforestation efforts and other efforts that affect land use, in line with the provisions of the government's policy statement.

In the plan, afforestation was to increase from 1,100 ha in 2018 to 2,300 ha in 2022. The impact of the Climate Action Plan was preliminarily estimated at a -134 kt CO_2 eq. increase in annual removal in the year 2030. These plans have been reiterated and enhanced in the fiscal policy of the government for the years 2021 to 2025 where afforestation is planned to increase to 2,500 ha annually in the year 2025 (Ministry of Finance and Economic Affairs 2020, pg. 290).

The Icelandic Forest Service (IFS) has estimated how the increased government funding described above, resulting in a more than doubling of annual afforestation from the year 2022, will affect the future net annual emissions/removals of GHGs. Projected removal can be seen in **Figure 10.4** divided between Afforested land (Land converted to forest Land) and Managed forest land (Forest land remaining forest land).

[70] Improvement plan for the LULUCF inventory 2020-2023 (Umbótaáætlun 2020-2023 - Vegna bókhalds Íslands um losun gróðurhúsalofttegunda og bindingu kolefnis vegna landnotkunar). *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/Umb%C3%B3ta%C3%A1%C3%A6tlun%202020-2023.pdf

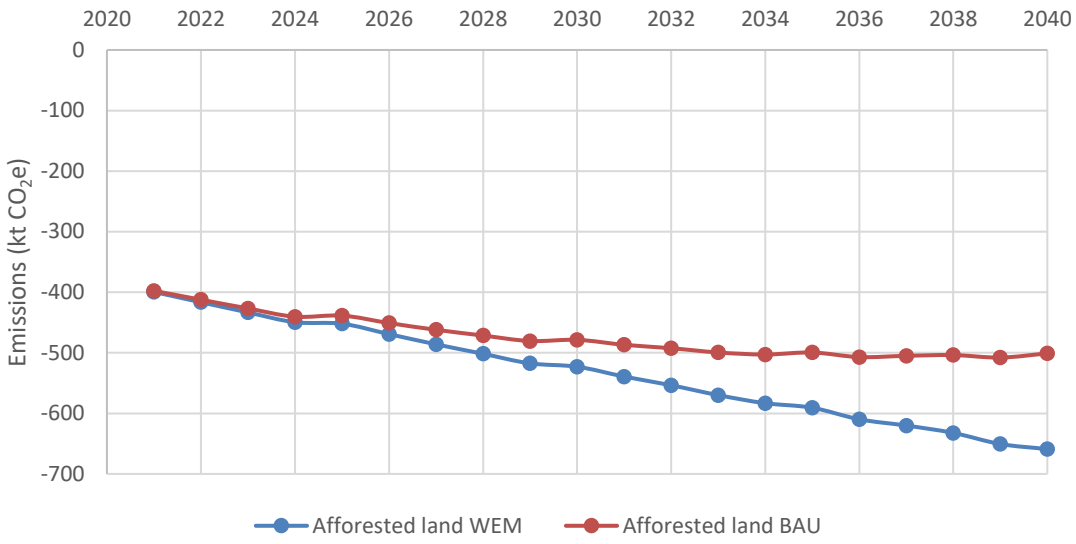


	2021	2025	2030	2035	2040
Afforestation WEM (kt CO_2 e)	-400	-452	-523	-610	-659
Forest management WEM (kt CO_2 e)	-122	-128	-125	-124	-135
Total WEM (kt CO_2 e)	**-522**	**-580**	**-648**	**-714**	**-794**

Figure 10.4 Projected net emissions/removal of afforestation and forest management from 2021-2040, [kt CO_2e].

The Climate Action Plan only affects the net removals of Afforested land. By running a BAU scenario with an unchanged annual afforestation rate of 1,100 ha since 2021, the effect of the Climate Action Plan was estimated as shown in

Figure 10.5 below.



	2021	2025	2030	2035	2040
Afforestation BAU (kt CO_2e)	-398	-439	-479	-500	-659
Afforestation WEM (kt CO_2e)	-400	-452	-523	-591	-501
Ex-ante emissions impact of PaMs (kt CO_2e)	**-2**	**-13**	**-75**	**-84**	**-158**

Figure 10.5 BAU and WEM projected net removals of afforestation in the period 2021 – 2040, [kt CO_2e].

10.3.2 Expanding Revegetation (602)

The goal of the measure is to promote increased soil reclamation to increase carbon sequestration from the atmosphere, stop soil erosion and reduce greenhouse gas emissions from land. Soil reclamation will be supported to increase carbon sequestration from the atmosphere, reduce greenhouse gas emissions from land and simultaneously support biodiversity. An emphasis will be placed on taking action on land which is emitting carbon from the soil.

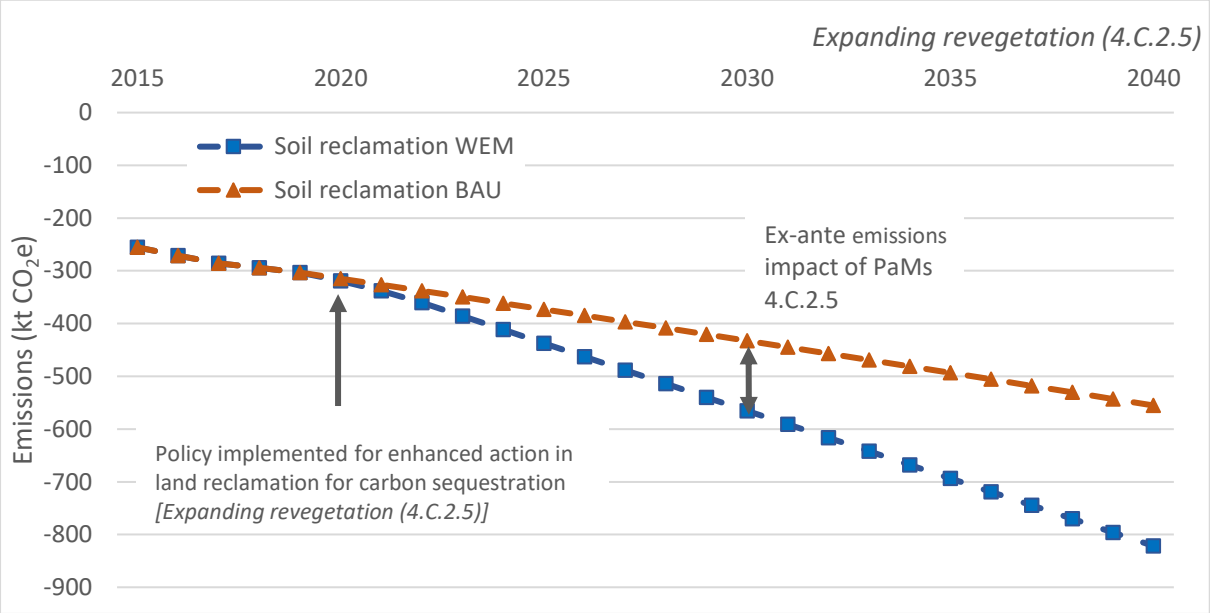
In the first publication of the Climate Action Plan (2018) it was put forward that an extensive effort is required to restore wetlands, birch forests, and scrubland, stop soil erosion and support further soil reclamation and afforestation in Iceland. Subsequently, the Ministry of the Environment, Energy and Climate trusted the task of implementing this extensive effort to its agencies, the Soil Conservation Service of Iceland and the Icelandic Forest Service, in close collaboration with the Ministry.

