Report on Policies, Measures and Projections

Projections of Greenhouse Gas Emissions in Iceland until 2040

Submitted to the European Union under Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action

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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) and39 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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Abbreviations

AR4	Assessment Report 4
AR5	Assessment Report 5
BAT	Best Available Techniques
BAU	Business as Usual
CF	Cultivated forest
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
EAI	Environment Agency of Iceland (*Umhverfisstofnun*)
EC	Energy Consumption
ECAC	European Civil Aviation Conference
EEA	European Environment Agency
ES	Energy Supply
ESR	Effort Sharing Regulation (EU) 2018/842
EU	European Union
EU ETS	European Union Emission Trading System
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
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
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 policies and measures (PaMs) and greenhouse gas (GHG) projections for the second time in 2021 in line with the reporting obligations described in the **Sections 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 for the Environment and Natural Resources published an updated Climate Action Plan in 2020, which forms the basis for the PaMs reported here. The Action Plan included 48 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. Four 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, and a new gas and compost plant.

GHG emissions savings from the following PaMs have been quantified for this submission: electrification of harbours and electrification of fishmeal factories (**Section 5.3.1**), electrification 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.

Based on the Environment Agency of Iceland´s (EAI) calculations and assumptions, emissions from Iceland (excluding LULUCF) are expected to increase between 2020 and 2021, after which the total emissions begin to decrease until 2040 (see **Figure ES.0.1**).

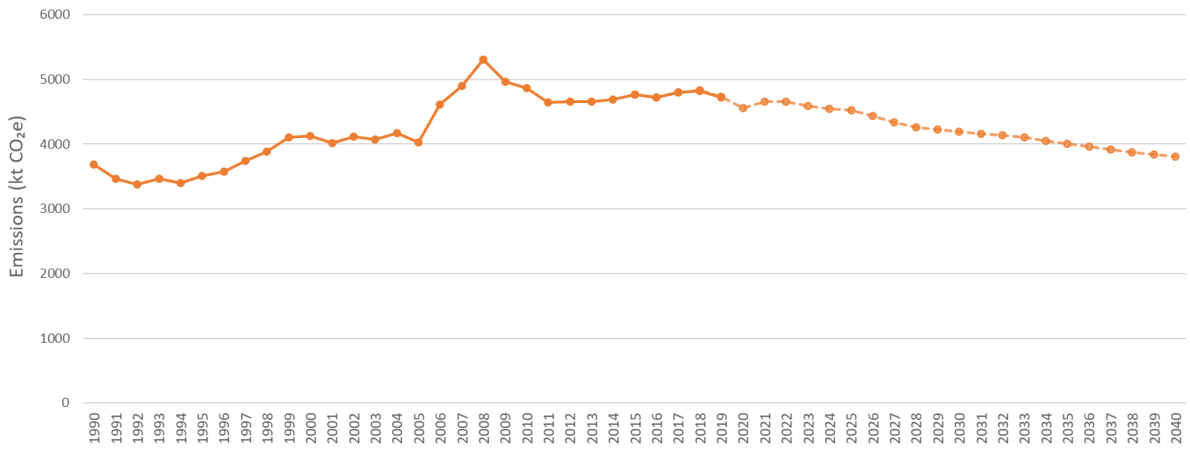

Figure ES.0.1 Total GHG emissions from 1990 to 2040 (excluding LULUCF)

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[1] in 2015 with the European Union and its Member States concerning Iceland's participation in the Joint Fulfilment Agreement. Therein the Parties agreed to fulfil their emission limitation and reduction commitments inscribed in the third column of Annex B to the Kyoto Protocol jointly. 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.

However, for the Paris Agreement period, from 1 January 2021 to 31 December 2030, Iceland and Norway have joined the EU in the commitment of -40% reduction in greenhouse gas emissions, according to the EEA Joint Committee Decision (JCD) No 269/2019[2], that amends Protocol 31 to the EEA Agreement on cooperation in specific fields outside the four freedoms[3]. 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)[4]), Regulation (EU) 2018/841 (hereafter referred to as the LULUCF Regulation[5]), 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. The national target for Iceland is -29% compared to 2005 emissions, according to JCD 269/2019, where Annex I of ESR is adapted.

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*[6]). The implementation of the relevant provisions of the Governance Regulation is in process, as well as the implementation of Commission Implementing Regulation (EU) 2020/1208 and Commission Delegated Regulation (EU) 2020/1044, as these two regulations are now being incorporated to the EEA Agreement. Other delegated and implementing regulations based on Regulation (EU) 2018/1999 that will be incorporated to the EEA Agreement will also be implemented in Icelandic law subsequently. Regulation No 520/2017 on data collection and information from institutions related to Iceland's inventory of greenhouse gases emissions and carbon removal, that implemented Regulation (EU) No 525/2013, will be revised in parallel.

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

[2] 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] https://www.efta.int/EEA/Policy-Areas-2422

[4] 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

[5] 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

[6] https://www.althingi.is/lagas/nuna/2012070.html

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 4 future years ending with 0 or 5 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 and its Member States concerning Iceland's participation in the Joint Fulfilment Agreement. Therein the Parties agreed to fulfil their emission limitation and reduction commitments inscribed in the third column of Annex B to the Kyoto Protocol jointly. 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.

However, for the Paris Agreement period, from 1 January 2021 to 31 December 2030, Iceland and Norway have joined the EU in the commitment of -40% reduction in greenhouse gas emissions, according to the EEA Joint Committee Decision (JCD) No 269/2019, that amends Protocol 31 to the EEA Agreement on cooperation in specific fields outside the four freedoms. 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)), Regulation (EU) 2018/841 (hereafter referred to as the LULUCF Regulation), 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. The national target for Iceland is -29% compared to 2005 emissions, according to JCD 269/2019, where Annex I of ESR is adapted.

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*). The implementation of the relevant provisions of the Governance Regulation is in process, as well as the implementation of Commission Implementing Regulation (EU) 2020/1208 and Commission Delegated Regulation (EU) 2020/1044, as these two regulations are now being incorporated to the

EEA Agreement. Other delegated and implementing regulations based on Regulation (EU) 2018/1999 that will be incorporated to the EEA Agreement will also be implemented in Icelandic law subsequently. Regulation No 520/2017 on data collection and information from institutions related to Iceland's inventory of greenhouse gases emissions and carbon removal, that implemented Regulation (EU) No 525/2013, will be revised in parallel.

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 4 future years ending with 0 or 5 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 policies and measures and projections, national GHG policies and measures and national projections of anthropogenic GHG emissions, is provided by the Icelandic Climate Act, which describes the roles and responsibilities of the relevant government agencies in this sector. The Law 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 greenhouse gas policies and measures, 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), 37 (and Annex XXIV) and 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 and its Member States concerning Iceland's participation in the Joint Fulfilment Agreement. Therein the Parties agreed to fulfil their emission limitation and reduction commitments inscribed in the third column of Annex B to the Kyoto Protocol jointly. 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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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*). The implementation of the relevant provisions of the Governance Regulation is in process, as well as the implementation of Commission Implementing Regulation (EU) 2020/1208 and Commission Delegated Regulation (EU) 2020/1044, as these two regulations are now being incorporated to the EEA Agreement. Other delegated and implementing regulations based on Regulation (EU) 2018/1999 that will be incorporated to the EEA Agreement will also be implemented in Icelandic law subsequently. Regulation No 520/2017 on data collection and information from institutions related to Iceland's inventory of greenhouse gases emissions and carbon removal, that implemented Regulation (EU) No 525/2013, will be revised in parallel.

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 4 future years ending with 0 or 5 immediately following the reporting year.

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 policies, measures 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 Annex VII of the Governance Regulation, the report should include total GHG projections and separate estimates for the emission sources falling under EU ETS Directive 2003/87/EC (which Iceland has incorporated; see also **Section 0**), emissions falling under the ESR and the projected emissions by sources and removals by sinks under the LULUCF Regulation. In order to avoid confusion, when referring to the emissions outside the scope of the EU ETS, we refer to ESR as a consistent attribution of sectors.

1.3 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 Source and sink category 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

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 CO2 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 fertilizers	✓	NA	NA	NA	NA	NA	NA
3J Other (please specify)	NO	NO	NO	NO	NO	NO	NO
4A Forest land	✓	✓	NA	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 2021 submission is the second 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 of the planned improvements were completed for this submission and, therefore, those improvements will remain on the improvement plan and be prioritized for the next submission.

Table 1.3 Improvement Actions for PaMs and Projections

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	Low	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 2021 GHG Projections submission.	High	Partially completed

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

Table 1.4 Improvement Actions for PaMs and projections

Improvement ID	*Improvement Action*	*Priority*	*Status*
Energy (Other)	Acquire ex-post analysis of ongoing PaMs	Medium	Not started
Energy (Other)	Increase number of ex-ante evaluated PaMs	High	Started
Energy (Other)	Investigate CCS quantification possibilities.	High	Started
Transport	Increase number of ex-ante evaluated PaMs	Medium	Started
Transport	Expand ex-ante analysis to more ferries when more measures have been confirmed	Low	Not started
Waste	Improve wastewater projections	Medium	Not started
Waste	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 emissions reductions target

As stated in chapter 1.1 Iceland is along with Norway, a part of a joint commitment with the EU Member States to reduce greenhouse gas emissions by 40%[7] in 2030 compared to 1990 levels under the Paris Agreement and will apply the key pieces of EU climate legislation accordingly.

Iceland submitted its Nationally Determined Contribution (NDC) under the Paris Agreement in June 2015. According to the NDC, Iceland is a part of a joint fulfilment of a -40% 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 first NDC[8]. The cooperation entails that Iceland will a) continue participation in the EU Emissions Trading Scheme and b) have a target for emissions outside the EU-ETS by the same methodology as applied to EU Member States. The target for Iceland within the collective delivery has been set at -29%, according to JCD No 269/2019.

The Icelandic Government has, however, 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 (Ministry for the Environment and Natural Resources, 2020)[9]. At the Climate Ambition Summit in December 2020 Iceland's Prime Minister announced a more ambitious target of 55% reduction in non-ETS emissions in 2030.

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 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 for 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

[7] On 21 April this year the EU agreed upon a new goal of 55% reduction instead of 40%. The final text of the deal still needs ratification by the European Parliament and by EU ministers at the Council.
[8] Iceland's Intended Nationally Determined Contribution, Submission by Iceland to the ADP. *UNFCCC*. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Iceland%20First/INDC-ICELAND.pdf
[9] Last April the Minister for Environment and Natural Resources submitted a bill for the Icelandic Parliament that proposes the enshrinement of the target of carbon neutrality in 2040 into law.

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), 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 most likely 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). This plan is Iceland's main instrument to reach the commitment in the Paris Agreement, specifically the emissions reduction 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 1 billion ISK per year of funding from '22-'31.

The plan includes 48 measures across all sectors that aim to reduce GHG emissions and increase carbon sequestration. 15 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.

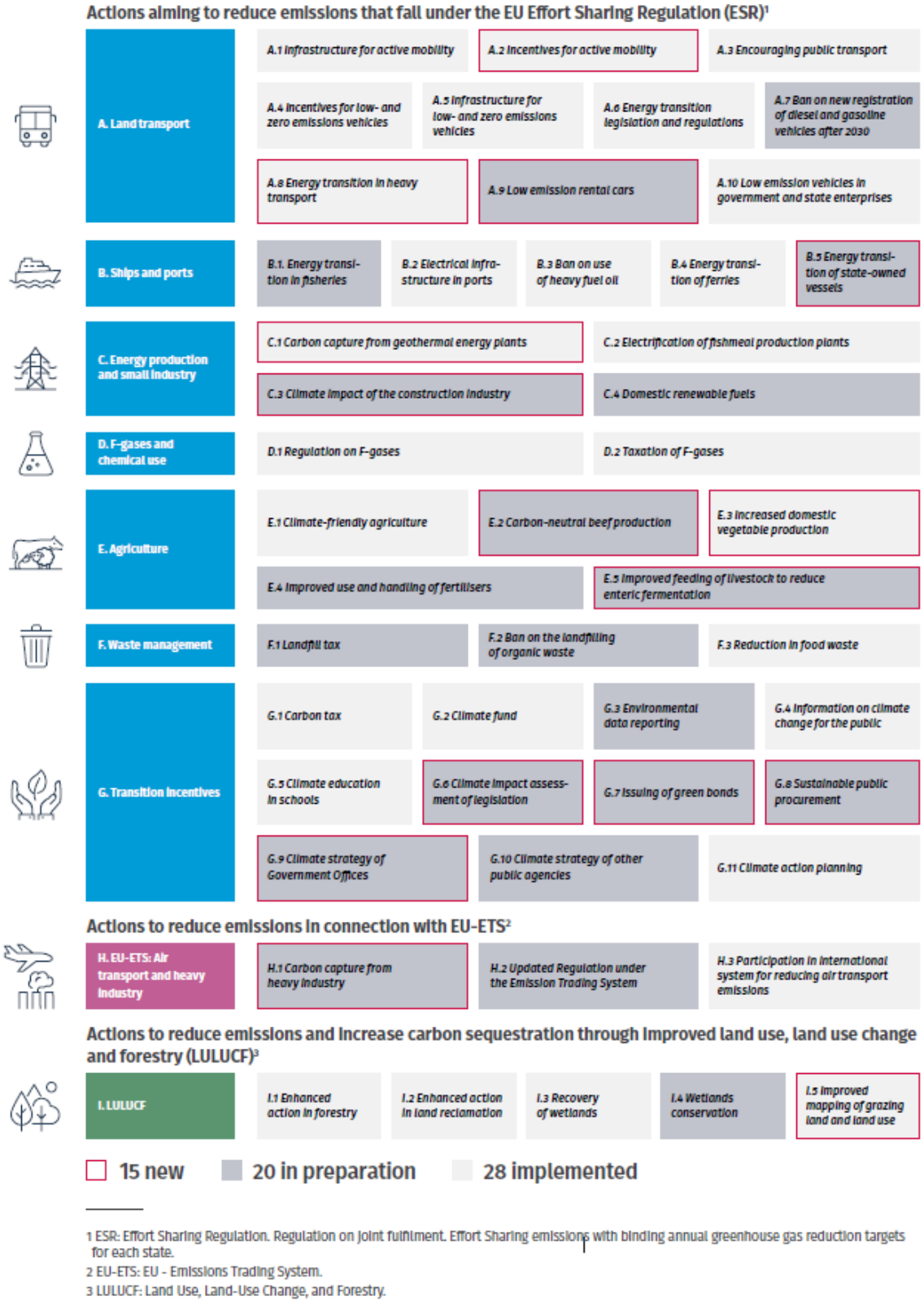

Figure 2.1 Summary of measures in Iceland's 2020 Climate Action Plan, indicating whether they are new and whether at the time of publication they were being implemented or in preparation

The following are the key differences between the 2018 and 2020 action plan.

- Changed commuting behaviour has been given more weight;
- Waste and wastefulness have been emphasized;
- Fields in which the government can lead by example have been highlighted.

According to an analysis of the updated Climate Action Plan, emissions from the ESR sectors are projected to be over 1.000 kt CO2e lower in 2030 than 2005. The Climate Action Plan is, therefore, expected to- decrease emissions by 35% in 2030 compared to 2005, which would meet Iceland's binding Effort Sharing reduction target of 29%. In addition, a further 5-11% emission reduction was expected from measures that are presented in the plan but remain yet to be quantified. The estimated impacts of the Climate Action Plan can be seen in **Figure 2.2** below.

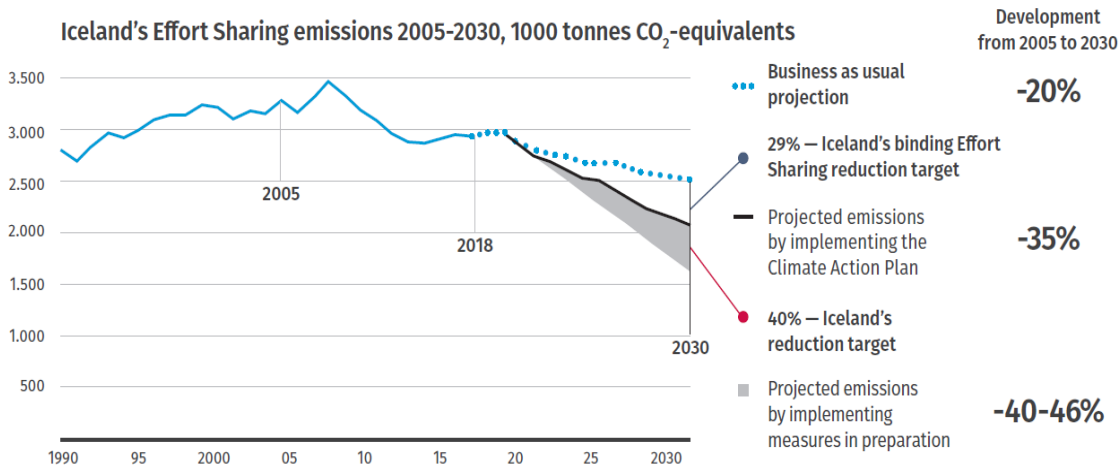

Figure 2.2 Iceland's historical GHG emissions that fall under the Effort Sharing Regulation to 2018, and projected emissions in 2030 without the Action Plan, with the Action Plan and plus measures currently in preparation.

2.1.5 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 to 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.

2.1.6 Updated ETS for aviation and CORSIA

Iceland is part of the EU Emissions Trading Scheme (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 to 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%[10] 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) is in 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 as well as all other ECAC states.

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 scheme for GHG emission allowance trading within the Community, was incorporated to the EEA Agreement through EEA Joint Committee Decision No 146/2007. The EU ETS Directive was implemented in Icelandic legislation through the Climate Change Act No 70/2012.

For the European Member States, emissions not falling under the EU ETS are referred to as ESR emissions, with reference to the Effort Sharing Regulation.

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 to the EEA Agreement with EEA Joint Committee Decision No 112/2020 and implemented in 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 the ESR 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 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, 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

[10] https://ec.europa.eu/clima/policies/eu-climate-action/2030_ctp_en

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:

- Reducing GHG emissions efficiently and effectively,
- To increase carbon sequestration from the atmosphere,
- Promoting 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 establishes 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.

Article 5 of the Climate Act describes the obligation of the Minister for the Environment and Natural Resources 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 for the Environment and Natural Resources 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, that is now 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. 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 for the production of 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).

The Climate Act was amended in 2019[11]. Notable changes include the rewording of the act in order to specifically include provisions on reporting on PaMs and projections; another notable change is the legal establishment of Iceland's Climate Council and the definition of its role in advising the

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

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 will also be 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. The implementation of the relevant provisions of the Governance Regulation in Icelandic law is in process, as well as the implementation of Implementing Regulation (EU) 2020/1208 and Delegated Regulation (EU) 2020/1044, as these two regulations are now being incorporated to the EEA Agreement. Other delegated and implementing regulations based on Regulation (EU) 2018/1999 that will be incorporated to 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 for the Environment and Natural Resources holds responsibility for activities related to the development and implementation of the national PaMs in climate change prevention.

The Environment Agency of Iceland (EAI) 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 EAI is also responsible for the submission of the National GHG Inventory for each year. The same experts in the Team for Climate Change and Air Pollution, under the Department for Climate Change and Green Communities, 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.

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 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;
- 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 for the Environment and Natural Resources**
- **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.

