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5TH Biennial Report

Under the United Nations Framework Convention on Climate Change



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1. Executive summary

This report is Iceland's Eight National Communication and Fifth Biennial Report as required under the Framework Convention on Climate Change and the Kyoto Protocol. The Fifth Biennial report is attached as an annex (Annex I). The report was prepared in accordance with UNFCCC guidelines.

This report is based on the National Inventory Report (NIR) for greenhouse gases, submitted in April 2022. The latest National Inventory Report (NIR) for greenhouse gases was submitted in April 2023.

Iceland has ratified the UNFCCC, the Kyoto Protocol and the Doha amendment to the Kyoto Protocol. Iceland ratified the Paris Agreement in September 2016.

National circumstances

Iceland is a constitutional republic with a multi-party parliamentary system of government. The Constitution was adopted on 17 June 1944, when the Republic was established. Legislative power is vested in Parliament (Althingi) and the president, in that bills of legislation are passed by Parliament and submitted to the president for confirmation. Upon confirmation by the president's signature, the bill in question acquires the force of law. The Government must be supported by a majority of Parliament in order to remain in power. The 63 members of Parliament are elected from six constituencies based on proportional representation, for a term of four years. Over the past thirty years, the participation of women in politics has increased significantly and their share of seats in Parliament has increased from 15% to 47,6%. The president is the head of state and is elected for a term of four years by a direct vote of the electorate.

The population of Iceland was 368.792 on 1 January 2021. (See Figure 2-2.) With only 3 inhabitants per square kilometre, Iceland is one of the least densely populated countries in Europe. In 2000–2015, annual average population growth was 1.1% and the natural increase (births less deaths) 0.8%. Around 63% of the population over 230 thousand) live in the capital city of Reykjavík and its surrounding municipalities. In 1990 this same ratio was 57%, demonstrating higher population growth in the capital area than in smaller communities and rural areas.

The largest town outside the capital area is Akureyri, located in North Iceland, with a population of just over 19 thousand. Most of the remaining inhabitants live in small towns along the coast.

Iceland is in the North Atlantic between Norway, Scotland, and Greenland. (Figure 2-5). It is the second-largest island in Europe and the third largest in the Atlantic Ocean, with a land area of some 103 thousand square kilometres, a coastline of 4,970 kilometres and a 200-nautical-mile exclusive economic zone extending over 758 thousand square kilometres in the surrounding waters. Iceland enjoys a warmer climate than its northerly location would indicate because a part of the Gulf Stream flows around the southern and western coasts of the country. In Reykjavík the average temperature is nearly 11°C in July and just below zero in January.

Geologically speaking, the country is very young and bears many signs of still being in the making. Iceland is mostly mountainous and of volcanic origin. The Mid-Atlantic Ridge runs across Iceland from the south-west to the north-east. This area is characterized by volcanic activity, which also explains the abundance of geothermal resources. Glaciers are a distinctive feature of Iceland, covering about 10% of the total land area. The largest glacier, also the largest in Europe, is Vatnajökull in Southeast Iceland with an area of 8,300 km2. Glacial erosion has played an important part in giving the valleys their present shape, and in some areas, the landscape possesses alpine characteristics. Regular monitoring has shown that all glaciers in Iceland are presently receding, they are smelting faster which has resulted in significant changes in the areas closest to the glaciers.

Iceland is situated just south of the Arctic Circle. The mean temperature is considerably higher than might be expected at this latitude. Relatively mild winters and cool summers characterize Iceland's oceanic climate. The average monthly temperature varies from -3 to +3 °C in January and from +8 to +15°C in July. Storms and rain are frequent, with annual precipitation ranging from 400 to 4000 mm on average annually, depending on location. The mild climate stems from the Gulf Stream and attendant warm ocean currents from the Gulf of Mexico. The weather is also affected by polar currents from East Greenland that travel southeast towards the coastline of the northern and eastern part of Iceland.

The amount of daylight varies greatly between the seasons. For two to three months in the summer there is almost continuous daylight; early spring and late autumn enjoy long twilight, but from November until the end of January, the daylight is limited to only three or four hours.

Iceland is endowed with natural resources that include the fishing grounds around the island within and outside the country's 200-mile Exclusive Economic Zone as well as hydroelectric and geothermal energy resources. The Icelandic economy displays the characteristics of an advanced economy, with high income levels and a relatively large services sector. Its distinguishing features are its large marine and energy sectors based on ample resources, a growing tourism sector, and a high labour participation rate.



Iceland is the 17th largest fishing nation in the world, according to the FAO SOFIA 2022 report. See Figure 1. Nearly all catch from Iceland gets exported. The fishing and fish processing sector are still one of the main economic pillars and the backbone of export activities in Iceland although its relative importance has somewhat diminished as other sectors such as tourism have been growing rapidly in recent years. See Figure 2.11.

A comprehensive fisheries management system based on individual transferable quotas has been developed. Total allowable catches (TACs) are issued with the aim of promoting conservation and efficient utilization of marine resources. All commercially important species are regulated within the system. In addition to the fisheries management system, there are several other explicit and direct measures to

rationalize investments in the fishing sector, to support its aims and reinforce conservation and socio-economic sustainability.

The energy profile is unusual as 85% of primary energy use in 2019 came from renewable resources, hydro and geothermal. This share was even higher in 2020-2021 due to COVID-19 effects on lower transport fuel consumption. The remaining 15% came from imported fossil fuels, which are mainly used in transportation, road and aviation, and the fishing industry.

Tourism has increased rapidly in Iceland in recent years. In 2021 the total number of foreign overnight visitors to Iceland was just under 700 thousand as the impacts of the Covid-19 pandemic decreased somewhat. This was a 44% increase from 2020, when foreign visitors numbered just under half million. In 2019 the total number of foreign visitors was around 2 million.[1]

Around 688,000 tourists came on flights through Keflavík International Airport in 2021, or 98.5% of the total number of visitors. Around 10,000 came with the ferry Norræna through Seyðisfjörður, or around 1.5% of the total. Around 100 came on flights through Reykjavík Airport or Akureyri Airport. It must be assumed that there are variations in counts at Keflavik International Airport, as they cover all departures, including foreign national's resident in Iceland. See Figure 2.20.



Greenhouse gas inventory information

Iceland's total emissions of greenhouse gases, excluding LULUCF, were 4,510 kt. CO2-equivalent in 2020.

[1] https://www.ferdamalastofa.is/en/recearch-and-statistics/numbers-of-foreign-visitors

Since 1990, Iceland's total GHG emissions have increased by almost a quarter. This trend in increasing emission is dominated by:

- the expansion of the metal production sector, in particular the aluminium sector
- increases in emissions from geothermal energy utilization due to an increase in electricity production, which increased 18-fold between 1990 and 2019
- the road transport sector CO_2 emissions almost doubling since 1990 due to population growth, number of cars per capita, more mileage driven, and a growing number of larger vehicles; these changes can partly be attributed to a significant increase in the number of tourists in Iceland in the last 10 years.

In contrast, annual emissions have seen an overall decline since 1990 from commercial fishing, with GHG emissions reducing by approximately a quarter over the time series. Emissions from both domestic flights and navigation have also declined since 1990.

Table 3.1 Emissions of GHG by sector in Iceland for the reported time series [kt CO_{2e}]

Sector	1990	1995	2000	2005	2010	2015	2019	2020	Change '90-'20	Change '19-'20
1 Energy	1,836	2,053	2,181	2,155	2,020	1,848	1,849	1,659	-10%	-10%
2 Industrial Processes	958	565	1,010	955	1,917	1,983	2,020	1,986	107%	-1.7%
3 Agriculture	662	618	627	605	631	655	621	618	-6.5%	-0.5%
4 Land Use, Land Use Change and Forestry	9,199	9,175	9,194	9,232	9,196	9,107	9,020	9,010	-2.1%	-0.1%
5 Waste	219	270	302	304	296	261	223	247	12%	10%
Total without LULUCF	**3,674**	**3,506**	**4,119**	**4,019**	**4,865**	**4,746**	**4,713**	**4,510**	**23%**	**-4.3%**
Total with LULUCF	**12,873**	**12,681**	**13,314**	**13,251**	**14,061**	**13,853**	**13,733**	**13,519**	**5.0%**	**-1.6%**
International bunkers (memo items)	249	241	465	427	380	829	1,170	342	37%	-71%

As shown in 3.1, the largest contributor by far of total GHG emissions without LULUCF is CO_2, followed by CH_4, N_2O and fluorinated gases (PFCs, HFCs, and SF_6). Over the time series, emissions of CO_2 have increased most, and PFCs and N_2O emissions have decreased significantly.

Policies and measures

In September 2018 the Icelandic government published a Climate Action Plan for the years 2018-2030; and updated version of the action plan was released in June 2020, which is the plan currently being put in action. The action plan has two main goals: achieving the emission reductions of the Paris Agreement for 2030 and reaching carbon-neutrality in 2040. To reach these goals the revised action plan set forth 48 policies and measures (PaMs) which mostly focus on electrification of the transport sector and increased efforts in

afforestation, revegetation and wetland restoration. The revision of the plan also contained significantly improved analysis to estimate the individual and collective mitigation gains of the measures presented.

According to the Climate Act, the Government shall, in consultation with stakeholders, review and update the Climate Action Plan every fourth year, based on international commitments and the Government's goals. PaMs shall be developed and put in motion by an inter-ministerial committee. The committee shall also prepare an annual progress report on the status of implementation of the climate plan and its measures, emissions development and whether or not the development is in accordance with the Climate Action Plan. The first such progress report was published in September 2021 to follow up on the progress of the 2020 Climate Action Plan. Besides the 48 PaMs put forth in the 2020 Climate Action Plan, two new GHG PaMs were introduced in the progress report: 1) energy change in the production sector; 2) increased knowledge and research to improve the LULUCF sector of the GHG inventory. According to the progress report, thirty PaMs (out of 50 PaMs in total) have currently been implemented, seventeen are in progress and three are in preparation. In August 2022, a new progress report was published. No new PaMs were introduced in the newest progress report and by the time of the publication of the progress report, 34 PaMs have been implemented, 15 are in progress and one is in preparation.

A minimum of ISK 46 billion (approx. 310 million EUR) is expected to be spent on key climate measures in the period 2020-2024.

The EU Emissions Trading Scheme (EU-ETS) was transposed into Icelandic law in 2011. Aviation became part of the emission trading system in 2012 and primary production of non-ferrous metals in 2013. The emission trading system covers about 40% of emissions from Iceland in 2015. A carbon tax on fossil fuel use was introduced in 2010. The tax is levied on fossil fuels in liquid or gaseous form with respect to the carbon content of the fuels. With these measures more than 90% of CO_2 emissions are covered by economic instruments in Iceland.

Various changes have been made in taxes and levies with the aim of reducing emissions from transportation. The excise duty on passenger cars and the semi-annual road tax are now based on carbon dioxide emissions. The Director of Customs is authorized at clearance to waive VAT on electric or hydrogen vehicles up to a certain maximum and there are special provisions regarding the excise duty and semi-annual road tax for vehicles that drive on methane gas. A minimum of 5% renewable fuel of the total energy content of the fuel for land transportation is required as of 1 January 2015. Efforts have been made regarding official procurement of low-carbon and fuel-efficient vehicles, and increased share of public transport, walking and bicycling in transport.

The policy on waste management is manifested in in national plans and in legislation.

Projections

Iceland's total historical and projected emissions of GHGs *excluding* LULUCF are presented in Figure 5.1 for the WEM scenario. The total emissions are expected to have reached their peak in 2018 and to follow a downward trend until 2040. Iceland's GHG emissions will be 1% lower in 2040 than they were in 1990, but they will be 24% lower than they were in 2015.

The main cause for the projected decrease in emissions from the energy sector is the impact of the energy transition in road transportation, which is changing rapidly from predominantly fossil fuel vehicles to electric vehicles, as well as a substantial decrease in emissions from fishing. IPPU will mainly change

because of a projected decrease in emissions from F-gases due to the newly implemented F-gas regulation which limits the import of F-gases. Emissions reductions from IPPU will remain relatively low, however, due to an expected increase in emissions from the metal industry. Agriculture emissions will decrease because of a projected decrease in some livestock population numbers. Waste emissions are expected to peak in 2021 and decrease significantly due to better practices in solid waste disposal and the treatment of biological waste.

Iceland's total historical and projected emissions of GHGs *including* LULUCF emissions are presented in Figure 5.2. The total emissions incl. LULUCF are expected to have decreased by 8% in 2030 and 9% in 2040 compared to emissions in 1990. Carbon sequestration due to forest land has increased 17-fold in 2020 compared to 1990 levels and is expected to change from -510 kt CO_2 p.a. in 2020 to -794 kt CO_2 p.a. in 2040.

Impacts and adaptation measures

Temperature in Iceland exhibits large inter-decadal variations. The longest continuous temperature record comes from Stykkishólmur on the west coast of Iceland. Statistical treatment of data from this station and of non-continuous measurements at other locations in Iceland, allows this record to be extended back to 1798, see Figure . This record shows that during the 19th century, temperatures were cooler than in the 20th century, and that the magnitude of inter-annual variations in temperature were larger. In the 1920s, there was a period of rapid warming, as also observed in global averages, but in Iceland, the temperature change was greater and more abrupt. From the 1950s, temperatures in Iceland had a downward trend with a minimum reached during the years of Great Salinity Anomaly in the late 1960s, when sea ice was prevalent during late winter along the north coast. Conditions were rather cool in the 1970s with 1979 being the coldest year of the 20th century in Iceland. Since the 1980s, Iceland has experienced considerable warming, and in first decade of the 21st century, temperatures reached values comparable to those observed in the 1930s. The warmest year in the series was 2016. While there are pronounced inter-decadal temperature swings in Iceland, the long-term warming rate is similar to the global average, suggesting that the rapid warming in the period 1979 to 2021 is a combination of local variability and large-scale background warming. This remains true both for the annual average and individual seasons.

Continuous precipitation records extend back to the late 19th century, but precipitation has been measured at several stations since the 1920s. The station network, however, has insufficient coverage in the Icelandic highland where precipitation tends to be greater than in lowland areas. Recently, an estimate for precipitation in all of Iceland during the last decades of the 20th century has been derived using high-resolution atmospheric reanalysis. The results show significant decadal variations in precipitation, and a tendency for higher amounts of precipitation during warmer decades. The long-term station records indicate that precipitation tends to increase by 4% to 8% for each degree of warming. Furthermore, several new studies suggest an increase in precipitation intensity during the warming of recent decades. Variations in ocean currents, impacts on glaciers, agricultural land and fish stock are of great concern.

Financial assistance and transfer of technology

International Development Cooperation is one of the key pillars of Iceland's foreign policy, with the main goal of contributing to the fight against poverty in the world's poorest countries and guided by the Sustainable Development Goals (SDGs).

For nearly four decades, Iceland's official development cooperation has placed focus on the sustainable utilization of natural resources, including fisheries and geothermal and other renewable energy sources. This has been grounded on Iceland's experience and expertise in utilizing its own resources for its social, economic and human development.

In line with best practices in development cooperation and OECD-DAC guidelines, Iceland's development cooperation in bilateral partner countries is based on close cooperation with local communities and their needs and is based on detailed needs assessment. The same preconditions apply to the activities of multilateral partners. However, it is worth noting that Iceland's first OECD-DAC Peer Review (2017) highlighted the need to further mainstreaming environmental activities across its development cooperation portfolio and strengthen the harmonization of climate change, business and development cooperation strategies within Iceland's Ministry for Foreign Affairs in accordance with the Kyoto Protocol. The Ministry for Foreign Affairs is developing an environment and climate change strategy, that will be supported by an action plan that will guide environmental mainstreaming in all development cooperation.

With respect to core funding to multilateral institutions that don't have an explicit climate change mandate, although possible to retrieve information on climate relevant proportions of the projects they support from OECD-DAC, these contributions are not part of the information provided in the total climate related summary in this report. Apart from core funding, reporting on climate specific finance through multilateral institutions is identified based on an application of Rio markers in the same manner as bilateral climate-specific finance. Climate specific projects are those with climate change mitigation and climate change adaption markers, marked as having significant or principal objective in applicable category. Additional are cross– cutting projects which have more than one climate category with marked either significant or principal marker. All funds specified in this report have been disbursed.

Most of Iceland's bilateral environmental contributions are channelled through the GRÓ Centre (before 2020 UN University training programs) based in Iceland. The GRÓ Training Programs provide support to climate change adaptation and mitigation in LDCs, gender mainstreaming, capacity building through the four programs: GRÓ Geothermal Training Program, the GRÓ Fisheries Training Program, the GRÓ Land Restoration Training Program, and the GRÓ Gender Equality Studies and Training Program.

Research and systematic observation

Most of the climate-related research in Iceland is focused on climate processes and climate system studies and impacts of climate change. Other efforts involve modelling and prediction, and large ongoing projects deal with mitigation measures, but there has been less research on socio-economic aspects.

The Icelandic Meteorological Office (IMO) is a governmental institute responsible for producing regular and specific weather forecasts. It conducts monitoring and scientific studies of geohazards and hazard zoning in Iceland. It is involved with several kinds of research within the fields of meteorology, hydrology and geosciences and has a leading role in climate change studies in Iceland both in research and in its role as an advising body to the government. It conducts glaciological measurements and modelling with a special focus on glacio-hydrology.

Although IMO research and evaluation of climate change is mainly centred on the climate of Iceland, the IMO has also been active in many inter-national climate research projects. Studies of the spatial characteristics and long-term changes in timeseries of temperature, precipitation, sea level pressure, river runoff and glacier changes have been conducted by IMO staff and published in international peer-reviewed journals.

Icelandic scientists have for many years contributed to paleoclimatological work with their participation in many ice and sediment core projects.

The IMO has led the scientific committee on climate change and the impacts of climate change in Iceland since 1999. The committee has published 3 reports since then (2000, 2008 and 2018) and the next one is expected to be published in 2023.

Both the Marine and Freshwater Research Institute (MFRI) and the Icelandic Meteorological Office (IMO) contribute to ocean climate observations. The IMO and MFRI have been supporting Meteo France in deploying surface drifters with barometers and SST for weather observations and climate in recent years. The MFRI maintains a monitoring net of about 70 hydrobiological stations on 10 standard sections (transects) around Iceland with most of the sections extending beyond the continental slope. These stations are monitored three to four times per year for measurements of temperature and salinity and once or two times a year for phosphate, nitrate and silicate and once a year for phytoplankton and zooplankton. Some of these stations have been monitored regularly since around 1950. The MFRI has monitored carbonate system parameters on two-time series stations northeast and west of Iceland since 1983. A network of about 10 continuous sea surface temperature meters is maintained at coastal stations all around the country.



Education, training and public awareness

The educational system in Iceland is administered by the Ministry of Education, Science and Culture. The Ministry prepares educational policy, oversees its implementation, and is responsible for educational matters at all educational levels. Education has traditionally been organised within the public sector, but there are few private institutions in the school system, all of which receive public funding.

The National Curriculum Guide from 2013[22] applies to all grades and subjects in compulsory schools and further specifies what is to be coordinated in all Icelandic compulsory schools. Based on the objective

[22] https://www.government.is/topics/education/curriculum/

articles of the preschool, compulsory school, and upper secondary school acts, six fundamental pillars of education have been defined for the competence that pupils should achieve at compulsory school. One of the six pillars is "Education towards sustainability", which concerns the interplay of the environment, economy, society, and welfare. Sustainability includes respect for the environment, sense of responsibility, health, democratic working methods, and justice, not only at present time but also for future generations. Environmental protection, climate change and biodiversity are examples of tasks to be tackled. Sustainability is considered a prerequisite to understand the importance of one's own welfare and that of others. Education for sustainability further encompasses that in their studies children and youth come to grips with diverse problems and points of controversy. Teaching and working methods of the school are to be interwoven with the idea that the aim of education is capability for action. This involves training in democratic working methods and that children and youth are trained to be interested in and want to take part in society.

A fundamental principle of the Icelandic education system is that everyone is to have equal access to education irrespective of sex, economic status, geographic location, religion, disability and cultural or social background. The educational system is divided into four levels. Pre-school is the first educational level and is intended for children below the compulsory age for education. Parents are free to decide whether their children attend preschool. Compulsory Level is the second educational level. Children and adolescents must by law attend 10 years of compulsory education from the age of 6 to 16. Upper Secondary Level is the third educational level which generally incorporates the age group from 16 to 19. Everyone has the legal right to enter school at that school level, irrespective of their results at the end of compulsory schooling. Those that have the right to enrol in upper secondary school also have the right to study until the age of 18.

The Eco-Schools Programme is an international project funded by the government and managed in Iceland by the NGO Landvernd (The Icelandic Environment Association). Eco-Schools is a programme for environmental management and certification which aims at enhancing environmental education and to strengthen environmental policy in schools. It is designed to implement sustainable development education in schools by encouraging children and students to take an active role in how their school can be run for the benefit of the environment. Schools that fulfil the necessary criteria are awarded the Green Flag for their work, which they keep for two years, before they need to renew their permission to flag the Green Flag.

2. National circumstances

2.1 Government structure

Iceland is a constitutional republic with a multi-party parliamentary system of government. The Constitution was adopted on 17 June 1944, when the Republic was established. Legislative power is vested in Parliament (Althingi) and the president, in that bills of legislation are passed by Parliament and submitted to the president for confirmation. Upon confirmation by the president's signature, the bill in question acquires the force of law. The Government must be supported by a majority of Parliament in order to remain in power. The 63 members of Parliament are elected from six constituencies based on proportional representation, for a term of four years. Over the past thirty years, the participation of women in politics has increased significantly and their share of seats in Parliament has increased from 15% to 47,6%. The president is the head of state and is elected for a term of four years by a direct vote of the electorate.

General elections are generally held every four years, but the Constitution allows for early dissolution of Parliament, which triggers early elections.

The most recent election was held on 25th of September 2021. The results of the elections were as follows: The Independence Party obtained 24,4 % of votes and 16 seats, the Progressive Party 17,3 % and 13 seats the Left Green Movement 12,6 % and 8 seats, the Social Democratic Alliance 9,9 % and 6 seats, and the Pirate Party 8,6 % and 6 seats, The People's Party 8,8% and 6 seats, The Liberal Reform Party 8,3% and 5 seats, the Centre Party obtained 5,4 % and 3 seats. Other parties did not received votes above the required minimum of 5%.

The coalition government of the Left-Green Movement, the Independence Party and the Progressive Party which first took office in November 2017 stays in power, with the total of 37 members out of 63 in the Parliament.

The government is headed by a prime minister, and the executive branch is divided among 12 ministers. Iceland's court system is divided into three levels: district courts (currently eight in number), the Court of Appeals, and the Supreme Court. Judicial power lies with the Supreme Court, the Court of Appeals and the district courts, and the judiciary is independent. Significant amendments were made to the Act on the Judiciary in spring 2016 with the establishment of a new Court of Appeals, which started operating on January 1st 2018.

The country is divided into 64 municipalities, (see Figure 2.1) and local authorities are elected every four years. The largest municipality is the capital, Reykjavík, with 133.262 inhabitants but the greater capital area has around 232.280 inhabitants in 6 municipalities. The smallest municipality on the other hand has less than 50 inhabitants.[3]

[3] https://hagstofa.is/



Figure 2.1 Municipalities in Iceland 2021.

In 1990 the number of municipalities was 204, but an attempt has been made to unite small municipalities, and this has resulted in fewer, but more populous, municipalities. This trend is likely to continue since the tasks of local authorities have grown increasingly complex in recent years. The local authorities have their own sources of revenue and budgets and are responsible for various areas that are important with regards to greenhouse gas emissions. This includes physical planning, waste-management, granting industry licenses and the design and operation of public transport. Municipalities also play an important role in education.

The Ministry of the Environment, Energy and Climate is responsible for the implementation of the UNFCCC and coordinated national climate change policymaking in close cooperation with the Ministry of Food, Agriculture and Fisheries, Ministry of the Interior, Ministry of Finance, Ministry of Foreign Affairs and the Prime Minister's Office. Several public institutions and public enterprises, operating under the auspices of these ministries, also participated directly or indirectly in preparing the national implementation policy.

2.2 Population

The population of Iceland was 368.792 on 1 January 2021. See Figure 2.2. With only 3 inhabitants per square kilometre, Iceland is one of the least densely populated countries in Europe. In 2000–2015, annual average population growth was 1.1% and the natural increase (births less deaths) 0.8%. Around 63% of the population over 230 thousand) live in the capital city of Reykjavík and its surrounding municipalities. In 1990 this same ratio was 57%, demonstrating higher population growth in the capital area than in smaller communities and rural areas.

The largest town outside the capital area is Akureyri, located in North Iceland, with a population of just over 19 thousand. Most of the remaining inhabitants live in small towns along the coast.

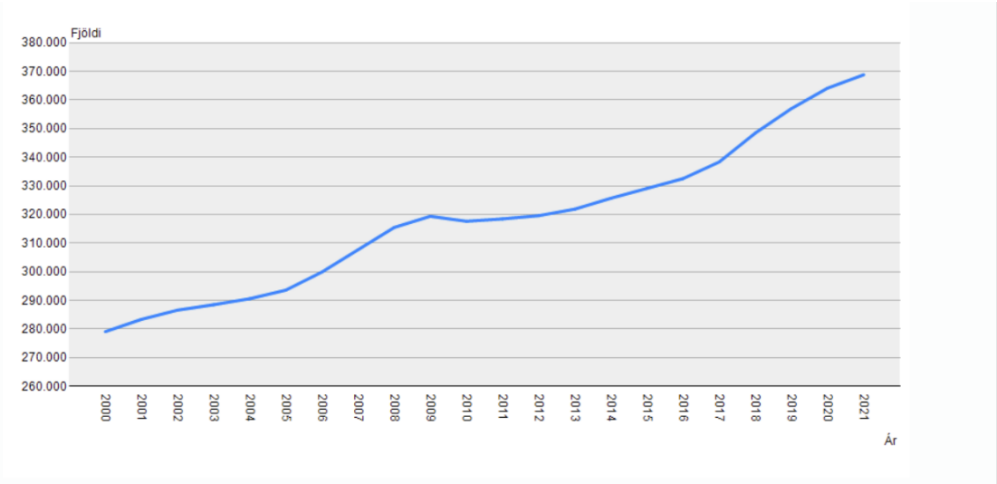


Figure 2.2 Population in Iceland 2000-2021

As in other advanced countries, the population of Iceland is ageing, but at a relatively slower pace than in most OECD countries. In 2021,[4] despite high life expectancy, the ratio of the total population aged over 65 to the population of working age was 14,7%. See Figure 2.3.

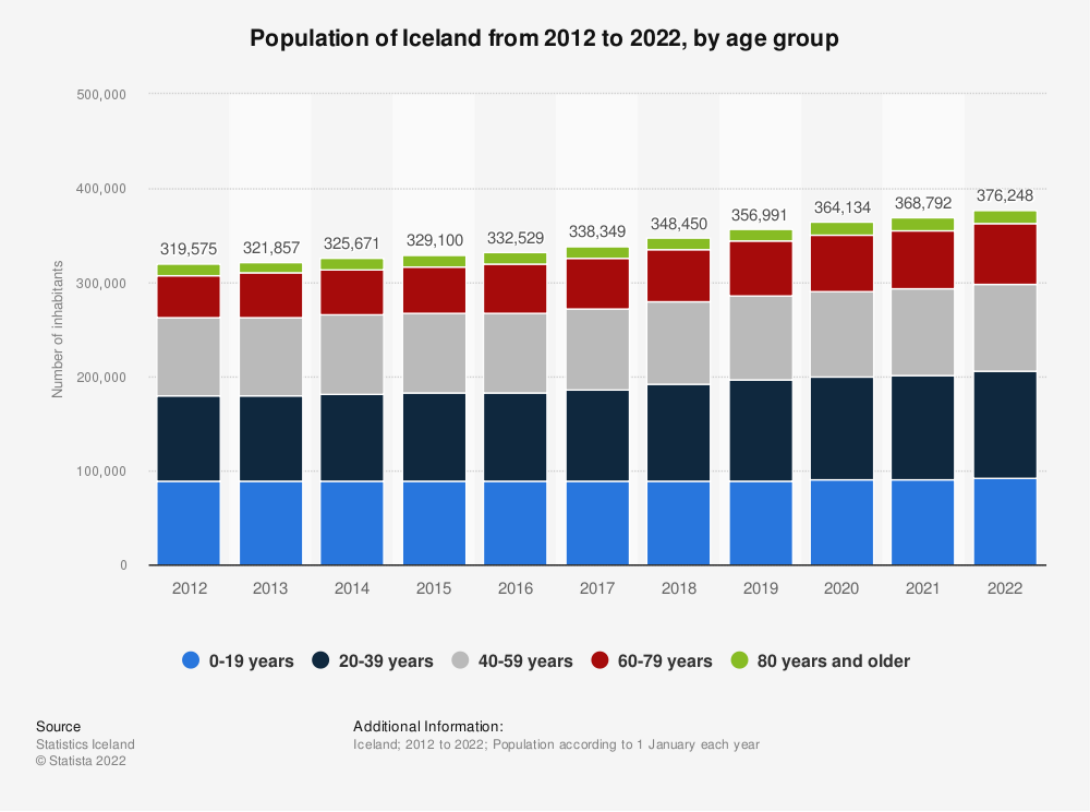


Figure 2.3 Population by age 2021[5]

[4] https://hagstofa.is/utgafur/frettasafn/mannfjoldi/kjarnafjolskyldur-1-januar-2021/

[5] https://www.statista.com/statistics/594621/total-population-in-iceland-by-age/

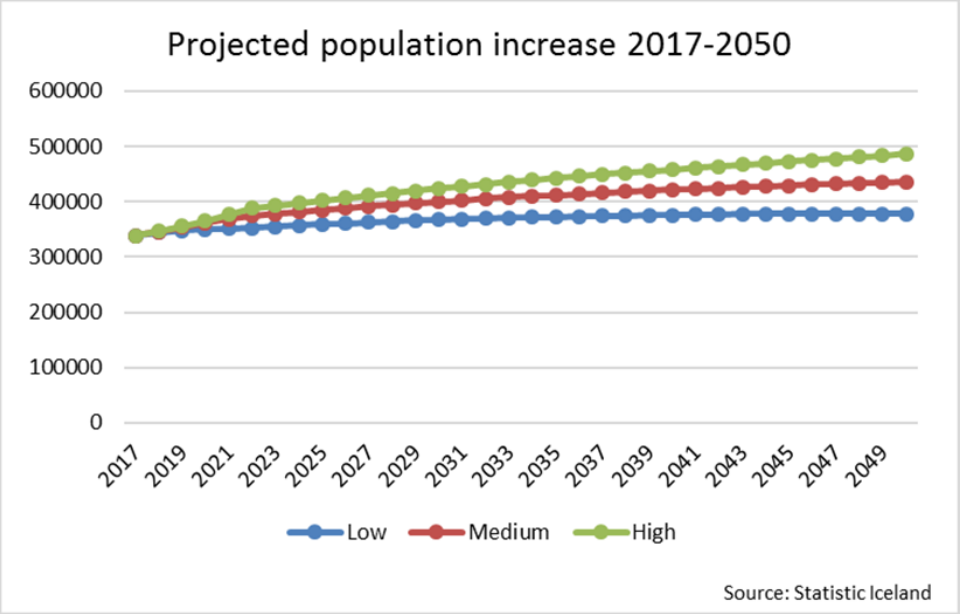


Figure 2.4 Projected population increase in Iceland 2017 – 2050

Figure 2.4 shows three scenarios for population growth until 2050. A low estimate predicts that the population will reach around 380.000 in 2050, the medium estimate predicts the population will reach around 436.000 and the high estimate predicts that the population will reach around 487.000 in 2050.

2.3 Geography

Iceland is in the North Atlantic between Norway, Scotland, and Greenland. (Figure 2.5). It is the second-largest island in Europe and the third largest in the Atlantic Ocean, with a land area of some 103 thousand square kilometres, a coastline of 4,970 kilometres and a 200-nautical-mile exclusive economic zone extending over 758 thousand square kilometres in the surrounding waters. Iceland enjoys a warmer climate than its northerly location would indicate because a part of the Gulf Stream flows around the southern and western coasts of the country. In Reykjavík the average temperature is nearly 11°C in July and just below zero in January.



Figure 2.5 Geographic location of Iceland

Geologically speaking, the country is very young and bears many signs of still being in the making. Iceland is mostly mountainous and of volcanic origin. The Mid-Atlantic Ridge runs across Iceland from the south-west to the north-east. This area is characterized by volcanic activity, which also explains the abundance of geothermal resources. Glaciers are a distinctive feature of Iceland, covering about 10% of the total land area. The largest glacier, also the largest in Europe, is Vatnajökull in Southeast Iceland with an area of 8,300 km^2. Glacial erosion has played an important part in giving the valleys their present shape, and in some areas, the landscape possesses alpine characteristics. Regular monitoring has shown that all glaciers in Iceland are presently receding, they are smelting faster which has resulted in significant changes in the areas closest to the glaciers.

Rivers and lakes are numerous in Iceland, covering about 6% of the total land area. Freshwater supplies are abundant, but the rivers flowing from the highlands to the sea also provide major potential for hydropower development. Geothermal energy is another domestic source of energy.

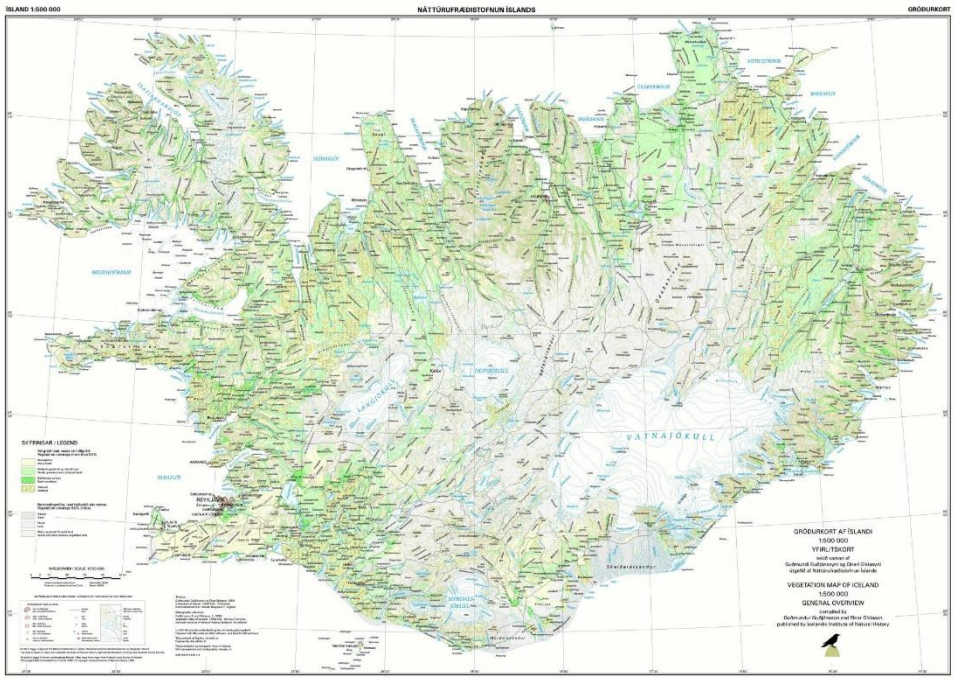


Figure 2.6 Vegetation map of Iceland

Soil erosion and desertification is a problem in Iceland. More than half of the country's vegetation cover is estimated to have disappeared because of erosion since the settlement period. This is particularly due to clearing of woodlands and overgrazing, which have accelerated erosion of the sensitive volcanic soil. Remnants of the former woodlands now cover less than 1,200 km^2, or only about 1% of the total surface area. Around 60% of the vegetation cover is dry land vegetation and wetlands. Arable and permanent cropland amounts to approximately 1,300 km^2. Systematic revegetation and land reclamation began more than a century ago with the establishment of the Soil Conservation Service of Iceland in 1907, which is a governmental agency. Reforestation projects have also been numerous in the last decades, and especially noteworthy is the active participation of the public in both soil conservation projects and reforestation projects.

Iceland has access to rich marine resources in the country's 758,000-km^2 exclusive economic zone. The abundance of marine plankton and animals' results from the influence of the Gulf Stream and the mixing of the warmer waters of the Atlantic with cold Arctic waters. Approximately 270 fish species have been found within the Icelandic 200-mile exclusive economic zone; about 150 of these are known to spawn in the area.

2.4 Climate profile

Iceland is situated just south of the Arctic Circle. The mean temperature is considerably higher than might be expected at this latitude. Relatively mild winters and cool summers characterize Iceland's oceanic climate. The average monthly temperature varies from-3 to +3 °C in January and from +8 to +15°C in July. Storms and rain are frequent, with annual precipitation ranging from 400 to 4000 mm on average annually, depending on location. The mild climate stems from the Gulf Stream and attendant warm ocean currents from the Gulf of Mexico. The weather is also affected by polar currents from East Greenland that travel southeast towards the coastline of the northern and eastern part of Iceland.

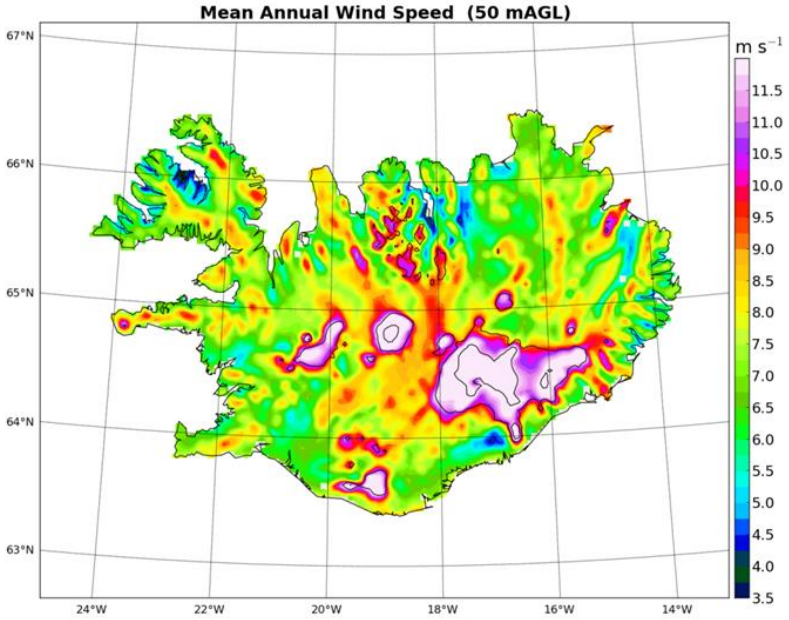


Figure 2.7 Mean annual average wind speed at 50 m above ground level

Figure 2.7 shows annual average wind speed in Iceland. The figure is from a study of the wind energy potential of Iceland made by the Icelandic Met Office. The study shows that Iceland compares with areas such as Scotland and the western coasts of Ireland and Norway, which are ranked within the highest wind power class in Europe. These areas are characterized by average winds above 6 m/s over sheltered terrain and average winds above 8.5 m/s at the coast, measured at 50 m above ground level.

The amount of daylight varies greatly between the seasons. For two to three months in the summer there is almost continuous daylight; early spring and late autumn enjoy long twilight, but from November until the end of January, the daylight is limited to only three or four hours.

2.5 The Economy

Iceland is endowed with natural resources that include the fishing grounds around the island within and outside the country's 200-mile Exclusive Economic Zone as well as hydroelectric and geothermal energy resources The Icelandic economy displays the characteristics of an advanced economy, with high income levels and a relatively large services sector. Its distinguishing features are its large marine and energy sectors based on ample resources, a growing tourism sector, and a high labour participation rate.

Policies of market liberalization, privatization and other structural changes were implemented in the late 1980s and 1990s, including membership of the European Economic Area by which Iceland was integrated

into the internal market of the European Union. Economic growth started to gain momentum by the middle of the 1990s, rekindled by replenishing fish stocks and economic efficiency due to sustainable quota allocations, a global economic recovery, a rise in exports and a new wave of investment in the aluminium sector. During the second half of the 1990s, the liberalization process continued, competition increased, the Icelandic financial markets and financial institutions were restructured and expanded rapidly, and the exchange rate policy became more flexible. Iceland experienced until 2007 one of the highest growth rates of GDP among OECD countries.

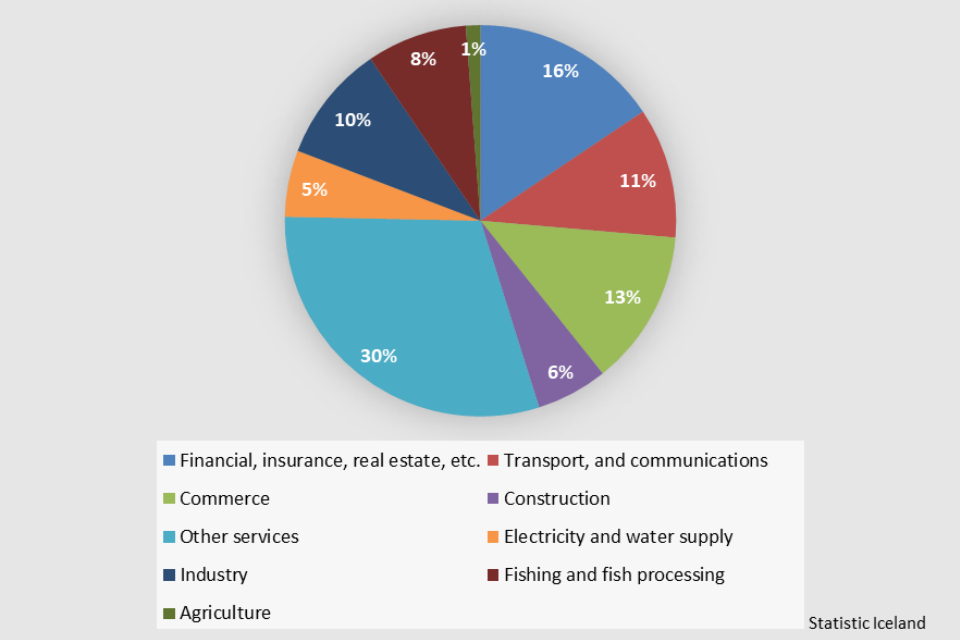


Figure 2.8 Breakdown of GDP in 2015 by sector.

Iceland was severely hit by an economic crisis when its three largest banks collapsed in the fall of 2008. The blow was particularly hard owing to the enormous size of the banking sector in relation to the overall economy as it had grown to be ten times the annual GDP. The crisis resulted in serious contraction of the economy followed by increase in unemployment, a depreciation of the Icelandic króna by over 40% in 2009 compared with the 1st quarter of 2008 and a drastic increase in external debt. Private consumption has contracted by a quarter since 2007. The pandemic-related collapse of foreign tourism and international travel during Covid affected Iceland's GDP which was –8,8% per capita in 2020, but bounced back to 2.7% in 2021. See Figure 2.8 for breakdown of GDP in 2015.

The annual national accounts for 2021 show a 4.3% increase in Gross Domestic Product (GDP) in real terms compared with a 7.1% decrease in the previous year. At the same time, gross domestic final expenditure (GDFE), the aggregate of household and government final consumption expenditure and gross fixed capital formation, is estimated to have increased by 7.2% in volume. Household final consumption expenditure (HFCE) increased by 7.6%, gross fixed capital formation (GFCF) by 13.6% and government final consumption expenditure (GFCE) by 1.8%. Due to a greater increase of imports than of exports, the contribution of external trade to economic growth during the period was negative. Even though the decrease in GDP in 2020 has reversed to a considerable extent in 2021, GDP in this year is still 3% lower in volume than in 2019, prior to the COVID-19 pandemic. Due to a greater increase of imports than of exports, the contribution of external trade to economic growth during the period was negative. Even though the decrease in GDP in 2020 has reversed to a considerable extent in 2021, GDP in this year is still 3% lower in volume than in 2019, prior to the COVID-19 pandemic.

Exports are estimated to have increased by 12.3% in volume in 2021 compared with the previous year. The increase in exports of services was 20.3% during the year, while exports of goods increased by 7.6% during

the same period. Imports increased by 20.3% in 2021 compared with 2020, imports of goods by 21% and imports of services by 18.6%. Due to a greater increase of imports than the increase of exports, the contribution of external trade as a whole to economic growth during the period was negative. The deficit in the balance of trade in goods and services amounted to 68.8 billion ISK in 2021, compared with a deficit of 22.3 billion ISK in 2020, at current prices.

The value of exported goods from Iceland in 2021 amounted to 762.4 billion ISK fob and the value of imported goods amounted to 994.3 billion ISK cif (926.5 billion ISK fob). Thus, there was a trade deficit, calculated on fob value, of 231.8 ISK billion in 2021 compared with a trade deficit of 145.3 billion ISK in 20201 at current rates of exchange.2. Yet the total value of imports of goods in 2021 was 222.8 billion ISK higher (28.9%) than in 2020.

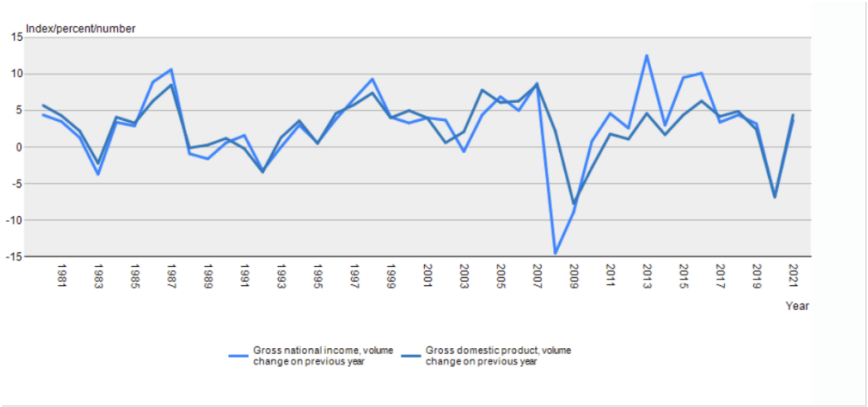


Figure 2.9 GDP and Gross national income 1998-2016

The unemployment rate has followed the recession in GDP and national income, see Figure 2.10.

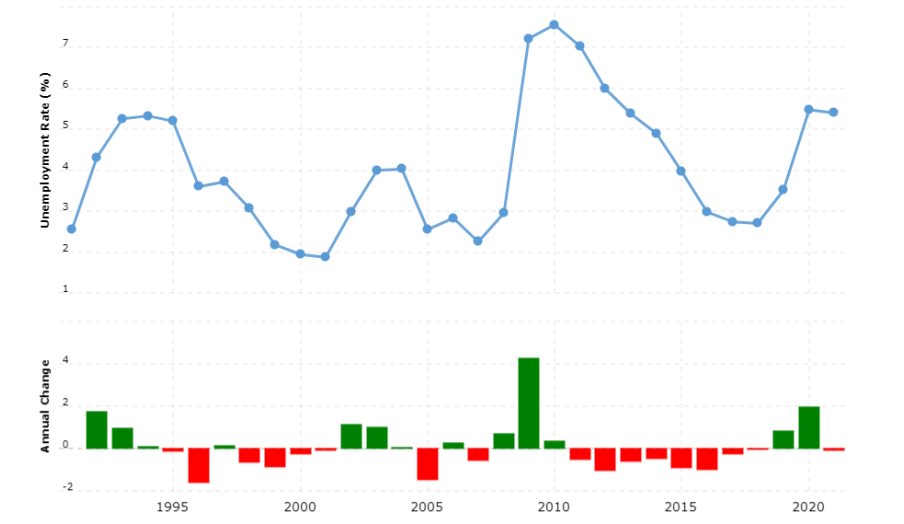


Figure 2.10 Unemployment 1991-2016. [6]

6 https://www.macrotrends.net/countries/ISL/iceland/unemployment-rate'>Iceland Unemployment Rate 1991-2022

2.6 Development of economic sectors

2.6.1 Fisheries

Iceland is the 17th largest fishing nation in the world, according to the FAO SOFIA 2022 report. See Figure 2.11. Nearly all catch from Iceland gets exported. The fishing and fish processing sector are still one of the main economic pillars and the backbone of export activities in Iceland although its relative importance has somewhat diminished as other sectors such as tourism have been growing rapidly in recent years.

Throughout most of the 20th century, the fishing and fish processing sector was of key importance to the Icelandic economy and to a considerable extent, economic growth was generated by this sector. In 2022, the total catch of Icelandic fishing vessels was 1.417 thousand tons which is 259 thousand tons more than in 2021. In 2021 the marine products' exports contributed to nearly 24% of the export value for goods and services and have increased over the course of 2022, mainly owing to the increase in the quota for capelin.

A comprehensive fisheries management system based on individual transferable quotas has been developed. Total allowable catches (TACs) are issued with the aim of promoting conservation and efficient utilization of marine resources. All commercially important species are regulated within the system. In addition to the fisheries management system, there are several other explicit and direct measures to rationalize investments in the fishing sector, to support its aims and reinforce conservation and socio-economic sustainability.

Between the years 2020 and 2021, export value increased by 7%, excluding aquaculture, and amounted to 296 billion ISK (FOB) up from 275 billion ISK (FOB). The exports of frozen products generated nearly half of the export value, of which the iced and frozen cod were of greatest value, 56,8 billion ISK and 46,8 billion ISK respectively.

In 2021 around 15% of the products' export value was exported to the United Kingdom (44,8 billion ISK) followed by France 42,1 billion, United States (27,8 billion ISK) and Spain (21,6 billion ISK) as the largest markets. Between 2021 and 2020 the exports to the United Kingdom have been declining by 14.800 tons, while at the same time exports to France have increased by 9.000 tons for the same period.

Of the total exports of 644 thousand tons in 2021 about 76,1% were exported to Europe, 10,6% to Asia and 7,5% to North America. In terms, total exports value of 296,2 billion ISK about 73,1% of the export revenues were from the European market and 12,4% of the export revenues from North America. [6]

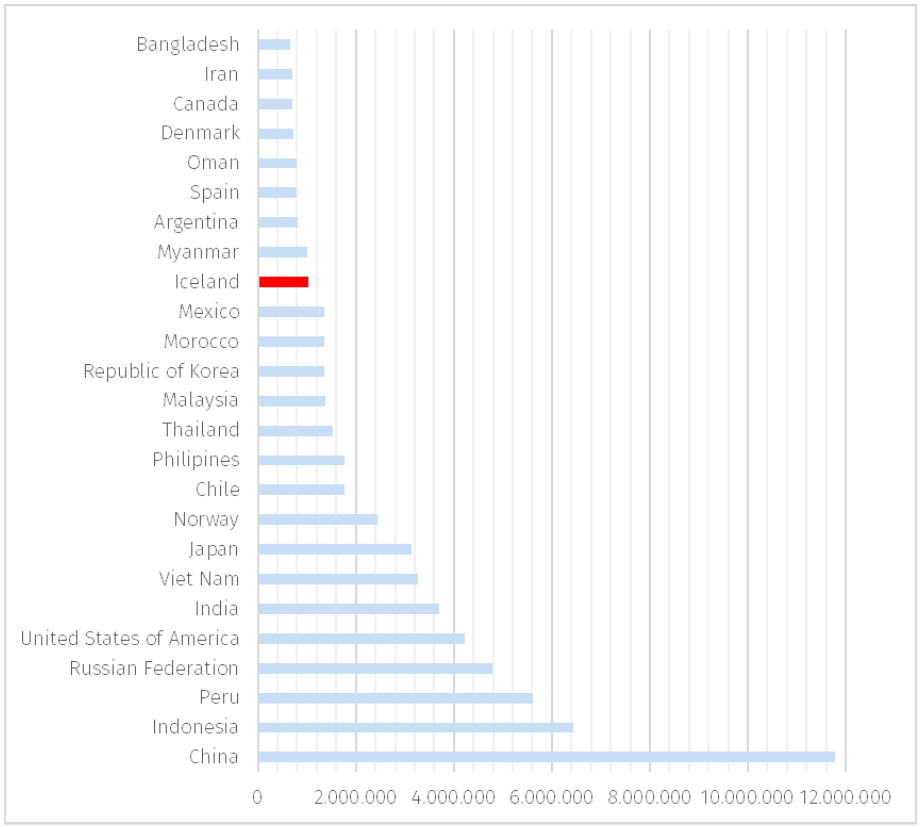


Figure 2.11 Marine Capture production – 20 largest producers 2014[7]

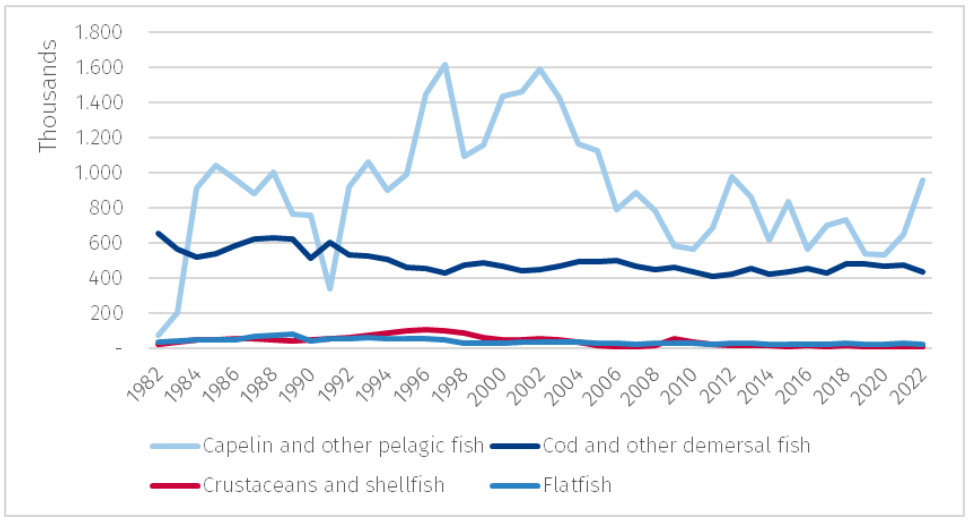


Figure 2.12 Fish catch 1992 – 2012

Figure 2.12 shows significant fluctuations in the total catch over time. This is mainly due to the fluctuation of the pelagic catch.

[7] FAO The State of World Fisheries and Aquaculture (SOFIA) 2022.

2.6.2 Export

In Iceland, the total value of exports of goods in 2021 was ISK 136.2 billion, 21.8% higher than in 2020. Exports of aluminum and aluminum products had the largest share in exported manufacturing products or 37.3% of total exports. Marine products contributed to 38.8% of the total exports and their value was 7.4% higher than in 2020. Fresh fish and frozen fish fillets had the largest share in marine products. Fresh fish was 11.3% of total exports and frozen fish fillets were 9.6% of total exports. The largest trading countries in the export of goods were the Netherlands, Spain, and United Kingdom but 68.8% of all exports went to EEA countries.[8]

Exports of services has increased as the economy has become increasingly service oriented. Tourism has soared over the past few years and has been one of the main drivers of export growth. The total value of exports of services for 2021 was 95.6 billion ISK higher than in 2020, or 25%. The increase in exports of services is mainly due to increase in exports of travel and transportation as the impacts of the Covid-19 pandemic decreased somewhat in 2021. The value of exported travel was estimated 165.4 billion ISK in 2021 and increased by 91% compared with 2020. The value of exported transportation was estimated 120.4 billion ISK in 2021 and increased by 31% compared with 2020.[9]

In Iceland, the total value of imports of goods in 2021 was ISK 222.8 billion, 28.9% higher than in 2020. The increase was mainly in transport equipment and capital goods. The largest import categories were industrial supplies (28.8%) and capital goods (22.2%)[10]. The total value of imports of services for 2021 was 63.5 billion ISK higher, or 21%, than in 2020. The value of imports of travel was 96.3 billion ISK in 2021 and increased by 36% compared with 2020. The value of imports of transportation was 75.1 billion ISK in 2021 and increased by 23% compared with the year before.[11]

2.6.3 Energy profile

The energy profile is unusual, as 85% of primary energy use in 2019 came from renewable resources, hydro and geothermal. This share was even higher in 2020-2021 due to COVID-19 effects on lower transport fuel consumption. The remaining 15% came from imported fossil fuels, which are mainly used in transportation, road and aviation, and the fishing industry.

Iceland has extensive domestic energy sources in the form of hydro and geothermal energy. The development of energy sources in Iceland may be divided into three phases. The first phase covered the electrification of the country, utilization of hydropower and harnessing the most accessible geothermal fields, especially for space heating. In the second phase, steps were taken to harness the resources for the power-intensive industry by building larger hydropower plants. This began in 1966 with the signing of agreements on the building of an aluminium plant, and in 1979 a ferrosilicon plant began production. In the third phase, following the oil crisis of 1973-74, efforts were made to use domestic sources of energy to replace oil, particularly for space heating and fishmeal production in recent years. Oil has almost disappeared as a source of energy for space heating in Iceland. Domestic energy has replaced oil in industry and other fields where such replacement is feasible and economically viable.

Electricity consumption per capita is very high in Iceland compared to other OECD-countries, with 50 MWh/capita in 2020, next comes Norway with 23 MWh/capita (2020) and Canada and Finland with 15-16 MWh/capita (in 2019). See Figure 2.13.

[8] https://tradingeconomics.com/iceland/exports

[9] https://www.statice.is/publications/news-archive/external-trade/trade-in-services-by-classification-and-countries-2021/

[10] https://www.statice.is/publications/news-archive/external-trade/trade-in-goods-final-data-for-the-year-2021/

[11] https://tradingeconomics.com/iceland/imports

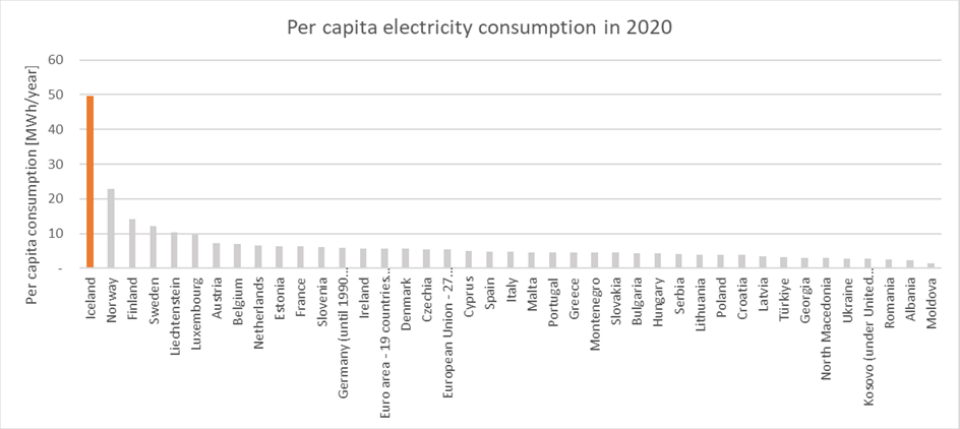


Figure 2.13 Electricity consumption per capita in Europe countries 202020 (Eurostat).

Renewable energy sources, primarily hydroelectric and geothermal, account for 99.9% of electricity production (see electricity produced by source in Figure 2.14), and 99,7% of space heating.

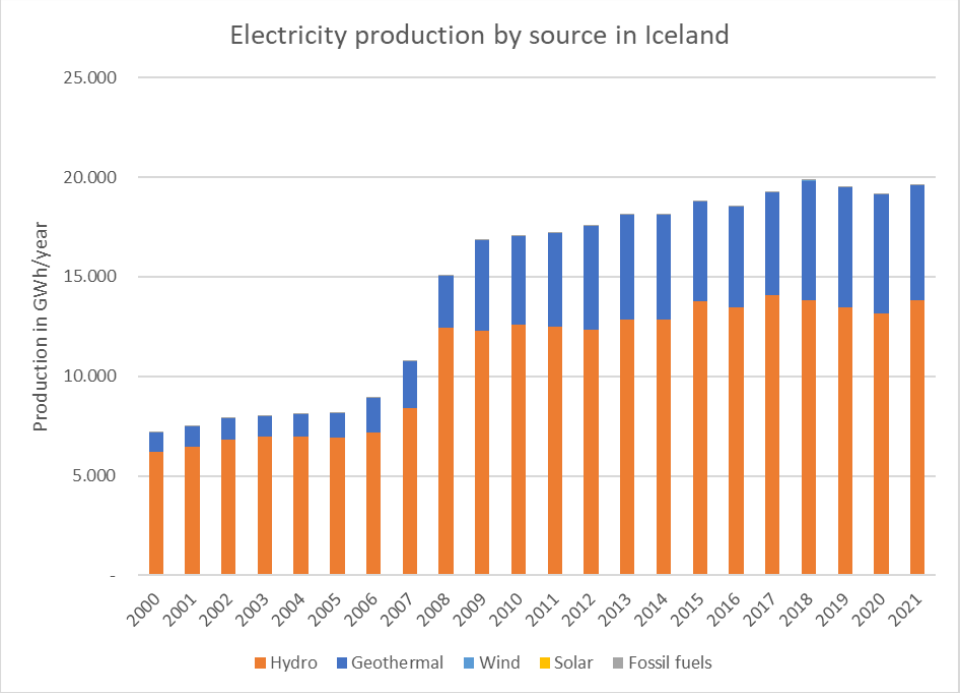


Figure 2.14 Electricity production by sources 2000-2021

The majority of electricity consumption in Iceland has historically been in the energy intensive industry. In 2021 these industries consumed 79%, or 14,994 GWh, of the electricity consumed, see Figure 2.15.

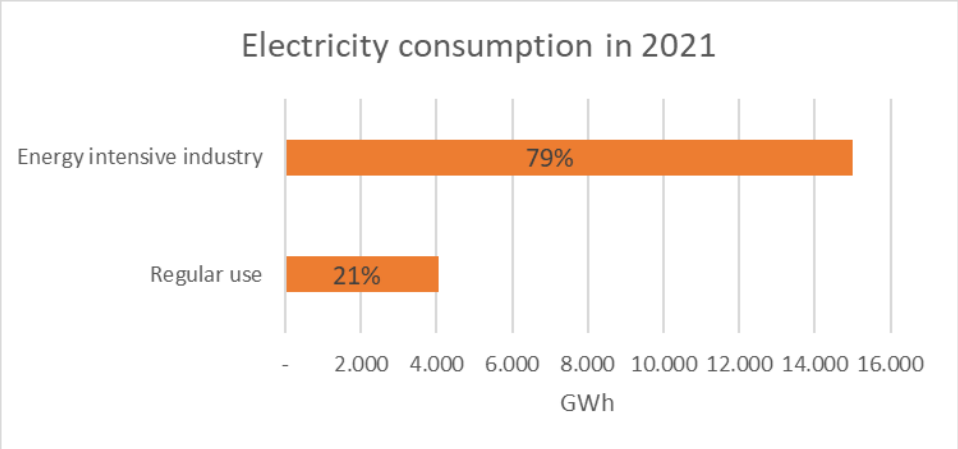


Figure 2.15 Total electricity consumption in Iceland in 2021 was 19,049 GWh

The consumption of energy intensive industries is split between aluminium smelters, which consumed 83% or 12,457 GWh, the ferroalloy industry, aluminium foil industry and data centers, see Figure 2.16.

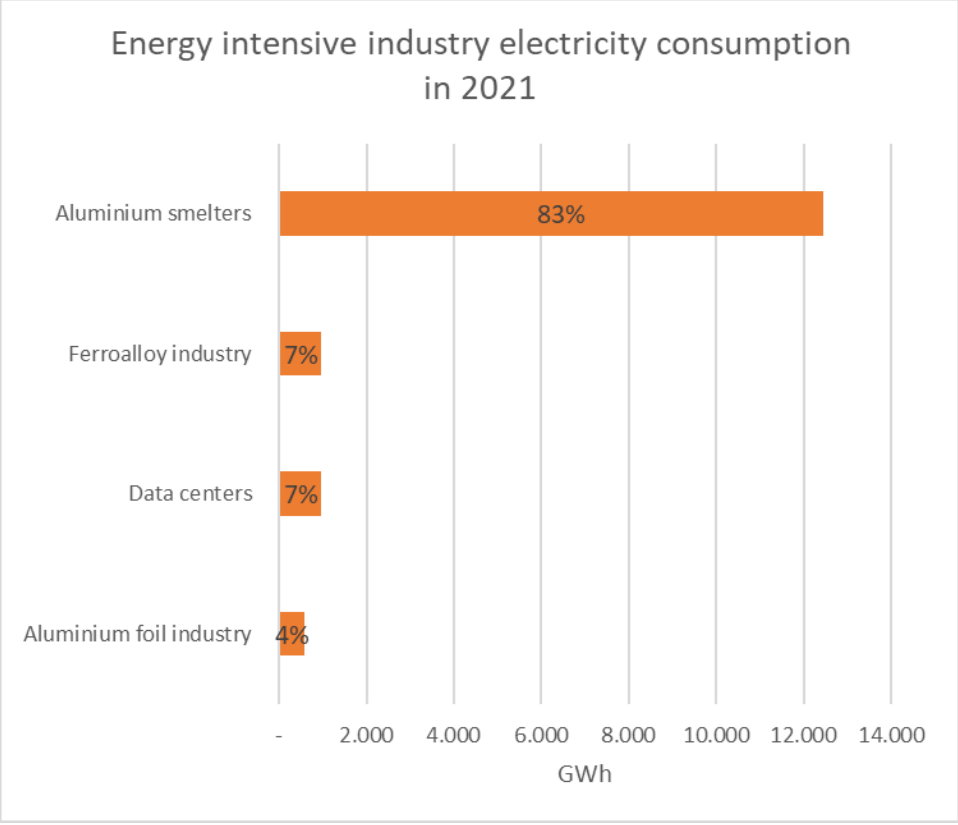


Figure 2.16 Electricity consumption of Energy intensive industries in Iceland in 2021

Figure 2.16, shows the electricity consumption of Energy intensive industries in Iceland in 2021. The total consumption was 14,994 GWh.

The remaining consumption, referred to as regular use in the graphs, includes residential use, utilities, services, fisheries, agriculture, and other industries. The total consumption of these groups was 4,055GWh in 2021, with other industry, service and residential use being the largest consumption groups, consuming around 25% each, see Figure 2.17.