An extensive plan on improved land use in favour of climate change was presented in June 2019 (Government of Iceland, June 2019). The plan is for four years and actions described in it have already been started accordingly. In addition to carbon sequestration the actions are meant to work against land degradation and to support biodiversity. According to the plan the yearly scope of land reclamation will double over the period and the scope of the main projects will increase from approximately 6,000 hectares on average in 2018 to 7,630 hectares in 2020, 9,100 hectares in 2021, 10,600 in 2022, and 12,200 in 2023 without taking self-seeding into account. The scope of the

project "Farmers revegetate the land" *("Bændur græða landið")*[71] will triple and the scope of projects supported by the fund Landbótasjóður[72] will double in size.

Collaboration projects between the Icelandic Forest Service and the Soil Conservation Service of Iceland will be greatly reinforced, with an emphasis on reclaiming birch forests, willow bushes and heathland, such as in the "Hekluskógar"project. Land reclamation will be increased around the whole country and support for NGOs will be increased. In addition to this, in 2020, various projects with a focus on reclaiming soil quality, for example through soil conservation associations on the edge of the highlands, will be undertaken due to a temporary special investment effort by the Government because of the COVID-19 pandemic.

Figure 10.6 shows projected BAU and WEM scenarios for carbon sequestration from soil conservation and land reclamation quantified by The Soil Conservation Service of Iceland. The BAU scenario is based on projections of historical trends. The WEM scenario is instead constructed on projections which include policies and measures defined in the Climate Action Plan (2020) where land reclamation is planned to increase to 12,200 ha in the year 2023.



	2020	2025	2030	2035	2040
Soil reclamation BAU (kt CO_2e)	-315	-373	-433	-493	-555
Soil reclamation WEM (kt CO_2e)	-319	-437	-565	-694	-822
Ex-ante emissions impact of PaMs (kt CO_2e)	**-4**	**-64**	**-133**	**-200**	**-266**

Figure 10.6 BAU and WEM projected net emissions/removals through soil reclamation in the period 2020-2040.

[71] *Soil Conservation Service of Iceland (Landgræðslan).* https://land.is/heim/malaflokkar/baendur-graeda-landid/

[72] *Soil Conservation Service of Iceland (Landgræðslan.* https://land.is/heim/malaflokkar/landbotasjodur/

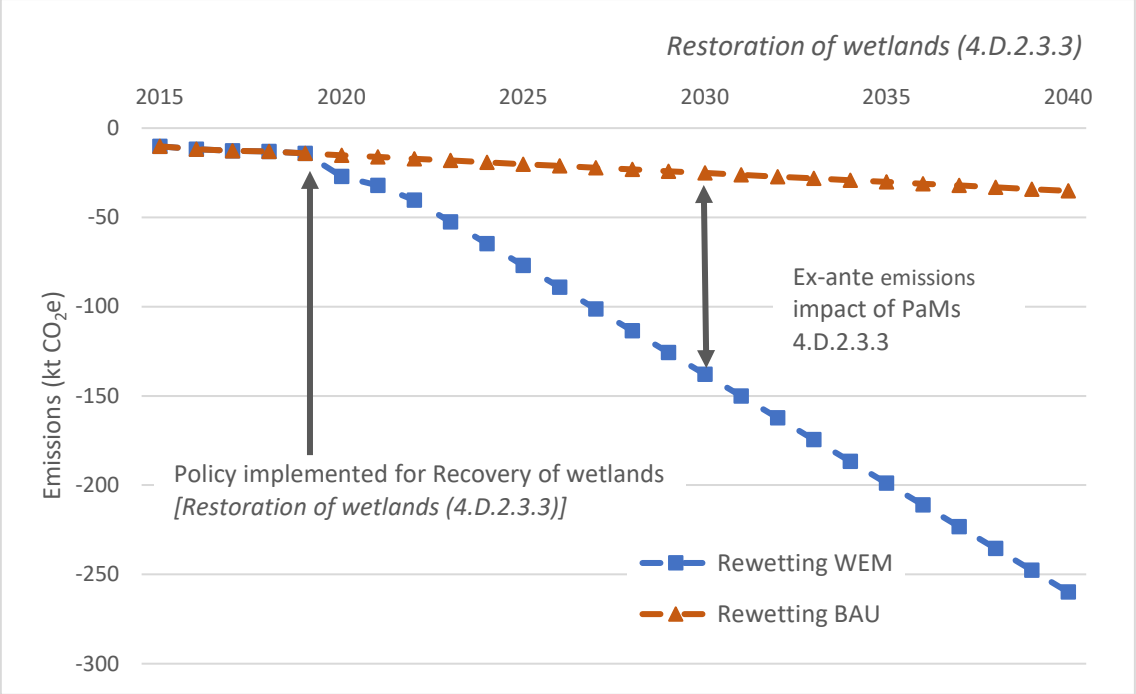
10.3.3 Restoration of Wetlands (604)

Wetland reclamation to reduce greenhouse gas emissions from land will be increased. Wetland reclamation will be supported, as well as research on the impact of wetland reclamation and the draining of wetlands on greenhouse gas emissions. The benefits of wetland reclamation are not only reduced greenhouse gas emissions from land, but also, for example, better water distribution and more diverse birdlife. In the first publication of the Climate Action Plan (2018) it was put forward that an extensive effort is required to restore wetlands, birch forests and scrubland, stop soil erosion and support further soil reclamation and afforestation in Iceland. Subsequently, the Ministry of the Environment, Energy and Climate trusted the task of implementing this extensive effort to its Agencies; the Soil Conservation Service of Iceland and the Icelandic Forest Service, in close collaboration with the Ministry.

An extensive plan on improved land use in favour of climate change was presented in June 2019. The plan is for four years and actions described in it have already been started accordingly. The scope of wetland reclamation will be increased from 50 hectares on average per year in 2016-2018 to 240 hectares in 2020, 250 hectares in 2021, 410 hectares in 2022 and 610 hectares in 2023. This will be done through the project "Wetland reclamation" *("Endurheimt votlendis"*), organised by the Soil Conservation Service of Iceland. In addition, in 2020, 150 hectares of wetlands will be reclaimed through the Government's temporary special investment efforts due to the COVID-19 pandemic.

It has been estimated that approximately 350,000 hectares of wetlands have been drained in Iceland in the latter half of the last century. This constitutes approximately 36% of all wetlands in Iceland. This proportion is much higher in the lowlands than the highlands. The goal of the project "Wetland reclamation" is to support the reclamation of previously drained wetlands.

Figure 10.7 shows projected BAU and WEM scenarios for carbon storage from recovery of wetlands quantified by The Soil Conservation Service of Iceland. The BAU scenario for recovery of wetlands is also based on projections of historical trends, whereas the WEM scenario is constructed on projections which include policies and measures defined in the Climate Action Plan (2020) where recovery of wetlands is planned to increase to 610 ha in the year 2023.