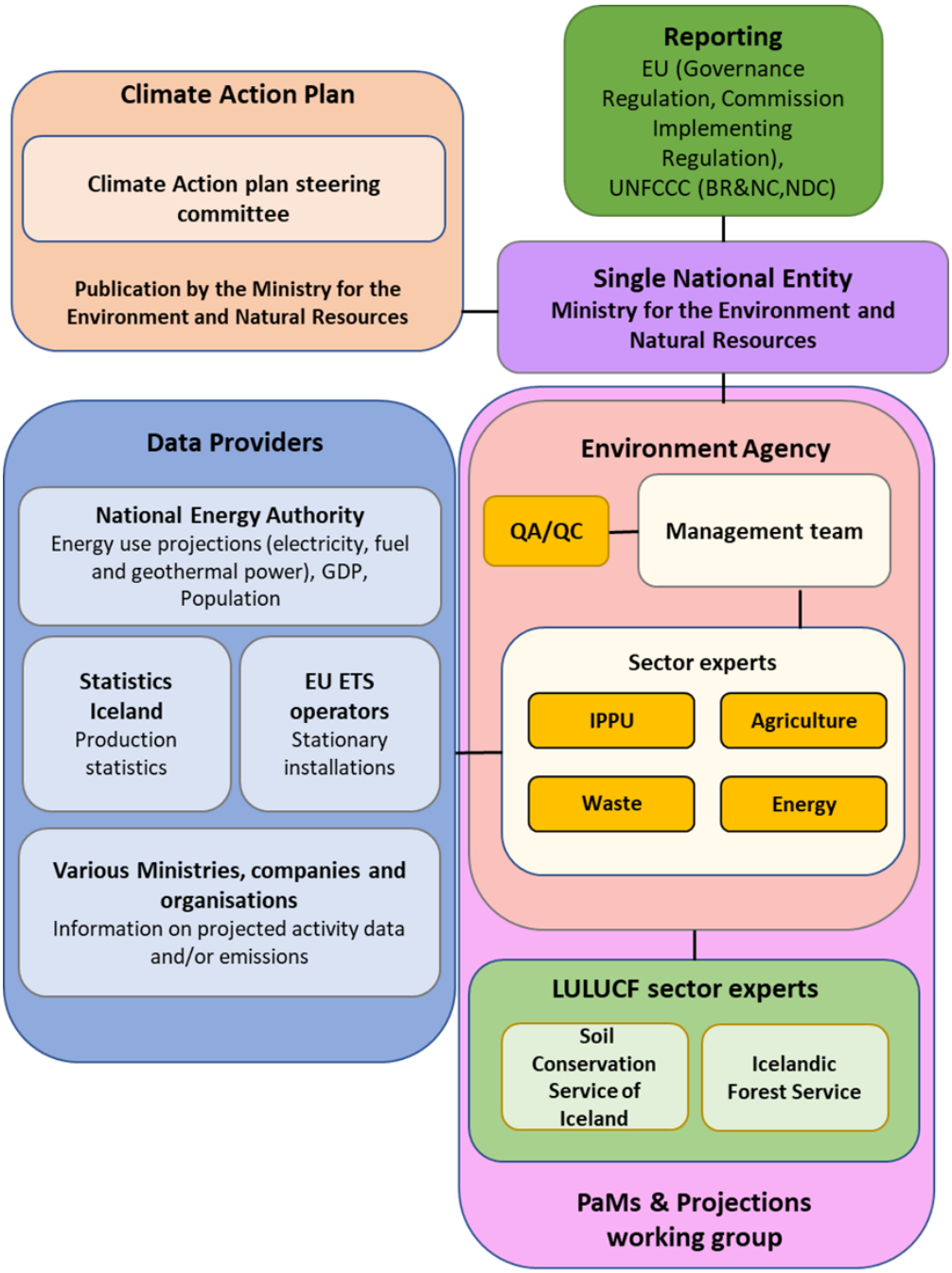

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Figure 3.1 Information flow chart of institutional arrangements for PaMs and Projections reporting in Iceland

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

The Ministry for the Environment and Natural Resources 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 for the Environment and Natural Resources** 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 for the Environment and Natural Resources appoints an **Inter-ministerial Steering Committee** that formulates proposals for climate measures and oversees their implementation. The following ministers nominate one representative each: The Prime Minister, Minister of Finance and Economics; Minster of Tourism, Industry and Innovation; Minister of Education, Science and Culture; Minister of Transport and Local Government and Minister 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 for the Environment and Natural Resources*, 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 *Team for Climate Change and Air Pollution* 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 for the Environment and Natural Resources.
- 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.

No later than six months before the deadline of the Reporting, a kick-off meeting between the PaMs and Projections working group members, including inventory experts from the EIA's *Team for Climate Change and Air Pollution*, inventory experts from the **Soil Conservation Service of Iceland (SCSI)** and the **Icelandic Forest Service (IFS)**, is organized 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).

Two to three months 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. 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 being confidentially reported 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*. Inventory experts from the EAI are involved in the PaMs quantification and projections calculations for the *Climate Action Plan* 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 for the Environment and Natural Resources** 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 for the Environment and Natural Resources facilitates communications between other relevant ministries and the EAI where applicable. For example, experts on agriculture, from the **Ministry of Industries of Innovation**, 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 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.

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 are able to prepare the calculations of both inventories in parallel. Therefore, for example, the 2021 PaMs & Projections has 2019 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 projections scenario.

The policies and measures included in the report are predominantly based on the Government's most recent Climate Action Plan. 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 often than every four years. 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 Agriculture 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), amount of fertilizers applied to agricultural soils. The development of animal numbers, fertilizer use and crop production are based on historical trends. The animal number projections are approved by experts in the *Ministry of Agriculture* under the *Ministry of Industries and Innovation*. 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 was then allocated to the various waste categories based on historical trends and operation permits of waste handling companies, while taking into account 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 categorized 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 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 1996-2019 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 for the Environment and Natural Resources 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 for the Environment and Natural Resources 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 in to 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 those Articles of the Governance Regulation that are related to reporting on climate. Art. 17 is not implemented,

but according to the Declaration on national plans[12], related to the EEA Joint Committee Decision No 269/2019[13], 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 will 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-report, submitted by the Environment Agency of Iceland.

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 for the Environment and Natural Resources** 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 for the Environment and Natural Resources appoints an **Inter-ministerial Steering Committee** that formulates proposals for climate measures and oversees their implementation. The following ministers nominate one representative each: The Prime Minister, Minister of Finance and Economics; Minster of Tourism, Industry and Innovation; Minister of Education, Science and Culture; Minister of Transport and Local Government and Minister 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 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.

[12] *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

[13] *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 the last submission of the PaMs & Projections reporting in 2019, the Environment Agency of Iceland (EAI) organized 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 EIA gained some valuable insights and contacts that were maintained throughout the preparation stage of the reporting.

After 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 has held several stakeholder meetings throughout the development process of the fuel projections, for example 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 for the Environment and Natural Resources, 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 nr. 1425/2020.

The Agriculture experts from the EAI presented draft agriculture projection scenarios to agriculture experts from the Ministry of Agriculture, under the Ministry of Industries and Innovation. 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 in the autumn of 2020. A timeline for the work was established and collaboration has been maintained throughout the preparation period of the 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 this is the first PaMs and Projections report produced by Iceland, under the provisions of Regulation (EU) No 525/2013, the process of information gathering, calculations and reporting is expected to improve in future submissions. Furthermore, the ever increasing importance and visibility of climate change matters in Iceland is hoped to lead to increased staff capacity in the various teams participating in the compilation of future inventory- and PaMs and projections reports.

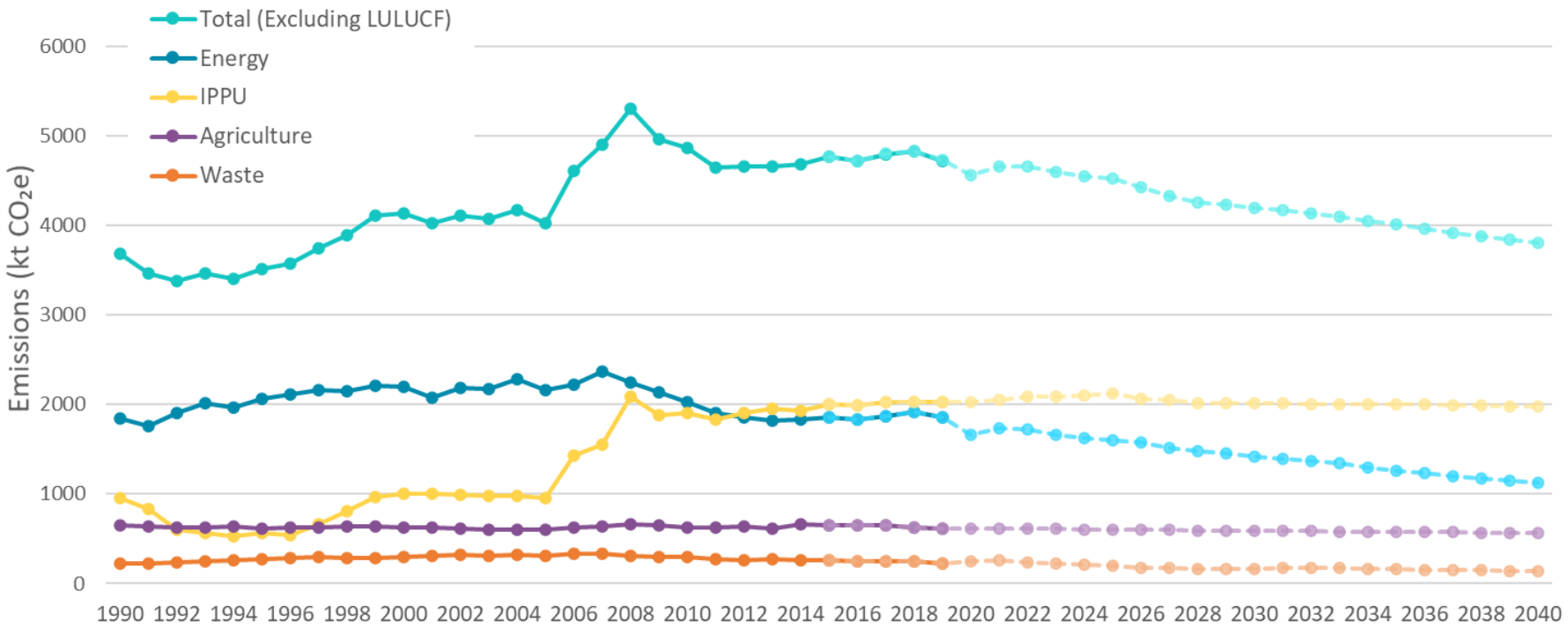
4 Summary of Projections

4.1 Total GHGs

Iceland's total historical and projected emissions of GHGs (excl. 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 have a downward trend until 2040. Iceland's GHG emissions will still be 3% higher in 2040 than they were in 1990, but they will be 20% lower than they were in 2015.

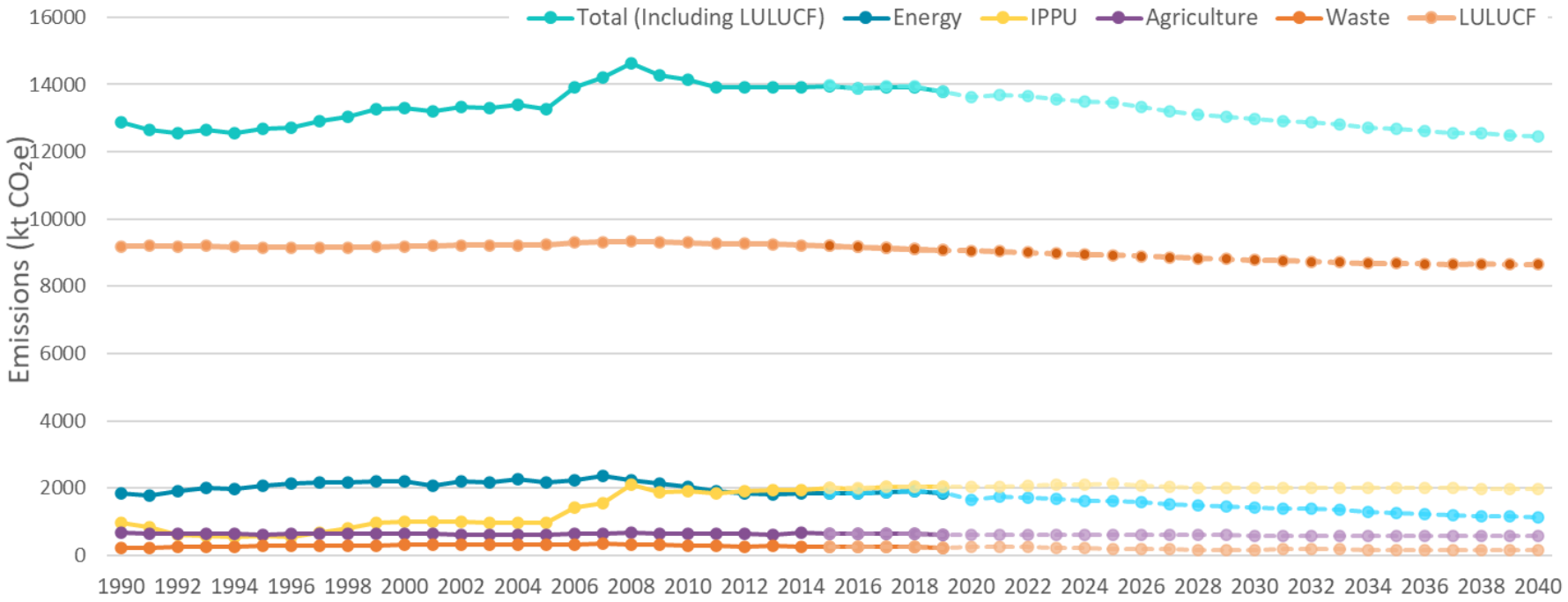
The main cause for the projected decrease in emissions from the energy sector is the impact of the electrification of the car fleet as well as a substantial decrease in emission from fishing. IPPU will mainly change because of a projected decrease in emissions from F-gases due to the newly implemented F-gas regulation which limits the import of F-gases. However, emissions reductions from IPPU will remain relatively low 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.

LULUCF emissions are expected to have decreased by 4% in 2030 and 6% in 2040 compared to emissions in 1990. Carbon sequestration due to forest land has increased 10-fold in 2019 compared to 1990 levels and is expected to change from -446 kt CO_2 p.a. in 2019 to -765 kt CO_2 p.a. in 2040.



	Emissions (kt CO_2e)						
Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Energy	1,849	1,852	1,662	1,606	1,417	1,264	1,120
IPPU	958	1,998	2,030	2,123	2,019	2,004	1,980
Agriculture	657	653	618	603	591	578	567
Waste	219	261	248	195	169	161	142
Total excluding LULUCF	**3,683**	**4,764**	**4,558**	**4,526**	**4,196**	**4,006**	**3,808**

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	9,192	9,202	9,062	8,922	8,786	8,675	8,645
Total excluding LULUCF	3,683	4,764	4,558	4,526	4,196	4,006	3,808
Total including LULUCF	**12,875**	**13,966**	**13,620**	**13,448**	**12,982**	**12,681**	**12,453**

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 fairly steady from 2015. Based on the current projections, ETS emissions will 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**).

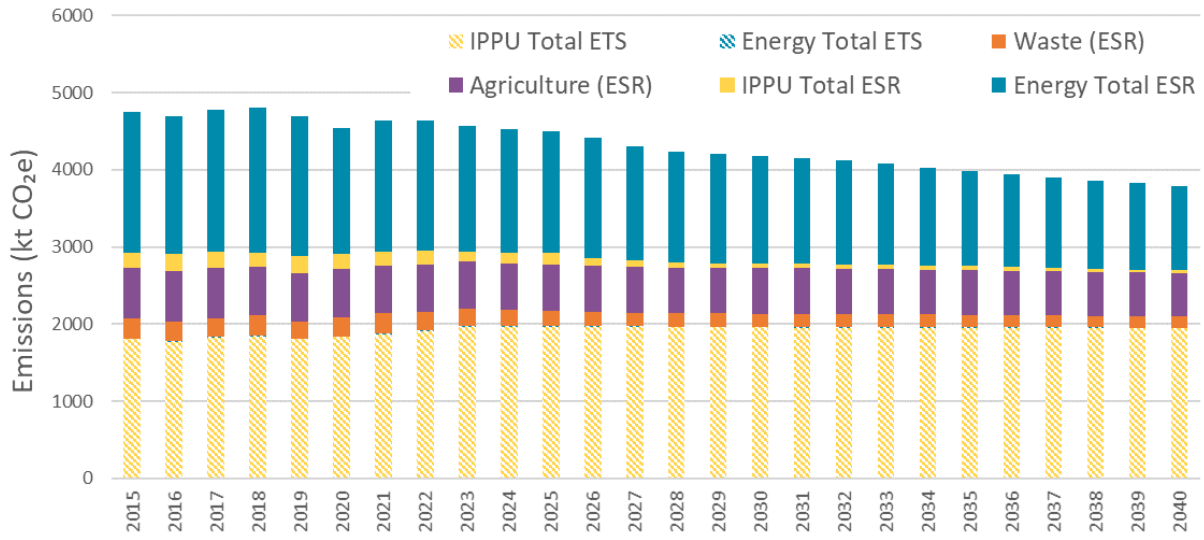


Figure 4.3 Sectoral ETS and ESR GHG projections, WEM scenario

Table 4.1 Sectoral ETS and ESR GHG projections, WEM scenario

	Emissions (kt CO_2e)						
Sector	**2005**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Total ETS	856	1,813	1,843	1,971	1,967	1,960	1,954
Total ESR (ktCO_2e)	3,141	2,936	2,695	2,534	2,210	2,028	1,837

The projected ESR emissions for the year 2030 amount to approximately 2210 kt CO_2e, which corresponds to 30 % less than the year 2005. Iceland´s commitment for the year 2030 is -29% under the ESR.

4.2 Methodology Overview

The methodologies used to calculate GHG projections are consistent with the latest NIR. For information on the sectoral methods see the NIR (2021). Where methodologies are not described within the sectoral chapters the method from the NIR has been followed. The following exceptions should be noted:

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 (excluding LULUCF) and is therefore reported in a separate chapter (see **Section 0**). An overview of the historical and projected total emissions for the Energy sector within Iceland is given within **Table 5.1Error! Reference source not found.**.

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 utilize a higher share of fossil fuels.

The largest contributor of GHG emissions from the Energy Sector (excluding 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 Energy are based on an unpublished fuel and energy projection which will be finalised and published during the summer of 2021 and at that time the emission projections will also be revised.

5.1 Emission trends

The historical and projected trend for the Energy Sector (excluding Transport) can be seen in **Figure 5.1.** Overall, emissions from the Energy Sector (excluding Transport) have declined by 36 % between 1990 and 2019. In contrast, only a small decline is currently projected up until 2040.

Within the Energy sector (excluding road transport) the largest sources are manufacturing industries and construction (1A2), fishing (1A4c) and geothermal energy production (1B2d), see **Error! R eference source not found.**.

Emissions from Fishing (1A4c) have been steadily decreasing since 1996, with some annual variations. Emissions are projected to peak in 2021, and steadily decline between 2021 and 2040. No major changes are expected in the sector for the time period. Some emission savings are reported, however, due to increased share of renewable energy used in fishing. In the projections it is assumed that biodiesel is the most likely 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. Other sectors are also projected to remain relatively steady.

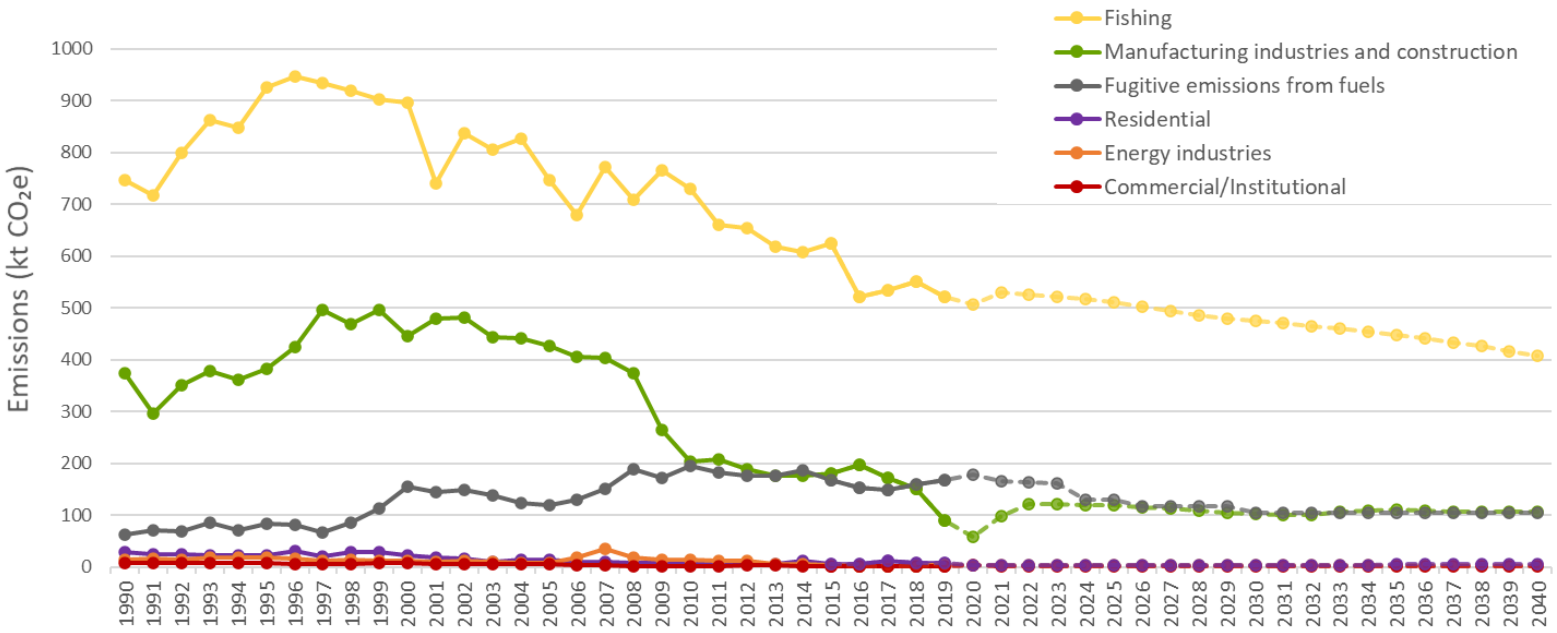


Figure 5.1 Energy (excluding Transport) Emissions of Total GHGs (kt CO2e), WEM scenario

Table 5.1 Historical and projected emissions (kt CO2e) in the Energy sector

	Emissions (kt CO_2e)						
Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Energy industries (1A1)	14	4	3	3	3	3	3
Manufacturing industries and construction (1A2)	373	180	58	119	102	110	107
Commercial/Institutional (1A4a)	8	2	2	2	2	2	2
Residential (1A4b)	28	6	4	4	4	5	5
Fishing (1A4c)	746	624	506	511	476	448	408
Fugitive emissions from fuels (1B)	62	168	177	129	105	105	105
Energy excluding Transport (1A1,1A2,1A4,1B)	**1232**	**984**	**750**	**768**	**691**	**673**	**631**

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 approximately 2% of the total emissions from Energy (excluding Transport). The split between ESR and ETS emissions is projected to remain fairly constant over the time series (Error! Reference source not found.**).**

Figure 5.2 ETS and ESR GHG projections in the Energy Sector (excluding Transport), WEM scenario

5.2 PaMs

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

Table 5.2 Policies and Measures included in Energy

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	Implemented	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

PaM Name	*GHG(s)*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*Description*
						effectively bans the use of heavy fuel oil in the territorial sea of Iceland.
Carbon capture from geothermal energy plants (105)	CO_2	Planning, Research	Implemented	WEM	No	CO2 emissions from geothermal power plants will be reduced trough carbon capture, for example the CarbFix method.
Carbon tax (701)	CO_2	Fiscal	Implemented	WEM	No	The carbon tax will be increased to reduce fossil fuel use and the resulting CO2 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	CO2 emissions from the construction industry will be reduced through various incentives.