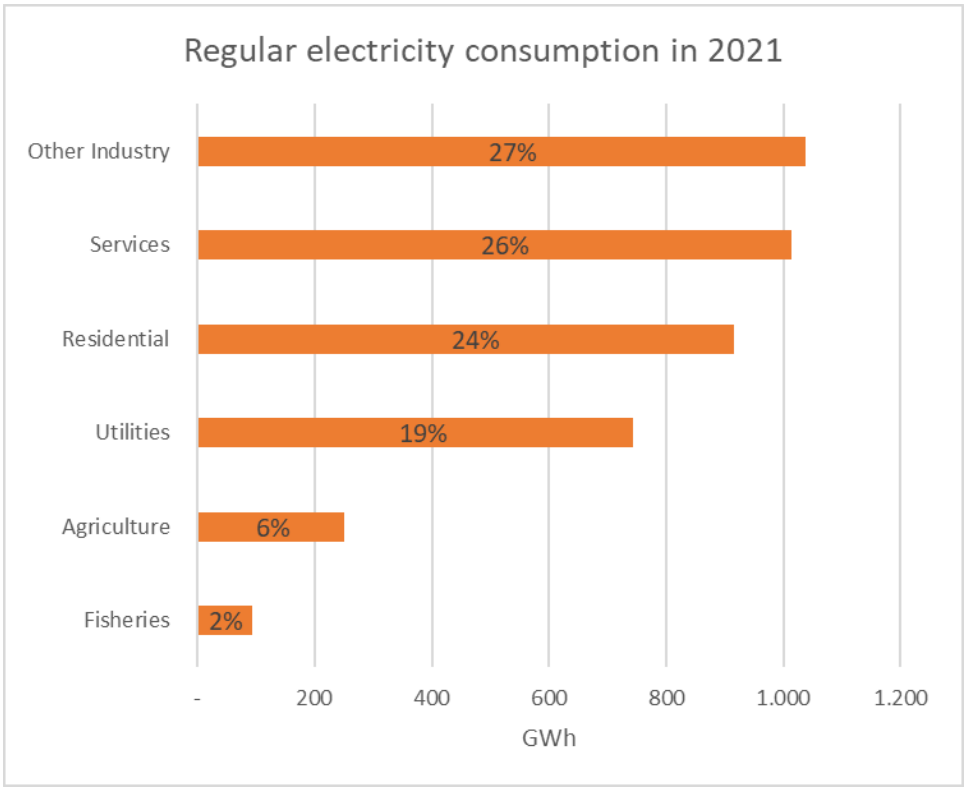


Figure 2.17 Regular electricity consumption in Iceland in 2021.

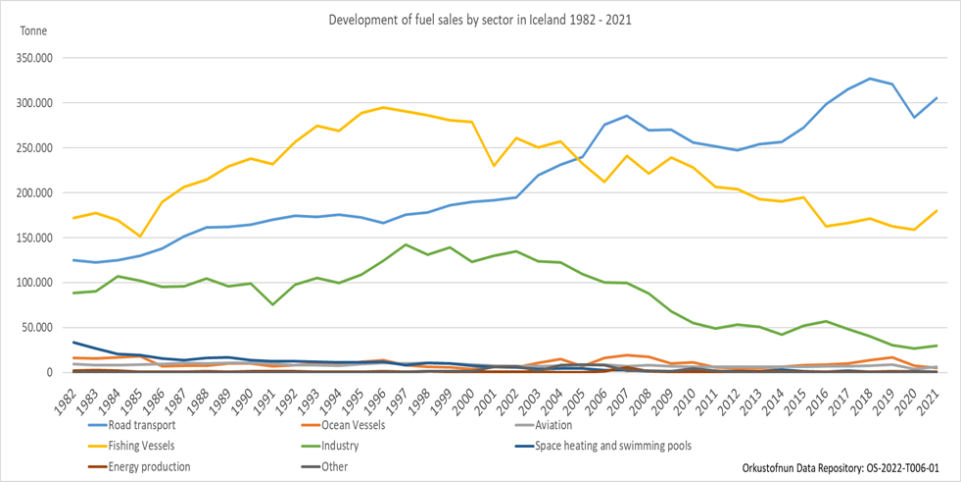


Figure 2.18 Domestic oil consumption in Iceland 1980 –2021.

Geothermal heat and hydropower account for around 85% of the country's primary energy consumption in 2019.

In 2021, the total installed capacity for electricity production was 2,933 MW most of which is hydropower, 71.7%, and geothermal power, 25.8%, see Figure 2-19. Some 92,4% of all homes in Iceland are heated with geothermal energy.

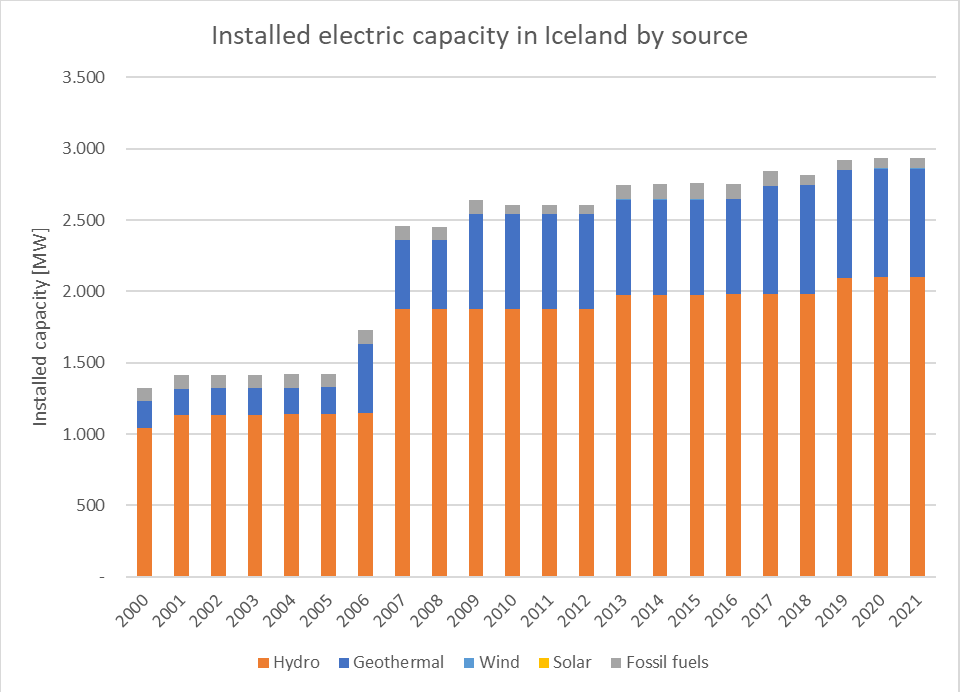


Figure 2.19 Installed electric capacity by source in Iceland.

Hydro power developments can have various environmental impacts. The most noticeable is usually connected with the construction of reservoirs, which are necessary to store water for the winter season. Such reservoirs affect the visual impact of uninhabited wilderness areas in the highlands and may inundate vegetated areas. Other impacts may include disturbance of wildlife habitats, the disappearance or alteration of waterfalls, reduced sediment transportation in glacial rivers downstream from the reservoirs and changed conditions for fresh-water fishing. Geothermal developments may also have environmental impacts, among them the drying up of natural hot springs. Development of high-temperature fields causes air pollution by increasing the natural H_2S emission from the fields. Geothermal power plants associated steam stack exhaust and transmission pipelines for geothermal water create visual impacts in the environment. Noise is associated with boreholes, power generation and water pumps, and pumping water underground at geothermal power plants can lead to earthquakes.

2.6.4 Industry

The production structure of Iceland's manufacturing sector is unique among industrialised countries in many respects. First, the manufacturing sector is dominated by two sub-sectors, food processing and aluminium production, which together account for roughly ¾ of total manufacturing. Second, production of machinery and other investment goods is relatively limited. Food production is directed partly at the domestic market, but a larger share, or 62% (in 2015), focuses on seafood production for export. Other less important sub-sectors are machinery equipment production (12%), building materials production (3%), and pharmaceuticals/chemical products (3%).

2.6.5 Tourism

Tourism has increased rapidly in Iceland in recent years. In 2021 the total number of foreign overnight visitors to Iceland was just under 700 thousand as the impacts of the Covid-19 pandemic decreased

somewhat. This was a 44% increase from 2020, when foreign visitors numbered just under half million. In 2019 the total number of foreign visitors was around 2 million.[12]

Around 688,000 tourists came on flights through Keflavík International Airport in 2021, or 98.5% of the total number of visitors. Around 10,000 came with the ferry Norræna through Seyðisfjörður, or around 1.5% of the total. Around 100 came on flights through Reykjavík Airport or Akureyri Airport. It must be assumed that there are variations in counts at Keflavik International Airport, as they cover all departures, including foreign national´s resident in Iceland. See Figure 2.20**.**

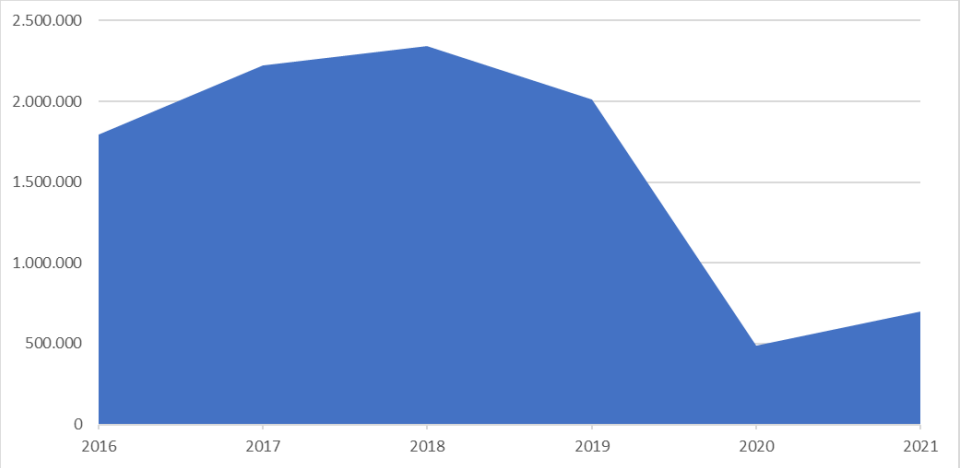


Figure 2.20 Foreign visitors' arrivals by air and sea to Iceland 2016-2021.

In 2020, roughly 12,600 persons were employed in tourism in Iceland. This was a decrease by nearly half compared with 2019 which is the lowest recorded employment figure in tourism since 2013. The number of persons employed in tourism increased by roughly 109% during the period 2012-2018, or by about 13% per year, on average.

In 2020, roughly 5,5% of total working hours are estimated to have been directly related to the production of goods and services for tourism final consumption while tourism direct contribution to GDP is estimated at 3,9%. For comparison, these estimates were, on average, roughly 10.4% for the period 2018-2019.[13]

[12] https://www.ferdamalastofa.is/en/recearch-and-statistics/numbers-of-foreign-visitors

[13] https://statice.is/publications/news-archive/national-accounts/employment-in-tourism-2009-2020/



Figure 2.21 Export of goods and services 2013-2022. [14]

2.6.6 Transport

The domestic transportation network consists of roads and air transportation. Public transportation is mainly in the capital area and few of the bigger towns. Public transportation outside the main urban areas is primitive and has been difficult to operate, due to thin population and widespread private car ownership. In 2016, Iceland had 717 registered vehicles per 1,000 inhabitants, in 2021 this number was up to 750 registered vehicles per 1,000 inhabitants, a total of 329.000 vehicles. Most vehicles still run on gasoline, but the number of vehicles using other types of energy is on the rise. See Figure 2.22.

National roads totalled 12,900 km in 2017, of which 4,920 km are classified as major roads.

[14] https://www.statice.is/statistics/economy/external-trade/trade-in-good-and-services/

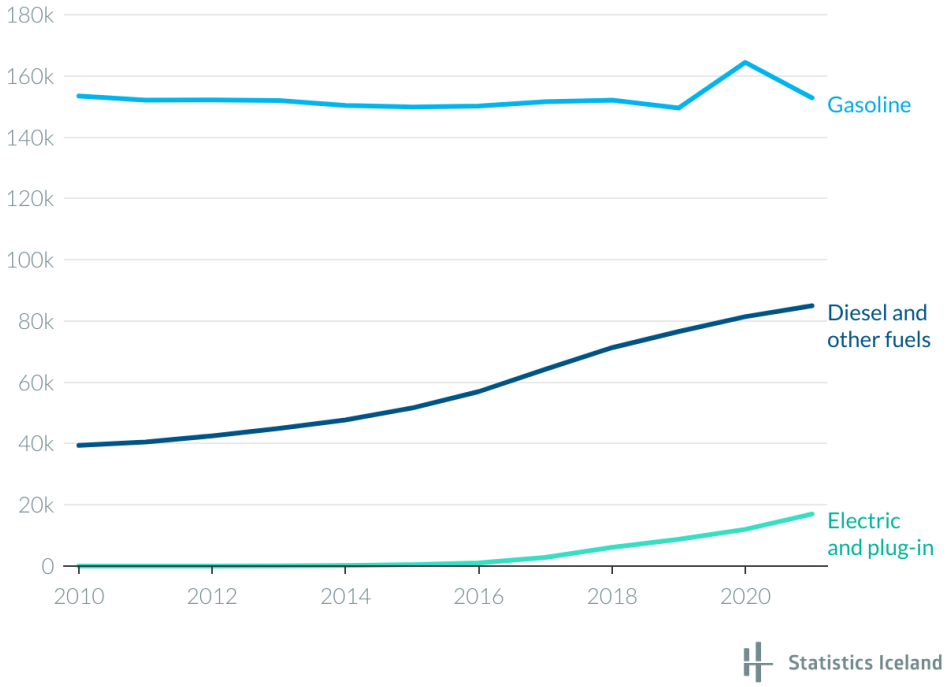


Figure 2.22 Household vehicle ownership by type of energy.

2.6.7 Aviation

Aviation plays a key role in Iceland. The country's geographical location makes undisturbed international air transportation imperative. Domestic aviation is also important because of long travel distances within the country combined with a small population. An investment in a railway system is therefore not a viable option.

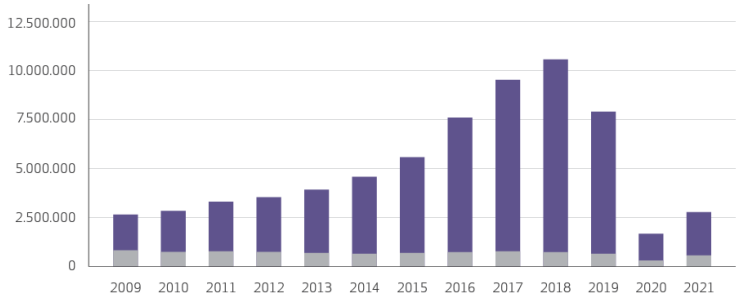


Figure 2.23 International passengers in Icelandic airports with scheduled services 2009-2021

Source: Isavia

In 2021 the total number of international passenger movements through Isavia airports numbered just over 2.7 million in 2021, which is a 60.9% increase from 2020. The number of international passengers using Icelandic scheduled flight airports increased from just under 1.4 million to just under 2.2 million, i.e. a

decrease of some 57.9% between years. There was an increase at most Icelandic airports, i.e. 12.3% in Egilsstaðir Airport, 58.1% at Keflavík Airport, around 98.5% at Reykjavík Airport but a decrease of 21% at Akureyri Airport. In 2016, the total number of international passengers was 6.7 million of which 2.2 million were transit passengers. 99.3% passed through Keflavik International Airport in 2016.

Just over 98,000 aircrafts passed through Icelandic airspace in 2021, an increase of around 30% from 2020. A total of over 131 million kilometres were flown in the Icelandic air traffic control area, or more than 27% more than the previous year. Just over a third of all air traffic over the North Atlantic crosses the Icelandic air traffic control area.[15] By comparison 165.640 aircrafts entered the Reykjavík Oceanic Control Area in 2016.[16]

Iceland has numerous harbours large enough to handle international ship traffic, which are free of ice throughout the year. The two main shipping lines operate regular liner services to the major ports of Europe and the US.

2.6.8 Construction

In the late 1970s the number of completed residential flats and houses in Iceland lay above 2000 annually. The number decreased steadily until 2001 when construction expanded rapidly with a peak in 2007 with 3300 houses and flats completed. This expansion coincided with major building projects, the Kárahnjúkar hydropower plant and dam and the Alcoa aluminium smelter in eastern Iceland. After the economic crises, the numbers of residential buildings completed each year dropped dramatically, with a rise again in 2012-2019. See figure 2.24.

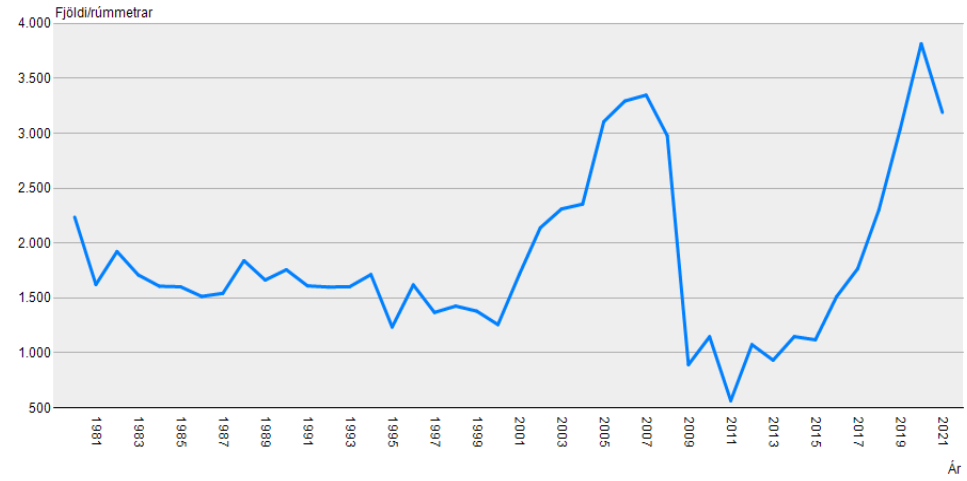


Figure 2.24 Completed Residential buildings in Iceland 1980-2021.

In 2022, the emission from Icelandic buildings was estimated for the first time: base year emission was 360.000 tons CO2eq. The largest sources of emissions are building materials, especially cement, (45%) and energy usage (30%). 74 measures have been defined that will be implemented in a public-private

[15] http://www.isavia.is/media/1/flugtolur2016finalenska.pdf
[16] www.isavia.is/media/1/flugtolur2016finalenska.pdf

cooperation in 2022-2030. The goal is to reduce emission from Icelandic buildings by 43% before 2030. The emission, the goal and the measures will be reviewed before end of year 2024.

2.6.9 Agriculture, land management and forestry

Approximately 6% of the total land area of Iceland is suitable for agriculture. A higher percentage is usable for grazing livestock but 25% of the country lies beneath 200 m above sea level. Production of meat and dairy products is mainly for domestic consumption. The principal crops have been hay, potatoes, and other root vegetables. Cultivation of other crops, such as barley and oats, has increased significantly, especially for fodder, but is still heavily dependent on favourable summers. There is also a lot more variety in horticultural crops. Vegetables and flowers are mainly cultivated in greenhouses heated with geothermal water and lit with electricity in winter.

In Iceland, the human impact on ecosystems is strong. The entire island was estimated to be about 65% covered with vegetation at the time of settlement in the year 874. Today, Iceland is only about 25% vegetated. This reduction in vegetative cover is the result of a combination of harsh climate and intensive land and resource utilization by a farming and agrarian society over 11 centuries. Estimates vary as to the percentage of the island originally covered with forest and woodlands at settlement, but a range of 25 to 30% is plausible.

Organized forestry is considered to have started in Iceland in 1899. Afforestation through planting did increase considerably during the 1990s from an average of around 1 million seedlings annually in the 1980s to 4 million in the 1990s. Planting reached a high of about 6 million seedlings per year during 2007 – 2009 but was reduced after the financial crisis to about 3.5 million seedlings in 2012. Around 1100-1900 ha was afforested annually in the period of 1990-2007. Planting of native birch has been increasing proportionate to the total afforestation, comprising 24% of seedlings planted in the period 1990-2007. From its limited beginnings in 1970, state supported afforestation on farms and privately-owned land has become the main channel for afforestation activity in Iceland, comprising about 80% of the afforestation effort today. The total area of forest and other wooded land is 1840 km2 covering 1.8% of the surface of Iceland. Native birch forest and woodland cover 1460 km2 and cultivated forest cover 380 km2.

The Soil Conservation Service of Iceland, an agency under the Ministry of Food, Agriculture and Fisheries, was founded in 1907. The main tasks of the agency are combating desertification, sand encroachment and other soil erosion, the promotion of sustainable land use and reclamation and restoration of degraded land. A pollen record from Iceland confirms the rapid decline of birch and the expansion of grasses in 870-900 AD, a trend that continued to the present. As early as around 1100 more than 90% of the original Icelandic forest was gone and by 1700 about 40% of the soils had been washed or blown away. Vast gravel-covered plains were created where once there was vegetated land. Ecosystem degradation is one of the largest environmental problems in Iceland. Vast areas have been decertified after over-exploitation and the speed of erosion is often magnified in certain areas by volcanic activity and harsh weather conditions.

Land reclamation activities focused in the beginning on areas in south and southwest Iceland where problems of drifting sand were most evident in threatening farms and fishing villages. After World War II the reclamation effort was spread more widely but still with a focus on south Iceland. With increased resources after 1974 reclamation activity was extended to many inland locations that were prime sources of sand along major rivers or near outlets of rivers. With detailed information acquired from mapping of erosion severity, recent reclamation activity has become wider spread, more selective and targeted.

2.6.10 Waste

Waste management in Iceland has undergone impressive changes in the 21st century with increased separate collection of waste for recovery purposes. There was a steady increase of the total amounts of waste up to 2008 when there was a peak and then a fast decrease following the economic crisis. The total waste per capita reached 2008 levels again around 2013. It reached a peak in 2016 but has been decreasing ever since. From the year 1995, the amount of waste destined for landfill or other final disposal has decreased by more than 70% while there has been a fast increase in the amount of waste for recovery. Figure 2.25 and Figure 2.26 shows the development of the amounts of waste and the fate of the waste during this period.

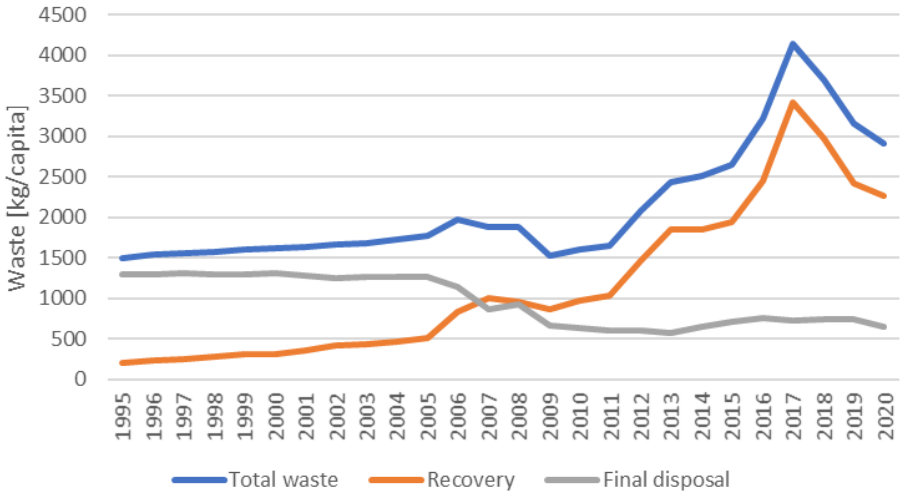


Figure 2.25 Changes in the amount of waste per capita in the years 1995 – 2020

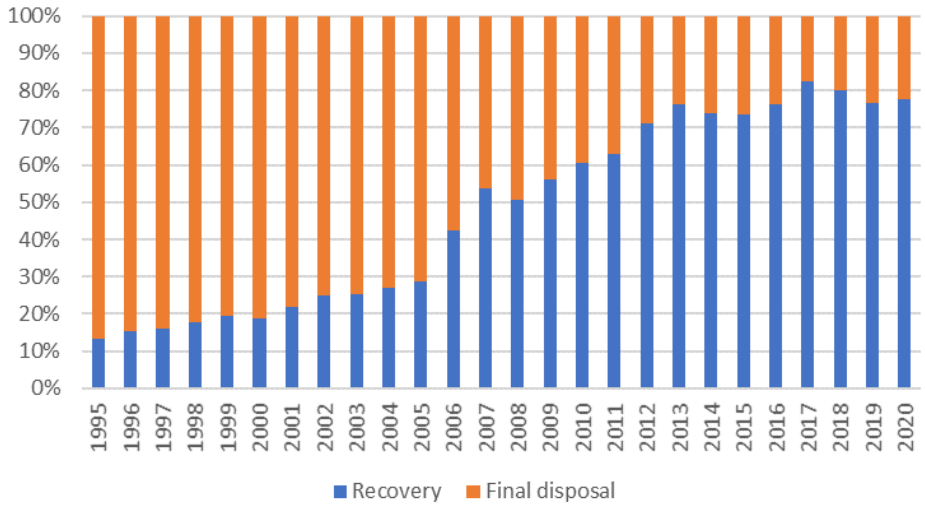


Figure 2.26 The development of the fate of waste in the years 1995 - 2020

Since 2002, there has also been great development in the composition of waste where mixed non-household waste has decreased very fast due to increased separation by the industry. More separation of waste has provided possibilities for increased waste recovery.

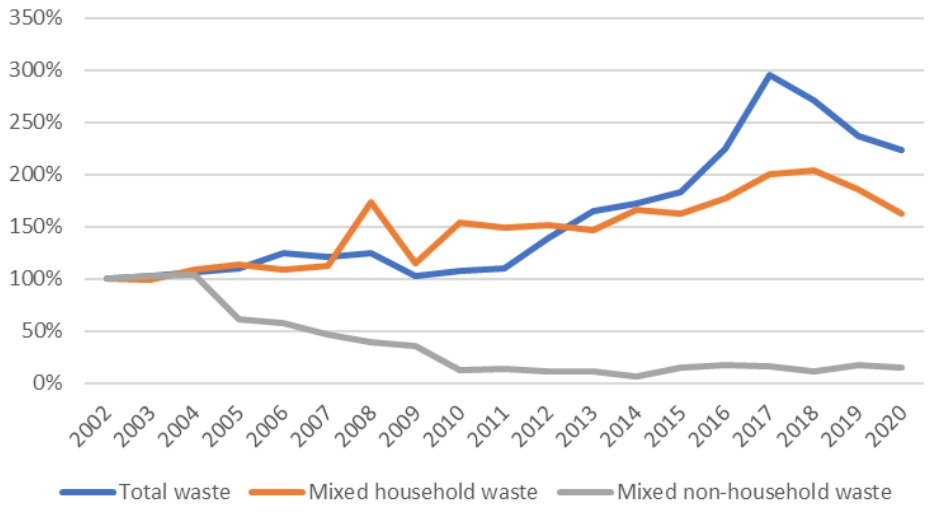


Figure 2.27 Proportional changes in the amount of waste per capita relative to 2002.

3. Greenhouse gas inventory information

3.1 Introduction

In this chapter the Iceland's greenhouse gas (GHG) emissions and their trends for the period 1990-2020 is presented. Information on Iceland's national system for greenhouse gas inventory and the national registry is also presented. The information is consistent with Iceland's 2022 greenhouse gas inventory submission to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat with the latest data for the year 2020.

In 2020, Iceland's total emissions of greenhouse gases, excluding LULUCF, where 4,510 kt. CO2 equivalent.

Summary tables of GHG emissions in the common reporting format are presented in Annex II. The presented data is on direct greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Nitrogen trifluoride (NF_3) emissions do not occur in Iceland. Emissions of the indirect greenhouse gases NO_x, NMVOC and CO as well as SO_2 are also included in the inventory, in compliance with the reporting guidelines.

Iceland submitted to UNFCCC the 2022 annual Inventory data (CRF and NIR) in spring 2022. During UNFCCC's centralised review (19 – 23 September 2022) the expert review team (ERT) raised some issues that were solved during the review week and led to recalculations of Iceland's inventory. Iceland therefore resubmitted the 2022 inventory data (CRF) to the UNFCCC on 23rd of September 2022. Iceland's 2022 National Inventory Report (NIR) was updated in accordance with the latest submission of 2022 (v4).

The recalculations done as a result of the review did not change Iceland's total emissions. The recalculations were within the KP LULUCF leading to changes in the removal units (RMU) for the second Kyoto period.

All inventory data information published in this National Communication are based on Iceland's 2022 National Inventory Report and CRF reporting tables submitted on September 23rd, 2022, if not otherwise indicated.

3.2 Background Information

The 1992 United Nations Framework Convention on Climate Change (UNFCCC) was ratified by Iceland in 1993 and entered into force in 1994. One of the requirements under the Convention is that Parties are to report their national anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol, using methodologies agreed upon by the Conference of the Parties to the Convention (COP).

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. Iceland acceded to the Kyoto Protocol on May 23rd, 2002. The Kyoto Protocol commits Annex I Parties to individual, legally binding targets for their GHG emissions:

3.2.1 First commitment period of the Kyoto Protocol (2008-2012)

For the first commitment period of the Kyoto Protocol, the GHG emissions were not to increase by more than 10% from the level of emissions in 1990. Iceland's Assigned Amount Units (AAUs) for the first

commitment period were decided in Iceland's Initial Report under the Kyoto Protocol[17] and amounted to 18,523,847 tonnes of carbon dioxide equivalents (CO_2e). Decision 14/CP.7 on the "Impact of single project on emissions in the commitment period" allowed Iceland to report certain industrial process carbon dioxide (CO_2) emissions separately and not include them in national totals; to the extent they caused Iceland to exceed its assigned amount. For the first commitment period, from 2008 to 2012, the CO_2 emissions falling under decision 14/CP.7 were not to exceed 8,000,000 tonnes.

At the end of the commitment period, a total of 1,542,761 RMUs were available from Art. 3.3 and Art. 3.4 activities and 33,125 AAUs, CERs and ERUs from Joint Implementation Projects, resulting in an available assigned amount of 20,098,931 AAUs. Emissions from Annex A sources (including those falling under the scope of Decision 14/CP.7) for the entire CP1 were 23,356,066 tonnes CO_2e, corresponding to 3,257,140 tonnes CO_2e in excess of Iceland´s available assigned amount. Two projects fulfilled the provisions of Decision 14/CP.7, with a total of 5,912,964 tonnes CO_2e. Of these emissions, 2,655,824 tonnes were reported under the national totals, to match the total available amounts of AAUs, and 3,257,140 tonnes were reported separately under decision 14/CP.7. Iceland was thus in compliance with its commitments.

3.2.2 Kyoto Protocol - Second commitment period (Doha amendment – 2013-2020)

Iceland communicated to the UNFCCC a commitment to a quantified economy-wide emission reduction target of 20% below 1990 levels by 2020 in the second commitment period of the Kyoto Protocol.[18] This target is to be fulfilled jointly with the EU and its 28 Member States according to a bilateral agreement between Iceland and EU where Iceland participates in the overall target of EU and its member states to reduce the emission of 20% to 2020. See Figure 3.1.

Iceland did not carry over any credits from the first commitment period of the Kyoto Protocol.

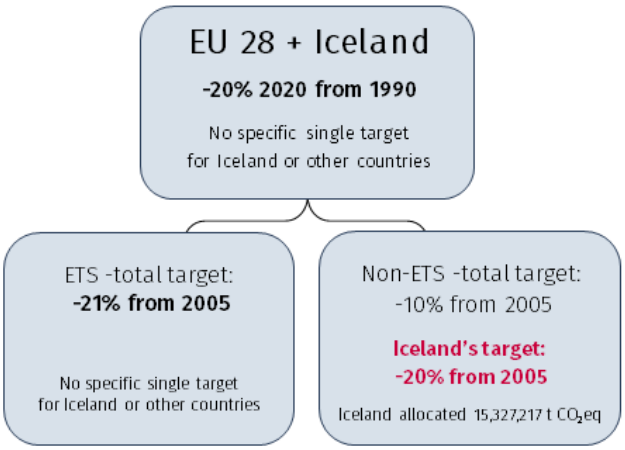


Figure 3.1 EU's 2020 target.

[17] The Initial report for Iceland can be downloaded here.

[18] https://unfccc.int/sites/default/files/resource/docs/2012/awglca15/eng/misc01a02.pdf: Additional information relating to the quantified economywide emission reduction targets contained in document FCCC/SB/2011/INF.1/Rev.1

In 2015 a Joint Fulfilment Agreement[19] was concluded between the European Union (EU), its Member States and Iceland. This Agreement concerned Iceland's participation in these parties' joint fulfilment of commitments in the second commitment period of the Kyoto Protocol. Therein the Parties agree to fulfil jointly their quantified emission limitation and reduction commitments for the second commitment period inscribed in the third column of Annex B to the Kyoto Protocol. Iceland's individual assigned amount was established at 15,327,217 AAUs. These AAUs were to cover the emissions not covered by Directive 2003/87/EC (EU-ETS Directive).

According to Article 4 and Annex I of the Joint Fulfilment Agreement, Regulation (EU) No 525/2013 ("MMR") and current and future Delegated and Implementing Acts based on Regulation (EU) No 525/2013 shall be binding upon Iceland. This includes for instance Commission Implementing Regulation (EU) No 749/2014, which further details the content and format required for the various reporting requirements under Regulation (EU) No 525/2013. The legal acts were rendered applicable in Iceland in 2015 with an amendment to Act No 70/2012, cf. Act No 62/2015.

Iceland plans to use removal units (RMU) for the second Kyoto period to meet its Kyoto Protocol target; in addition, Iceland will need to use market-based mechanisms to reach its target.

According to the 2022 reviewed inventory (NIR and CRF reporting tables), the estimation for the commitment period is as follows:

- Total CP2 emissions, as per the scope of the Joint Fulfilment Agreement: 23,031 kt CO_2e
- Allocated allowances: 15,327 kt CO_2e
- Removal units: 4,299 kt CO_2e
- Emissions in excess of allocations: 3,404 kt CO_2e

This is done in addition to domestic action, that is discussed in Chapter 3.2.4 below.

At the time of writing, an ongoing discussion between Iceland and the EU is taking place, where the arrangement on the compliance will be set, in accordance with the bilateral agreement mentioned above. The process is expected to be finalized in early 2023.

3.2.3 Paris Agreement period (2021-2030)

Under the Paris Agreement, Iceland will be part of a collective delivery with the EU-Member states and Norway, to reach a target of 55% reduction of greenhouse gas emissions by 2030 compared to 1990 levels.

This arrangement was stated in in Iceland´s updated NDC submitted to the UNFCC on February 18, 2021.

Iceland will ensure fulfilment of its fair share of the collective delivery of the 55% target by;

a) continuing participation in the EU Emissions Trading System (EU-ETS) according to Directive 2003/87/EC,
b) reducing emissions falling under the scope of the EU's Effort Sharing Regulation (ESR) No 2018/842 - ESR) relative to the 2005 emission level. The current Effort Sharing target for 2030 is 29% reduction relative to 2005. At the time of writing, work is in progress to determine a new target in line with the updates of the EU's "Fit for 55" legislation package. In accordance with the ESR framework, it is expected that the new Effort Sharing target for Iceland will be set at 40-43% reduction.

[19] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2015.207.01.0017.01.ENG&toc=OJ%3AL%3A2015%3A207%3ATOC

c) implementing the reporting and accounting rules pertaining to emissions and removals from the land use, land use change and forestry (**LULUCF**) as prescribed by the LULUCF Regulation (EU) 2018/841).

In addition to Iceland's commitments towards the EU, the Government has in 2021 in its Agreement[20] on the Platform for the Coalition Government of the Independence Party, the Left Green Movement and the Progressive Party, set a domestic target of 55% emission reduction by the year 2030, relative to 2005 for the emissions falling under the scope of the Effort Sharing Regulation.

Iceland's and Norway's joint fulfilment with the EU Member States for the Paris Agreement was agreed upon with the uptake in October 2019 of relevant EU legislation into the European Economic Area (EEA) Agreement[21]. In addition to the above mentioned ESR and LULUCF regulation, the agreement now also includes relevant parts of the Governance of the Energy Union Regulation (EU) No 2918/1999 replacing the MMR Regulation (EU) No 525/2013).

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*) [22]. Commission Implementing Regulation (EU) 2020/1208 and Commission Delegated Regulation (EU) 2020/1044, are now incorporated into the EEA Agreement through the EEA Joint Committee Decision no 223/2021[23]. At the time of writing, work is underway to write a new regulation aiming at implementing the JCD No 223/2021 into Icelandic legislation. The same regulation will also serve as a recast of Regulation No 520/2017, on data collection and information from institutions related to Iceland's inventory of greenhouse gas emissions and carbon removal, that implemented Regulation (EU) No 525/2013. This new regulation is expected to be published in 2023.

3.2.4 Climate strategies

A climate strategy was adopted by the Icelandic government in 2007. The long-term strategy was to reduce net GHG emissions in Iceland by 50 – 75% by 2050, compared to 1990 levels. Over a shorter period, Iceland aimed to ensure that emissions of GHGs would not exceed Iceland's obligations under the Kyoto Protocol in the first commitment period. In November 2010, the Icelandic government adopted a Climate Action Plan[24] in order to execute the strategy.

In September 2018 the Icelandic government published a Climate Action Plan[25] for the years 2018-2030; an updated version of the action plan was released in June 2020[26], which is the plan currently being put in action. The action plan has two main goals: achieving the emission reductions of the Paris Agreement for 2030 and reaching carbon-neutrality in 2040. To reach these goals the revised action plan set forth 48

[20] Agreement on the Platform for the Coalition Government of the Independence Party, the Left Green Movement and the Progressive Party

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

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

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

[24] https://www.stjornarradid.is/media/umhverfisraduneyti-media/media/PDF_skrar/Adgerdaaaetlun-i-loftslagsmalum.pdf, in Icelandic

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

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

policies and measures (PaMs) which mostly focus on electrification of the transport sector and increased efforts in afforestation, revegetation and wetland restoration. The revision of the plan also contained significantly improved analysis to estimate the individual and collective mitigation gains of the measures presented.

According to the Climate Act, the Government shall, in consultation with stakeholders, review and update the Climate Action Plan every fourth year, based on international commitments and the Government's goals. PaMs shall be developed and put in motion by an inter-ministerial committee. The committee shall also prepare an annual progress report on the status of implementation of the climate plan and its measures, emissions development and whether or not the development is in accordance with the Climate Action Plan. The first such progress report was published in September 2021 (Ministry of the Environment and Natural Resources[27]) to follow up on the progress of the 2020 Climate Action Plan. Besides the 48 PaMs put forth in the 2020 Climate Action Plan, two new GHG PaMs were introduced in the progress report: 1) energy change in the production sector; 2) increased knowledge and research to improve the LULUCF sector of the GHG inventory. According to the progress report, thirty PaMs (out of 50 PaMs in total) have currently been implemented, seventeen are in progress and three are in preparation. In August 2022, a new progress report was published (Ministry of the Environment, Energy and Climate[28]). No new PaMs were introduced in the newest progress report and by the time of the publication of the progress report, 34 PaMs have been implemented, 15 are in progress and one is in preparation.

A minimum of ISK 46 billion (approx. 310 million EUR) is expected to be spent on key climate measures in the period 2020-2024.

3.3 Trends in Greenhouse Gases

3.3.1 Emission Trends Overview

GHGs that, according to Annex A of the Kyoto Protocol as modified by the Doha Amendment[29], are to be considered in national GHG inventories, are:

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

Iceland reports emissions of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. No emissions of NF_3 occur in Iceland, there are no imports and no industry potentially using NF_3 (e.g. semiconductors, LCD manufacture, solar panels and chemical lasers) at present.

[27] 2021 Progress report on the Climate Action Plan, published September 2021 (in Icelandic)
[28] 2022 Progress report on the Climate Action plan, published August 2022 (in Icelandic)
[29] https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment

Total amounts of GHGs emitted in Iceland during the period 1990 to the most recent inventory year are presented in the following figures and tables, expressed in terms of contribution by gas and sector in kt CO_2 equivalents (CO_2e). Global warming potential (GWP) values used are the 100-year time horizon values from the 4th assessment report (AR4) of the IPCC.

Iceland also reports emissions from indirect GHGs, this includes:

- Nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOC) and carbon monoxide (CO) which have an indirect effect on climate through their influence on GHGs, especially ozone; and
- Sulphur dioxide (SO_2) which affects climate by increasing the level of aerosols that have in turn a cooling effect on the atmosphere.

The emission trends from indirect GHGs are presented separately in Section 3.4. The section below describes trends in GHG emissions as per Iceland's most recent National Inventory Report (NIR). For more thorough discussions on methods and recalculations for individual subsectors the reader is referred to the NIR 2022[30].

[30] Iceland's 2022 NIR can be found here.

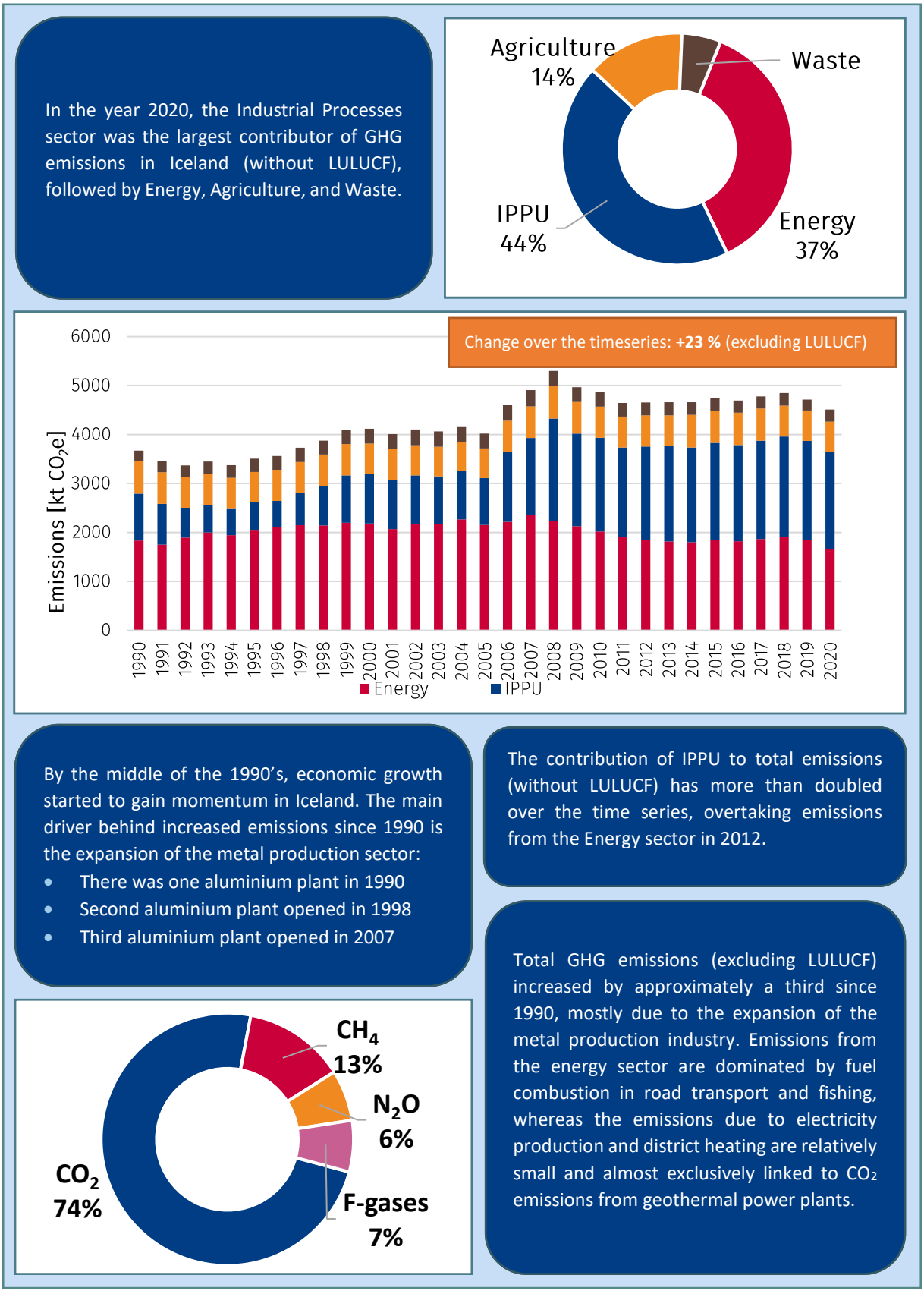


Figure 3.2 Overview of GHG emissions (without LULUCF)

Figure 3.2. shows the overview of GHG emissions (without LULUCF), from top to bottom: (1) emission by sector for 2020 (2) emission by sector over the time series and (3) emissions by gas for the latest year.

Overall trend

Since 1990, Iceland's total GHG emissions have increased by almost a quarter. This trend in increasing emission is dominated by:

- the expansion of the metal production sector, in particular the aluminium sector
- increases in emissions from geothermal energy utilization due to an increase in electricity production, which increased 18-fold between 1990 and 2019
- the road transport sector CO_2 emissions almost doubling since 1990 due to population growth, number of cars per capita, more mileage driven, and a growing number of larger vehicles; these changes can partly be attributed to a significant increase in the number of tourists in Iceland in the last 10 years.

In contrast, annual emissions have seen an overall decline since 1990 from commercial fishing, with GHG emissions reducing by approximately a quarter over the time series. Emissions from both domestic flights and navigation have also declined since 1990.

Emissions during 1990 - 1999

Total emissions show a slight decrease between 1990 and 1994, with the exception of 1993. From 1995-1999 total emissions increased slightly.

By the middle of the 1990's, economic growth started to gain momentum in Iceland. The main driver behind increased emissions since 1990 is the expansion of the metal production sector. In 1990, 87,839 tonnes of aluminium were produced in one aluminium plant in Iceland. A second aluminium plant was established in 1998 and a third one in 2007.

Emissions during 2000 - 2007

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

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

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

Emissions during 2008 - 2011

Between 2008 and 2011 annual emissions steadily decreased.

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

Emissions from fuel combustion in the transport and construction sector decreased each year between 2008 and 2011, because of the economic crisis. In 2015 the emissions were slightly higher than in 2011, yet still approximately 20% below the peak in 2007.

Emissions since 2011

Emissions have increased steadily since 2011, with the exception of the year 2016 which saw a slight decrease.

In 2019, aluminium production had increased almost tenfold compared to 1990. Parallel investments in increased power capacity were needed to accommodate for this increase. The size of these investments is large compared to the size of Iceland´s economy. In 2019 total emissions from the aluminium sector were 13% lower than in 2008 due to improved technology and process control.

Table 1 Emissions of GHG by sector in Iceland for the reported time series [kt CO_2e].

Sector	1990	1995	2000	2005	2010	2015	2019	2020	Change '90-'20	Change '19-'20
1 Energy	1,836	2,053	2,181	2,155	2,020	1,848	1,849	1,659	-10%	-10%
2 Industrial Processes	958	565	1,010	955	1,917	1,983	2,020	1,986	107%	-1.7%
3 Agriculture	662	618	627	605	631	655	621	618	-6.5%	-0.5%
4 Land Use, Land Use Change and Forestry	9,199	9,175	9,194	9,232	9,196	9,107	9,020	9,010	-2.1%	-0.1%
5 Waste	219	270	302	304	296	261	223	247	12%	10%
Total without LULUCF	**3,674**	**3,506**	**4,119**	**4,019**	**4,865**	**4,746**	**4,713**	**4,510**	**23%**	**-4.3%**
Total with LULUCF	**12,873**	**12,681**	**13,314**	**13,251**	**14,061**	**13,853**	**13,733**	**13,519**	**5.0%**	**-1.6%**
International bunkers (memo items)	249	241	465	427	380	829	1,170	342	37%	-71%

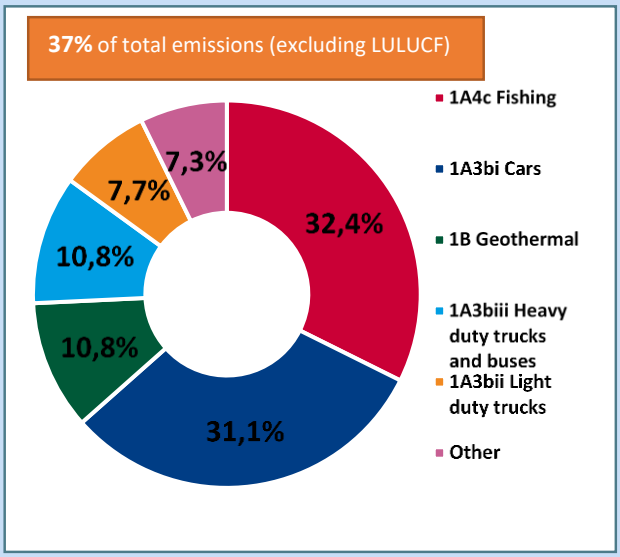
As shown in Table 2, the largest contributor by far of total GHG emissions without LULUCF is CO_2, followed by CH_4, N_2O and fluorinated gases (PFCs, HFCs, and SF_6). Over the time series, emissions of CO_2 have increased most, and PFCs and N_2O emissions have decreased significantly.

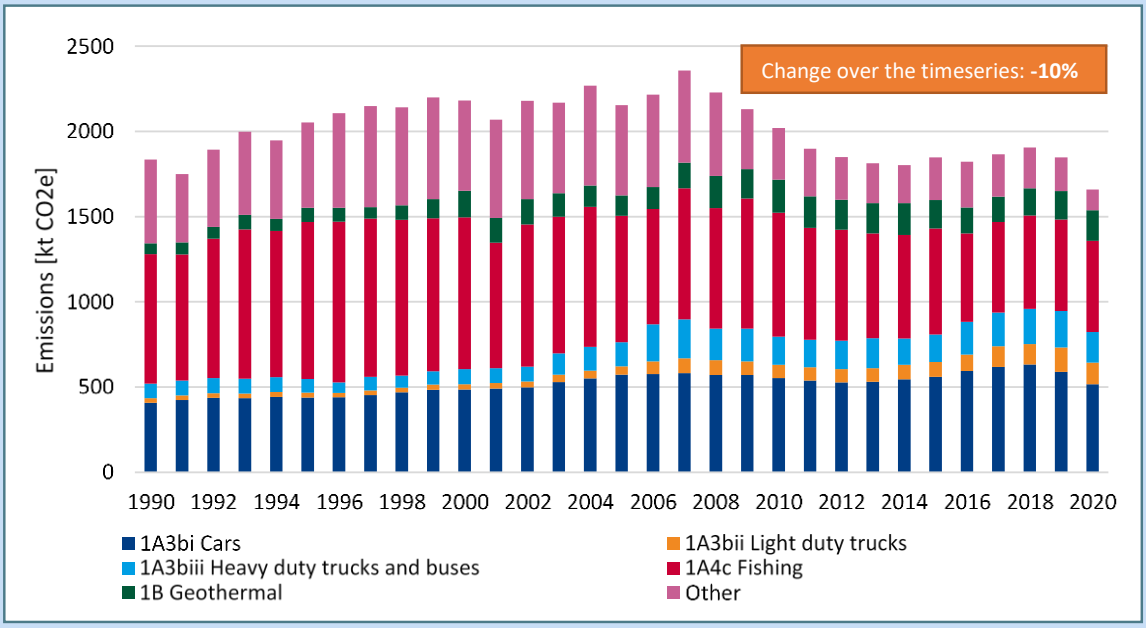
Table 2 Emissions of GHG gases by gas for the reported time series (without LULUCF) [kt CO_2e].

GHG	1990	1995	2000	2005	2010	2015	2019	2020	Change '90-'20	Change '19-'20	% Total in latest year
CO_2	2,216	2,460	2,923	2,968	3,617	3,534	3,546	3,329	50%	-6.1%	74%
CH_4	606	630	659	648	656	631	570	590	-2.8%	3.4%	13%
N_2O	356	343	342	311	305	312	295	295	-17%	0.1%	6.5%
PFCs	495	69	150	31	172	104	97	96	-81%	-1.4%	2.1%
HFCs	0.3	3.4	44	58	111	163	203	198	57348%	-2%	4.4%
SF_6	1.1	1.2	1.3	2.5	4.7	1.6	2.3	3.2	188%	39%	0.1%
Total	3,674	3,506	4,119	4,019	4,865	4,746	4,713	4,510	23%	-4.3%	100%

3.3.2 Energy (CRF sector 1)

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





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

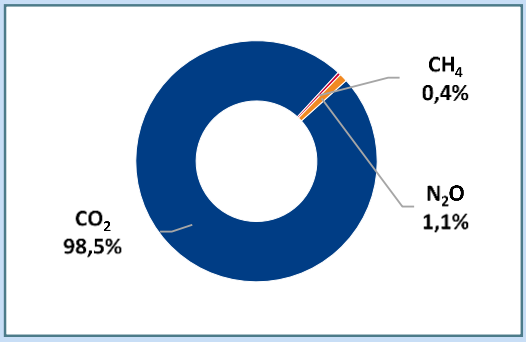


Figure 3.3 Overview of emission from the Energy sector

Figure 3.3 shows the overview of emissions from the Energy sector; from top to bottom: (1) emission by subsector for the latest year, (2) emission by subsector over the time series and (3) emission by gas for the latest year.

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

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

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

The emission trends are discussed in more detail below by subsector. These are categorised into fuel combustion, which covers all direct emissions from oxidation of fuel for generating heat or mechanical work to a process, geothermal and fugitive emission, which covers emission from the extraction, transformation and transportation of primary energy carriers. Emissions from transport have significantly increased since 1990, whilst emissions from energy industries, fishing and manufacturing industries and construction have decreased as can be seen in Table 3. The causes of these emission trends are discussed below.

The energy sector includes emissions from **electricity and heat production**. Iceland relies heavily on renewable energy sources for electricity and heat production, thus emissions from this sector are very low (accounting for >1% of the sector's total emission for the whole timeseries). The sources of emissions from electricity and heat production are:

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

Emissions from the energy industries sector have generally decreased since 1990. In 1995 there were issues in the electricity distribution system (snow avalanches in the Westfjords and icing in the northern part of the country) that resulted in higher emissions that year. Unusual weather conditions during the winter of 1997/1998 led to unfavourable water conditions for the hydropower plants, with unusually low levels in the water reservoirs leading to less electricity production. This created a shortage of electricity which was met by burning oil for electricity and heat production. In 2007 a new aluminium plant was established. Due to

the delay of the Kárahnjúkar hydropower project, the aluminium plant was initially supplied with electricity from the distribution system. This led to electricity shortages for the district heating systems and industry depending on curtailable energy, leading to increased fuel combustion and emissions.

Increased emissions from the **manufacturing industries and construction** source category over the period 1990 to 2007 are explained by the increased activity in the construction sector during the period. The knock-off effect of the increased levels of economic growth was increased activity in the construction sector. Emissions rose until 2007, where the rise, particularly in the years prior to 2007, was related to the construction of Iceland's largest hydropower plant (Kárahnjúkar, building time from 2002 to 2007). The construction sector collapsed in the fall of 2008 due to the economic crisis and the emissions from the sector decreased by over half between 2007 and 2011. Emissions from fuel combustion at the cement plant decreased rapidly due to the collapse of the construction sector and in 2011 the plant closed. The fishmeal industry is the second most important source within manufacturing industries and construction. Emissions from fishmeal production decreased over the period due to replacement of oil with electricity as well as a drop-in production.

Emissions from the **Transport** sector have increased by over half across the time series. The largest increase in emissions is from road transport, owing to an increase in the number of cars per capita, more mileage driven and until 2007 an increase in larger vehicles. Since 1990, the vehicle fleet in Iceland has increased significantly, driven by the growing population, increase in cars per capita and increased tourism. Emissions from road vehicles peaked in 2018 after a decreasing trend from the previous 2007 peak which has been followed by a rise in road emissions since 2012. In recent years, more fuel economic vehicles have, however, been imported – a turn-over of the trend from the years 2002 to 2007 when larger vehicles were imported. New registrations of electric vehicles and plug-in hybrids have also been increasing rapidly since 2014. Emissions from both domestic flights and navigation have declined since 1990. This decrease in navigation and aviation has compensated for rising emissions in the transport sector to some extent.

The **fisheries** dominate the Other sector (1A4). Emissions from fisheries rose from 1990 to 1996 because a substantial portion of the fishing fleet was operating in unusually distant fishing grounds. From 1996, the emissions have generally been decreasing and reached levels below 1990 in 2011. Emissions remain below 1990 levels, however there are large annual variations due to the inherent nature of fisheries.

Emissions from **geothermal energy utilization** has accounted for 3-8% of the total annual GHG emissions (excluding LULUCF) in Iceland since 2015. Iceland relies heavily on geothermal energy for space heating (over 90% of households) and electricity production (approx. 30% of the total electricity production in recent years). Table 3 shows the emissions from geothermal energy from 1990 to 2019. Electricity production using geothermal power increased approximately 20-fold during this period resulting in an increase in emissions. Emissions from geothermal utilization are site and time-specific and can vary greatly between areas and the wells within an area as well as by the time of extraction. Carbon capture and storage occurs at one of the geothermal power plants (Hellisheiði), and captured emissions are deducted from the total emissions from this category. For more information on this topic the reader is referred to Chapter 3.4.2 of Iceland's latest National Inventory Report (NIR) 2022[31]

[31] https://ust.is/library/Skrar/loft/NIR/ISL_NIR%202022_15%20april%20submission_submitted.pdf

Emissions from geothermal energy exploitation are set under sector 1B2d (under Fugitive emissions from fuels) for lack of better place to report them; it is though not an intuitive location given that no fuels are involved in the production of geothermal energy.

Fugitive emissions from fuels

Emissions from distribution of oil products are a minor source in Iceland (>1 kt CO_2e). There are no other fugitive emissions from fuels in Iceland and no coal, oil, or gas production emissions.

Memo items

Emissions from international aviation and marine bunker fuels are excluded from national totals as is outlined in the IPCC Guidelines. These emissions are presented separately for information purposes but are included in Table 3. GHG emissions from marine and aviation bunkers have more than quadrupled since 1990 mostly due to increased tourism in recent years.

CO_2 emissions from biomass are also reported as memo items and are excluded from national totals. These emissions have been reported since 2003 and have been rapidly increasing over recent years due to increase in the use of biofuels.

Table 3 Total GHG emissions from the Energy sector for the reported time series [kt CO_2e].

Energy Sector	1990	1995	2000	2005	2010	2015	2019	2020	Change '90-'20	Change '19-'20
1A1 Energy industries	13.5	15.3	6.6	3.4	8.6	4.2	5.0	1.8	-87%	-64%
1A2 Manufacturing industries	238	217	226	185	85	62	54	45	-81%	-17%
1A3 Transport	724	784	869	1,056	981	984	1,075	887	23%	-17%
1A3a Domestic aviation	34	30	28	26	21	21	28	13	-61%	-53%
1A3b Road transport	523	550	608	766	805	819	950	825	58%	-13%
1A3d Domestic navigation	33	38	13	23	35	27	53	25	-24%	-53%
1A4 Other sectors (fishing)	797	952	920	761	737	630	546	545	-32%	0%
1A4a Commercial/ Institutional	8	8	7	5	2	2	4	3	-64%	-24%
1A4b Residential stationary	28	22	21	13	9	6	4	5	-81%	23%
1A4c Fishing	761	922	892	743	727	622	538	537	-29%	0%
1A5 Other	0	2	5	29	14	0	2	0	197%	-79%
1B2 Fugitive emissions from fuels (incl. Geothermal energy)	62	83	155	120	195	168	167	179	189%	7%
1B2d Geothermal	62	82	154	119	194	167	166	179	190%	8%
Total Emissions	**1,836**	**2,053**	**2,181**	**2,155**	**2,020**	**1,848**	**1,849**	**1,659**	**-10%**	**-10%**
International aviation (Memo)	221	238	411	425	380	680	965	264	19%	-73%
International navigation (Memo)	28	3	54	2	0	149	206	78	178%	-62%
CO_2 from biomass (memo)	NO	4	5	6	7	43	58	53	-	-9%

3.3.3 Industrial Processes and Product Use (CRF sector 2)

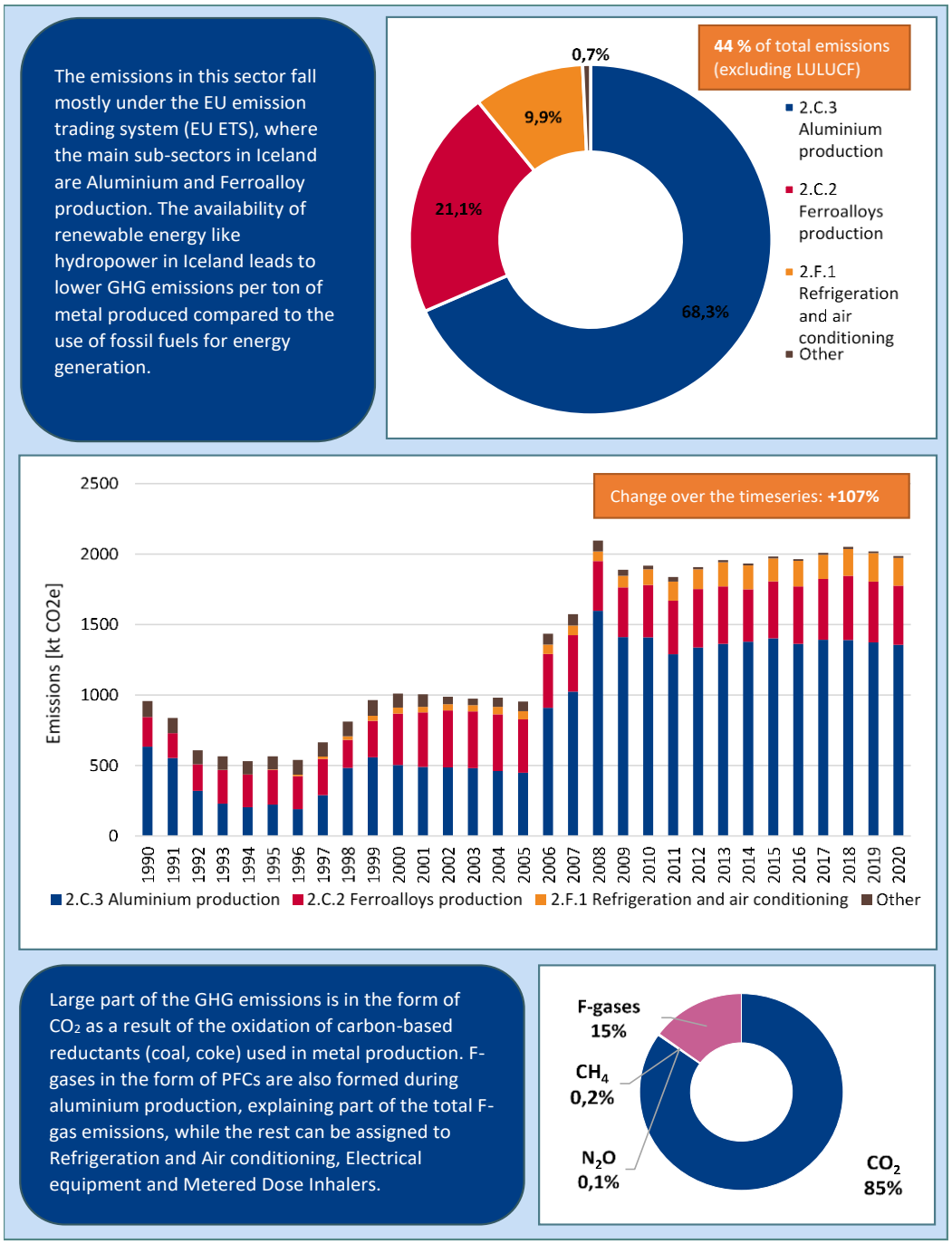


Figure 3.4 Emission from industrial Processes and Product Use

Figure 3.4 shows the overview of emissions from the Industrial processes and product use (IPPU sector), from top to bottom: (1) emission by subsector for the latest year, (2) emission by subsector over the time series and (3) emissions by gas for the latest year.

The Industrial Processes and Product Use (IPPU) sector is the second largest contributor to national GHG emissions after land-use, land-use change and forestry. The emissions from this sector are dominated by

CO_2, hydrofluorocarbons (HFCs) and perfluorocarbon (PFC). HFCs are used as substitutes for ozone depleting substances (ODS) in refrigeration systems. Perfluorocarbon emissions in Iceland come mostly from the aluminium industry (tetrafluoromethane, CF4 and hexafluoroethane, C_2F_6), and to a small extent from refrigeration equipment (hexafluoroethane (C_2F_6) commercially known as PFC116, and octafluoropropane (C_3F_8), commercially known as PFC-218.

Emissions from IPPU have increased over the time series primarily due to the expansion of energy-intensive industry, primarily from metal production (aluminium smelting and ferroalloy production), see Table 4.

Metal production accounts for approximately 90% of the IPPU sector emissions in recent years:

Aluminium production is the main source within the metal production category, accounting for the majority of total Industrial Processes emissions across the time series. Aluminium is produced at three plants. The production technology in all aluminium plants is based on using centre worked prebaked anode cells. The main energy source is electricity, and industrial process CO_2 emissions are mainly due to the anodes that are consumed during electrolysis. In addition, the production of aluminium gives rise to emissions of PFCs. Due to the expansion of the existing aluminium plant in 1997 and the establishment of a second aluminium plant in 1998, emissions increased from 1997 to 1999. From 2000, the emissions showed a steady downward trend until 2005. The PFC reduction was achieved through improved technology and process control and led to a 98% decrease in the amount of PFC emitted per tonne of aluminium produced during the period of 1990 to 2005. In 2006, the PFC emissions rose significantly due to an expansion of one smelter, but PFC emissions per tonne of aluminium decreased from 2007 to 2011 through improved process technology. The third aluminium plant was established in 2007 and reached full production capacity in 2008. PFC emissions per tonne of aluminium are generally high during start up and usually rise during expansion. PFC emission declined in 2009 and 2010 through improved process technology until December 2010 at the third smelter, when a rectifier was damaged in fire. This led to increased PFC emissions leading to higher emissions at the plant in 2010 than in 2009. Since 2010 the average PFC emissions for all three aluminium smelters is around 0.1 t CO_2e/t Al produced.

The production of **ferroalloys** accounts for approximately a fifth of Industrial Processes emissions. CO_2 is emitted due to the use of coal and coke as reducing agents and from the consumption of electrodes and other carbon-containing additives (carbon blocks, electrode casings and limestone). In 1998 a power shortage caused a temporary closure of the ferrosilicon plant, resulting in exceptionally low emissions that year. In 1999, however, the plant was expanded (addition of the third furnace) and emissions have therefore increased considerably since 1990. In late 2016, a silicon metal plant opened, which contributed slightly to the increase in emissions from this subsector for the year 2017. The new plant ceased operations in mid-2017, but another silicon plant started its operations in May 2018.

Emissions from the **production of minerals** has significantly decreased since 1990. Cement production was the dominant contributor until 2011 when the sole cement plant shut down. CO_2 derived from carbon in the shell sand used as raw material is the source of CO_2 emissions from cement production. Emissions from the cement industry reached a peak in 2000 but declined until 2003, partly because of cement imports. In 2004 to 2007 emissions increased again because of increased activity related to the construction of the Kárahnjúkar hydropower plant (built 2002 to 2007) although most of the cement used for the project was imported.

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

Imports of HFCs (**F-gases**) started in 1993 and have increased steadily until 2018. In 2019 a tax scheme was established, putting a tax on the import of F-gases according to their global warming potential. Since 2019 the import has been decreasing. No HFC/PFCs were routinely used for refrigeration before 1993 and the only HFCs reported before then is HFC-134 in Metered Dose Inhalers, therefore there has been a substantial increase since 1990.