	2020	2025	2030	2035	2040
Rewetting BAU (kt CO_2e)	-15	-20	-25	-30	-35
Rewetting WEM (kt CO_2e)	-27	-77	-138	-199	-260
Ex-ante emissions impact of PaMs (kt CO_2e)	**-12**	**-57**	**-113**	**-169**	**-225**

Figure 10.7 BAU and WEM projected net emissions/removals through the recovery of wetlands in the period 2020-2040.

10.4 Methodology of projections

The methodologies used to generate WEM projections for the LULUCF sector are based on the historical inventory, see NIR (2021). Please refer to the latest edition of the National Inventory Report where information about activity data and emission factors is collected. Only a WEM scenario has been calculated for the LULUCF sector, no data was available to calculate a WAM or WOM scenario. For the sectors 4.A, 4.D.1 and 4.D.2.3.3 a comparison between BAU and WEM was carried out (**Figure 10.4**,

Figure 10.5, **Figure 10.6** and **Figure 10.7**).

10.4.1 Data & Assumptions

An overview of the data and assumptions used as a basis for the LULUCF projections can be found in **Table 10.3**. A further description is provided below.

Table 10.3 Basis for LULUCF projections.

LULUCF	**Basis for projections**
4. A Forest land	Historical trend, model projecting C stock change, sample statistics (601)
4.B Cropland	Linear extrapolation of historical trends
4.C Grassland	Linear extrapolation of historical trends, quantification of Expanding revegetation (602)
4.D Wetlands	Linear extrapolation of historical trends, quantification of Restoration of wetlands (604)
4.E Settlements	Linear extrapolation of historical trends
4.F Other Land	Linear extrapolation of historical trends

The emission estimates in the LULUCF sector are to a large degree determined by the development of land areas categorised by their use. Therefore, the LULUCF emission estimates and their projections must primarily methodologically solve the issue of land areas. The actual development of six major IPCC land use categories as reported in the latest emission inventory (NIR, 2020) is used. The projections are based on the observed trends and anticipation of increased soil reclamations and rewetting of wetlands.

In this second submission of the PaMs & Projections Report, improvements of the model projecting the development of C stock change in forest land has been undertaken. In the last submission only afforestation since 1990 was projected but in this submission the projection of all forest land is covered, and a complete estimation has been done. Instead of using plantation statistics to estimate species and age structure of cultivated forest, a sample plot statistic of the national forest inventory was used in a similar way as in the Icelandic National Forestry Accounting Plan (Snorrason et. al 2020). A more realistic approach to estimate future harvesting was used by comparing wood production of the period 1996-2019 to potential harvesting of forest defined as available for wood supply. Only 17% of potential harvesting was carried out in this period.

The methodology used for the projection of emissions from Cropland, Grassland, Wetlands, Settlements and Other land is in line with the model adopted for the national inventory according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. However, as already described above (**Sections 10.3.2** and **10.3.3**), greater emphasis was given on increasing carbon capture and storage in land reclamation and wetland recovery and conservation with potentiate action plans designed on behalf of the Icelandic government in line with the increased flexibility afforded by higher financial contributions.

11 Cross-Cutting

The PaMs from the Climate Action Plan (2020) which are cross-cutting and will affect more than one of the sectors presented in the previous chapters are listed in Table 11.1 below. Short descriptions of each policy or measure are provided, with more information on all the PaMs provided in separate subchapters below. Currently, the majority of the policies have been implemented, although none of them have been quantified or included in the WEM projections scenario.

Table 11.1 Policies and Measures included in Cross-Cutting.

PaM Name	*GHG(s)*	*Instrument type*	*Status*	*Scenario*	*Description*
Climate fund (703)	GHGs	Economic	Imple-mented	Not included	Climate education and innovation will be supported through the new Icelandic Climate fund.
Climate strategy of Government Offices (704)	GHGs	Economic, Planning	Imple-mented	Not included	A climate strategy has been introduced for Government Offices. Various measures aim to reduce GHG emissions and remaining emissions will be offset.
Climate education in schools (706)	GHGs	Education	Imple-mented	Not included	Climate education in schools will be reinforced.
Information on climate change for the public (707)	GHGs	Economic, Education	Imple-mented	Not included	Information on climate issues, the effects of climate change, mitigation and adaptation will be supported through various means.
Climate action planning (709)	GHGs	Planning	Imple-mented	Not included	Climate issues will be addressed through Iceland's National Planning Strategy.
Issuing of green bonds (711)	GHGs	Economic	Adopted	Not included	Evaluation will be made on the feasibility of issuing green bonds in order to raise green investor interest in traditional state loans.
Sustainable public procurement (712)	GHGs	Economic, Planning	Imple-mented	Not included	Environmental and climate issues will be evaluated in all government purchasing with a new policy on sustainable public procurement.
Climate strategy of other public agencies (713)	GHGs	Regulatory, Voluntary/ Negotiated agreements	Adopted	Not included	All other public agencies will need to set a Climate Strategy. The same applies to local government.
Climate impact assessment of legislation (714)	GHGs	Regulatory	Imple-mented	Not included	The climate impact of all new legislation will be evaluated.

Climate fund (703)

In the first edition of the Climate Action Plan (2018) a measure on the establishment of a Climate fund ("*Loftslagssjóður*") was proposed. The fund formally started operating in 2019 and the Climate Act has been updated and altered to further define and formalise its purpose. The Icelandic Centre for Research (*Rannís*) has been entrusted with the management of the fund, a board has been established and allocation rules have been defined. The main purpose of the fund is to support and encourage climate education, research and innovation.

The fund began accepting applications in November 2019 and received 203 applications. The first grants were allocated to 10 innovation- and 22 education projects in May 2020[73]. A few of the deciding parameters on which projects received grants from the fund were whether they would have positive climate and societal impacts, the level of novelty and whether they would be useful widely or for a limited area/group. The first grants that were allocated were 165 million ISK. The Climate fund received 158 applications for the second allocation of funding in 2021. In total, 170 million ISK was allocated in grants to 24 projects: 12 educational projects and 12 innovation projects[74]. The fund will allocate over 500 million ISK in grants to various such educational and climate innovation projects over the next five years.

An overview of the projects which received grants from the fund in March 2021 is provided in **Table 11.2** and **Table 11.3** below. This measure is connected to policy 706 and 707 on education on climate issues for the public and in schools.

Table 11.2 Innovation projects which received funding from the Climate Fund in March 2021.

Innovation projects		
Main applicant	*Amount applied for (in 1.000 ISK)*	*Name of the project*
Gerosion ehf.	9,836	AlSiment sustainable cement
Jarðgerðarfélagið ehf.	10,000	Bokashi for municipalities, new sustainable approach in waste management
GreenBytes ehf.	10,000	Food waste reduction through data science innovation and impact awareness
Vatnaskil ehf.	10,000	Simulation of hydrology and GHG emissions in wetlands and drained wetlands
Humble ehf.	9,720	Humble – App against food waste
Náttúrustofa Suðausturlands ses.	8,587	Carbon reserves and CO_2 flow from soil – collaborative project on monitoring of selected land types
Neskortes ehf.	3,935	CO_2 measured with a drone
Efla hf.	2,880	Carbon footprint of food
Íslensk NýOrka	10,000	Body and system design for a multi-purpose electric catamaran
Vetnis ehf.	10,000	Hydrogen chain
Þorvarður Árnason	10,000	Scientific tourism – new platform for the gathering and dissemination of information on climate change
Skógræktin	4,056	Drying of wood with geothermal energy

[73] *Rannís*. https://www.rannis.is/frettir/uthlutun-ur-loftslagssjodi
[74] *Rannís*. https://www.rannis.is/frettir/uthlutun-ur-loftslagssjodi-2021

Table 11.3 Education projects which received funding from the Climate Fund in March 2021.