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 PaMs is provided below.

Energy transition in fisheries (101)

Reduce greenhouse gas emissions from the fishing industry through various policies and measures. Systematic measures will be undertaken to achieve an energy change in the fishing industry. The Icelandic fishing sector has already achieved significant results in reducing greenhouse gas emissions in recent years, but there are still many opportunities for improvement. It is crucial to use seize those opportunities in order for Iceland to reach its climate targets. Creating a defined framework in order for the sector to be able to do its part to reduce greenhouse gas emissions is a joint venture between the government and the fishing sector. A working group with representatives from 5 ministries, led by the Ministry of Finance and Economic Affairs, has been appointed to work towards this goal. This working group will make proposals on how to achieve energy change in the fishing sector by the 1st of December 2020. The working group should consult stakeholders in the fishing industry and elsewhere as appropriate. One of the working group's tasks is to assess how financial incentives to accelerate energy change in the fishing sector can be adopted in order for results to be achieved faster. The group shall furthermore suggest proposals on how the share of renewable energy sources can be increased in fishing, how blending with sustainable fuels can be implemented and what the impact of a sales obligation will be in this context. EFLA's analysis, „Energy change in ships: possibilities for energy change at sea" (EFLA, 2019), which was made for the second publication of the Climate action plan, will be taken into account. The group should furthermore make proposals on

the magnitude of greenhouse gas emissions reductions to be achieved by the fishing sector. It is probable that fuel use will need to be reduced by 50-60% compared to 2005.

Electrical infrastructure in ports (102)

Encourage the further electrification of ports across the country. Ports across the country will be further electrified systematically. In 2020 grants 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. Tourism companies will also have the opportunity to apply for grants as there are many possibilities for electrification 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 are able to 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 infrastructure. Furthermore, the cost-efficiency of reserve power to offset volatile demand needs to be analysed. Possibly, it could be met by hydrogen. The measure is managed by the project management group on energy change in collaboration with municipalities and harbour management.

Electrification of fishmeal plants (103)

Finalize the electrification of fish-meal factories and ensure that there will not be a setback in the development which has already occurred. The energy change in fish meal factories will be finalized in collaboration with the operators. In the past years fish meal 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. A part of the emissions from fish meal factories falls under ETS. Emissions from fish meal factories are volatile in nature, but the overall trend over the last few years is downward. In 1997 ESR emissions from fish meal factories was at its highest, at over 180 kt. It had, however, been reduced to 12 kt in 2019. It must be ensured that this development continues and does not suffer from any setbacks by working on quitting the burning of fossil fuels in fish meal factories completely. One of the measures that will be taken is establishing how electricity security can be increased in the places where fish meal factories are operating, how other technological hindrances such as local loop can be overcome, and how it can be ensured that the price of electricity to fish meal factories is cost-effective compared to oil. The fish meal factory association and representatives from the various operators have already been contacted.

Ban on use of heavy fuel oil (104)

Reducing and ultimately stopping the use of fuel oil in the Icelandic coastal zone. 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 share of sulphur. Fuel oil is, among others, used in shipping and when it burns a lot of soot and air pollutants are released into the atmosphere. The policy has been expanded since the first publication of the climate action plan and in December 2019 the Minister for the Environment and Natural resources signed a regulation

on the sulphur content of particular liquid fuels. On the 1st of January 2020 a similar requirement as is in place in so-called ECA-areas in the Baltic and North seas, where the restrictions on fuel oil are some of the strictest, came into force in the Icelandic coastal zone. 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. The Environment Agency has a monitoring role with this regulation and restrictions will be increased if it is deemed necessary.

Carbon capture from geothermal energy plants (105)

Effective emissions reductions from geothermal power plants. Ways to further diminish greenhouse gas 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 CO2. In 2018, geothermal power plants were the source of 5,3% of Iceland's ESR emissions. In the past years these emissions 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 in collaboration with the University of Iceland and foreign collaborators (see measure 306: Carbon capture from heavy industry) and it has received interest all over the world. ON and 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 CO2 into the basaltic rock HS Orka has been exploring various other solutions and the possibilities to capture CO2 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 is connected with measure H.1 on carbon capture from heavy industry.

Carbon tax (701)

There has been a carbon tax in place in Iceland since the 1st of January 2010 after the implementation of Law nr. 129/2009 on environmental- and natural resource taxes. The tax revenue from this tax for the years 2015-2017 can be seen in **Table 5.3** below.

Table 5.3 Tax revenue from the carbon tax 2015-2017 by category at the prices of each year.[14]

Tax revenue (million ISK.)	*2015*	*2016*	*2017*
Gas and diesel	1 865	2 024	2 261
Petrol	946	931	988
Fuel oil	447	491	541
Mineral oil	16	17	17
Total	**3 274**	**3 464**	**3 806**

According to the Climate Action Plan (2018) the carbon tax will continue to increase in the next years. 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 2019-2023, it was raised again by 10 % in January 2019. This will be followed by another 10 % increase in 2020. A report has furthermore been made by the Ministry of Finance and Economic Affairs which considered the costs and benefits of further fuel and vehicle taxes between 2020-2025 (Ministry of Finance and Economic Affairs, 2018).

[14] *Althingi*. https://www.althingi.is/altext/148/s/0996.html

Carbon tax on fossil fuels. A carbon tax is imposed on fossil fuels. The carbon tax is a measure which reduces the use of fossil fuels, both in transport and from other sectors. Around the middle of the year 2019 and at the start of 2020, the Institute of Economic Studies at the University of Iceland worked on analysis of the impact of a carbon tax on the fossil fuel use of Icelandic homes and businesses, at the request of the Ministry for the Environment and Natural Resources. The analysis indicates that it is possible to reduce the consumption of fossil fuels, and thereby GHG emissions from fossil fuel consumption in Iceland, 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 the homes using 1-2% less fossil fuels than otherwise. Businesses reduce their fossil fuel consumption by approximately 0,3% when the price increases by 1%. At the beginning of 2018 the carbon tax was raised by 50%, in line with the government's policy statement. The tax was raised by 10% at the start of 2019 and again by 10% at the start of 2020.

Domestic renewable fuels (702)

Assess the cost-effectiveness of domestic fuel production. The cost-effectiveness and environmental benefits of domestic fuel production will be assessed. In the cost-benefit analysis an emphasis will be placed on ensuring that all EU requirements on such production, including lower greenhouse gas emissions, would be fulfilled. Hydrogen, methane, methanol, ethanol and bio diesel 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 in the field, and the possibilities for domestic production until 2030 has been assessed. In 2020 an additional analysis to determine the cost-efficiency of domestic fuel production and map the obstacles to utilizing 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 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 price 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 B.1 on energy change in the fishing sector, it will be mapped whether requiring the mixing sustainable fuels with other fuels 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)

Identify opportunities to reduce greenhouse gas emissions from the building industry. Greenhouse gas emissions from the construction industry will be systematically reduced. It is difficult to assess the climate impact of the construction industry from the National Inventory, but the main emissions occur during construction and are caused by the choice and import of construction materials and the use of heavy machinery, for example to transport minerals. Only emissions from a small part of this, that is the use of heavy machinery, falls under Iceland's ESR emissions. After the first edition of the Climate Action Plan (2018) was published, the Ministry for the Environment and Natural Resources initiated a lot of research into the climate- and environmental impacts of the construction industry. Examples of the research which was undertaken include the climate impacts of the construction industry, life cycle analysis, the treatment of waste and frost proof sustainable concrete. The conclusions of this research will be finished at the Innovation Centre Iceland (Nýsköpunarmiðstöð Íslands) in the near future. In addition, the Green Building Council Iceland (Grænni byggð) has conducted an analysis of the circular economy and the construction industry, construction waste

pathways have been mapped, guidelines on the treatment of construction waste have been published and information brochures and appraisals of environmental certifications (for example BREEAM and the Nordic Swan Ecolabel) have been completed. A collaboration project, managed by the Housing and Construction Authority (Húsnæðis- og mannvirkjastofnun), has been set afoot to work on a plan to reduce greenhouse gas emissions from the construction industry based on the aforementioned research and projects. A broad base of companies from the entire value chain of the construction industry, as well as representatives from the Ministry of Social Affairs, which is responsible for housing and construction issues, and the Ministry for the Environment and Natural Resources, which is responsible for climate issues, will be participating in the collaboration project. Other stakeholders, such as other Ministries or government organisations will be consulted as appropriate. A proposal for this plan is expected to be handed over to the Ministries no later than the 1st of November 2020. Among the measures which will be explored is whether all public buildings should be required to have environmental certifications (such as for example Svansvottun).

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 case in this report for the energy sector. Furthermore, they were not quantified 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), where quantified individually due to availability of data on specific developments within the relevant sectors. These data sets were acquired from the relevant companies and associations, which formed 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 case is formed to represent the development excluding the effects of PaM 102. Quantification of the BAU case 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 case is formed to represent the development excluding the effects of PaM 103. Quantification of the BAU case is based on recent development in the fishmeal industry, i.e., development of fuel utilisation changes 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 fuel, 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 last submission of the PaMs & Projections reporting in 2019, the Environment Agency of Iceland (EAI) organized expert review meetings for the energy sectors 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.

After 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 has 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 (2021) and fuel projections from the Fuel Projection Working Group. This data will be published in summer 2021, but experts from the EA are a part of the committee and therefore had access to this data.

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 (unpublished)
1.A.2 Manufacturing industries and construction	Fuel projections (unpublished)
1.A.4 Other sectors	Fuel projections (unpublished)
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

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 from geothermal power which are from the operators of the geothermal power plants in Iceland. Fuel projections were available by fuel type and activity. In instances where fuel splits by activity were not available, the most recent historical split was used. This has only been applied to relatively small

subsectors within Iceland and is therefore not considered to be a priority for improvement. For a full list of Iceland's planned improvement see Section 1.4,.

Reductions in fuel use from policies have been assumed to be included in the fuel projections generated by the *Fuel Projection Working Group* (unpublished*)*. 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 policy was 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 cases.

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. 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 tonnes of CO_2 emissions per ship type in 2015 were obtained from a report on energy change by Landsnet (2016). In the Business as Usual (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 (>1000V) connection in Icelandic harbours. However, PaM 102 is expected to have 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**.

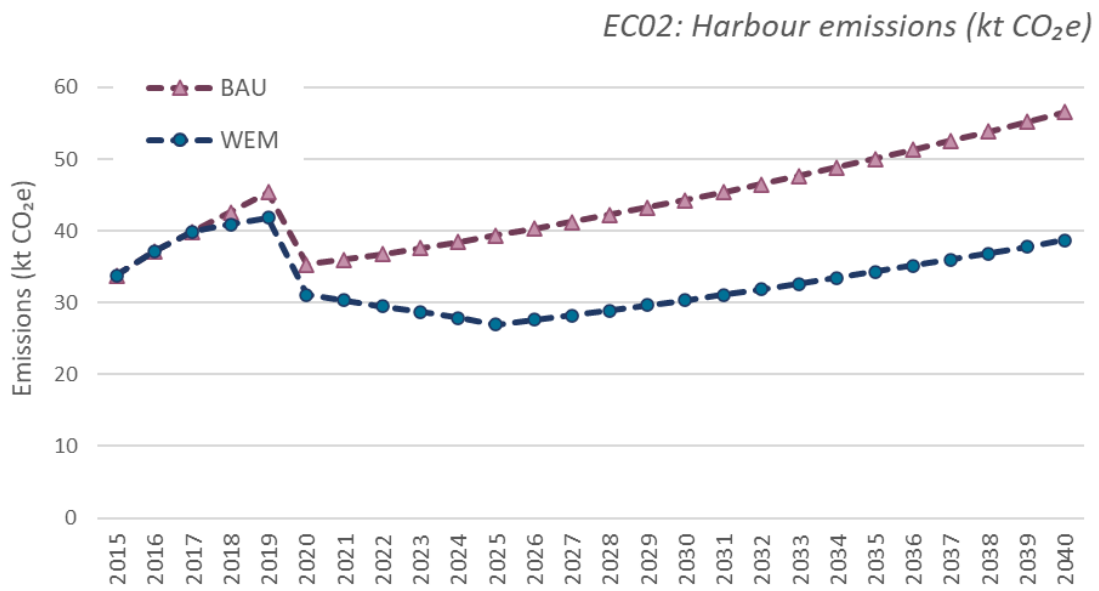


Figure 5.3 Quantified ex-ante emission impact of PaM 102: electrical infrastructure in ports (kt CO_2e).

The fuel use by vessel type is calculated by dividing the tonnes 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**Error! Reference source not found. 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)

In the IPCC subsector 1A2, fishmeal production is one of the quantified PaMs (103). 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 in order to ensure technical availability for electrification. The goal is for all fishmeal factories to switch completely over to electricity by 2030. Ways to facilitate this switch must be discussed by government, power companies and the fishmeal producers´ association. This is in line with the parliamentary resolution on energy change, which was approved in Parliament on May 31st, 2017.

The PaM Electrification of fishmeal production plants (103) was quantified specifically in relation to the WEM scenario. This was done in order to obtain a BAU case in contrast to the WEM case, in which significant development was assumed to occur regardless of this PaM. The BAU case is

therefore based on the assumption that without PaM 103, electrification of fishmeal industry would still continue, albeit slower due to less government assistance.

Projections of total oil use in fishmeal factories for the years 2020 – 2030 is 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 the past decades, as well as PaM 103's measures proposed in the Climate Action Plan.

Electrification of fishmeal factories has been an ongoing effort, initiated between the energy company Landsvirkjun and the fishmeal factories. This effort has been ongoing for more than a decade. In 2017 Landsvirkjun and the Association for Fishmeal Factories, signed a letter of intent to make it economically feasible to utilise electricity for fishmeal factories. Consequently, the BAU 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. Therefore, the BAU case is relatively similar to the WEM case in the initial years of the 2020's. However, it is assumed that without government assistance through the Climate Action Plan, fishmeal factories would not reach full electrification in the period 2020-2035. Therefore, considerable emission abatement would be assigned to the presence of PaM 103, especially after 2027.

In order to project a BAU case for fishmeal factory fuel use, an average change in utilisation of oil was found. There were significant changes in 2014 and 2015 of fuel use which created outliers in the data set and therefore omitted from the average change in fuel use. Average change in fuel use between 2010 – 2020 amounted to approximately -13% between years, with the omission of outliers. This average decrease in fuel use was not applied to the years 2020-2027 and instead the trend in those years was assumed to follow the results of the Fuel Projections Working Group. This was mainly done to keep the BAU case equal or higher than the WEM case as the WEM case is assuming effects of all efforts, be they governmental or between other stakeholders and the BAU case is assumed to be WEM minus the efforts of PaM 103 in the Climate Action Plan. If the -13% decrease would be applied to fuel use in 2020, the BAU case would have been more favourable, compared to the WEM case, in the time period 2020-2027. Therefore, the -13% decrease in fuel use is applied from 2028 and onwards resulting in fuel use to continue until 2040 at least.

The results of the BAU and WEM cases show that with all existing measures total CO_2e savings amounted to 6.6 kt in the year 2030. Total savings during the time period 2028 – 2040 amounted to

45 kt CO_2e, see figure **Figure 5.4**

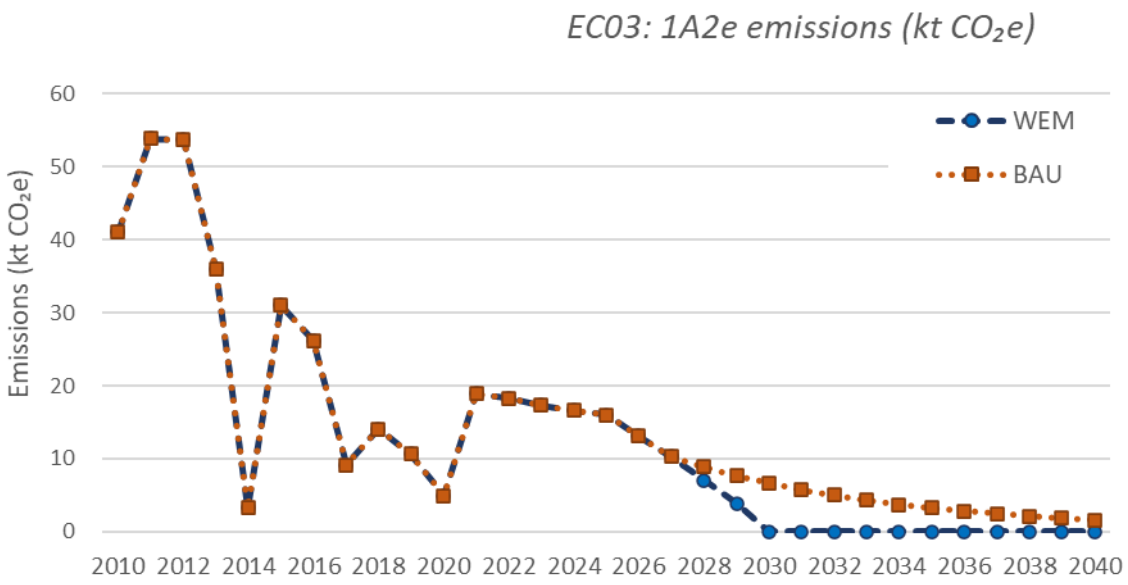


Figure 5.4 Quantified ex-ante emissions impact of PaM 103: the electrification of fishmeal factories (kt CO_2e). Results of WEM case from 2021 and onwards are acquired from the Working group on Fuel Projections.

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.

At the time of submission of this report on Policies, Measures and Projections the updated fuel projections for road transport have not be finalized. Therefore, the projections presented here are from the previous version of the fuel projections from 2016 (Eldsneytisspá 2016 – 2050). The fuel projections for Iceland will be updated and published during the summer of 2021 and at that time the emission projections will also be updated.

Fuel projections for other transport sectors have been updated with data from the fuel projections which will be published in the summer of 2021.

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 emission because of the financial crisis in Iceland. After 2014 there is a significant increase in emission 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.