HFCs are used as substitutes for ozone depleting substances (ODS) that are being phased out in accordance with the Montreal Protocol. Refrigeration and air conditioning are the main uses of HFCs in Iceland, and the fishing industry plays a preeminent role. HFCs stored in refrigeration units constitute banks of refrigerants which emit HFCs during use due to leakage. Very minor amounts of PFCs are used in certain refrigerant blends, and the PFC emissions from refrigeration and air conditioning is on the order of a few tens of tons of CO_2e.

The sole source of SF_6 emissions is leakage from electrical equipment such as gas insulated switchgear. Emissions have been increasing since 1990 due to the expansion of the Icelandic electricity distribution (Table 5). The peak in leakage in 2010 was caused by two unrelated accidents during which the SF6 contained in equipment leaked into the atmosphere. The peak in 2018 was due to equipment breakdown that caused leakage.

The use of **solvents and products containing solvents** (CRF sector 2D3) leads to emissions of non-methane volatile organic compounds (NMVOC), which are regarded as indirect GHGs as the NMVOC compounds are oxidized to CO_2 in the atmosphere over time. These CO_2 emissions are also included in this inventory.

Also included in the IPPU sector are emissions of **N_2O from medical and other uses** and emissions of **CO_2 from lubricants and paraffin wax use**. Other sources of emissions included in the Icelandic inventory are CH_4 and N_2O emissions from **tobacco**, as well as GHG and precursor emissions from **firework use**. Historically, industrial processes has been an important source of N_2O, but emissions have been significantly reduced since the shutdown of the fertiliser plant in 2001.

Table 4 GHG emissions from Industrial Processes and Product Use for the reported time series [kt CO_2e].

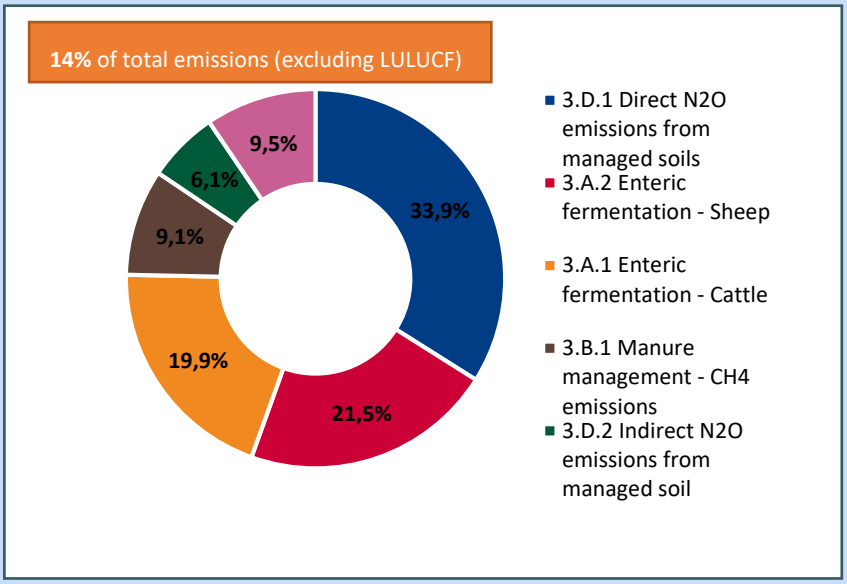
Industry Sector	1990	1995	2000	2005	2010	2015	2019	2020	Change '90- '20	Change '19- '20
2A Mineral products	52	38	65	55	10	0.7	1.0	0.9	-98%	-6%
2B Chemical industry	47	41	18	-	-	-	-	-	NA	NA
2C Metal production	844	469	868	828	1,781	1,807	1,805	1,775	110%	-2%
2D Non-energy products from fuels and solvent use	7.1	7.8	7.7	7.3	5.6	6.1	6.0	6.2	-13%	3%
2F Product uses as substitutes for ozone depleting substances	0.3	3.4	44	58	111	163	203	198	57367%	-2%
2G Other product manufacture and use	7.2	5.8	6.3	6.5	8.6	4.9	5.1	6.0	-17%	18%
Total Emissions	**958**	**565**	**1,010**	**955**	**1,917**	**1,983**	**2,020**	**1,986**	**107%**	**-2%**

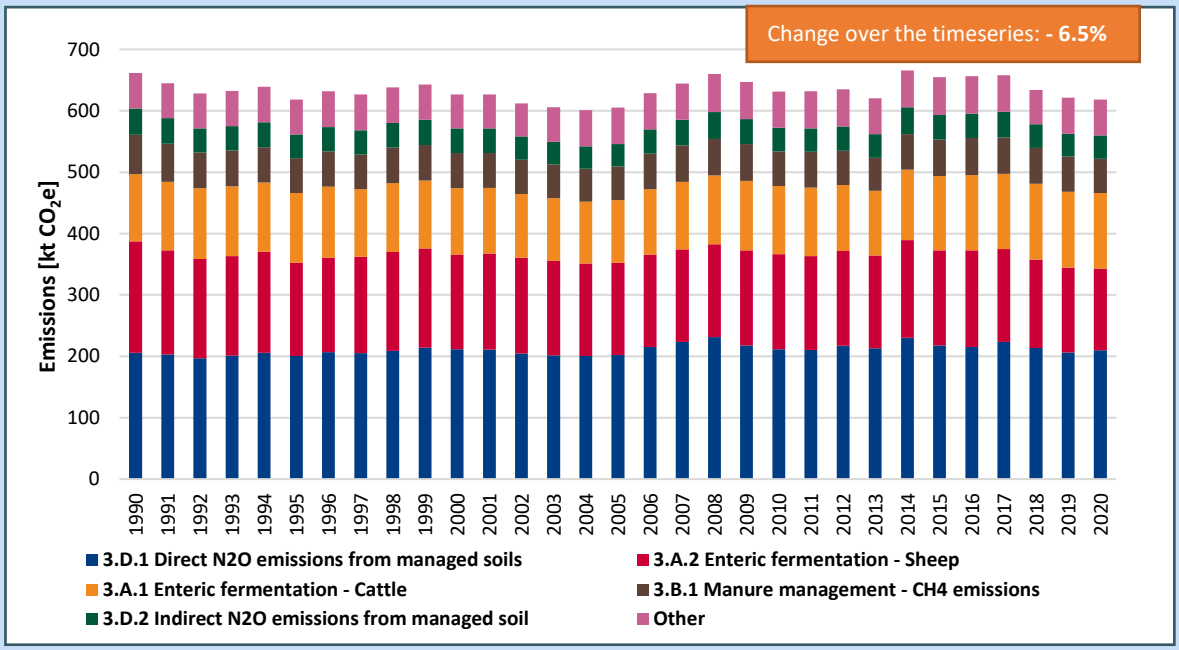
Table 5 Total HFC, PFC and SF_6 emissions from F-gas consumption [kt CO_2e].

GHG	1990	1995	2000	2005	2010	2015	2019	2020	Change '90- '20	Change '19- '20
HFCs	0.34	3.4	44	58	111	163	203	198	57348%	-2%
PFCs	495	69	150	31	172	104	97	96	-81%	-1%
SF_6	1.1	1.2	1.3	2.5	4.7	1.6	2.3	3.2	188%	39%

3.3.4 Agriculture (CRF sector 3)

Emissions are dominated by agricultural soils and enteric fermentation across the time series. Approximately 90% of emissions from enteric fermentation are caused by the two biggest livestock categories: Sheep and Cattle





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

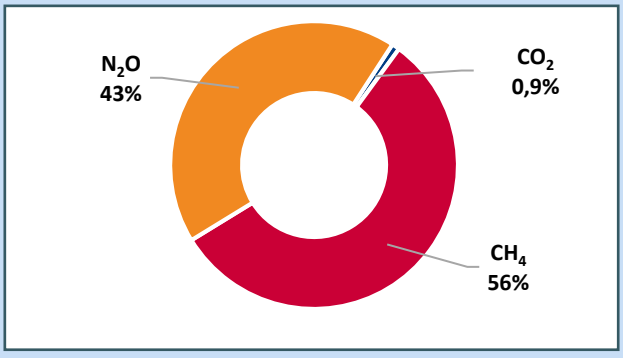


Figure 3.5 Overview of emissions from the agriculture sector

Figure 3.5, shows the overview of emissions from the agriculture sector, from top to bottom: (1) emission by subsector for the year 2020, (2) emission by subsector over the time series and (3) emissions by gas for the latest year.

Iceland is self-sufficient in all major livestock products, such as meat, milk, and eggs. Traditional livestock production is grassland based and most farm animals are native breeds, i.e. dairy cattle, sheep, horses, and goats, which are all of ancient Nordic origin, one breed for each species. These animals are generally smaller than the breeds common elsewhere in Europe. Beef production, however, is partly through imported breeds, as is most poultry and all pork production. There is not much arable crop production in Iceland, due to the cold climate and short growing season. Cropland in Iceland consists mainly of cultivated hayfields, but potatoes, barley, beets, and carrots are grown on limited acreage. Emissions from agriculture are closely coupled with livestock population sizes, especially cattle and sheep. Another factor that has a considerable impact on emission estimates is the amount of nitrogen in fertiliser applied annually to agricultural soils. A decrease in livestock population size of sheep between 1990 and 2005 was partly counteracted by increases of livestock population of horses, swine, and poultry, but led to overall emission decreases and resulted in a decrease of total agriculture emissions during the same period (Table 6).

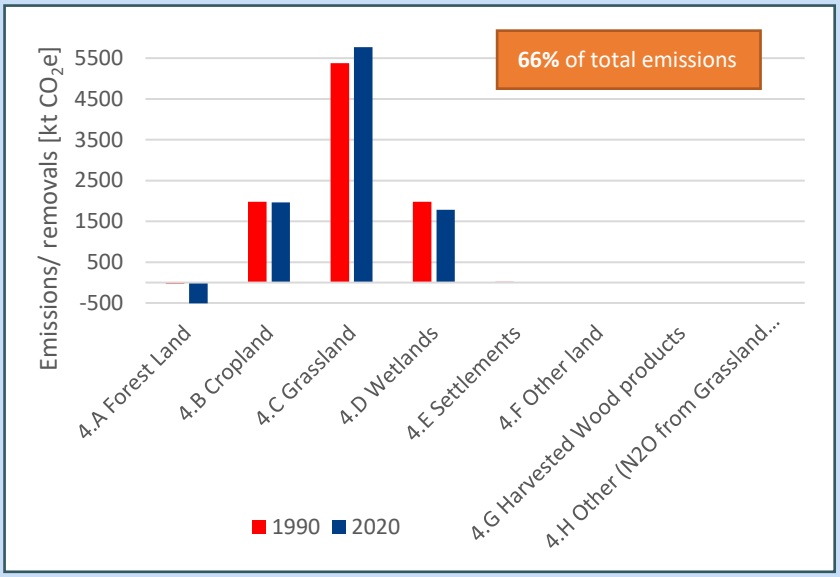
In 2005-2018 increased fertiliser use lead to higher emissions from agriculture. However, sharp decrease in sheep livestock numbers since 2016 and slight decrease in fertiliser use since 2018 have led to decreased emissions again. The emissions from Agriculture have though stayed relatively stable since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

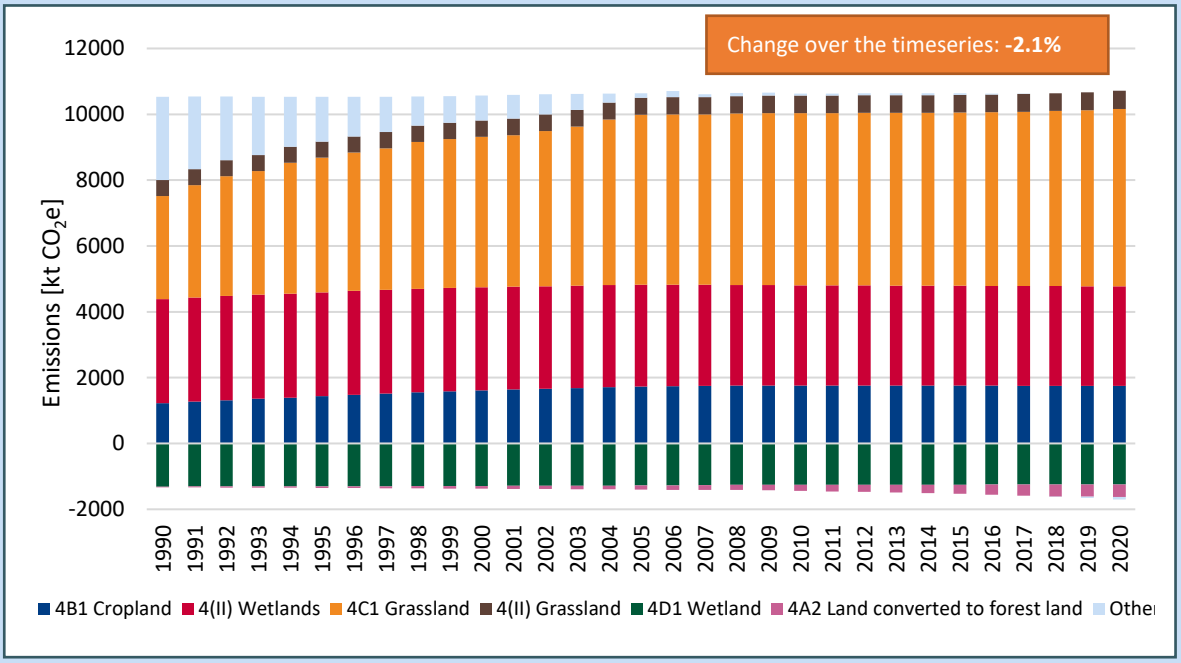
Table 6 GHG emissions from agriculture sector for the reported time series [kt CO_2e].

Agriculture sector	1990	1995	2000	2005	2010	2015	2019	2020	Change '90-'20	Change '19-'20
3A Enteric fermentation	326	303	298	289	303	314	297	291	-11%	-2%
3B Manure management	86	76	77	74	76	79	76	74	-14%	-2%
3D Agricultural soils	248	239	252	238	250	258	243	248	0%	2%
3G Liming	0.5	0.0001	0.04	1.8	0.3	2.1	3.7	3.9	735%	4%
3H Urea application	0.06	0.06	0.07	0.07	0.13	0.17	0.22	0.19	252%	-12%
3I Other C-containing fertilisers	NE	NE	NE	2.3	1.7	1.2	1.9	1.4	NA	-26%
Total Emissions	**662**	**618**	**627**	**605**	**631**	**655**	**621**	**618**	**-6.5%**	**-0.5%**

3.3.5 Land Use, Land-Use Change and Forestry (LULUCF, CRF sector 4)

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





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

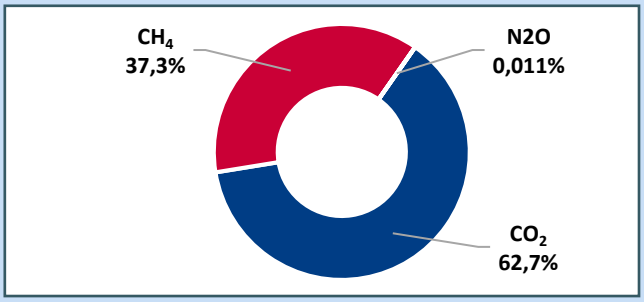


Figure 3.6 Overview of emissions and removals from the LULUCF sector.

Figure 3.6 shows the Overview of LULUCF sector, from top to bottom: (1) absolute emission and removals by subsector for the latest year, (2) emission and removals by subsector over the time series and (3) absolute emissions and removals by gas for the latest year.

Net emissions (emissions – removals) in the LULUCF sector have slightly decreased over the time period. Emission increase from grassland is explained by drainage of wetland, converting wetlands to grassland, which is somewhat counterbalanced within the category by increased removals through revegetation. Increase in wetland drainage decreases the area of wetland and consequently the emissions. The increased removals through afforestation are explained by increased activity in the category and changes in forest growth with stand age. Decreased emissions from cropland are explained by changes in the agricultural sector, leading to less cropland area.

Analyses of trends in emissions of the LULUCF sector must be interpreted with care as some potential sinks and sources are not included. Uncertainty estimates for reported emissions are considerable and observed changes in reported emissions, therefore do not necessarily significantly different from zero.

Table 7 GHG emissions and removals from the LULUCF sector for the reported time series [kt CO_2e].

LULUCF Sector	1990	1995	2000	2005	2010	2015	2019	2020	Change '90- '20	Change '19- '20
4.A Forest Land	-30	-53	-89	-140	-295	-400	-490	-510	1604%	4%
4.B Cropland	1,979	1,977	1,974	1,972	1,970	1,969	1,967	1,967	-1%	0%
4.C Grassland	5,375	5,372	5,446	5,557	5,718	5,744	5,756	5,766	7%	0%
4.D Wetlands	1,852	1,858	1,844	1,825	1,799	1,791	784	1,783	-4%	0%
4.E Settlements	22	22	18	18	4	4	4	4	-82%	3%
4.F Other land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0.0028	NA,NE	0.001	NA	NA
4.G Harvested Wood products	NO,NA	NO,NA	0.0004	-0.0002	-0.03	-0.12	-0.08	-0.04	NA	-47%
Total Emissions	**9,199**	**9,175**	**9,194**	**9,232**	**9,196**	**9,107**	**9,020**	**9,010**	**-2.1%**	**-0.1%**

3.3.6 Waste (CRF sector 5)

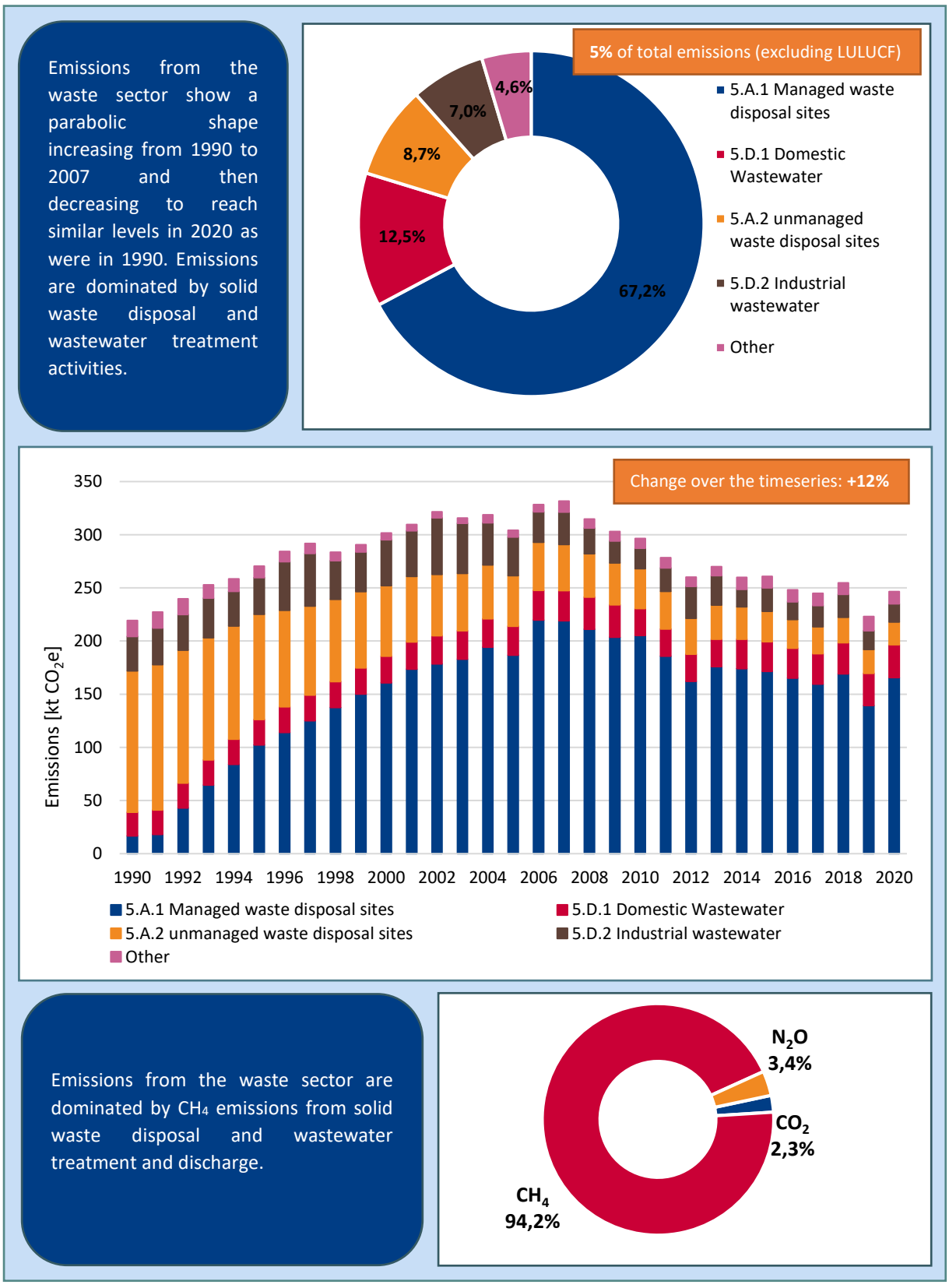


Figure 3.7 Overview of emissions from the waste sector.

Figure 3.7 shows the overview of emissions from the waste sector, from top to bottom: (1) emission by subsector for the latest year, (2) emission by subsector over the time series and (3) emissions by gas for the latest year.

Most emissions from the waste sector are CH_4 emissions from solid waste disposal on land. The remaining emissions arose from wastewater treatment, waste incineration and the biological treatment of waste, i.e. composting. The trend in waste emissions is dominated by:

An increase in **Solid Waste Disposal (SWD)** emissions between 1990 and 2006 was caused by the accumulation of degradable organic carbon in recently established managed, anaerobic solid waste disposal sites which are characterised by higher methane production potential than the unmanaged SWDS they succeeded. The decrease in emissions from the waste sector since 2006 is caused by a decrease in SWD emissions which is due to a rapidly decreasing share of waste landfilled since 2004 and by an increase in methane recovery at SWDS. The total increase of SWD emissions between 1990 and 2019 amounted to 9%.

Emissions from **composting** have been steadily increasing from 1995 when composting started. Improved collection of organic waste leads to a rapid increase of the emissions in recent years.

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

Wastewater handling emissions have decreased slightly since 1990. Emissions from domestic wastewater have increased due to an increase in population. Industrial wastewater emissions are based on amount of fish processed in Iceland, and there are some annual fluctuations which cause changes in emissions.

Table 8 GHG emissions from the waste sector for the reported time series [kt CO2e].

Waste Sector	1990	1995	2000	2005	2010	2015	2019
5A Solid Waste Disposal	150	201	227	234	243	200	162
5B Biological Treatment of Solid Waste	NO	0.3	0.3	0.9	2.6	3.7	4.1
5C Incineration and Open Burning of Waste	15	10	6.0	5.5	6.5	7.1	9.4
5D Wastewater Treatment and Discharge	55	59	68	64	45	50	48
Total	**219**	**270**	**302**	**304**	**296**	**261**	**223**

3.4 Emission Trends for Indirect Greenhouse Gases and SO_2

Nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and carbon monoxide (CO) have an indirect effect on climate through their influence on GHGs, especially ozone. Sulphur dioxide (SO_2) affects climate by increasing the level of aerosols that have in turn a cooling effect on the atmosphere. Data presented here, and submitted to the UNFCCC, is in accordance with guidelines for reporting air pollutants under the Convention on Long Range Transport of Atmospheric Pollutants (CLRTAP) and as reported by Iceland in 2022 (Informative Inventory Report (IIR) and Nomenclature For Reporting (NFR) tables[32]). The emissions presented in this section are from the energy, IPPU, agriculture and waste sectors as no indirect greenhouse gas emissions from the LULUCF sector have been compiled to date.

3.4.1 Nitrogen Oxides (NO_X)

The main source of NO_x in Iceland is the Energy sector, as can be seen in Figure 3.8. The main contributors to this sector are commercial fishing and transport, followed by manufacturing industries and construction. In industrial processes, the main NO_x source is ferroalloys production.

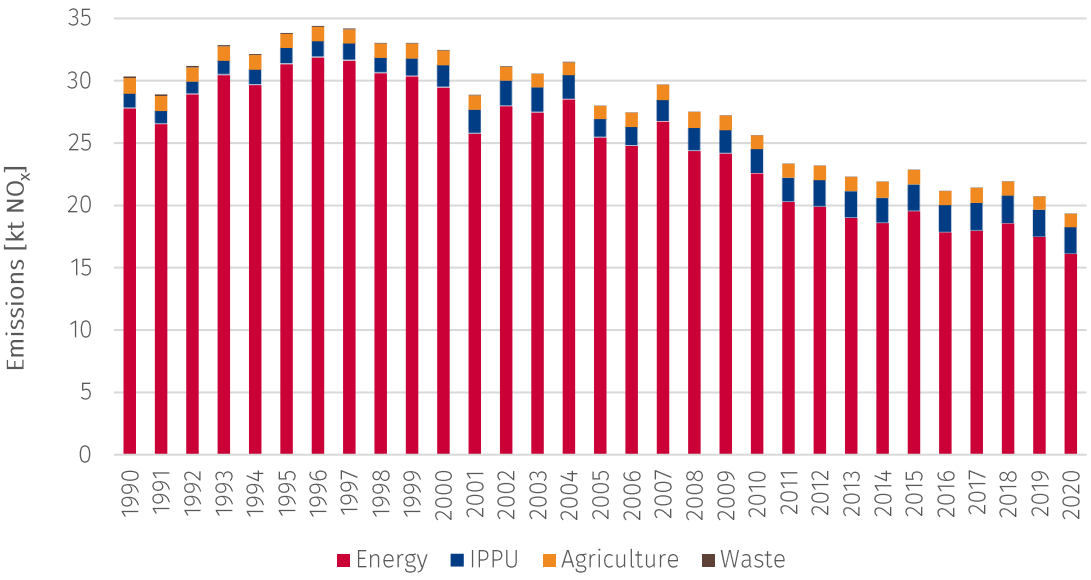


Figure 3.8 Emissions of NOx by sector for the reported time series [kt].

3.4.2 Non-Methane Volatile Organic Compounds (NMVOC)

The main sources of NMVOCs are the Industrial processes, followed by Agriculture and the Energy sector, as can be seen in Figure 3.9. In the Energy sector, NMVOC emissions are dominated by road transport. These emissions decreased rapidly after the use of catalytic converters in all new vehicles became obligatory in 1995. In Industrial processes, NMVOC are mostly emitted in various solvent uses, as well as in food and beverage production. In the Agriculture sector, manure management is the greatest source of NMVOC. The total emissions have been showing a general downward trend since 1990.

[32] Iceland's 2022 submission to the CLRTAP can be found here.

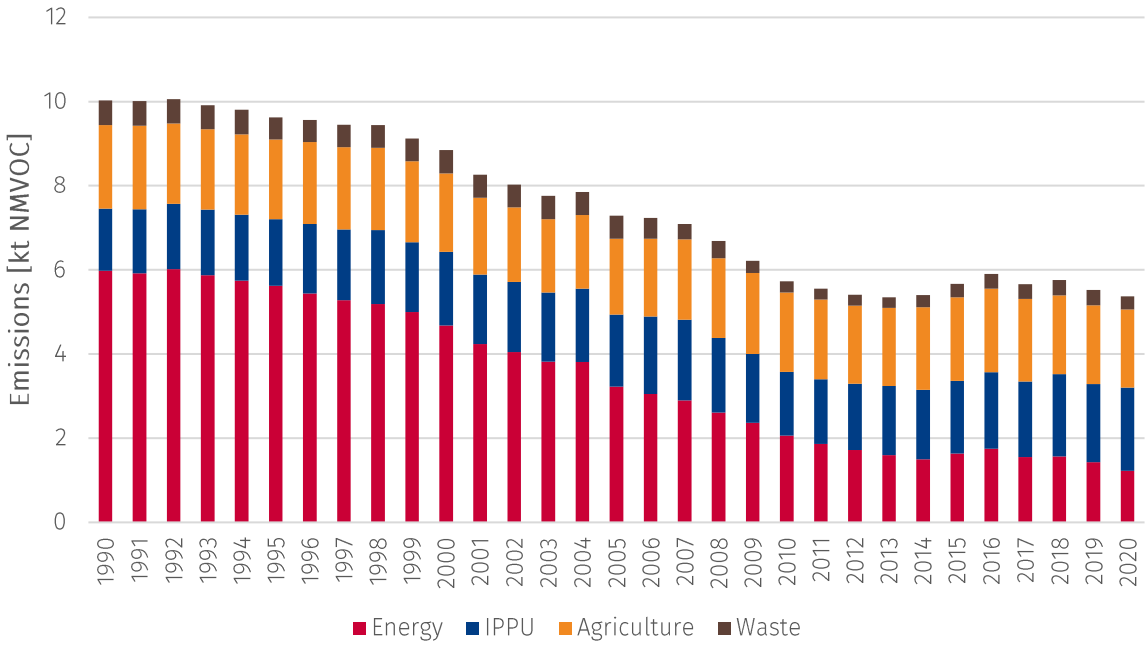


Figure 3.9 Emissions of NMVOC by sector for the reported time series [kt].

3.4.3 Carbon Monoxide (CO)

Industrial Processes are the most prominent contributors to CO emissions in Iceland, as can be seen in Figure 3.10. Within industrial processes, almost all the CO emissions are due to primary Aluminium production. It is worth mentioning that emissions from road transport have decreased rapidly after the use of catalytic converters in all new vehicles became obligatory in 1995. Total CO emissions have more than doubled since 1990.

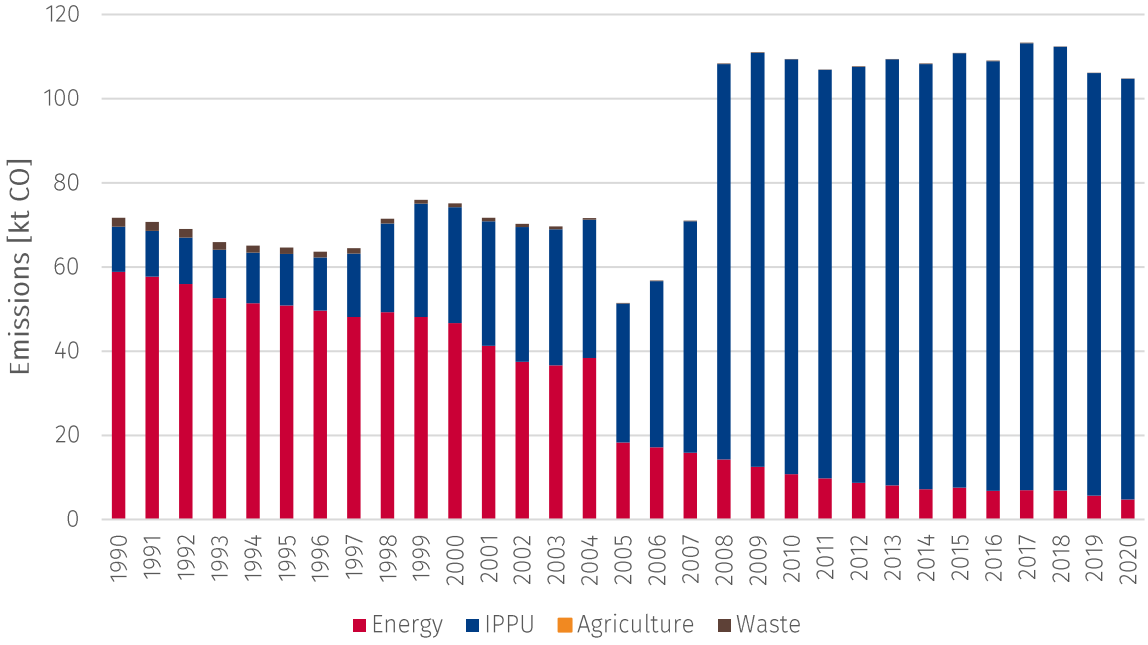


Figure 3.10 Emissions of CO by sector for the reported time series [kt].

3.4.4 Sulphur Dioxide (SO_2)

Geothermal energy exploitation is by far the largest source of SO_2 emissions in Iceland. Sulphur emitted from geothermal power plants is in the form of hydrogen sulphide and is reported here in kt SO_2-equivalents. Emissions have doubled since 1990 due to an increase in electricity production at geothermal power plants. Other significant sources of SO_2 in Iceland are industrial processes, as can be seen in Figure 3.11.

Emissions from industrial processes are dominated by metal production. Until 1996 industrial process sulphur dioxide emissions were relatively stable. Since then, the metal industry has expanded, leading to an increase in SO_2 emissions. The fishmeal industry is the main contributor to SO_2 emissions from fuel combustion in the sector Manufacturing Industries and Construction. Emissions from the fishmeal industry increased from 1990 to 1997 but have declined since as fuel has been replaced with electricity and production has decreased.

SO_2 from the fishing fleet depend upon the use of residual fuel oil. When fuel prices rise, the use of residual fuel oil rises and the use of gas oil drops. This leads to higher sulphur emissions as the sulphur content of residual fuel oil is significantly higher than in gas oil. The rising fuel prices since 2008 have led to higher SO_2 emissions from the commercial fishing fleet in recent years. As a result of this, emissions have decreased at a lower rate compared to fuel consumption.

Across the time series, annual SO_2 emissions in Iceland have more than doubled.

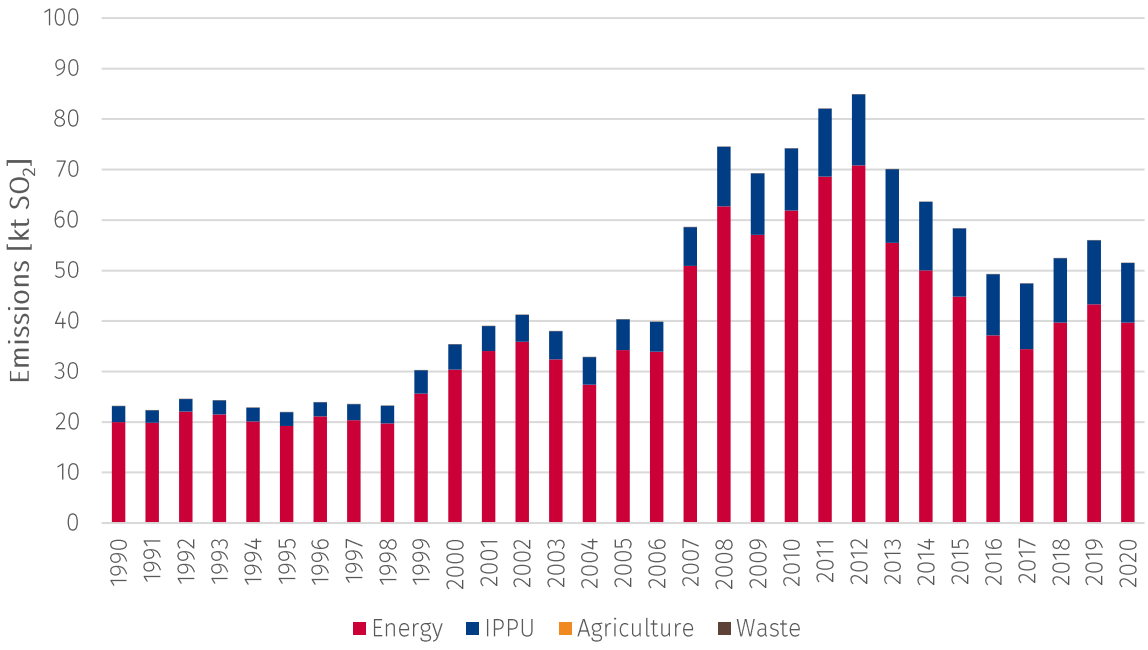


Figure 3.11 Emissions of SO_2 by sector for the reported time series [kt SO2].

As the emissions from volcanos are natural, they are not included in national totals.

3.5 National System for Estimation of Greenhouse Gases

3.5.1 Institutional Arrangements

The Climate Change Act No 70/2012 establishes the national system for the estimation of GHG emissions. In accordance with this Act the Environment Agency of Iceland (EAI), an agency under the auspices of the Ministry of the Environment, Energy and Climate, carries the overall responsibility for the national inventory. The EAI compiles and maintains the GHG emission inventory, except for the LULUCF sector which is compiled by the Soil Conservation Service of Iceland and the Icelandic Forest Service in collaboration with the Agricultural University of Iceland. The EAI reports to the Convention and to the EU. The Act specifies that the EAI is allowed to request all data needed for the inventory from relevant authorities, agencies, companies and individuals; the obligations are further elaborated in Regulation No 520/2017 on data collection and information from institutions related to Iceland's inventory. The regulation is currently being recast, amongst other things to reflect changes in responsibilities of various data providers.

The UNFCCC national focal point is within the Ministry of the Environment, Energy and Climate and is responsible for approving the final inventory before its submission to the UNFCCC.

Figure 3.12 illustrates the flow of information and allocation of responsibilities in the Icelandic emission inventory system for reporting to the UNFCCC. The main data providing institutions are also listed, including information on which sector they are contributing data to.

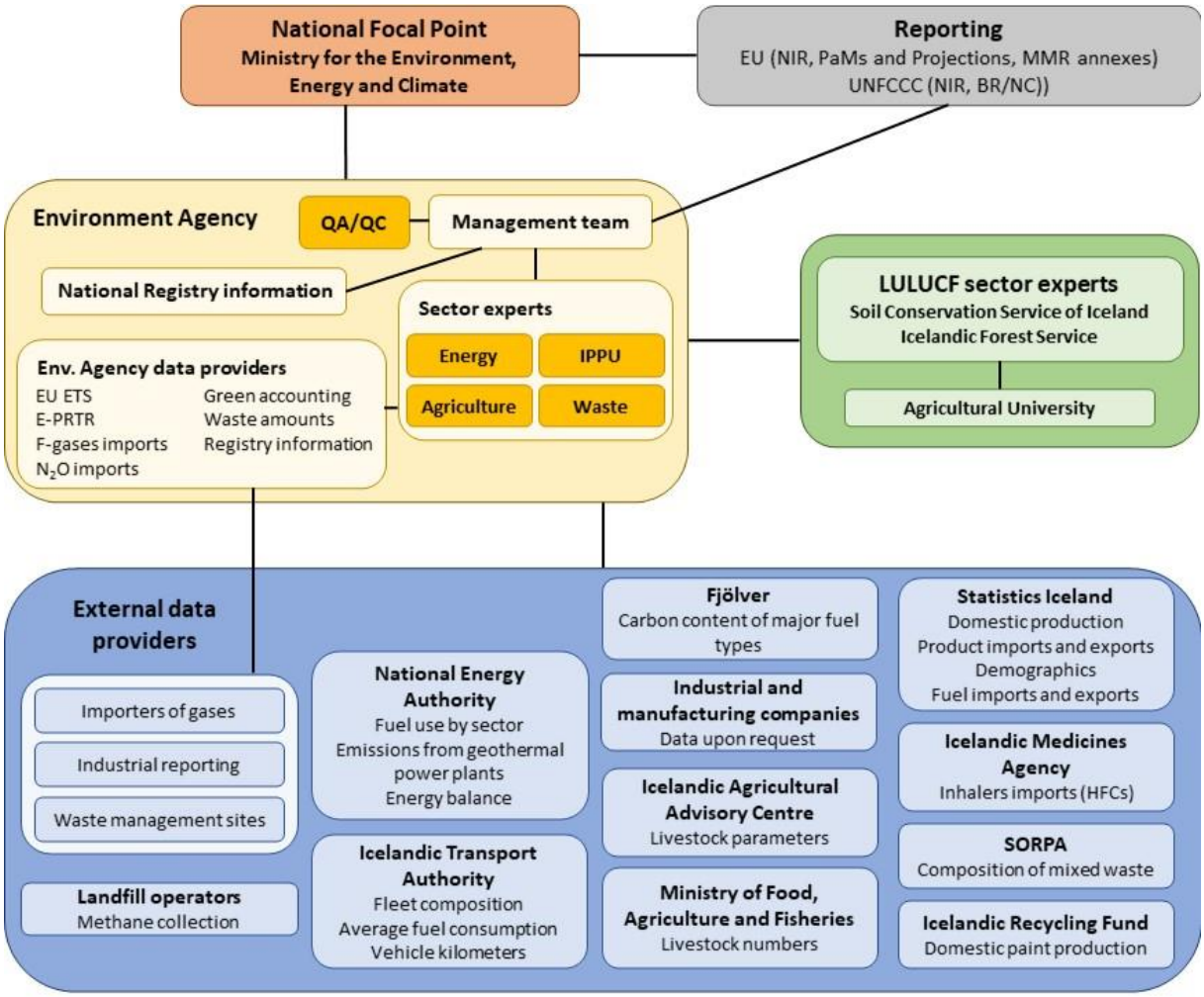


Figure 3.12 Information flow and distribution of responsibilities on reporting

3.5.2 National legislation

The Climate Change Act No 70/2012

In June 2012 the Icelandic Parliament passed a law on climate change (Act No 70/2012). The objectives of the Climate Change Act are the following:

- Reducing GHG emissions efficiently and effectively,
- To increase carbon sequestration from the atmosphere,
- Promoting mitigation to the consequences of climate change, and
- To create a framework for the Government to fulfil its international obligations regarding climate change.

Act No 70/2012 superseded Act No 65/2007. Article 6 of Act No 70/2012 addresses Iceland's GHG inventory. It states that the EAI compiles Iceland's GHG inventory in accordance with Iceland´s international obligations. Act No 70/2012 established the form of relations between the EAI and other bodies concerning data handling. Responsibilities from the various bodies are further specified in Regulation No 520/2017, as described below.

The EAI has made formal agreements with the necessary collaborating agencies involved in the preparation of the inventory, to cover responsibilities such as data collection and methodologies, data delivery timelines

and uncertainty estimates. The data collection for the first commitment period of the Kyoto protocol was based on these agreements.

Act No 70/2012 establishes the national system for the estimation of GHG emissions by sources and removals by sinks, the national registry, emission permits and establishes the legal basis for installations and aviation operators participating in the EU ETS. The Act specifies that the EAI is the responsible entity for the national accounting as well as for the inventory of emissions and removals of GHGs according to Iceland's international obligations.

Regulation No 520/2017

The Regulation on data collection and information from institutions related to Iceland's inventory on GHG emissions and removal of carbon from the atmosphere No 520/2017[33] was adopted in June 2017. This regulation establishes formally the data provision modalities, such as content, format and deadlines for data submission to the EAI; furthermore, it implements parts of EU Regulation No (EU) 525/2013 on a mechanism for monitoring and reporting GHG emissions and for reporting other information at national and Union level relevant to climate change ("MMR") and delegated Acts. As the new reporting period under the Paris Agreement is starting, Regulation (EU) 525/2013 is no longer in force, and has been superseded by Governance Regulation (EU) 2018/1999; In addition, details on the structure, format, submission processes and review of information provided related to the reporting requirements outlined in Regulation (EU) 2018/1999 are outlined in Commission Implementing Regulation (EU) 2020/1208.

Regulation No 520/2017 is currently being revised, in order to reflect the changes due to the new Commission Implementing Regulation (EU) 2020/1208 and after changes in the organisation of the inventory work. Main changes include clearer definitions of responsibilities of the various institutions and other data providers involved, clearer deadlines and clearer provisions on what can be done if data providers fail to provide the data required as per the regulation.

Furthermore, Commission Implementing Regulation (EU) 2020/1208 establishes stricter rules on the establishment, operation and functioning of the National inventory system[34], reference to which will be included in the updated regulation.

3.5.3 Planned improvements to the national system

In order to better implement the requirements of Articles 26 to 29 of Commission Implementing Regulation (EU) 2020/1208, there are plans to set up a steering committee for the inventory, as a part of the national system. The exact roles and modalities of functioning of such a committee are yet to be defined; it is thought that such a committee will be coordinated by the EAI and be composed of representatives from the Soil Conservation Service, the Forestry Service, the Ministry of the Environment, Energy and Climate and possibly other ministries, as well as major data providers and stakeholders. The aim of such a committee will be, amongst other things, enhanced QA of the inventory as well as prioritisation of improvements needed. Furthermore, it is planned to establish separate working groups for various key subsectors of the inventory, to enhance collaboration between experts in the inventory team, various ministries as well as experts from other institutions, companies, universities and research centres.

[33] https://www.reglugerd.is/reglugerdir/eftir-raduneytum/umhverfis--og-audlindaraduneyti/nr/0520-2017
[34] Art. 26-29 of Regulation (EU) 2020/1208

3.6 National registry

Iceland is a part of the single Union Registry[35] operated by the European Commission. The main regulation governing the Union Registry is Commission Regulation (EU) No 389/2013, which amongst other things describes the responsibilities of the EU as the Central Registry Administrator, the responsibilities of the national administrators, as well as the interlinkage between national registries, the International Transaction Log and the EU Transaction Log (see articles 4 til 8 of the regulation for more details on this). In practice, this means that there is an Icelandic part of the Union Registry that holds the AAUs that Iceland was assigned for the second commitment period of the Kyoto Protocol, which will be used to fulfil Iceland's commitment jointly with the EU. All operators located in Iceland falling under the EU ETS also have an account in the Icelandic part and the Union Registry. All accounts are managed by Iceland's national administrator, and all transactions are recorded in the European Union Transaction Log.

The registry administrator is Ms. Sigríður Rós Einarsdóttir, at the Environment Agency of Iceland, Suðurlandsbraut 24, 108 Reykjavík, Iceland (sigridur.einarsdottir@umhverfisstofnun.is and ets-registry@ust.is). Since the Icelandic registry is a part of the EU registry, all aspects of the registry, such as database structure, conformity to the technical standards for data exchange between registry systems, procedures employed in the national registry to minimize discrepancies in the issuance, transfer, acquisition, cancellation and retirement of units, security measures employed in the national registry and disaster recovery plan are described in the EU regulation mentioned above.

The EU registry's website is https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/union-registry_en and the Icelandic part of the registry can be accessed through the EU's website.

3.7 Inventory Preparation: Data Collection, Processing and Storage

3.7.1 Data Collection

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

- The EAI collects the bulk of data necessary to run the general emission model, i.e. activity data and emission factors, for all sectors apart from LULUCF. Activity data is collected from various institutions and companies, as well as by EAI directly as listed and illustrated above in Section 3.5.1.
- Information on fuel use reported by all companies under the EU ETS (as per Directive 2003/87/EC) is used directly in the inventory calculations.
- According to Icelandic Regulation No 851/2002 on green accounting, industry is required to hold, and to publish annually, information on how environmental issues are handled, the amount of raw material and energy consumed, the amount of discharged pollutants, including GHG emissions, and waste generated. Emissions reported by installations have to be verified by independent auditors, who need to sign the reports before their submission to the Environment Agency. The green accounts are then made publicly available on the website of the EAI.

[35] https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/union-registry_en

- The National Energy Authority collects fuel sales data by sector; however, the sectoral split of the NEA does not entirely match that of the IPCC, thus the EAI processes the data in order to ensure correct attribution to the IPCC codes as per the CRF.
- The Soil Conservation Service of Iceland provides information on revegetated areas and assesses other land use categories on the basis of its own geographical database and other available supplementary land use information. The Icelandic Forest Service provides information on forest land, natural birch shrubland and harvested wood products.

Emission factors are taken mainly from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands and the 2013 Revised supplementary methods and good practice guidance arising from the Kyoto Protocol. When available, country specific emission factors are used.

The annual inventory cycle (See Figure 3.13) describes individual activities performed each year in preparation for next submission of the emission estimates.

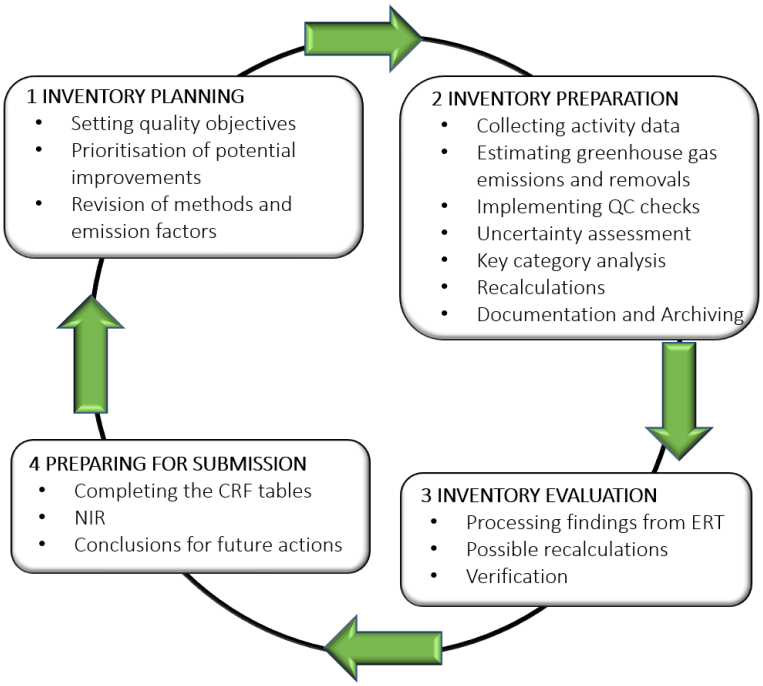


Figure 3.13 Iceland's annual inventory cycle.

3.7.2 Processing

A new annual cycle begins with an initial planning of activities for the inventory cycle by the inventory team and major data providers as needed, taking into account the outcome of the internal and external review as well as the recommendations from the UNFCCC and EU reviews. The initial planning is followed by a period assigned for compilation of the national inventory and improvement of the National System. The estimation methods of all GHGs are harmonized with the IPCC Guidelines for National Greenhouse Gas Inventories. Methodologies and data sources for each sector are described in Chapters 3 – 7 of the 2022 NIR.

After compilation of activity data, emission estimates and uncertainties are calculated, and quality checks performed to validate results. All emission estimates are imported into the CRF Reporter software. The sectoral experts for LULUCF import the LULUCF data separately.

A series of internal review activities are carried out annually to detect and rectify any anomalies in the estimates, e.g. time series variations, with priority given to emissions from industrial plants falling under the EU ETS, other key source categories and for those categories where data and methodological changes have recently occurred.

After an approval by the Ministry of the Environment, Energy and Climate, the GHG inventory is submitted to the UNFCCC by the EAI.

3.7.3 Storage

A document management system (Gopro.net), is used to store email communications concerning the GHG inventory. Digital copies of paper documents, e.g. written letters, are also stored on the document management system. The system runs on its own virtual server and uses a MS SQL server 2019 running on a separate server. Both servers are running Windows Server 2019.

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

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

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

Backups are taken daily, a subset of those is regularly set for at least 15 months storage. The exact backup schedule is currently under evaluation.

The land use database IGLUD is stored on a server of the Soil Conservation Service of Iceland (SCSI) as well as spreadsheets containing calculations regarding other land use classes than forest land. Data regarding forest land, forestry and harvested wood products are stored on servers of the Icelandic Forest Service.

3.8 Capacity of inventory team

3.8.1 Training and capacity-building activities for inventory compilers

The Icelandic inventory team has proactively sought and engaged in training and capacity building activities. These training and capacity building activities aim to support individuals within the inventory team as part of a staff development plan. In addition, more general training has been received at the institutional level including the improvement to inventory systems and transparency. This is important in terms of business continuity, for example when key individuals leave the Agency, or change roles, leaving knowledge gaps that may require filling at short notice. The main recent activities are outlined below.

- Training by the consulting company which has been helping staff at the Environment Agency for several years (Aether ltd.). Examples from the last few years include:

  - Energy: During the review of the Energy files in 2018, a staff member from Aether came to Iceland and worked with the EAI staff to redo all the calculation files. This served both to ascertain that all calculations were done using EFs and methodologies consistent with the 2006 IPCC guidelines and provided an opportunity for new staff members to familiarise themselves with the Energy sector.
  - IPPU: Almost 90% of the IPPU emissions come from metal production, where the data is obtained from EU ETS verified reports and the data quality is considered to be very good. The rest of the IPPU emissions are mostly from the use of refrigerants and other F gases. During the review of the F gases inventory, started in 2019, a staff member from Aether came to Iceland and worked with the main IPPU sectoral expert of the agency, provided training in the methodologies to be used, and assisted the EAI in generating new calculations files. QC of the files by the Aether staff provided further training opportunities, with numerous Skype meetings between Aether and the EAI to discuss the files.
  - Agriculture: in 2018 and 2020, training sessions were organised with the consultant, on the basics of estimating emissions from Agriculture, including practicalities of the excel files, imports into CRF, as well as specific aspects particular to the Icelandic conditions. Furthermore, updates of the Agriculture sector that took place for this submission were done in collaboration with consultants at Aether.
  - Waste: During an in-country visit of Aether staff members in 2019, Aether presented an overview of the waste calculations files. Furthermore, a Skype meeting was held to explain the scientific background of GHG emissions from waste management.
  - Uncertainties (all sectors, including LULUCF): General, as well as sector-specific training sessions were organised in late 2020/early 2021 with Aether to provide an overview of uncertainty analyses, as well as to go over the uncertainty analysis of each sector with sectoral experts at Aether.
- Participation in capacity building activities proposed by the EU, yearly sector specific capacity-building webinars, among them:
  - LULUCF: Virtual Workshop 2021 - Present challenges for LULUCF reporting and accounting. Organized by the European Commission´s Joint Research Centre.
  - Participation in webinars to support the assessment of implications of the 2019 Refinement to the 2006 IPCC Guidelines for National and EU Greenhouse Gas Inventories organized by Aether for European Commission.
  - All sectors: Capacity-building webinars organised by DG Climate action on ESD review 2021 and LULUCF trial review.
- Participation in a Nordic inventory experts' working group, where inventory compilers from Norway, Sweden, Finland, Denmark and Iceland meet once a year (separate meetings for LULUCF and for the other sectors (including general/ QA/QC)) and discuss various aspects of the inventory compilation, ranging from technical aspects of emission estimates to logistical issues with submission to EU and/or UNFCCC.
- Participation in a Nordic expert group on F gases, funded by the Nordic Council of Ministers, discussing and comparing methods and parameters used by the various Nordic countries.
- Participation in the annual training session for the COPERT model, organized by the European Environment Agency and carried out by EMISIA, the developer of the software. The training includes an overview of the software, information on the latest updates and a Q&A session with the participants. This one-and-a-half-day training is attended by the members of the inventory team every year.

3.8.2 Capacity and staffing

Additional funding has been allocated by the Icelandic government to the Environment Agency of Iceland, the Soil Conservation Service of Iceland and the National Forestry Service in recent years, in order to ensure that the teams responsible for the GHG inventory does have the capacity to fully adhere to all reporting obligation, including (but not limited to) the work associated with the new EU regulations pertaining to the commitment period under the Paris Agreement (2021-2030 - for instance, the Effort Sharing Regulation (EU) 2018/842, the Governance Regulation (EU) 2018/1999 and the Commission Implementing Regulation (EU) 2020/1208).

3.9 Key Category Analysis

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

The results of the key category analysis including LULUCF are shown in Table 3.9, and the key category analysis excluding LULUCF is shown in Table 10 below.

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

Table 9 Key categories of Iceland's GHG inventory (including LULUCF)

✓= Key category

IPCC source category		Gas	Level 1990	Level 2020	Trend
Energy (CRF sector 1)					
1A2	Fuel combustion - Manufacturing Industries and Construction	CO_2	✓		✓
1A3b	Road Transportation	CO_2	✓	✓	✓
1A3e	Other Mobile Machinery	CO_2	✓		✓
1A4c	Agriculture/Forestry/Fishing	CO_2	✓	✓	✓
1B2d	Fugitive Emissions from Fuels - Other (Geothermal)	CO_2		✓	✓
IPPU (CRF sector 2)					
2C2	Ferroalloys Production	CO_2	✓	✓	✓
2C3	Aluminium Production	CO_2	✓	✓	✓
2C3	Aluminium Production	PFCs	✓		✓
2F1	Refrigeration and Air Conditioning	Aggregate F-gases		✓	
Agriculture (CRF sector 3)					
3A1	Enteric Fermentation – Cattle	CH_4	✓		
3A2	Enteric Fermentation – Sheep	CH_4	✓	✓	✓
3D1	Direct N_2O Emissions from Managed Soils	N_2O	✓	✓	

Land use, Land use change and Forestry (CRF sector 4)					
4A1	Forest Land Remaining Forest Land	CO_2		✓	✓
4A2	Land Converted to Forest land	CO_2		✓	✓
4B1	Cropland Remaining Cropland	CO_2	✓	✓	✓
4B2	Land Converted to Cropland	CO_2	✓		✓
4C1	Grassland Remaining Grassland	CO_2	✓	✓	✓
4C2	Land Converted to Grassland	CO_2	✓	✓	✓
4D1	Wetlands Remaining Wetlands	CO_2	✓	✓	✓
4(II) Grassland	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	✓	✓	
4(II) Grassland	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO_2	✓	✓	
4(II) Wetlands	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	✓	✓	✓
4(II) Wetlands	Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO_2	✓	✓	
Waste (CRF sector 5)					
5A1	Managed Waste Disposal Sites	CH_4		✓	✓
5A2	Unmanaged Waste Disposal Sites	CH_4	✓		✓

Table 10 Key categories of Iceland's GHG inventory (excluding LULUCF). ✓= Key category.

IPCC source category		Gas	Level 1990	Level 2020	Trend
Energy (CRF sector 1)					
1A2	Fuel combustion - Manufacturing Industries and Construction	CO_2	✓	✓	✓
1A3a	Domestic Aviation	CO_2	✓		✓
1A3b	Road Transportation	CO_2	✓	✓	✓
1A3d	Domestic Navigation	CO_2	✓	✓	
1A3e	Other Mobile Machinery	CO_2	✓		✓
1A4b	Residential Combustion	CO_2	✓		✓
1A4c	Agriculture/Forestry/Fishing	CO_2	✓	✓	✓
1B2d	Fugitive Emissions from Fuels - Other (Geothermal)	CO_2	✓	✓	✓
IPPU (CRF sector 2)					
2A1	Cement Production	CO_2	✓		✓
2B10	Fertiliser Production	N_2O	✓		✓
2C2	Ferroalloys Production	CO_2	✓	✓	✓
2C3	Aluminium Production	CO_2	✓	✓	✓
2C3	Aluminium Production	PFCs	✓	✓	✓
2F1	Refrigeration and Air Conditioning	Aggregate F-gases		✓	
Agriculture (CRF sector 3)					
3A1	Enteric Fermentation – Cattle	CH_4	✓	✓	
3A2	Enteric Fermentation – Sheep	CH_4	✓	✓	✓
3A4 Horses	Enteric Fermentation – Horses	CH_4	✓	✓	
3B11	Manure Management – Cattle	CH_4	✓	✓	
3D1	Direct N_2O Emissions from Managed Soils	N_2O	✓	✓	✓
3D2	Indirect N_2O Emissions from Managed Soils	N_2O	✓	✓	
Waste (CRF sector 5)					
5A1	Managed Waste Disposal Sites	CH_4		✓	✓
5A2	Unmanaged Waste Disposal Sites	CH_4	✓		✓
5D2	Industrial Wastewater Treatment	CH_4	✓		✓

3.10 Quality Assurance & Quality Control (QA/AC)

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

3.10.1 Background information on Iceland's QA/QC activities

Quality aspects of Iceland's Climate Change and Air Quality Measurement, Reporting and Verification (MRV) system are stored in the QA/QC Hub. The Hub is an online solution, and forms part of its Air Quality and Climate Change Data Portal. The QA/QC Hub provides a centralized basis for the inventory team to design, manage and record its QA/QC activities. The use of the QA/QC hub started in the fall of 2019 and has not yet been fully operationalised; it is expected that it will be fully implemented for the next submission.

The Hub is focused around three interconnecting elements:

- a record of comments produced by previous review processes
- an area for planning and tracking improvement work; and
- an area for planning QA/QC activities.

The interaction of these elements is outlined in Figure 3.14.

The logic of this design is that it will enable the inventory team to link its ongoing review outcomes and internal development ideas to its 'live' improvements list and QA/QC activities. This should ensure that over time, Iceland's inventory submissions continue to evolve in terms of quality. Importantly, the inventory team will be able to provide transparent evidence to the way it handles and prioritizes its inventory improvements and QA/QC activities.

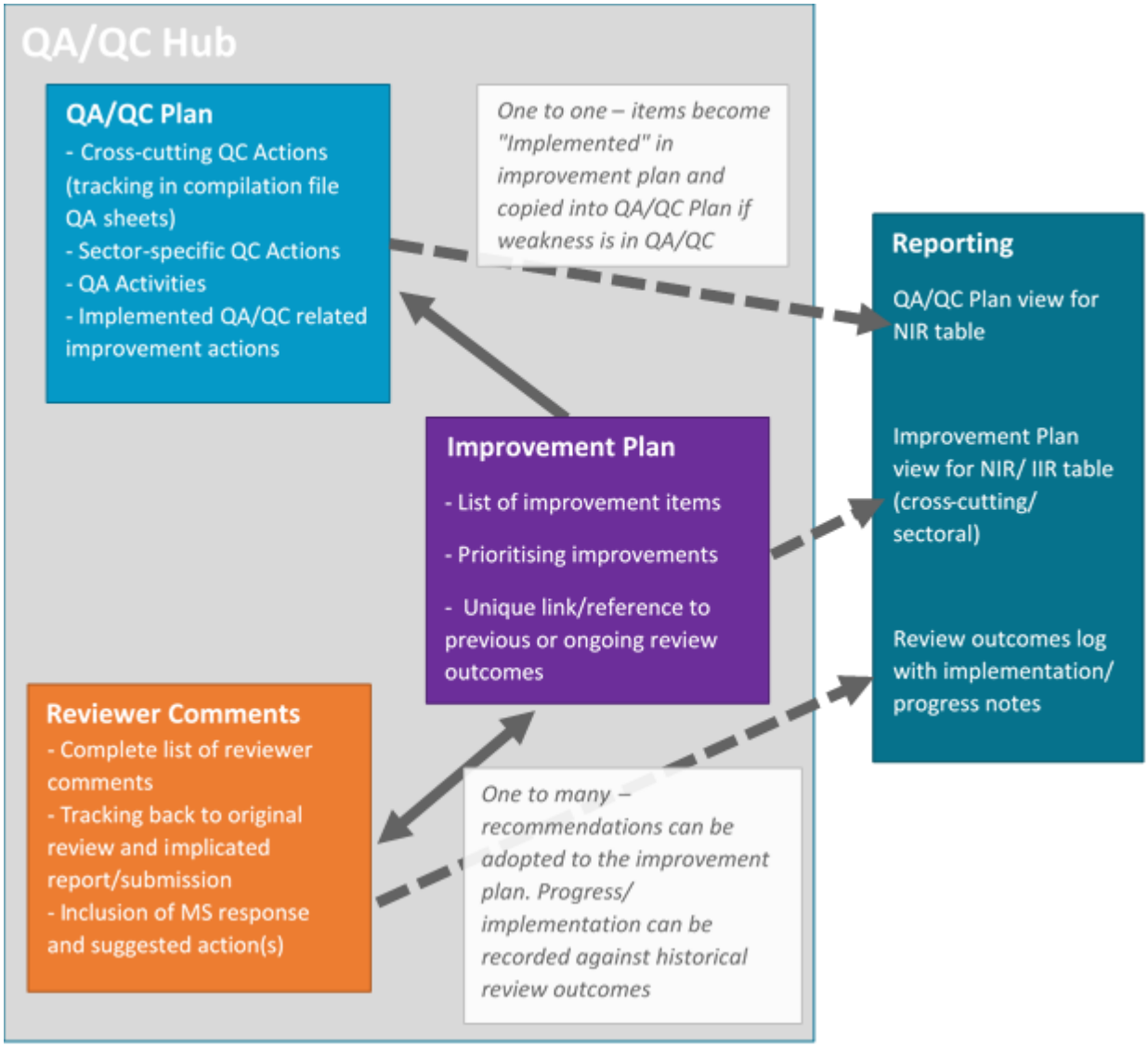


Figure 3.14 Schematic overview of the elements included in the QA/QC hub

The logic of this design is that it will enable the inventory team to link its ongoing review outcomes and internal development ideas to its 'live' improvements list and QA/QC activities. This should ensure that over time, Iceland's inventory submissions continue to evolve in terms of quality. Importantly, the inventory team will be able to provide transparent evidence to the way it handles and prioritizes its inventory improvements and QA/QC activities.

The live improvements and QA/QC lists can be viewed and recorded at sectoral or cross-cutting level. Crucially, all activities are designed to be time-bound and signed off as part of the annual inventory cycle. This enables the inventory team to provide an ongoing record of sector-specific and cross-cutting activities through its national inventory reporting. Once fully operationalised, the QA/QC Hub will lead to:

- enhanced transparency of inventory compilation and reporting
- increased documentation and understanding of Iceland's inventory improvement prioritization (taking into account national capacity and feasibility)
- improved response to, and engagement with, the international inventory review processes

3.10.2 Roles and responsibilities overview

The overall responsibility over the inventory lies with the inventory team leader at the Environment Agency of Iceland (EAI), who has overall responsibility for the completion of QA/QC activities, submission, improvements planning and review coordination. Within the inventory team at the EAI there are two sectoral subgroups within the team, one Energy/IPPU group and one Agriculture/Waste group. Data collection, processing, QC and improvements are conducted within each group, in collaboration with the team leader. The various roles within the inventory team are described below:

- Inventory team leader - overall responsibility for the accurate and timely production and submission of the inventories, according to the rules and deadlines specified in relevant domestic and international legislation; The team leader is responsible for the communication with the Icelandic ministries and with data providers, as well as communication with EU and UNFCCC experts/expert review teams.
- NIR coordinator - responsible for leading the work on producing the greenhouse gas inventory.
- Sectoral experts - main knowledge holders on individual inventory sectors. They are responsible for completion of day-to-day data processing and QC activities. Each sector comprises 3 to 4 sectoral experts; prior to each submission cycle, it is decided how roles are divided between the sectoral experts, making sure that QC activities are done by someone other than the individual who did the calculations. In addition, each NIR chapter is proof-read by one of the experts not involved in the writing of the chapter.
- Lawyer – responsible for all the legal aspects of the inventory work, such as examining new legal texts, implementing EU regulation into domestic legislation, as well as understanding Iceland's various air pollutants and greenhouse gases commitments.
- Communications strategist – responsible for coordinating all media-related activities relating to the inventory work, such as publication of news, website updates, as well as lectures and seminars.

The LULUCF part of the inventory is overseen by the Soil Conservation Service of Iceland (SCSI), and the calculations relating to forestry are covered by the Icelandic Forestry Service (IFS).

3.10.3 Quality Assurance (QA)

Iceland's GHG inventory is subjected yearly to reviews by experts mandated by the European Commission and almost yearly by experts mandated by the UNFCCC. Results from these reviews are considered annually and decisions are taken on how the recommendations will be taken forward in the development and improvement of the inventory and the national system. The inventory submitted in 2017 was subjected to a UNFCCC in-country review, but no UNFCCC review took place in 2018. In September 2019, a UNFCCC desk review took place.