Education projects		
Reykjavík Tool Library ehf.	5,317	Connecting Loops-Roaming Repair Café
Íris Indriðadóttir	160	Explain it to me
Bless Bless Productions sf.	5,321	Full Steam Ahead
Matís ohf.	9,940	Green entrepreneurs of the future
Finnur Ingimarsson	2,508	Let's draw the lines
Katrín Magnúsdóttir	10,000	Protectors of the climate – Education project on climate change
Vilborg Gissurardóttir	9,987	The climate leader: education, expedition and leadership training
Listasafn Reykjavíkur	10,000	North Atlantic Triennial
Compass ehf.	5,400	Ormhildur the brave – A climate fiction
Orkusetur	1,300	The bus school
Ungir umhverfissinnar	1,303	Information pack on climate change
Belgingur reiknistofa í veðurfræði ehf.	10,000	Climate data and scientific literacy

Climate strategy of Government Offices (704)

The government aims to set an example in climate policy and be a positive role model for organisations, businesses, and the public. The government's Climate Strategy (*Loftslagsstefna Stjórnarráðsins*) is designed to reduce GHG emissions from all government operations and Ministries significantly and carbon offset the remaining emissions generously.

Efforts to map the government's operations were started in 2018 and consequently measures to reduce their GHG emissions by 40% by 2030 were defined. There is an emphasis on reducing emissions from flights, vehicles, waste, energy use and cafeteria meals. The Icelandic Government approved their Climate Strategy in April 2019 (Government of Iceland). The Strategy was followed by an action plan for the years 2019-2021 and the strategy itself applies until 2030.

The policy directs the spotlight to the importance of organisations and companies reducing their carbon footprint and developing a climate policy. Furthermore, it increases demand for climate friendly solutions, such as sustainable taxis and rental cars and effective transport contracts. A portal to connect emissions from flights to goals regarding reducing GHG emissions is also being developed and will be available to all government agencies. This measure is directly connected to the Climate strategy of other public agencies (see measure 713).

Climate education in schools (706)

Since the first edition of the Climate Action Plan (2018) was released the education material which is already available in Iceland has been mapped, with the goal of determining what kind of material is missing and where improvements can be made. The Ministry of Education and Children will use the mapping and further direct it to the Directorate of Education to use it to develop and revise education materials. It is expected that various educational projects will be presented in the near future (see measure 707 on climate education for the public), and that a part of them will be useful for the entire educational system. NGO's such as Landvernd and The Icelandic Youth Environmentalist Association (*Ungir Umhverfissinnar*) have, furthermore, been effective sustainability and environmental educators and have provided educational materials and presentations around the country.

When the education system's curricula are reviewed next, climate change education will be made a priority and educational grants will be allocated by the Ministry of Education and Children to climate

education projects. Education on climate change will be increased at all educational levels and provided through various educational channels. The goal is for schools to be able to offer varied and comprehensive education on climate change, its consequences and what we can do to combat it, in line with the sustainability principle which lays at the core of all education. Sustainability education, environmental awareness, community spirit and climate issues are all important issues for educators to raise in schools. Climate matters are complex and overlap with many other societal issues. It is important to ensure that quality education material, which touches on the science behind climate change and the impacts of a changing climate on the environment, communities, democracy, equality and human rights, exists. It is also essential that the education material is appropriate or adjustable for different education levels.

The young generation has already made a difference in climate issues in Iceland and has been active in climate panels and protests. A contract has been signed with the NGO Landvernd on creating educational material on climate change and climate issues for schools, in light of its experience in creating education material on sustainability and environmental issues. The education material is connected to the project Eco-Schools Iceland ("*Skólar á grænni grein*")[75], which has been running in Iceland since 2001 and currently reaches over 200 schools at all education levels, ranging from preschools to universities. The distribution of participating schools around the country can be seen in **Figure 11.1** below. Landvernd's education on climate issues is for all schools, independent of whether they are participating in Eco-Schools Iceland or not. The goal is for more schools to participate in the project in the future. The project is part of to the world's largest environmental education organisation, the Foundation for Environmental Education (FEE)[76].

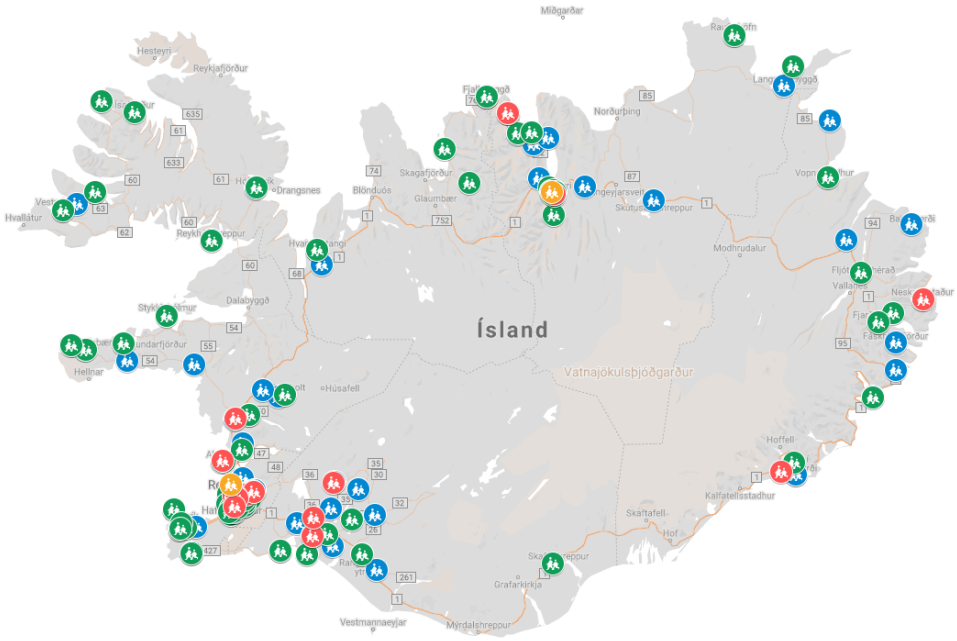


Figure 11.1 Schools participating in the Eco-Schools Iceland project. Green represents preschools, blue represents primary schools, red represents secondary schools and orange represents universities.[77]

[75] *Landvernd – Icelandic Environment Association*. https://landvernd.is/graenfaninn/
[76] *The Foundation for Environmental Education*. https://www.fee.global/
[77] *Landvernd – Icelandic Environment Association*. https://landvernd.is/graenfaninn/um-skola-a-graenni-grein/

Information on climate change for the public (707)

Education on climate issues will be supported in a variety of ways. Since the first edition of the Climate Action Plan (2018) was published, several new projects have been set afoot. The education system plays an important role in raising awareness in the younger generations and collaboration with education authorities is essential. Ways to further support education on climate issues, the impacts of consumerism and waste, will be explored. A mapping of the education material that is currently available to the public in Iceland has been undertaken by the Ministry of Education and Children and will lay the foundations for this.