In the WEM scenario, emissions from road transport are projected to decrease in 2020. 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 from 2015. It is predicted that in 15 years, the proportion of 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 two policies in the WEM scenario (see section 6.3):

- The electrification for ferries (PaM 208, see section 6.3.1)
- The electrification of harbours (PaM 102, see section 6.3.1)

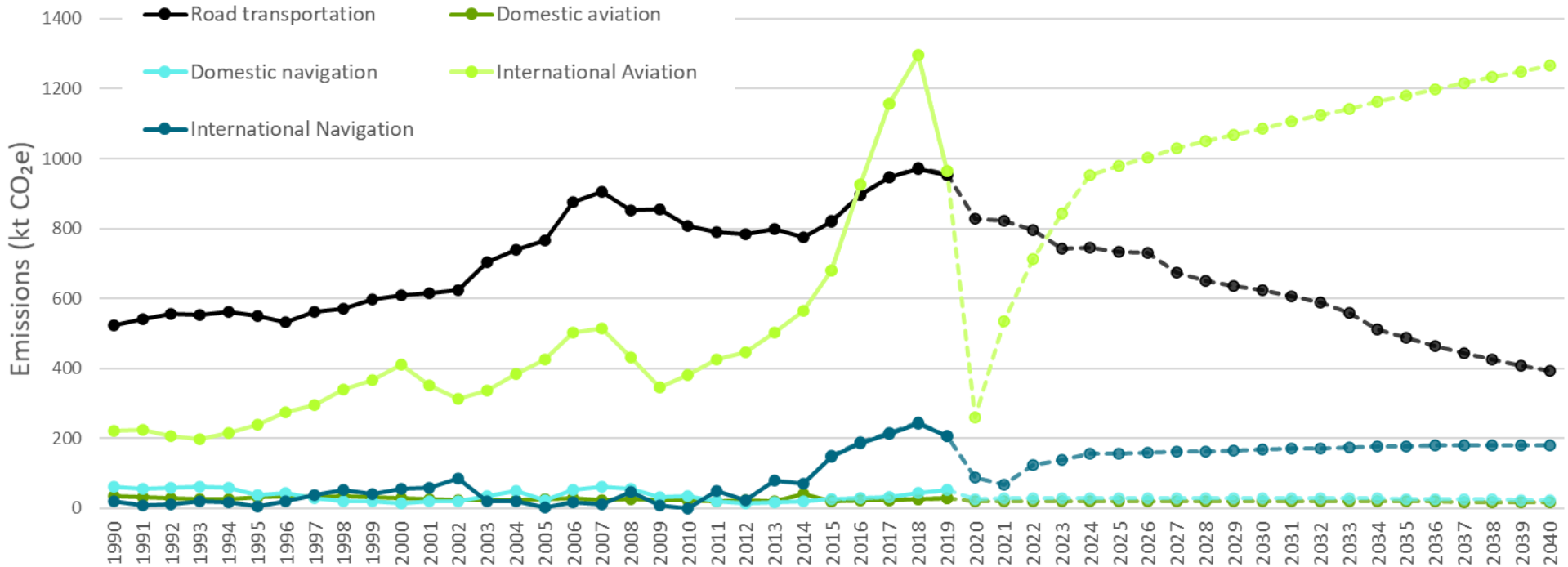


Figure 6.1 and Table 6.1; Transport Emissions (including international bunkers), Total GHGs (kt CO2e), WEM scenario

	Emissions (kt CO_2e)						
Sector	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Domestic aviation (1A3a)	34	21	19	20	19	18	17
Road transportation (1A3b)	523	820	827	732	622	488	392
Domestic navigation (1A3d)	60	27	24	29	28	27	21
Transport (1A3)	**617**	**868**	**870**	**781**	**670**	**533**	**431**
International Aviation (memo)	*221*	*680*	*258*	*979*	*1086*	*1180*	*1265*
International Navigation (memo)	*19*	*148*	*87*	*156*	*168*	*177*	*181*

6.2 PaMs

Thirteen transport PaMs are currently implemented or planned with the objective of reducing GHG emissions, summarised in Error! Reference source not found. below. Seven PaMs are related to the e lectrification 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	Implemented	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	Implemented	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 eco-friendly 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	Implemented	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	Implemented	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.

PaM Name	*GHG(s)*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*Description*
						Further measures will be adopted.
Ban on new registration of diesel and gasoline vehicles after 2030 (204)	CO_2, CH_4, N_2O	Regulatory	Planned	WAM	No	Registration of new diesel and gasoline vehicles will be banned after 2030. Some exceptions are expected, taking into account harsh climate and safety issues.
Infrastructure for active mobility (205)	CO_2, CH_4, N_2O	Fiscal, Planning	Implemented	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	Implemented	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	Implemented	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	Implemented	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	Implemented	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

PaM Name	*GHG(s)*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*Description*
						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 PaM that has been quantified; the electrification / fuel change of ferries (208), is described in more detail in Section 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).

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 GHGs 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, will be followed. The agreement includes (among others) a substantial effort to build new biking paths in the capital area (approximately 70-100 km of paths), as well as building 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.

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 January 1st 2020. The updated law states that all types of bikes should be subsidized if they will promote increased outdoor activity, improve public health and reduce road transport.

The government and six municipalities in the capital signed an agreement in September 2019 with an ambitious plan to build up transport infrastructure and public transportation in the capital area in

the next 15 years. The agreement 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 greenhouse gas emissions to reach the government´s and municipalities´ climate goals, reduce traffic jams etc. *Borgarlínan* is a part of the agreement and the preparations for construction are currently underway.

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 the two-year period 2019-2020 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) where all countries can participate voluntarily before participation becomes binding. Currently, 81 countries have committed themselves to participate voluntarily from 2021-2026. These countries are responsible for over 76% of all international aviation. 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. The Minister for the Environment and Natural Resources recommended updates at the spring assembly of Parliament in 2020.

Energy transition of state-owned vessels (212)

Reducing 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 Guards, are already being analysed. The analysis consists of looking at possible alterations of 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 bio diesel will also be increased. Furthermore, a decision has been taken on building a new marine research ship and the tender for its build are currently being prepared. An emphasis was put on saving energy and limiting the environmental impact in the design process, among others through 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, such as using LED lighting and the cooling water for the diesel engine for heating. It is also assumed that the ship will be equipped with engines which can be powered not only by fossil-fuels, but also by bio fuels 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 later on. Land electricity will furthermore be used at harbour. It is expected that heat exchangers will be set up at the ships home harbour in order 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 Industries and Innovation, which is also the Ministry for energy issues. That Ministry is, therefore, responsible for the measure.

Electrification of ferries (208)

The aim of this PaM is to achieve an energy change in ferries which are in regular operation and which are categorized 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 August 22nd2020.
- 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 9 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.

A plan will be made for fuel change in ferries which are in regular operation, with the goal of switching to ferries which use only carbon neutral energy sources no later than the next renewal.

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.

Measure 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, its potential impact on emissions has not been estimated nor included in the WEM scenario projections.

Measure on 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 PaM 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 last submission of the PaMs & Projections reporting in 2019 expert review meetings were organized 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 Transport and Local Government, 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

With the exception of road transport, the methodology used to calculate projected emissions from transport are based on fuel projections from the Fuel Projection Working Group. This data will be published in summer 2021, but experts from the EA are a part of the committee and therefore had access to this data.

At the time of submission of this report on Policies, Measures and Projections the updated fuel projections for road transport have not be finalized. Therefore, the projections presented here are from the previous version of the fuel projections from 2016 (Eldsneytisspá 2016 – 2050). The fuel projections for Iceland will be updated and published during the summer of 2021 and at that time the emission projections will also be updated.

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 (unpublished)
1.A.3.b Road transportation	Fuel projections (2016)
1.A.3.c Railways	NA
1.A.3.d Domestic Navigation	Fuel projections (unpublished)
1.A.3.e Other transportation	Fuel projections (unpublished)
Memo items: international bunkers	
M. IB International Aviation	Fuel projections (unpublished)
M. IB International Navigation	Fuel projections (unpublished)

Projections for aviation and navigation are based on fuel projections generated by the National Energy Authority and the Fuel Projection Working Group (unpublished). 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 a BAU scenario was calculated for the quantified measure (**208**) and fuel savings from the policy was estimated by subtracting the WEM scenario from the fuel projections from the BAU scenario.

Road Transport

As stated before, the updated fuel projections for road transport have not be finalized. Therefore, the projections presented here are from the previous version of the fuel projections from 2016 (Eldsneytisspá 2016 – 2050). This fuel projection was used to run COPERT (same methodology as historical emission calculations, see 2021 National Inventory Report) to make emission projections.

These emissions projections will be updated as soon as new fuel projection data becomes available.

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 power the hybrid engines. From 2021 (WEM scenario) and onwards it is expected to use some amount of diesel annually, due to regular trips to Þorlákshöfn.

To calculate the BAU scenario to 2040, historical data from 2011 for fuel used by the old Herjólfur ferry was used, and it was projected to increase linearly to 2031 when it would reach the maximum possible fuel used. The maximum possible fuel used was calculated based on the maximum possible trips that the ferry could make.

Emissions from ferry trips running on gas/diesel oil were calculated following the tier 1 IPCC methodology as is applied in the historical and projections 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.

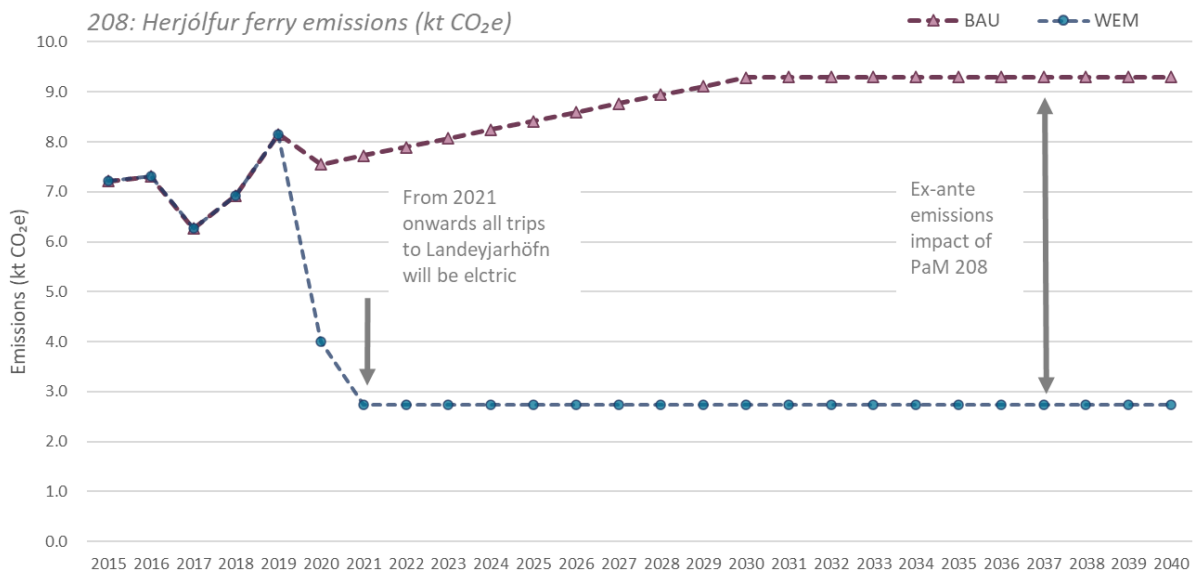


Figure 6.2 Quantified ex-ante emissions impact of PaM 208: the electrification of ferries (kt CO_2e)

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 PaM 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), predominantly in the fishing industry, also contributes significantly to emissions from the IPPU sector. An overview of the historical and projected total emissions for the IPPU sector within Iceland is given within **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. Since the previous submission of projected emissions within IPPU no methodological changes were applied for the emission estimation in the metal sector, while F-gases were estimated in a new way, taking into account the import quotas decided by the Icelandic legislature and calculating the emissions for each subcategory within sector 2F1 the same way as for the historical emissions.

7.1 Emission trends

The historical and projected emissions trend in IPPU is presented in **Figure 7.1** and **Table 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 2020 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 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 linearly 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, indicating that the maximal CO_2 emissions from IPPU have been reached. As the aluminium industry has already nearly reached maximal production capacity, the projections show only a slight increase in emissions compared to 2019 emissions and relatively constant PFC emissions, even though a prediction of PFC emissions is difficult to achieve. The aluminium smelters in Iceland are currently operating using the best technology available, following the best practices set out in the BAT Directive 2006/21/EC. 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 has, however, still been in the development stage. The aim is to scale-up the process and bring the technology to commercial size by 2024[15], when we may see a drastic change in GHG projections for aluminium smelters.

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

The **Ferroalloys** industry currently has two operating plants which produce ferrosilicon and silicon metal. One plant has operated since 1979, and the other one started operation in 2018. There is a third silicon metal plant which is currently not operating, and it is unclear whether operations are to be resumed. Due to this uncertainty, this plant was excluded from the projections. The ferroalloys industry shows a decrease in emissions, primarily due to the efforts of one company who plans to become carbon neutral by 2040 (Elkem, 2018, in Icelandic).

F-gases are mostly used for refrigeration and air conditioning in Iceland. The biggest share 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 peaks and dips 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. Transport refrigeration, including the fishing fleet, generates the biggest emissions and has a lifetime of 7 years. The peak in 2019 is, therefore, due to an increase in F-gas imports in 2012. 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. The EU Directive 517/2004 was implemented into the Icelandic Regulation system with Regulation No. 1279 from 31/12/2018, 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 the new Regulation No. 1425/2020 defines a new quota with a quicker phase out of these compounds. A comparison between the two scenarios, the import quota according to Regulation No. 1279/2018 (BAU) and the 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 since the only cement production plant closed in 2011. The projections are based on only one 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 fertilizer production plant, which stopped production in 2001, and a diatomite production plant, which stopped production in 2004. There is no information regarding 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	1	1	1	1	1	1
Chemical industry (2B)	47	NO	NO	NO	NO	NO	NO
Metal industry (2C)	844	1,810	1,837	1,966	1,962	1,955	1,950
Non-energy products from fuels and solvent use (2D)	7	8	8	8	8	8	8
Electronics industry (2E)	NO	NO	NO	NO	NO	NO	NO
Product use as substitutes for ODS (2F)	0	179	178	143	44	35	17
Other product manufacture and use (2G)	7	5	5	4	4	4	3
Other (please specify) (2H)	NO	NO	NO	NO	NO	NO	NO
IPPU (2)	**958**	**2,002**	**2,029**	**2,122**	**2,019**	**2,003**	**1,979**

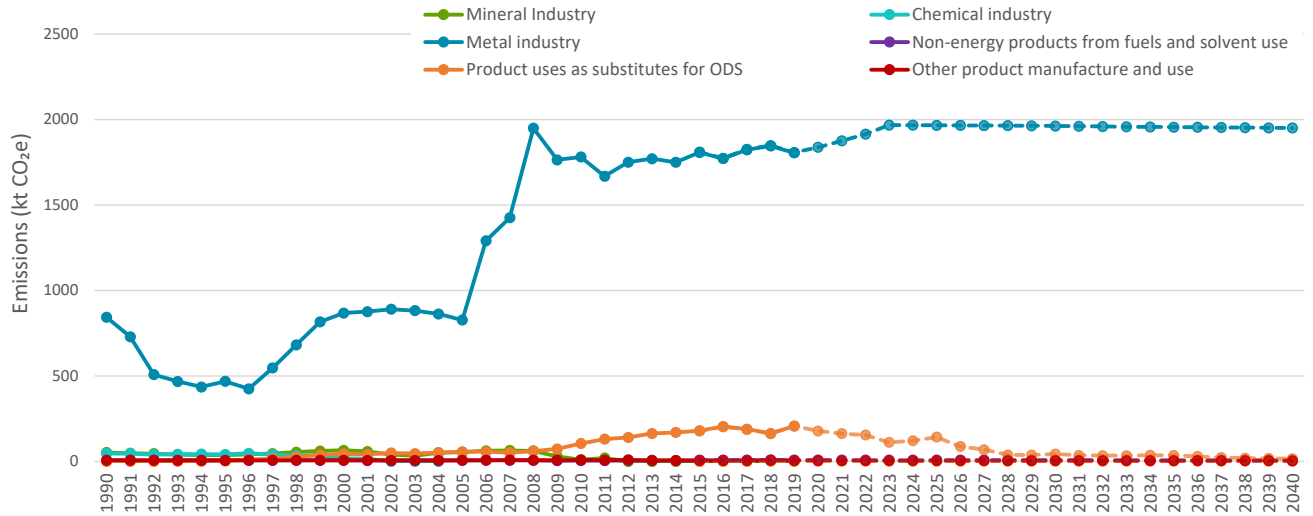


Figure 7.1 IPPU Emissions Total GHGs (kt CO_2e), WEM scenario. Unbroken lines represent historical emissions, broken lines projected emissions.

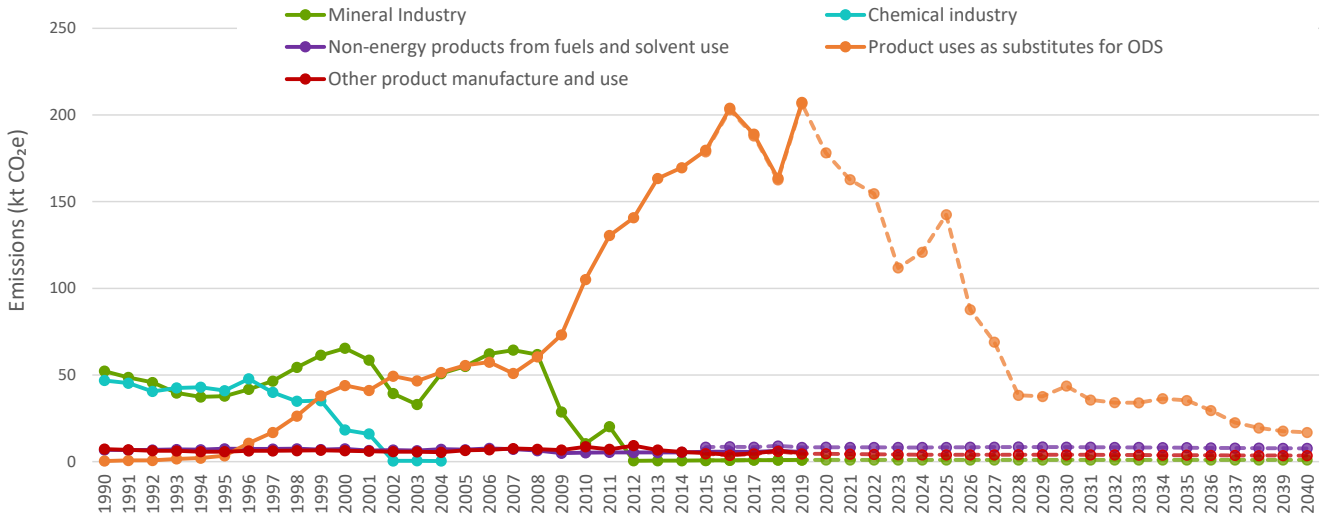


Figure 7.2 IPPU Emissions without Metal sector (2C) (kt CO_2e), WEM scenario. Broken lines represent projected emissions.

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 2C Metal sector are fairly constant while the ESR part, especially the F-gases (2F) are expected to decrease substantially (**Figure 7.3)**.