Iceland volunteered for an EU step 2 review (as described in Art. 32 of Regulation (EU) 749/2014), which took place in April 2019. In 2020, the inventory was submitted to a comprehensive review by the EU, as specified by Art. 4 of Regulation (EU) 2018/842. This review focussed on emissions falling within the scope of Regulation (EU) 2018/842, which are the so called "Effort-sharing" emissions, i.e. all emissions other than the EU-ETS or LULUCF emissions. Emissions of the years 2005, 2016, 2017 and 2018 were reviewed, as emissions for those years were used in order to determine Iceland's annual emission allocations (AEAs) pertaining to Art. 4 of Regulation (EU) 2018/842. At the end of the review, Iceland provided the review team with 3 revised estimates (one in the IPPU sector, one in the Agriculture sector and one in the Waste sector).

The most recent review took place in the autumn of 2022, with a centralised UNFCCC review during the week of 19 - 23 November. During the review, changes were made to the KP-LULUCF accounting part of forestry and revegetation, and the inventory was resubmitted at the end of the review week. The changes made to the KP-LULUCF accounting did not impact the national totals.

Further Quality Assurance is provided by Iceland's collaboration with consultants at Aether Ltd., who assist with and review sector-specific methodological choices and calculations. As part of this collaboration, the calculations for the Agriculture and Waste sectors were revised and improved in recent years, whereas the calculations for the Energy sector were revised in 2018. In 2019, F gases and the Agriculture sector were largely reviewed and improved. Furthermore, Iceland participates in various international experts' groups which aim at discussing and enhancing the overall quality of the inventory, as described in the chapter 3.8.1 above on training and capacity-building.

3.10.4 Quality Control (QC)

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

QC activities include the following:

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

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

As the QA/QC procedure is still being implemented, sector- and subsector specific guidelines on nature and frequency of QC checks are in the process of being developed. An example of a general checklist all sectors have to complete is given in Table 11. As staff changes and general time restrictions could affect QC procedures, the checklist is divided into three sections: minimum requirements, which have to be carried out each year and do not necessarily require a deep knowledge of the sector and then further controls and checks which require a certain experience within the sector and take also longer time to be performed.

Data and emissions pertaining to EU ETS under Directive 2003/87/EC ("The ETS Directive"), as calculated in the inventory, are systematically cross-checked against the EU ETS annual emission reports; such a comparison is used to report on emissions under the EU ETS via the MMR-IR Article 10 Template. 40% of the emissions reported by Iceland (without LULUCF) are covered by the EU ETS and therefore are of the highest quality.

Further QC activities include the comparison between the atmospheric pollutants NO_x, CO, NMVOC and SO_2 reported in this inventory with the data reported under CLRTAP. This comparison is submitted to the EU via MMR-IR Article 7 template. In general, the data agrees well, except in the case of aviation where the data reported under CLRTAP comes from the Eurocontrol dataset, whereas the data reported in the NIR, where the disaggregation between landing and take-off is not necessary, are based on fuel sales and emission factors from the 2006 IPCC Guidelines.

Table 11 Example of minimum, medium and full QC requirements to be performed within the emission inventory team according to time constraints and staff capacities.

Check	Description
1 - MINIMUM: small degree of sector knowledge necessary	
Activity data source	Is the appropriate data source being used for activity data?
Correct units	Check that the correct units are being used
Unit carry through	Are all units correctly carried through calculations to the summary table? This includes activity data and emission factors.
Calculations check	All calculations checked by a second person
Double counting	Check to ensure no double counting is present
Notation keys	Review the use of notation keys and the associated assumption to ensure they are correct.
2 - MEDIUM: a certain degree of sector knowledge necessary	
Method validity	Are the methods used valid and appropriate?
Trend check	Carry out checks on the trend to identify possible errors. Document any stand out data points.
Emission factor applicability	Where default emission factors are used, are they correct? Is source information provided?
Time series consistency	Are activity data and emission factor time series consistent?
Spot checks	Complete random spot checks on a data set.
3 - FULL: sector specific knowledge required	
Recalculations	Check values against previous submission. Give reasons where the two values do not match.
Sub-category completeness	Is the reporting of each sub-category complete? If not, this should be highlighted.
Documentation	Is there sufficient documentation?
Colour coding	Has colour coding been used in a consistent and accurate manner? Are there any significant data gaps of weaknesses?
Cross check data	Where possible cross check data against alternative data sources.
Data source referencing	All source data submitted must be referenced
Links to source data	Where possible, links to the source data must be provided
Raw primary data	All raw primary data must be present in the workbook

3.10.5 Planned improvements for QA/QC activities

The configuration of roles and responsibilities mentioned in section 3.10.2, is still being developed, as well as the QC procedures mentioned above. It is also planned to fully document the results of QC activities for each sector and providing evidence of such activities by including screenshots of the Q Comments tool discussed under section 3.10.4.

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

3.11 Uncertainty Analysis

The uncertainty analysis is based on the Approach 1 – error propagation of the IPCC 2006 Guidelines (Vol.1, Chapter 3, Table 3.2). The uncertainties of activity data are collected from data providers or evaluated based on expert judgements. The uncertainties of default emission factors are derived from the values proposed in the 2006 IPCC Guidelines or the 2019 EMEP/EEA Guidebook. The error propagation is used to estimate the uncertainty for each category, the inventory as a whole and the latest inventory year compared to the base year.

The results of the uncertainty estimation are summarised in Table 3.12.

Table 12 Uncertainties 2020

	Without LULUCF		With LULUCF	
	Uncertainty 2020 [%]	Trend [%]	Uncertainty 2020 [%]	Trend [%]
CO_2	1.6%	2.3%	22.0%	15.5%
CH_4	3.1%	4.3%	54.5%	8.5%
N_2O	7.2%	3.3%	2.4%	0.8%
HFCs	4.6%	7.8%	1.5%	2.2%
PFCs	0.32%	2.09%	0.11%	0.49%
SF_6	0.030%	0.039%	0.010%	0.011%
Total GHG	**9.2%**	**10.0%**	**58.9%**	**17.9%**

When excluding LULUCF the trend uncertainty is **10.0%** and the total inventory uncertainty is **9.2%.** The total inventory uncertainty is **58.9%** and the trend uncertainty estimate for this submission is **17.9%.** as can be seen in Table 12.

4. Policies and Measures

4.1 Introduction

This chapter provides an overview of climate -related policies and measures in Iceland, focusing on the emission-reduction efforts necessary to comply with national, European and international commitments. In 2015 a Joint Fulfilment Agreement[36] was concluded between the European Union (EU), its Member States and Iceland. This Agreement concerned Iceland´s participation in these parties' joint fulfilment of commitments in the second commitment period of the Kyoto Protocol. Therein the Parties agree to fulfil jointly their quantified emission limitation and reduction commitments for the second commitment period inscribed in the third column of Annex B to the Kyoto Protocol. Iceland's individual assigned amount was established at 15,327,217 AAUs.

According to Article 4 and Annex I of the Joint Fulfilment Agreement, Regulation (EU) No 525/2013 ("MMR") and current and future Delegated and Implementing Acts based on Regulation (EU) No 525/2013 shall be binding upon Iceland. This includes for instance Commission Implementing Regulation (EU) No 749/2014, which further details the content and format required for the various reporting requirements under Regulation (EU) No 525/2013. The legal acts were rendered applicable in Iceland in 2015 with an amendment to Act No 70/2012, cf. Act No 62/2015.

Iceland plans to use removal units (RMU) for the second Kyoto period to meet its Kyoto Protocol target; in addition, Iceland will need to use market-based mechanisms to reach its target.

Under the Paris Agreement, Iceland will be part of a collective delivery with the EU-Member states and Norway to reach a target of 55% reduction of greenhouse gas emissions by 2030 compared to 1990 levels. Iceland will ensure fulfilment of its fair share of the collective delivery of the 55% target by

a) continuing participation in the EU Emissions Trading System (**EU-ETS**) according to Directive 2003/87/EC,

b) reducing emissions falling under the scope of the EU's Effort Sharing Regulation (Regulation (EU) 2018/842 - **ESR**) relative to the 2005 emission level. The current Effort Sharing target for 2030 is 29% reduction relative to 2005, but at the time of writing, work is in progress to determine a new target in line with the updates of the EU's "Fit for 55" legislation package. In accordance with the ESR framework, it is expected that the new Effort Sharing target for Iceland will be set at 40-43% reduction.

c) implementing the reporting and accounting rules pertaining to emissions and removals from the land use, land use change and forestry (**LULUCF**) as prescribed by the LULUCF regulation (Regulation (EU) 2018/841).

Iceland's and Norway's joint fulfilment with the EU Member States for the Paris Agreement was agreed upon with the uptake in October 2019 of relevant EU legislation into the European Economic Area (EEA) Agreement[37]. This includes the LULUCF Regulation (EU) No 2018/841, the Effort Sharing Regulation (EU) No 2018/842, as well as relevant parts of the Governance of the Energy Union Regulation (EU) No 2918/1999 replacing the MMR Regulation (EU) No 525/2013).

[36] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2015.207.01.0017.01.ENG&toc=OJ%3AL%3A2015%3A207%3ATOC
[37] Decision of the EEA Joint Committee No 269/2019

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*)[38]. Commission Implementing Regulation (EU) 2020/1208 and Commission Delegated Regulation (EU) 2020/1044, are now incorporated into the EEA Agreement through the EEA Joint Committee Decision no 223/2021[39]. At the time of this writing, work is underway to write a new regulation aiming at implementing the JCD No 223/2021 into Icelandic legislation. The same regulation will also serve as a recast of Regulation No 520/2017, on data collection and information from institutions related to Iceland's inventory of greenhouse gas emissions and carbon removal, that implemented Regulation (EU) No 525/2013. This new regulation is expected to be published in 2023.

In addition to Iceland's commitments towards the EU, the country has set itself a domestic target of 55% decrease in emissions by the year 2030 relative to 2005 for the emissions falling under the scope of the Effort Sharing Regulation. This was decided at the end of 2021 in an agreement[40] between the three parties forming the government.

Iceland currently reports 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, and national projections of anthropogenic GHG emissions by sources and their removal by sinks for a sequence of four future years ending with zero or five immediately following the reporting year.

The policies and measures described in this chapter are designed to help Iceland meet its commitments towards the EU, the Paris Agreement and the UNFCCC, namely to decrease Iceland's emissions according to its joint target with the EU for the year 2030, as well as to serve as stepping stones in order to reach Iceland's goal of being carbon neutral at the latest by 2040. These steps are taken in order to ensure that on a longer term, Iceland becomes and remains carbon neutral or carbon negative, thus contributing to the overall objective of the Convention to stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system.

4.2 Iceland's Climate Action

4.2.1 Iceland's National Emission Reductions Target

Iceland, along with Norway, is part of a joint commitment with the EU Member States and Norway to reduce greenhouse gas emissions by 55%[41] by 2030 in comparison with 1990 levels under the Paris Agreement and will apply key pieces of EU climate legislation accordingly.

Iceland submitted an updated Nationally Determined Contribution (NDC) under the Paris Agreement in February 2021. According to the NDC, Iceland is a part of a joint fulfilment of a -55% emissions target for

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

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

[40] Agreement on the Platform for the Coalition Government of the Independence Party, the Left Green Movement and the Progressive Party

[41] On 14 July 2021 the European Commission presented the Fit for 55 package, which contains a set of legislative proposals to make the EU's climate, energy, land use, transport, and taxation policies fit for reaching the European Green Deal's objective of reducing net greenhouse gas emissions by at least 55% by 2030. The final text of the deal still needs ratification by the European Parliament and by EU ministers at the Council.

2030 (compared to 1990 emissions) with the EU and its Member States. The intention to deliver the target in cooperation with the EU is stated in Iceland's latest NDC[42]. The cooperation entails that Iceland will take part in three key climate mitigation legislative frameworks:

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

The Effort Sharing target for Iceland within the collective target with the EU and Norway of 40% lower emissions in 2030 compared to 1990, had been set at -29% in 2030 compared to 2005, according to JCD No 269/2019. The target for Iceland within the updated collective delivery of -55% has not been set. The Icelandic Government has furthermore announced more ambitious targets than set forth for Iceland by the EU. In the 2018 and 2020 Climate Action Plans, the Government announced goals to achieve at least a 40% reduction in non-ETS emissions in 2030 compared to 2005 and of achieving carbon neutrality in 2040 (Law 95/2021 amending the Climate Act 70/2012)[43]. In November 2021, the then newly formed government announced an independent, more ambitious target of 55% reduction for ESR emissions in 2030 relative to 2005 in the Governmental agreement[44]. Furthermore, Iceland has implemented a national carbon neutrality target through law No 95/2021 on Climate Issues[45], stating that Iceland is to achieve carbon neutrality and full energy conversion no later than 2040, which will make Iceland the first state to be independent of fossil fuels 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 of the Environment formulated the strategy in close collaboration with the ministries of Transport and Communications; Fisheries; Finance; Agriculture; Industry and Commerce; Foreign Affairs; and the Prime Minister's Office. The long-term strategy was to reduce net GHG emissions of 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.

[42] Iceland's Intended Nationally Determined Contribution, Submission by Iceland to the ADP. *UNFCCC*. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Iceland%20First/Iceland_updated_NDC_Submission_Feb_2021.pdf

[43] Last April (2021) the Minister of the Environment, Energy, and Climate submitted a bill for the Icelandic Parliament that proposes the enshrinement of the target of carbon neutrality in 2040 into law.

[44] *Government of Iceland (Stjórnarráð Íslands)*. https://www.stjornarradid.is/library/05-Rikisstjorn/Agreement2021.pdf

[45] *Parliament (Alþingi)*. https://www.althingi.is/thingstorf/thingmalalistar-eftir-thingum/ferill/?ltg=151&mnr=711

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

4.2.2 The 2018 Climate Action Plan

In 2018, Iceland's government published a new Climate Action Plan spanning the years 2018-2030 (Ministry for the Environment and Natural Resources, 2018[46]); this time in association with significant funding earmarked for the implementation of and follow-through on the actions. This plan was developed with the following aim: Reaching Iceland's international 2030 target. At that time, the approximate non-ETS emission reduction target was a 29% reduction compared to emissions in the year 2005 (see also Section 1.1 on Iceland's commitment for 2030)) and reaching carbon neutrality no later than 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 *Inter-Ministerial Steering Committee* for Climate Action, as well as results of the calculations shown in the report on Policies, Measures, and Projections published in 2019, resulting in the publication of the 2020 Action Plan.

4.2.3 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[47]). 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 no later than 2040. Over a five-year period, from 2020 to 2024, the government will allocate a minimum of 46 billion ISK to climate mitigation measures. According to the government's latest Fiscal Policy 2022-2026 (*Ministry of Finance and Economic Affairs*, 2021) funding for climate action will continue to increase. In addition to previously determined climate funding (*Ministry of Finance and Economic Affairs*, 2020), climate action will receive an additional one billion ISK per year of funding from 2022-2031.

The plan includes 48 measures across all sectors that aim to reduce GHG emissions and increase carbon sequestration. Fifteen measures have been added since the 2018 action plan. The main sectoral changes that are expected to impact Iceland's GHG emissions until 2030 are the phaseout of fossil fuels in transport and an increase in carbon sequestration in LULUCF, by restoration of woodlands and wetlands, revegetation,

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

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

and afforestation. Emphasis is placed on immediate action and therefore 28 measures had already been started when the Action Plan was published.

The total direct cost of the main climate actions are at least 46 billion ISK for the 5 years 2020-2024, according to the Climate Action Plan. Some of the actions have a related cost figure (see the Climate Action Plan) whereas some of them don't, either because it has not been estimated or because it does not lead to direct cost.

4.2.4 The 2022 Progress Report

According to the Climate Act, the government shall, in consultation with stakeholders, review and update the Climate Action Plan every fourth year based on international commitments and the government's goals. Climate measures shall be developed and put in motion by an Inter-ministerial committee. The committee shall also prepare an annual progress report on the status of implementation of the climate plan and its measures, emissions development and whether or not the development is in accordance with the Climate Plan. The second progress report was published in July 2022 (*Ministry for the Environment and Natural Resources*, 2021[48]) to follow up on the progress of the 2020 Climate Action Plan. No new mitigation measures are introduced in the progress report compared to the previous progress report in 2021. According to the 2022 progress report, 34 PaMs (out of 50 in total) have currently been implemented, 15 are in progress and 1 is in preparation stages.

[48] *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/URN/Stoduskyrsla_Adgerdaaaetlun_2022.pdf

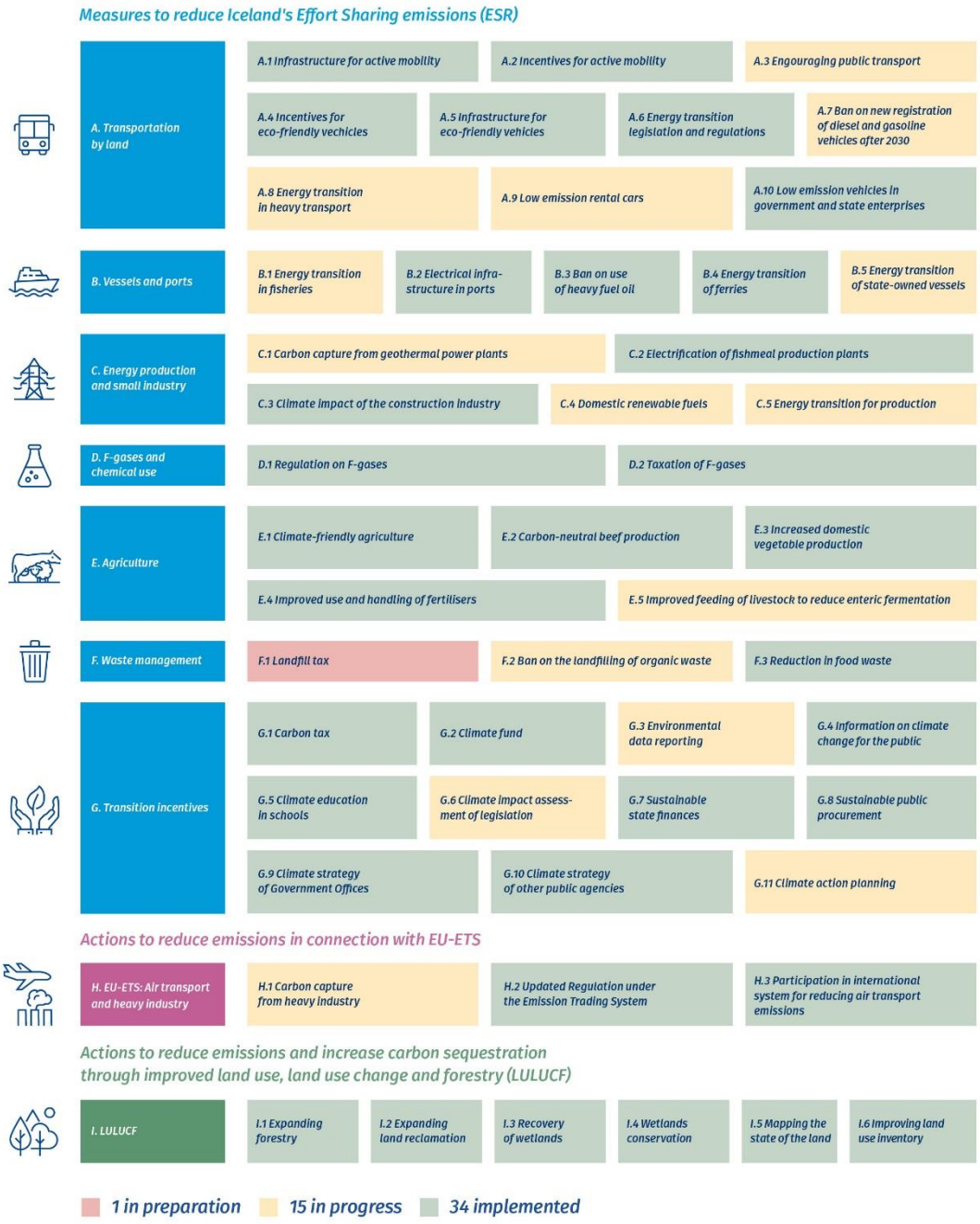


Figure 4.1 Summary of measures in Iceland's 2020 Climate Action Plan and 2021 Progress Report.

Figure 4.1 shows the summary of measures in Iceland's 2020 Climate Action Plan and 2021 Progress Report, indicating whether they are new and whether at the time of publication they were being implemented, in progress or in preparation

4.2.5 Cost-Benefit Analysis of Actions in the 2020 Climate Action Plan

A cost-benefit analysis of 23 action within the 2020 Climate Action Plan was published in 2022. The analysis was launched by the Ministry of Environment, Energy and Climate and conducted by the The Institute of

Economic Studies at the University of Iceland. This is the first formal estimation on the economic scope of climate actions in Iceland. The social impact of the climate actions was also looked into.

According to the report, actions within the LULUCF sector appear to have the most net benefit whereas actions with incentives for zero emission vehicles, ban on the landfilling of organic waste and increased domestic vegetable production have the most net cost. The details can be found in the report.[49]

4.2.6 LULUCF Mitigation Plan

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

In August 2022 the Icelandic government published an action plan for soil conservation and forestry for 2022-2026 (*Government of Iceland, 2022*[50]). This action plan include 27 measures which aim to protect ecosystems, increase biodiversity and promote sustainable land use.

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.

4.2.7 Iceland's Long-Term Low Emission Development Strategy

Iceland communicated its first Long-Term Low Emission Development Strategy "On the Path to Climate Neutrality"[51] (hereafter called "Strategy"), based on the encouragements in the Paris Agreement, in October 2021. The Strategy declares that Iceland is committed to reducing its overall GHG emissions and reaching climate neutrality no later than 2040 and become fossil fuel free by 2050, which should set Iceland on a path to net negative emissions. In addition, the 2021 Agreement on the Platform for the Coalition Government states that the goal is to achieve both carbon neutrality and full energy conversion no later than 2040. The foundation and various milestones that have been reached on the path to climate neutrality are described in the Strategy. Key documents and policies are introduced, and insight is given into context and framing of overarching climate targets and commitments.

4.2.8 Updated ETS for Aviation and CORSIA

Iceland is part of the EU Emissions Trading System (EU ETS), through its commitments under the EEA agreement. The revised legal framework for the ETS Phase IV from 2021 to 2030 has been adopted in accordance with the Joint Commitment Decision No 112/2020. The ETS is an important tool for reducing GHG

[49] *Hagfræðistofnun.* 2022 Áhrif aðgerða í loftslagsmálum. Kostnaðar- og ábatamat. https://ioes.hi.is/sites/ioes.hi.is/files/2022-07/A%C3%B0ger%C3%B0aa%CC%81%C3%A6tlun%20skilaeintak%201507_2022.pdf (in icelandic)

[50] *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/library/01--Frettatengt---myndir-og-skrar/MAR/Fylgiskjol/Landoglif_Adgerdaaaetlun2026%20-%20Copy%20(1).pdf

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

emissions cost-effectively and is designed to reduce European GHG emissions by 55%[52] 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 has been adjusted in accordance with the new period. Aviation in the EU ETS is in revision, since the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) takes place from 2021. The revision is to implement CORSIA by the EU in a way that it will be consistent with the EU's 2030 climate objectives. Initially, CORSIA is based on voluntary participation; Iceland is taking part in the system from the beginning and participated in the baseline period from 2019-2020 with all other European Civil Aviation Conference (ECAC)[53] states.

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

4.3.1 Note on Terminology

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

For the EU Member States, emissions (outside of LULUCF) not falling under the EU ETS are referred to as ESR emissions, with reference to the Effort Sharing Regulation 2018/842; for emissions that occured during the period 2013-2020, the term „ESD" emissions is sometimes used, with reference to the Effort Sharing Decision No 406/2009/EC of the European Union; The scope of the ESR regulation and of the ESD decision are the same.

4.3.2 Policy Background

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

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

All the other actions cover ESR or LULUCF emissions.

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

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

4.3.3 Historical Split Between ETS and Joint Fulfilment

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

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

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

4.4 Energy (Excluding Transport)

The Energy Sector (1) contains all emissions from fuel combustion, energy production, and distribution of fuels. Historically, transport has contributed to approximately one fifth of Iceland's GHG emissions (excl. LULUCF) and is therefore reported in a separate chapter.

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

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

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

Nine energy consumption (EC) PaMs are currently implemented or adopted, with the objective of reducing GHG emissions (see Table 13). Currently there are no specific energy supply (ES) PaMs.

Table 13 Energy Policies and Measures

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Energy transition in fisheries (101)	Reduced fossil fuel use of fishing ships by 50-60% in 2030 compared to 2005 and achieving a corresponding 69-144 kt reduction in CO_2e emissions in 2030 compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Economic, Planning, Regulatory, Research, Voluntary/ negotiated agreements	Planned	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Electrical infrastructure in ports (102)	11 kt CO_2e reduction in emissions from ships at harbour in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Fiscal, Planning	Implemented	Ministry of Industries and Innovation (ANR)	12	14	16	18
Electrification of fishmeal production plants (103)	9 kt CO_2e reduction in emissions from fishmeal production plants in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Economic, Planning, Voluntary/ negotiated agreements	Implemented	Ministry of Industries and Innovation (ANR)	58	74	74	74
Ban on use of heavy fuel oil (104)	A regulation will be issued tightening fuel requirements which effectively bans the use of heavy fuel oil in the territorial sea of Iceland.	CO_2, CH_4, N_2O	Regulatory	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Carbon capture from geothermal energy plants (105)	108 kt CO_2e reduction in emissions from geothermal energy plants in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2	Planning, Research	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Carbon tax (701)	The goal is for the carbon tax and other road transport policies to reduce emissions	CO_2	Fiscal	Implemented	Ministry of Finance and	Estimate of impact not available.			

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
	by 51 kt CO_2e in 2030 compared to a baseline scenario.				Economic Affairs (FJR)				
Domestic renewable fuels (702)	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.	CO_2, CH_4, N_2O	Research	Implemented	Ministry of Industries and Innovation (ANR)	Estimate of impact not available.			
Climate impact of the construction industry (710)	CO_2 emissions from the construction industry will be reduced through various incentives.	CO_2	Planning, Regulatory	Implemented	Ministry of Social Affairs and Labour	Estimate of impact not available.			
Energy transition in manufacturing industries (106)	Changing from fossil fuels in manufacturing industries by subsidising new equipment which uses renewable energy.	CO_2, CH_4, N_2O	Economic, Planning, Voluntary	Adopted	Ministry of Industries and Innovation	Estimate of impact not available.			

Two of the PaMs have been quantified; the impact of the electrical infrastructure in ports (102) and electrification of fishmeal production plants (103), and are described in more detail in chapter 5. Additional information on the PaMs is provided below. For more information on PaMs, see the Climate Action Plan (2020) and the Progress Report (2022).

4.4.1 Energy Transition in Fisheries (101)

Systematic measures will be undertaken to achieve an energy change in the fishing industry to reduce GHG emissions. The Icelandic fishing sector has already achieved significant results in reducing emissions in recent years, but there are still many opportunities for improvement. It is crucial to seize those opportunities in order for Iceland to reach its climate targets. Creating a defined framework for the sector to be able to do its part to reduce GHG emissions is a joint venture between the government and the fishing sector. A working group with representatives from five ministries, led by the Ministry of Finance and Economic Affairs, has been appointed to work towards this goal. This working group finished a report in 2021[54] proposing a target 50% decrease in emissions from fishing ships in 2030 compared to 2005.

4.4.2 Electrical Infrastructure in Ports (102)

Ports across the country will be further electrified systematically. In 2020 grants were provided 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 in that sector. Whale watching boats and other smaller boats, which sail shorter distances with tourists, to and from the same port, could, for example, possibly be electrified. Unlike the larger fishing ships, tourism boats which do many trips a day, would need access to fast charging stations, which are currently not very common.

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

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

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

A report on the status of electrification of harbours and next steps was published in 2021[55]. It concluded that the status of electrification is generally good, but there are certain types of ships that cannot use electricity while at port. Future grants should focus on building infrastructure for those types of ships.

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

4.4.3 Electrification of Fishmeal Plants (103)

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

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

4.4.4 Ban on Use of Heavy Fuel Oil (104)

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

The policy has been expanded since the first publication of the Climate Action Plan (2018). In December 2019, the *Minister of Environment and Natural Resources* signed a regulation on the sulphur content of particular liquid fuels. On 1 January 2020, a requirement came into force in the Icelandic Coastal Zone, which is a similar requirement as that which is in place in Emission Control Areas (ECAs)[56] in the Baltic and North seas, where the restrictions on fuel oil are some of the strictest. After these regulation changes, the permitted Sulphur content of marine fuel in Iceland is only 0.1% in the Icelandic Coastal Zone and internal waters. Previously, the Sulphur content was permitted to be up to 3.5%. This effectively prohibits the burning of fuel oil unless ships use approved methods to limit emissions of Sulphur dioxide[57]. The Environment Agency of Iceland (EAI) has a monitoring role with this regulation and restrictions will be increased if it is deemed necessary. In 2020, no heavy fuel oil was imported to Iceland.

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

[56] Emission Control Areas (ECAs) or Sulphur Emission Control Areas (SECAs) are sea areas in which stricter controls were /established to minimise airborne emissions from ships as defined by Annex VI of the 1997 MARPOL Protocol.

[57] Incorporated into Icelandic law in December 2019 through an update to Regulation No 124/2015 on the Sulphur content of certain liquid fuels. https://island.is/reglugerdir/nr/0124-2015

4.4.5 Carbon Capture from Geothermal Energy Plants (105)

Possibilities to further reduce GHG emissions from geothermal power plants will be investigated. Although fossil fuels are not used as an energy source in geothermal power plants, they still emit CO_2 since CO_2 is discharged to the atmosphere as a result of degassing of mantle-derived magma in geothermal systems in Iceland. In 2020, geothermal power plants were the source of 6.6% of Iceland's ESR emissions.

In the past years, emissions from geothermal power plants have decreased significantly due to measures by *Orka náttúrunnar* (ON) at the geothermal plant Hellisheiðarvirkjun. Reykjavík Energy (*Orkuveita Reykjavíkur*) developed the "CarbFix," or "gas-in-rock" method[58] in collaboration with the University of Iceland (*Háskóli Íslands*) and foreign collaborators (see Measure 306: Carbon capture from heavy industry) and it has received widespread interest.

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

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

4.4.6 Carbon Tax (701)

There has been a carbon tax in place in Iceland since 1 January 2010, after the implementation of Law No 129/2009 on Environmental- and Natural Resource taxes[59]. The carbon tax amount, per ton CO_2, can be seen for different fuel types in Table 14 below.

Table 14 The carbon tax amount per ton CO_2 for different fuel types[60]

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

As can be seen in Table 14 the carbon tax has been increasing over the past decade. Carbon taxes tackle carbon emissions from fossil fuels, both from transport and other sources, comprehensively. At the beginning of 2018 carbon taxes were raised by 50%, and in line with the government's fiscal plan for 2019 to 2023, it was raised again by 10% in January 2019, and again by another 10% in 2020.

The Institute of Economic Studies (*Hagfræðistofnun*) at the University of Iceland, published an analysis of the impact of a carbon tax on the fossil fuel use of Icelandic homes and businesses in 2020, at the request of the *Ministry of the Environment and Natural Resources*[61]. The analysis indicates that it is possible to

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

[59] *Parliament (Althingi).* Law No 129/2009 on Environmental- and Resource Taxes. https://www.althingi.is/lagas/nuna/2009129.html

[60] Overview of Carbon tax from 2010 to 2021. *Parliament (Althingi).* https://www.althingi.is/altext/151/s/1220.html

[61] *The Institute of Economic Studies.* "The impact of a carbon tax on the fossil fuel use of homes and businesses" ("Áhrif kolefnisgjalds á eldsneytisnotkun"). https://ioes.hi.is/files/2021-04/Ahrif_kolefnisgjalds_a_eldsneytisnotkun.pdf

reduce the consumption of fossil fuels, and thereby GHG emissions from fossil fuel consumption, by imposing a carbon tax. According to the analysis, homes reduce their fossil fuel consumption by approximately 0.35% when the price increases by 1%. The tax results in homes using 1 to 2% less fossil fuels. Businesses reduce their fossil fuel consumption by approximately 0.3% when the price increases by 1%.

4.4.7 Domestic Renewable Fuels (702)

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

The report on domestic fuel production by the Ministry of Industries and Innovation, which was mentioned in the first edition of the Climate Action Plan (2018), was submitted to Parliament in April 2019. It contains an overview of domestic fuel production and knowledge of the industry, and the possibilities for domestic production until 2030 were assessed[62]. In 2021, a report was published which analysed the feasibility of the production of e-fuels in Iceland[63]. An additional analysis to determine the cost-efficiency of domestic fuel production and map the obstacles to utilising it will be undertaken. The results will be used to build a foundation for a guide to sustainable fuels in Iceland, i.e., which fuels are most cost-effective to use in which industry/operation, such as heavy transport and in ships, and to determine where more research is necessary. The project management team on energy change will receive the analysis and propose the next steps.

General climate measures such as a higher fossil fuel prices because of the carbon tax and concessions for climate friendly vehicles are in part aimed to increase the demand for sustainable fuels, and in that way, support the domestic production of sustainable fuels. In Measure 101 on the energy transition in the fisheries, it will be mapped out how the usage of a mixture of renewable fuels and other fuels on ships can be implemented, 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.

4.4.8 Climate Impact of the Construction Industry (710)

In September 2020, a joint project between the government and the business sector was launched, called "Building a Greener Future" ("*Byggjum grænni framtíð*")[64]. The project involves the creation of a roadmap to environmentally friendly construction until 2030. It estimates the emissions from the construction industry and sets goals for reducing GHG emissions and other environmental impacts of the construction sector. Furthermore, actions will be defined to achieve those goals.

A great emphasis has been placed on the project being carried out in broad collaboration between companies from the construction industry and the government. Considering this, a project group was set up, the members of which were appointed by representatives from the Federation of Icelandic Industries (*Samtök Iðnaðarins*), the Green Building Council of Iceland (*Grænni byggð*), the Environment Agency of

[62] *Parliament (Althingi).* https://www.althingi.is/altext/pdf/149/s/2043.pdf

[63] *Government of Iceland (Stjórnarráð Íslands).* https://www.stjornarradid.is/efst-a-baugi/frettir/stok-frett/2021/06/23/Skyrsla-um-fysileika-thess-ad-framleida-rafeldsneyti-a-Islandi/

[64] *Building a Greener Future (Byggjum grænni framtíð).* https://byggjumgraenniframtid.is/

Iceland (EAI), the Icelandic Road and Coastal Administration (*Vegagerðin*), the Icelandic Association of Local Authorities (*Samband íslenskra sveitarfélaga*), the Ministry of Culture and Business Affairs. The purpose of the group is to manage the "Building a Greener Future" project. Results from the project will be published early in 2022.

4.4.9 Energy Transition in Manufacturing Industries (106)

There are many opportunities for energy transition from fossil fuel to renewable fuel in different sectors of manufacturing industries, such as food production and industries linked to fisheries. In 2021 the Energy fund provided grants and many of the projects that were funded were for manufacturing industries[65].

4.5 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 the Waste section 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.

Thirteen transport PaMs are currently implemented or planned with the objective of reducing GHG emissions. They are summarised in Table 15. Seven PaMs are related to the electrification or fuel change of the car fleet, three are to do with promoting public transport, cycling or walking, two are on the electrification of ferries and the final one has to do with mitigation of emissions from aviation.

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

Table 15 Transport Policies and Measures.

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Participation in an international system for mitigating emissions from aviation (ETS and CORSIA) (705)	According to an estimate by the International Civil Aviation Organization (ICAO) international air carriers will need to carbon offset 2.5 million kt CO_2e to achieve carbon neutral growth between the years 2021-2035.	CO_2	Economic, Regulatory	Implemented	Ministry of Finance and Economic Affairs , Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Incentives for low- and zero emission vehicles (201)	The quantified objective of policies 201, 202, 203 and 204 combined is a 51 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Fiscal	Implemented	Ministry of Finance and Economic Affairs	Estimate of impact not available.			
Infrastructure for low- and zero emission vehicles (202)	The quantified objective of policies 201, 202, 203 and 204 combined is a 51 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Economic	Implemented	Ministry of Industries and Innovation	Estimate of impact not available.			
Legislation and regulations for clean energy transition (203)	The quantified objective of policies 201, 202, 203 and 204 combined is a 51 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Regulatory, planning	Implemented	Ministry of Industries and Innovation	Estimate of impact not available.			

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Ban on new registration of diesel and gasoline vehicles after 2030 (204)	Ban new registration of passenger cars fueled by diesel or gas from 2030. The quantified objective of policies 201, 202, 203 and 204 combined is a 51 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Regulatory	Planned	Ministry of Transport and Local Government	Estimate of impact not available.			
Infrastructure for active mobility (205)	The quantified objective of policies 205 and 209 combined is a 10 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Fiscal, Planning	Implemented	Ministry of Finance and Economic Affairs	Estimate of impact not available.			
Encouraging public transport (206)	16 kt CO_2e reduction in emissions from road transport in 2030, compared to a baseline scenario in the Climate Action Plan	CO_2, CH_4, N_2O	Economic, Regulatory, planning	Implemented	Ministry of Finance and Economic Affairs	Estimate of impact not available.			
Low emission vehicles in government and state enterprises (207)	900 t CO_2e reduction in emissions from ships road transport in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Fiscal, Regulatory, planning	Implemented	Ministry of Finance and Economic Affairs	Estimate of impact not available.			
Energy transition of ferries (208)	4 kt CO_2e reduction in emissions from ferries in 2030, compared to a baseline scenario in the Climate Action Plan	CO_2, CH_4, N_2O	Fiscal, Planning	Implemented	Ministry of Transport and Local Government	5.6	6.5	6.5	6.5

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Incentives for active mobility (209)	The quantified objective of policies 205 and 209 combined is a 10 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Economic, Fiscal, Information, Planning	Implemented	Ministry of Finance and Economic Affairs	Estimate of impact not available.			
Energy transition in heavy transport (210)	Transitioning 15-25% of heavy transport vehicles to clean fuels in 2030 and achieving a corresponding 14 kt CO2e reduction in emissions from heavy transport in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Fiscal, Planning	Implemented	Ministry of Industries and Innovation	Estimate of impact not available.			
Low emission rental cars (211)	Transitioning 30-50% of rental cars to sustainable fuels in 2030 and achieving a corresponding 28-46 kt CO_2e reduction in emissions from rental cars in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Economic, Fiscal, Planning	Implemented	Ministry of Industries and Innovation	Estimate of impact not available.			
Energy transition of state-owned vessels (212)	The action aims to reduce the use of fossil fuel in state owned vessels other than ferries.	CO_2, CH_4, N_2O	Fiscal, planning	Adopted	Ministry of Industries and Innovation	Estimate of impact not available.			

Measures from Table 15 above will impact emissions from the Transport sector. The policy that has been quantified; the electrification / fuel change of ferries (208), is described in more detail. Additional information on PaMs that have not been quantified is provided below. For more information on PaMs, see the Climate Action Plan (2020) and the Progress Reports from 2021 and 2022.[66]

4.5.1 Electrification or Fuel Change of the Vehicle Fleet (201-204, 207, 210, 211)

The accelerated uptake of electric vehicles or vehicles fuelled by renewable fuels has the possibility to significantly reduce Iceland's GHG emissions due to the country's heavy dependency on cars for transport. The seven PaMs that are to do with the electrification or energy change of the vehicle fleet in the 2020 Action Plan are the following: 201-204, 207, 210, 211.

4.5.2 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[67], will be followed. The agreement includes, inter alia, a substantial effort to build new biking paths in the Capital Area (approximately 70 to 100 km of paths), as well as new walking bridges and underpasses. Simultaneously, work on bike paths between urban areas will be continued according to the Transport Plan (*Samgönguáætlun*) 2020-2034 and in cooperation with the relevant municipalities[68].

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

The government and six municipalities in the capital area signed a treaty in September 2019 with an ambitious plan to build up transport infrastructure and public transportation in the capital area in the next 15 years.[69] The treaty contains the most extensive transportation construction plan in the history of Iceland. The goal is to greatly boost public transport, improve transport for all modes of transportation, reduce GHG emissions to reach the government's and municipalities' climate goals, reduce traffic jams etc. *Borgarlínan*, a new public transportation system in the Capital Area, is a part of the agreement and the preparations for construction are currently underway (COWI 2017).

[66] *Government of Iceland (Stjórnarráð Íslands).* Climate Action Plan. https://www.stjornarradid.is/verkefni/umhverfi-og-natturuvernd/loftslagsmal/adgerdaaaetlun-i-loftslagsmalum/

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

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

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

4.5.3 Participation in an International System for Mitigating Emissions from Aviation (ETS and CORSIA) (705)

Iceland will participate in a new international system, CORSIA (e. Carbon Offsetting and Reduction Scheme for International Aviation), by the International Civil Aviation Organization (ICAO), which is meant to reduce greenhouse gas emissions from aviation. The goal of CORSIA is to achieve a carbon neutral growth in international aviation from 2020 with carbon offsetting through certain project certifications. The scope of CORSIA encompasses flight operators which emit more than 10 kt CO_2 from international aviation from aircrafts, with a maximum take of weight of over 5,700 kg.

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

4.5.4 Energy Transition of State-Owned Vessels (212)

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

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

4.5.5 Electrification of Ferries (208)

The aim of this measure is to achieve an energy change in ferries which are in regular operation, and which are categorised as a part of the national highway system. Energy sources in ferries which are in regular

operation will be switched out for more sustainable non-fossil fuelled options where technological development allows it.

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

- *Herjólfur*, the biggest ferry in Iceland, sails multiple times per day as the primary connection between Vestmannaeyjar (Westman Islands, which has a population of approximately 4,200) and the Icelandic mainland. The new *Herjólfur* is a hybrid, and it is expected that the ship will sail completely on electricity from the Icelandic coast to Vestmannaeyjar. The first fully electrified sailing *of Herjólfur* occurred on 22 August 2020. In certain weather or oceanic 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 projection scenario, see chapter 5.
- *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 for nine months of the year, but during the summer, *Baldur´s* operations are supported by market conditions. When the next description for tender for the sailing of the ferry will be made, energy change will be encouraged.

4.6 Industrial Processes and Product Use (PPU)

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

PaMs with the objective of reducing GHG emissions relevant for the IPPU sector, both implemented and adopted, are summarised in Table 16.

Table 16 IPPU Policies and Measures.

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Regulation on F-gases (301)	Stepwise reduction of import of HFCs from 271 kt CO_2e/year (baseline) to 32.5 kt CO_2e/year in 2036 (=12% of baseline).	HFC, PFC	Economic, Regulatory	Implemented	Ministry of the Environment, Energy and Climate	49	61	27	1.0
MAC Directive 2006/40/EC (302)	From 1 January 2017, the use of fluorinated greenhouse gases with a GWP higher than 150 in all new vehicles put on the EU market will be totally banned.	HFC, PFC	Regulatory	Implemented	Ministry of Infrastructure	Estimate of impact not available.			
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).	GHGs	Regulatory	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
BAT for Manufacture of Glass (304)	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).	GHGs	Regulatory	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Taxation of F-gases (305)	Reduction of amount of import of F gases, no quantified objective available.	HFC, PFC	Fiscal	Implemented	Ministry of Finance and Economic Affairs	Estimate of impact not available.			
Carbon capture from heavy industry (306)	CO_2 emissions from heavy industry will be reduced through carbon capture, for	CO_2	Regulatory	Adopted	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
	example using the Carbfix method.								
Updated Regulation under the Emission Trading System (ETS) (307)	43% decrease of emissions within ETS in 2030 compared to 2005.	CO_2, PFC	Regulatory	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Environmental data reporting (708)	Regulation will be issued for better environmental data reporting, on, e.g., material use, GHG emissions among other pollutants.	GHGs	Regulatory	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			

The PaMs on reducing GHG emissions from IPPU in the 2020 Action Plan and 2022 Progress Report are predominantly focused on achieving the phasing out of F-gases.

Iceland adopted Regulation (EU) No 517/2014 on fluorinated greenhouse gases (F-gas Regulation) in December 2018, in line with the 2018 Action Plan. This regulation limits the total amount of the most significant F-gases which can be sold, banning the use of F-gases in many new types of equipment where less harmful alternatives are available, and preventing emissions of F-gases from existing equipment. The F-gas regulation is adapted to Icelandic conditions and the import quota differs from the values stated in the Annex V of the Regulation. A stricter quota was adopted in December 2020 through amendment (Regulation 1425/2020) to Regulation 1066/2019 on F-gases which took effect in January 2021, further accelerating the decrease in F-gas emissions in Iceland.

Further measures to reduce the use of F-gases are the implementation of a taxation system based on the GWP of the F-gases imported in bulk. This was implemented into Icelandic legislation with an amendment (Act No 135/2019) to Act No 129/2009 on Environmental and Resource Taxes.

4.6.1 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 to implement the 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 17. Certain other provisions are made in the regulation which aim to further reduce F-gas emissions, such as limits on their marketing and use. Refilling big systems with F-gases which have a very high global warming potential (maximum 2,500 GWP) will be banned. This regulation is an important step in reducing GHG emissions from the use of F-gases in Iceland. The Environment Agency of Iceland (EAI) is in charge of monitoring the regulation in line with provisions in the chemical law. Restrictions will be further increased if deemed necessary.

Table 17 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

4.6.2 MAC Directive 2006/40/EC (302)

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

4.6.3 BAT for Non-Ferrous Metals Industries (303)

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

4.6.4 BAT for Manufacture of Glass (304)

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

4.6.5 Taxation of F-Gases (305)

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

4.6.6 Carbon Capture from Heavy Industry (306)

According to a declaration of intent[70], which was signed in 2019 by Reykjavík Energy, Elkem, Alcoa Fjarðaál, Rio Tinto Iceland, Norðurál, PCC Bakki, and the Government of Iceland, the possibility to use the "Carbfix" method to reduce emissions from the heavy industries in Iceland is to be explored. In connection to this Iceland implemented and transposed into Icelandic law (No 12 from 18 March 2021) Directive 2009/31/EC (the CCS Directive) so that the heavy industry in Iceland would be able to use the Carbfix method to store CO_2 that has been captured from their activities.

Reykjavík Energy (*Orkuveita Reykjavíkur*) developed the Carbfix[71] method or "gas to rock" 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 is dissolved in water under pressure and the water is subsequently pumped to a depth of 500-800 meters into the basalt strata, where the CO_2 is permanently mineralised. The gas is, in this way, turned into rock. ON Power, a subsidiary of Reykjavík Energy, has used the method for years to reduce emissions from Hellisheiði Geothermal Power Plant with good results.

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

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

To enable the heavy industry in Iceland to use the Carbfix method there are plans to develop methods to separate the density of CO_2 in emissions from heavy industry, so that similar measures can be used as in the Hellisheiði Geothermal Power Plant.

4.6.7 Updated regulations according to the Emission Trading System (EU ETS) for Phase 4 (307)

Iceland participates in the EU ETS. New regulations came into effect when the fourth phase (2021-2030) of the system started in 2021. The stricter rules are designed to achieve a 43% decrease in emissions within the EU ETS sectors in 2030 compared to 2005. The EU ETS is the Union's key instrument to reduce GHG emissions and is meant to create an economic incentive to reduce GHG emissions.

The EU ETS is based on making certain sectors in the European Economic Area (EEA) dependent on emission allowances. A certain limited total of emission allowances is allocated to the whole EEA per year, and the total allowances decrease each year. Emission allowances are in part allocated for free, and in part auctioned off and can then be traded. In this manner, the EU ETS creates a financial incentive to reduce GHG emissions from operations.

Since the EU ETS was established, it has been expanded to include more sectors in the system and the rules have become stricter. The third phase of the EU ETS came to an end by the end of 2020 and the fourth phase, which is to cover the years 2021 - 2030, has taken over. With Act No 35/2021 Alþingi passed relevant changes on the Climate Act No 70/2012 to implement the EU regulations regarding the fourth phase.

4.6.8 Environmental Data Reporting (708)

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

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

4.6.9 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[72].

[72] *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/#

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

Five Agriculture (AG) PaMs are currently planned with the objective of reducing GHG emissions, summarised in Table 18.

Table 18 Agriculture Policies and Measures.

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Climate-friendly agriculture (401)	Participation of 15 farms in 2020, participation of 100 farms in 2023.	CO_2, CH_4, N_2O	Information, Education, Planning	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Improved feeding of livestock to reduce enteric fermentation (402)	Research shows that supplements can reduce enteric fermentation in livestock, that results in methane emissions; these possibilities will be explored in the Icelandic context.	CO_2, CH_4, N_2O	Research	Adopted	Ministry of Food, Agriculture and Fisheries	Estimate of impact not available.			
Improved use and handling of fertilisers (403)	Use of N-fertiliser, -10% in 2030 compared to a BAU scenario.	CO_2, CH_4, N_2O	Education, Planning, Regulatory	Adopted	Ministry of Food, Agriculture and Fisheries	3.8	5.6	7.3	9.0
Carbon-neutral beef production (404)	Carbon neutrality of beef farms by 2040.	CO_2, CH_4, N_2O	Education, Planning, Regulatory	Implemented	Ministry of Food, Agriculture and Fisheries	Estimate of impact not available.			
Increased domestic vegetable production (405)	Increase of vegetable production by 25% from 2020 to 2023, carbon neutrality of horticulture in 2040.	CO_2, CH_4, N_2O	Planning, Regulatory	Implemented	Ministry of Food, Agriculture and Fisheries	Estimate of impact not available.			

The PaMs described in Table 4.6 are all from the Climate Action Plan (2020) and the Progress Report (2021).

4.7.1 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-farming." The aim of this measure is to provide farmers with comprehensive counselling and education on how they can reduce their GHG emissions and increase carbon sequestration on their farms and land through a project called "Climate friendly farming" (*Loftslagsvænni landbúnaður*). The goal is to reduce GHG emissions from farming and land use and increase carbon sequestration in soils and vegetation. In the first edition of the Climate Action Plan (2018) a collaboration project with sheep farmers, with the goal to reduce GHG emissions and increase carbon sequestration in farming and land use, was described. The preparation of the project has been managed by the Icelandic Agricultural Advisory Centre (RML), the Icelandic Forestry Association and the Soil Conservation Service of Iceland (SCSI), in collaboration with the Icelandic Sheep Farmers Association (*Landssamtök sauðfjárbænda*), the Icelandic Farmers Association (*Bændasamtök Íslands*), the *Ministry of the Environment, Energy, and Climate* and the *Ministry of Food, Agriculture, and Fisheries*. Courses, that will be open to all farmers, will be held with the aim of increasing farmers' knowledge and interest in climate issues. The project began in February 2020 with an open meeting for all farmers. Voluntary participants receive guidance on future planning, that focuses on reducing the carbon footprint of their farms and is based on data from each individual farm. In 2020, 13 sheep farmers participated in the project. In 2021, this had expanded to 43 participants, including 15 cattle farmers. One of the aims of the project is to include different types of farms and around 100 farms are expected to participate in 2023.

4.7.2 Improved Feeding of Livestock to Reduce Enteric Fermentation (402)

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

4.7.3 Improved Use and Handling of Fertilisers (403)

The policy has been expanded since the first edition of the Climate Action Plan (2018). The policies "Reduced use of non-organic fertiliser" and "Improved manure management" have been combined in one policy. Emissions from fertiliser use in farming will be reduced by improving manure management practices and reducing the use of inorganic fertilisers. An emphasis will be placed on increasing farmers' knowledge and access to information on how best to reduce greenhouse gas emissions (CH_4 and N_2O) from agriculture. An important aspect of this effort is to enforce the regulation on protection against water pollution due to nitrogen compounds (NO_x) from agriculture and other operations (Icelandic regulation No. 796/1999). According to the regulation the size of a manure storage should be based on a holding a capacity of at least six months of manure, or the possibility of using the manure in a reasonable manner as organic fertiliser

on soil. The policy scope includes the fertiliser use of all farmers, but it will begin with cattle- and sheep farmers since measures in those fields have already begun (see policies 401 and 402). Through those measures farmers will, among other things, be provided with advice that aims to improve the use of manure, and it will be researched systematically how farmers use their manure. Knowledge and experience from this work will highlight the possibilities that exist to reduce GHG emissions with improved fertiliser use and lay a foundation for increased training and information sharing to other farming sectors. Consequently, it will be the responsibility of the project management group on climate action in agriculture to implement the policy for all farmers. A milestone report is due to be released in 2022. It will make proposals on:

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

4.7.4 Carbon-Neutral Beef Production (404)

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

4.7.5 Increased Domestic Vegetable Production (405)

The aim of this measure is to increase vegetable production in Iceland and promote carbon neutrality in horticulture. Production of Icelandic vegetables will be increased by 25% in the next three years. Organic vegetable production will receive increased financial support and efforts will be made for Icelandic horticulture to become carbon neutral no later than 2040. This was agreed upon when the contract for the operation conditions of horticulture production (horticulture contract)[73] was reviewed in May 2020. To support carbon neutrality in Icelandic horticulture by the year 2040, a part of the funding for the horticulture

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

contract will be spent specifically on climate action. Knowledge on carbon emissions and sequestration will be increased, the treatment and use of resources and fertilisers will be improved, waste will be reduced, and an emphasis will be placed on effective agriculture, increased sustainability, and other actions that support reaching the target of carbon neutral farming. A holistic approach will be undertaken, focusing on policy strategy in climate-, energy-, employment-, and regional affairs, among other significant issues. Farmers' knowledge on climate issues, and possibilities to reduce carbon emissions and increase carbon sequestration, will be improved further. This will be achieved, partly by increasing farmers' access to direct council and education. The emphasis will be on knowing the possibilities of each individual horticultural farm directly, and to build up a transparent and certified framework for the project. At the end of 2020, the Ministry of Food, Agriculture, and Fisheries and the Icelandic Association of Horticulture Producers (*Samband garðyrkjubænda*) decided to fund two specific projects that the Icelandic Association of Horticulture Producers will manage. The projects are vegetation in the city and carbon sequestration. They will focus on increasing knowledge, public interest, and participation in cultivation in order to increase carbon sequestration.

4.8 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 categorisation 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 SCSI and the 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.

Figure 4.2 shows the relative division of the area of Iceland to the six main land use categories reported, in according to IGLUD land use map 2020 and other land use estimates available for the reporting.

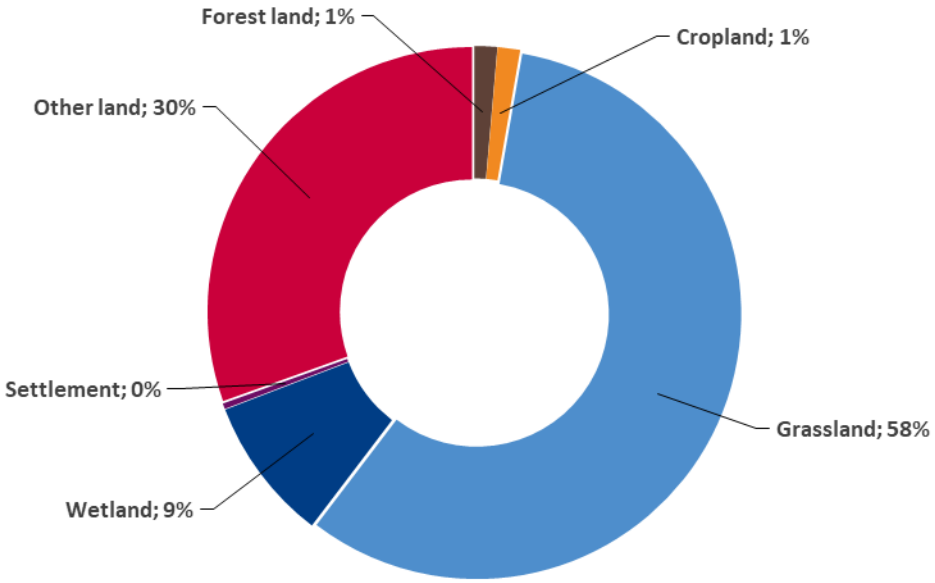


Figure 4.2 Relative size of land use categories in Iceland.

Both emissions from sources and removals by sinks are reported for this sector. More information on historical emissions and removals of the land use categories is reported in the NIR 2022.

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.

Six LULUCF PaMs are currently planned with the objective of reducing GHG emissions and increasing removals and are summarised in Table 19. 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 19 LULUCF Policies and Measures.

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2eq)			
						2025	2030	2035	2040
Enhanced action in forestry (601)	134 kt CO_2e increased carbon sequestration due to increased afforestation 2030, compared to a baseline scenario; 258 kt CO_2e increased carbon sequestration in 2040, compared to a baseline scenario.	CO_2, CH_4	Fiscal	Implemented	Ministry of the Environment, Energy and Climate	13	75	84	158
Expanding revegetation (602)	137 kt CO_2e increased carbon sequestration due to revegetation 2030, compared to a baseline scenario; 273 kt CO_2e increased carbon sequestration in 2040, compared to a baseline scenario.	CO_2, CH_4	Planning	Implemented	Ministry of the Environment, Energy and Climate	64	133	200	266
Wetlands Conservation (603)	The objective is to ensure that emissions from drained wetlands do not increase.	CO_2, CH_4	Regulatory, Voluntary Agreement	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Restoration of wetlands (604)	107 kt CO_2e reduction in emissions due to the restoration of wetlands in 2030, compared to a baseline scenario; 210 kt CO_2e reduction in emissions in 2040, compared to a baseline scenario.	CO_2, CH_4	Research, Planning	Implemented	Ministry of the Environment, Energy and Climate	57	113	169	225
Improved mapping of grazing land and land use (605)	The state of grazing land will be mapped and used for grazing management	CO_2, CH_4	Information, Research, Planning	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Improvement plan for the LULUCF inventory (606)	Increased capacity in the LULUCF inventory and increased research to improve the foundation for estimating emissions and sequestration from the LULUCF sector.	CO_2, CH_4	Research	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			

4.8.1 Enhanced Action in Forestry (601)

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

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

4.8.2 Expanding Revegetation (602)

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

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

An extensive plan on improved land use in favour of climate change was presented in June 2019 (Government of Iceland, June 2019). The plan is for four years and actions described in it have already been started accordingly. In addition to carbon sequestration the actions are meant to work against land degradation and to support biodiversity. According to the plan the yearly scope of land reclamation will double over the period and the scope of the main projects will increase from approximately 6,000 hectares on average in 2018 to 7,630 hectares in 2020, 9,100 hectares in 2021, 10,600 in 2022, and 12,200 in 2023 without taking self-seeding into account. The scope of the project "Farmers revegetate the land" *("Bændur græða landið")*[74] will triple and the scope of projects supported by the fund Landbótasjóður[75] 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.

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

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

4.8.3 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 Environment Agency of Iceland (EAI) and Soil Conservation Service of Iceland SCSI 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.

4.8.4 Restoration of Wetlands (604)

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

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

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

4.8.5 Improved Mapping of Grazing Land and Land Use (605)

The aim of this measure is to 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 already 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[76]. A draft report on the status of soils and flora in Iceland was published at the same time[77].

The project is based on the collaboration between the The Soil Conservation Service of Iceland (SCSI), the Sheep Farmers Association, the Farmers Association of Iceland, and the *Ministry of Food, Agriculture, and Fisheries*. It is financed through agricultural contracts, although the SCSI 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.

4.8.6 Improvement Plan for the LULUCF Inventory (606)

The aim of this measure is to improve the capacity in the LULUCF inventory and increased research to improve the foundation for estimating emissions and sequestration from the LULUCF sector. An improvement plan from 2020 to 2023, containing 20 improvement actions, has already been published[78]. The goal of the plan is to strengthen the National Inventory and to ensure that Iceland fulfils its obligations to the UNFCCC and EU.

4.9 Waste

For most of the 20th century Solid Waste Disposal Sites (SWDS) in Iceland were numerous, small, and located close to the locations of waste generation. In 1991, the SWDS Álfsnes was opened, which is currently the biggest SWDS in Iceland and is serving the capital and all surrounding municipalities, where approximately two thirds of the population of Iceland lives. A new biogas and composting plant called GAJA has been built at Álfsnes and started operating in the second half of 2020. According to the operation permit[79] issued by the Environment Agency of Iceland, the plant is expected to turn up to 30-40 kt of waste into compost and methane gas annually. The methane will mostly be used as fuel for vehicles, and therefore the emissions from methane produced in GAJA is included in the Road transport sector (see Section 6). There was a trial to produce electricity from the recovered methane, but this could not compete with the cheaper electricity production from geothermal or hydropower plants, so the methane is mostly used for vehicle fuel. Other plans to utilise the methane produced in GAJA[80] include for asphalt production, where it would be replacing diesel oil, and for 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, in Reykjanes, south-west Iceland) 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

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

[77] *Grólind*. https://grolind.is/wp-content/uploads/2020/06/GroLind_stodumat_18_06_2020.pdf

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

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

[80] *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

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%.

Four waste management PaMs are currently implemented or planned with the objective of reducing GHG emissions and are summarised in Table 20

Table 20 Waste Policies and Measures.

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2eq)			
						2025	2030	2035	2040
Ban on landfilling of organic waste (501)	Decrease amount of waste landfilled: amount of biological waste landfilled 2021 = 0 kt, amount of biodegradable waste landiflled 2023 = 0 kt.	CH_4	Regulatory	Implemented	Ministry of the Environment, Energy and Climate	45	103	143	174
Landfill tax (502)	Decrease in amount of waste sent to landfill, a quantified objective is not available.	CH_4	Fiscal	Planned	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Reduction in food waste (503)	Reduction of food waste throughout entire value chain by 50% in the next 10 years.	CH_4	Education, Information	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Gas and compost plant (504)	25.000 tonnes of organic waste/ year (max capacity: 35.000 tonnes) and produce 12.000 tonnes of compost and 3 million Nm^3 of CH_4 each year.	CH_4	Regulatory, Voluntary Agreement	Implemented	SORPA Municipal Association	Estimate together with ban on landfilling of organic waste (501) above			
Pay-as-you-throw system (505)	Encourage increased recycling.	CO_2, CH_4, N_2O	Economic, Regulatory	Adopted	Local government	Estimate of impact not available.			
Extended manufacturer's warranty (506)	Extended manufacturer's warranty introduced to all packaging	CO_2, CH_4, N_2O	Regulatory	Adopted	Local government	Estimate of impact not available.			

Three PaMs are from the 2020 Action Plan (501, 502 and 503) and two are from the *Ministry of the Environment, Energy, and Climate's* waste strategy, *Towards a Circular Economy*, from 2021[81] (505 and 506). The measures listed here from the Action Plan, and many others, are also included in the waste strategy. Twelve measures from the waste strategy were incorporated into legislation in 2021 with an amendment to Act No 55/2003 on Waste Management [82]. Most of them aim to decrease waste production and improve sorting, which will in turn decrease greenhouse gas emissions.

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

4.9.1 Ban on Landfilling of Organic Waste (501)

The measure has been expanded upon since the first edition of the Climate Action Plan (2018) and is now an individual measure. The measure is twofold. The first part declares that landfilling bio and biological waste will be banned in Iceland as a main rule. The second part announces a ban on landfilling any waste that has been collected specially. These bans will be in place from 1 January 2023, according to an amendment in 2021 to Act No 7/1998 on Public Health and Pollution Control and Act No 55/2003 on the Treatment of Waste[83]Provisions in the bill specify that a special collection of bio and biological waste shall be set afoot and that landfilling this waste will be prohibited. Bio waste contains food-, kitchen- and garden waste which can biodegrade. This is a change in the legislation and the goal of the law is, among other things, to create conditions that support a circular economy. The provisions are meant to lead to the sorting of bio waste from other waste in the whole country and it being prepared for reuse or recycling, in line with how the treatment of waste is prioritised. In the capital area, bio waste will be partly diverted to the gas and composting plant *Sorpa*, but in the countryside it is more likely that bio waste will be used for composting as a rule. The measure also includes banning the landfilling of biodegradable waste starting from the year 2023. Biodegradable waste contains all waste that can decompose through the agency of microorganisms, such as waste from slaughterhouses, fishing, breweries, domestic animals, timber, fish oil, paper, sewage, and bio waste. Local authorities will also be obliged to set up a special collection of household waste, which shall cover at least paper and cardboard, metals, plastics, glass, organic waste, textiles, and hazardous waste. Individuals and legal entities will be required to sort household waste. A general prohibition will be on landfilling or incineration of the types of waste that have been collected separately, except for waste residues that are not suitable for reuse or recycling.

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

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

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

4.9.2 Gas and Compost Plant (504)

A new gas and composting plant, GAJA, started operating at a small scale in the second half of 2020[84]. It is the first plant of its kind in Iceland, and it will process municipal solid waste from households from the entire capital area, which contains around two thirds of Iceland's population. It is planned to process 30 kt of organic waste every year (max capacity: 40 kt) and produce 10 to 12 kt of compost and 3,000,000 Nm3 of CH_4 each year. The plant was unable to operate fully in 2021, and consequently, the expected step wise increase in its operational scale was delayed slightly. The plant is expected to operate at 75% capacity from 2023 onwards, turning 30 kt of waste into compost and methane gas annually.

4.9.3 Landfill Tax (502)

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

4.9.4 Reduction in Food Waste (503)

The goal of this measure is to systematically reduce food waste by encouraging several short-term and long-term projects. In the past years, several projects have been undertaken by the government, NGOs, and companies to reduce food waste, such as the creation of various educational material, the organisation of events to raise public awareness, school projects and discount systems in stores for food products that are nearing the expiration date, innovation in using by-products from food production, a defined government policy, and courses on the better use of food products.

Until 2023, the Environmental Agency of Iceland will continue to raise awareness on how much food is currently going to waste, education on food waste will receive 15 million ISK per year in funding. The continued running of the Icelandic website on food waste[85] will be ensured and an analysis will be undertaken of possible unnecessary regulatory requirements on food products that have no impact on food safety but may be causing food waste. A survey on Icelanders' attitudes towards food waste has already been undertaken to track changes in local public opinion.

The Minister of the Environment, Energy, and Climate formed a project team on food waste to create a holistic plan for the next years on effective measures against food waste. The team (which consists of representatives from consumers, the business sector, NGOs, young people, and the government) submitted a report including 24 proposed food waste reduction measures in June 2020[86]. Out of the propositions, the government will be responsible for implementing 14 of the measures and the business sector will be

[84] *GAJA*. https://sorpa.is/um-sorpu/gas-og-jardgerdarstod

[85] *Food Waste (Matarsóun)*. https://samangegnsoun.is/matarsoun/

[86] 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

responsible for the remainder. The goal is to reduce food waste, throughout the entire value chain, by 30% in 2025 and by 50% in 2030.

4.9.5 Pay-as-you-Throw System (505)

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

4.9.6 Extended Manufacturer's Warranty (506)

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

4.9.7 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 21.

Table 21 Other initiatives that may impact GHG emissions from the Waste sector.