One of the roles of the Climate Fund, which was established in the autumn of 2019 (see measure 703), is to support education on climate issues and the impacts of climate change. When project grants were being allocated by the Ministry of the Environment, Energy and Climate for the second time in February 2020, an emphasis was placed on supporting collaboration projects between NGOs, the public and others regarding strengthening the circular economy and supporting climate issues, in line with the aims of the previous Climate Action Plan (2018).

The government has, furthermore, directly funded several educational projects on climate issues and will continue to do so. This includes the television series "What have we done?" ("*Hvað höfum við gert?*") which was shown on national television (*RÚV*) in 2019[78]. A second season, "What can we do?" ("*Hvað getum við gert*?") was subsequently aired on national television in 2021[79]. The emphasis of the second season is on what actions individuals, businesses, and the government can undertake to combat climate change.

The project "Retreating glaciers" ("*Hörfandi jöklar*") also received funding from the government. The impacts of climate change on glaciers in Iceland is well known and has been monitored and researched by scientists for decades. The impacts on Vatnajökull, Europe's largest glacier, can be seen in **Figure 11.2** below. The Retreating glaciers project aims to increase awareness of the impact of climate change in Iceland and in the rest of the world. Information on the retreating glaciers in Iceland, based on monitoring by the Icelandic Meteorological Office (*Veðurstofa Íslands*) and the University of Iceland's Institute of Earth Sciences (*Jöklahópur Jarðvísindastofnunar Háskóla Íslands*), through Vatnajökull National Park (*Vatnajökulsþjóðgarður*), has been made more accessible for the public through their educational website[80].

[78] *RÚV*. https://www.ruv.is/sjonvarp/spila/hvad-hofum-vid-gert/27624
[79] *RÚV*. https://www.ruv.is/sjonvarp/spila/hvad-getum-vid-gert/30574
[80] *Vatnajokull National Park (Vatnajökulsþjóðgarður).* https://www.vatnajokulsthjodgardur.is/is/svaedin/horfandi-joklar

Figure 11.2 The outline of Vatnajökull Glacier, c.a. 1890 and 2010. Sources: The Icelandic Meteorological Office and the University of Iceland's Institute of Earth Sciences[81].

Many education projects, organised by the government, organisations, NGOs, youth organisations, the media and others are well underway. The Environment Agency of Iceland, for example, manages extensive environmental education for the public, other organisations and businesses which is directly connected to climate issues. The Icelandic Climate Council (*Loftslagsráð*) has a monitoring role of the dissemination of information and education.

Climate action planning (709)

In the summer of 2018, the Minister of the Environment, Energy and Climate entrusted the National Planning Agency (*Skipulagsstofnun*) with proposing an update to the National Planning Strategy (*Landsskipulagsstefna*) 2015-2026 (National Planning Agency, 2016) where a clearer policy on climate issues, landscape and public health would be defined in regard to planning operations. The National Planning Agency's proposal was presented to the Minister in the spring of 2021 (National Planning Authority, 2021).

The National Planning Strategy contains the government's policy and guidance for municipalities' planning. The policy update focuses on how the planning of municipalities can purposefully support the achievement of the government's climate-, landscape-, and public health targets. In the update, guidance is proposed on how municipalities can use long-term planning strategies to shape the development of land-use and the built environment, both in rural and urban areas. The policy expects municipalities to form a policy on climate focused planning, for planning to support the

[81] *Vatnajokull National Park (Vatnajökulsþjóðgarður)*. https://www.vatnajokulsthjodgardur.is/is/svaedin/horfandi-joklar/joklarannsoknir/43-utlinur-jokla-og-yfirbordskort

achievement of carbon neutrality, and to strengthen resilience against climate change through various adaptation measures. In climate focused planning, climate goals are prioritised when settlements and land-use changes are being planned. In this way, planning can be used to support improved commuting behaviour, climate friendly construction, and the preservation and sequestration of carbon in soils and flora, for example[82].

The Minister of the Environment, Energy and Climate will propose the parliamentary resolution to Parliament. The measure is connected to various other measures in the Action Plan, such as measures **601**, **602**, and **604** on supporting forestry, land- and wetland reclamation, and measures **205**, **206**, and **209** on changed travel habits, active modes of transportation, and the strengthening of the public transport system.

Issuing of green bonds (711)

The feasibility of issuing green government bonds and opening pathways to green investors for conventional government loans will be explored. There are possibilities to finance well defined sustainable projects through issuing certain green government bonds. This would send a clear signal to investors about the importance of environmental issues and how the finance sector could support climate change prevention. Issuing green bonds is for the most part similar to issuing other bonds. The main difference is, however, that the money goes to environmentally friendly projects. The issuing of green bonds has been increasing on international markets in the past years and there has been more pressure on investors to direct investment to projects that support reaching long term sustainability and climate targets.

The Icelandic Treasury has hitherto not issued green bonds, but a project management group set up by the Minister of Finance and Economic Affairs is now assessing what possibilities are available. The group was set up in June 2020 and consists of representatives from the Ministry of Finance and Economic Affairs, the Ministry for Foreign Affairs, the Ministry of the Environment, Energy and Climate, the Prime Minister's Office, and the Central Bank of Iceland. The group will, furthermore, participate in work on an independent ESG (environmental, social, governance) investment certification for the Icelandic Treasury, if that is the course that is decided to be taken. This is an international certification that focuses on emphasizing environmental and social issues as well as good management practices and can possibly facilitate green investment in traditional government bonds. Although the Icelandic Treasury has not yet issued green bonds, the City of Reykjavík has become the first party to design a Green Bond Framework in Iceland in 2019[83] to fund projects that align with its climate policy[84].

Sustainable public procurement (712)

Sustainability will be taken into account in all public procurement as a main rule. The Central Public Procurement (*Ríkiskaup*) developed a new public procurement policy on Sustainable procurement (*Sjálfbær innkaup – Stefna ríkisins*) which was published in January 2021. The government procures goods and services for 117 billion ISK every year, which allows for many opportunities to form a clear environmental policy regarding procurement. Creating a demand for more environmentally friendly goods and services can have significant direct and indirect effects on the market and help pave the way for other businesses or organisations to do the same thing.

[82] *National Planning Authority (Skipulagsstofnun).* https://www.landsskipulag.is/um-landsskipulagsstefnu/frettir/landsskipulagstillaga-afhent-umhverfis-og-audlindaradherra
[83] *City of Reykjavík (Reykjavíkurborg).* https://reykjavik.is/graen-skuldabref-green-bonds
[84] *City of Reykjavík (Reykjavíkurborg).* https://reykjavik.is/sites/default/files/reykjavik_green_bond_framework_2019_-_baeklingur.pdf

The key topics regarding Sustainable public procurement policy for the next years are:

1. To achieve economical and sustainable procurement that ensures long-term sustainability;
2. To increase the professional capacity of public procurers to support an efficient performance of government services;
3. To ensure sufficient competition in the market and stimulate recruitment and innovation through increased cooperation with the market;
4. Use digital procurement solutions and information technology systematically for data analysis and joint procurement.
5. Ensure that the public and companies have easy access to information on government procurement.

It is possible to be more environmentally conscious in the purchasing of several procurement categories, such as in contracts for purchasing painting- and construction material, cleaning supplies, paper goods, writing equipment, printing, electronics and other machinery. The carbon footprint can also be significantly decreased by improving the design of buildings, using sustainable concrete and improving other construction practices.