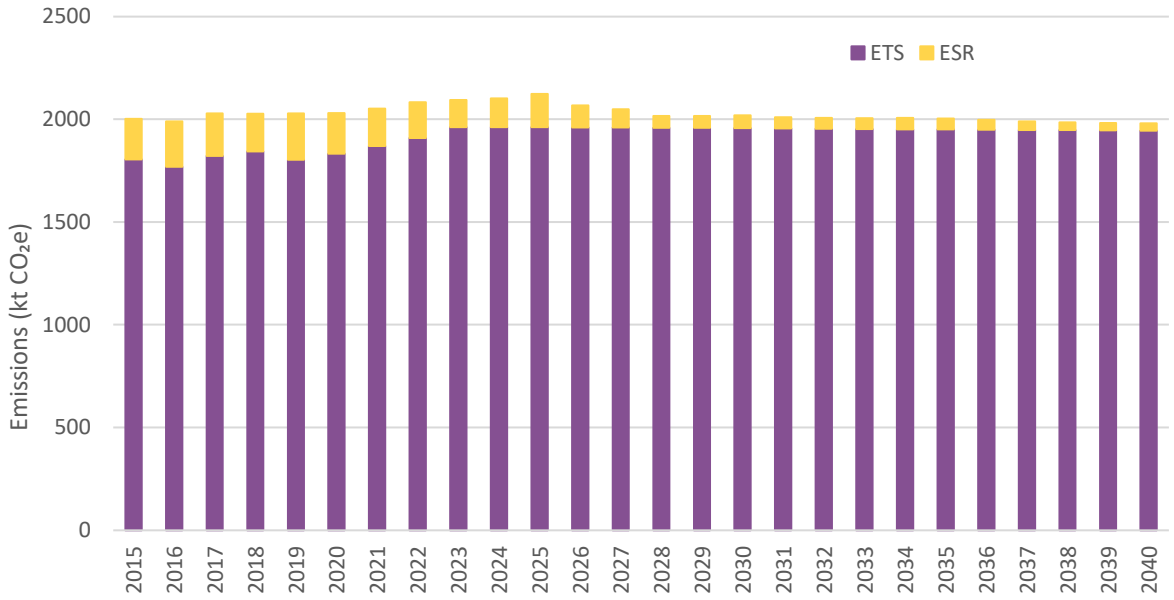


Figure 7.3 ETS and ESR GHG projections in the Industry sector, WEM scenario

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 Policies and Measures included in IPPU

PaM Name	*GHG*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*CRF code*	*Description*
Regulation on F-gases (301)	HFC, PFC	Economic, Regulatory	Implemented	WEM	Yes	2F	A regulation on F-gases will be issued adopting EU-regulation 517/2014 which includes i.e. import quota on F-gases.
MAC Directive 2006/40/EC (302)	HFC, PFC	Regulatory	Implemented	WEM	No	2F1e	Gradual ban of F-gases in passenger cars by enforcing the use of gases with a GWP lower than 150. Adopted in

PaM Name	*GHG*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*CRF code*	*Description*
							Icelandic Regulation 165/2008.
BAT for Non-Ferrous Metals Industries (303)	GHGs	Regulatory	Implemented	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 Manufacture of Glass (304)	GHGs	Regulatory	Implemented	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	Adopted	Not included in a projection scenario	No	2F	F-gases will be taxed to reduce further the use of F-gases. (Art.13 added to Icelandic law 129/2009 in 2020)
Carbon capture from heavy industry (306)	CO_2	Regulatory	Implemented	Not included in a projection scenario	No		CO_2 emissions from geothermal power plants 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	Implemented	WEM	No	2C	Updated regulation for the EU ETS will be adopted for the 4th trading period.
Environmental data reporting (708)	GHGs	Regulatory	Adopted	Not included in a projection scenario	No		Regulation will be issued for better environmental data reporting, such as material use, GHG emissions among other pollutants.

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

Iceland adopted the F-gas Regulation (EU) 517/2014 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 (regulation No. 1425/2020) and 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 on the basis of the global warming potential of the F-gases imported in bulk. This was implemented into the Icelandic legislation with Art.13 added with Icelandic law No. 135/2019 to the Icelandic law No. 129/2009 (Act 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 2500 GWP) will be banned. This regulation is an important step in reducing GHG emissions from the use of F-gases in Iceland. The Environment Agency 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. Adopted into Icelandic Regulation 165/2008.

BAT for Non-Ferrous Metals Industries (303)

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).

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 tax has already been implemented and approved in Parliament and took force on the 1st of January 2020 (Art.13 added to Icelandic law 129/2009 "Act on environmental and resource taxes" in 2020). The tax is based on the polluter pays principle which demands 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's fairly simple technologically to phase out F-gases.

Carbon capture from heavy industry (306)

Explore whether heavy industry in Iceland can systematically capture CO_2 from their operations. The „Carbfix[16]" or „gas to rock" method 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 basalt strata, where the CO_2 is permanently mineralized. The gas is, in this way, turned into rock. ON, a subsidiary of Reykjavík Energy, has used the method to reduce emissions from Hellisheiði Geothermal Power Plant in the last years with good results. According to a declaration of intent, 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 from their processes directly and pump it into basalt strata. The project is very extensive and will span 5 to 10 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 utilize the Carbfix method within the CCS.

Updated regulation under the Emission Trading System (EU ETS) for the 4th trading period (307)

Iceland will continue to participate in the ETS. New regulations have taken effect when the 4th 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 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

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

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 will last for the next 10 years, has taken over. The rules will become even stricter during this period. The rules and implementation of the ETS in Iceland need to be updated in line with the new ETS period and the Minister for the Environment and Natural Resources recommended the appropriate legislative changes at the spring assembly of Parliament in 2020. The legislative changes have not been finalised yet but are under way.

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 regulation nr 7/1998 on health and pollution prevention was altered; an obligation to report a special „green account" (grænt bókhald) was 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 is to receive more detailed data from the operators that are bound to report environmental data, in order to have better information on resource use and pollution in Iceland. A regulation on „emissions accounts" (*útstreymisbókhald*) will build on the same base as the regulation on „green accounts" and weave in further provisions to ensure that all data that the Environment Agency of Iceland needs to fulfil its legal obligations, such as reporting to EFTA's regulatory agency and the UNFCCC, is gathered and reported. The regulation on environmental data reporting is expected to apply to businesses that currently fall under the law on 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 goal is for a 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 finalized 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[17].

7.2.1 Quantified PaMs & Interlinkages with Projections

The PaM **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 place 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 PaM has not been quantified separately but is part of the quantification of **301**.

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[18]. 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 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 utilize 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 approx. 40% of Iceland's emissions are from this sector.

The recently adopted EU F-gas Regulation 517/2014 (implemented with Icelandic Regulation No. 1279/2018 and updated – quota system with No. 1425/2020) 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

[17] *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/#
[18] *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 December 2020 with Icelandic Regulation nr. 1425/2020.

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 5 years, maximal production allowance according to operation permits
2.D Non-energy products from fuels and solvent use	GDP, population 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, population projection, trends over the past 10 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 until the year 2035 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 and extended to the year 2040 as no big changes are expected in these subsectors.

According to the Icelandic Ministry of Industries and Innovation, 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, fertilizer, diatomite or steel[19]. Therefore, the projections are based on the current production, and have been increased to reflect the maximal permitted allowance according to the operation permits or to reach production amounts communicated by the individual companies. The quantification of the effects of the EU-Emission Trading System (**307**) and the Carbon Capture and Storage (**306**) were not taken into account. 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 on the whole the emissions are reduced but this cannot be quantified for the Icelandic companies separately. The Carbon Capture and Storage (306) was added to the Icelandic legislative system (law No. 12 from 18 march 2021) by adapting Directive 2009/31/EC (the CCS Directive) with the aim to enable the EU ETS industry in Iceland to utilize 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.

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 2020. Both scenarios (import quota according to regulations No. 1279/2018 – 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 2008-2018 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 taken into account 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.
C) It is expected that F-gases in refrigeration shipping containers (reefers) are phased out by the year 2030, based on a report from the European Union[20]; this has been applied to the calculation model.

Figure 7.4 shows the comparison between the two scenarios and clearly illustrates that a rapid phasing out of F-gases, achieved by the revised 2020 import quota regulation (1425/2020), will drive further emission reductions from this category. The BAU scenario presents an expected peak from this category in 2025, which is anticipated to shift to 2019 under the WEM scenario. Under the WEM scenario an increase is still expected in 2025, due to the high imports in 2018 before the import quota came into force. **Table 7.5** reports the emission amounts and the difference between both scenarios. With the new import quota regulation of 2020 emissions decrease by 76% in 2030 compared to 2015 and by 91% in 2040 compared to 2015.

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

[20] *European Commission*. https://ec.europa.eu/clima/sites/clima/files/f-gas/docs/2011_study_en.pdf, Table 6-7, page 202

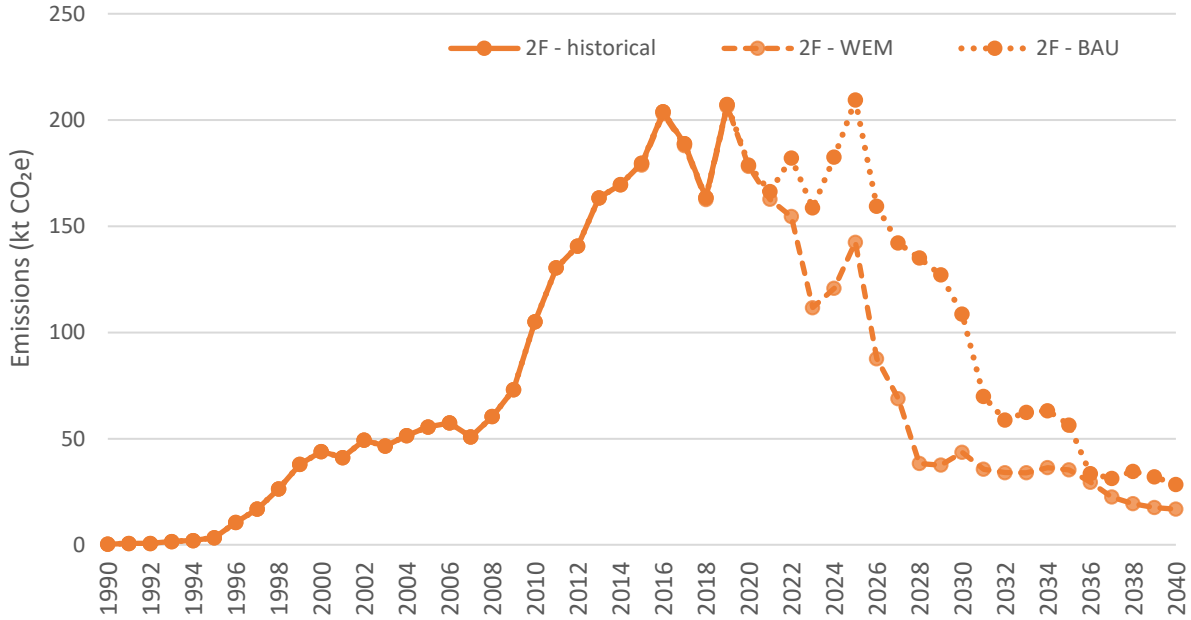


Figure 7.4 GHGs emissions from Product Uses as Substitutes for ODS (2F) due to the use of F-gases, WEM scenario compared to BAU scenario

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	180	179	209	109	56	29
2F1 Refrigeration and Air Conditioning - WEM	180	178	143	44	35	17
Difference WEM-BAU	0	-1	-67	-65	-21	-12
% Difference	0%	0%	-32%	-60%	-37%	-41%

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 fertilizers (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 6% 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 2019, 84 % of CH_4 emissions were caused by enteric fermentation, the rest by manure management. In the same year, 93 % 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 fertilizer 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 13% (85 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.

Methane emissions from enteric fermentation are projected to decrease by 20% in 2040 compared to 2015, while methane emissions from manure management are increasing by 10%. This is mainly due to the predicted increase of poultry. Emissions from the category agricultural soils are projected to decrease by 10 %. Projections for Liming and Urea were based on the historical emissions 1990-2019 interpolated linearly to reach 2040. These emissions show an increase of 7% in 2040 compared to 2015 (**Table 8.1**).

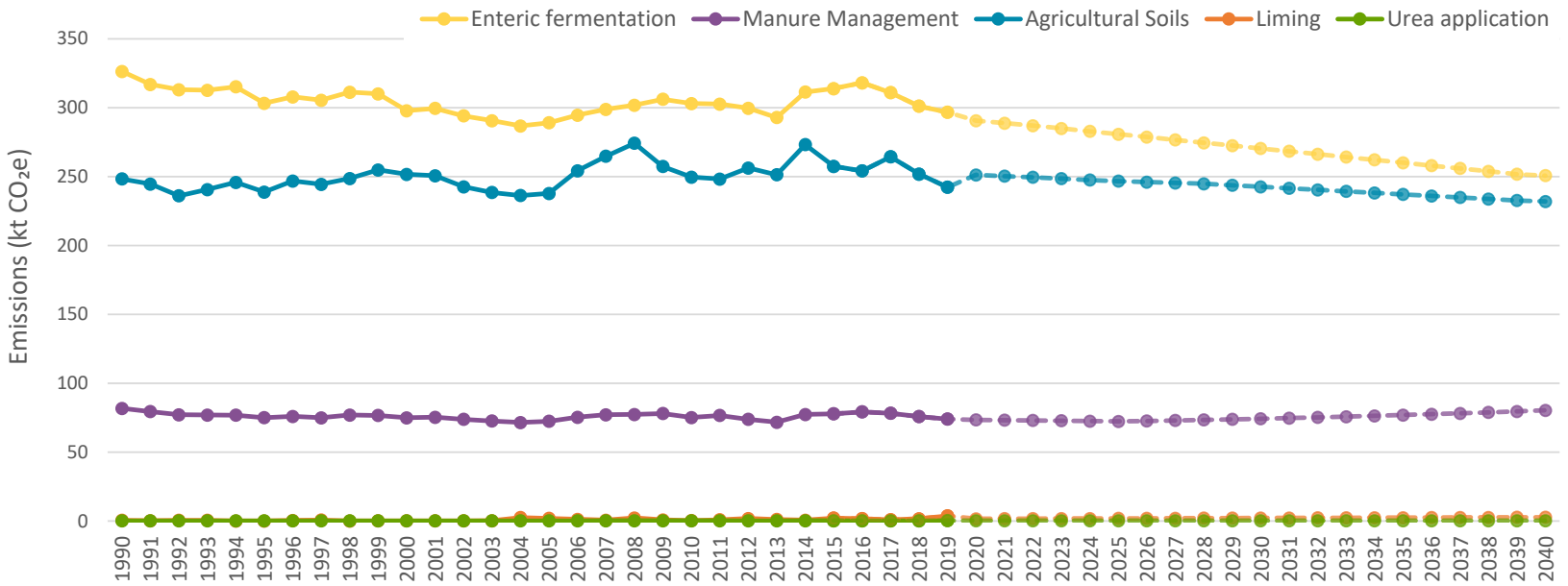


Figure 8.1 Agriculture Emissions Total GHGs (kt CO_2e), WEM scenario. Unbroken lines represent historical emissions, broken lines projected emissions.

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	281	270	260	251
Manure Management (3B)	82	78	73	72	74	77	80
Agricultural Soils (3D)	248	257	251	247	243	237	232
Liming (3G)	0.5	2	2	2	2	2	3
Urea application (3H)	0.1	0.2	0.1	0.1	0.1	0.2	0.2
Agriculture (3)	**657**	**651**	**617**	**602**	**589**	**577**	**566**

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 Policies and Measures included in Agriculture

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	Adopted	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	Adopted	WEM	Yes, 3D	Information on manure and synthetic fertilizer 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	Planned	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	Planned	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).

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 special 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, in order 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 Farmer's Association of Iceland (*Bændasamtök Íslands*), The Ministry for the Environment and

Natural Resources and The Ministry of Industries and Innovation. Courses, that will be open to all farmers, will be held with the aim of increasing knowledge and farmer's interest in climate issues. The project started in February 2020 with an open meeting for all farmers. Consequently, sheep farmers which participate in quality control in sheep farming can apply for participation in a special goal- and action- oriented project. Participants will receive guidance on making a plan that focuses on reducing the carbon footprint of their farms and is based on data from each farm. It was planned that 15 farms would participate in 2020 and expected that there will be approximately 100 participating farms 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. Research on improved feeding practices to reduce enteric fermentation from ruminants will be carefully monitored. Enteric fermentation is the process that causes methane emissions from the digestive system of livestock. The main source of GHG emissions from livestock and animal husbandry is enteric fermentation. 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. It will be explored whether it is possible to reduce emissions from enteric fermentation in Iceland through such pathways and domestic research and development will be supported. The implementation of this policy is aligned with policy **401** on carbon neutrality in cattle farming, 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 fertilizer" and „Improved manure management" have been combined in one policy. Emissions from fertilizer use in farming will be reduced by improving manure management practices and reducing the use of inorganic fertilizers. An emphasis will be placed on increasing farmers' knowledge and access to information on how best to reduce greenhouse gas (methane and nitrous oxide) emissions from agriculture. An important aspect of this effort is to enforce the regulation on protection against water pollution due to nitrogen compounds (NOx) 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 6 months of manure or the possibility of using the manure in a reasonable manner as organic fertilizer on soil. The policy scope includes the fertilizer 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 fertilizer use and lay a foundation for increased training and information sharing to other farming sectors. Consequently, it will be the project management group on climate action in agriculture's role to implement the policy for all farmers. The project management group will release the first milestone report by the end of 2020 and will make proposals on: 1) How to reduce the use of non-organic fertilizers and how the government and farmers can support this. 2) How to improve the use of organic fertilizer, such as with methane production, and how the government and farmers can support this. 3) Whether organic matter and compost can be used more in agriculture and how best

to facilitate this. 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 farmer's knowledge on carbon emissions and sequestration, improved feeding and manure management techniques will be built up. The basis 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 the project is ongoing and a management group with representatives from the Ministry of Industries and Innovation, the Ministry for the Environment and Natural Resources and the Farmer's 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 be improving the data that lay the foundation for the carbon inventory for cattle farming, and on the other hand increasing 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 (*búvörusamnignar*) 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 3 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) 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 fertilizers 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 farmer' access to direct council and education. An emphasis will be on knowing the possibilities of each individual horticultural farm directly and to build up a transparent and certified framework for the project. The project management team on the agricultural contracts will be in charge of the funding for specific projects for the year 2020, after receiving proposals from the coalition of horticultural farmers (*Samband garðyrkjubænda*). The proposals will be finalised by the end of the summer in 2020. How the funding for the years 2021-2026 will be managed will be decided by the end of 2020.

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 area would be fall into the LULUCF sector. Nevertheless, the Ministry of Environment and Natural Resources plans to measure the effects of these educational policies with the number of participating farmers.

402 proposes to look into innovative feeding systems to reduce methane emissions from enteric fermentation from ruminants, also 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[21], 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 are not part of the National Inventory Report. Greenhouses in Iceland are heated by 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.

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 **paragraph 8.3.1**

8.2.2 Stakeholder Engagement

After the last submission of the PaMs & Projections reporting in 2019, the Environment Agency of Iceland (EA) organized 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 Environment and Natural Resources, and the Ministry of Industries and Innovation, collaboration and exchange of information and ideas increased and consolidated over the past years. A meeting was held during spring 2020 with experts from both of the ministries and the Icelandic Farmer´s association to discuss the measure 404, climate friendly beef production.

Experts from the Ministry of Agriculture, under the Ministry of Industries and Innovation helped to provide livestock scenarios for the projection calculation. The experts from the Ministry reviewed the scenarios and in collaboration with the EAI the most appropriate projection scenarios were determined.

8.3 Methodology of projections

The methodology used to generate projections for the Agriculture 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

[21] "Seaweed supplementation to mitigate methane (CH4) emissions by cattle (SeaCH4NGE)" *EitFood*. https://www.eitfood.eu/projects/seaweed-supplementation-to-mitigate-methane-ch4-emissions-by-cattle-seach4nge

the entire Agriculture sector, no data was available to calculate a WAM or WOM scenario. Only for the sector 3D1 Inorganic N-fertilizers a comparison between BAU and WEM was carried out (Figure 8.2Figure 7.4).

8.3.1 Data & Assumptions:

The projections on how the agriculture sector will develop in Iceland have been 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 characterization (such as pregnancy rates, days on pastures/ in housing, feed digestibility, weight) were kept constant over the projected time series and correspond to the values used in the latest 2021 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 used in the historical inventory and could not be projected due to a lack of data and the 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 fertilizers	Linear extrapolation of historical trends

The trend in livestock populations has been predicted by extrapolation to 2040 based on the historical available data. The historical data is collected from the Ministry of Industry and Innovation and are the same numbers which 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 Industry and Innovation, which has responsibility for the agriculture 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 1980-2019 and the composition of this category (dairy cattle, other mature cattle, growing cattle) was calculated based on the average of the years 2015-2019. Horses were also extrapolated using the available historical data (1990-2019), 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 (2010-2019) as the more recent years reflect the

actual development in sheep farming better. Swine, goats, poultry are also calculated using the 10-year (2010-2019) trend.

Table 8.4 Livestock number projections and milk yield per dairy cow (kg/year)

Category	2015	2020	2025	2030	2035	2040	% change '15-'40
Dairy Cattle	27,441	23,519	22,258	20,997	19,735	18,474	-33%
Milk yield	5,851	6,400	6,500	6,500	6,500	6,500	11%
Cattle	78,776	76,253	77,290	78,327	79,364	80,401	2%
Sheep	745,832	640,667	604,069	567,472	530,874	502,920	-33%
Goats	1,476	2,289	2,952	3,615	4,279	4,942	235%
Horses	79,429	76,658	76,366	76,077	75,789	75,510	-5%
Swine	42,542	40,847	42,640	44,434	46,227	48,021	13%
Poultry	718,935	899,968	1,021,704	1,143,455	1,265,219	1,386,995	93%

The livestock projections in **Table 8.4** show that the number of dairy cattle is projected to decrease by 33 % from 2015 until 2040, while the average annual milk yield per dairy cow is projected to increase by 11 %. While 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 2%. Sheep numbers on the other hand decrease by 33% and horses by 5%. Goats, if linearly projected into the future show a 235% increase in numbers, that is they increase from ca. 1,500 to nearly 5,000. This trend does not affect the GHG emissions that much, as the numbers of goats are still low, but it 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. The category poultry also shows a substantial increase, or of 93%.