Initiative	Description
The Green Steps Program[87]	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[88]	This initiative has been run by the EAI since 2016 with the goal of prioritising a circular economy. It focuses on better efficiency, creating less waste as well as increasing education to prevent waste generation. Every couple of years the focus is on a particular waste category such as: food, plastic, textiles, electronics, construction or paper.
Bokashi experiment in the Rangárvellir municipality	In 2020, *Jarðgerðarfélagið*, the Rangárvallasýsla (South Iceland) waste processing plant and the SCSI 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 will be successful, other municipalities may follow suit.
Decreased GHG emissions with increased treatment of wastewater [89]	In 2021, the Environment Agency of Iceland had an analysis done on the scope of emissions from wastewater in Iceland and the possibilities of decreasing those emissions. The results showed that there are opportunities in increased wastewater treatment and the use of sludge for land reclamation and restoration.
Other measures in Towards a Circular Economy	Funds were allocated by the *Ministry of the Environment, Energy, and Climate* to a number of other initiatives, i.e., for the development of necessary infrastructure that can contribute to the implementation of a circular economy in Iceland, the promotion of domestic waste recycling, support for home composting, the strengthening of repair and maintenance services, abolition of VAT on the resale of used goods, improved waste statistics, support for infrastructure development for waste incineration and more. Some of these measures have already begun while others are still in planning.

4.10 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 22 below. Short descriptions of each policy or measure are provided, with more information on all the PaMs provided in separate subchapters below. Currently, the majority of the policies have been implemented, although none of them have been quantified or included in the WEM projections scenario.

[87] *Green Steps Program ("Græn skref").* https://graenskref.is/english/

[88] *Together against waste ("Saman gegn sóun").* https://samangegnsoun.is/

[89] *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

Table 22 Policies and Measures included in Cross-Cutting.

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2eq)			
						2025	2030	2035	2040
Climate fund (703)	Climate education and innovation will be supported through the new Icelandic Climate fund	GHGs	Economic	Implemented	Ministry of Finance and Economic Affairs (FJR), Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Climate strategy of Government Offices (704)	The goal is to reduce emissions from public agencies, primarily by reducing international travel. The target is to reduce emissions by 165 kt CO_2e in 2030 compared to a baseline scenario.	GHGs	Economic	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Climate education in schools (706)	Climate education in schools will be reinforced.	GHGs	Education	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Information on climate change for the public (707)	Information on climate issues, the effects of climate change, mitigation and adaptation will be supported through various means.	GHGs	Economic, Education	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Climate action planning (709)	Climate issues will be addressed through Iceland's National Planning Strategy.	GHGs	Planning	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Issuing of green bonds (711)	Evaluation will be made on the feasibility of issuing green bonds in order to raise green investor interest in traditional state loans.	GHGs	Economic	Implemented	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Sustainable public procurement (712)	Environmental and climate issues will be evaluated in all government purchasing with a new policy on sustainable public procurement.	GHGs	Economic	Implemented	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Climate strategy of other public agencies (713)	All other public agencies will need to set a Climate Strategy. The same applies to local government.	GHGs	Regulatory, Voluntary/ Negotiated agreements	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Climate impact assessment of legislation (714)	The climate impact of all new legislation will be evaluated.	GHGs	Regulatory	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			

4.10.1 Climate Fund (703)

In the first edition of the Climate Action Plan (2018) a measure on the establishment of a Climate fund ("*Loftslagssjóður*") was proposed. The fund formally started operating in 2019 and the Climate Act has been updated and altered to further define and formalise its purpose. The Icelandic Centre for Research (*Rannís*) has been entrusted with the management of the fund, a board of 5 people was appointed. The main purpose of the fund is to support and encourage climate education, research and innovation.

The first grants, in total 165 million ISK were allocated in May 2020, to 10 innovation- and 22 education[90]. 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 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[91]. The fund will allocate over 500 million ISK in grants to various such educational and climate innovation projects over the next five years.

An overview of the projects which received grants from the fund in March 2021 is provided in Table 23 and Table 24. This measure is connected to policy 706 and 707 on education on climate issues for the public and in schools.

Table 23 Innovation projects which received funding from the Climate Fund in March 2021.

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

Table 24 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

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

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

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

4.10.2 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 the 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).

4.10.3 Climate Education in Schools (706)

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

When the education system's curricula are reviewed next, climate change education will be made a priority and educational grants will be allocated by the Ministry of Education and Children to climate education projects. Education on climate change will be increased at all educational levels and provided through various educational channels. The goal is for schools to be able to offer varied and comprehensive education on climate change, its consequences and what we can do to combat it, in line with the sustainability principle which lays at the core of all education. Sustainability education, environmental awareness, community spirit and climate issues are all important issues for educators to raise in schools. Climate matters are complex and overlap with many other societal issues. It is important to ensure that

quality education material, which touches on the science behind climate change and the impacts of a changing climate on the environment, communities, democracy, equality and human rights, exists. It is also essential that the education material is appropriate or adjustable for different education levels.

The young generation has already made a difference in climate issues in Iceland and has been active in climate panels and protests. A contract has been signed with the NGO Landvernd on creating educational material on climate change and climate issues for schools, in light of its experience in creating education material on sustainability and environmental issues. The education material is connected to the project Eco-Schools Iceland ("*Skólar á grænni grein*")[92], 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 inFigure 4.3 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)[93].

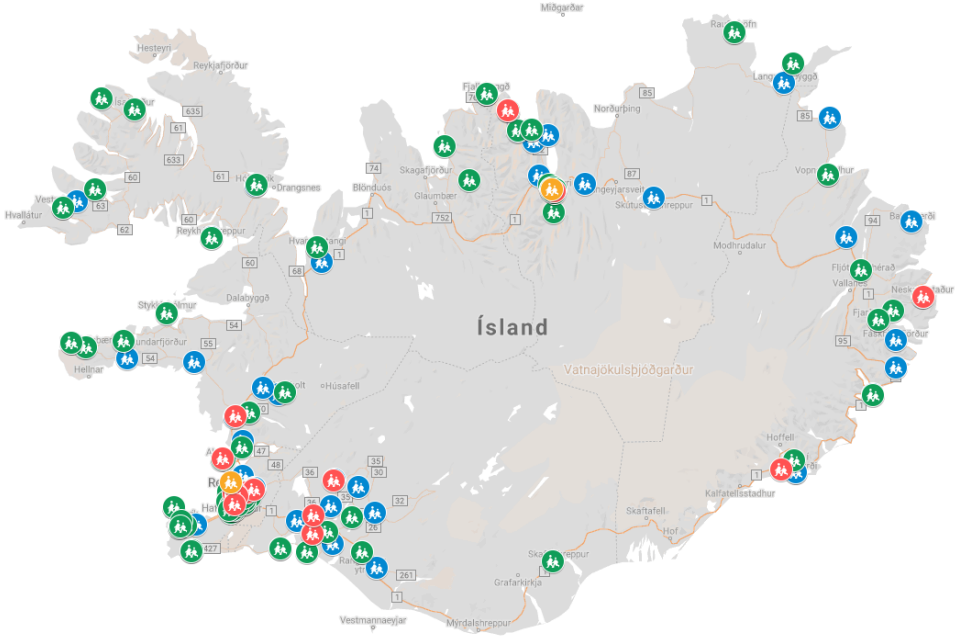


Figure 4.3 Schools participating in the Eco-Schools Iceland project. Green represents preschools.94

In Figure 4.3 the Schools participating in the Eco-Schools Iceland project are listed. Green represents preschools, blue represents primary schools, red represents secondary schools and orange represents universities.

4.10.4 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

[92] *Landvernd – Icelandic Environment Association.* https://landvernd.is/graenfaninn/

[93] *The Foundation for Environmental Education.* https://www.fee.global/

[94] *Landvernd – Icelandic Environment Association.* https://landvernd.is/graenfaninn/um-skola-a-graenni-grein/

important role in raising awareness in the younger generations and collaboration with education authorities is essential. Ways to further support education on climate issues, the impacts of consumerism and waste, will be explored. A mapping of the education material that is currently available to the public in Iceland has been undertaken by the Ministry of Education and Children and will lay the foundations for this.

One of the roles of the Climate Fund, which was established in the autumn of 2019 (see measure 703), is to support education on climate issues and the impacts of climate change. When project grants were being allocated by the *Ministry of the Environment, Energy, and Climate* for the second time in 2021, an emphasis was placed on supporting collaboration projects between NGOs, the public and others regarding strengthening the circular economy and supporting climate issues, in line with the aims of the previous Climate Action Plan (2018).

The government has, furthermore, directly funded several educational projects on climate issues and will continue to do so. This includes the television series "What have we done?" ("*Hvað höfum við gert?*") which was shown on national television (*RÚV*) in 2019[95]. A second season, "What can we do?" ("*Hvað getum við gert?*") was subsequently aired on national television in 2021[96]. 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 4.4. 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[97].

[95] *RÚV.* https://www.ruv.is/sjonvarp/spila/hvad-hofum-vid-gert/27624

[96] *RÚV.* https://www.ruv.is/sjonvarp/spila/hvad-getum-vid-gert/30574

[97] *Vatnajokull National Park (Vatnajökulsþjóðgarður).* https://www.vatnajokulsthjodgardur.is/is/svaedin/horfandi-joklar



Figure 4.4 The outline of Vatnajökull Glacier, c.a. 1890 and 2010.[98].

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.

4.10.5 Climate Action Planning (709)

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

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

[98] *Vatnajokull National Park (Vatnajökulsþjóðgarður).* https://www.vatnajokulsthjodgardur.is/is/svaedin/horfandi-joklar/joklarannsoknir/43-utlinur-jokla-og-yfirbordskort, and The Icelandic Meteorological Office and the University of Iceland's Institute of Earth Sciences.

climate focused planning, for planning to support the achievement of carbon neutrality, and to strengthen resilience against climate change through various adaptation measures. In climate focused planning, climate goals are prioritised when settlements and land-use changes are being planned. In this way, planning can be used to support improved commuting behaviour, climate friendly construction, and the preservation and sequestration of carbon in soils and flora, for example[99].

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

4.10.6 Issuing of Green Bonds (711)

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

The Icelandic Treasury has hitherto not issued green bonds, but a project management group set up by the *Minister of Finance and Economic Affairs* is now assessing what possibilities are available. The group was set up in June 2020 and consists of representatives from the *Ministry of Finance and Economic Affairs*, the *Ministry for Foreign Affairs*, the *Ministry of the Environment, Energy, and Climate*, the Prime Minister's Office, and the Central Bank of Iceland. The group will, furthermore, participate in work on an independent ESG (environmental, social, governance) investment certification for the Icelandic Treasury, if that is the course that is decided to be taken. This is an international certification that focuses on emphasising 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[100] to fund projects that align with its climate policy[101].

4.10.7 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

[99] *National Planning Authority (Skipulagsstofnun).* https://www.landsskipulag.is/um-landsskipulagsstefnu/frettir/landsskipulagstillaga-afhent-umhverfis-og-audlindaradherra

[100] *City of Reykjavík (Reykjavíkurborg).* https://reykjavik.is/graen-skuldabref-green-bonds

[101] *City of Reykjavík (Reykjavíkurborg).* https://reykjavik.is/sites/default/files/reykjavik_green_bond_framework_2019_-_baeklingur.pdf

significant direct and indirect effects on the market and help pave the way for other businesses or organisations to do the same thing.

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

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

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

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

4.10.8 Climate Strategy of Other Public Agencies (713)

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

Government organisations and government majority owned companies have the possibility to sign up for the project "Green steps in government operations" ("*Græn skref í ríkisrekstri*")[102] and a similar project is currently being developed for municipalities[103]. Participants in the project publish "Green accounting" ("*Grænt bókhald*") which will be updated and expanded to include GHG emissions with a focus on internal operations. Public entities, including municipalities, return GHG emission information to the EAI and use

[102] *Grænskref*. https://graenskref.is/

[103] *Environice*. https://www.environice.is/thjonusta/verkfaerakista-sveitarfelaga/

emission factors which are published by the Agency. Reporting GHG emission information is mandatory for traditional office operations, according to a specification in the Climate Act, but reporting of specific operations, such as construction/maintenance, is optional. Municipalities have already established a collaboration platform on climate issues and the UN Sustainable Development Goals to support and strengthen the solidarity and conversation between municipalities on these issues[104]. As of March 2022, 159 out of 199 government organisations and government majority owned companies are participating in the initiative, and 88 have published their green accounting.

4.10.9 Climate Impact Assessment of Legislation (714)

The climate impact of legislative bills will be estimated, in addition to the impacts on the economy, financial impacts on municipalities, impacts on NGO's, organisations and different population segments, as well as gender equality. Law nr. 123/2015 on public finances has been updated in order for it to be mandatory for Ministries to assess the climate impacts of any bill they wish to propose to Parliament[105]. By implementing the obligation to assess the climate impact of legislative bills, the legislator highlights the importance of gaining control of climate change.

4.11 Planning

Environmental assessment of public plans or programs is based on the Environmental Impact and Strategic Assessment Act No. 111/2021. The objective of the Act is to promote sustainable development, healthy environment and environmental protection by environmental assessments of public plans and programs that are likely to have a significant environmental impact. Environmental assessment for individual projects in Iceland is based on the same act. The objectives of the law are e.g. to ensure that an assessment of the environmental impact of a relevant project has been carried out before a consent is granted and to minimize as far as possible the negative environmental impacts of projects. Public consultation is a key feature of the legislation.

The National Planning Strategy is based on provision in the Planning Act No. 123/2010. The National Planning Strategy propose a policy on planning which is intended to ensure common interests in local authority plans and to support sustainable development and efficient planning. It should also support the coordination of policy making on land use on both state and local authority levels. The National Planning Strategy is a policy document, a parliamentary resolution for a 12-year period which is implemented primarily through local authority plans (regional plans, municipal plans and detail plans). It can also influence government programmes in specific issues concerning land use. Additionally, it can entail planned projects, such as guidelines or development projects to implement certain policy objectives.

The first National Planning Strategy was approved by the Parliament in 2016 (NPS 2015-2026), prepared by the National Planning Agency on behalf of Minister for the Environment and Natural Resources. NPS 2015-2026 propose a policy on planning in the central highlands, rural areas, urban areas and marine spatial

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

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

planning. In addition, a general policy concerning sustainability, resilience, quality of life and competitiveness issues in planning.

The current policy (NPS 2015-2026) addresses climate change in planning, a mitigation as well as an adaptation. It sets out a vision for local authority plans, in order to contribute reductions in greenhouse gas emissions. Local authorities are encouraged to improve the quality of urban environment, with emphasis on higher density of urban areas and integrated development and transport planning. Local authorities should also take account of climate change over the longer term, including factors such as coastal change, flood risk and avalanche. [106]

4.12 Policies and measures in accordance with Article 2 of the Kyoto protocol

(Minimisation of adverse impacts in accordance with Article 2.3 and 3.14 of the Kyoto Protocol)

4.12.1 Bunker fuels

The EU Emissions Trading Scheme (EU-ETS) was transposed into Icelandic law in 2011 (Act No. 64/2011). The transposition included directive 2008/101/EC by which aviation became included in the trading scheme. Act No. 64/2011 was repealed by Act No. 70/2012 on Climate Change. Iceland's participation in the EU-ETS started on 1 January 2012 when aviation became part of the emission trading system.

The initial scope of the trading system with respect to aviation covered all flights departing from or arriving in an aerodrome in the European Economic Area. With a temporary derogation from the directive, enforcement of the trading system has been limited to flights within the European Economic Area. Fights within Iceland and flights between Iceland and destinations in the European Economic Area fall under Act No. 70/2012, which requires airline operators to remit allowances to competent authorities to cover their greenhouse gas emissions.

Aviation in the EU ETS is in revision, since the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) takes place from 2021. The revision is to implement CORSIA by the EU in a way that it will be consistent with the EU's 2030 climate objectives. Initially, CORSIA is based on voluntary participation; Iceland is taking part in the system from the beginning and participated in the baseline period from 2019-2020 with all other European Civil Aviation Conference (ECAC)[107] states.

4.12.2 Minimization of adverse effects

Adverse effects of climate change can be reduced by limiting global warming through reductions in greenhouse gas emissions. Iceland's efforts to reduce emissions and increase carbon sequestration can therefore be expected to contribute to limiting adverse effects in other countries.

[106] NPS 2015-2026

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

Iceland has focused on supporting developing countries with projects that aim at strengthening infrastructure in order to increase resilience to climate change. Information on minimization of adverse impacts in accordance with article 3, paragraph 14 of the Kyoto Protocol can be seen in Table 4.13.

Table 25 Information on Minimization of Adverse Impacts in Accordance with Article 3, Paragraph 14 of the Kyoto Protocol

Actions	Implementation
Progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse gas emitting sectors, taking into account the need for energy price reforms to reflect market prices and externalities	Planning of economic instruments in Iceland, inter alia for limiting emissions in the greenhouse gas emitting sectors is subject to different methodologies. These involve feasibility and efficiency and consideration of national and international circumstances.
Removing subsidies associated with the use of environmentally unsound and unsafe technologies	Subsidies associated with the use of environmentally unsound and unsafe technologies have not been identified in Iceland.
Cooperating in the technological development of non-energy uses of fossil fuels, and supporting developing country Parties to this end	Iceland does not have support activities in this field.
Cooperating in the development, diffusion, and transfer of less-greenhouse-gas-emitting advanced fossil-fuel technologies, and/or technologies, relating to fossil fuels, that capture and store greenhouse gases, and encouraging their wider use; and facilitating the participation of the least developed countries and other non-Annex I Parties in this effort	• Iceland is the home of the Carbfix project[108], a multinational project located at the Hellisheiði geothermal plant where CO_2 captured in geothermal steam is injected back into the basaltic rock underground. The project is demonstrates the feasibility of sequestering carbon dioxide into basaltic bedrock and store it there permanently as a mineral. The project's implications for the fight against global warming may be considerable, since basaltic bedrock susceptive of CO_2 injections are widely found on the planet and CO_2 capture-and-storage and mineralization in basaltic rock is not only confined to geothermal emissions or areas. Furthermore, a direct air capture plant has been set up, where the CO_2 captured from the air is injected into the bedrock together with the CO_2 captured from the geothermal wells. With funding from the European Union, the aim is to demonstrate how the CarbFix method can be used worldwide. • The Government of Iceland has supported developing countries in the area of sustainable utilization of natural resources through its administration of the United Nations University Geothermal Training Program – now under the auspices of UNESCO (see chapter 7). The Geothermal Training Program, which started thirty-five years ago, has built up expertise in the utilization of geothermal energy by training 554 experts from 53 countries. The program provides their graduating fellows with the opportunity to enter MSc and PhD programmes with Icelandic universities. Iceland will continue its support for geothermal projects in developing countries with geothermal resources, which can be utilized to decrease their dependency on fossil fuels for economic development. • Furthermore, the government of Iceland has financially contributed to various climate-specific projects within the Geothermal Exploration Project East Africa, the Energy Sector Management Assistance Program (ESMAP), Sustainable Energy for All (SEforALL), Ukraine geothermal project, Nicaragua geothermal project, as well as the International Renewable Energy Agency (IRENA). More information can be found in Iceland's fourth Biennial Report submitted to the UNFCCC, in particular Tables 6-3 and 6-4.

[108] www.carbfix.com

Actions	Implementation
Strengthening the capacity of developing country Parties identified in Article 4, paragraphs 8 and 9, of the Convention for improving efficiency in upstream and downstream activities relating to fossil fuels, taking into consideration the need to improve the environmental efficiency of these activities	See above
Assisting developing country Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies	Iceland does not have support activities in this field.

5. Projections

5.1 Total GHGs by sector

Iceland's total historical and projected emissions of GHGs *excluding* LULUCF are presented in Figure 5.1 below, for the WEM scenario. The total emissions are expected to have reached their peak in 2018 and to follow a downward trend until 2040. Iceland's GHG emissions will be 1% lower in 2040 than they were in 1990, but they will be 24% lower than they were in 2015.

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

Iceland's total historical and projected emissions of GHGs *including* LULUCF emissions are presented in Figure 5.2. The total emissions incl. LULUCF are expected to have decreased by 8% in 2030 and 9% in 2040 compared to emissions in 1990. Carbon sequestration due to forest land has increased 17-fold in 2020 compared to 1990 levels and is expected to change from -510 kt CO_2 p.a. in 2020 to -794 kt CO_2 p.a. in 2040.

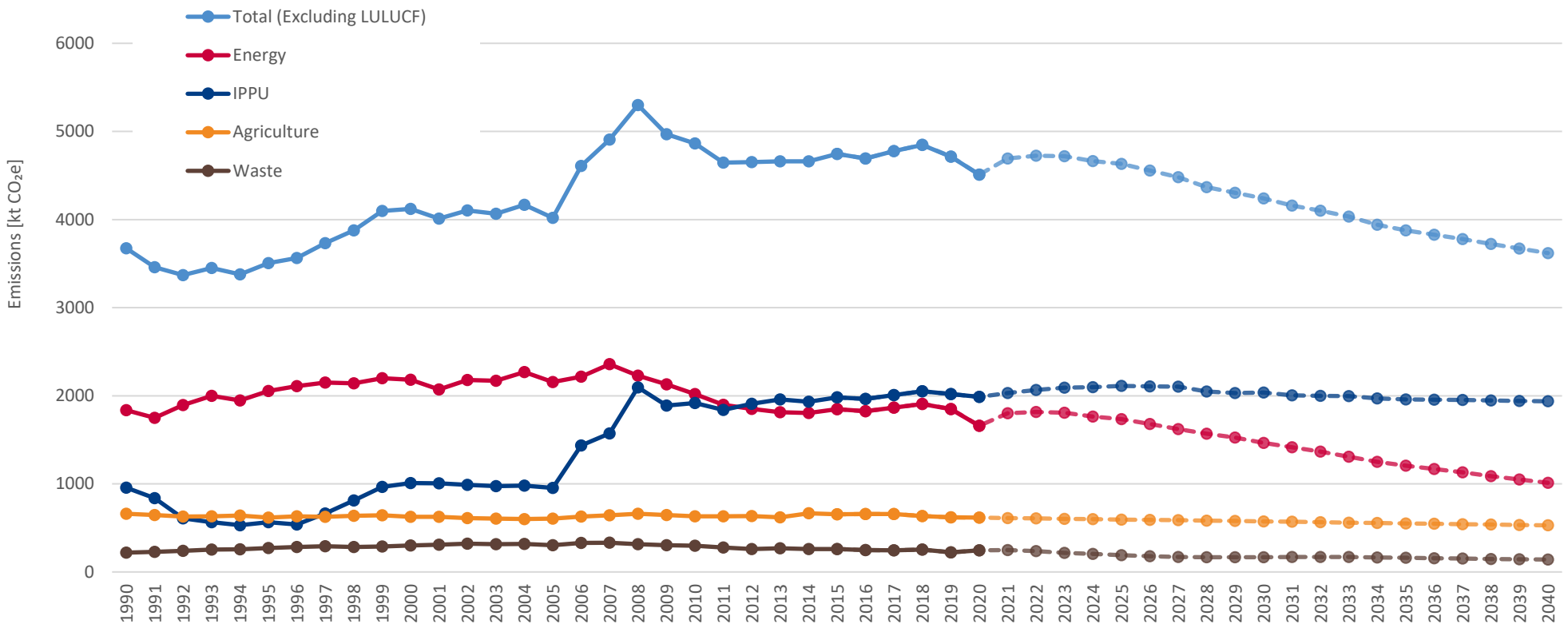


Figure 5.1 Total historical and projected GHG emissions (excluding LULUCF) in the WEM scenario 1990-2040, [kt CO_2e].

Table 26 Total historical and projected GHG emissions (excluding LULUCF) in the WEM scenario 1990-2040, [kt CO2e].

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

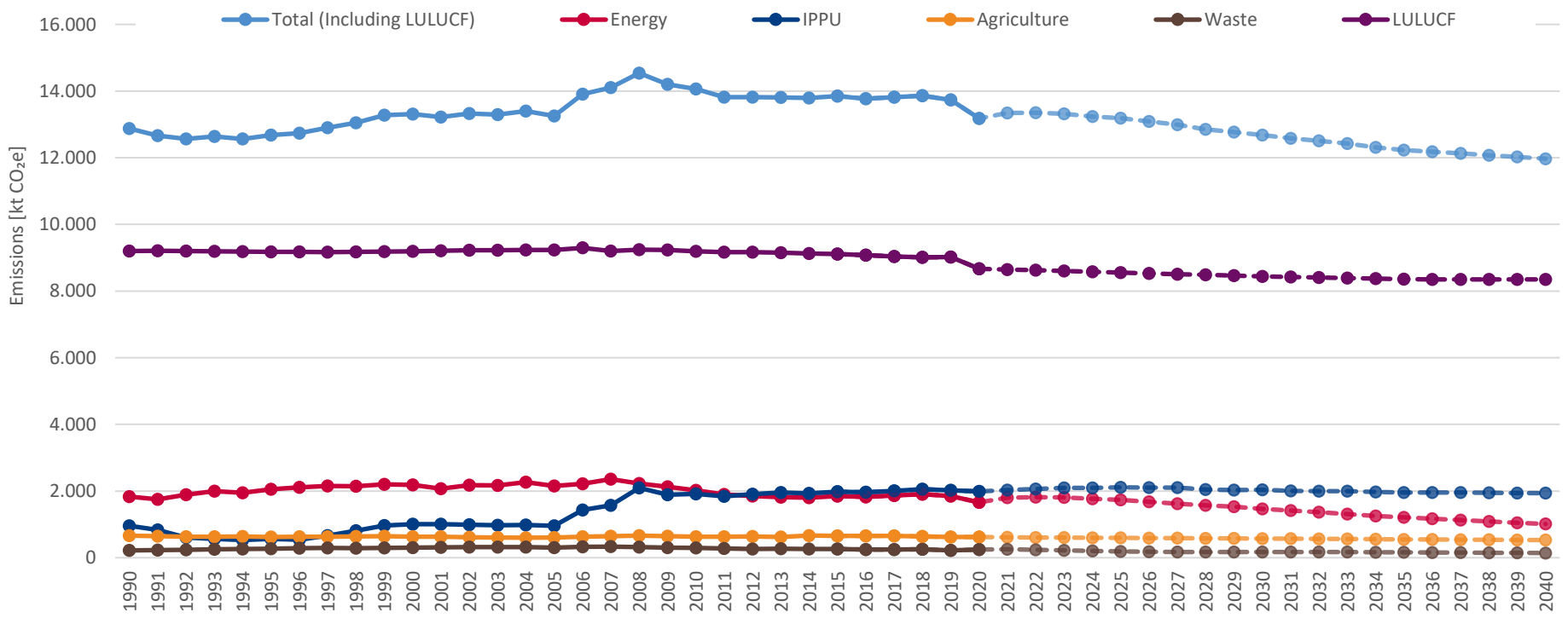


Figure 5.2 Total historical and projected GHG emissions (including LULUCF) in the WEM scenario 1990-2040, [kt CO2e].

Table 27 Total historical and projected GHG emissions (including LULUCF) in the WEM scenario 1990-2040, [kt CO2e].

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

5.1.1 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 5.3 below for the WEM scenario. In Iceland, all emissions currently generated from the Production of Iron and Steel (Iron alloys and silicon metal – 1A2a) and Non-Ferrous Metals (Aluminum - 1A2b) and industrial emissions from the Metal Industry (2C) are covered under the EU ETS.

As can be seen in Figure 5.3, emissions from ETS industry have remained reasonably steady from 2015. Based on the current projections, ETS emissions increase by almost a quarter between 2005 and 2040 (see Table 28). ESR emissions are, however, expected to decrease between 2005 and 2040.

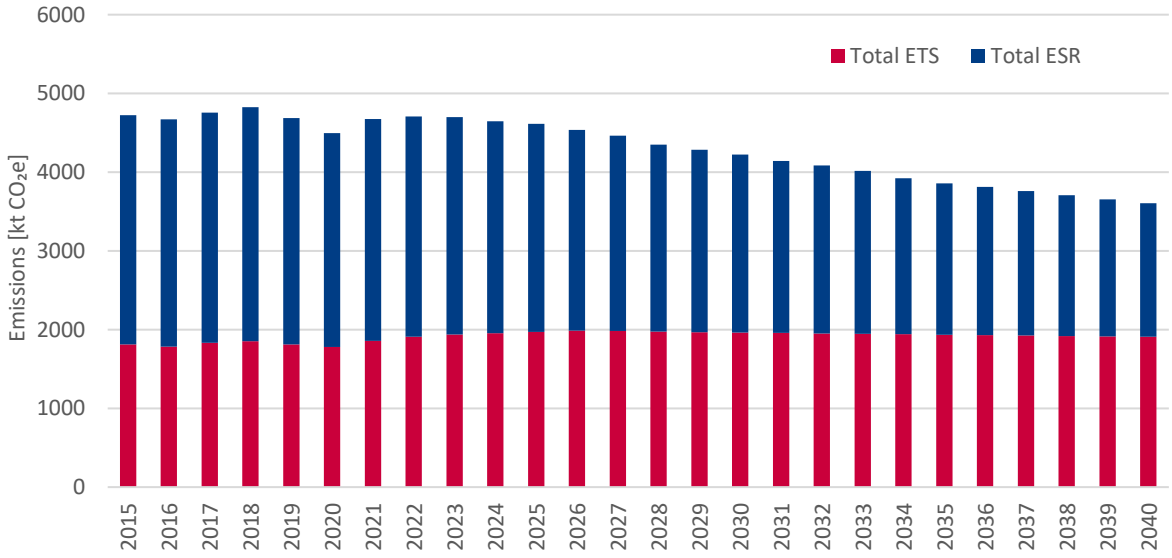


Figure 5.3 ETS and ESR GHG projections, WEM scenario, [kt CO2e].

Table 28 ETS and ESR GHG projections, WEM scenario, [kt CO_2e].

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

The projected ESR emissions for the year 2030 amount to approximately 2,261 kt CO_2e, which corresponds to 28% lower emissions than in 2005. Iceland's commitment for the year 2030 is -29% under the ESR. At the time of writing, work is in progress to determine a new target in line with the updates of the EU's "Fit for 55" legislation package. In accordance with the ESR framework, it is expected that the new Effort Sharing target for Iceland will be set at 40-43% reduction.

ESR emission projections per sector can be seen in Figure 5.4. Most of the emission reduction until 2040 occurs in the Energy sector, and a proportionally high emission reduction can also be observed in the IPPU sector (the reduction is predominantly derived from reduced F-gas imports). Lower emission reductions occur in Agriculture and Waste.

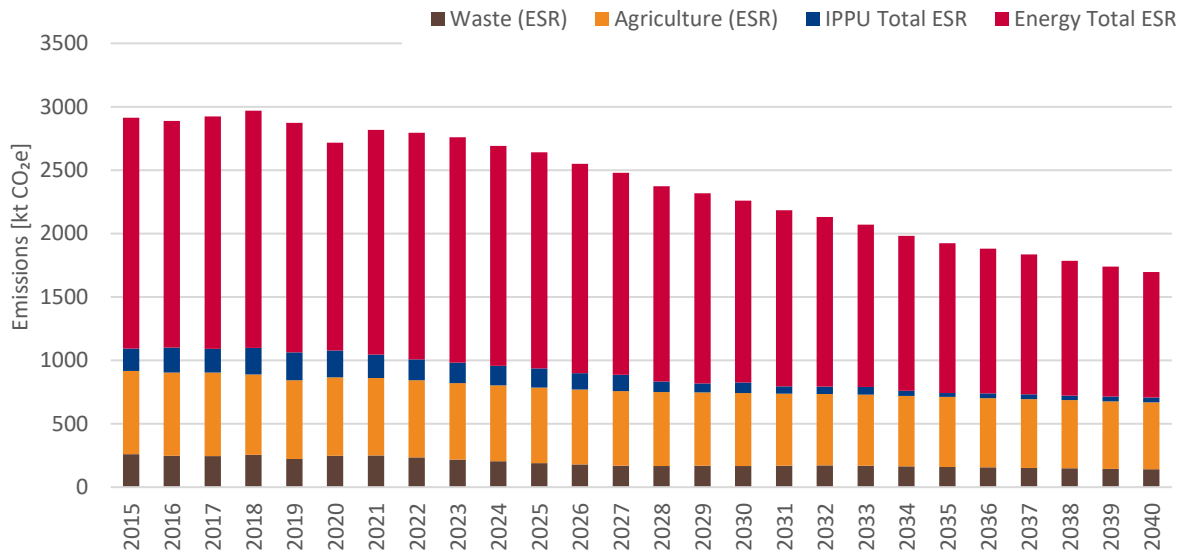


Figure 5.4 ESR emission projections split by sector, WEM scenario, [kt CO2e].

5.2 Total GHGs by gases

Iceland's total historical and projected emissions of GHGs excluding LULUCF by gases are presented in Figure 5.5. for the WEM scenario. The main greenhouse gas is (CO^2) following by methane (CH_4). Iceland's total historical and projected emissions of GHGs including LULUCF emissions by gases are presented in Figure 5.6. The main greenhouse gas is (CO2) following by methane (CH_4).

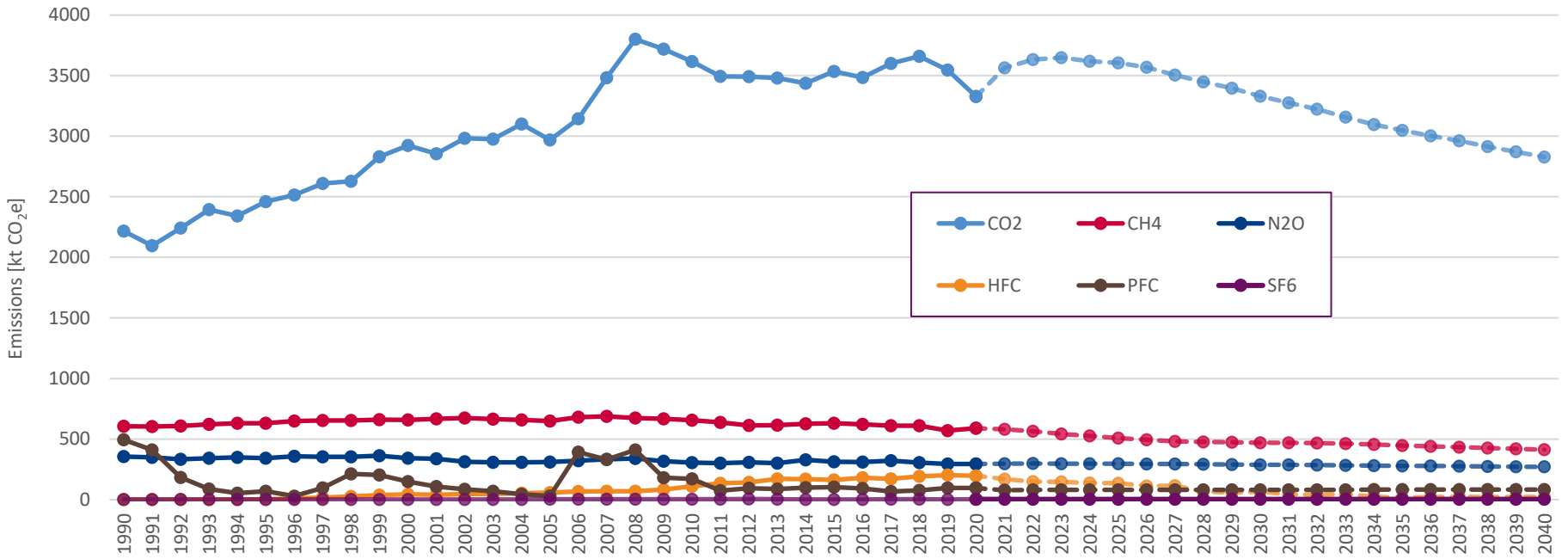


Figure 5.5 Total historical and projected GHG emissions (excluding LULUCF) in the WEM scenario 1990-2040, [kt CO_2e].

Table 29 Total historical and projected GHG emissions (excluding LULUCF) in the WEM scenario 1990-2040, [kt CO2e].

	Emissions [kt CO_2e]						
Greenhouse gas	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
CO_2	2216	3534	3329	3605	3330	3048	2828
CH_4	606	631	590	509	470	447	412
N_2O	356	312	295	296	289	279	271
HFC	0.3	163	198	136	68	16	23
PFC	495	104	96	82	82	82	82
SF_6	1.1	1.6	3.2	2.7	2.7	2.7	2.7
Total excluding LULUCF	3,674	4,746	4,511	4,630	4,241	3,876	3,620

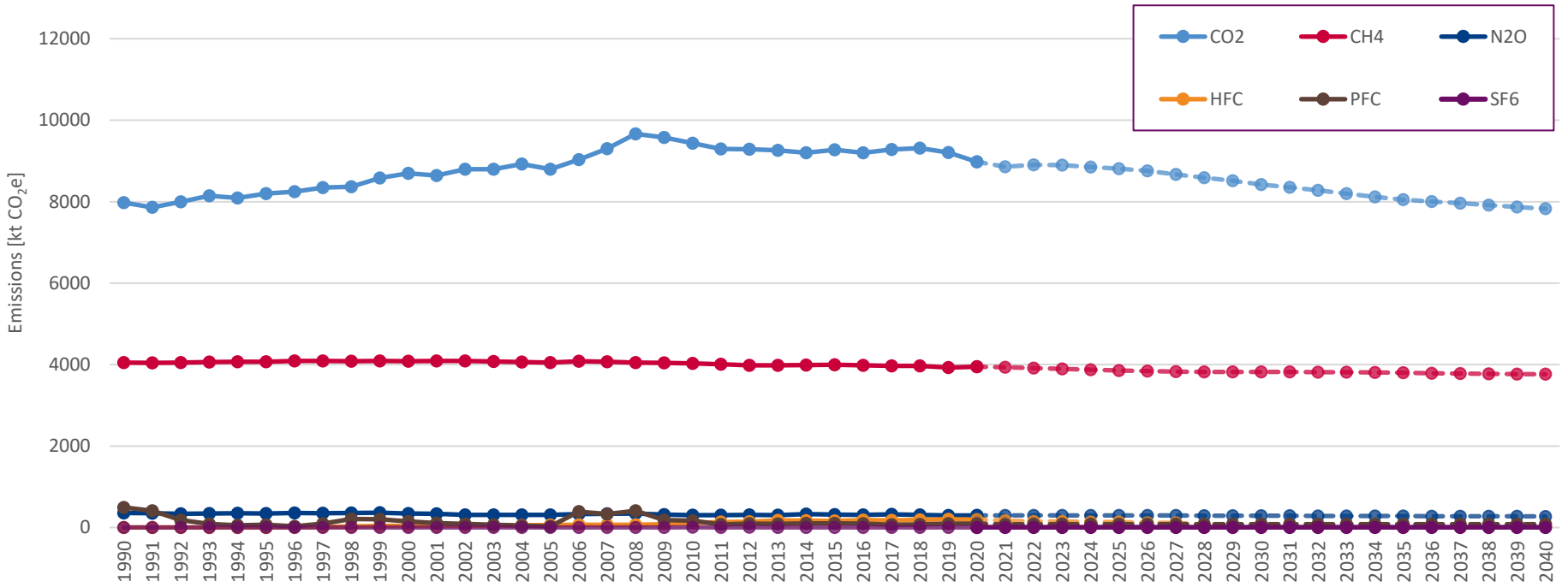


Figure 5.6 Total historical and projected GHG emissions (including LULUCF) in the WEM scenario 1990-2040, [kt CO_2e].

Table 30 Total historical and projected GHG emissions (including LULUCF) in the WEM scenario 1990-2040, [kt CO2e].

	Emissions [kt CO_2e]						
Greenhouse gas	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
CO_2	7975	9275	8980	8812	8422	8051	7826
CH_4	4046	3996	3947	3855	3818	3797	3764
N_2O	356	313	296	297	290	280	272
HFC	0.3	163	198	136	68	16	23
PFC	495	104	96	82	82	82	82
SF_6	1.1	1.6	3.2	2.7	2.7	2.7	2.7
Total including LULUCF	12,873	13,853	13,182	13,184	12,682	12,230	11,970

5.3 Methodology Overview

The methodologies used to calculate GHG projections are consistent with Iceland's 2022 NIR and the most recent report on Policies and Measure and Projections which was submitted to the EU in 2022109. For information on the sectoral methods see the NIR (2022). Where methodologies are not described within the sectoral chapters the method from the NIR has been followed.

Since the submission of the 7th National Communication in 2018 (NC7 there have been extensive changes in the reporting of projections by Iceland. In the NC7 the arrangement for projections of greenhouse gases in Iceland had not been properly in place and no authority had the formal responsibility for greenhouse gas projection. In 2017, the Economic Institute of the University of Iceland (HHÍ), published a study of Iceland´s mitigation potential and options in the report Iceland and climate issues (Ísland og loftslagsmál), which was used as the basis for projections in the NC7. Although the projections were not fully in compliance with the UNFCCC projection guidelines, it was thought to give a broad picture of the status of the emission profile and what to expect until 2030.

In 2018 the Environment Agency of Iceland, which is responsible for the NIR, was given role of submitting a report on Policies, Measure and Projections to the EU in accordance with EU Regulation 525/2013 which has been implemented in Iceland. The first submission was in 2019 and will be submitted at least every other year. These projections are in accordance with UNFCCC requirements and based on the same methodology and assumptions as the historical greenhouse gas inventory.

Only WEM (with existing measures) projections are reported in these National Communications, as was done in Iceland's submission on policies, measures and projections to the EU. Work is in progress to produce WAM (with additional measures) projections for the next report to the EU, due in March 2023; These will be included in Iceland's first biennial transparency report. Currently there are no plans to produce WOM (without measures) projections, due to lack of reliable information on how emissions would evolve if no measures were set in place.

5.4 Energy (excluding Transport)

The Energy Sector (1) contains all emissions from fuel combustion, energy production, and distribution of fuels. Historically, transport has contributed to approximately one fifth of Iceland's GHG emissions (excl. LULUCF) and is therefore reported in a separate chapter. An overview of the historical and projected total emissions for the Energy sector within Iceland is given within Table 5.6.

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

[109] https://ust.is/library/Skrar/loft/NIR/PaMsProjections_Report%202022_published.pdf

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

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

The projections for the Energy sector are based on fuel projections until 2060 which were published by the National Energy Authority (NEA) 2021[110], except for geothermal projections which are based on unpublished projections by the NEA from 2021.

The historical and projected trend for the Energy Sector (excl. Transport) can be seen in

Figure 5.7. Overall, emissions from the Energy Sector (excl. Transport) have declined by 31% between 1990 and 2020. Emissions are projected to decrease by 44% in 2040 compared to 1990.

Within the Energy sector (excl. Transport) the largest sources are Manufacturing Industries and Construction (1A2), Fishing (1A4c) and Geothermal Energy Production (1B2d), see Table 5.6.

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

Emissions from Manufacturing Industries and Construction (1A2) have also been decreasing over the historical time series but are projected to remain relatively constant until 2040. Emissions from Geothermal Energy (Fugitive Emissions 1B) have historically been increasing but are projected to decrease up until 2030 due to increased injections of CO_2 into basaltic rock[111]. Other sectors are also projected to remain relatively steady.

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

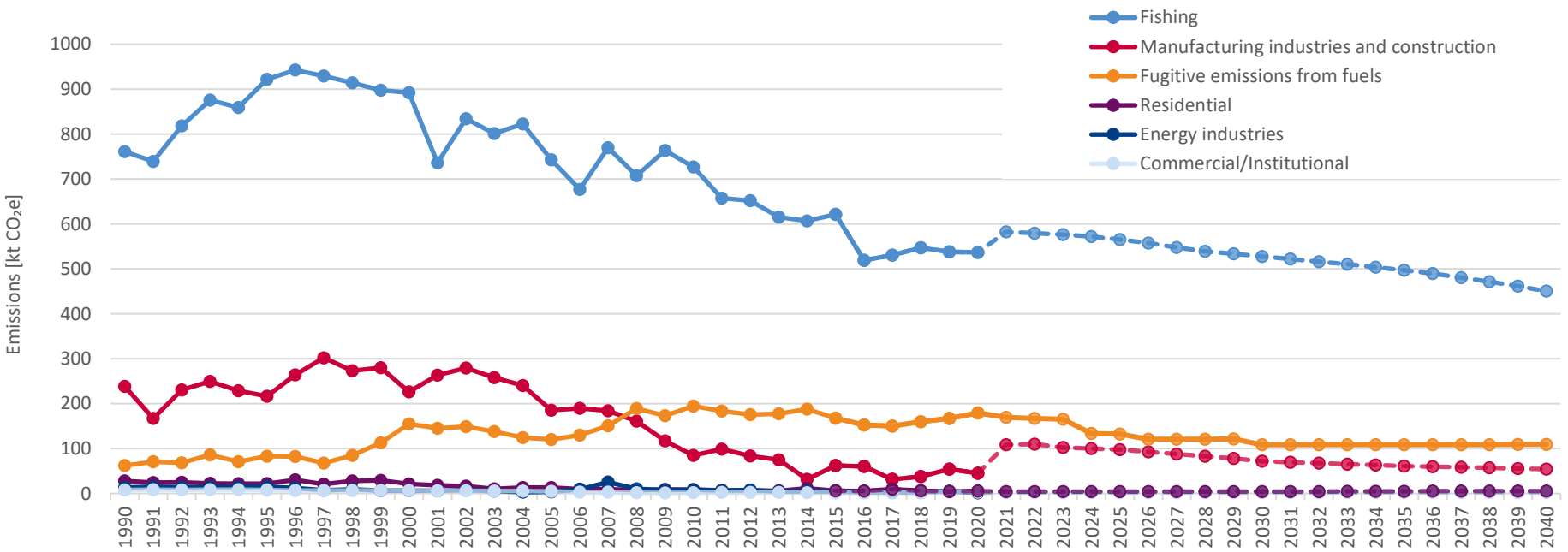


Figure 5.7 Energy (excluding Transport) Emissions of Total GHGs, WEM scenario, [kt CO_2e].

Table 31 Historical and projected emissions in the Energy sector, [kt CO_2e].

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

5.4.1 ESR vs EU ETS emissions in Energy

In Iceland, all emissions from the production of Iron and Steel and Non-Ferrous Metal (Iron alloys and silicon - 1A2a and aluminum - 1A2b) are accounted for under the EU ETS, including emissions from fuel combustion for energy. Overall, this contributes to less than 1% of the total emissions from Energy (excl. Transport). The split between ESR and ETS emissions is projected to remain reasonably constant over the time series (see Figure 5.8).

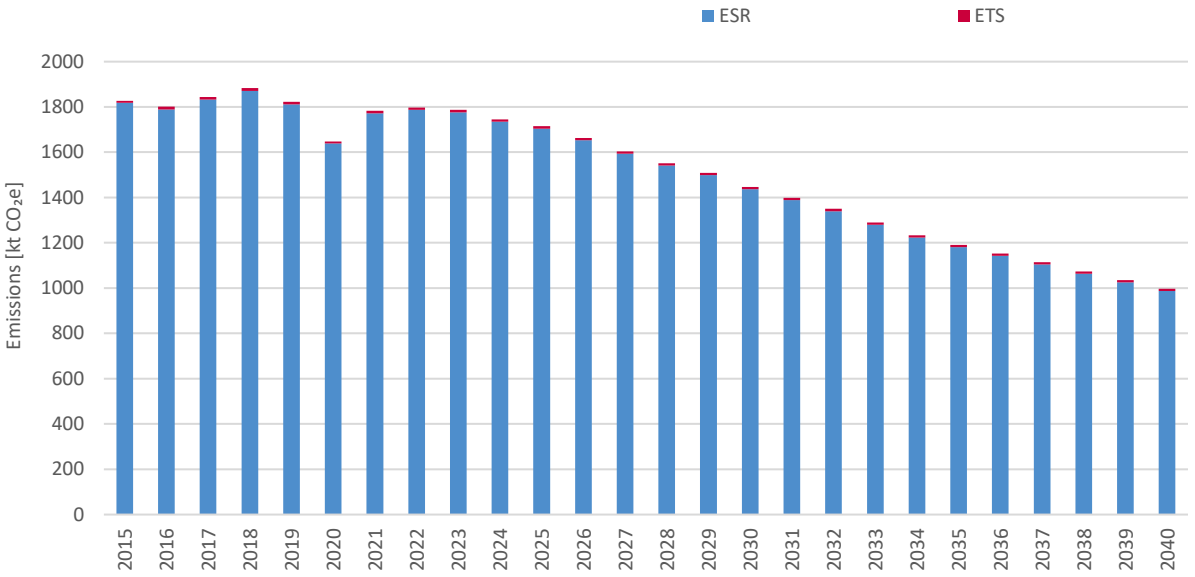


Figure 5.8 ETS and ESR GHG projections in the Energy Sector (excl. Transport), WEM scenario, [kt CO2e].

5.4.2 Methodology of projections

The methodology used to generate projections for the Energy Sector (excluding Transport) are based on the historical inventory, see NIR (2022) and fuel projections from the Fuel Projection Working Group (2021)[112]

An overview of the data and assumptions used as a basis for the energy projections is presented in Table 5.7. A further description is provided below.

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

Table 32 Activity data basis for energy projections

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

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

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 five PaMs (102, 103, 104, 105, & 701) in the energy sector (see details about each PaM in chapter 4 of this report) is represented in the WEM scenario produced by the Fuel Projection Working Group and the Energy Projection Working Group. These results are represented as the WEM scenario for the Energy sector in this report.

Each PaM is integrated into the projections as follows:

- PaM **102**, Electrical infrastructure in ports, is quantified individually. Therefore, a BAU scenario has been estimated to represent the development of emissions excluding the effects of PaM **102**. The quantification of the BAU scenario is based on recent development of vessel port visits and the difference in time spent at bay between ship types.
- PaM **103**, Electrification of fishmeal production, is quantified individually. Therefore, a BAU scenario has been estimated to represent the development of emissions excluding the effects of PaM **103**. The quantification of the BAU scenario is based on the recent developments in the fishmeal industry, i.e., developments in fuel utilisation change in the years 2010-2020.
- 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.
- PaM **701**, Carbon tax, is accounted for in the WEM scenario of the Fuel Projection Working Group.

5.4.3 Quantification of measures

Two measures within the energy sector are quantified, Electrical Infrastructure in Ports (102) and Electrification of Fishmeal Plants (103). The quantification is described in this chapter whereas the description of the measures is in the chapter about Policies and Measures.

Electrical Infrastructure in Ports (102) - Quantification

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

The number of ships by ship type and tons of CO_2 emissions per ship type in 2015 were obtained from a report on energy change by Landsnet (2016).[113] In the BAU scenario, the number of ships were projected using Organisation for Economic Co-operation and Development (OECD) GDP as a proxy, whilst emissions per ship during time at harbour were kept constant. In the WEM scenario, the number of ships were projected using the same GDP proxy, but the emissions at harbour were reduced linearly, for general ship operations, from the start of the policy to 2025. This reflects the goal of the PaM to meet electricity demands of all general ship operations in harbours by 2025. Moreover, general ships are defined as all ships except cruise ships and cargo ships, as there are no high-voltage (>1,000V) connections in Icelandic harbours. However, PaM **102** is expected to have a significant effect on higher utilisation rates of existing infrastructure, i.e., 400V connections, which are present. Therefore, cruise ships and cargo ships are expected, in both the WEM scenario and the BAU scenario, to utilise oil in harbours, while all other ships are expected to phase out fuel use in harbours linearly, ending at full electricity utilisation in 2025, see Figure 5.9.

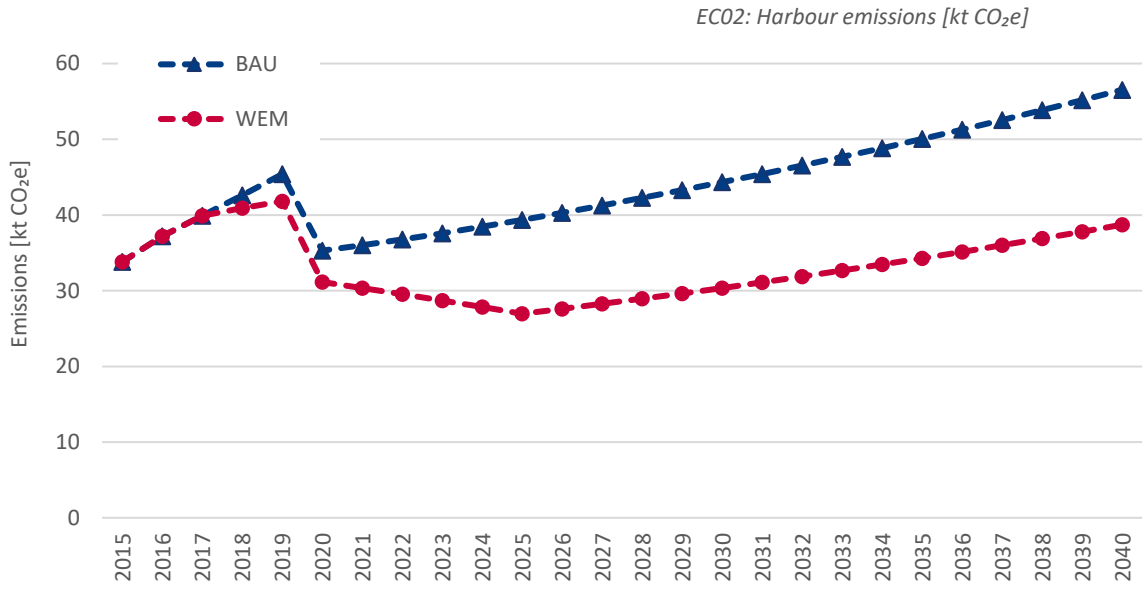


Figure 5.9 Quantified ex-ante emission impact of PaM 102: electrical infrastructure in ports [kt CO2e].

[113] Landsnet: Möguleg Orkuskipti (Possible Energy Change): https://rafhladan.is/bitstream/handle/10802/16831/M%c3%b6guleg%20orkuskipti%20%c3%a1%20%c3%8dslandi%20-%20samantekt%20%c3%a1%20afl%c3%be%c3%b6rf%20og%20sparna%c3%b0i%20%c3%ad%20losun%20CO2%20%28002%29.pdf?sequence=1

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

The allocation of vessel types to IPCC sectors is in Table 5.8 below.

Table 33 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 Plants (103) - Quantification

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

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

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

A "without measures" (WOM) scenario has been created to contrast all measures, actions, and plans associated with the electrification of fishmeal factories. This scenario is based upon the main assumption that without all measures, both governmental and non-governmental, regarding electrification of fishmeal factories, no electricity would have been utilised throughout the timeline. To estimate the amount of fuel

used in this scenario, information and data were gathered from the AFF regarding the number of fish received for processing every year since 2010. Furthermore, the AFF provided data on the amount of electricity and oil utilised to process the fish. Subsequently, the energy used to process one unit of fish was calculated for both oil and electricity. Energy intensity was assumed to be commensurable between plants utilising electricity and those utilising oil. This assumption could be improved, however, only a few plants have run their operations purely on electricity for an entire year, and therefore, energy losses due to different energy carriers and technologies could not be analysed for this assessment. The average energy intensity over a 16-year period was 526 kWh/t of processed fish, with a standard deviation of 31 kWh/t. Subsequently, the amount of fish were assumed to be processed with fossil fuels only, while the energy intensity of 526 kWh/t was used as a proxy for estimating the potential fuel use in the WOM scenario.

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

Unusual weather conditions during the winter of 2021-2022 led to unfavourable water conditions for the hydropower plants, with unusually low levels in the water reservoirs leading to less electricity production. This created a shortage of electricity and the consequence was that the National Power Company (Landsvirkjun) announced that operations utilising interruptible electricity, including fishmeal factories, would cease to receive electricity for an undecided period of time.

The prospect of this actuality seems to have influenced the WEM scenario, as the increase in emissions in 2022 does not reflect the emission levels of previous five years. However, the amount of fish processing aligns relatively well with those years. Therefore, the increase of emissions in 2022 in the WEM scenario does adequately reflect this situation, where interruptible electricity was not sold to buyers in the first half of 2022. Moreover, the slow levelling-off of emissions in the WEM scenario between 2023 and 2030 reflects the possibility of some interruption in electricity supply during the timeline, and/or slow infrastructure development in the realm of power lines where they are needed.

The results of the WOM and WEM scenarios show that with all current existing measures (WEM scenario) total CO_2e savings amounted to 13 to 77 kt CO_2e p.a. throughout the timeline 2010 to 2040, when compared to the WOM scenario (See Figure 5.10). Furthermore, cumulative abatement during the Paris Agreement period (2021-2030) amounts to approximately 600 kt CO_2e.

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

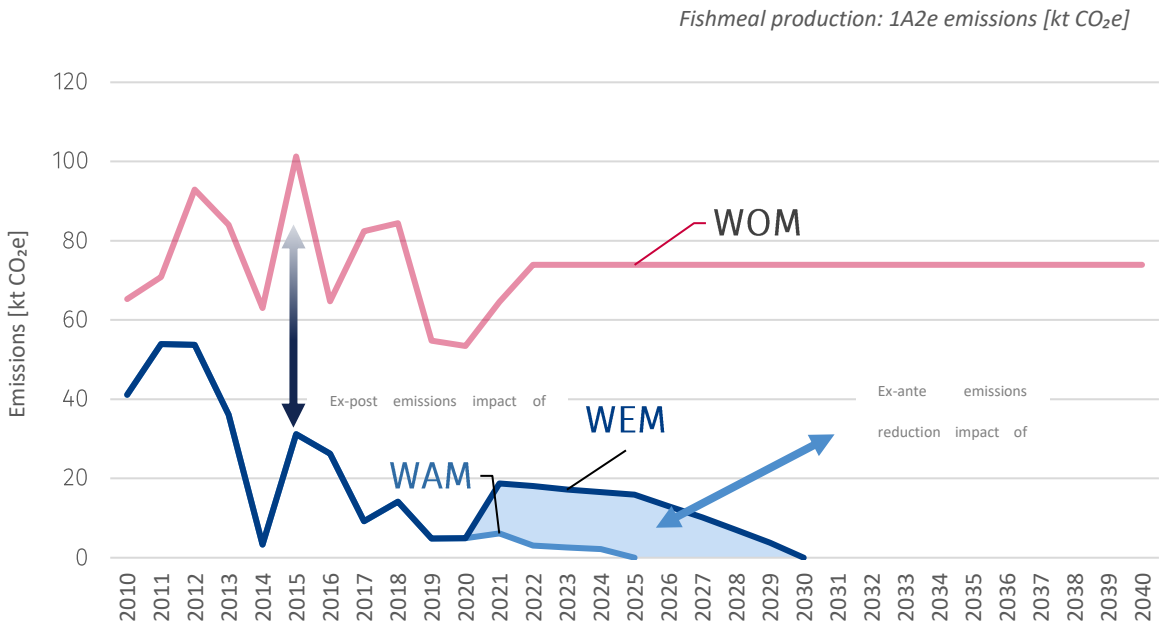


Figure 5.10 Quantified ex-ante and ex-post emissions impact of a group of measures.

Figure 5.10 shows the quantified ex-ante and ex-post emissions impact of a group of measures, including measure 103: the electrification of fishmeal factories [kt CO2e]. Results of the WEM scenario from 2021 onwards are acquired from the Working Group on Fuel Projections, the WOM scenario from different parameters and assumptions discussed in the chapter and the WAM scenario as the best technologically viable option.

5.5 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 Waste section include increased methane recovery, which in Iceland is primarily utilised as a vehicle fuel. Increased use of methane as vehicle fuel is reported in road transport projections.

The projections for the Energy sector are based on fuel projections until 2060 which were published by the National Energy Authority (NEA) 2021[114].

Figure 5.11 presents an overview of the historical and projected emissions from Transport. The trend in Transport emissions is dominated by the increase in road transport emission between 1990 and 2007. This is followed by a decrease in road transport emissions because of the financial crisis in 2008. After 2014 there is a significant increase in emissions from road transport, mainly due to increased tourism. The effect of increased tourism can also be seen in the emissions from international aviation.

Emissions projections from international bunkers (aviation and navigation), in comparison with emissions from other transport subsectors, can also be seen in Figure 5.11. As stated before, emissions from international bunkers are not included in the national total.

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

A slight decline in fuel use in domestic navigation and domestic aviation has been projected between 2020 and 2040. However, the projections presented in Figure 5.11 consider additional reductions in fuel use in domestic navigation due to one policy in the WEM scenario:

- The electrification for ferries (PaM 208)

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

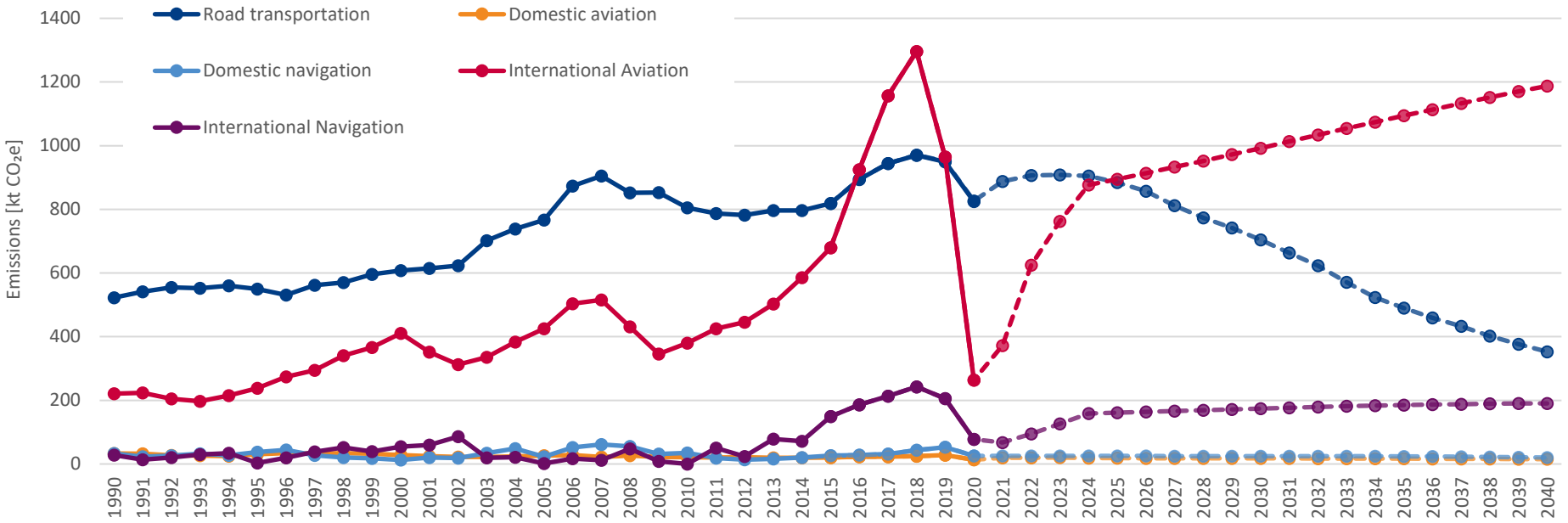


Figure 5.11 Transport Emissions (including international bunkers), Total GHGs, WEM scenario, [kt CO2e].

Table 34 Transport Emissions (including international bunkers), Total GHGs, WEM scenario, [kt CO2e].

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

5.5.1 Methodology of Projections

The methodology used to calculate projected emissions from transport are based on fuel projections from the Fuel Projection Working Group (2021). In addition to the Fuel Projection, data from sibyl baseline[115] was purchased to run COPERT 5.5.1 (same methodology as historical emission calculations, see 2022 NIR).[116]

An overview of the data and assumptions used as a basis for the transport projections can be found in Table 35. A further description is provided below.

Table 35 Basis for Transport projections.

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

Projections for aviation and navigation are based on fuel projections generated by the National Energy Authority and the Fuel Projection Working Group. Fuel projections were available by fuel type and activity. The fuel projections generated by the National Energy Authority for domestic navigation have considered the implementation of related quantified policies.

The impact of 11 PaMs (705, 201, 202, 203, 205, 206, 207, 208, 209, 210 and 211) in the transport sector (see chapter 4) is represented in the WEM scenario produced.

5.5.2 Quantification of measures

One measure within the transport sector is quantified, Electrification of Ferries (208). The quantification is described in this chapter whereas the description of the measure is in the chapter about Policies and Measures.

Electrification of Ferries (208) - Quantification

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 powerd by diesel fuel. 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

[115] *Emisia.* https://www.emisia.com/utilities/sibyl-baseline/
[116] COPERT. https://www.emisia.com/utilities/copert/

2022 (WEM scenario) and onwards it is expected to use some amount of diesel annually, due to regular trips to Þorlákshöfn, which is the altrenative port further away from the usual rout to the port in Landeyjarhöfn.

Historical data on the old Herjólfur ferry's fuel use from 2011 was used to calculate the BAU scenario to 2040. Fuel use was projected to increase linearly to 2031 when it would reach the maximum possible fuel usage. The maximum possible fuel usage was calculated based on the maximum number of trips that the ferry could possibly make. Emissions from ferry trips running on gas/diesel oil were calculated following the Tier 1 IPCC (2006) methodology as is applied in the historical and projected GHG inventory. The impact of this policy on emissions from the Herjólfur ferry is presented in Figure 5.12. 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.

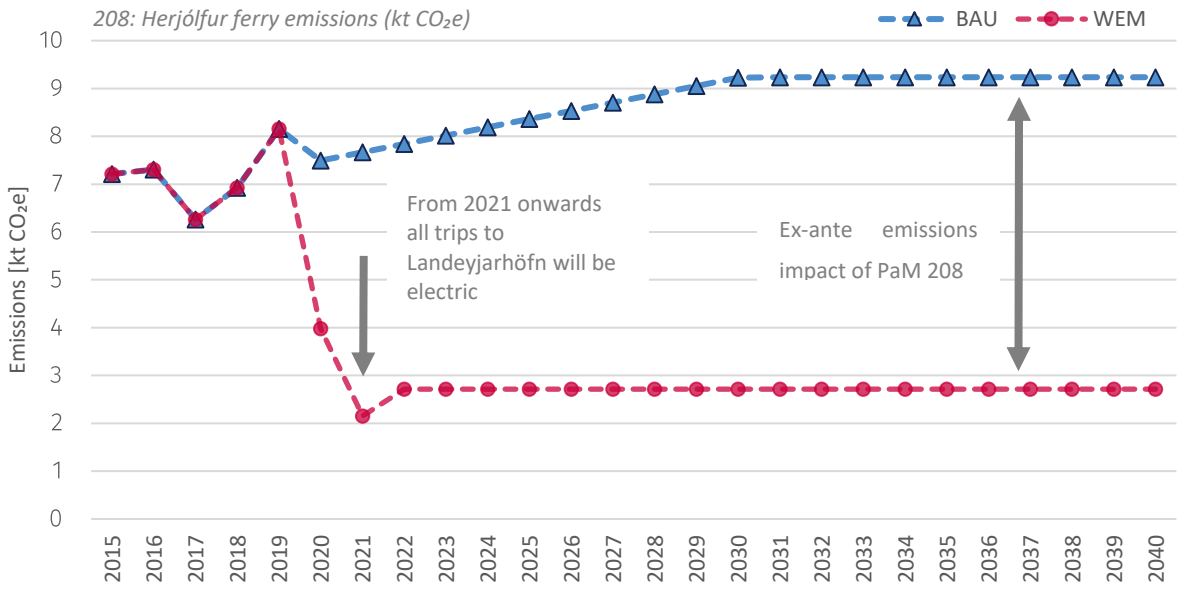


Figure 5.12 Quantified ex-ante emissions impact of PaM 208: the electrification of ferries [kt CO2e]

Emission savings in CO_2e and % from BAU can be seen in Table 36. Emissions for the WEM scenario for 2020 and 2021 are based on data received from the operator of Herjólfur, and it shows that the emissions savings in 2021 were 5.5 kt CO_2e.