The Icelandic government furthermore purchases food for approximately 3 billion ISK per year and can, as a big buyer, have a significant impact on food demand, support sustainable procurement, reduce the carbon footprint and support innovation. In the procurement policy for food for government agencies (Government of Iceland, March 2019), which the Ministry of Higher Education, Science and Innovation published in May 2019, an emphasis is placed on altering procurement processes so that cafeterias have access to package free food and that a public calculator for the carbon footprint of food will be designed. It has been declared that the goal is to keep the consumption of red meat in moderation. It has been ensured that the procurement policy for food and the policy on sustainable government purchasing will work together.

Climate strategy of other public agencies (713)

All government and public entities will be exemplary in climate policies. The Government's Climate Policy, which was approved in May 2019, puts a requirement on all government agencies, which was expanded further with updated climate legislation in June 2019. All government agencies, municipalities and government majority owned companies shall, by law, develop a climate policy and set itself a GHG emission reduction target. The EAI will monitor all the climate policies and make sure appropriate measures are undertaken accordingly. The EAI will, furthermore, provide guidance on how to calculate GHG emissions from operations and the results of certain measures.

Government organisations and government majority owned companies have the possibility to sign up for the project "Green steps in government operations" ("*Græn skref í ríkisrekstri*")[85] and a similar project is currently being developed for municipalities[86]. Participants in the project publish "Green accounting" ("*Grænt bókhald*") which will be updated and expanded to include GHG emissions with a focus on internal operations. Public entities, including municipalities, return GHG emission information to the EAI and use emission factors which are published by the Agency. Reporting GHG emission information is mandatory for traditional office operations, according to a specification in the Climate Act, but reporting of specific operations, such as construction/maintenance, is optional. Municipalities have already established a collaboration platform on climate issues and the UN Sustainable Development Goals to support and strengthen the solidarity and conversation between

[85] *Grænskref*. https://graenskref.is/
[86] *Environice*. https://www.environice.is/thjonusta/verkfaerakista-sveitarfelaga/

municipalities on these issues[87]. As of March 2022, 159 out of 199 government organisations and government majority owned companies are participating in the initiative, and 88 have published their Green accounting.

Climate impact assessment of legislation (714)

The climate impact of legislative bills will be estimated, in addition to the impacts on the economy, financial impacts on municipalities, impacts on NGO's, organisations and different population segments, as well as gender equality. Law nr. 123/2015 on public finances has been updated in order for it to be mandatory for Ministries to assess the climate impacts of any bill they wish to propose to Parliament[88]. By implementing the obligation to assess the climate impact of legislative bills, the legislator highlights the importance of gaining control of climate change.

[87] *Icelandic Association of Local Authorities (Samband íslenskra sveitarfélaga)*. https://www.samband.is/verkefnin/umhverfis-og-urgangsmal/loftslagsmal-og-heimsmarkmid-sameinudu-thjodanna/

[88] *Parliament (Alþingi)*. https://www.althingi.is/altext/pdf/151/s/0144.pdf

12 Sensitivity Analysis

12.1 Agriculture – Livestock Activity Data

Livestock population projections are based on historical trends or the trend of the past 10 years for all major livestock categories, using linear extrapolation. These projections are the main determinants of GHG emissions from agriculture. A sensitivity analysis has been performed to assess the impact on emissions from Agriculture of applying different trends to project livestock numbers.

For the various sheep subcategories, livestock projections based on the historical trend were used for the sensitivity analysis. This resulted in livestock numbers of sheep which grew more different from the projections based on the 10-year trend as the projections stretched further into the future (see **Table 12.1**). A visual comparison between the different sheep projection scenarios can be seen in **Figure 12.1**.

Table 12.1 Number of sheep (1000s) projected using the historical trend and 10-year trend (using linear extrapolation).

Scenario	2020	2025	2030	2035	2040
Mature sheep (historical trend)	350	341	333	325	317
Mature sheep (10 yr trend)	346	328	311	293	275
% difference	1%	4%	7%	11%	15%
Rams (historical trend)	11	11	10	10	10
Rams (10 yr trend)	11	11	11	11	10
% difference	-2%	-3%	-3%	-3%	-4%
Young sheep (historical trend)	86	86	86	86	86
Young sheep (10 yr trend)	77	69	61	53	44
% difference	11%	24%	41%	64%	95%
Lambs (historical trend)	208	204	199	194	199
Lambs (10 yr trend)	206	196	185	175	173
% difference	1%	4%	7%	11%	15%
Total sheep (historical trend)	**655**	**642**	**628**	**615**	**612**
Total sheep (10 yr trend)	**641**	**604**	**567**	**531**	**503**
% difference	**2%**	**6%**	**11%**	**16%**	**22%**

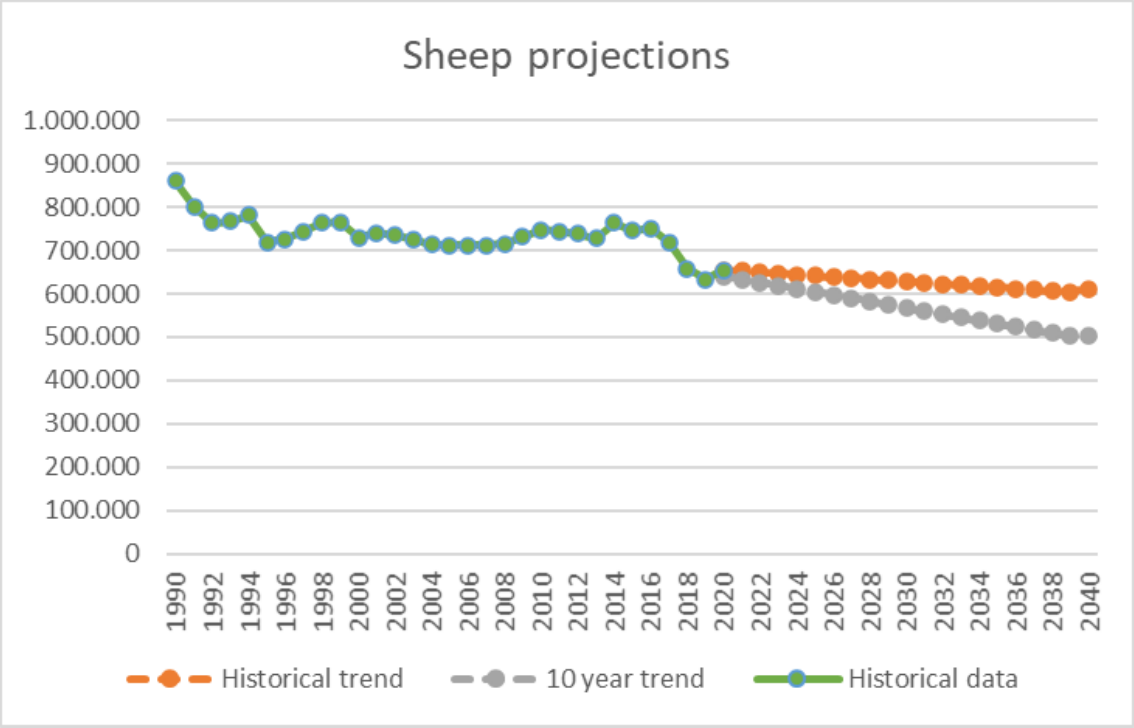


Figure 12.1 Comparison between the number of sheep projected by using the historical trend versus the 10-year trend.