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

The quantification of the measure **403** allows the comparison of the BAU and the WEM scenario for the use of inorganic N-fertilizers. For the BAU scenario, the amount of N-fertiliser used in Iceland as reported in the NIR (1990-2019) was used to predict its usage until 2040. The historical data show 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 fertilizers are imported, the international value of the local currency contributes to the fluctuations. For the WEM scenario, a 10% reduction of fertilizer use in 2035 from the BAU value is expected. From 2030 to 2040 another linear decrease is projected, as this action is also an education/ training programme and it is expected that it will be rolled out gradually and reach more and more farmers with time. **Figure 8.2** shows the difference between the two scenarios resulting in a decrease of 11 kt CO_2e in 2040 between WEM and BAU (**Table 8.5**).

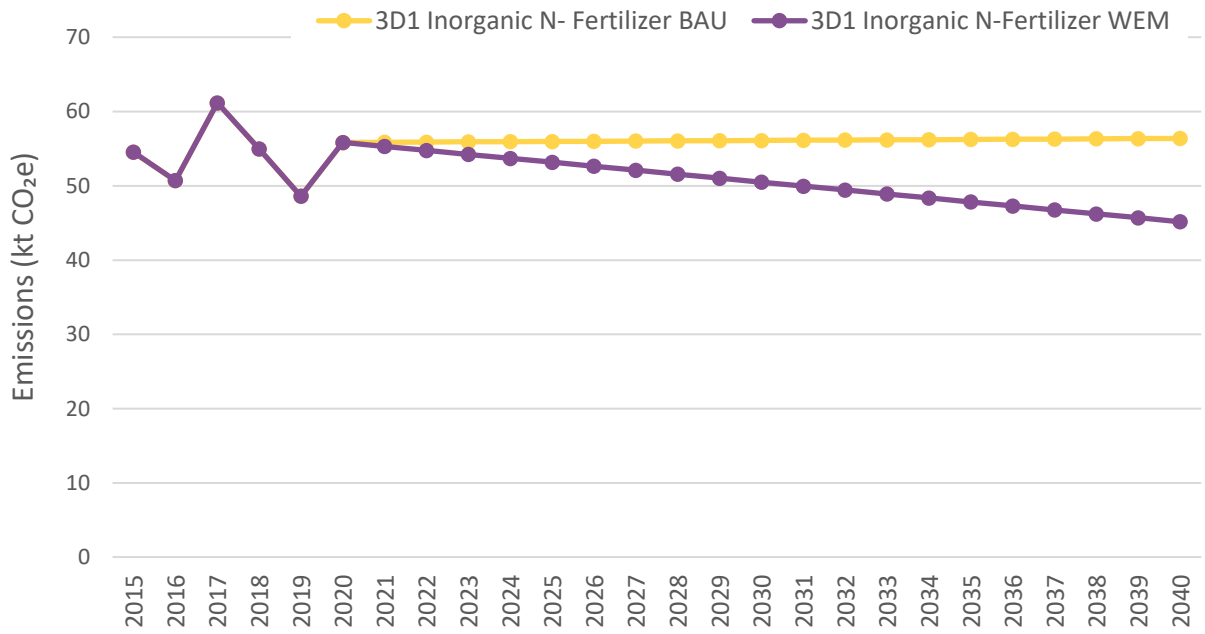


Figure 8.2 Comparison of emissions deriving from inorganic N-fertilizers (CRF category 3D1) between BAU (yellow) and WEM (purple) scenario.

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-fertilizers - BAU	55	56	56	56	56	56
3D1 Inorganic N-fertilizers - WEM	55	56	53	51	48	45
Difference WEM-BAU	-	-	-3	-6	-8	-11
% Difference	0%	0%	-5%	-10%	-15%	-20%

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 is being built at Álfsnes and started operating in early 2021. According to the operation permit[22] issued by the Environment Agency of Iceland, the plant is expected to turn 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 utilize the methane produced in GAJA[23] include in 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 2028 when they will remain fairly steady until 2034

[22] *EAI*. https://ust.is/library/sida/atvinnulif/starfsleyfi-og-eftirlitsskyrslur/Starfsleyfi%20undirrita%c3%b0.pdf, in Icelandic

[23] *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

when they will start to decrease again. The decrease up to 2028 is due to the addition of the new gas and composting plant and the consequent 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 until 2028.

After 2028, emissions are projected to remain fairly steady until 2034. 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 2034 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 and a slight increase of composting. The small step change between 2021 and 2023 is due to the stepwise start of the gas and composting plant which is expected to operate at full capacity from 2023 onwards. 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 to 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	179	116	90	81	61
Biological treatment of solid waste (5B)	0	4	4	12	12	13	13
Incineration and open burning of waste (5C)	15	7	14	14	14	14	14
Wastewater treatment and discharge (5D)	55	50	51	52	52	53	54
Other (please specify) (5E)	NO	NO	NO	NO	NO	NO	NO
Waste (5)	**219**	**261**	**248**	**195**	**169**	**161**	**142**

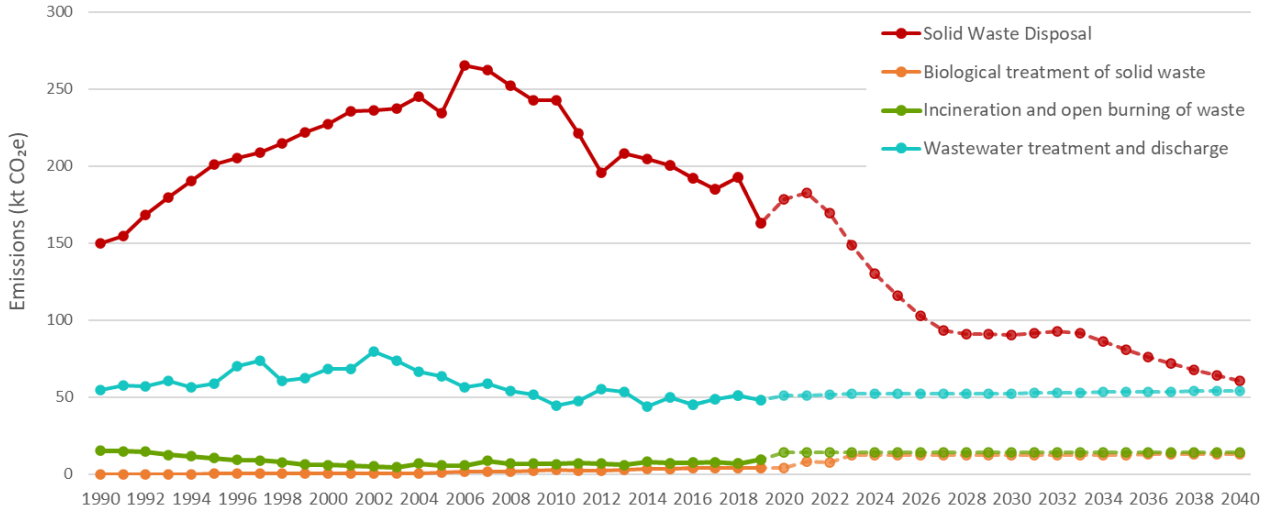


Figure 9.1 Waste Emissions Total GHGs (kt CO2e), WEM scenario. Unbroken lines represent historical emissions, broken lines projected emissions.

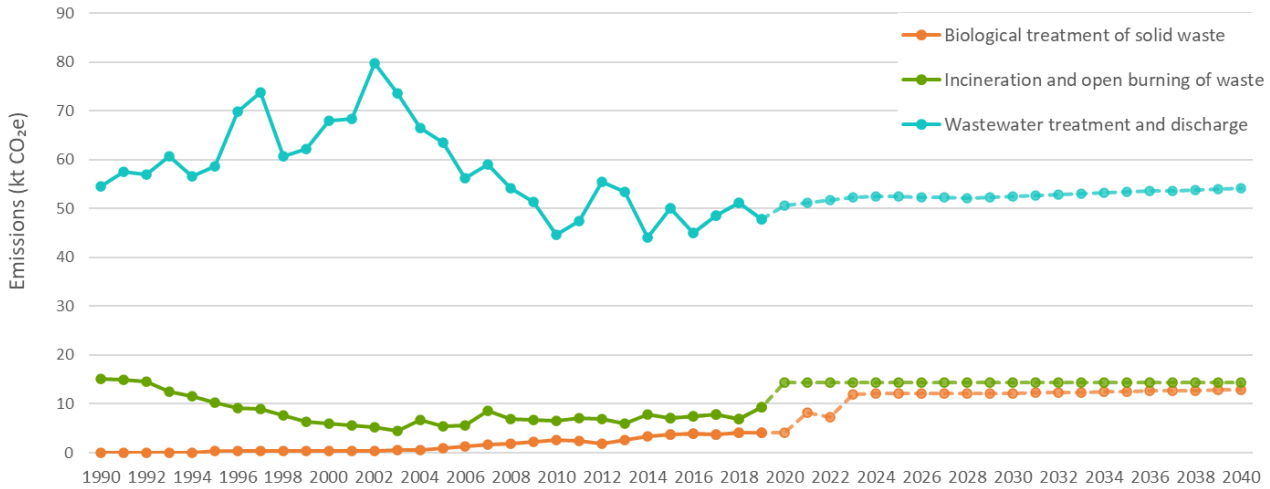


Figure 9.2 Waste Emissions excluding 5A Solid Waste Disposal Sites, total GHGs (kt CO2e). Broken lines represent projected emissions.

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 Policies and Measures included in Waste

PaM Name	*GHG*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*CRF*	*Description*
Ban on landfilling of organic waste (501)	CH_4	Regulatory	Implemented	WEM	Yes	5A	Landfilling of organic waste will be banned from 2021.
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	Adopted	WEM	Yes	5B	A new gas and composting plant is being built and will start operating at Iceland´s largest landfill site in 2020.

Three PaMs are from the 2020 Action Plan (**501, 502 and 503**). The gas and compost plant **(504**) and the ban on landfilling of organic waste (**501**) have been implemented and are, therefore, 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 and in the Climate Action Plan (Ministry for the Environment and Natural Resources, 2020).

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. Landfilling bio and biological waste will be banned in Iceland as a main rule, starting in the year 2021, according to a new legislative bill which was submitted to Parliament in 2020[24], amending law nr 55 (2003) on the treatment of waste (*Lög um meðhöndlun úrgangs*). Provisions in the bill specify that a special collection of bio and biological waste shall be set afoot and

[24] *Althingi*. https://www.althingi.is/lagas/nuna/2003055.html

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 it 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 the how the treatment of waste is prioritized. In the capital area bio waste will be diverted to the gas- and composting plant of Sorpa, at least in part, 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.

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 going to landfill every day in Iceland. Sorting will be encouraged and aim of the tax is to decrease as well total waste generation. In the first edition of the Climate Action Plan (2018) a landfill tax measure was introduced. It is proposed that the tax be 15 ISK/kg of landfilled general waste, with exception of inert waste for which 0,5 ISK/kg of landfilled inert waste is proposed. The Ministry of Finance and Economic Affairs is currently collaborating with the Ministry for the Environment and Natural Resources 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.

Reduction in food waste (503)

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 in Iceland, 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.
In 2020, the Environment Agency will continue to raise awareness on how much food is currently going to waste, education and promotion of information on food waste will receive more funding. The continued running of the Icelandic website about food waste[25] 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' attitude towards food waste has already been undertaken to track possible attitude changes.

The Minister for the Environment and Natural resources formed a project management team on food waste to form 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[26]. Out of the propositions, the government will be responsible for implementing 14 of the

[25] *Food Waste (Matarsóun).* matarsoun.is
[26] 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

measures and the business sector will be responsible for the rest. The goal is to reduce food waste, throughout the entire value chain, by 50% in the next 10 years.

Gas and compost plant (504)

A new gas and composting plant from Sorpa started operating in January 2021. 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 25.000 tonnes of organic waste every year (max capacity: 35,000 tonnes) and produce 1,.000 tonnes of compost and 3 million Nm^3 of CH_4 each year.

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 in Waste

Initiative	*Description*
The Green Steps Program[27]	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[28]	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 in 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 [29]	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. This analysis found that there are opportunities with increase wastewater treatment and the use a sludge for land reclamation.

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 measure requesting a landfill tax

[27] *Green Steps Program ("Græn skref").* https://graenskref.is/english/
[28] *Together against waste ("Saman gegn sóun").* https://samangegnsoun.is/
[29] *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

(**502**) has not been implemented yet in the legislative system due to delays and is also not quantifiable due to a lack of data.

The measure to reduce food waste (**503**) has 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.

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 in the beginning of 2021 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 40,000 tonnes/year of general waste according to the operation permit and the company has provided data about a stepwise increase from 30,000 t in the first year (2021) of operation up to 39,000 t in the third year (2023). The output of the plant is expected to be 12,000 tonnes of compost and 3 million Nm^3 of methane gas annually.

9.2.2 Stakeholder Engagement

After the last submission of the PaMs & Projections reporting in 2019 expert review meetings were organized 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 Waste experts from the EA 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 EA with projections for the future operations of the gas & 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**Figure 7.4).

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, operation permit of gas and composting plant, 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, taking into account 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 summarized as follows:

A) Calculation of overall waste generation until 2040 by correlating historical waste generation data as reported in the NIR (1990-2019) with population. A population forecast until the year 2040 was made available from 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.

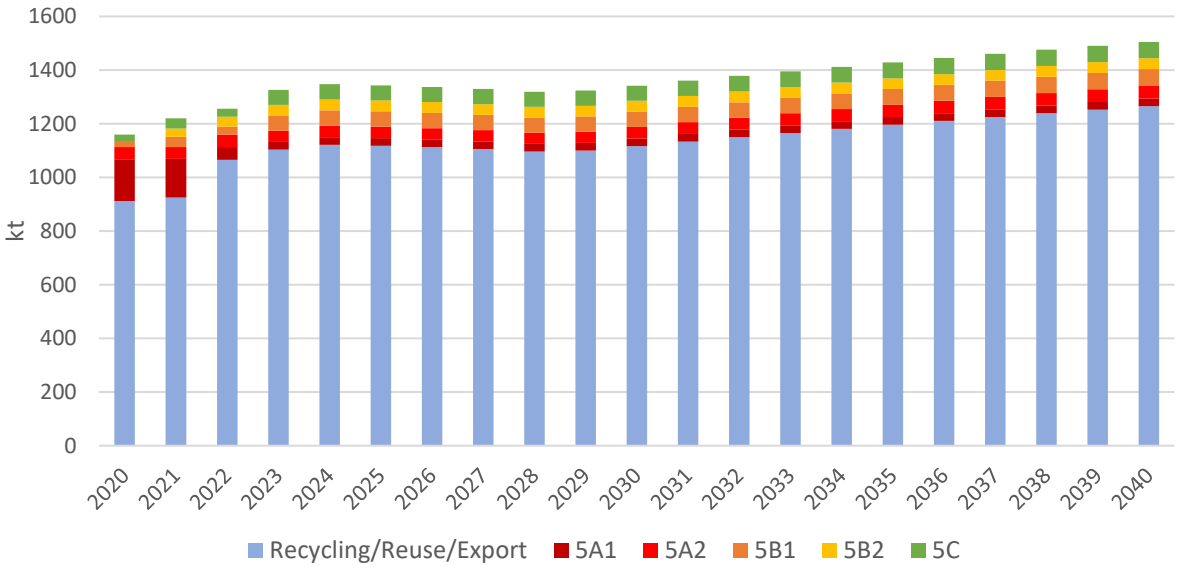


Figure 9.3 Waste allocation following the mass balance starting from total waste generation projected with population increase for the WEM scenario.

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 2015-2019) from (A) • communication of expected methane generation from operators.	• 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 compostable waste (IPCC categories Garden, Paper, Wood, Sludge) from 2023. The so created difference in amount is allocated to 5B.
5.A 2 Solid Waste Disposal Unmanaged	• 4% of total waste produced (average 2015-2019) 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 2015-2019) 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 2021 according to operation permit[30] (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[31]	• same as scenario BAU
Recycling/Reuse/Export	• Assumed average share (2015-2019) of 77% of total waste produced.	• Applying a mass balance of all allocations above the recycling/reuse and export increased from 77% to 86% over 20 years.

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. Currently no direct data for emission calculation are available from the gas and composting plant (category 5B2) as it started operations in early 2021. The emissions are calculated according to the IPCC guidelines, with default emission factors. Once plant specific emission factors are available, the projections can be refined with this

[30] *EAI*. https://www.ust.is/atvinnulif/mengandi-starfsemi/starfsleyfi/urgangur-og-efnamottaka/hofudborgarsvaedid/gas-og-jardgerdarstod-sorpu-alfsnesi-gaja/ (in Icelandic)
[31] *EAI*. https://www.ust.is/atvinnulif/mengandi-starfsemi/starfsleyfi/urgangur-og-efnamottaka/sudurnes/kalka-sorpeydingarstod-adur-sorpeydingarstod-sudurnesja/ (in Icelandic)

data. Regarding the waste allocation to 5C- Incineration, it is expected to increase the amount of waste going to the only operative incinerator until reaching the full capacity according to its current operation permit in order to allocate the waste which partly cannot be sent to landfills (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 (-189 kt CO_2e), 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 contained (+8 kt CO_2e by 2040). **Table 9.6** reports the emission decrease and increases for both categories over the projected time series.

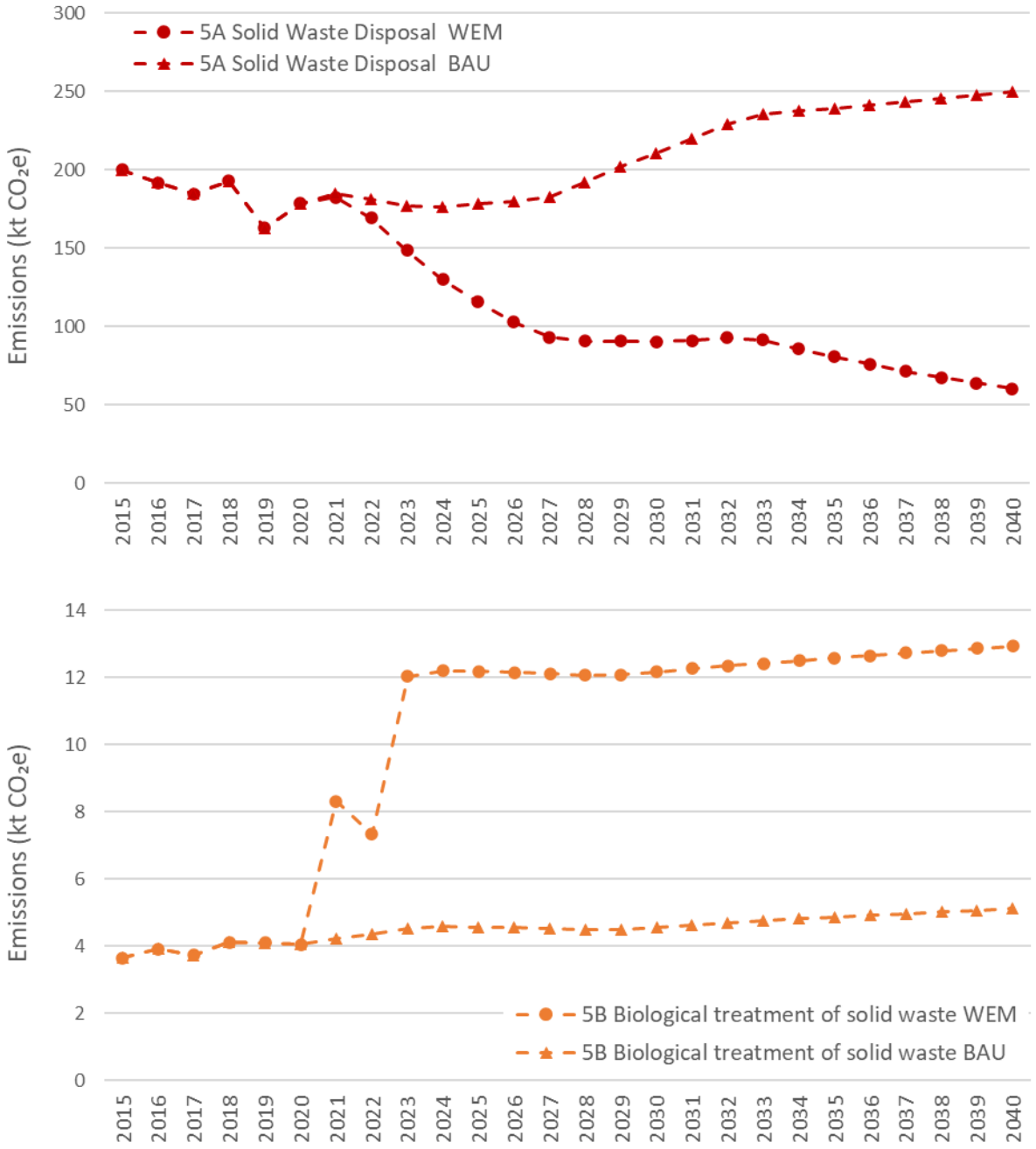


Figure 9.4 Quantified ex-ante impact of PaM 504 and 501 on GHG emissions from Solid Waste Disposal Sites (5A) on top and Biological Treatment of Waste (5B, bottom)(kt CO_2e).