Table 36 Quantified ex-ante emissions impact of measure 208 with emissions savings [kt CO_2e].

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

The plan is to switch all ferries which are operated by the state to electricity or renewable fuels by the next renewal of the fleet. Based on information received from the Icelandic Road and Coastal Administration

(*Vegagerðin*) it is, however, still unknown when the other ferries which are operated will be renewed. Therefore, the calculation of this measure currently only considers the electrification of Herjólfur.

5.6 Industrial Processes and Product Use (IPPU)

Emissions, including projected emissions, from IPPU are dominated by the Metal industry (2C), specifically ferroalloys and aluminium production. The use of fluorinated gases (F-gases) in products as substitutes for Ozone Depleting Substances (ODS, 2F), mostly in the fishing industry, industrial refrigeration and commercial refrigeration, also contributes significantly to emissions from the IPPU sector. An overview of the historical and projected total emissions for the IPPU sector within Iceland can be found in Table 37 and Figure 5.13. There is no Electronics industry (2E) in Iceland and therefore this is reported as NO.

Emissions from the Metal Industry (2C) have increased considerably during the past 30 years due to the expansion of existing aluminium smelters and the addition of new smelter facilities. Currently, there are two ferroalloy plants and three aluminium smelters operating in Iceland. It has been assumed that the number of aluminium and ferroalloy plants remains at current levels for the projected years. Permits for more plants have been released, but due to a lack of information on whether or when these plants will begin operating and due to the current worldwide economic situation, they are not included in the WEM projections.

The most recent aluminium smelter started operating in 2007 and CO_2 emissions from Aluminium production increased in a strong correlation with production. In contrast, perfluorocarbon (PFC) emissions occur mostly during the first years of operation, causing the spike in emissions in 2008. They also occur in case of increased voltage in the production line (anode effect). Two aluminium facilities are already producing close to the maximal operating allowance. The projections show only a slight increase in emissions compared to 2020 emissions and relatively constant PFC emissions, since a prediction of PFC emissions is difficult to achieve. The aluminium smelters in Iceland are currently operating using the best available technology, following the best practices set out in the Directive 2006/21/EC (BAT Directive). They do, therefore, not foresee any possibilities to reduce emissions until there is a change in technology. The ELYSIS technology, developed through a partnership between the aluminium companies Alcoa and Rio Tinto, has the potential to drastically reduce GHG emissions from the aluminium industry worldwide. This technology is, however, still in the development stage. The aim is to scale-up the process and demonstrate the technology commercially in 2023[117].

The Ferroalloys industry currently has two operating plants which produce ferrosilicon and silicon metal. One plant has been in operation since 1979, but the other one started operation in 2018. Due to this uncertainty, this plant is excluded from the projections. The ferroalloys industry shows a decrease in emissions, primarily due to the efforts of one company to become carbon neutral by 2040[118].

F-gases are mostly used for refrigeration and air conditioning in Iceland. The biggest source in F-gas emissions derives from the fishing fleet, which relies on HFCs for the cooling and freezing systems on board. Trends in projected emissions from ODS are presented in Table 5.12. As can be seen from the graph the

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

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

emissions show some variation which can be explained by the nature of the calculation method. All 2F1 subcategories have different lifetimes, so the emissions occur a certain number of years after the import of the gases. The calculation is also based on the import amounts of one calendar year. If a shipment is coming late in the year, the F-gases might be stockpiled and not used immediately in the same year, even though it appears so from the calculation method. Regulation (EU) 517/2004 is implemented into Icelandic legislation with Regulation No 1066/2019, defining a quota system on the amount of F-gases to be imported each year and steps for phasing it out. This quota system was revised in 2020, and revised Regulation No 1066/2019 defines a new quota with a quicker phase out of these compounds.

The Mineral industry (2A) has seen a big drop in emissions as the only cement production plant in Iceland closed in 2011. The projections are based on a single facility producing mineral wool, which is having a fairly constant production target (based on communication from the facility), and therefore, constant emissions over time. The Chemical industry (2B) is insignificant in the Icelandic inventory, with no emissions reported under this sector since 2005. In the past, there were a fertiliser production plant, which stopped production in 2001, and a diatomite production plant, which stopped production in 2004. There is no information on plans of opening new production facilities in these two sectors and the historical and projected emissions (for the Mineral industry only) can be seen in Figure 5.13.

Table 37 Historical and projected emissions [kt CO_2e] in the IPPU sector

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

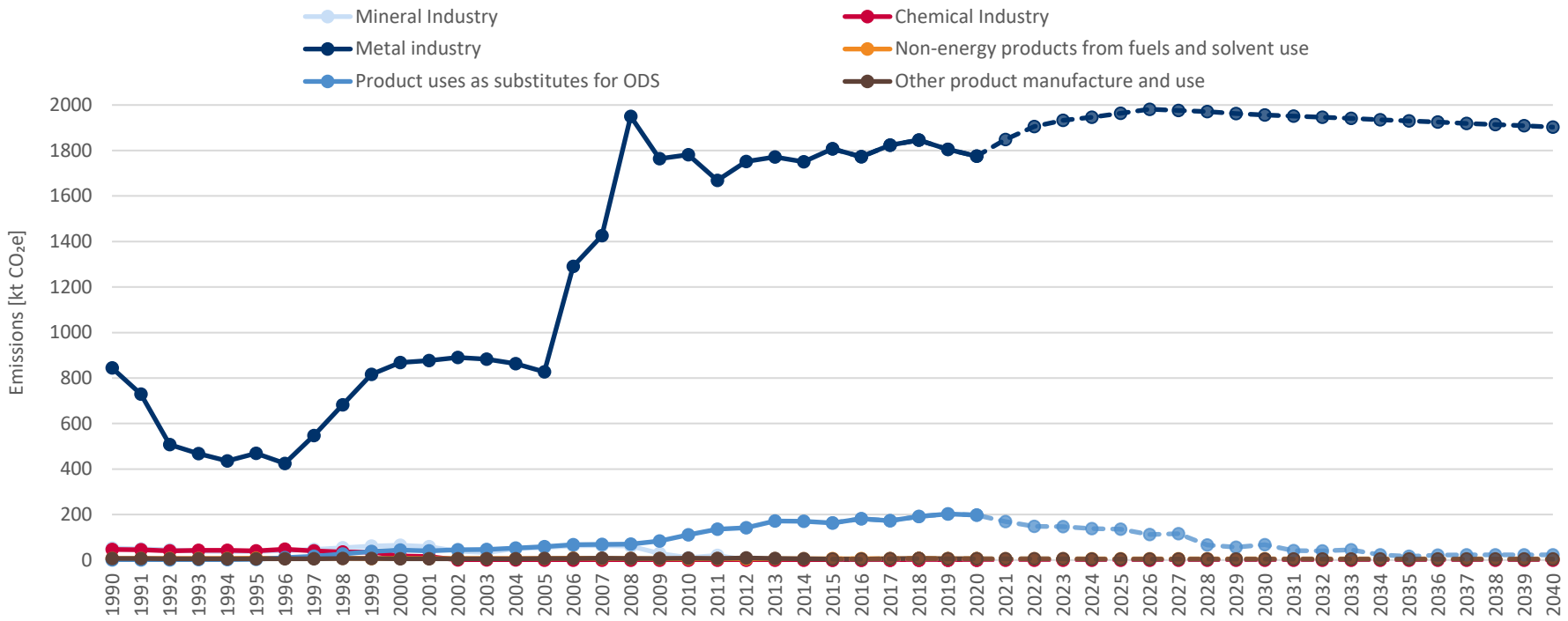


Figure 5.13 IPPU Emissions Total GHGs [kt CO2e], WEM scenario. Unbroken lines represent historical emissions, broken lines projected emissions.

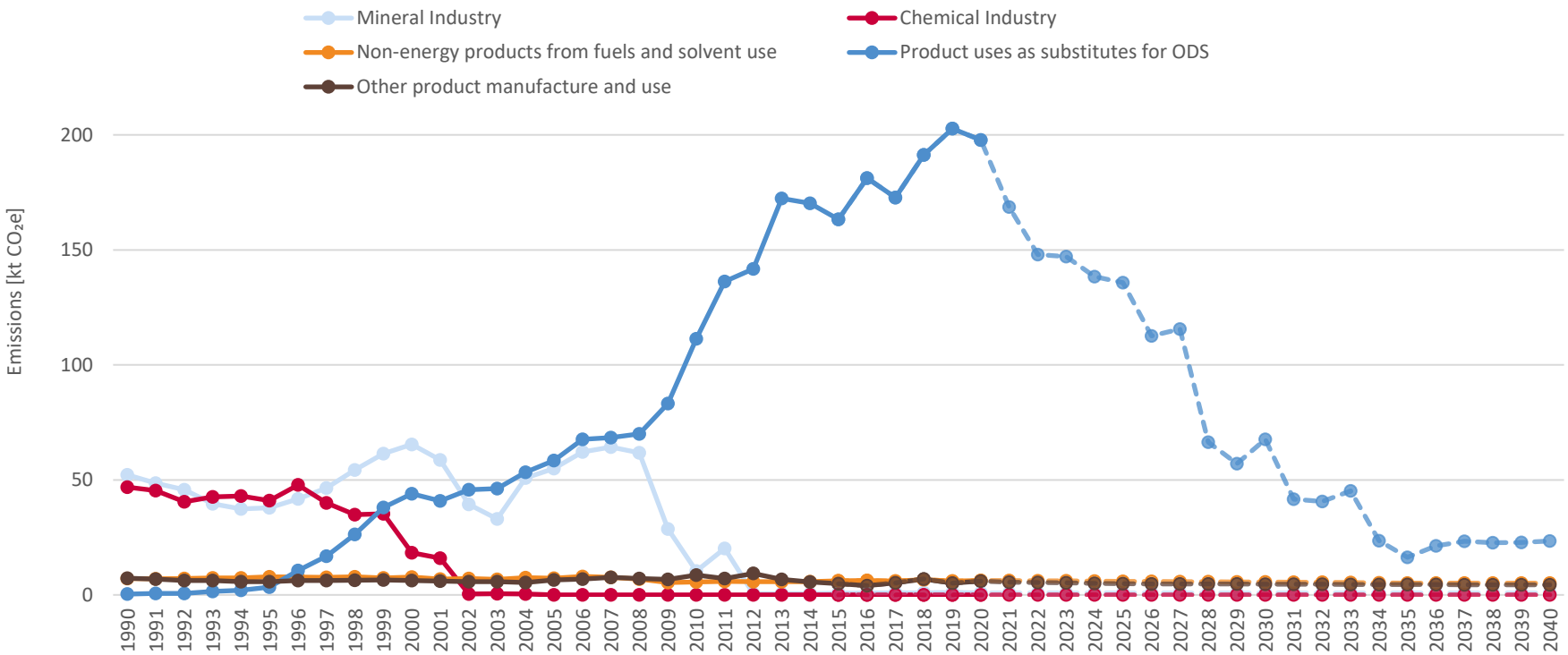


Figure 5.14 IPPU Emissions without the metal sector (2C) [kt CO2e], WEM scenario. Broken lines represent projected emissions.

5.6.1 ESR vs EU ETS emissions in Industry

In Iceland, process emissions from the 2C Metal Industry, that is ferroalloys and aluminium production are accounted for under the EU ETS (Directive 2003/87/EC). Overall and historically, this contributes to approximately 90% of the total emissions from the Industry sector. The projections under the WEM scenario show that the EU ETS contribution will increase up to 98% as the emissions for the Metal sector (2C) are fairly constant while the ESR part, especially the F-gases (2F) are expected to decrease substantially (Figure 5.15).

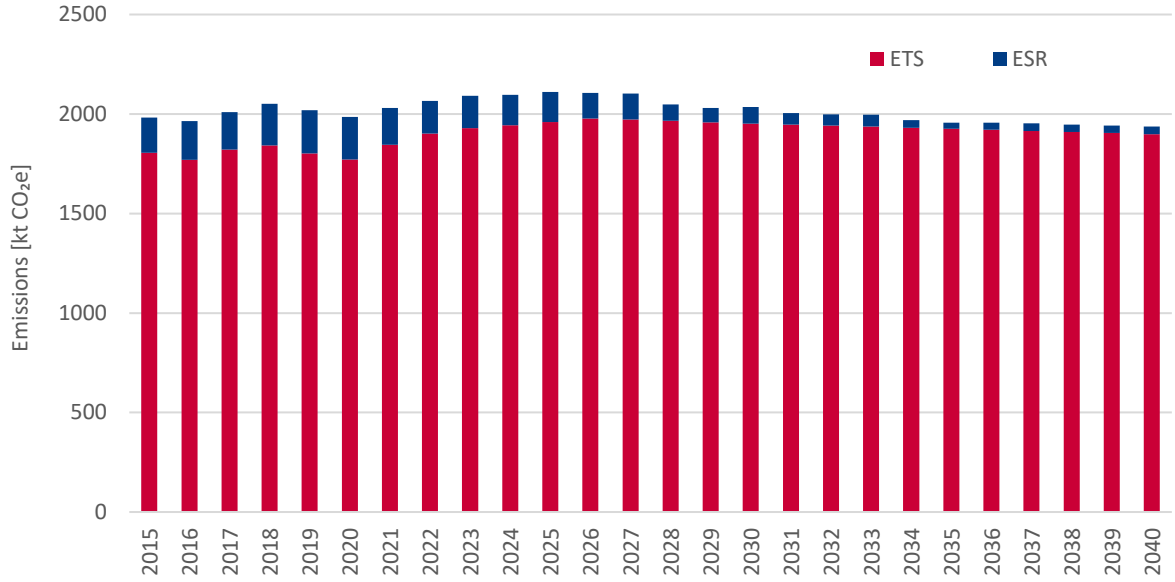


Figure 5.15 ETS and ESR GHG projections in the Industry sector, WEM scenario, [kt CO2e].

5.6.2 Methodology of projections

The methodology used to generate WEM projections for the IPPU sector are based on the historical inventory. Please refer to the 2022 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.

The impact of six PaMs (301, 302, 303, 304, 307 and 708) in the IPPU sector (see chapter 4) is represented in the WEM scenario produced.

An overview of the activity data and assumptions used as a basis for the IPPU projections can be found in Table 38. 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 38 Activity data basis for IPPU projections.

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

2.A Mineral Industry and 2.C Metal Industry

The main companies (mineral wool, ferroalloys, and aluminium) were asked to provide a production and emission estimate or to confirm or reject the calculated emission estimates based on historical inventory data for the previous PaMs and Projection report. This data has been used. No big changes are expected in these subsectors.

According to the Icelandic Ministry of Higher Education, Science and Innovation, and the Department of Energy, Industry, and Business affairs, there are currently no plans for adding new aluminium smelters, ferroalloys plants, or for resuming production of cement, fertiliser, diatomite, or steel[119]. Therefore, the projections are based on the current production and the production amounts communicated by the individual companies, also taking into account the maximal permitted allowance according to the operation permits. The quantification of the effects of the EU-Emission Trading System (307) and the Carbon Capture and Storage (306) were not considered. The ETS aspires to an emission reduction for the whole European region, by giving emission allowances to companies. In case of higher emissions, the companies can trade for other emission allowances, so overall the emissions are reduced but this cannot be quantified for the Icelandic companies separately.

Directive EU 2009/31/EC on carbon capture and storage (CCS directive) was implemented into Icelandic legislation with an amendment to Act No. 7/1998 on Hygiene and Pollution Control and Act No 70/2012 on Climate. The aim was to enable the EU ETS industry in Iceland to use the Carbfix method, to store CO2 and be able to subtract stored emissions from their emissons according to the EU ETS. The utilisation of this technique within the industry is still in a developmental stage.

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

2.F Product uses as substitutes for ODS

The projected emissions deriving from F-gases (sector 2F1) are based on the maximum allowed import quota for each year starting with 2021. See chapter about Policies and Measures.

5.6.3 Quantification of measures

One measure within the IPPU sector is quantified, Regulation on F-Gases (301). The quantification is described in this chapter whereas the description of the measure is in the chapter about Policies and Measures.

Regulation on F-Gases (301) - Quantification

The projected emissions deriving from F-gases (sector 2F1) are based on the maximum allowed import quota for each year starting with 2021. Both scenarios (import quota according to Regulations No 1066/2019 – BAU and No 1425/2020 – WEM, see Table 17) have been calculated using the following assumptions:

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

Figure 5.16 shows the comparison between the two scenarios and clearly illustrates that a rapid phasing out of F-gases, achieved by Regulation No 1425/2020 amending Regulation No 1066/2019, will drive further emission reductions from this category. Under both scenarios, some increase is still expected in certain years, due to the import fluctuations in the past and different lifetime of equipment. Table 39 reports the emission amounts and the difference between both scenarios. With the new import quota regulation of 2020 emissions decrease by 59% in 2030 compared to 2015 and by 86% in 2040 compared to 2015.

Table 39 Comparison of emissions for 2F1 Refrigeration and Air Conditioning, BAU and WEM scenario.

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

5.7 Agriculture

Iceland is self-sufficient in all major livestock products, such as meat, milk, and eggs. Traditional livestock production is grassland based and most farm animals are native breeds, i.e., dairy cattle, sheep, horses, and goats, which are all of an ancient Nordic origin, one breed for each species. These animals are generally smaller than the breeds common elsewhere in Europe, and therefore, the calculated emissions from these breeds, based on default IPCC (2006) emission factors, might be slightly overestimated. Beef production, however, is partly through imported breeds, as is most poultry and all pork production. There is not much arable crop production in Iceland, due to a cold climate and short growing season. Cropland in Iceland consists mainly of cultivated hayfields, although potatoes, barley, beets and carrots are grown on limited acreage. The projections encompass emissions from enteric fermentation (3A), manure management (3B), agricultural soils (3D), liming (3G), urea (3H), and other carbon-containing fertilisers (3I). A number of agriculture categories are not occurring in Iceland and have therefore not been included in the projections, e.g., rice cultivation (3C), prescribed burning of savannas (3E) and field burning of agricultural residues (3F).

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

Historically the biggest source of GHG emissions from the agriculture sector in Iceland is enteric fermentation, although manure management and agricultural soils are also significant sources. The decrease of GHG emissions since 1990 is mainly due to a decrease in the sheep livestock population, reducing methane emissions from enteric fermentation, and reduced fertiliser application, reducing N_2O emissions from agricultural soils. The historical and projected trend can be seen in Figure 5.17. Emissions from agriculture are projected to decrease by 19% (126 kt CO_2e) in 2040 compared to the 2015 level. This is due to a projected decrease in livestock numbers, mostly sheep and dairy cattle, which are key categories in methane emissions from enteric fermentation and nitrous oxide emissions from manure management.

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

Table 40).

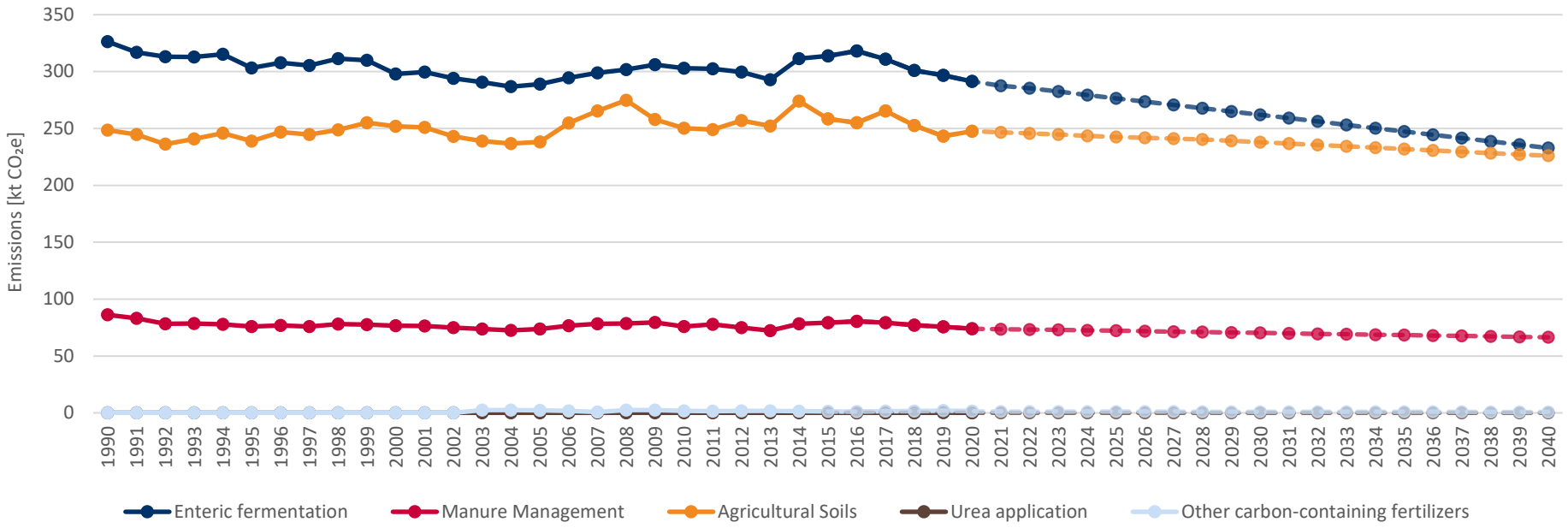


Figure 5.16 Agriculture Emissions Total GHGs [kt CO2e], WEM scenario. Unbroken lines represent historical emissions, broken lines projected emissions

Table 40 Historical and projected emissions [kt CO_2e] in the Agriculture sector.

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

5.7.1 Methodology of projections

The methodology used to generate projections for the Agriculture Sector is based on the historical inventory. For more detail, refer to the 2022 edition of the National Inventory Report where information about activity data and emission factors is collected. Only a WEM scenario has been calculated for the entire Agriculture sector, no data was available to calculate a WAM or WOM scenario. Only for the sector 3D1 Inorganic N-fertilisers, a comparison between BAU and WEM was carried out. The impact of one PaM (403) in the Agriculture sector (see chapter 4) is represented in the WEM scenario produced.

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

An overview of the activity data and assumptions used as a basis for the Agriculture projections can be found in Table 41. All parameters necessary for livestock characterisation (such as pregnancy rates, days on pasture/in housing, feed digestibility, weight) were kept constant over the projected time series and correspond to the values used in the 2022 NIR submission. The milk yield per dairy cow was slightly raised to reach 6,500 kg per year and then kept constant as it is not known how the development of feeding practices translates into milk yield. The emission factors are the same as are used in the historical inventory and could not be projected due to a lack of data and their high uncertainty.

Table 41 Basis for Agriculture projections.

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

The trend in livestock populations has been predicted by extrapolation to 2040 based on the available historical data. The historical data is collected from the Ministry of Food, Agriculture and Fisheries and are the same numbers as are used for agriculture calculations in the 2022 NIR.

To assess the best possible trends considering the variability of the historical data, experts from the Ministry of Food, Agriculture and Fisheries, which has responsibility for the agricultural sector, were consulted. Those experts determined the most representative projections for each livestock category, based on their expectation of future developments in each agricultural sector. Impacts of agricultural contracts, consumer behaviour and the level of imports of agricultural goods were also considered. The agricultural contracts

will be reviewed again in 2023 and renegotiated in 2026, at which point the projections in each livestock category may change.

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

Table 42 Livestock number projections [number] and milk yield per dairy cow [kg/year].

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

The livestock projections in Table 42 show that the number of dairy cattle is projected to decrease by 31% from 2015 until 2040, while the average annual milk yield per dairy cow is projected to increase by 11%. While the number of dairy cattle decreases, the number of growing cattle or other mature cattle for meat production increases so that the total amount of cattle increases by 3%. Sheep numbers decrease by 45% and horses by 6%. Goats, if linearly projected into the future show a 248% increase in numbers, i.e., they increase from around 1,500 animals to approximately 5,000. This trend does not have a big impact on GHG emissions, as the numbers of goats are still low. This projected increase can be explained by government subsidies for goat farming established in recent years. In fact, before 2010 the number of goats did not reach 1,000. Poultry populations also increase substantially, or by 83%.

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

5.7.2 Quantification of measures

One measure within the Agriculture sector is quantified, Improve Use and Handling of Fertilisers (403). The quantification is described in this chapter whereas the description of the measure is in the chapter about Policies and Measures.

Improved Use and Handling of Fertilisers (403) - Quantification

The quantification of measure 403 allows a comparison of the BAU and the WEM scenarios for the use of inorganic N-fertilisers. For the BAU scenario, the amount of N-fertilisers used in Iceland, as reported in the NIR (1990-2020), was used to predict its usage until 2040. The historical data shows a high yearly variability due to the nature of the import system which registers imports during one calendar year, i.e., stockpiling can occur in case of shipments arriving late in the year. In addition, as all inorganic fertilisers are imported, the international value of the local currency contributes to the fluctuations. For the WEM scenario, a 10% reduction of fertiliser use in 2030 is expected, compared to the BAU scenario. From 2030 to 2040, the linear decrease is projected to continue, as this action also includes an education/training programme. Therefore, it is expected that the action will be rolled out gradually and reach more and more farmers with time, resulting in a 16% reduction of fertiliser use by 2040 compared to 2015. Figure 5.18 shows the difference between the two scenarios resulting in a decrease of 9 kt CO_2e in 2040 between WEM and BAU (Table 43).

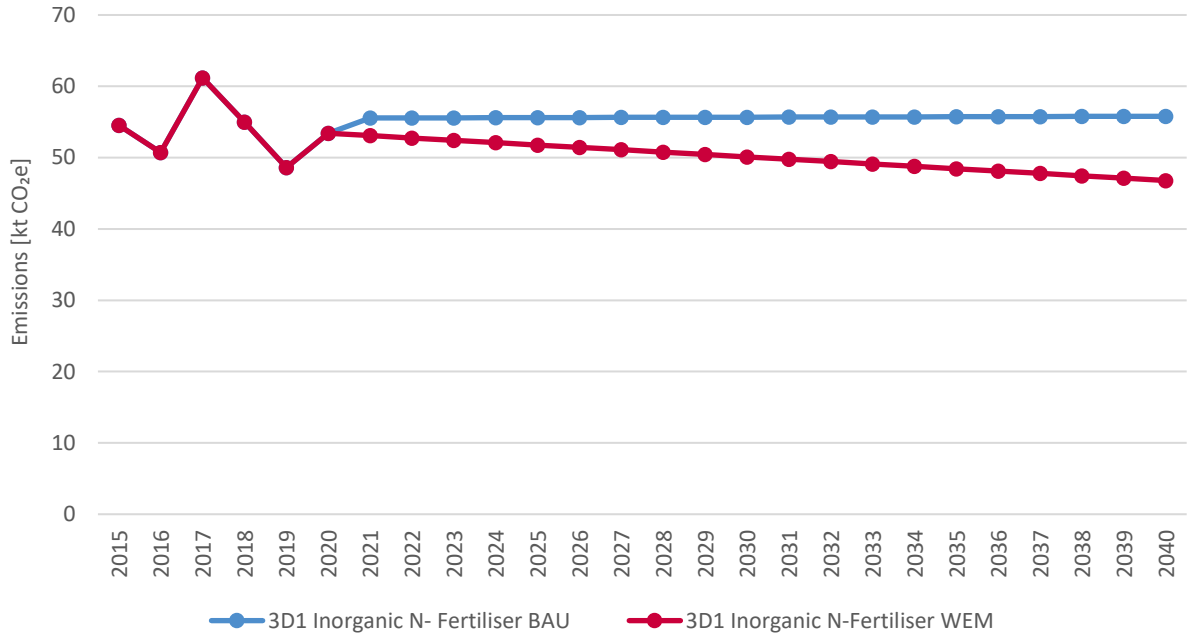


Figure 5.17 Comparison of emissions deriving from inorganic N-fertilisers (CRF category 3D1) between BAU (blue) and WEM (red) scenario, [kt CO2e].

Table 43 Comparison of emissions for inorganic N-fertilisers BAU and WEM scenario.

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

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

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

Almost 90% of the total area of Iceland is included in two land use categories i.e. Other land and Grassland. Land categories have been changed considerably in the 2021 submission, as part of the Other land category is now under Grassland (See also Chapter 6.7 Grassland (CRF 4C) of NIR 2022 (Environment Agency of Iceland, 2022)). This change is due to new data available for this year's submission. Figure 5.19 shows the relative division of the area of Iceland to the six main land use categories reported.

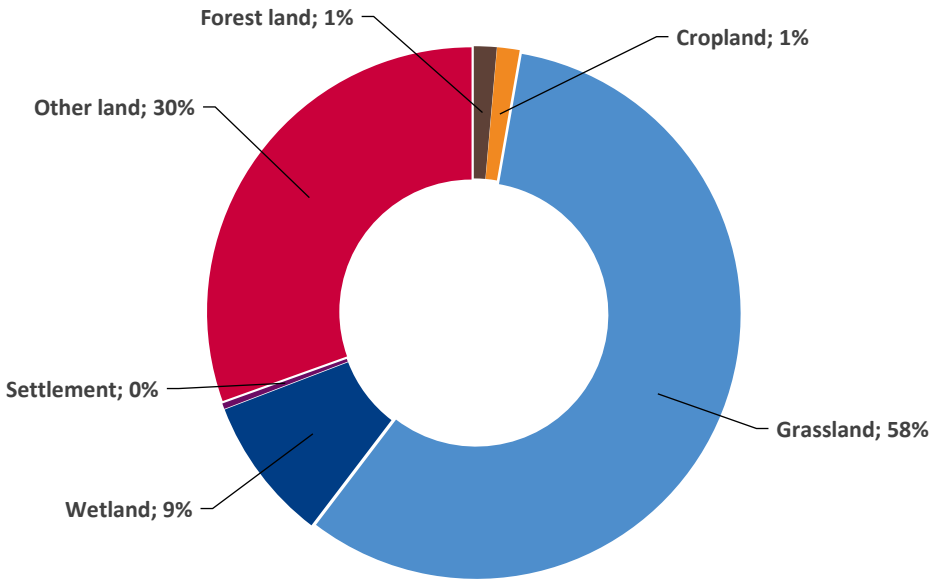


Figure 5.18 Relative size of land use categories in Iceland according to IGLUD land use map 2020 and other land use estimates available for the reporting.

FA 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.

The historical and projected emissions trend in LULUCF is presented in

Table 44 and Figure 5.20. 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, see Figure 5.20. 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.

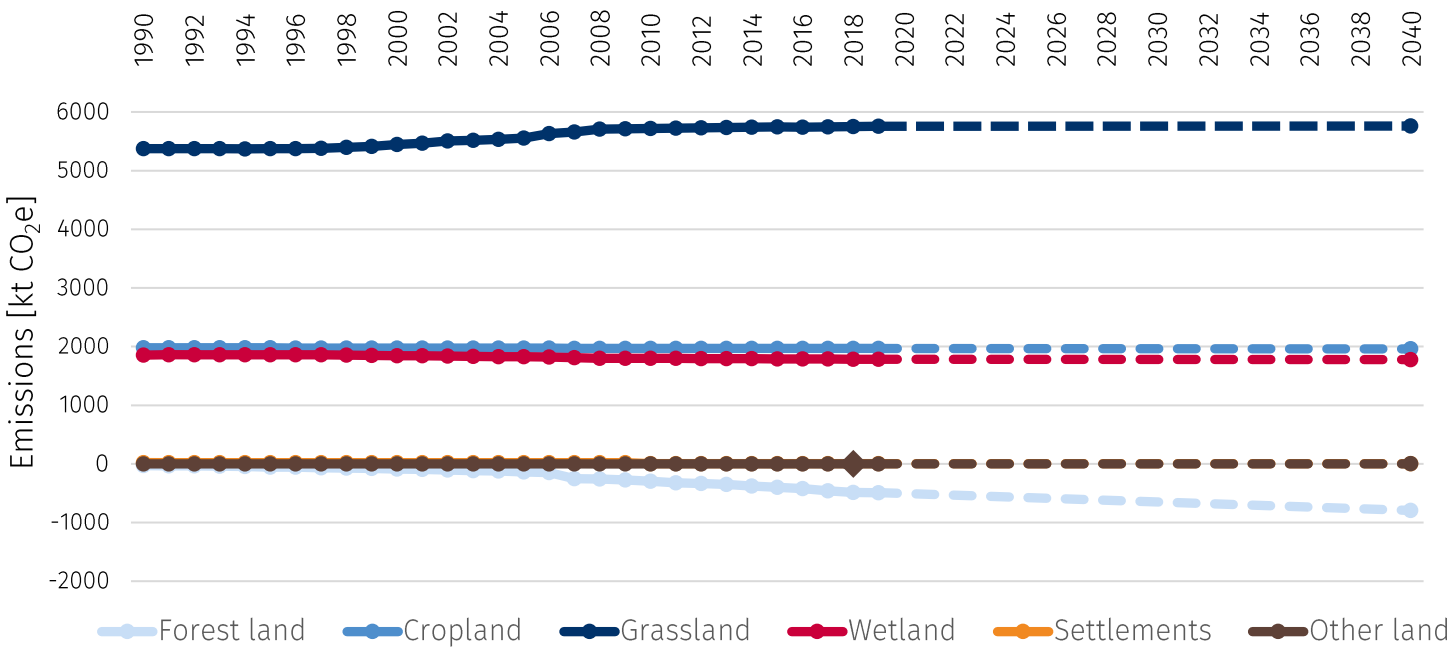


Figure 5.19 LULUCF Emissions Total GHGs [kt CO2e], WEM scenario.

Table 44 Historical and projected emissions [kt CO_2e] in the LULUCF sector.

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

5.8.1 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 2022 submission 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. The impact of five PaMs (601, 602, 603, 604, and 605) in the LULUCF sector (see chapter 4) is represented in the WEM scenario produced.

An overview of the data and assumptions used as a basis for the LULUCF projections can be found in Table 45. A further description is provided below.

Table 45 Basis for LULUCF projections.

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

The emission estimates in the LULUCF sector are to a large degree determined by the development of land areas categorised by their use. Therefore, the LULUCF emission estimates and their projections must primarily methodologically solve the issue of land areas. The actual development of six major IPCC land use categories as reported in the 2022 NIR is used. The projections are based on the observed trends and anticipation of increased soil reclamations and rewetting of wetlands.

In the 2022 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 2021 submission only afforestation since 1990 was projected but in the 2022 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.

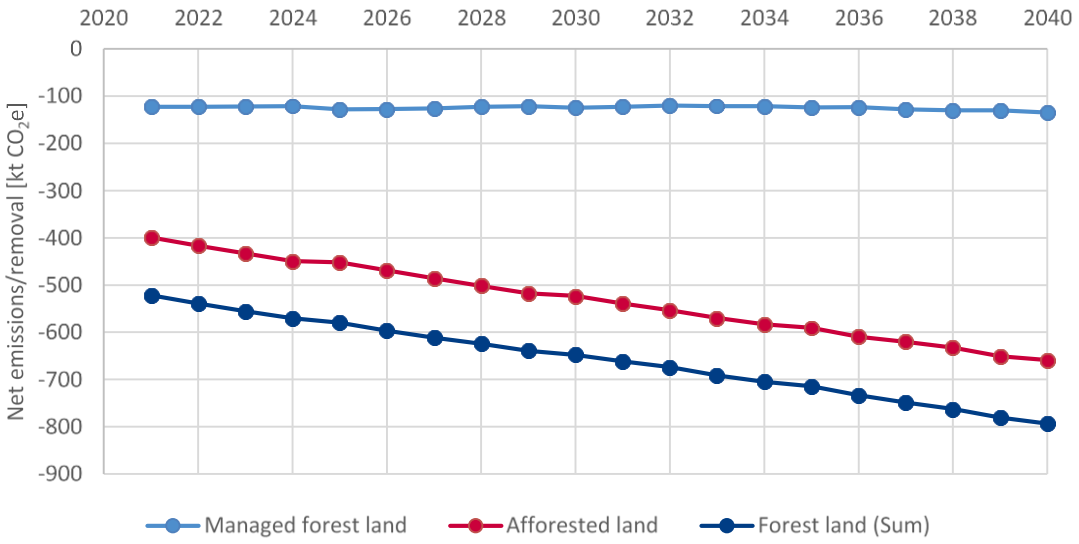
The methodology used for the projection of emissions from Cropland, Grassland, Wetlands, Settlements and Other land is in line with the model adopted for the national inventory according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. However, greater emphasis was given on increasing 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.

5.8.2 Quantification of measures

Three measures within the LULUCF sector are quantified, Enhanced action in forestry (601), Expanding revegetation (602) and Restoration of wetlands (604). The quantification is described in this chapter whereas the description of the measures is in the chapter about Policies and Measures.

Enhanced action in forestry (601) - Quantification

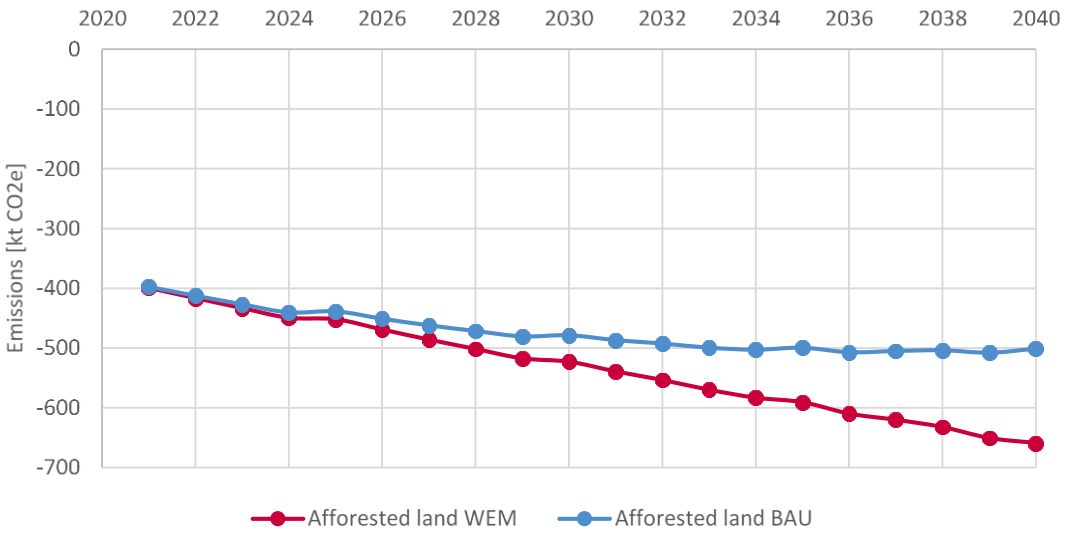
The Icelandic Forest Service (IFS) has estimated how the increased government funding, resulting in a more than doubling of annual afforestation from the year 2022, will affect the future net annual emissions/removals of GHGs. Projected removal can be seen in Figure 5.21, divided between Afforested land (Land converted to forest Land) and Managed forest land (Forest land remaining forest land).



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

Figure 5.20 Projected net emissions/removal of afforestation and forest management from 2021-2040, [kt CO2e].

The Climate Action Plan only affects the net removals of Afforested land. By running a BAU scenario with an unchanged annual afforestation rate of 1,100 ha since 2021, the effect of the Climate Action Plan was estimated as shown in Figure 5.21.

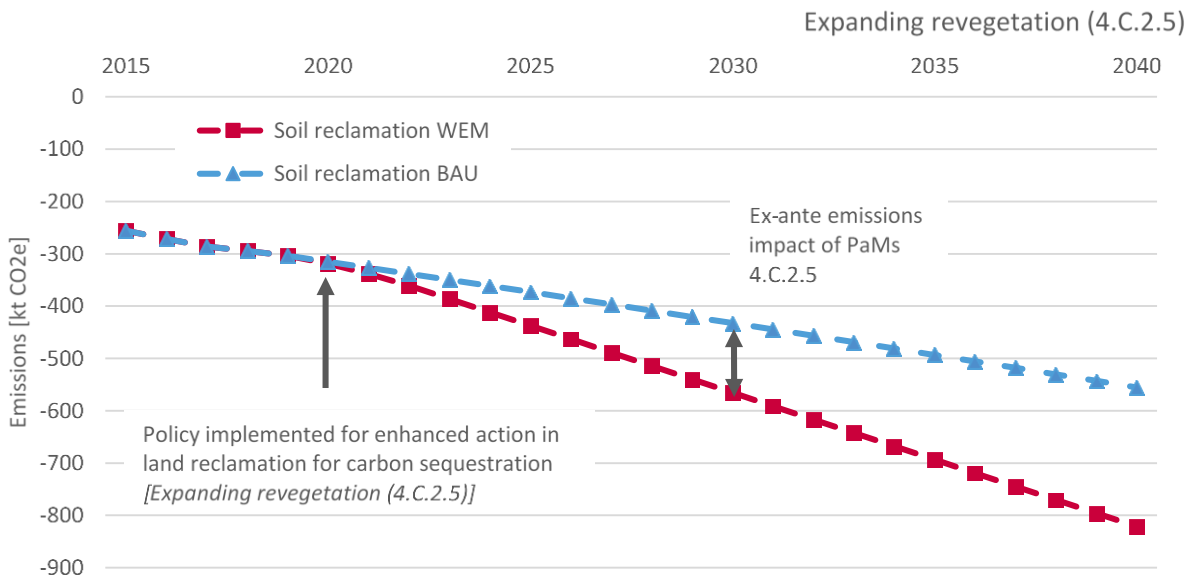


	2021	2025	2030	2035	2040
Afforestation BAU (kt CO_2e)	-398	-439	-479	-500	-659
Afforestation WEM (kt CO_2e)	-400	-452	-523	-591	-501
Ex-ante emissions impact of PaMs (kt CO_2e)	**-2**	**-13**	**-75**	**-84**	**-158**

Figure 5.21 BAU and WEM projected net removals of afforestation in the period 2021 – 2040, [kt CO_2e].

Expanding revegetation (602) - Quantification

Figure 5.22 shows projected BAU and WEM scenarios for carbon sequestration from soil conservation and land reclamation quantified by The Soil Conservation Service of Iceland. The BAU scenario is based on projections of historical trends. The WEM scenario is instead constructed on projections which include policies and measures defined in the Climate Action Plan (2020) where land reclamation is planned to increase to 12,200 ha in the year 2023.

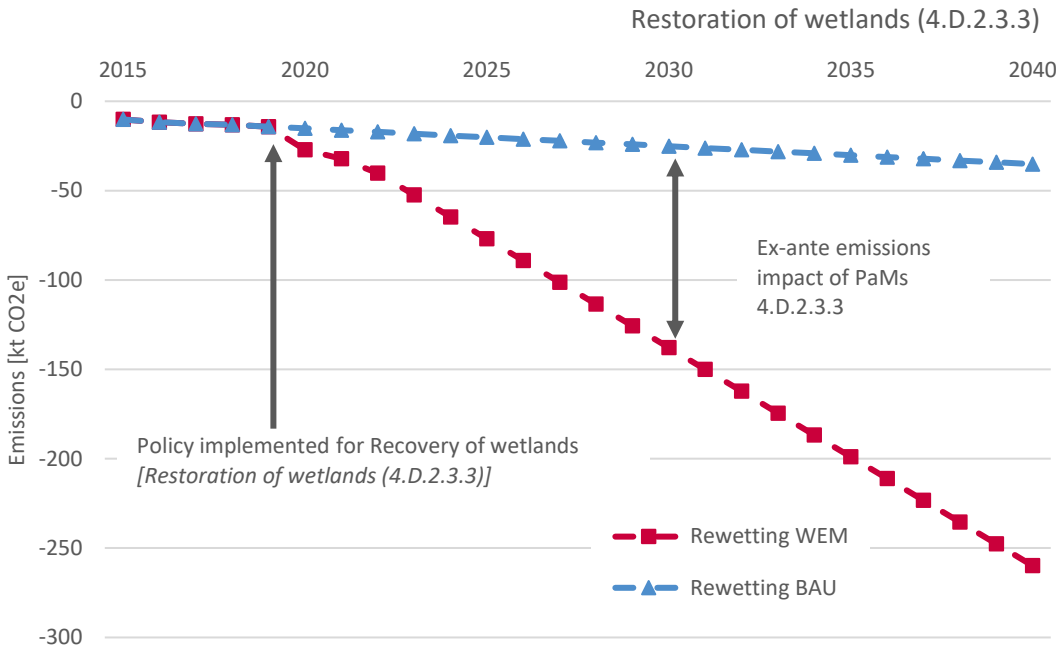


	2020	2025	2030	2035	2040
Soil reclamation BAU (kt CO_2e)	-315	-373	-433	-493	-555
Soil reclamation WEM (kt CO_2e)	-319	-437	-565	-694	-822
Ex-ante emissions impact of PaMs (kt CO_2e)	-4	-64	-133	-200	-266

Figure 5.22 BAU and WEM projected net emissions/removals through soil reclamation in the period 2020-2040.

Restoration of wetlands (604) – Quantification

Figure 5.24 shows projected BAU and WEM scenarios for carbon storage from recovery of wetlands quantified by The Soil Conservation Service of Iceland. The BAU scenario for recovery of wetlands is also based on projections of historical trends, whereas the WEM scenario is constructed on projections which include policies and measures defined in the Climate Action Plan (2020) where recovery of wetlands is planned to increase to 610 ha in the year 2023.



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

Figure 5.23 BAU and WEM projected net emissions/removals through the recovery of wetlands in the period 2020-2040.

5.9 Waste

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

For most of the 20th century Solid Waste Disposal Sites (SWDS) in Iceland were numerous, small, and located close to the locations of waste generation. In 1991, the SWDS Álfsnes was opened, which is currently the biggest SWDS in Iceland and is serving the capital and all surrounding municipalities, where approximately two thirds of the population of Iceland lives. A new biogas and composting plant called GAJA has been built at Álfsnes and started operating in the second half of 2020. According to the operation permit[120] issued by the Environment Agency of Iceland, the plant is expected to turn up to 30-40 kt of waste into compost and methane gas annually. The methane will mostly be used as fuel for vehicles, and therefore the emissions from methane produced in GAJA is included in the Road transport sector (see Chapter 5.5). 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

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

vehicle fuel. Other plans to utilise the methane produced in GAJA[121] include asphalt production, where it would be replacing diesel oil, and coffee roasting, where it would be replacing propane gas.

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

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

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

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 46.

Figure 5.25 reports the emission trends for all waste subsectors. The emissions from Solid Waste Disposal (5A) are projected to decrease until 2030, after which they will remain fairly steady until 2035, when they will start to decrease again. The decrease until 2030 is due to the addition of the new gas and composting plant and the subsequent ban of landfilling organic and decomposable waste (see PaMs 501 and 504). Both of these PaMs decrease the amount of waste that is landfilled. During that time, there is also a steady methane recovery from the landfill sites. These two factors (less waste and high methane recovery) coupled together cause the decrease in emissions from solid waste disposal over the projected timeseries.

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

Table 5.21 shows historical and projected emissions from the waste sector, excluding emissions from Solid Waste Disposal (5A). Emissions from Biological Treatment of Waste (5B) are projected to increase due to the addition of the gas and composting plant, GAJA, and a slight increase in composting. The small step change between 2019 and 2020 is due to the start of the gas and composting plant, which began operating at a small scale in the second half of 2020. The plant was unable to operate fully in 2021 and consequently the

[121] *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

expected step wise increase in its operational scale was delayed slightly. The plant is expected to operate at 75% capacity from 2023 onwards, turning 30 kt of waste into compost and methane gas annually.

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

Table 46 Historical and projected emissions [kt CO_2e] in the Waste sector.

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

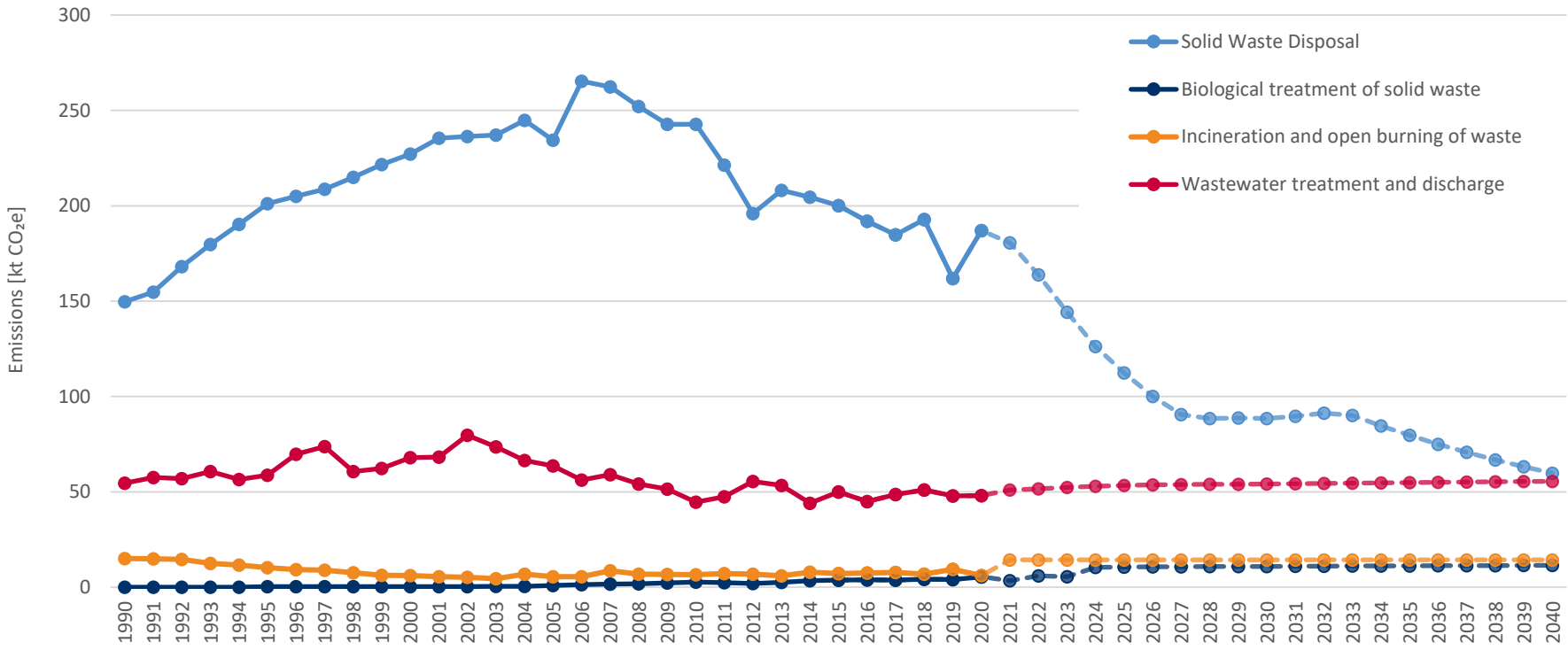


Figure 5.24 Waste Emissions Total GHGs [kt CO2e], WEM scenario. Unbroken lines represent historical emissions, broken lines projected emissions.

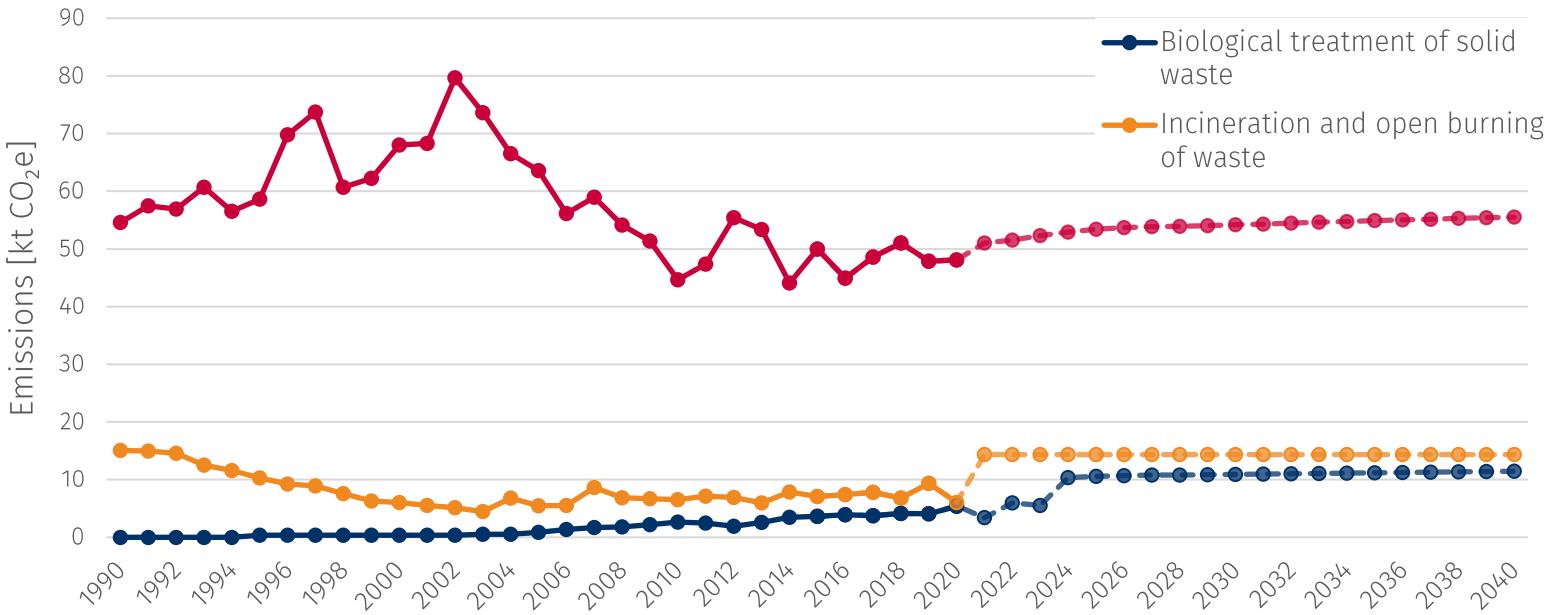


Figure 5.25 Waste Emissions excluding 5A Solid Waste Disposal Sites, total GHGs [kt CO2e]. Broken lines represent projected emissions.

5.9.1 Methodology of projections

The methodology used to generate projections for the waste sector is based on the historical inventory. Please refer to the 2022 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.

The impact of two PaMs (501, 504) in the Waste sector (see chapter 4) is represented in the WEM scenario produced.

An overview of the data and assumptions used as a basis for the Waste projections can be found in Table 47. A further description is provided below.

Table 47 Basis for Waste projections.

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

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

A) Calculation of overall waste generation until 2040 by correlating historical waste generation data as reported in the NIR (1990-2020) with population. A population forecast until the year 2d040 was made available by the Energy Authority.
B) A graphical representation for the WEM scenario waste allocation is given in Figure 5.25. Allocation of generated waste to the subcategories as reported in Table 5.22.
C) Application of greenhouse calculations according to the approach described in the 2022 National Inventory Report; the same parameters and emission factors are applied throughout the whole-time series 2020-2040.

Table 48 Waste allocation applying a mass balance starting from total waste generation projected with population increase.

	BAU	WEM
5.A 1 Solid Waste Disposal Managed	• 15% of total waste produced (average 2016-2020) from (A) • Communication of expected methane generation from operators.	• 78% of total waste sent to landfil between 2017 & 2019 was from Sorpa, the largest waste managment company in Iceland. This share is assumed to continue throughout the projected timeseries. The total amount of landfilled waste is estimated from the operation permit of Sorpa, which will be reducing the amount of waste landfilled drastically[122]. • Action **501** is taken into account and no organic waste can be sent to any landfill in the country (managed or unmanaged) in 2021, and no biodegradable waste (IPCC categories Garden, Paper, Wood, Sludge) from 2023. The so created difference in amount is allocated to 5B. • Communication of expected methane generation from operators.
5.A 2 Solid Waste Disposal Unmanaged	• 4% of total waste produced (average 2016-2020) from (A)	• 4% of total waste produced (average 2016-2020) from (A) • Action **501** is taken into account and no organic waste can be sent to landfill in 2021, and no compostable waste from 2023. The so created difference in amount is allocated to 5B.
5.B 1 Composting	• Assumed 2% of total waste produced (average 2016-2020) from (A)	• Compost rate is increased from 2% to accommodate the waste which cannot be landfilled anymore in 5A1 and 5A2 and reaches 4% at its maximum.
5.B 2 Anaerobic biodigester	• Not included	• Start of operations in the second half of 2020 according to operation permit[123] (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[124]	• Same as BAU scenario
Recycling/Reuse/Export	• Assumed average share (2016-2020) of 78% of total waste produced.	• Applying a mass balance of all allocations above the recycling/reuse and export increased from 75% to 87% over 20 years.

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:

[122] *Sorpa.* http://sorpa.dccweb.net/media/2/sorpa---undirritad.pdf

[123] *EAI.* https://www.ust.is/atvinnulif/mengandi-starfsemi/starfsleyfi/urgangur-og-efnamottaka/hofudborgarsvaedid/gas-og-jardgerdarstod-sorpu-alfsnesi-gaja/ (in Icelandic)

[124] *EAI.* https://www.ust.is/atvinnulif/mengandi-starfsemi/starfsleyfi/urgangur-og-efnamottaka/sudurnes/kalka-sorpeydingarstod-adur-sorpeydingarstod-sudurnesja/

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

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

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

The comparison between the BAU and WEM scenario can be seen in the previous chapter.

5.9.2 Quantification of measures

Two measures within the Waste sector are quantified together, Ban on Landfilling of Organic Waste (501) and Gas and compost plant (504). The quantification is described in this chapter whereas the description of the measures is in the chapter about Policies and Measures.

Ban on Landfilling of Organic Waste (501) and Gas and compost plant (504) - Quantification

An overview of the data and assumptions used as a basis for the Waste projections can be found in the next chapter. The comparison between the BAU and WEM scenario is best seen in Figure 5.27, where the changes for category 5A Solid Waste Disposal Sites and 5B Biological Treatment of waste is reported in separate graphs. While the emissions in 5A show an important decrease by 2040 (-181 kt CO2 when compared with the BAU scenario), the emissions in 5B increase, due to an increased composting rate (from 2% to 4%) and the addition of a new waste handling facility, the gas and composting plant. The increase in this ategory, however, is rather limited (+7 kt CO2e by 2040 when compared with the BAU scenario). The table below reports the emission decrease and increases for both categories over the projected time series.

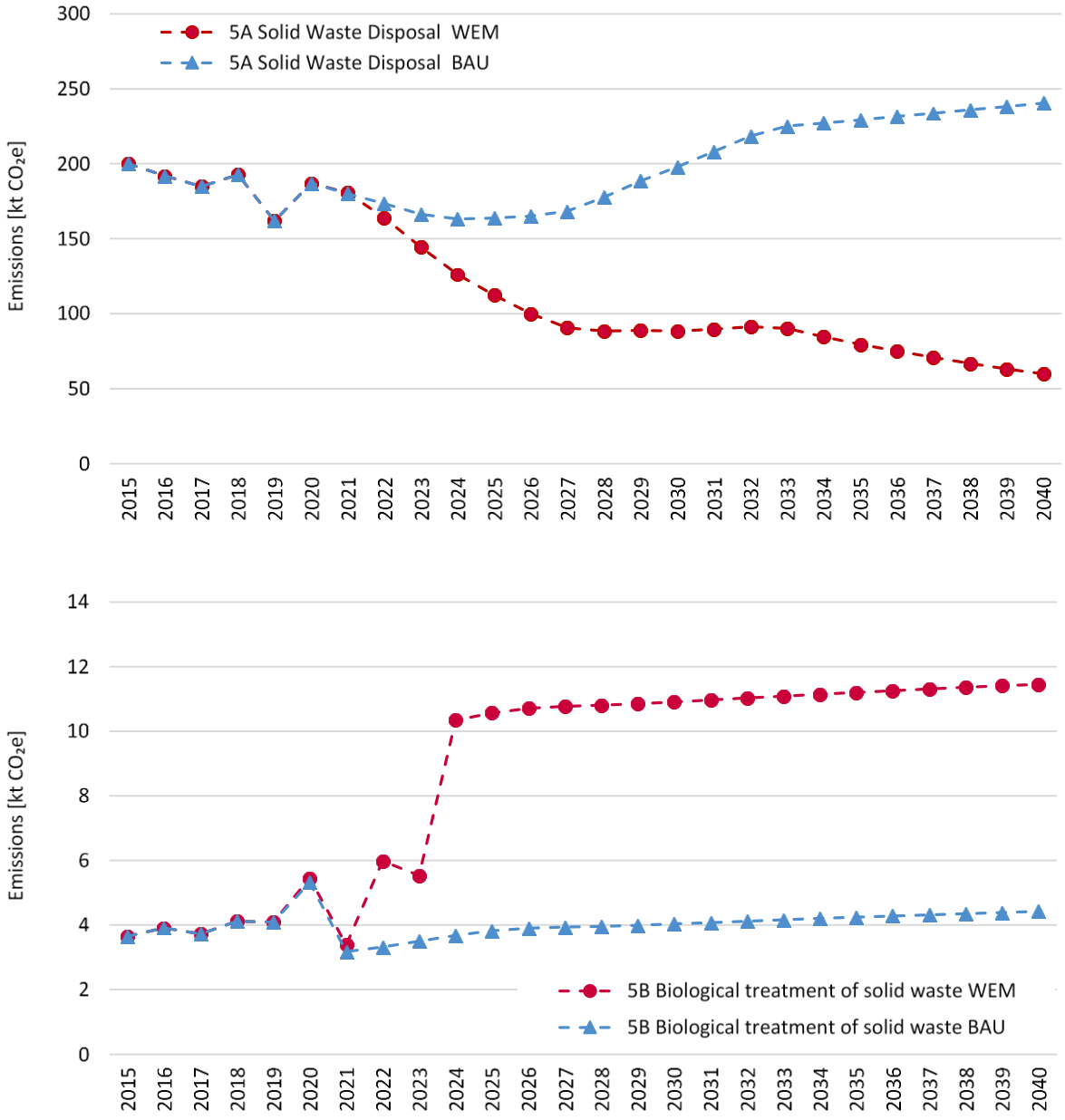


Figure 5.26 Quantified ex-ante impact of PaM 504 and 501 on GHG emissions from Solid Waste Disposal Sites (5A) on top and Biological Treatment of Waste (5B, bottom) [kt CO2e].

Table 49 Comparison of emissions for 5A – Solid Waste Disposal sites and 5B – Biological treatment of solid waste, BAU and WEM scenario.

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

5.10 Sensitivity Analysis

Sensitivity analysis has been made for part of the agricultural sector and the LULUCF sector, see below. No quantitative sensitivity analysis has been made for other sectors or for the inventory as a whole. In general terms, the emissions are dependent on the national population as well as GDP. The emissions from the heavy industry is in general not very dependent on national population or GDP since the production is for foreign markets.

5.10.1 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 50). A visual comparison between the different sheep projection scenarios can be seen in Figure 5.28.

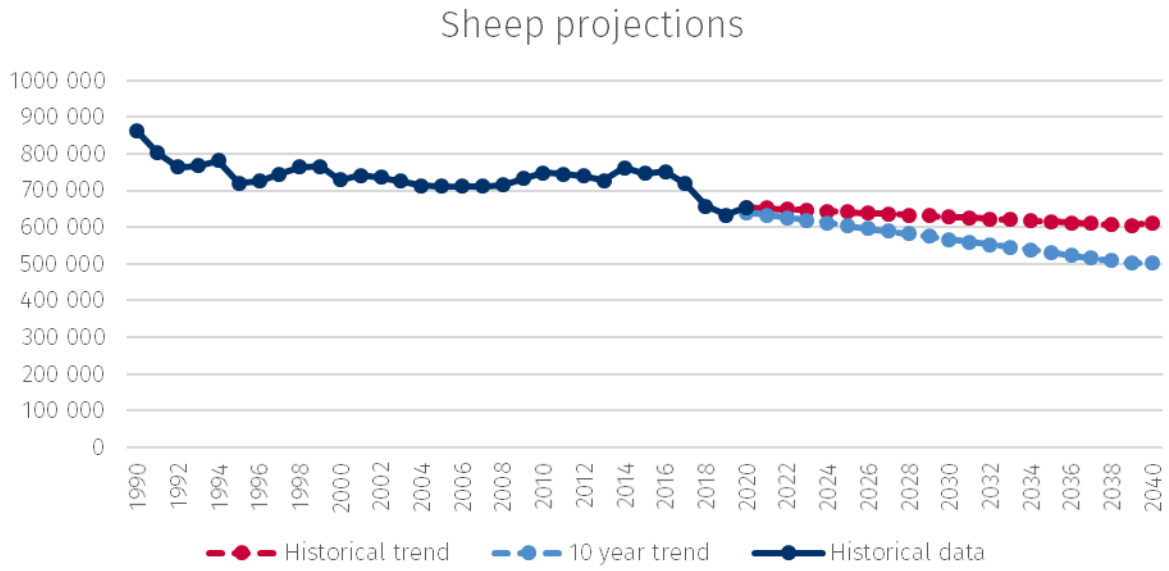


Figure 5.27 Comparison between the number of sheep projected by using the historical trend versus the 10-year trend.