For the various cattle subcategories, livestock projections based on the trend of the past 10 years were used for the sensitivity analysis. This resulted in livestock numbers of cattle which were between 11 to 41% higher than the projections based on the historical trend (see **Table 12.2**). A visual comparison between the different cattle projection scenarios can be seen in **Figure 12.2**.

Table 12.2 Number of cattle (1,000s) projected using the historical trend and 10-year trend (using linear extrapolation).

Scenario	**2020**	**2025**	**2030**	**2035**	**2040**
Dairy cows (10 yr trend)	27	28	29	30	32
Dairy cows (historical trend)	24	22	21	20	18
% difference	13%	27%	38%	50%	78%
Heifers (10 yr trend)	7	7	8	9	9
Heifers (historical trend)	6	6	6	6	7
% difference	17%	17%	33%	50%	29%
Steers (10 yr trend)	23	25	27	29	31
Steers (historical trend)	21	21	22	22	22
% difference	10%	19%	23%	32%	41%
Calves (10 yr trend)	23	25	27	29	32
Calves (historical trend)	21	22	22	22	22
% difference	10%	14%	23%	32%	45%
Total Cattle (10 yr trend)	**84**	**91**	**98**	**105**	**113**
Total Cattle (historical trend)	**76**	**77**	**78**	**79**	**80**
% difference	**11%**	**18%**	**26%**	**33%**	**41%**

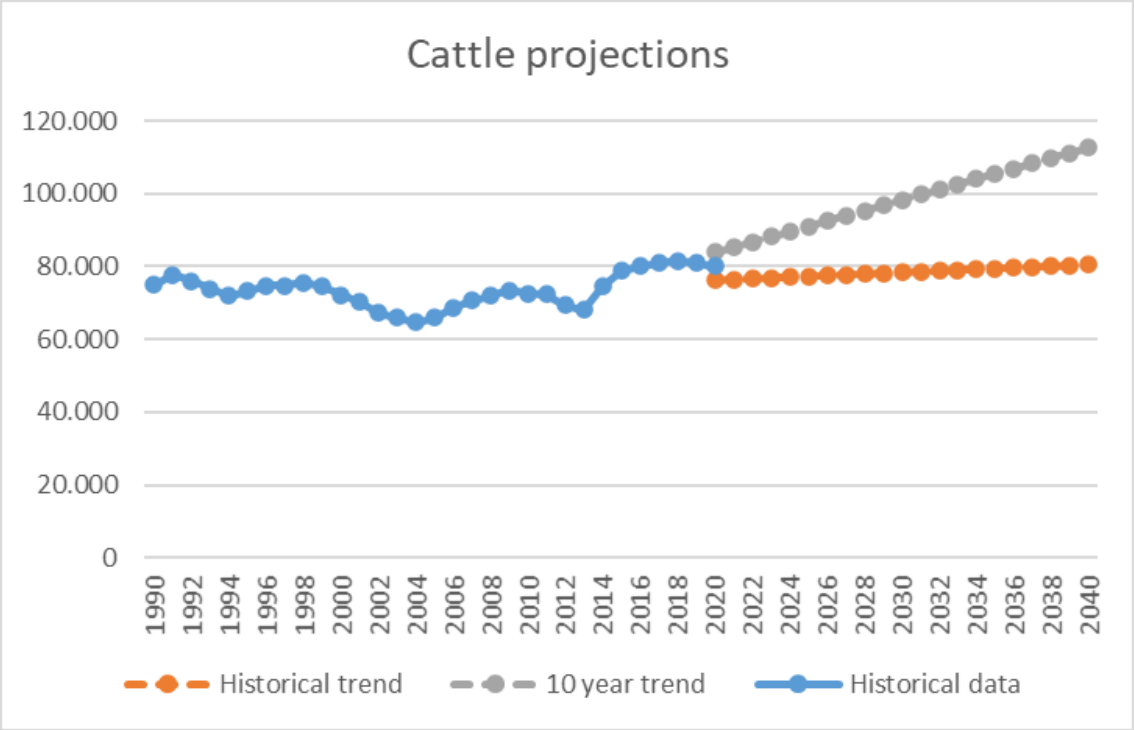


Figure 12.2 Comparison between the number of cattle projected by using the historical trend versus the 10-year trend.

Table 12.3 below shows the results of the sensitivity analysis. To avoid confusion, the following is reiterated:

- In the Sensitivity Analysis scenario:
  - Sheep projections are based on the historical trend;
  - Cattle projections are based on the 10-year trend.
- In the WEM scenario:
  - Sheep projections are based on the 10-year trend;
  - Cattle projections are based on the historical trend.

The different livestock projections scenarios were presented to experts at the Ministry of Food, Agriculture and Fisheries, which has responsibility for the agriculture sector. The livestock projections selected for the WEM scenario are based on their expert judgement, rather than on a regression analysis, due to their in-depth knowledge of the agriculture sector. More information on the agriculture projections is provided in **Section 8.3.1**.

Table 12.3 Sensitivity analysis results: total GHG emissions (kt CO_2e) in the livestock projections scenarios.

	Emissions (kt CO_2e)				
Scenario	**2020**	**2025**	**2030**	**2035**	**2040**
Cattle & sheep Sensitivity Analysis	638	636	639	641	645
Cattle & sheep WEM Scenario	618	603	591	578	567
Difference in kt CO_2e	20.0	33.4	47.9	63.2	78.2
% Difference	3%	5%	8%	10%	12%

In the sensitivity analysis scenario, emissions from agriculture are projected to be approximately 12% higher in 2040 compared to the WEM projections scenario used for the agriculture sector. The total emissions from the Agriculture sector in the different scenarios can be seen in **Figure 12.3** and **Figure 12.4** below. The Sensitivity Analysis scenario, emissions from the agriculture sector remain very stable throughout the projected time series. The impact of the increase in the number of cattle counteracts the impact of the reduction in the number of sheep, resulting in a minimal change in emissions.