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	179	178	210	239	250
5A Solid Waste Disposal - WEM	200	179	116	90	81	61
Difference WEM-BAU	-	-	-63	-120	-158	-189
% Difference	0%	0%	-35%	-57%	-66%	-76%
5B Biological treatment of solid waste - BAU	4	4	5	5	5	5
5B Biological treatment of solid waste - WEM	4	4	12	12	13	13
Difference WEM-BAU	-	-	8	8	8	8
% Difference	0%	0%	166%	166%	159%	153%
5A, 5B – BAU	204	183	183	215	244	255
5A, 5B – WEM	204	183	128	102	93	73
Difference WEM-BAU	0	0	-55	-112	-151	-181
% Difference	0%	0%	-30%	-52%	-62%	-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 2021 (Environment Agency of Iceland, 2021)). 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.

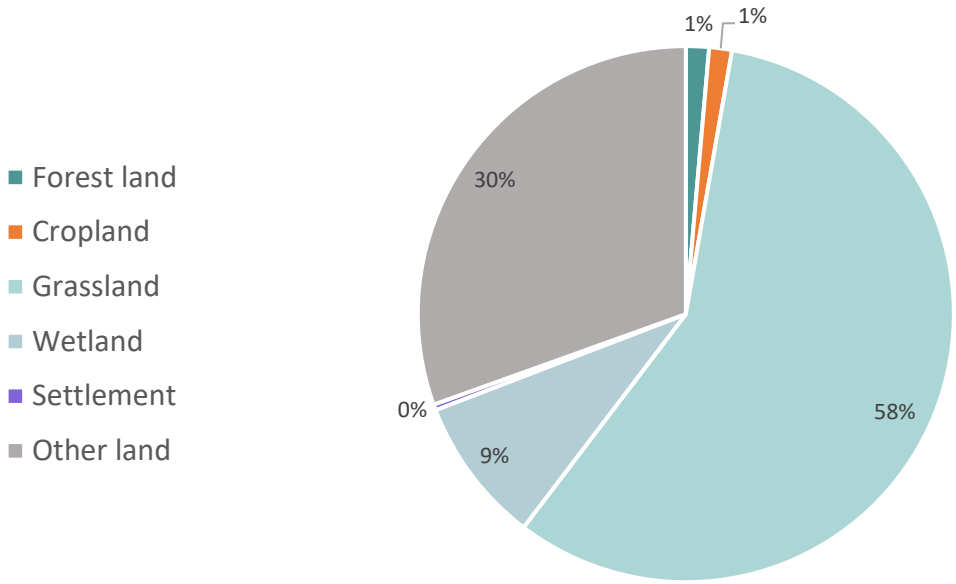


Figure 10.1 Relative size of land use categories in Iceland according to IGLUD land use map 2019 and other land use estimates available for the reporting.

Both emissions from sources and removals by sinks are reported for this sector. The net contribution of the main land use categories is summarized in **Figure 10.2**Error! Reference source not found. More information on historical emissions and removals of the land use categories is reported in the NIR 2021.

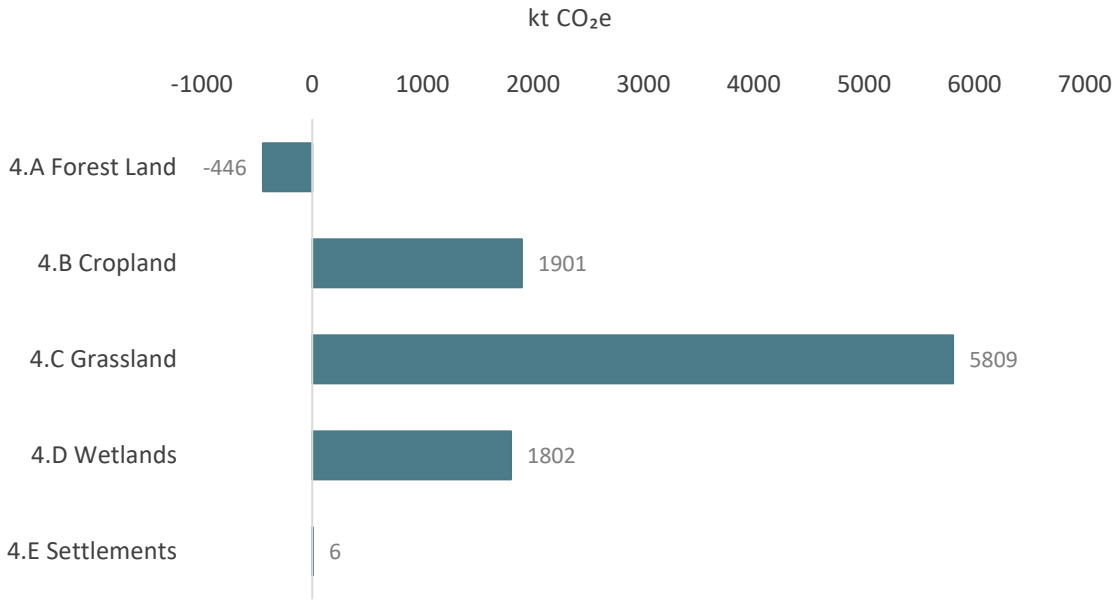


Figure 10.2 The net emissions/removals of land use categories (kt CO_2e) in 2019. Emissions from Other land (4F) are not included in this graph. Since last year's submission, the N_2O emission from Cropland management of organic soils is reported under the Agricultural sector and not included here.

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**Error! Reference source not found. 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 soil carbon storage capacity of areas of land reclaimed more than 60 years ago (**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 abandoned for more than 20 years" and "Wetland drained for more than 20 years" to Grassland.

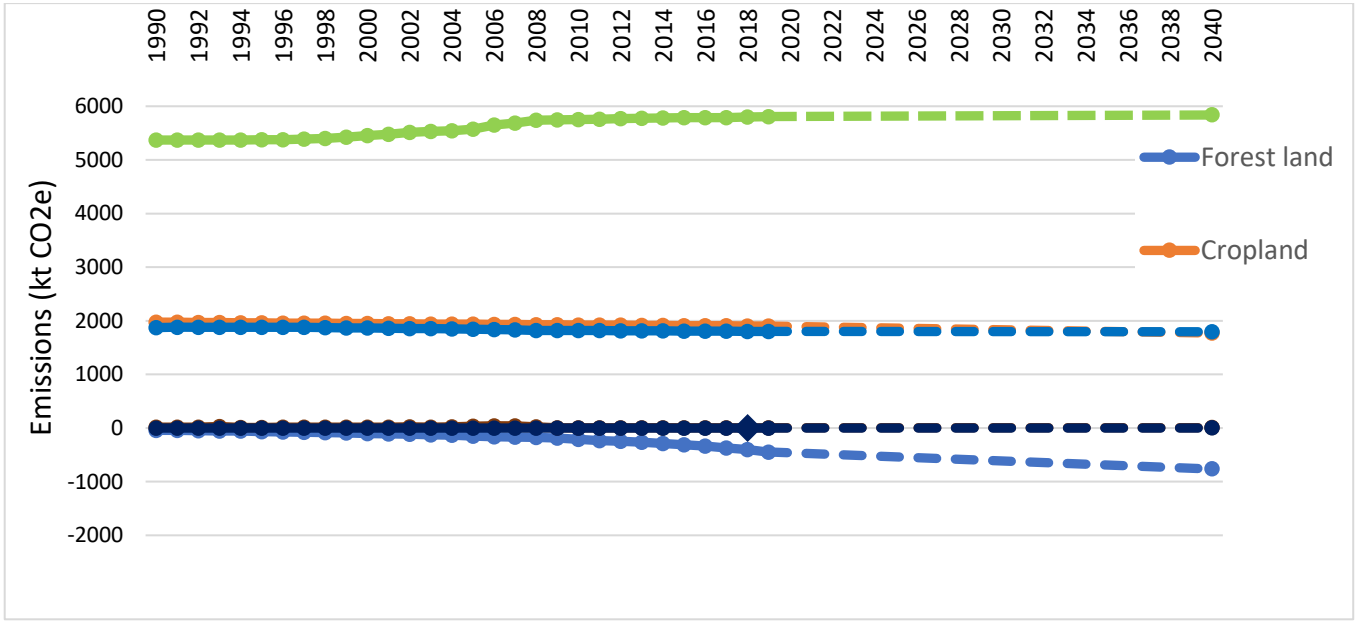


Figure 10.3 LULUCF Emissions Total GHGs (kt CO_2e), WEM scenario

Table 10.1 Historical and projected emissions (kt CO_2e) in the LULUCF sector

	Emissions (kt CO_2e)						
Categories	**1990**	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Forest land (4.A)	-43	-446	-452	-532	-606	-678	-765
Cropland (4.B)	1975	1901	1895	1864	1833	1802	1771
Grassland (4.C)	5372	5809	5812	5786	5755	5748	5837
Wetlands (4.D)	1872	1802	1801	1798	1798	1797	1795
Settlements (4.E)	16	6	6	6	6	6	6
Other Land (4.F)	0	0	0	0	0	0	0
Total LULUCF	**9192**	**9072**	**9062**	**8922**	**8786**	**8675**	**8645**

10.2 PaMs

Five 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** **Policies and Measures included in LULUCF

PaM Name	*GHG(s)*	*Instrument type*	*Status*	*Scenario*	*Ex-ante*	*Description*
Enhanced action in forestry (601)	CO_2, CH_4	Fiscal	Implemented	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	Implemented	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	Implemented	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	Implemented	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	Implemented	WEM	No	The state of grazing land will be mapped and used for grazing management

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) and Improved mapping of grazing land and land use (605) is provided below.

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[32]. A draft report on the status of soils and flora in Iceland was published at the same time[33]

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 Industry and Innovation. 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.

Stakeholder Engagement

The Environment Agency of Iceland organized 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.

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

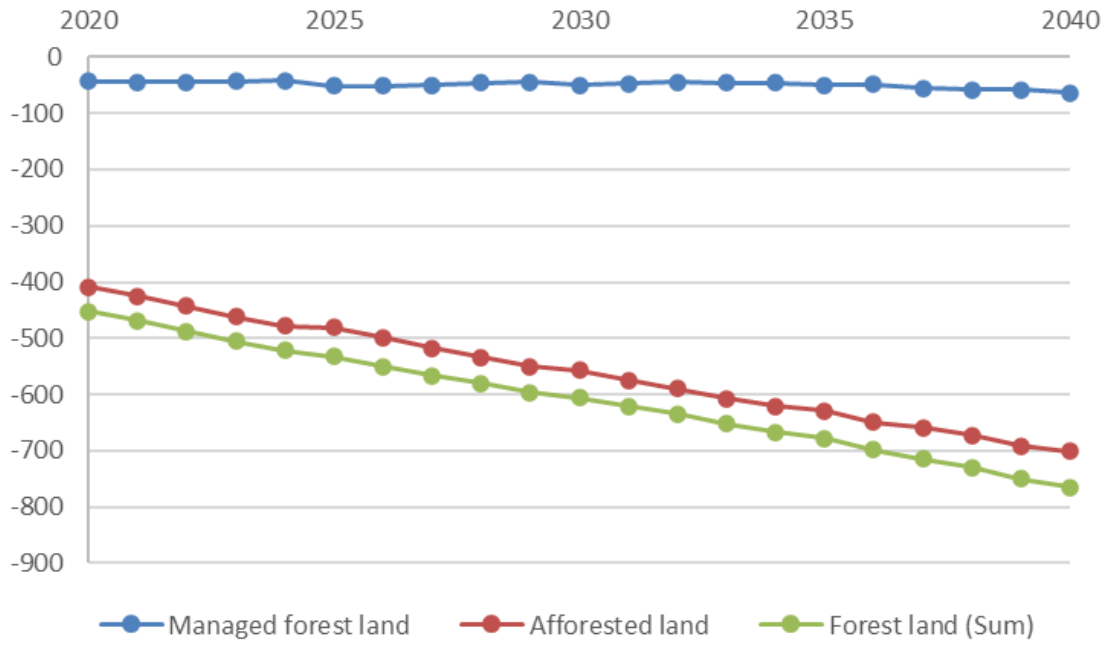
10.3 Quantified PaMs & Interlinkages with Projections

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 year 2021-2025 where afforestation is planned to increase to 2,500 ha annually in the year 2025 (Ministry of Finance and Economic Affairs 2020, pg. 290).

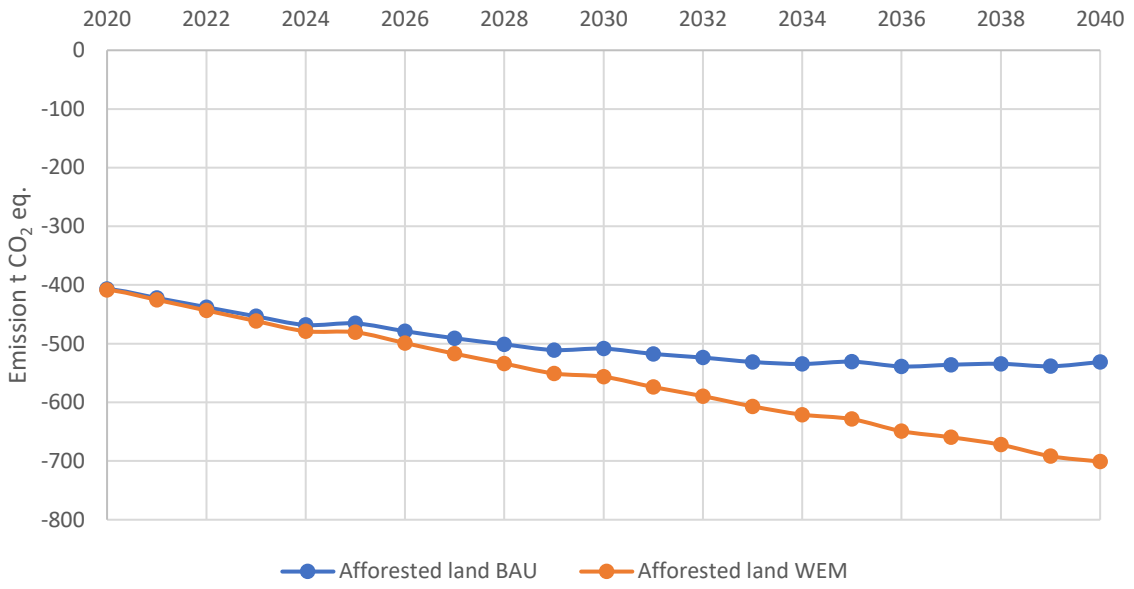
The Icelandic Forest Service (IFS) has estimated how the increased government funding described above, resulting in a more than doubling of annual afforestation from the year 2022, will affect the future net annual emissions/removals of GHGs. Projected removal can be seen in **Figure 10.4** divided between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



	2020	2025	2030	2035	2040
Afforestation WEM (kt CO_2 e)	-408	-481	-556	-629	-701
Forest management WEM (kt CO_2 e)	-44	-52	-50	-50	-64
Total WEM (kt CO_2 e)	**-452**	**-532**	**-606**	**-678**	**-765**

Figure 10.4 Projected net emisison/removal of afforestation and forest management in the period 2020-2040.

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 2018, the effect of the Climate Action Plan was estimated as shown in **Figure 10.5** below.



	2020	2025	2030	2035	2040
Afforestation BAU (kt CO2e)	-407	-465	-508	-531	-531
Afforestation WEM (kt CO2e)	-408	-481	-556	-629	-701
Ex-ante emissions impact of PaMs (kt CO2e)	**-1**	**-15**	**-48**	**-98**	**-170**

Figure 10.5 BAU and WEM projected net removals of afforestation in the period 2020.2040.

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.

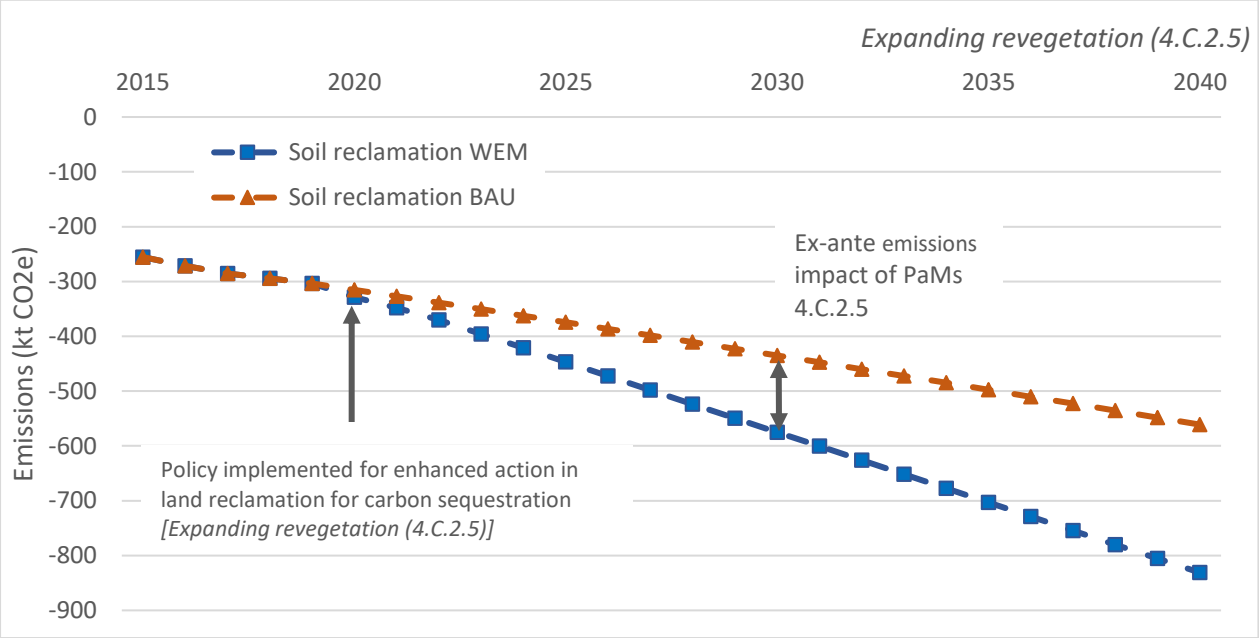
In the first publication of the Climate Action Plan (2018) it was put forward that an extensive effort is required to restore wetlands, birch forests and scrubland, stop soil erosion and support further soil reclamation and afforestation in Iceland. Subsequently, the Ministry for the Environment and Natural Resources 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 4 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")*[34] will triple and the scope of projects supported by the fund Landbótasjóður[35] 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 Hekluskógar. 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 CO2e)	-315	-374	-435	-497	-561
Soil reclamation WEM (kt CO2e)	-329	-447	-575	-703	-831
Ex-ante emissions impact of PaMs (kt CO2e)	**-14**	**-73**	**-140**	**-206**	**-270**

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

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

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

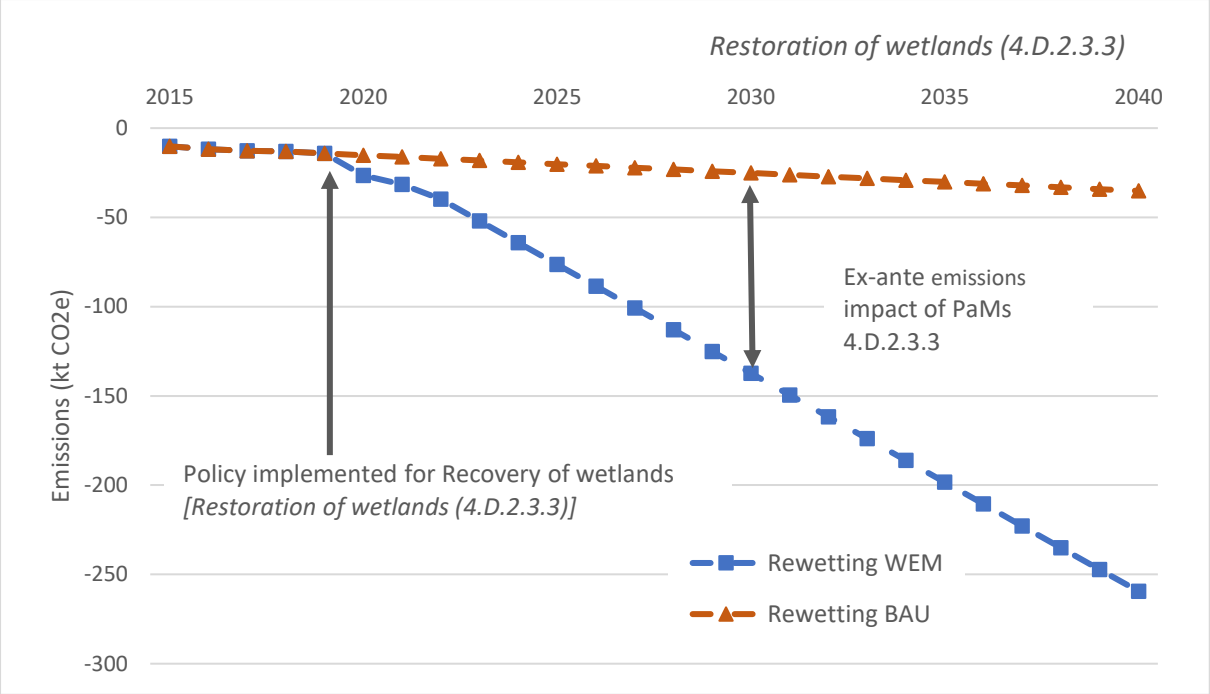
10.3.3 Restoration of Wetlands (604)

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 for the Environment and Natural Resources 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 4 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 CO2e)	-15	-20	-25	-30	-35
Rewetting WEM (kt CO2e)	-27	-76	-137	-198	-259
Ex-ante emissions impact of PaMs (kt CO2e)	**-11**	**-56**	**-112**	**-168**	**-224**

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 categorized 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 of 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	Implemented	Not included	Climate education and innovation will be supported through the new Icelandic Climate fund.
Climate strategy of Government Offices (704)	GHGs	Economic, Planning	Implemented	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	Implemented	Not included	Climate education in schools will be reinforced.
Information on climate change for the public (707)	GHGs	Economic, Education	Implemented	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	Implemented	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	Adopted	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	Implemented	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 formalize 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[36]. 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[37]. The fund will allocate over 500 million ISK in grants to various such educational and climate innovation projects over the next 5 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

[36] *Rannís*. https://www.rannis.is/frettir/uthlutun-ur-loftslagssjodi
[37] *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, Science and Culture 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, Science and Culture 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*“)[38], 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)[39].