Table 50 Number of sheep (1,000s) 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-year trend)	346	328	311	293	275
% difference	1%	4%	7%	11%	15%
Rams (historical trend)	11	11	10	10	10
Rams (10-year trend)	11	11	11	11	10

% difference	-2%	-3%	-3%	-3%	-4%
Young sheep (historical trend)	86	86	86	86	86
Young sheep (10-year trend)	77	69	61	53	44
% difference	11%	24%	41%	64%	95%
Lambs (historical trend)	208	204	199	194	199
Lambs (10-year trend)	206	196	185	175	173
% difference	1%	4%	7%	11%	15%
Total sheep (historical trend)	**655**	**642**	**628**	**615**	**612**
Total sheep (10-year trend)	**641**	**604**	**567**	**531**	**503**
% difference	**2%**	**6%**	**11%**	**16%**	**22%**

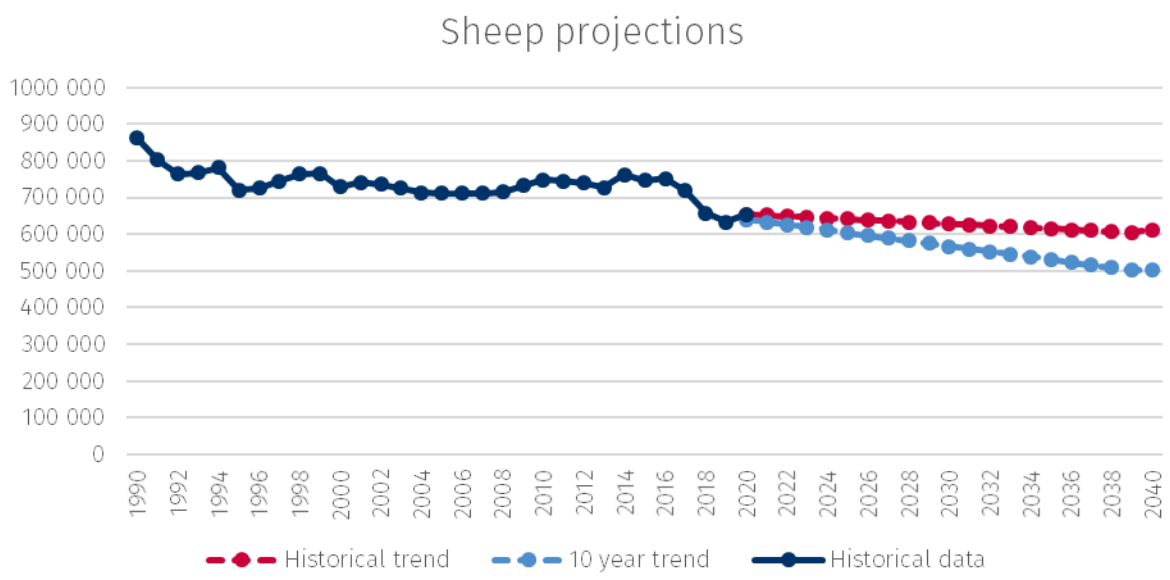


Figure 5.27 Comparison between the number of sheep projected by using the historical trend versus the 10-year trend.

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 5.26) A visual comparison between the different cattle projection scenarios can be seen in Figure 5.29.

Table 51: Number of cattle (1,000s) projected using the historical trend and 10-year trend (using linear extrapolation).

Scenario	2020	2025	2030	2035	2040
Dairy cows (10 yr trend)	27	28	29	30	32
Dairy cows (historical trend)	24	22	21	20	18
% difference	13%	27%	38%	50%	78%
Heifers (10 yr trend)	7	7	8	9	9
Heifers (historical trend)	6	6	6	6	7

% difference	17%	17%	33%	50%	29%
Steers (10 yr trend)	23	25	27	29	31
Steers (historical trend)	21	21	22	22	22
% difference	10%	19%	23%	32%	41%
Calves (10 yr trend)	23	25	27	29	32
Calves (historical trend)	21	22	22	22	22
% difference	10%	14%	23%	32%	45%
Total Cattle (10 yr trend)	**84**	**91**	**98**	**105**	**113**
Total Cattle (historical trend)	**76**	**77**	**78**	**79**	**80**
% difference	**11%**	**18%**	**26%**	**33%**	**41%**

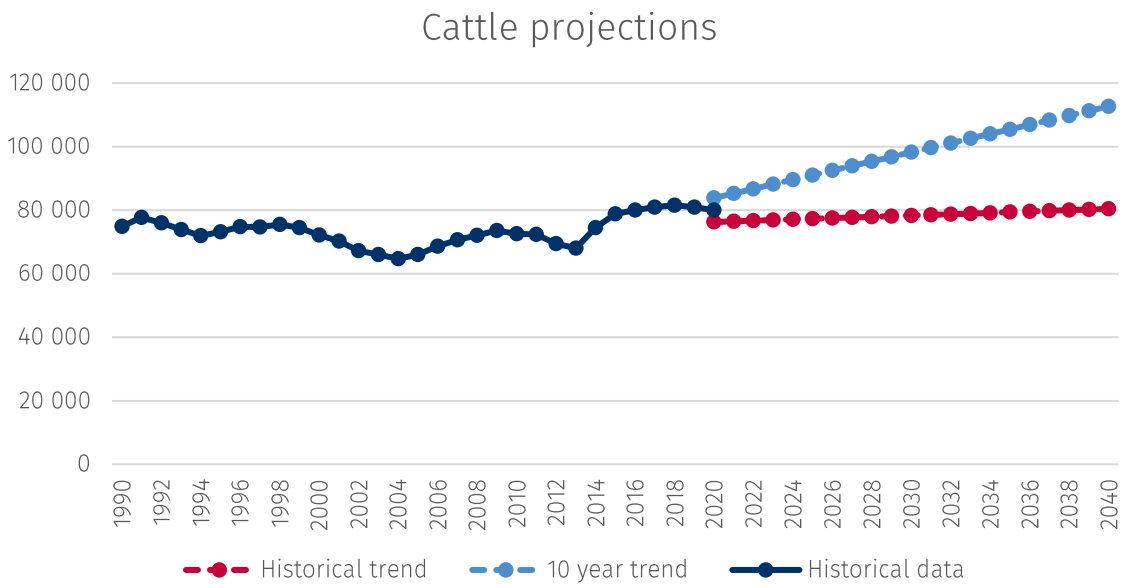


Figure 5.28 Comparison between the number of cattle projected by using the historical trend versus the 10-year trend

Table 52 shows the results of the sensitivity analysis. To avoid confusion, the following is reiterated:

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

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

Table 52 Sensitivity analysis results: total GHG emissions [kt CO2e] in the livestock projections scenarios.

Scenario	2020	2025	2030	2035	2040
Cattle and sheep sensitivity analysis	638	636	639	641	645
Cattle and 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 5.30 and 5.31 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.

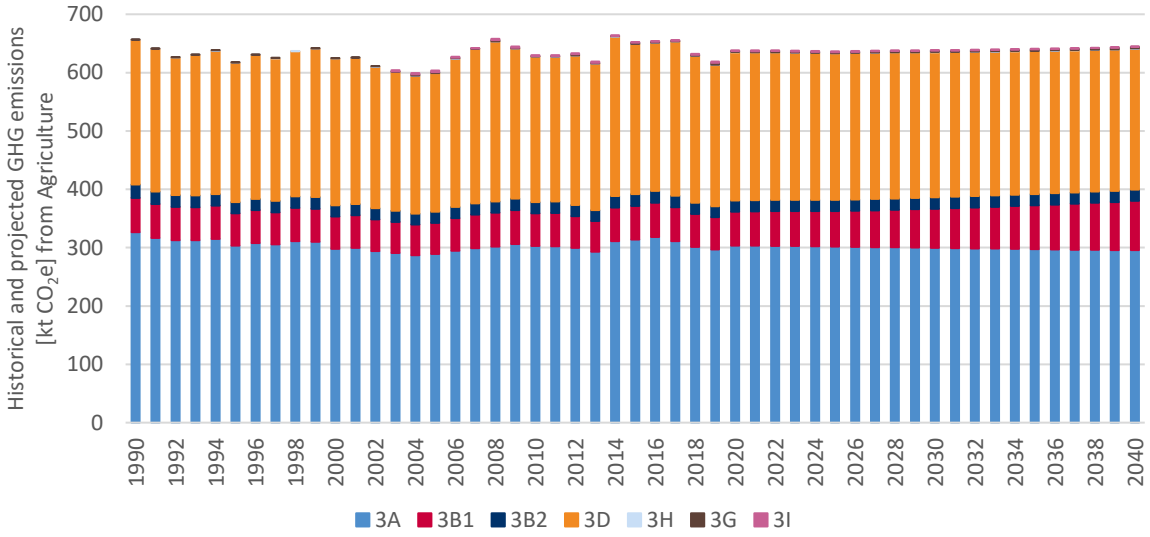


Figure 5.29 Historical and projected GHG emissions [kt CO2e] from the Agriculture sector in the sensitivity analysis scenario

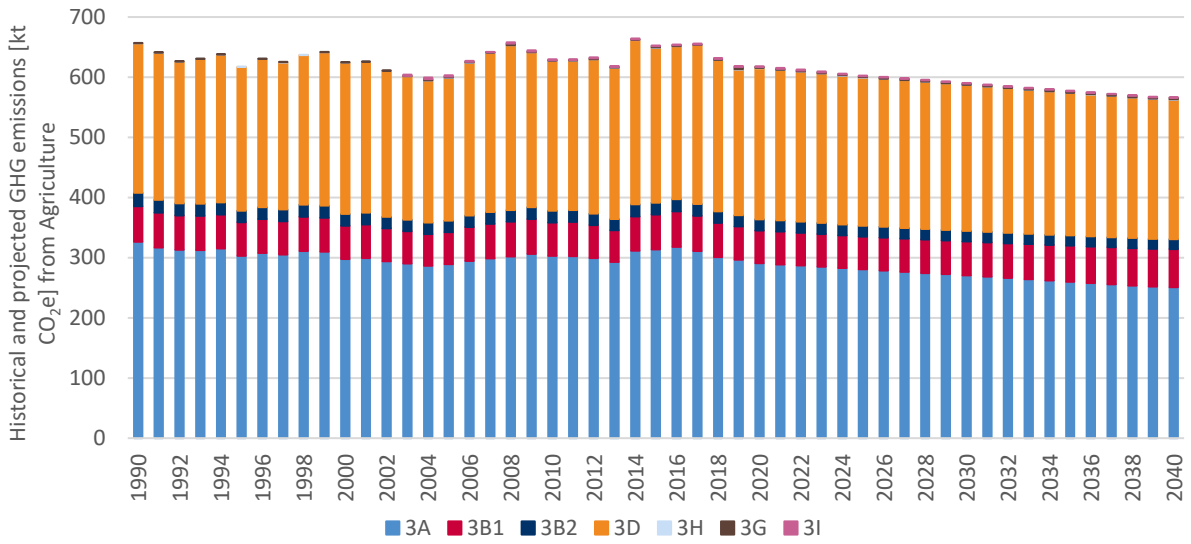


Figure 5.30 Historical and projected GHG emissions [kt CO2e] from the Agriculture sector in the WEM scenario.

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.

5.10.2 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 53 and Figure 5.32 below. The WEM scenario with calibration was used for the projections.

Table 53 Sensitivity analysis results showing the effects of the calibration on emission removals from the forest land category.

Scenario	2020	2025	2030	2035	2040
WEM with calibration [kt CO_2e]	-452	-532	-606	-678	-765
WEM without calibration [kt CO_2e]	-375	-445	-507	-567	-644
Difference [kt CO_2e]	-77	-87	-100	-111	-121
% Difference	17%	16%	16%	16%	16%

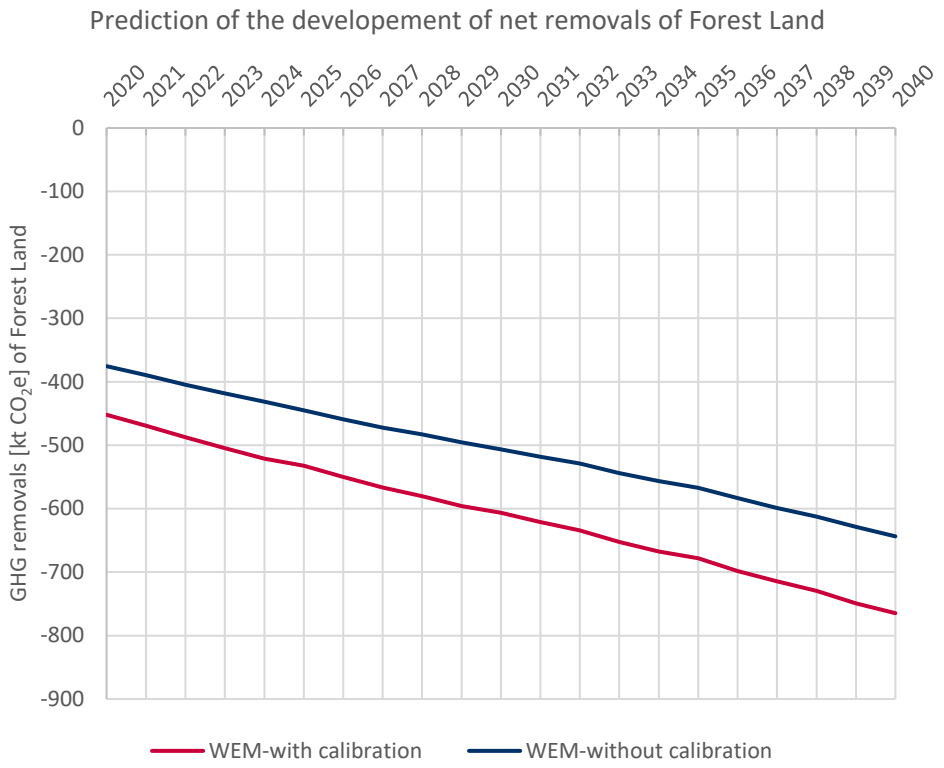


Figure 5.31 Prediction of the development of net removals of forest land in the WEM-with-calibration and WEM-without calibration scenarios.

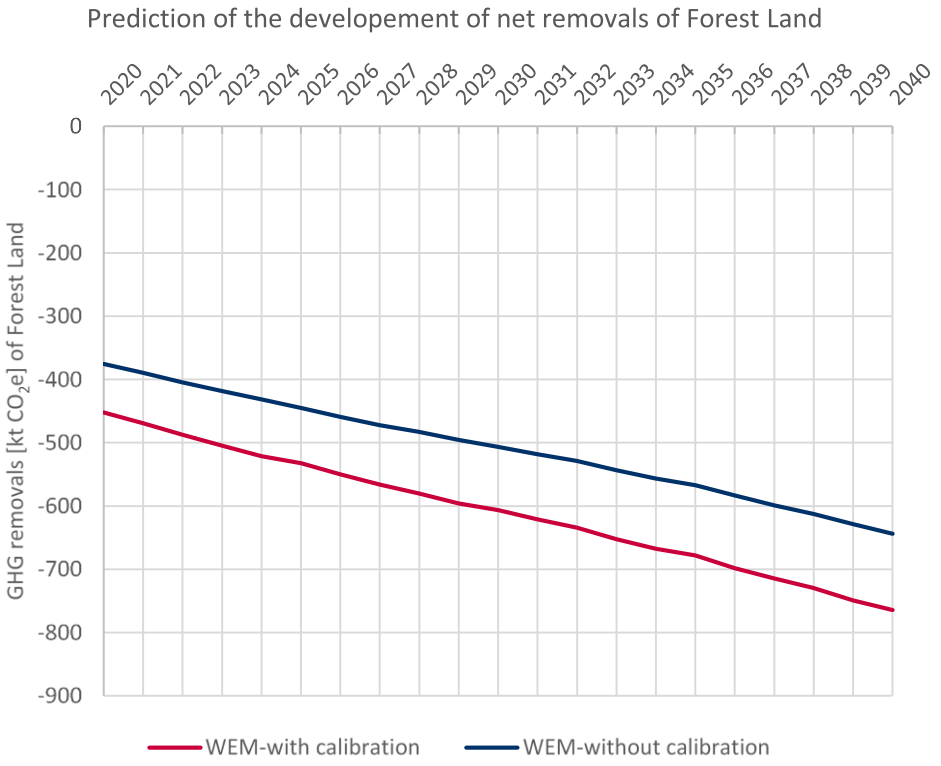


Figure 5.32 Prediction of the development of net removals of forest land in the WEM-with-calibration and WEM-without calibration scenarios.

6. Impacts and adaptation measures

6.1 Climate variations

6.1.1 Observed variability

Temperature in Iceland exhibits large inter-decadal variations. The longest continuous temperature record comes from Stykkishólmur on the west coast of Iceland. Statistical treatment of data from this station and of non-continuous measurements at other locations in Iceland, allows this record to be extended back to 1798, see Figure 6.1. This record shows that during the 19th century, temperatures were cooler than in the 20th century, and that the magnitude of inter-annual variations in temperature were larger. In the 1920s, there was a period of rapid warming, as also observed in global averages, but in Iceland, the temperature change was greater and more abrupt. From the 1950s, temperatures in Iceland had a downward trend with a minimum reached during the years of Great Salinity Anomaly in the late 1960s, when sea ice was prevalent during late winter along the north coast. Conditions were rather cool in the 1970s with 1979 being the coldest year of the 20th century in Iceland. Since the 1980s, Iceland has experienced considerable warming, and in first decade of the 21st century, temperatures reached values comparable to those observed in the 1930s. The warmest year in the series was 2016. While there are pronounced inter-decadal temperature swings in Iceland, the long-term warming rate is similar to the global average, suggesting that the rapid warming in the period 1979 to 2021 is a combination of local variability and large-scale background warming. This remains true both for the annual average and individual seasons.

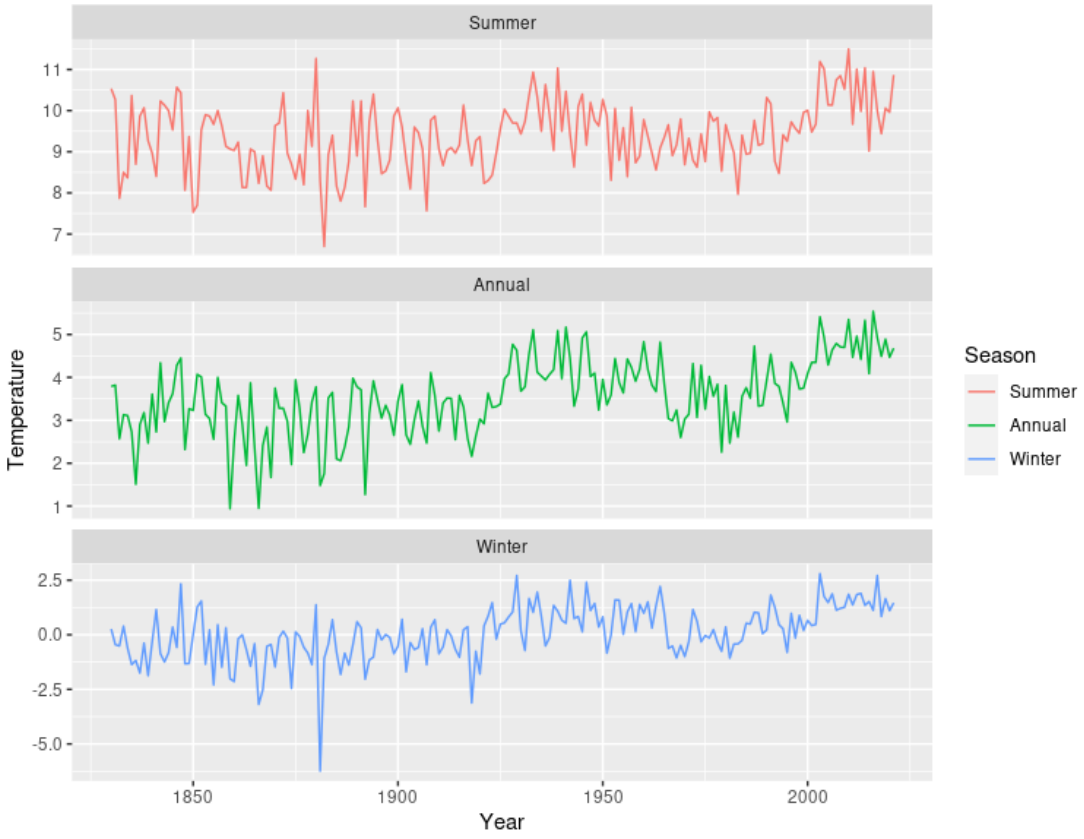


Figure 6.1 Mean annual temperature in Stykkishólmur 1798–2021.

Figure 6.1 illustrates the mean annual temperature in Stykkishólmur 1798–2021. Prior to 1850, the data are a composite of measurements from several stations and thus less reliable than the post-1850 data. The top panel shows the summer season (JJA), the bottom panel the extended winter season (NDJFM) and the middle panel the annual average. Decadal variations in precipitation are also significant in Iceland.

Continuous precipitation records extend back to the late 19th century, but precipitation has been measured at several stations since the 1920s. The station network, however, has insufficient coverage in the Icelandic highland where precipitation tends to be greater than in lowland areas. Recently, an estimate for precipitation in all of Iceland during the last decades of the 20th century has been derived using high-resolution atmospheric reanalysis. The results show significant decadal variations in precipitation, and a tendency for higher amounts of precipitation during warmer decades. The long-term station records indicate that precipitation tends to increase by 4% to 8% for each degree of warming. Furthermore, several new studies suggest an increase in precipitation intensity during the warming of recent decades.

6.1.2 Climate projections

Based on the results of climate models, the currently observed warming is expected to continue. The warming rates differ between emission scenarios and between models. An analysis of the CMIP6 SPSS scenarios for many models showed that over the 21st century the warming is likely to be 1–4 °C on average see Figure 6.2 and increase in precipitation to be 2–5%. The uncertainty range is quite large, for temperature the span between the 5th and 95th percentile ranges was around 4 °C but for precipitation 20–25%.

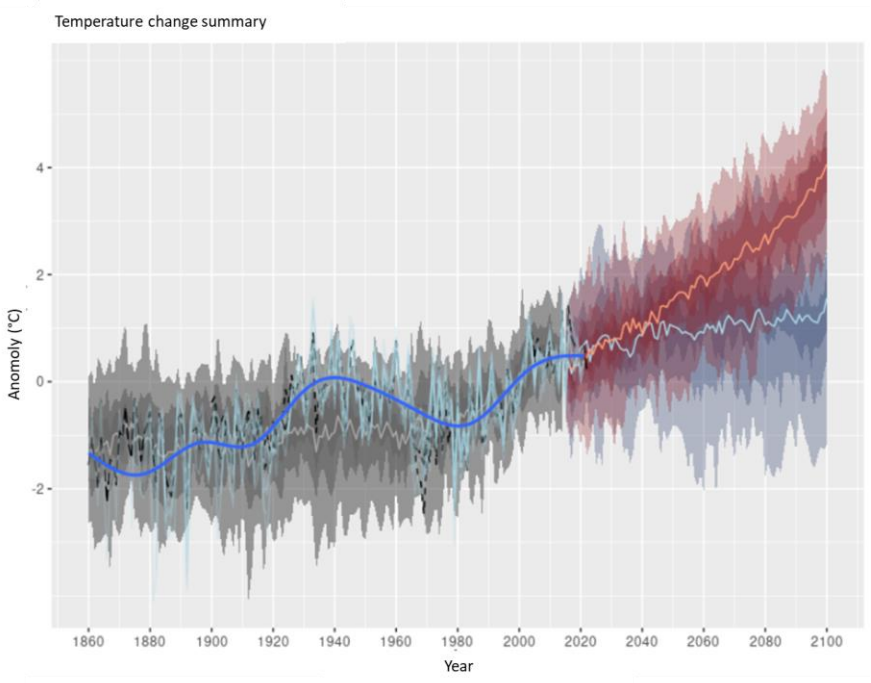


Figure 6.2 Warming in Iceland and surrounding areas.

Figure 6.2 illustrates warming in Iceland and surrounding areas. Estimated warming in a region covering Iceland and neighbouring oceanic areas in the 21st century. According to the CMIP6 models for two different scenarios SSP1_2.6 (blue) and SSP5_8.5 (red). Thick lines indicate ensemble averages for the scenarios. Also

shown in grey is the results of the 20th century CMIP6 experiments. Light blue and dashed lines indicate observations during the 20th century.

6.2 Variations in ocean currents

The climate of Europe and the northern North Atlantic is much milder than at comparable latitudes in Asia and North America. This is due to heat transport from the south with air and water masses. A key process in this respect is the so-called Atlantic Meridional Overturning Circulation (AMOC) in the North Atlantic. This circulation is due to sinking of ocean water, because of cooling of surface waters and ice formation at high latitudes. After sinking, this water is called deep water and it subsequently flows at depth to southern latitudes. In the northern North Atlantic, huge amounts of deep water are formed, e.g., in the Arctic Ocean, the Greenland Sea and the Labrador Sea. The deep water that is formed north of the Greenland–Scotland Ridge flows over the ridge on both sides of Iceland, as well as through the Faroe–Shetland Channel.

Many numerical models predict that the production of deep water will be reduced because of increasing greenhouse gases in the atmosphere. This happens when more fresh water is introduced to the Nordic Seas because of melting of glaciers, thawing of permafrost and increased precipitation that makes the surface layers fresher and therefore reduce the intensity of vertical convection. This in turn leads to reduced deep-water flow over the Greenland–Scotland Ridge and a compensating reduction of flow of warm surface waters into the Nordic Seas, thus inducing a lowering of the temperature in the area. Ice-core data from the Greenland Ice Sheet indicate that this can happen rather quickly or within decades. Research projects measuring changes in the fluxes over the Greenland-Scotland Ridge have succeeded in deriving a time series of the northward flux of Atlantic water and the southward flux of deep water as well as the associated heat fluxes. The time series now available have revealed that the flow of deep water across the Greenland-Scotland Ridge has been quite stable. The observations have shown that after the mid-1990s the flux of Atlantic water and the associated heat flux across the Greenland-Scotland Ridge increased. The increase has been attributed to both increased flow and increased temperature of the inflowing Atlantic water. In the sixth assessment report of IPCC (2021) it was concluded that there is medium confidence that the Atlantic Meridional Overturning Circulation (AMOC) will not experience an abrupt collapse before 2100, if it were to occur, it would very likely cause abrupt shifts in regional weather patterns and water cycle. While there is low confidence in 20th century AMOC change, it is very likely that AMOC will decline over the 21st century. The possible slowdown of the AMOC may reduce the rate of temperature rise near Iceland but is not likely to lead to lowering of the temperature.

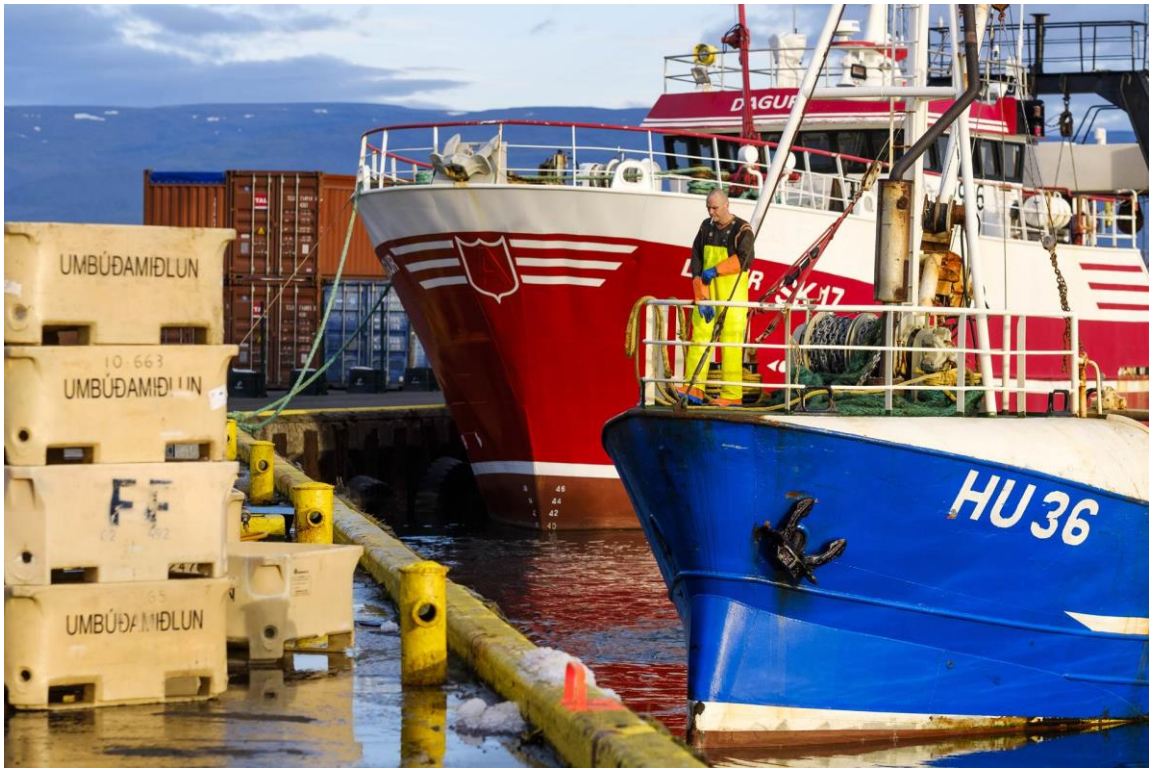
6.3 Impacts on marine ecosystems and fish stocks

To project the effects of climate change on the marine ecosystem is a challenging task. Available evidence suggests that, as a general rule, primary and secondary production and thereby the carrying capacity of the Icelandic marine ecosystem is enhanced in warm periods, while lower temperatures have the reverse effect. Within limits, this is a reasonable assumption since the northern and eastern parts of the Icelandic marine ecosystem border the Polar Front. In cold years the Polar Front can be located close to the coast northwest to northeast of Iceland. During warm periods it occurs far offshore, when levels of biological production are enhanced through nutrient renewal and associated mixing processes, resulting from an increased flow of Atlantic water onto the north and east Icelandic plateau.

Since 1998 and until present temperature and salinity of the waters around Iceland have usually been above the long-term average. Similarly, over the last twenty years the salinity and temperature levels of Atlantic

water south and west off Iceland have almost continuously been above the average. At the same time, there have been indications of increased flow of Atlantic water onto the mixed water areas over the shelf north and east of Iceland in spring and, in particular, in late summer and autumn. Whether this indicates the beginning of a long-term period of increased presence of Atlantic water, resulting in higher temperatures and increased vertical mixing over the north Icelandic shelf is not possible to state at this stage.

Many parameters can affect how an ecosystem and its components, especially those at the upper trophic levels, will react to changes in temperature, salinity, and levels of primary and secondary production. However, observations by the Marine and Freshwater Research Institute indicate that changes in the marine ecosystem around Iceland during past two decades are likely to be related to the recent warming. The most marked ones and best registered are chances in abundance and distribution of many fish stocks.



To large extent the response of commercial fish stocks to a warming of the marine environment around Iceland has been similar to that which occurred during the warming between 1920s and 1960s. Thus, during recent warm period since 1996 marked changes have been observed in the distribution of many fish species. Southern commercial species have extended farther north (e.g. haddock, monkfish, mackerel, blue whiting, saithe), a northern species is retreating (capelin), rare species and vagrants have been observed more frequently (e.g. greater fork beard, blue antimora, snake pipefish, sea lamprey, Ray's bream, ocean sunfish), and 34 species, from both shelf and oceanic waters, have been recorded for the first time since 1996. Recent analysis of trends in annual groundfish surveys have observed a general shift to the northeast for majority of species observed. The magnitude of these changes will, however, be no less dependent on the success of future fisheries management aiming at long term sustainable level for all commercial species.

The Marine and Freshwater Research Institute and the University of Iceland conduct studies on sea water carbonate chemistry and the air-sea flux of carbon dioxide. Research on seasonal biogeochemical processes enables evaluation of the magnitude of the ocean carbon dioxide sink and its relation to

oceanographic conditions. The North Atlantic Ocean is overall a strong sink for carbon dioxide, but it is, however, evident that the conditions are both regionally variable and changing in response to rising atmospheric carbon dioxide.

There are long term time series from quarterly observations, since 1983, of ocean carbon dioxide at two sites near Iceland which differ significantly in oceanographic characteristics. The time series are invaluable for assessing long term trends and rates of change. They reveal rapid ocean acidification in the Iceland Sea at 68°N. The surface pH there falls 50% faster than is observed in the sub-tropical Atlantic. The rapid rate of change is because the Iceland Sea is a strong sink for carbon dioxide and the sea water is cold and relatively poorly buffered. The sea water calcium carbonate saturation state is low in these waters and it falls with the lowering pH. The calcium carbonate saturation horizon which lies at about 1700 m is shoaling which results in large areas of sea floor becoming exposed to undersaturated waters with respect to aragonite (calcium carbonate). At shallower depths the sea water saturation state is falling with unknown consequences for benthic calcifying organisms.

The biological effects and ecosystem consequences of the carbonate chemistry changes are of concern and are being studied. Thus, it is hoped gain increased knowledge and to further understand the potential risk of ocean acidification in Icelandic waters.

6.4 Impacts on glaciers

Glaciers are a distinctive feature of Iceland, covering about 10% of the total land area. The largest glacier is Vatnajökull ice cap in southeast Iceland with an area of 7,720 km2 in 2019. Climate changes are likely to have a substantial effect on glaciers and lead to major runoff changes. The changes in glacier runoff are already substantial and are expected to increase in the future, and they are one of the most important consequences of future climate changes in Iceland. The runoff increase may, for example, have practical implications for the design and operation of hydroelectric power plants.

Rapid retreat of glaciers does not only influence glacier runoff but leads to changes in fluvial erosion from current glacier areas, and changes in the courses of glacier rivers, which may affect roads and other communication lines. A recent example of this is the change in drainage from Skeiðarárjökull, a large, south-flowing outlet glacier from Vatnajökull ice cap. Due to thinning and retreat of the glacier, the outlet of river Skeiðará moved west in 2009 and the river merged with another glacier river, Gígjukvísl. The outlet of Súla river at the western part of the terminus followed in 2016 and merged with Gígjukvísl also. Consequently, all glacier meltwater from Skeiðarárjökull now flows under the bridge over Gígjukvísl and little water flows in the river courses of Súla and Skeiðará. Skeiðará was previously crossed by the longest bridge in Iceland, over a kilometer long, which has now been dismantled. Glacier downwasting in Iceland and other glacier areas outside the polar regions is of international interest due to the contribution of glaciers and small ice caps to rising sea level. Glacier variations in Iceland are monitored by a voluntary network of lay people who visit ca. 40 glacier termini annually and measure the change in the terminus position. The monitoring shows that today, most non-surging glaciers in Iceland are retreating (Figure 6.3). Tens of named glaciers have disappeared entirely since 2000.

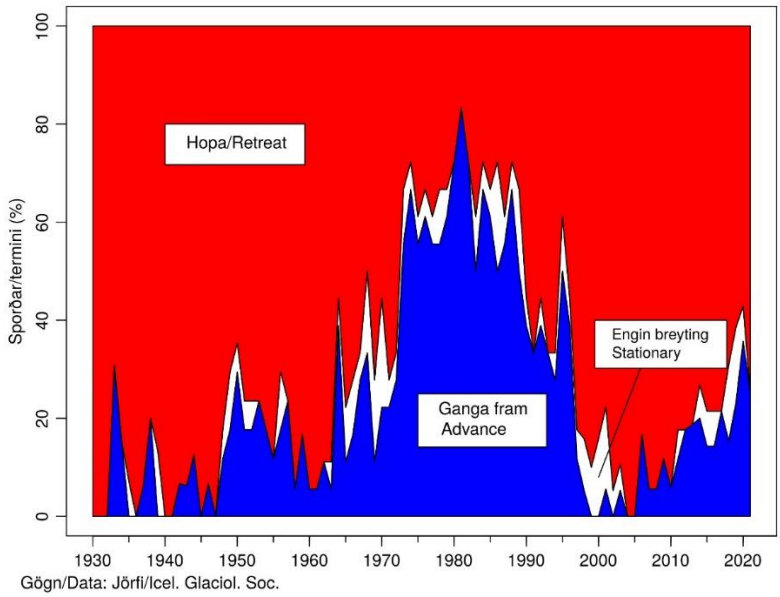


Figure 6.3 Annual proportion of monitored non-surging glacier termini.

Figure 6.3 shows the annual proportion of monitored non-surging Icelandic glacier termini that advanced or retreated in the period 1931 to 2021. The figure is based on data from 10–20 glaciers for most years. Source: The database of the Icelandic Glaciological Society.

Remote-sensing measurements of glacier topography from satellites and aircraft (optical stereo images and airborne lidar measurements) show significant thinning of the Icelandic glaciers during the 21st century. The glaciers are mapped regularly in order to monitor the currently on-going ice wastage. The Vatnajökull, Langjökull and Mýrdalsjökull ice caps were mapped using satellite images in late summer 2021 and Hofsjökull was mapped in 2020. The glacier maps and other available information about glacier mass balance and changes in glacier extent show that glaciers in Iceland lost ca. 550 gigatonnes of ice, 16% of their mass, between the end of the 19th century and 2021. Almost half of this ice melted after 1994/1995. Figure 6.4 shows the elevation change of Mýrdalsjökull in the period 2010 to 2021. The average lowering of the glacier surface is ca. 9 m over this period.

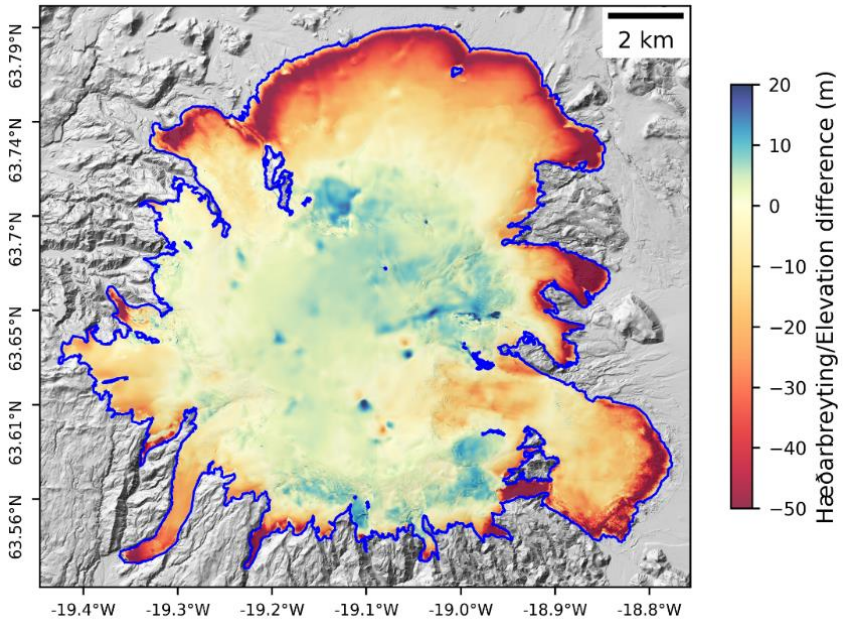


Figure 6.4 Elevation changes of Mýrdalsjökull ice cap.

Figure 6.4 Illustrates the Elevation changes of Mýrdalsjökull ice cap, based on aerial lidar measurements (2010) and Pléiades stereo images (2021). (Pléiades © CNES (2021), Distribution AIRBUS DS)

The thinning of large glaciers, such as the Vatnajökull ice cap, one of Europe's largest ice masses, reduces the load on the Earth's crust which rebounds. Consequently, large parts of the central highland and SE-Iceland are now experiencing uplift (see Figure 6.5). The uplift does not, however, reach to the urban southwest part of Iceland, where subsidence occurs because of other geotectonic processes-. The uplift along the southeastern coast will counteract the impact of rising global sea level during the 21st century for this region of Iceland. The subsidence in southwestern part of Iceland will on the other hand exacerbate the impact of rising sea level in the North Atlantic Ocean around Iceland.

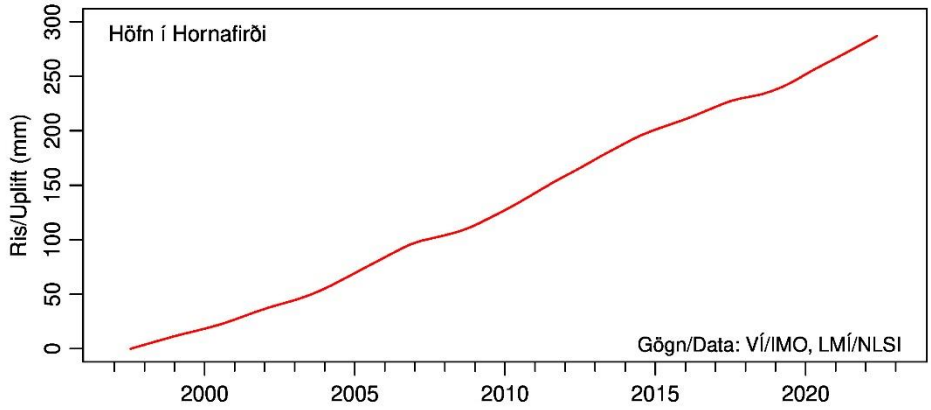


Figure 6.5 Crustal uplift measured by GPS at Höfn in Hornafjörður in SE-Iceland

Modelling of the Icelandic glaciers shows that glacier runoff will increase and that usable hydropower from the glacier rivers will increase by 20% until 2050. The current hydropower system can capture about half of this increase. The peak runoff is expected to occur in the latter part of the 21st century.

Although glaciers and ice caps in Iceland constitute only a small part of the total volume of ice stored in glaciers and small ice caps globally, studies of their sensitivity to climate changes have a general significance because these glaciers are among the best monitored glaciers in the world. Field data from glacier regions in the world are scarce due to their remote locations and difficult and expensive logistics associated with glaciological field work. Results of monitoring and research of Icelandic glaciers are therefore valuable within the global context, in addition to their importance for evaluating local hydrological consequences of changes in glacier areas in Iceland.

Studies on regional sea level rise reveal indicate that the sea-level rise in Iceland may be quite different from the global average. The main reason for this is that the melting of the Greenland ice sheet will affect the gravitational field around Greenland in a way that, with other things being equal, would lower sea level in the vicinity of Greenland. This effect can be calculated given assumptions about glacial melt, and its "fingerprint" mapped. When other changes, such as the thermal expansion of the oceans and the residual isostatic adjustment from the last glaciation are factored in, sea level in the vicinity of Greenland does actually rise, but less than the global average. Figure 6.6 shows results of such calculations (adapted from IPCC, 2013) for Iceland and the neighboring coastal ocean. The figure shows the sea-level rise around Iceland as a percentage of global sea-level rise for all four RCP scenarios examined by IPCC (2013) and includes sea-level rise due to thermal expansion, glacier melt, dynamical changes and the fingerprint of gravitational changes. Around much of the Icelandic coast the sea-level rise around Iceland is 30–40% of global average. Once vertical land motion is added it becomes clear that along the south coast of Iceland, the uplift is fast enough to out-pace the regional sea-level rise

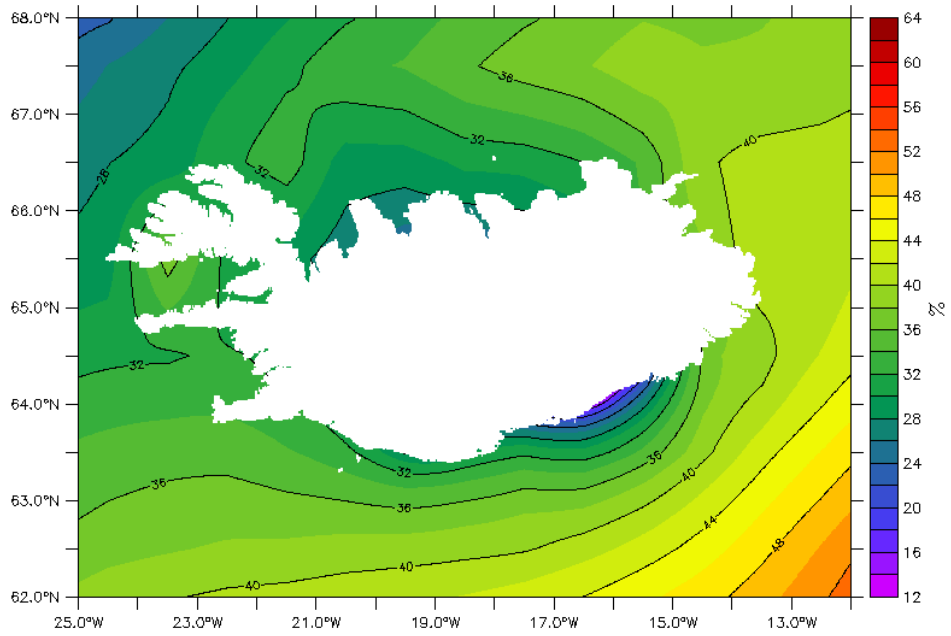


Figure 6.6 Sea level rise around Iceland by 2100.

Figure 6.6 illustrates the sea level rise around Iceland by 2100., as a fraction of the global averaged sea level change. Shown is the average fractional change for four different RCP scenarios spanning a significant range in warming during the 21st century. The effects included are sea-level change due to thermal expansion, ice melt and changes in the gravitational field due to melting of glaciers in Iceland and ice melt in Greenland. Adapted from IPCC, 2013.

Recent research using the CIMP6 projections has increased confidence in these counter-intuitive results and using model of sea level response it seems likely that the contributions from Arctic and Antarctic ice mass loss will close cancel in Iceland. This can be seen in Table 54 that shows projected sea level rise in Reykjavik under 4 different SSPs scenarios.

Table 54 Sea level rise in Reykjavik in 2100 split into contributions from different sources (median, 17th and 83rd percentile). Source[125][126][127][128]

	SSP2-4.5	SSP3-7.0	SSP5-8.5	SSP5-8.5 *Low Confidence*
Stero- dynamic Sea Level	0.29 (0.20, 0.38)	0.34 (0.23, 0.46)	0.44 (0.30, 0.59)	0.44 (0.30, 0.59)
Glaciers	-0.05 (-0.10, -0.00)	-0.06 (-0.11, -0.01)	-0.07 (-0.12, -0.02)	-0.09 (-0.14, -0.02)
Greenland	-0.14 (-0.23, -0.07)	-0.20 (-0.28, -0.12)	-0.22 (-0.31, -0.15)	-0.31 (-1.02, -0.15)
Antarctica	0.13 (0.03, 0.34)	0.13 (0.03, 0.36)	0.13 (0.04, 0.40)	0.22 (0.03, 0.65)
Land Water Storage	0.03 (0.02, 0.04)	0.03 (0.02, 0.05)	0.03 (0.01, 0.04)	0.03 (0.01, 0.04)
Vertical Land Motion	0.01 (-0.03, 0.04)	0.01 (-0.03, 0.04)	0.01 (-0.03, 0.04)	0.01 (-0.03, 0.04)
Total (2100)	*0.26 (0.07, 0.52)*	*0.26 (0.05, 0.55)*	*0.32 (0.08, 0.65)*	*0.36 (-0.40, 0.84)*

6.5 Impacts on agriculture, land management and forestry

This chapter has been reviewed by experts from the Icelandic forest service and the soil conservation service of Iceland.

[125] Jet Propulsion Laboratory Sea Level Projection Tool

[126] Fox-Kemper, B., H. T. Hewitt, C. Xiao, G. Aðalgeirsdóttir, S. S. Drijfhout, T. L. Edwards, N. R. Golledge, M. Hemer, R. E. Kopp, G. Krinner, A. Mix, D. Notz, S. Nowicki, I. S. Nurhati, L. Ruiz, J-B. Sallée, A. B. A. Slangen, Y. Yu, 2021, Ocean, Cryosphere and Sea Level Change. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In press.

[127] Garner, G. G., R. E. Kopp, T. Hermans, A. B. A. Slangen, G. Koubbe, M. Turilli, S. Jha, T. L. Edwards, A. Levermann, S. Nowikci, M. D. Palmer, C. Smith, in prep. Framework for Assessing Changes To Sea-level (FACTS). Geoscientific Model Development.

[128] Garner, G. G., T. Hermans, R. E. Kopp, A. B. A. Slangen, T. L. Edwards, A. Levermann, S. Nowikci, M. D. Palmer, C. Smith, B. Fox-Kemper, H. T. Hewitt, C. Xiao, G. Aðalgeirsdóttir, S. S. Drijfhout, T. L. Edwards, N. R. Golledge, M. Hemer, R. E. Kopp, G. Krinner, A. Mix, D. Notz, S. Nowicki, I. S. Nurhati, L. Ruiz, J-B. Sallée, Y. Yu, L. Hua, T. Palmer, B. Pearson, 2021. IPCC AR6 Sea-Level Rise Projections. Version 20210809. PO.DAAC, CA, USA. Dataset accessed at https://podaac.jpl.nasa.gov/announcements/2021-08-09-Sea-level-projections-from-the-IPCC-6th-Assessment-Report.

Approximately 60% of the total land area of Iceland is currently used for grazing and or fodder production and the raising of livestock[129]. Around 6% of this area is cultivated, with the remainder devoted to raising livestock or left undeveloped. Production of meat and dairy products is mainly for domestic consumption. The principal crops have been hay, potatoes and other root vegetables. Cultivation of other crops, such as barley and oats, has increased rapidly in the recent years and they are now becoming one of the staples. In addition to this there is considerable cultivation of vegetables and flowers in greenhouses heated with geothermal water and lit with electricity in winter.

In Iceland the human impact on ecosystems is strong. The entire island was estimated to be about 65% covered with vegetation at the time of settlement in the year 874. Today, Iceland is only about 25% vegetated. This reduction in vegetative cover is the result of a combination of harsh climate and intensive land and resource utilization by a farming and agrarian society over 11 centuries. Estimates vary as to the percentage of the island originally covered with forest and woodlands at settlement, but a range of 25 to 30% is plausible.



Organized forestry is considered to have started in Iceland in 1899. Afforestation through planting increased considerably during the 1990s from an average of around 1 million seedlings annually in the 1980s to 4 million in the 1990s. Planting reached a high of about 6 million seedlings per year during 2007 – 2009 but was reduced after the financial crisis to about 3 million seedlings during 2010-2017. Around 1100-1900 ha

[129] https://grolind.is/wp-content/uploads/2020/06/Kortlagning-beitilanda-2020.pdf

was afforested annually in the period of 1990-2007 but decreased to 500-800 ha in 2010-2017. Planting of native birch has been increasing proportionate to the total afforestation, comprising 27% of seedlings planted in the period 1990-2013 and over 30% since 2018. From its limited beginnings in 1970, state supported afforestation on farms and privately-owned land became the main channel for afforestation activity in Iceland, comprising about 80% of the afforestation effort in 2017. Since then, other projects have increased proportionately more, especially state supported planting on eroded land, mostly with native birch, and planting financed by the private sector, often specifically for CO_2 sequestration. Annual planting is again up to 6 million seedlings in 2022 and increasing. The total area of forest and other wooded land in 2017 was around 1945 km^2 covering 1.9% of the total surface of Iceland. Native birch forest and woodland cover around 1520 km^2 and cultivated forest cover around 425 km^2. That area is up to just over 2000 km^2 in 2022[130].

The Soil Conservation Service of Iceland, an agency under the Ministry of Food, Agriculture and Fisheries (BM) was founded in 1907. The main tasks of the agency is combating desertification, sand encroachment and other soil erosion, the promotion of sustainable land use and reclamation and restoration of degraded land. A pollen record from Iceland confirms the rapid decline of birch and the expansion of grasses in 870-900 AD. Around 1900 more than 90% of the original Icelandic forest was gone and by 1700 about 40% of the soils had been washed or blown away. Vast gravel-covered plains were created where once there was vegetated land. Ecosystem degradation is one of the largest environmental problems in Iceland. Vast areas have been desertified after over-exploitation and the speed of erosion is often magnified in certain areas by volcanic activity and harsh weather conditions.

Land reclamation activities focused in the beginning on areas in south and south west Iceland where problems of drifting sand were most evident in threatening farms and fishing villages. After World War II the reclamation effort was spread more widely but still with a focus on south Iceland. With increased resources after 1974 reclamation activity was extended to many inland locations that were prime sources of sand along major rivers or near outlets of rivers. With detailed information acquired from mapping of erosion severity, recent reclamation activity has become wider spread, more selective and targeted. In 2021 the total extent of restored areas or areas undergoing restoration was estimated to be at least 3400 km^2.

6.6 Impacts on terrestrial ecosystems

Iceland's natural terrestrial ecosystems can be roughly divided into; heathland , wetlands, grasslands, woodlands, and barren or sparsely vegetated areas. Effects of warmer climate on most terrestrial ecosystems in Iceland are not expected to differ from those earlier described for forests. As for the managed ecosystems, the warmer climate is likely to extend the length of the growing season and increase plant production. Higher winter temperature is also likely to stimulate decomposition of litter and soil organic matter and thereby mineralization of nutrients, with more available for plant growth. However, new insect species that may have negative impact on the vegetation are also likely to establish[131]. All these changes will have effects on the function, structure and distribution of terrestrial ecosystems. Similar changes are

[130] Þröstur Eysteinsson, Icelandic Forest Service, pers. com. (24.10.2022)

[131] Halldórsson, G., Sigurdsson, B.D., Hrafnkelsdóttir, B., Oddsdóttir, E.S., Eggertsson, Ó. & Ólafsson, E. 2013. New arthropod herbivores on trees and shrubs in Iceland and changes in pest dynamics: A review. Icelandic Agricultural Sciences, 26, 69-84.

expected in Iceland[132] as in other parts of the high-boreal, sub-arctic and arctic areas, as described e.g. in the IPCC report from 2022. [133]

Many areas in Iceland have suffered from extensive historic vegetation change and soil erosion due to, among other factors, heavy livestock grazing and periods of cold climate. The grazing pressure in many areas has decreased and one effect of the warmer climate is to enhance reestablishment of former vegetation and productivity of many of these areas. Indeed, it was recently shown (2011) that satellite-based vegetation index (NDVI) of the whole country during the period 1982-2010 has increased, especially after 2000. It has been concluded that vegetation of sparsely vegetated or barren areas should mostly benefit from warmer climate; at least if changes in precipitation patterns do not counteract its effects. Increased precipitation could lead to increased water erosion of barren soils.

The prediction of higher production of Icelandic plant communities in future climate was, however, only partly confirmed by the ITEX-project (International Tundra Experiment). It experimentally simulated during 3-5 years a climate warming of 1-2 °C in two widespread, but contrasting plant communities. A dwarf-shrub heath showed up to 100% increase in height growth, while biomass production in a moss heath was not affected. It was concluded that the sensitivity of Icelandic tundra communities to climate warming varies greatly depending on initial conditions in terms of species diversity, dominant species, soil and climatic conditions as well as land-use history. If, however, some large-scale changes occur in land cover, it would affect distribution and diversity of both flora and fauna, and some rare species might become endangered while other might benefit. Other possible negative impacts of climate change on terrestrial ecosystems include increasing risks of plant diseases and insect pests.

The rate of successful introduction (intended and unintended) of arthropod species in Iceland has increased with warming climate and among them are several pest species on trees and shrubs. Higher temperatures have also led to changes in outbreak pattern and intensity of native pest species.[1]

One rare plant community, highland permafrost string bogs (palsamires), is already under threat from the recent climate warming. The string bogs and their discontinuous permafrost areas might even disappear with further warming. Then their function as important habitats for plants and as breeding ground for birds could disappear as well. The permafrost string bogs hold much soil organic matter that currently is unavailable to decomposition. The thawing of these soils could therefore result in more emissions of GHGs.

Decomposition of organic matter and the subsequent CO_2 emission rate is primarily temperature controlled, where oxygen can access it. Warmer winters will increase decomposition of organic matter in terrestrial ecosystems, both litter and soil organic matter, and presumably increase the annual release of all GHGs (CO_2, CH_4 and N_2O). How this will affect the annual ecosystem GHG balance depends, however, on how fast and how much the summer carbon uptake (productivity) will be increased due to more plant cover, longer growing seasons, warmer temperatures, and increased nutrient availability in each ecosystem type.

Arctic Fox is the only native land mammal in Iceland. In a recent study it was shown that its growth and population size has varied with past climate fluctuations[134], that can be related to changes in its prey

[132] https://www.vedur.is/media/loftslag/Skyrsla-loftslagsbreytingar-2018-Vefur-NY.pdf

[133] Pörtner, Hans-Otto, et al. "Climate change 2022: Impacts, adaptation and vulnerability." IPCC Sixth Assessment Report (2022).

[134] Ester Rut Unnsteinsdóttir 2021. Íslenski melrakkinn - fyrsti hluti: stofnbreytingar, veiðar og verndun. Náttúrufræðingurinn, 91(3-4): 97-111.

populations.[135] Four bird species have become extinct in Iceland since 1844 (one globally) but during the same period several new bird species have colonized and become regular breeding birds. The climate warming during this period could possibly have influenced one extinction; the Little Auk, which is an Arctic seabird.[136]Some of the colonizations could also possibly be linked to warmer climate, especially winter climate. Establishment of new habitats, such as coniferous forests and urban gardens, has also been an important contributing factor. Encroachment of shrubs and other tall vegetation due to warming temperatures as well as decreased grazing will influence habitat suitability of waders, of which many populations are of international importance.[137] It should also be noted that plans of extensive forestry in order to combat climate change pose a real threat to wader populations. [138] Breeding success of the Ptarmigan, an important game species in Iceland, has been shown to be closely related to precipitation and wind. [139]More extreme weather could therefore affect the species. There have been large-scale changes in many seabird colonies of e.g. puffins and guillemots in S- and W-Iceland in recent decades. This collapse has been linked to less abundance of their feedstock fish, such as sand eel, in the same region.[140] Oceanic temperatures have steadily risen off the S and W coast of Iceland during the past decades, but it is not fully understood how and if that has affected the population dynamics of the feedstock fish.

There have been some studies that have shown that biogeochemistry of rivers has changed during recent years. The amount of dissolved organic carbon has e.g. increased with increased annual temperature. Salmon has also shown more growth and higher production per unit area in NE Iceland during the past 20 years, which has been related to warmer climate. There are some indications that the Arctic Char, which is a sub-arctic freshwater fish, has been becoming less frequent in shallow lakes in Iceland during the past years. This has been linked to its low optimum temperature, but other factors may also be important. A new fish species, Flounder, has also colonized Icelandic freshwaters in S- and W-Iceland during the last decade and is currently increasing its distribution in N and E Iceland. Previously its northern limits were in the Faeroe Islands. How this will affect the river ecosystems is not known.

[135] Pálsson, S., Hersteinsson, P., Unnsteinsdóttir, E.R. et al. Population limitation in a non-cyclic arctic fox population in a changing climate. Oecologia 180, 1147–1157 (2016). https://doi.org/10.1007/s00442-015-3536-7

[136] Náttúrufræðistofnun Íslands 2018c. Válisti fugla. https://www.ni.is/midlun/utgafa/valistar/

fuglar/valisti-fugla

[137] Tómas Grétar Gunnarsson 2020. Búsvæði og vernd íslenskra vaðfugla. Náttúrufræðingurinn 90 (2–3) bls. 145–162.

[138] Tómas Grétar Gunnarsson 2020. Búsvæði og vernd íslenskra vaðfugla. Náttúrufræðingurinn 90 (2–3) bls. 145–162.

[139] Ólafur K. Nielsen, Jenný Brynjarsdóttir og Kjartan Magnússon 2004. Vöktun rjúpnastofnsins 1999–2003. Fjölrit Náttúrufræðistofnunar, nr. 47 https://utgafa.ni.is/fjolrit/Fjolrit_47.pdf

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6.7 Adaptation measures

National circumstances and institutional arrangements

Iceland is a large island located at the confluence of the North Atlantic and Arctic Oceans with a land area of some 103 thousand square kilometres, a coastline of 4,970 kilometres and a 200-nautical-mile exclusive economic zone extending over 758 thousand square kilometres in the surrounding waters. Iceland is prone to a multitude of hazards including extreme storms, floods, earthquakes, volcanic eruptions, landslides, and avalanches.

Climate change is contributing to shifts in the magnitude and scale of hazards, and the emergence of risks in areas where they were previously unknown.

The economy relies inter alia on fisheries and tourism and therefore potential impacts on these industries because of the climate change are of high importance.

The Ministry of the Environment, Energy, and Climate is responsible for the issue of climate change adaptation. The Icelandic Met Office operates the national knowledge centre for climate change adaptation (NKCCCA) supported by an Office for Climate Services and Adaptation, which is responsible for the coordination and communication of information related to the impacts of climate change. The centre also strives to generate knowledge and build tools for the municipalities to develop adaptation measures. One of its ongoing projects involves a pilot with 4 municipalities to create guidelines for adaptation planning at the municipal level.

Moreover, an Office for Natural Hazards at the Met Office oversees monitoring of many climate-related natural hazards and frequently in collaboration with the Icelandic Avalanche and Landslide Disaster Fund operated by the Ministry of the Environment, Energy, and Climate.

Many governmental research institutes also play a role in monitoring the impacts of climate change, such as the Marine and Freshwater Research Institute and the Icelandic Institute of Natural History. The Met Office convenes a Partnership for Knowledge Production on the Impacts of Climate Change and currently chairs its first executive committee with membership from other primary research institutions. The Icelandic scientific committee is currently working on Iceland's fourth scientific report on the impacts of climate change in Iceland, forthcoming in 2023. All of these actors and stakeholder are key to the designing of adaptation measures that are built on the best available science.

The Icelandic Climate Council is mandated to offer guidance on climate change adaptation and the council has both provided technical reports on the matter and exchanges with governmental officials on adaptation via council meetings.

Legal frameworks

In 2019, Iceland adopted new provisions to its 2012 Climate Change Act on the preparation of a plan on the adaptation of Icelandic society to climate change. As a first step towards this end, Iceland adopted its first National Adaptation Strategy (NAS) in 2021, following a white paper on climate change adaptation produced by an expert working group on the issue. The work was furthermore based on Iceland's reports on the impacts of climate change in Iceland and a discussion paper on adaptation by Iceland's Climate Council.

Iceland is currently working towards its first National Adaptation Plan with a steering group in place for the development of a proposal for fall 2023 on the governance and modalities of such a plan to the Minister of Environment, Energy and Climate. Currently, the steering group is advisory to a targeted stakeholder engagement process with expert workshops for the aggregation of risks and potential adaptation measures in different sectors of society based on the NAS.

Vulnerability analysis

The Icelandic scientific reports on climate change, published in 2000, 2008 and 2018, have offered a mapping of potential vulnerabilities because of impacts from climate change.

Avalanche risk assessments

The framework for the avalanche and landslide risk assessments is structured, through laws and regulations.

The Icelandic Avalanche and landslide Committee oversees the preparation of hazard assessments and decision-making regarding the construction of defensive structures in urban residential areas that are at risk from avalanches and landslides. These projects are partly funded by the Icelandic Avalanche and landslide fund. The fund is financed through tax on property in Iceland 0,3 ‰.

The Icelandic Avalanche and Landslide Committee operates under the authority of the Minister of Environment, Energy and Climate. The role of the Icelandic Avalanche and Landslide Committee according to act on protection against avalanches and landslides is:

- To discuss and take a position on local government proposals for the construction of defensive structures in dangerous areas.
- Taking a stand on proposals for the purchase or transfer of real estate or other valuables instead of building fortifications or using other defensive measures.
- To make proposals to the Minister of the Environment, Energy and Climate for financial support from the Avalanche and Landslide Fund for the projects mentioned above.

The municipal constructions discussed by the Icelandic Avalanche and Landslide Committee must be approved by the Icelandic Avalanche and Landslide Committee before they begin. Thus, municipalities cannot incur financial obligations before the Icelandic Avalanche and Landslide Committee's approval is available. The Icelandic Avalanche and Landslide Committee then prioritizes projects in consultation with the relevant municipality and the Icelandic Meteorological Office. After a comprehensive assessment was made of the vulnerability in urban areas and needs for avalanche protection in Iceland in 1997, the committee has been working according to that assessment.

Since the Icelandic Avalanche and Landslide Committee was established in 1996, avalanche and landslide protection, including the purchase of properties that will not be protected, have taken place in a total of 15 urban areas, and 6 of them have been completed. It is the government's policy that all avalanche and landslide prevention projects shall be completed by 2030.

Defensive structures can be financed up to 90% of the total cost by the Avalanche and Landslide fund, whereas the maintenance of the structures can be financed up to 60% of the total cost.

In addition to financing risk assessments and defensive structures in urban areas that are at risk of avalanche and landslides, the fund also finances research related to avalanche and landslides and other issues that are intended to enhance the risk assessment and adaptation measures.

Hazard- and risk assessments are conducted upon request by The Icelandic Meteorological Office. The Icelandic Institute of Natural History collects data on landslides and hazards caused by them in collaboration with the Icelandic Meteorological Office. A temporary authorization has been granted to pay the cost of risk assessment due to volcanic eruptions, water floods and sea floods, which are extremely urgent projects from the Icelandic Avalanche and Landslide fund.

The municipalities use the hazard and risk assessments for their land-use planning and contingency plans.

The Icelandic Meteorological Office also monitors the local risk of urban avalanches, as well as sending out general warnings for avalanches and issuing evacuations orders.

Avalanche is the only type of natural hazard where decision of evacuation is taken by the Icelandic Met Office. The decision is done in close collaboration with the local authorities. Decision making of evacuation of other types of natural hazard is taken by the National Commissioner of the Icelandic Police.

Intended adaptation efforts

Iceland is planning to introduce its first formal portfolio of adaptation measures alongside the establishment of its first National Adaptation Plan which is mandated by law and is currently being scoped through the expert stakeholder engagement process based on the 2021 National Adaptation Strategy.

Progress in implementation

Parallel to the long-term development of the National Adaptation Plan, the government has begun the planning and implementation of capacity building adaptation measures. A key element in Iceland's climate change adaptation policy world is the Office for Climate Services and Adaptation located at the Met Office. Moreover, the Government has specifically been engaging the municipalities and regions to facilitate the integration of the adaptation policy cycle on the municipal level. Currently, the Icelandic Regional Development Institute is heading a project in collaboration with the Met Office and the National Planning

Agency to pilot an approach to establish climate change adaptation within the municipal governance structure.

Monitoring and evaluation

Iceland foresees the development of an M&E system for adaptation as part of the development of the National Adaptation Plan. The current National Adaptation Strategy has as its goal that adaptation measures will be systematically monitored and evaluated based on a diverse set of criteria.



Cooperation, lessons learned

Iceland participates in Nordic cooperation focused on adaptation and plans to hold the 6th Nordic Conference on Climate Change Adaptation (NOCCA 6) in Reykjavik in the spring 2023.

Adaptation-related research

Climate change impacts on infrastructure sectors are the subject of ongoing studies. While the results of these studies show that significant impacts can be expected plans for adaptation to climate change are in most cases not well developed. The most notable exception is the National Power Company (Landsvirkjun), but the likely impacts of expected climate change are taken fully into account in their operational strategies and investment planning. Rising sea level and consequent changes in ocean floods have also been taken into account in planning of harbour infrastructure and some coastal settlements by the Icelandic Road and Coastal Administration (IRCA), and its predecessor the Icelandic Maritime Administration (IMA), following recommendations from a 1992 report on expected sea-level rise. Some coastal communities have also in recent years carried out studies of the impacts of rising sea level on ocean floods hazard but so far, the results have not been formalized in as recommendations for explicit adaptation measures in the area plans for the respective communities.

7. Financial Assistance and transfer of technology

7.1 Iceland's International Development cooperation

International Development Cooperation is one of the key pillars of Iceland's foreign policy, with the main goal of contributing to the fight against poverty in the world's poorest countries and guided by the Sustainable Development Goals (SDGs).

For nearly four decades, Iceland's official development cooperation has placed focus on the sustainable utilization of natural resources, including fisheries and geothermal and other renewable energy sources. This has been grounded on Iceland's experience and expertise in utilizing its own resources for its social, economic and human development.