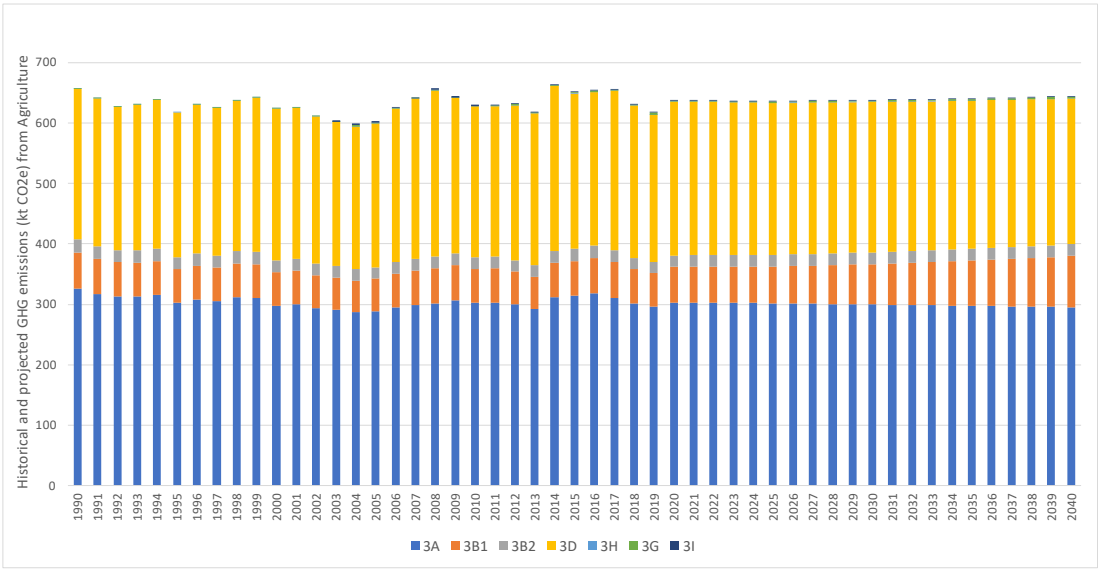


Figure 12.3 Historical and projected GHG emissions (kt CO_2e) from the Agriculture sector in the Sensitivity Analysis scenario.

In the WEM scenario, emissions from the agriculture sector are projected to decrease because the impact of the reduction in the number of sheep outweighs the impact of the increase in the number of cattle.

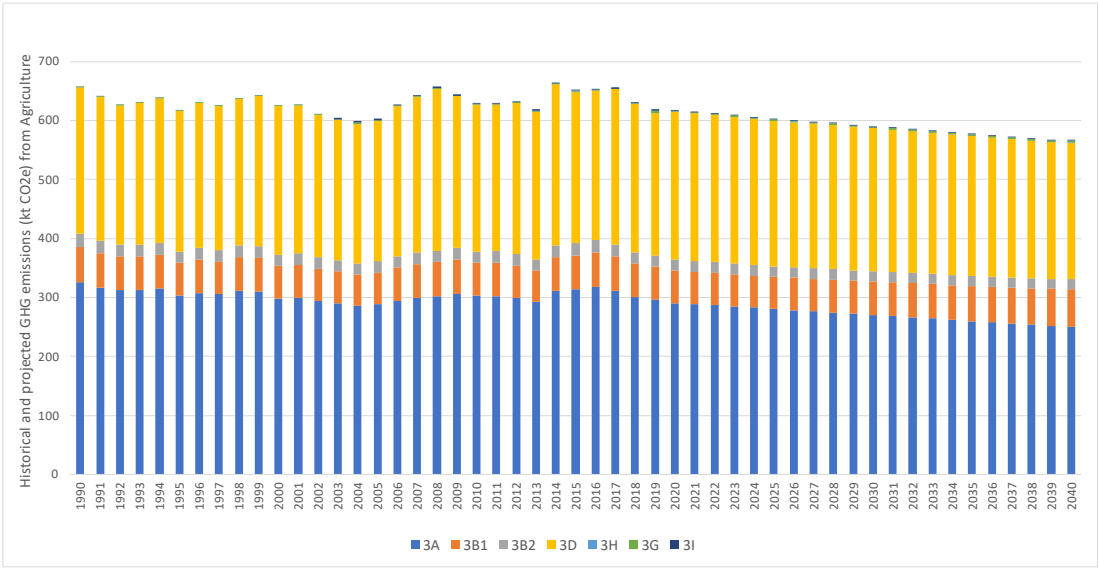


Figure 12.4 Historical and projected GHG emissions (kt CO_2e) from the Agriculture sector in the WEM scenario.

12.2 LULUCF – Development of net removals of Forest land

Forest land has two categories, Forest land remaining forest land (FrF) and Land converted to forest (LcF). The main sink of CO_2 is the gain of biomass in the cultivated forest (CF) of LcF with reported value 284 kt of CO_2 in the year 2020. The prognosis of the biomass gain of the CF was done by combined biomass growth and biomass loss model considering differences in the growth of the tree species with age and the harvest intensity. The model did simulate biomass gain of the CF rather well but nevertheless the ratio between the modelled and reported figures for the end year of reporting, (2020) was 0.86. Modelled figures were calibrated by the factor 1/0.86 to adjust for this difference. Similar calibration was done for FrF but there the model was predicting higher value (42%) for 2020 than reported. Consequently, the model values were adjusted by the ratio difference as for LcF. The effect on the Forest land category as a whole was 9% and the different predictions with and without calibration is shown in **Table 12.4** and **Figure 12.5** below. The WEM scenario with calibration was used for the projections.

Table 12.4 Sensitivity analysis results showing the effects of the calibration on emission removals from the forest land category.

	Emissions removals (kt CO_2e)				
Scenario	**2021**	**2025**	**2030**	**2035**	**2040**
WEM with calibration	-522	-580	-648	-714	-794
WEM without calibration	-474	-528	-589	-648	-723
Difference in kt CO_2e	-48	-52	-59	-67	-71
% Difference	9%	9%	9%	9%	9%

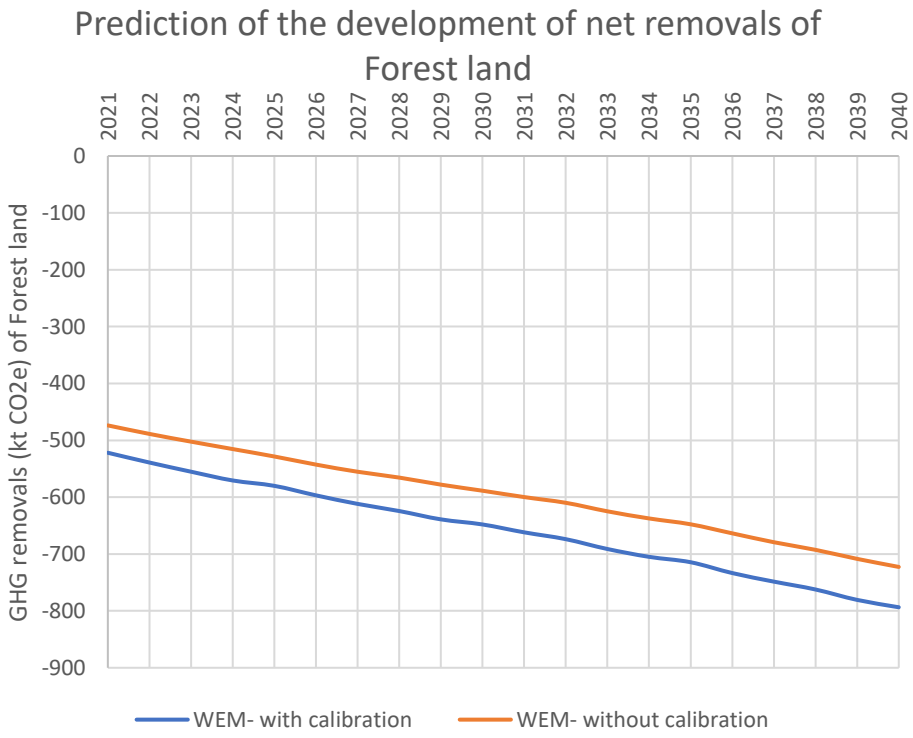


Figure 12.5 Prediction of the development of net removals of forest land in the WEM-with-calibration and WEM-without calibration scenarios.

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