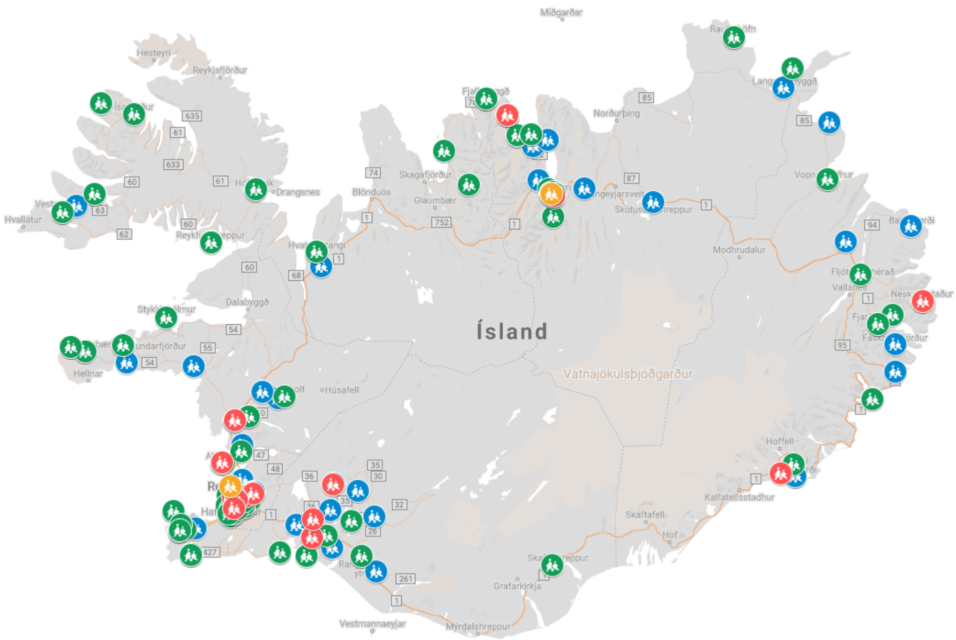


Figure 11.1 Schools participating in the Eco-Schools Iceland project. Green represents preschools, blue represents primary schools, red represents secondary schools and orange represents universities.[40]

[38] *Landvernd*. https://landvernd.is/graenfaninn/

[39] *FEE*. https://www.fee.global/

[40] *Landvernd*. 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, Science and Culture 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 for the Environment and Natural Resources 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?" ("H*vað höfum við gert?* ") which was shown on national television (RÚV) in 2019[41]. The a second season, "What can we do" ("*Hvað getum við gert*?") is currently being aired on national television[42]. 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[43].

[41] *RÚV*. https://www.ruv.is/sjonvarp/spila/hvad-hofum-vid-gert/27624
[42] *RÚV*. https://www.ruv.is/sjonvarp/spila/hvad-getum-vid-gert/30574
[43] *Vatnajökulsþjóðgarður*. https://www.vatnajokulsthjodgardur.is/is/svaedin/horfandi-joklar

Figure 11.2 The outline of Vatnajökull Glacier, c.a. 1890 and 2010. Source: The Icelandic Meteorological Office and the University of Iceland's Institute of Earth Sciences[44].

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 for the Environment and Natural Resources 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 regards 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, in order for planning to support

[44] *Vatnajökulsþjóðgarður*. https://www.vatnajokulsthjodgardur.is/is/svaedin/horfandi-joklar/joklarannsoknir/43-utlinur-jokla-og-yfirbordskort

the achievement of carbon neutrality and to strengthen resilience against climate change through various adaptation measures. In climate focused planning, climate goals are prioritized 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[45].

The Minister for the Environment and Natural Resources 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 for the Environment and Natural Resources, 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[46] to fund projects that align with its climate policy[47].

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.

[45] *National Planning Authority (Skipulagsstofnun).* https://www.landsskipulag.is/um-landsskipulagsstefnu/frettir/landsskipulagstillaga-afhent-umhverfis-og-audlindaradherra
[46] *City of Reykjavík.* https://reykjavik.is/graen-skuldabref-green-bonds
[47] *City of Reykjavík.* 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 Industries 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 Environment Agency of Iceland will monitor all the climate policies and that appropriate measures are undertaken accordingly. The Environment Agency 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*")[48] and a similar project is currently being developed for municipalities[49]. 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 Environment Agency 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

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

platform on climate issues and the UN Sustainable Development Goals to support and strengthen the solidarity and conversation between municipalities on these issues[50].

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 is in the process of being updated in order for it to be mandatory for Ministries to assess the climate impacts of any bill they wish to propose to Parliament[51]. By implementing the obligation to assess the climate impact of legislative bills, the legislator highlights the importance of gaining control of climate change.

[50] *Samband íslenskra sveitarfélaga*.. https://www.samband.is/verkefnin/umhverfis-og-urgangsmal/loftslagsmal-og-heimsmarkmid-sameinudu-thjodanna/

[51] *Althingi*. 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%**

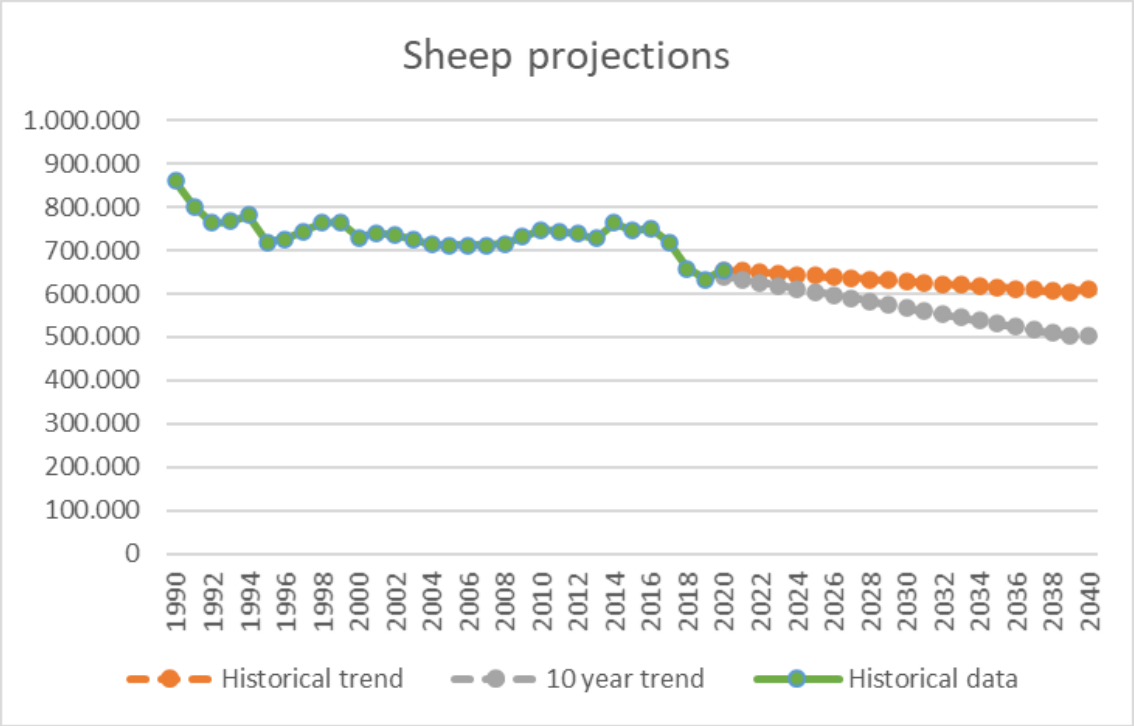


Figure 12.1 Comparison between the number of sheep projected by using the historical trend versus the 10 year trend.

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 (1000s) 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%**

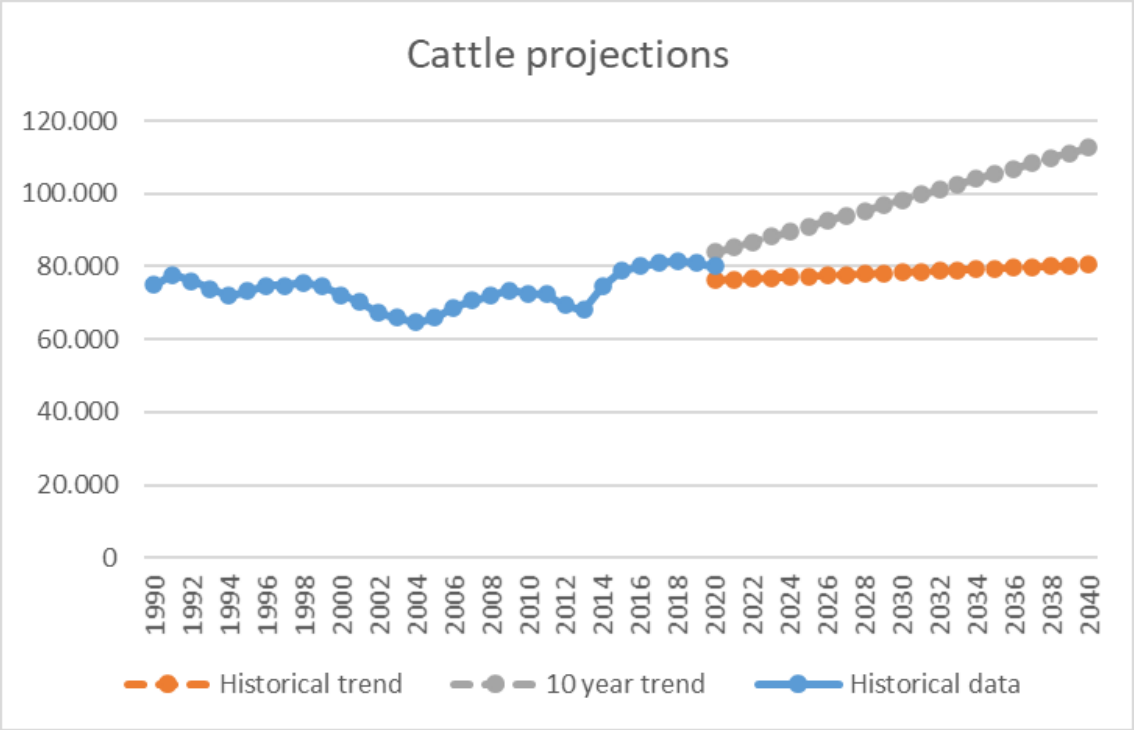


Figure 12.2 Comparison between the number of cattle projected by using the historical trend versus the 10 year trend.

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 Industry and Innovation, 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.

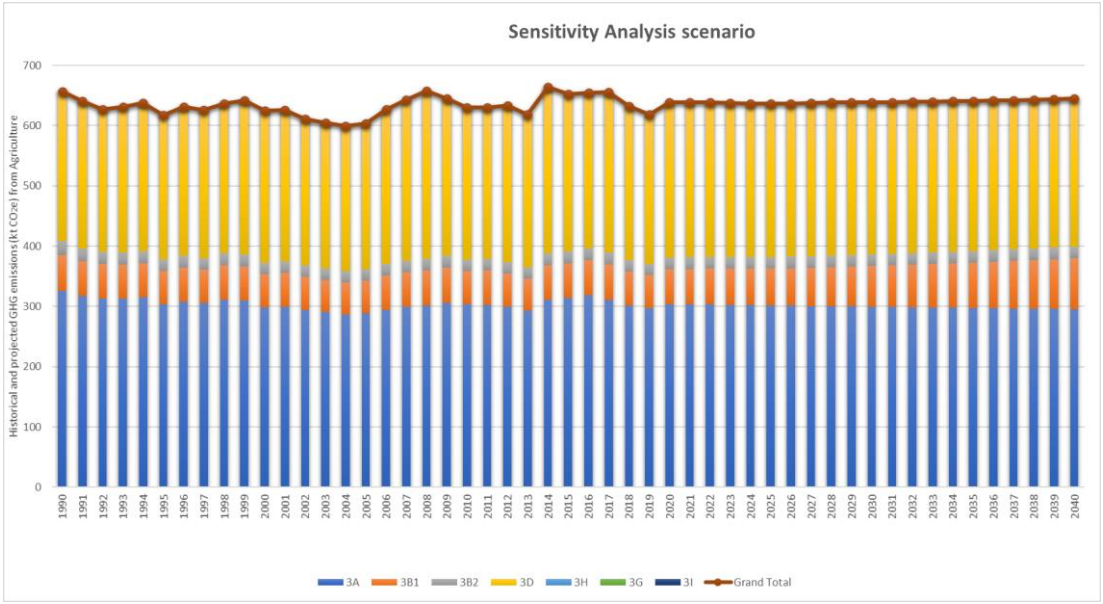


Figure 12.3 Historical and projected GHG emissions (kt CO_2e) from the Agriculture sector in the Sensitivity Analysis scenario.

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.

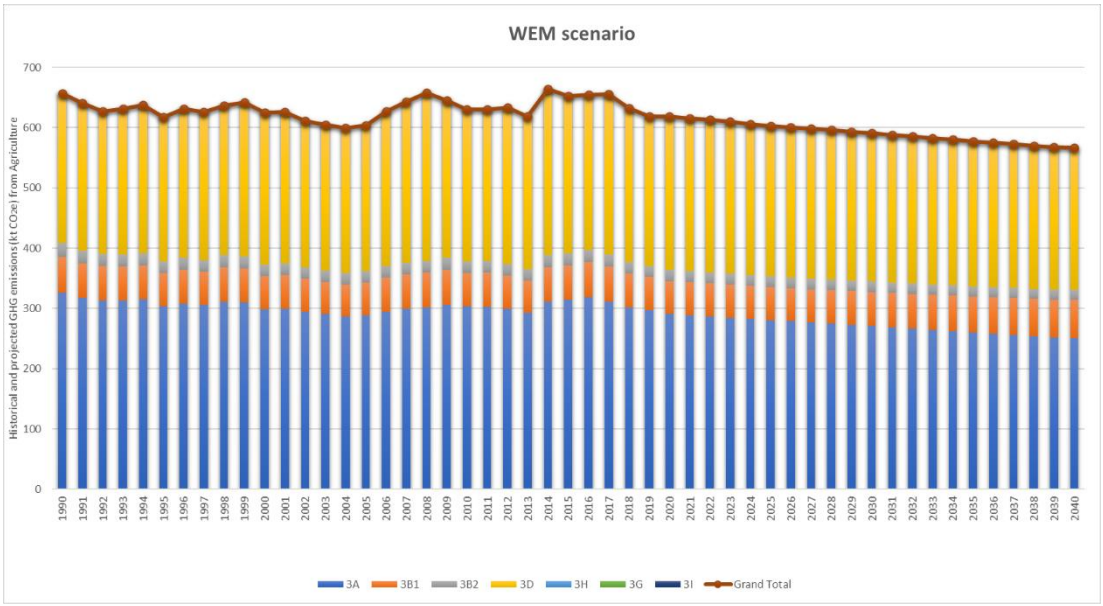


Figure 12.4 Historical and projected GHG emissions (kt CO_2e) from the Agriculture sector in the WEM scenario.

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 313 kt of CO_2 in the year 2019. 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, (2019) was 0.73. Modelled figures were calibrated by the factor 1/0.73 to adjust for this difference. Similar calibration was done for FrF but there the model was predicting higher value (12%) for 2019 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 17% 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	**2020**	**2025**	**2030**	**2035**	**2040**
WEM with calibration	-452	-532	-606	-678	-765
WEM without calibration	-375	-445	-507	-567	-644
Difference in kt CO_2e	-77	-87	-100	-111	-121
% Difference	17%	16%	16%	16%	16%

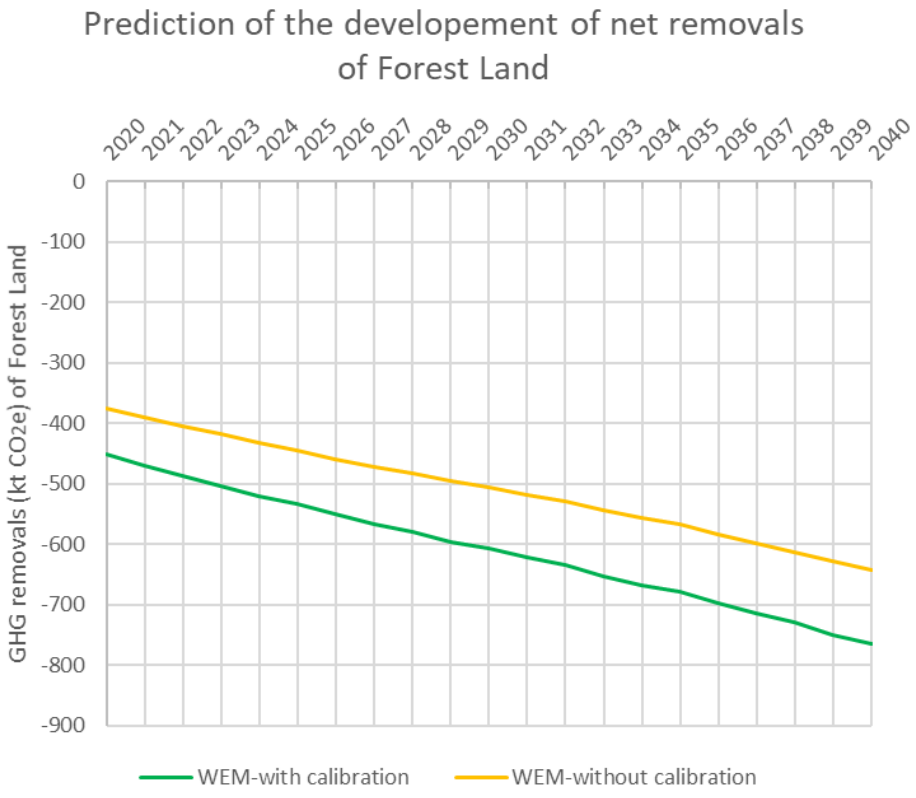


Figure 12.5 Prediction of the development of net removals of forest land in the WEM-with-calibration and WEM-without calibration scenarios.

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