This legacy is maintained in Iceland's Policy for International Development Cooperation for 2019-2023 which identifies two priority areas: (1) enhancing social infrastructure and peace efforts and (2) the protection of the earth and sustainable use of natural resources. Under the second pillar, five areas are identified as priority areas; a) Increased use of geothermal energy and other renewable energy sources (pursuant to UN SDG no. 7). b) The protection and sustainable management of the oceans and waters (pursuant to SDG no. 14). c) Recovering land quality and limiting land degradation (pursuant to SDG no. 15). d) Increasing the resilience and adaptability of societies due to the impacts of climate change (pursuant to SDG no. 13). e) Sustainable economic growth and decent work opportunities for all (pursuant to SDG no. 8).

In line with best practices in development cooperation and OECD-DAC guidelines, Iceland's development cooperation in bilateral partner countries is based on close cooperation with local communities and their needs and is based on detailed needs assessment. The same preconditions apply to the activities of multilateral partners. However, it is worth noting that Iceland's first OECD-DAC Peer Review (2017) highlighted the need to further mainstreaming environmental activities across its development cooperation portfolio and strengthen the harmonization of climate change, business and development cooperation strategies within Iceland's Ministry for Foreign Affairs in accordance with the Kyoto Protocol. The Ministry for Foreign Affairs is developing an environment and climate change strategy, that will be supported by an action plan that will guide environmental mainstreaming in all development cooperation.

7.2 Methodology

Iceland endeavours to follow best practices in international development cooperation and important efforts to that end have been made in recent years. In 2012, Iceland began the process of implementing the OECD Development Assistance Committee (DAC) statistical reporting methods (Creditor Reporting System, CRS), including the usage of the Rio Markers as a methodology for tracking finance for adaptation, mitigation, desertification and biodiversity. While the Rio Markers have guidelines and technical eligibility criteria agreed within OECD-DAC, the process of assigning markers to projects and programs is subjective and can vary between institutions and the quantification of climate relevant contribution can equally vary between countries. Iceland currently reports all programs or projects as 100% climate relevant finance if it has been marked with either Rio-marker 1 ('Significant") or Rio-marker 2 ("Principal"). While core funding to multilateral institutions is not marked with Rio Markers or accounted for in the OECD DAC marker, Iceland puts forth these contributions in BR-CTF 7a. Contributions to multilateral agencies which main mandate is climate actions such as UNCCD, SEforALL and Green Climate Fund are included in this report.

With respect to core funding to multilateral institutions that don't have an explicit climate change mandate, although possible to retrieve information on climate relevant proportions of the projects they support from OECD-DAC, these contributions are not part of the information provided in the total climate related summary in this report. Apart from core funding, reporting on climate specific finance through multilateral institutions is identified based on an application of Rio markers in the same manner as bilateral climate-specific finance. Climate specific projects are those with climate change mitigation and climate change adaption markers, marked as having significant or principal objective in applicable category. Additional are cross– cutting projects which have more than one climate category with marked either significant or principal marker. All funds specified in this report have been disbursed.



7.3 Financing

The Icelandic Government is committed to reach the UN target of 0.7% of gross national income (GNI) dedicated to official development assistance (ODA). The conceivable objective is to raise the targets slowly and steadily, going from 0.21% in 2014, 0,28% in 2019 with a slight decrease 0,02% during 2020, ending the year at 0.26% despite a nominal increase of 300 million ISK. During 2022 the percentage of GNI is expected to reach the target of 0.35%.

The share of climate-specific projects of total official development aid (ODA) was 25% during 2019 and 20% during 2020.

More funds have been directed towards adaptation than to mitigation for both reporting years. All projects are reported in accordance with OECD DAC directives. For the year 2019, projects marked as with a significant or primary objective against adaptation were approximately 40% of Iceland's climate ODA or about 747 million ISK. Mitigation had approximately 29% of Iceland's climate ODA, or 546 million ISK as a significant or primary objective. Crosscutting had approximately 31% of Iceland's climate ODA or about 580 million ISK, with more than one marker as significant or primary objective.

There is no significant change in direction or trends between years, with a slight increase of projects dedicated towards adaptation and slight decrease in projects dedicated mitigation, and an increase in cross-cutting (in reference to table 7.1). A considerable funding decrease is between the years 2019 and 2020 (Table 7.2). This is explained by the completion of large climate projects during 2020, and not establishing new projects until 2021. One example of such project is the Geothermal Exploration Project which effectively ended in 2019. Iceland has an increased focus on earth and sustainable use of natural resources in the newly adopted international development cooperation policy and has drastically increased funds towards climate and environmental projects for 2021 and 2022.

The table below presents the division of Iceland's ODA contribution to climate´s categories divided; mitigation, adaptation, and cross-cutting environmental topics.

Table 55 Summary information climate categories

Type of support, division of total ODA	2019	2020
Adaptation	10%	8%
Mitigation	7%	4%
Cross – cutting	8%	8%

Type of support, division of climate ODA	2019	2020
Adaptation	40%	41%
Mitigation	29%	21%
cross – cutting	31%	38%

Table 7.2 provides a summary of both bilateral and multilateral projects with a marked focus on mitigation, adaptation and cross-cutting environmental issues.

Table 56 Summary information climate-specific projects (%)

	2019	2020
Total bilateral climate related funds	1.434.351.028	1.184.975.046
Total multilateral climate related funds	439.873.468	394.766.790
total climate ODA	1.874.224.496	1.579.741.836
Grand Total ODA	**7.530.368.125**	**7.838.014.734**
Total share of climate ODA of total ODA	25%	20%

Table 7.3 provides a summary from table 7.4 which enlist both bilateral and multilateral projects with a marked focus on mitigation, adaptation, and cross-cutting environmental issues. The following tables represent BR-VTF Tables 7a and 7b[141] All detailed information is also found on the www.openaid.is website.

[141] See Iceland´s fifth biennial Reporting Common Tabular Format (BR CTF)

Table 57 Summary information climate-specific bilateral projects (ISK) categorized by type of support.

Mitigation	2019	2020
GRÓ training programs		
GRÓ Geothermal Training Program	251.000.002	130.615.750
GRÓ Land Restoration Training Program	141.449.999	105.000.000
Geothermal projects		
Expertise Geothermal Technical Advice – Fiji	1.820.286	
Expertise Geothermal Technical Advice - Kazakhstan	4.436.037	1.037.500
Technical Assistance Program in Geothermal Development - El Salvador	10.483.773	26.908.009
Geothermal Exploration Project in cooperation with the Nordic Development Fund (NDF)	38.872.862	38.260.338
Support to African Rift Geothermal Development Facility (ARGeo)	12.271.600	
Sustainable energy		
Energising Development, Mangochi District, Malawi	61.190.780	
ABC Children's Aid - Solar cells and batteries for ABC Burkina Faso		5.350.978
Total mitigation funds	**521.525.339**	**307.172.575**
Adaptation	**2019**	**2020**
WASH projects		
WASH Sierra Leone	167.587.707	119.627.000
Wash Liberia	25.134.000	12.468.600
Wash Uganda	94.920.000	
Wash Mozambique		99.097.327
Water and sanitation bilateral support - Uganda	61.830.414	47.395.152
Water and sanitation bilateral support - Malawi	84.823.466	85.818.057
Support to fisheries		
SDG Fund - Ocean Excellence - Sub-cooling technology for artisanal fisheries in Sierra Leone		1.000.000
Fund for collaborating with businesses - Marel - Improved quality of Vietnamese pangasius	2.839.400	
SDG Fund - Atmonia - Sustainable and Self-sufficient Production of Nitrogen Fertilizer in Cameroon		1.000.000
Buikwe, Uganda, school feeding program in response to COVID-19		58.839.000
SDG Fund - Aurora Seafood - Blue growth through new utilization of resources from the ocean		1.000.000
Technical assistance for the Lake Victoria Fisheries Management Improvement Project in Uganda	1.642.066	
Grants for participants from SIDS & W-Africa in the Rhodes Academy of Oceans Law and Policy study course on the law of the sea.	2.800.000	
Community Based Integrated Resiliency Program, Sierra Leone (BRIDGE)	26.086.396	15.373.785
Technical Assistance Program in Fisheries - Vietnam	8.116.703	932.017
Icelandic Consultancy work on seaweed aquaculture in the Philippines	3.973.403	
Icelandic consultancy work on aquaculture in Indonesia	4.133.470	
Expert advice to World Bank fisheries program for Albania		15.167.407
Operation of projects in regional cooperation - West Africa	26.583.073	21.642.420
GRÓ training programs[142]		
GRÓ Fisheries Training Program	222.000.001	166.221.000
Total adaptation funds	732.470.099	645.581.765

[142] GRÓ – International Centre for Capacity Development, Sustainable use of Natural Resources and Societal Change, that operates under the auspices of UNESCO.

Cross cutting	2019	2020
GRÓ training programs		
GRÓ Gender Equality Studies and Training Program	120.049.999	137.993.563
Gender and climate change		
Kebribeyah Climate Resilient Livelihood Project II		18.120.000
Community Resilience Project in Malawi	30.400.000	15.160.000
The Red Cross - Community Resilience Program II		35.710.000
Kebribeyjah Sustainable Livelihood Project, Ethiopia	27.157.334	13.578.667
Support for the participation of the National Rescue Representative in the international consultation with UNDAC / INSARAG	2.748.257	940.755
The Icelandic Red Cross and the International Federation of National Red Cross and Red Crescent Societies		10.717.721
Total Cross-cutting funds	**180.355.590**	**232.220.706**

Table 58 Summary information climate specific multilateral projects (ISK) categorized by type of support

Mitigation	2019	2020
SeForALL	25.168.000	25.809.600
Total mitigation funds	**25.168.000**	**25.809.600**

Adaptation	2019	2020
Least Developed Countries Fund	12.308.100	
DOALOS	3.000.000	6.000.000
Total adaptation funds	**15.310.119**	**6.002.020**

Cross cutting	2019	2020
World Bank		
Word Bank´s Blue Economy Programme (PROBLUE)	44.299.892	51.024.000
Energy Sector Management Assistance Program (ESMAP)	36.803.100	51.386.000
PROBLUE - Word Bank´s Blue Economy Program	48.688.800	
Energy Sector Management Assistance Program (ESMAP) - additional funding because of COVID-19		25.000.000
Donor Funded Staffing Program (DFSP), World Bank Group	117.933.050	8.272.588
AWEEF	18.685.500	
UNEP	521.928	428.634
FAO		
Food and Agricultural Organization of the United Nations (FAO) - PSMA Global international exchange system	20.507.806	-
The Food and Agricultural Organization (FAO)	9.441.589	13.005.197
WFP		
World Food Program (WFP) implementation of the School meal program in Mangochi, Malawi	42.523.614	41.291.420
World Food Program (WFP) framework agreement - core funding	49.976.555	49.977.731
UN Common agenda		2.567.600
UNCCD	508.015	
WEDO	9.505.500	
Multi-Partner Trust Fund (MPTF)		100.002.000
UNHCR		20.000.000
Total Cross-cutting funds	**399.395.349**	**362.955.170**

7.3.1 Provision of new and additional financial resources

Iceland is committed to assist developing countries in adapting to and mitigating the adverse effects of climate change and yet in 2020 Iceland did not increase 'new and additional' support, when compared to 2018.

There is no internationally agreed definition of what constitutes 'new and additional resources' under Article 4.3 of the UN Framework Convention on Climate Change. One definition, supported by several countries, is that 'new and additional financial resources' for climate-related activities should be additional to the international development aid goal of 0.7% of GNI.

Utilizing this definition and bearing in mind that Iceland's ODA reached its peak of 0,37% in 2008, Iceland would not be in the position to identify any new and additional financial resources for climate-related activities. As reported, Iceland had a slight decrease of 187 million ISK in climate funds from 2018 to 2020) and was therefore not able to report new and additional funding to the ODA portfolio. The new and additional funding is drawn from the growing aid program and has not diverted funds from existing development priorities or programs. To reiterate, Iceland looks at the decreasing ODA volumes in nominal terms in ISK from 2018 to 2020 to identify new and additional financial resources in climate-related activities, but not as a percentage of GNI. During the next phase of reporting, Iceland has increased the focus on climate and environment drastically, with considerable new and additional funding. This is Iceland's definition of new and additional financial resources in lack of international standard classification. There is a separate budget line in the State budget for environment and climate actions in international development cooperation. This budget line has been earmarked since 2012 and commenced with Iceland's Fast Start Finance commitments. Despite an earmarked budget line directed towards climate actions, climate projects can be found throughout the whole development budget, especially under the bilateral budget.

The environment and climate action portfolio is somewhat balanced between adaptation, mitigation and capacity building activities, and gives special attention to women's empowerment in the field of climate change and increasing access to renewable energy sources. The funding is channelled through multilateral agencies and trough bilateral work. Focus has been given to Iceland's longstanding bilateral partner countries, Malawi, and Uganda that are among the Least Developed Countries (LDCs).

7.3.2 Bilateral and regional financial contributions

There was a slight decrease to the bilateral development cooperation between 2019 and 2020; with a 11 % decrease. The decline in 2020 is marked by the Covid pandemic which clearly affected this work, especially towards technical assistance under geothermal and fisheries.

Iceland's bilateral work is with long-standing government partners in Malawi and Uganda. In both countries, the focus is mainly on collaboration at the district level where Iceland provides resources and technical assistance in support of district development plans, with the aim of strengthening basic service provision and institutional capacity. In accordance with OEDC DAC markers, Iceland classifies development support through international NGOs, to UN earmarked projects implemented by country offices and financial funding of the four United Nations University (UNU) Training Programs based in Iceland as bilateral work.

On the 1st of January 2020 the Programs became a part of GRÓ International Centre for Capacity Development, Sustainable use of Natural Resources and Societal Change, that operates under the auspices of UNESCO. Iceland emphasizes adaptation to climate changes in its climate-related bilateral work, which is integrated in its district development efforts in the partner countries, especially in education and water,

sanitation and hygiene (WASH). Large adaptation projects in 2019 and 2020 include Iceland's support to WASH projects in Buikwe and Namayingo districts in Uganda and in Mangochi district in Malawi, providing rural communities with improved access to clean water and sanitation facilities. In collaboration with UNICEF, Iceland also supported a new initiative in Liberia and Sierra Leone on improving access to climate resilient WASH services in fishing communities to improve livelihoods and conditions, with around 270 million ISK over the reporting period. In 2019, Iceland started cooperation with UNICEF in Uganda on improving access to WASH in South-Sudanese refugee hosting districts in the country through a humanitarian-development nexus approach. Finally, a geothermal exploration project in the East African Rift Valley aims to build capacity and expertise in the field of geothermal utilization.



Most of Iceland's bilateral environmental contributions are channelled through the GRÓ Centre (before 2020 UN University training programs) based in Iceland. The GRÓ Training Programs provide support to climate change adaptation and mitigation in LDCs, gender mainstreaming, capacity building through the four programs: GRÓ Geothermal Training Program, the GRÓ Fisheries Training Program, the GRÓ Land Restoration Training Program, and the GRÓ Gender Equality Studies and Training Program.

Regarding environmental contributions to multilateral agencies, Iceland is a founding member of SEforALL, the only donor to African Women Energy Entrepreneurs Framework (AWEEF) which is hosted under UNEP and contributes to UNFCCD under UNFCCC. Of high importance to Iceland is the increased focus on energy and fisheries by the World Bank where Iceland supports projects such as Global Program on Fisheries (PROFISH) and the Energy Sector Management Assistance Program (ESMAP). It should be noted that Iceland is not a member of the Global Environment Facility (GEF) and has therefore not made any financial contributions to the organization.

7.4 Knowledge Transfer Through Capacity Building

Iceland contributes to strengthened capacity building in developing countries to enhance mitigation and adaptation efforts. Iceland has committed resources that are creating enabling environments for private sector investment, strengthening national and regional institutional and regulatory frameworks, and assisting developing countries to take practical actions to cut emissions. Recognizing that climate change disproportionally affects developing countries and aligned with Iceland's emphasis on LDCs in its development cooperation strategy, the Government of Iceland focuses its technology transfer and capacity building in low-income countries.

Financial resources and transfer of technology for the purposes of adaptation and mitigation of climate change have in recent years been channelled mainly through the public sector and not through the private sector. However, Iceland recognizes the role that the private sector can play in achieving the SDGs and is taking decisive steps for improvement in this area, including in its development cooperation strategy. Iceland is well-known for its technical expertise and multi-stakeholder partnerships, particularly in geothermal energy, and will build on this comparative advantage when engaging further with the private sector, especially in climate-related activities. Iceland's support to technology transfer in relation to the implementation of the SDGs includes a broad spectrum of activities. These activities comprise transfer of both hard and soft technologies. The extent of this technology transfer is significant and cannot be clearly separated from other activities in Iceland's international development cooperation, including financial flows. In fact, many development projects funded by Iceland include both technology transfer and capacity building components. Since they form an integral part of a project, it is not possible to accurately account for them separately.

Iceland's measures related to the promotion, facilitation and financing of the transfer of, or access to, environmentally-sound technologies, have a focus on renewable energy. The sustainable utilization of natural resources is a priority area in Iceland's development cooperation, where Icelandic technical expertise, extensive knowledge and experience of utilization of geothermal energy contributes to the SDGs. The GRÓ Geothermal Training Program (GRÓ GTP) has for many years played an important role in that regard.

Iceland has a longstanding commitment to GRÓ Centre for Capacity Development, Sustainability and Societal Change, that operates under the auspices of UNESCO and that runs four training programs based in Iceland. The Programs were until 2020 operated as UNU Programs (United Nations University): The GRÓ Geothermal Training Program since 1979, the GRÓ Fisheries Training Program, since 1997, the GRÓ Land Restoration Training Program, since 2007, and the GRÓ Gender Equality Studies and Training Program, since 2009.

The four GRÓ programs have a strong relevance when it comes to adapting to and mitigating climate change. The Geothermal Training Program is aimed at increasing the sustainable use of geothermal energy, the Land Restoration Training Program focuses on reclaiming land and fighting desertification, where particular attention is given to the interaction of climate change and land degradation. The Gender Equality Studies and Training Program also gives particular attention to climate change, with a special module on environment and climate change. Many of the fellows in the GRÓ Fisheries Training Program undertake research projects related to the impacts of climate change on fisheries systems and the communities that depend on aquatic resources.

All four programs are directly linked to national and public institutions in Iceland and draw on their experts for lecturing and training of fellows who come from LDCs and other developing countries. The fellows are

trained in applicable science and research, relevant to their home country, and usually conduct their research with involvement from an official or research institutions in their home country. Through this method, the research is more likely to have an impact in the respective field in the home country and bring about further technological transfer. Fellows are chosen for and encouraged to further develop their leadership skills in order to further the transfer of knowledge after they return to their home country. Many fellows return to work in national expert institutions. Through the GRÓ training programs, Iceland has helped enhance the capacity of participating countries to adapt to and mitigate climate change through training of officials in the fields of geothermal energy, fisheries and sustainable land management sectors, as well as in gender equality.

Among the mitigation and adaptation programs Iceland has supported through multilateral channels are the two World Bank programs focused on the fisheries and renewable energy sectors. PROFISH aims at strengthening sustainable fisheries management, promote economic growth, ensure a healthy fish stock and enhance their yield.

ESMAP is a renewable energy program within the World Bank which assists low and middle-income countries to increase know-how and institutional capacity to achieve environmentally sustainable energy solutions for low carbon development, poverty reduction and economic growth. As part of the World Bank's response to the UN's Sustainable Energy for All Initiative (SEforALL), the Bank made an agreement with Iceland to collaborate on advancing geothermal energy utilisation in East Africa through five-year project between 2013 and 2017. Participating countries should at the end of the project have three key outputs from the project: A realistic assessment of potential geothermal sites; plans for further action where applicable, and; capacity to move forward on the basis of those plans and submit exploration drilling projects into funding pipelines. The project could extend to up to thirteen countries in the East Africa Rift Valley and is already under way in at least seven of them. The project in the East Africa Rift Valley is implemented in cooperation with several private partners and institutes, including technology transfer and capacity building to national experts and institutions in recipient countries.

The consequences of climate change affect women more severely than men. It is therefore important to include gender aspects in all discussion about climate change and programming. Iceland has actively promoted the important role of gender in the international climate negotiations, as well as supported several climate projects with the emphasis on women empowerment and gender equality, e.g., through organizations such as UN Women and the Women's Environment and Development Organization (WEDO). In this context a training course was developed by the GRÓ Gender Equality and Studies Program in close collaboration with Ugandan partners, and training and capacity building was provided for a selected number of experts and policy makers at the district level. In connection with our other Bilateral cooperation with Uganda.

Another area important to Iceland is the promotion of sustainable land management. Land degradation and desertification rank among the world's greatest environmental challenges, significantly affecting a range of issues such as climate, biodiversity, soil quality, food and water security, peace and human well-being, especially for the more vulnerable rural poor. By supporting the GRÓ Land Restoration Training Program, Iceland attempts to fight land degradation by strengthening institutional capacity and training of development country experts. The steps taken by Iceland to facilitate and finance the transfer of technology to developing countries and to build their capacity are taken into accordance with both the UNFCCC and Article 10 of the Kyoto Protocol.

8. Research and systemic observations

8.1 Climatic Research

Most of the climate-related research in Iceland is focused on climate processes and climate system studies and impacts of climate change. Other efforts involve modelling and prediction, and large ongoing projects deal with mitigation measures, but there has been less research on socio-economic aspects.

8.1.1 Climate process and climate system studies

The Icelandic Meteorological Office (IMO) is a governmental institute responsible for producing regular and specific weather forecasts. It conducts monitoring and scientific studies of geohazards and hazard zoning in Iceland. It is involved with several kinds of research within the fields of meteorology, hydrology and geosciences and has a leading role in climate change studies in Iceland both in research and in its role as an advising body to the government. It conducts glaciological measurements and modelling with a special focus on glacio-hydrology.

Although IMO research and evaluation of climate change is mainly centred on the climate of Iceland, the IMO has also been active in many inter-national climate research projects. Studies of the spatial characteristics and long-term changes in timeseries of temperature, precipitation, sea level pressure, river runoff and glacier changes have been conducted by IMO staff and published in international peer-reviewed journals.

Icelandic scientists have for many years contributed to paleoclimatological work with their participation in many ice and sediment core projects. Much of this work has taken place within the University of Iceland. Some examples of research topics within that field and in related fields include:

- A review of changes in the extent of Icelandic glaciers for the last 100–200 years.
- A review of the mass of Icelandic glaciers for the last 100–200 years and an estimate of their contribution to higher sea levels.
- Analysis of seafloor sediment cores from the coastal shelf north of Iceland to reconstruct changes in sedimentation, biota and ocean currents.
- Analysis of Tertiary and Quaternary oceanic paleo-fauna in order to chart changes in the system of ocean currents in that period.
- Reconstruction of climate change around the North Atlantic in the last 13,000 years by analysis of sedimentation (carbon content, pollen etc.) in lakes and fjords.

8.1.2 Modelling and prediction

The IMO has taken part in research projects where downscaling is used to generate projections of future climate change. In these studies, a numerical weather forecast model, or a regional climate model is used to refine for a limited area the projected climate changes from a global climate model. Results from such studies have been used to drive models of glacier retreat, changes in river runoff. The results of this work have been published in reports and peer reviewed articles.

8.1.3 Impacts of climate change

The IMO has led the scientific committee on climate change and the impacts of climate change in Iceland since 1999. The committee has published 3 reports since then (2000, 2008 and 2018)143144145 and the next one is expected to be published in 2023.

The IMO has also led a series of Nordic-Baltic climate impact projects focusing on three main renewable energy resources; hydropower, biofuels and wind power. These projects were funded by Nordic Energy Research. In these projects the objective was to make comprehensive assessment of the impact of climate change on Nordic renewable energy resources including hydropower, wind power, biofuels and solar energy. This included assessment of power production and its sensitivity and vulnerability to climate change on both temporal and spatial scales; assessment of the impacts of extremes including floods, droughts, storms, seasonal pattern and variability. The CE project finished with the release of the book "Impacts of Climate Change on Renewable Energy Resources – Their role in the Nordic Energy System" which was published by the Nordic Council of Ministers in 2007. The ensuing CES project had the goal of looking at climate impacts closer in time and assessing the development of the Nordic electricity system for the next 20–30 years. The project started in 2007 and finished in 2011 with the release of the book "Climate Change and Energy Systems – Impacts, Risks and Adaptation in the Nordic and Baltic countries".



Following the CES project, two projects on the cryosphere and wind, were initiated by some of the participants in the previous climate and energy related projects. These were the SVALI and ICEWIND projects,

[143] https://www.vedur.is/media/loftslag/vedurfarsbreytingar_umhvrn_2000.pdf
[144] https://www.vedur.is/media/loftslag/visindanefndloftslagsbreytingar.pdf
[145] https://www.vedur.is/media/loftslag/Skyrsla-loftslagsbreytingar-2018-Vefur-NY.pdf

both funded by the Top Research Initiative (TRI). The SVALI project examined the complex effects of climate change on Arctic glaciers, ice and snow. The projects tackle questions such as How fast is land ice volume in the Arctic and North-Atlantic area changing, and why? Will these processes continue to accelerate? What are the consequences for sea-level and ocean circulation? What are the implications for society? The ICEWIND project focuses on wind energy in cold areas and its main goal was to share knowledge between the Nordic countries and identify factors that delay or prevent the adoption of wind energy in the Nordic countries. In Iceland, the main focus has been on establishment of atlases for wind and icing as well as integration of wind power with other energy sources.

8.2 Systematic observation

This chapter has been reviewed by experts from the Icelandic Met office and the Marine and freshwater Research Institute.

The institutions most important for the observation of climate change are the Icelandic Meteorological Office (IMO) and the Marine and freshwater Research Institute (MRI). Other institutions monitor changes in natural systems that are affected by climate change, notably the Icelandic Institute of Natural History (IINH), which monitors the state of flora and fauna in Iceland and the Science Institute of the University of Iceland which monitors changes in glaciers and land movements. Furthermore, the National Land Survey of Iceland (NLSI) directs measurement campaigns for mapping vertical and horizontal land motion in Iceland.

8.2.1 Atmospheric, hydrological, glacier and earth observing systems

The IMO is responsible for atmospheric climate monitoring and observation. The IMO monitors and archives data from close to 200 stations. These stations are either manual (synoptic, climatological and precipitation stations) or automatic. The number of synoptic stations in operation (about 40) was relatively constant from 1960 to 2000 but with increasing numbers of automatic stations the synoptic network has been scaled down to 14 stations. The observations are distributed internationally on the WMO GTS (Global Telecommunication System). The manual precipitation network has been steadily expanding and now consists of about 70 stations measuring precipitation daily, including the synoptic stations. The majority of the precipitation stations report daily to the IMO database. The automation of measurements started in Iceland in 1987, and the number of automatic stations has been rapidly growing since then. The IMO now operates about 160 stations and about 25 in addition to this in cooperation with the National Power Company and the Maritime department of the Icelandic Road and Coastal Administration. A repository of data from the about 100 stations operated by the Public Roads Administration is also located at the IMO. Most automatic stations observe wind and temperature every 10 minutes, a few once per hour, and most transmit data to the central database every hour. Many stations also include humidity, pressure and precipitation observations, and a few observe additional parameters (shortwave radiation and ground temperatures) or observe at more than one level.

The IMO participates in the Global Atmospheric Observing Systems (GAOS). The IMO participated in the MATCH ozone-sounding program during the winter months from 1990 to 2012, and the data was reported to the WOUDC (World Ozone and Ultraviolet Radiation Data Centre), Canada.

The three GAW (Global Atmosphere Watch) stations are: the BAPM at Írafoss, Stórhöfði and Reykjavík. In Írafoss and Stórhöfði monitoring of the tropospheric ozone, carbon dioxide, methane and isotopes of oxygen and carbon are performed in cooperation with NOAA. Heavy metals and Persistent Organic Pollutants (POPs) in air and precipitation (currently POPs precipitation monitoring is only performed in Írafoss) are monitored and reported to AMAP and OSPAR, although the Stórhöfði station experienced a

malfunction in the Eyjafjallajökull eruption in 2010 and ozone monitoring from there has suffered since. The data is reported to AMAP, EMAP og OSPAR-CAMP í NILU in Norway.

In Reykjavik, data on global radiation are collected and reported annually to the World Radiation Data Centre in St. Petersburg (WRDC).

The IMO also monitors hydrological conditions in Iceland and runs a network of about 120 gauging stations in Icelandic Rivers. The network provides basic information for knowledge of the hydrology of Iceland. As the importance of monitoring and mediating information has been growing, the network has been updated and transmits data to the IMO centre at least once a day. The gauge network mainly measures water-flow, water-level and ground water, and in some cases other environmental factors.

Furthermore, the IMO runs flow monitoring network to watch, measure and warn against danger from floods originating in sub-glacial volcano and geothermal systems, or melt water, heavy rain and ice blockage of river-flow. The development of the network began in 1996, following glacial race in Skeiðará, and has in the last decade been extended to the areas south and north of Vatnajökull, south of Mýrdalsjökull, the South Iceland lowland and to Borgarfjörður. Each monitoring station has electronic registration equipment, pressure sensor to measure the water level, sensors for the conductivity and temperature in the water, solar panel which provides energy for the station, a telephone and a modem for the transfer of data. When conductivity or the water level reaches a given limit the IMO and the Icelandic Emergency Watch are alerted and a decision on actions can be taken.

The glaciers in Iceland have changed substantially in historic time, in particular in the most recent two to three decades; the decrease in glacier extent amounts to approximately 0,3–0,5% every year. The mass balance of the three largest glaciers, Vatnajökull, Hofsjökull and Langjökull, is monitored annually by scientists from the University of Iceland and the Icelandic Meteorological Office. The mass balance has been negative since 1995, with one excep-tion. The glaciers have lost ca. 275 km3 of ice since 1995, which corre-sponds to ca. 8% of their total volume.

The Icelandic Meteorological Office participates in the Global Cryosphere Watch (GCW) international collaboration established by the World Meteorological Organization (WMO) to fosters collaboration in observing all components of the cryosphere, The GCW has established procedures for accessing, sharing and utilizing cryosphere data and for developing value-added analyses and indicators based on in-situ, space-based, and airborne observations of the cryosphere. The outlines of Icelandic glaciers are delineated regularly, using maps, aerial photographs and satellite images. These data are delivered to an international database, e.g., by World Glacier Monitoring Service in Switzerland and Global Land Ice Measurements from Space (GLIMS) in the US.

The Icelandic Meteorological Office operates a network of continuous geodetic GPS stations in Iceland to monitor crustal deformation related to plate movements, volcanic unrest and earthquakes. With geodetic quality instruments and specialized software, it is possible to achieve the daily position of the stations to within a few millimetres. CGPS stations are therefore an excellent tool to monitor crustal deformation. These stations allow IMO staff to monitor isostatic crustal changes that occur as a result of glacier mass loss due to climate change.



8.2.2 Ocean climate observing systems

Both the Marine and Freshwater Research Institute (MFRI) and the Icelandic Meteorological Office (IMO) contribute to ocean climate observations. The IMO and MFRI have been supporting Meteo France in deploying surface drifters with barometers and SST for weather observations and climate in recent years. The MFRI maintains a monitoring net of about 70 hydrobiological stations on 10 standard sections (transects) around Iceland with most of the sections extending beyond the continental slope. These stations are monitored three to four times per year for measurements of temperature and salinity and once or two times a year for phosphate, nitrate and silicate and once a year for phytoplankton and zooplankton. Some of these stations have been monitored regularly since around 1950. The MFRI has monitored carbonate system parameters on two time series stations northeast and west of Iceland since 1983. A network of about 10 continuous sea surface temperature meters is maintained at coastal stations all around the country.

The MFRI has been involved in several monitoring projects of ocean currents, in cooperation with European and American scientists. This work has included European and Nordic projects such as the Variability of exchanges in the northern seas, West-Nordic Ocean Climate, Meridional Overturning Exchange with the Nordic seas (MOEN), Arctic-Subarctic Ocean Flux-Array for European Climate: west (ASOF-W), Thermohaline Overturning - at Risk? (THOR) and the North Atlantic Climate (NACLIM) project, which all involved the monitoring of fluxes of water and heat over the Greenland – Scotland Ridge.

9. Education, training and public awareness

9.1 General policy toward education, training, and public awareness

The educational system in Iceland is administered by the Ministry of Education and Children and The Ministry of Higher Education, Science, and Innovation. The Ministry of Education and Children prepares educational policy, oversees its implementation, and is responsible for educational matters at all educational levels up until university level, which the Ministry of Higher Education, Science and Innovation is responsible for. Education has traditionally been organised within the public sector, but there are few private institutions in the school system, all of which receive public funding.

The National Curriculum Guide[146] from 2013 applies to all grades and subjects in compulsory schools and further specifies what is to be coordinated in all Icelandic compulsory schools. Based on the objective articles of the preschool, compulsory school, and upper secondary school acts, six fundamental pillars of education have been defined for the competence that pupils should achieve at compulsory school. One of the six pillars is "Education towards sustainability", which concerns the interplay of the environment, economy, society, and welfare. Sustainability includes respect for the environment, sense of responsibility, health, democratic working methods, and justice, not only at present time but also for future generations. Environmental protection, climate change and biodiversity are examples of tasks to be tackled. Sustainability is considered a prerequisite to understand the importance of one's own welfare and that of others. Education for sustainability further encompasses that in their studies children and youth come to grips with diverse problems and points of controversy. Teaching and working methods of the school are to be interwoven with the idea that the aim of education is capability for action. This involves training in democratic working methods and that children and youth are trained to be interested in and want to take part in society.

Key policy documents of the government contain the priorities of the Icelandic government regarding sustainability and climate change; Welfare for the future (first published in 2002 and revised in 2007 and 2010), the Climate Change strategy (2007) and Climate Action Plan (first published in 2010, with new and updated plans published in 2018 and 2020). Those policies contain sections and stipulations on actions regarding education, public participation, awareness raising, media and the role of civil society in general. In September 2018 the government launched a Climate Action Plan which includes actions regarding education, training, and public awareness. The Action Plan was updated in June 2020 and two status reports have been issued since, in 2021 and 2022. In 2021 a White Paper on Climate adaptation was issued.

Individual local authorities have taken steps toward increased sustainability and climate change awareness. Reykjavik city has, in cooperation with Festa – the Icelandic Centre for Corporate Social Responsibility (CSR)[147] taken decisive steps towards increased climate change awareness and actions within companies in

[146] https://www.government.is/topics/education/curriculum/

[147] https://samfelagsabyrgd.is/en

the city. The companies were asked to sign a joint declaration on actions intended to fight climate change and adapt to it. The declaration has been signed by nearly 200 companies. Those companies who sign are invited to participate in organised training, dialogue events, conferences and workshops on climate change and CSR. Furthermore, extensive information is available on Festa's website on the progress of the companies who have signed the declaration, along with other information on climate change and corporate responsibility.

Reykjavík is also one of three municipalities whose mayors have signed the Global Covenant of Mayors for Climate & Energy[148] - an international alliance of cities and local governments with a shared long-term vision of promoting and supporting voluntary action to combat climate change and move to a low emission, resilient society. The other two municipalities are Akureyri and Hveragerði.

Some other municipalities have chosen different paths for working towards increased sustainability and climate change awareness. Several municipalities have earned the EarthCheck[149]silver certification and another example is the small municipality Djúpavogur joined the international Cittaslow movement[150] in 2013.



[148] https://www.globalcovenantofmayors.org/
[149] https://earthcheck.org/
150 https://www.cittaslow.org/

9.2 Primary, secondary, and higher education

A fundamental principle of the Icelandic education system is that everyone is to have equal access to education irrespective of sex, economic status, geographic location, religion, disability and cultural or social background. The educational system is divided into four levels. Pre-school is the first educational level and is intended for children below the compulsory age for education. Parents are free to decide whether their children attend preschool. Compulsory Level is the second educational level. Children and adolescents must by law attend 10 years of compulsory education from the age of 6 to 16. Upper Secondary Level is the third educational level which generally incorporates the age group from 16 to 19. Everyone has the legal right to enter school at that school level, irrespective of their results at the end of compulsory schooling. Those that have the right to enrol in upper secondary school also have the right to study until the age of 18.

There are currently seven higher education institutions in Iceland that fall under the auspices of the Ministry of Higher Education, Science, and Innovation: The University of Iceland and the University of Akureyri are public universities. The Agricultural University of Iceland and Hólar University College are public universities formerly under the auspices of the Ministry of Agriculture. Reykjavik University, Bifröst University and Iceland University of the Arts are private institutions that receive state funding and operate under structural charters approved by the Ministry of Education, Science and Culture. At University Level emphasis on education and research in the field of natural resources and environmental science is growing. Thus there are several programmes available, such as a two year diploma studies and a master's programme in natural resources sciences at the University of Akureyri; a master's programme in Environment and Natural Resources studies at the University of Iceland and a doctor's degree in Environmental studies; BSc and MSc degree in Nature and Environmental Science at the Agricultural University of Iceland and a MSc in Sustainable Energy at the University of Reykjavík, in addition to a variety of courses on sustainability, climate change and environmental issues available in all of those institutions.

The Eco-Schools Programme[151] an international project funded by the government and managed in Iceland by the NGO Landvernd (The Icelandic Environment Association)[152]Eco-Schools is a programme for environmental management and certification which aims at enhancing environmental education and to strengthen environmental policy in schools. It is designed to implement sustainable development education in schools by encouraging children and students to take an active role in how their school can be run for the benefit of the environment. Schools that fulfil the necessary criteria are awarded the Green Flag for their work, which they keep for two years, before they need to renew their permission to flag the Green Flag.

Each Eco-School forms an environmental committee and works towards an Eco-Code within the school. Schools can choose to work on up to 13 themes and set two-year goals for one or two of them at a time. Landvernd assesses their work and recognises those who meet the requirements with a Green Flag. The themes are: climate change, transportation, consumption, global equality, energy, water, waste, ecosystem restoration, biodiversity, nature conservation, local community, public health and wellness and landscapes.

[151] https://www.ecoschools.global/

[152] https://landvernd.is/english/

New environment assessment checklists have been developed for students to evaluate the status of environmental issues within their schools, such as climate change, transportation, and consumption.

As a part of the Eco-School programme, Landvernd participates in a European programme on climate change education. The goal of the programme is to design educational material for the upper secondary school level on complex environmental issues to support students' ability to take action on the climate change issue.

In 2021, 186 schools at all school levels participated in the programme, this includes 26% of all kindergartens, pre-schools, 53% of all elementary and secondary level schools, 47% of high schools and 29% of universities.

The programme is open to other schools, such as Sunday schools summer schools and schools of work, according to the international guidelines of the Eco-Schools Programme. The programme is financially supported by the Ministry of the Environment, Energy and Climate and the Ministry of Education and Children, as well as municipalities throughout the country.

9.3 Public information campaigns

In April 2021, climate change was one of the themes of the biannual conference on environmental issues hosted by the then Ministry for the Environment and Natural Resources, now Ministry of the Environment, Energy and Climate. The conference is attended by the environmental sector, the public and stakeholders and is one of the largest regular environmental events held in Iceland. The conference got an extensive coverage by the Icelandic media and evoked experience exchange and discussions on climate change in the Icelandic society.



The special climate change agenda of the government issued in 2015 introduced the project "Melting glaciers – a natural laboratory to study climate change", implemented by the Vatnajökull national park and the Icelandic Meteorological Office. The co-operation was renewed in 2019, and evolves around the visibility of climate change derived from the melting glaciers in Iceland with the target to increase people's awareness of climate change. The project involves dissemination of information to the public and education material on retreating glaciers, such as an educational brochure in Icelandic and English on the subject published in late 2017, both in paper and online[153] A special educational web for the project was launched in 2018[154] , which will be updated in parallel with a new website of Vatnajökull National Park. An annual newsletter has been published since 2018 and is available on the Icelandic glacier web portal www.islenskirjoklar.is, providing an overview of glacier changes from all institutes involved in glacier research in Iceland. The web portal was opened in spring 2022, partly funded by the Icelandic Climate Fund, and hosts glacier measurements carried out in Iceland, including mass balance, glacier termini positions and glacier outlines. A comprehensive photographic archive of Icelandic glaciers is part of the web portal, including historical photographs and repeat photographs.

In projects associated with "Melting glaciers", Icelandic scientists are producing new maps of the glaciers and updated information about their extent. These new data make it possible to visualize the rapid changes that are taking place on the glaciers and they are used to update information on the glaciers in the new glacier web portal and in the annual newsletter. These data are, furthermore, submitted to international scientific databases where they become part of a global dataset about glacier changes that is used in global assessments about glacier changes that are published regularly.

Teaching material for guides working with tourists within Vatnajökull National Park was published in 2018. An active conversation is ongoing with tourism operators to bridge the gap between the scientific community and glacier guides and others. This includes presentations on glacier and climate change in co-operation with Katla geopark, Vatnajökull National park and others. Information signs were installed on three hiking trails in front of Skaftafellsjökull, Heinabergsjökull and Breiðamerkurjökull, where visitors are presented with information about the glaciers and imagine the transformation caused by their melting.

As a part of the project "Melting glaciers", visual video presentations of changes that have occurred at the outlet glaciers of Vatnajökull since the 1980s and 1990s have been created by Kieran Baxter at the University of Dundee in collaboration with the Research Center of the University of Iceland in Hornafjörður. The videos combine historical aerial photographs from National Land Survey of Iceland with new drone imagery. They are created with advanced 3D technology that allows striking comparison of the photographs separated by >30 years. These videos and other visual products created for "Melting glaciers" have been presented a several meetings and conferences as well as in educational material about glacier changes produced by the IMO.

The Ministry of the Environment, Energy and Climate manages annually the Day of the Environment (April 25th) and the Day of the Icelandic Nature (September 16th), both of which are celebrated national wide. The former day is concentrated on international environmental issues such as climate change and sustainability. On those days the Minister of the Environment, Energy and Climate grants chosen individuals,

[153] https://www.vatnajokulsthjodgardur.is/static/files/Utgefid-efni/VJP-sameiginlegt/horfandi-joklar_2017_pdf-af-baekling.pdf
[154] https://www.vatnajokulsthjodgardur.is/en/areas/melting-glaciers

media, school children or companies awards for their commitment for the environment and these awards tend to get the attention of the mainstream media.

Several public campaigns conducted in Iceland by public and private parties contribute to the reduction of emissions. One of those is the annual "Bike to work" campaign[155], conducted by the National Olympic and Sports Association of Iceland with financial support from i.e. the public sector. The campaign – which over a period of two weeks encourages the public to leave their car at home and bike, walk or use public transport to work – has been widespread and successful, with good participation from the public. The same association conducts other campaigns aiming at encouraging people to use their own powers to transport – such as the "Lífshlaupið" campaign (where all kind of physical movement or sport count), and the "Bike to School" and "Walk to School" campaigns directed towards students.

In 2021, six of the largest municipalities in Iceland with just over 60% of the population, participated in the European Mobility Week[156], September 16 – 25, encouraging people to use environmentally friendly methods for transportation. In Iceland, this campaign is coordinated by the Ministry of the Environment, Energy and Climate.

The Eco-School project has proven to be a successful method, not only for increasing environmental awareness at schools but also in the homes of the children as they bring forward their knowledge on environmental issues and climate change to their parents and other family members. At the university level awareness raising projects are conducted, such as the annual "Green Days" at the University of Iceland organised by the students of the masters Environment and Natural Resources Programme.

Over the past years, media interest in climate change issues has increased considerable and many of Iceland's media now provide frequently an extensive coverage of climate change related issues; examples of this are TV series on both the mitigation of climate change (Hvað höfum við gert) and what can be done about it (Hvað getum við gert).

Due to Iceland's small population, the government's access to national and local media is relatively open, leading to a higher proportion of information dissemination on environmental issues. Information officers working for the Ministry of the Environment, Energy and Climate and its institutions have a direct and personal contact to key players within the mass media which gives them unique opportunity to present information through the largest TV and radio channels as well as the mainstream newspapers.

[155] https://hjoladivinnuna.is/

[156] https://mobilityweek.eu/home/



9.4 Training programmes

Iceland runs four training programmes, of which three benefits directly the fight against climate change.

The Geothermal Training Programme (GRÓ GTP)[157] is a postgraduate training programme, under the auspices of UNESCO, aiming at assisting developing countries in capacity building in geothermal research and development to enhance their use of renewable energy sources. The programme consists of six months annual training for practicing professionals from developing and transitional countries with significant geothermal potential, as well as an opportunity for outstanding fellows to pursue MSc and/or PhD degrees through cooperation with the University of Iceland and Reykjavík University. Also, the GRÓ GTP offers a variety of geothermal short courses on site in developing countries as well as other training activities.

The objective of the GRÓ Gender Equality Studies and Training (GRÓ GEST)[158] Programme is to use a multidisciplinary approach to promote gender equality and social justice in low to middle income, conflict and post-conflict countries through education and training. GRÓ GEST is currently involved in a project on gender and climate change in Uganda.

GRÓ GEST has offered a full PhD scholarship, in collaboration with Makerere University, Uganda. Furthermore, GRÓ GEST supports the implementation of two short courses on gender and climate change in Uganda in collaboration with Ugandan partners at Makerere University and several government agencies and ministries.

[157] https://www.grocentre.is/gtp
[158] https://www.grocentre.is/gest

GEST has previously produced study material and offered training courses on gender and climate change in Uganda, piloted in 2012-2013, and implemented again in 2019, and in Malawi in 2021. The overall objective of the course is to build knowledge and understanding of the causes of climate change and its impact on development and gender relations in Uganda/Malawi, and thus contributing to the strengthening of local capacity to design and implement gender-responsive climate change policies, strategies and programmes.

In 2021 GRÓ GEST financially supported the implementation of a Solar Sisters Nigeria initiative to bring awareness of advanced affordable solar power to rural communities in Nigeria through boosting the clean energy business enterprises of women. The initiative reached over 7000 energy users in 30 communities; contributing to the clean energy conversion in rural Nigeria.

GRÓ Land Restoration Training Programme (GRÓ LRT)[159] is a capacity development programme in the field of land restoration and sustainable land management, and has from the beginning been hosted at the Agricultural University and run in cooperation with the Soil Conservation Service of Iceland. GRÓ LRT was established in 2007 and run as part of the United Nations University from 2010-2019. In 2020, GRÓ LRT became part of GRÓ International Centre for Capacity Development, a category 2 UNESCO Centre based in Reykjavik, and is funded by the Government of Iceland and part of the country's international development cooperation.

GRÓ LRT's core activity is an intensive six-month postgraduate training in Iceland on ecological restoration and sustainable land management, custom-built for working professionals in developing countries faced with severe land degradation. As from 2022, the six-month training is eligible for 30 ECTS credits, meaning that fellows completing the training successfully also receive a Postgraduate Diploma in Ecosystem Restoration and Sustainable Land Management from the Agricultural University of Iceland. Since its establishment in 2007, 175 working professionals have participated in the six-month training, coming from 14 countries in Africa and Asia.

Since 2017, GRÓ LRT has expended into two new areas. Firstly, providing financial and technical support to develop and deliver short courses in its partner countries for working professionals in the fields of ecological restoration and sustainable land management. These courses are designed and delivered in cooperation with the GRÓ LRT partner institutions in Africa and Asia, and since 2017 GRÓ LRT has organised six such courses, three in Uganda, two in Mongolia and one in Ethiopia. Secondly, offering scholarships to former GRÓ LRT fellows, who have completed the six-month training programme, to pursue graduate studies at Icelandic universities in land restoration and related subjects. Five former fellows have received scholarships from GRÓ LRT since 2017, four for master's degree studies and one for PhD studies.

9.5 Resource or information centres

The website of the Icelandic government[160] contains official information on climate change; f.x. the government's Climate Action Plan, work on an adaptation policy, relevant acts, regulations, and policies, Q&A's about climate change, information on the United Nations Framework Convention on Climate Change and important external links. An English version of the government's website[161] was launched in January

[159] https://www.grocentre.is/lrt

[160] https://www.stjornarradid.is/verkefni/umhverfi-og-natturuvernd/loftslagsmal/

[161] https://www.government.is/topics/environment-climate-and-nature-protection/climate-change/

2018, with updated information about Iceland and climate change issues and links to relevant information on websites of other institutions.

Extensive information about climate change is available on the websites of the main institutions in the field of climate change, such as the Environment Agency of Iceland (EAI)[162]. At the EAI website, general information on possible and probable effects is to be found, as well as information on the causes, types of greenhouse gases, the Paris agreement and the ETS. Also, the web contains specific pages on how individuals can make a difference in their daily lives. The latest NIR (inventory reports) are available online. Among the most popular webpages of the EAI site is www.graenn.is (e. green.is) on how consumers can decrease their negative impact on the environment, including the climate. The EAI website highlights few indicators on the state of the environment, where climate change is one of six main categories[163]. The indicators are updated yearly and include i.a. yearly average heat and changes in Vatnajökull glacier. The EAI also frequently disseminates information about climate change issues via it's social media. This includes popular online lunch talks on various environmental issues, which the general public can relate to. EAI also oversees the Green Steps Program (Græn skref)[164], which is developed for government agencies in Iceland with the overall aim of decreasing environmental impact from daily operations in the public sector, as well as the Icelandic Association of Local Authorities' toolbox[165], which gives local authorities support in meeting their climate policy demands.

The Icelandic Meteorological Office[166] is another important resource. In 2021 it became the home of the Knowledge Centre on Climate Change Adaptation. The Knowledge Center is a forum of information on climate changes' effect on Iceland for the academic community, local governments, firms/companies, institutions and the general public. The Meteorlogical Office's official website also has a sub section on climate change containing extensive information on the background and science material on climate change. There the mechanisms behind climate change are explained in a simple language that should appeal to the public; the content of the IPCC reports is made accessible, both in English and Icelandic as well as news and information on the climate change impact in Iceland.

The websites of the Soil Conservation Service of Iceland[167] and the Icelandic Forest Service[168] provide information on climate-related challenges these institutions are engaged in.

Most of the institutions mentioned above, including the Ministry, have established and maintain Facebook pages and/or other social media to disseminate their information to the public, i.a. news and information on climate change. This has proven to be an important information channel, considered the limited financial resources of those institutions, as it is inexpensive, easily accessible and that most Icelanders have a registered Facebook account.

[162] https://www.ust.is/
[163] https://www.ust.is/graent-samfelag/graenn-lifstill/
[164] https://graenskref.is/
[165] https://loftslagsstefna.is/sveitarfelog/
[166] https://www.vedur.is/
[167] https://land.is/
[168] https://www.skogur.is/

Other information sources worth mentioning are e.g., the website of Orkusetur (Energy Centre)169 where the public can access information and calculators for diverse private energy use, such as on household electricity and heating, transportation, and carbon emissions. The website also provides short informative videos on private energy use and how to reduce it.

A variety of educational material on environmental issues, climate change included, is accessible on the website of the Directorate of Education (DE)[170]. This includes electronic books, videos, an interactive web-hub etc. The material is facilitated in cooperation with different agents, such as the EAI, environmental NGO's and others. Also, educational material on climate change is to be found on the website http://www.erjordinihaettu.com (Is the Earth at Risk?), the Nordic web https://nordeniskolen.org, and as part of NGO Landvernd's (The Icelandic Environment Association) website as a part of their Eco-Schools programme.

In addition, several privately-run websites and Facebook-groups and -pages disseminate news and information on climate change, such as www.loftslag.is, www.himinnoghaf.is, a Facebook-group for discussion and news on climate change, a Facebook-page called Paris 1,5 in addition to a number of pages and groups focusing on specific environmental issues contributing to climate change.

9.6 Involvement of the public and non-governmental organisations

In 2012 the ratification of the Aarhus Convention entered into force in Iceland, ensuring the public right to participation and information on environmental matters. The governments work on increasing NGO's and the public involvement in the field of climate change and environmental protection started over a decade earlier when the Ministry for the Environment established a formal platform for cooperation with environmental NGO's. The purpose is to ensure dialogue and consultation between the Ministry and the environmental NGO's, which is realised i.a. in an annual meeting between the Minister and the NGO's representatives. In all 18 NGOs participate in the platform, including Iceland's largest organisations in this field.

Many of the NGO's working in the field of environmental protection receive a financial support for their operation from the government as well as funding for specific projects. Amongst those projects are the Eco-School project described before, diverse projects enhancing bicycling as a climate friendly mean of transport and a long-term educational project for youths on revegetation and land care in connection to biodiversity and climate change (Vistheimt með skólum)[171]. Additionally, the government has sponsored the participation of NGOs representatives at COP meetings of the UNFCCC. The government support diverse other NGO's projects which fully or partially aim at fighting climate change.

The government also supports specific private projects on climate change, such as research projects on emissions from landfills in Iceland and a research comparing the legal framework of Iceland and Europe regarding climate change.

[169] https://orkusetur.is/

[170] https://mms.is/namsefni

[171] https://landvernd.is/graenfaninn/vistheimt-skolar/

The government also supports specific private projects on climate change, such as research projects on emissions from landfills in Iceland and research comparing the legal framework of Iceland and Europe regarding climate change.



9.7 Participation in international activities

Iceland participates in many different international activities. The participation in the European Mobility Week, the Bike to work international campaign and Eco-Schools programme are examples of participation in public projects across borders. The GRÓ-training programmes are examples of international cooperation with regards to education and training.

Icelandic authorities participate in diverse international cooperation programmes with regards to public information dissemination on the environment, including climate change. An example of this is the cooperation between the Environment Agency of Iceland with the European Environment Agency (EEA). Press releases from the EEA concerning climate change developments are distributed by the member countries on agency/Ministry websites and to national and local media. Information and best practice are also shared between member countries.

The Ministry of the Environment, Energy and Climate participates in an active network of communication and information officers from environment Ministries and national environmental agencies in the Nordic countries: Denmark, Norway, Sweden, and Finland as well as the Nordic Council of Ministers. The network meets annually and shares experience and information. Iceland has been active in the Nordic information cooperation during the latest COP meetings and has participated in various side events at the Nordic pavilion at the COP conference sites during the last years.

Iceland also participates in the platform for national coordinators working on the European Mobility Week. Iceland participates on average in one or two meetings of this platform annually, where participants exchange information and plan and coordinate the annual Mobility Week.

Annex I
5th Biennial Report

1 Introduction

The fifth Biennial Report of Iceland under the UNFCCC is submitted as an annex to Iceland´s 8th National Communication. The Biennial Report has been prepared in accordance with the UNFCCC biennial reporting guidelines (FCCC/CP/2011/9/Add.1).

The report provides information on greenhouse gas emissions and trends, on Iceland´s quantified economy-wide emission reduction targets, progress in achievements of quantified economy-wide emission reduction target, projection and provision of financial, technological and capacity-building support.

As the Biennial Report is submitted as an Annex to the National Communication and given the complementary between these two documents, where information required by the BR is already reported in the National Communication, cross-references to relevant sections of the National Communication (NC) are provided in the BR.

Tabular information as defined in the common tabular format (CTF) for the UNFCCC biennial reporting guidelines for developed country Parties (UNFCCC decision 19/CP.18) are enclosed in the report and have been officially submitted to the UNFCCC secretariat. The CTF tables were submitted through the electronic reporting facility provided by the UNFCCC Secretariat.

2 Information on greenhouse gas emissions and trends

2.1 National Inventory Arrangements

Act No. 70/2012 establishes the national system for the estimation of greenhouse gas emissions by sources and removals by sinks, a national registry, emission permits and establishes the legal basis for installations and aviation operators participating in the EU ETS.

Iceland's greenhouse gas inventory is addressed in Chapter III, Article 6 of Act No. 70/2012. The Environment Agency of Iceland (EA) is designated as the responsible authority for the national accounting and the inventory of emissions and removals of greenhouse gases according to Iceland's international obligations. The Environment Agency compiles Iceland's greenhouse gas inventory. Main data suppliers are listed and the type of information they are responsible for collecting and reporting to the Environment Agency:

- Soil Conservation Service of Iceland (SCSI)
- Iceland Forest Service (IFS)
- National Energy Authority (NEA)
- Agricultural University of Iceland (AUI)
- Iceland Food and Veterinary Authority
- Statistics Iceland
- The Road Traffic Directorate
- The Icelandic Recycling Fund
- Directorate of Customs

In June 2017, a new regulation No 520/2017 was published, in according to the Act on data collection and information from institutions related to Iceland´s inventory on GHG emissions and removal. The new regulation clarifies institutional, legal and procedural arrangements between different government agencies, and sets deadlines for delivering information. The regulation replaces the role a Coordinating Team had previously, with regards to cooperation between different entities.

The Environment Agency of Iceland (EA), an agency under the auspices of the Ministry of the Environment, Energy and Climate, carries the overall responsibility for the national inventory. EA compiles and maintains the greenhouse gas emission inventory, except for LULUCF which is compiled by the Soil Conservation Service of Iceland and the Icelandic Forest Service. EA reports to the Convention.

The contact person at the Environment Agency of Iceland is:

Nicole Keller
Environment Agency of Iceland
Suðurlandsbraut 24
IS-108 Reykjavík
Iceland

See further information on the Icelandic National Inventory and process in NC, chapter 3.

2.2 Greenhouse gas emissions and trends

The total amounts of greenhouse gases emitted in Iceland during the period 1990-2020 are presented in the following tables and figures, expressed in terms of contribution by gas and source. (See Annex III, Greenhouse gas inventories 1990-2020).

Table BR5 1 presents emission figures for greenhouse gases by sector in 1990, 1995, 2000, 2005, 2010, 2015, 2019 and 2019 expressed in kt. CO2-equivalents along with percentage changes for both time periods 1990-2020 and 2019-2020.

BR5 Table 1 Emissions of GHG by sector in Iceland for the reported time series [kt CO2e].

Sector	1990	1995	2000	2005	2010	2015	2019	2020	Change '90-'20	Change '19-'20
1 Energy	1,836	2,053	2,181	2,155	2,020	1,848	1,849	1,659	-10%	-10%
2 Industrial Processes	958	565	1,010	955	1,917	1,983	2,020	1,986	107%	-1.7%
3 Agriculture	662	618	627	605	631	655	621	618	-6.5%	-0.5%
4 Land Use, Land Use Change and Forestry	9,199	9,175	9,194	9,232	9,196	9,107	9,020	9,010	-2.1%	-0.1%
5 Waste	219	270	302	304	296	261	223	247	12%	10%
Total without LULUCF	**3,674**	**3,506**	**4,119**	**4,019**	**4,865**	**4,746**	**4,713**	**4,510**	**23%**	**-4.3%**

BR5 Table 2 presents emission figures for all greenhouse gases by gas in 1990, 1995, 2000, 2005, 2010, 2015, 2019, and 2020 expressed in kt. CO2-equivalents along with percentage changes for both time periods 1990-2020 and 2019-2020.

BR5 Table 2 Emissions of greenhouse gases by gas in Iceland during the period 1990-2020 (without LULUCF) [kt. CO2e].

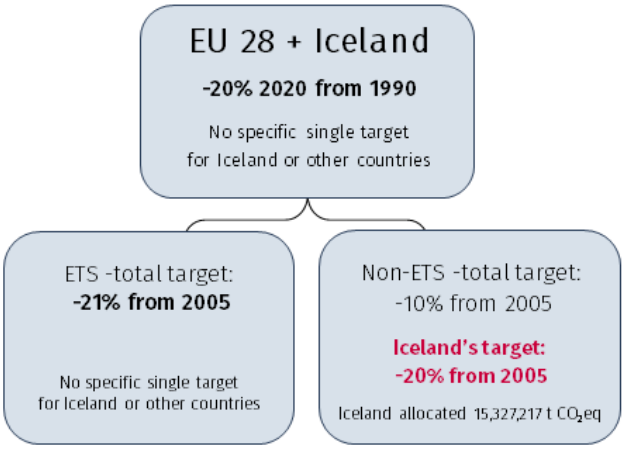
GHG	1990	1995	2000	2005	2010	2015	2019	2020	Change '90-'20	Change '19-'20	% Total in latest year
CO_2	2,216	2,460	2,923	2,968	3,617	3,534	3,546	3,329	50%	-6.1%	74%
CH_4	606	630	659	648	656	631	570	590	-2.8%	3.4%	13%
N_2O	356	343	342	311	305	312	295	295	-17%	0.1%	6.5%
PFCs	495	69	150	31	172	104	97	96	-81%	-1.4%	2.1%
HFCs	0.3	3.4	44	58	111	163	203	198	57348%	-2%	4.4%
SF_6	1.1	1.2	1.3	2.5	4.7	1.6	2.3	3.2	188%	39%	0.1%
Total	**3,674**	**3,506**	**4,119**	**4,019**	**4,865**	**4,746**	**4,713**	**4,510**	**23%**	**-4.3%**	**100%**

See further information on greenhouse gas emission and trends in NC, chapter 3.

3 Quantified economy-wide Emission Reduction target

Iceland's national emissions reduction target Iceland communicated to the UNFCCC a commitment to a quantified economywide emission reduction target of 20% below 1990 levels by 2020 in the second commitment period of the Kyoto Protocol. This target is to be fulfilled jointly with the EU and its 28 Member States according to a bilateral agreement between Iceland and EU where Iceland participates in the overall target of EU and its member states to reduce the emission of 20% to 2020. Iceland did not carry over any credits from the first commitment period of the Kyoto Protocol.

In 2015 a Joint Fulfilment Agreement was concluded between the European Union (EU), its Member States and Iceland. This Agreement concerned Iceland´s participation in these parties' joint fulfilment of commitments in the second commitment period of the Kyoto Protocol. Therein the Parties agree to fulfil jointly their quantified emission limitation and reduction commitments for the second commitment period inscribed in the third column of Annex B to the Kyoto Protocol. Iceland's individual assigned amount was established at 15,327,217 AAUs. These AAUs were to cover the emissions not covered by Directive 2003/87/EC (EU-ETS Directive).



BR5 Figure 1 EU´s 2020 target

According to Article 4 and Annex I of the Joint Fulfilment Agreement, Regulation (EU) No 525/2013 ("MMR") and current and future Delegated and Implementing Acts based on Regulation (EU) No 525/2013 shall be binding upon Iceland. This includes for instance Commission Implementing Regulation (EU) No 749/2014, which further details the content and format required for the various reporting requirements under Regulation (EU) No 525/2013. The legal acts were rendered applicable in Iceland in 2015 with an amendment to Act No 70/2012, cf. Act No 62/2015.

Iceland plans to use removal units (RMU) for the second Kyoto period to meet its Kyoto Protocol target; in addition, Iceland will need to use market-based mechanisms to reach its target.

According to the 2022 reviewed inventory (NIR and CRF reporting tables), the estimation for the commitment period is as follows:

- Total CP2 emissions, as per the scope of the Joint Fulfilment Agreement: 23,031 kt CO_2e
- Allocated allowances: 15,327 kt CO_2e
- Removal units: 4,299 kt CO_2e
- Emissions in excess of allocations: 3,404 kt CO_2e

This is done in addition to domestic action, that is discussed in Chapter 4 in the National Communication. At the time of writing, an ongoing discussion between Iceland and the EU is taking place, where the arrangement on the compliance will be set, in accordance with the bilateral agreement mentioned above. The process is expected to be finalized in early 2023.

4 Progress in achievement of quantified economy-wide emission reduction targets and relevant information

4.1 Mitigation actions and their effects

An overview of Iceland's mitigation actions and their effects is provided in chapter 4 in the NC. BR5 Table 3 below shows a summary of the policies and measures by sectors.

Iceland's total historical and projected emissions of GHGs excluding LULUCF are presented in Figure 1.1 below, for the WEM scenario. The total emissions are expected to have reached their peak in 2018 and to follow a downward trend until 2040. Iceland's GHG emissions will be 1% lower in 2040 than they were in 1990, but they will be 24% lower than they were in 2015.

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

Iceland's total historical and projected emissions of GHGs including LULUCF emissions are presented in Figure 1.2. The total emissions incl. LULUCF are expected to have decreased by 8% in 2030 and 9% in 2040 compared to emissions in 1990. Carbon sequestration due to forest land has increased 17-fold in 2020 compared to 1990 levels and is expected to change from -510 kt CO2 p.a. in 2020 to -794 kt CO2 p.a. in 2040.

BR5 Table 3 Policies and measures

Energy policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Energy transition in fisheries (101)	Reduced fossil fuel use of fishing ships by 50-60% in 2030 compared to 2005 and achieving a corresponding 69-144 kt reduction in CO_2e emissions in 2030 compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Economic, Planning, Regulatory, Research, Voluntary/ negotiated agreements	Planned	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Electrical infrastructure in ports (102)	11 kt CO_2e reduction in emissions from ships at harbour in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Fiscal, Planning	Implemented	Ministry of Industries and Innovation (ANR)	12	14	16	18
Electrification of fishmeal production plants (103)	9 kt CO_2e reduction in emissions from fishmeal production plants in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Economic, Planning, Voluntary/ negotiated agreements	Implemented	Ministry of Industries and Innovation (ANR)	58	74	74	74
Ban on use of heavy fuel oil (104)	A regulation will be issued tightening fuel requirements which effectively bans the use of heavy fuel oil in the territorial sea of Iceland.	CO_2, CH_4, N_2O	Regulatory	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Carbon capture from geothermal energy plants (105)	108 kt CO_2e reduction in emissions from geothermal energy plants in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2	Planning, Research	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			

Energy policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Carbon tax (701)	The goal is for the carbon tax and other road transport policies to reduce emissions by 51 kt CO_2e in 2030 compared to a baseline scenario.	CO_2	Fiscal	Implemented	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Domestic renewable fuels (702)	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.	CO_2, CH_4, N_2O	Research	Implemented	Ministry of Industries and Innovation (ANR)	Estimate of impact not available.			
Climate impact of the construction industry (710)	CO_2 emissions from the construction industry will be reduced through various incentives.	CO_2	Planning, Regulatory	Implemented	Ministry of Social Affairs and Labour	Estimate of impact not available.			
Energy transition in manufacturing industries (106)	Changing from fossil fuels in manufacturing industries by subsidising new equipment which uses renewable energy.	CO_2, CH_4, N_2O	Economic, Planning, Voluntary	Adopted	Ministry of Industries and Innovation	Estimate of impact not available.			

Transport policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Participation in an international system for mitigating emissions from aviation (ETS and CORSIA) (705)	According to an estimate by the International Civil Aviation Organization (ICAO) international air carriers will need to carbon offset 2.5 million kt CO_2e to achieve carbon neutral growth between the years 2021-2035.	CO_2	Economic, Regulatory	Implemented	Ministry of Finance and Economic Affairs (FJR), Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Incentives for low- and zero emission vehicles (201)	The quantified objective of policies 201, 202, 203 and 204 combined is a 51 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Fiscal	Implemented	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Infrastructure for low- and zero emission vehicles (202)	The quantified objective of policies 201, 202, 203 and 204 combined is a 51 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Economic	Implemented	Ministry of Industries and Innovation (ANR)	Estimate of impact not available.			
Legislation and regulations for clean energy transition (203)	The quantified objective of policies 201, 202, 203 and 204 combined is a 51 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Regulatory, planning	Implemented	Ministry of Industries and Innovation (ANR)	Estimate of impact not available.			

Transport policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Ban on new registration of diesel and gasoline vehicles after 2030 (204)	Ban new registration of passenger cars fueled by diesel or gas from 2030. The quantified objective of policies 201, 202, 203 and 204 combined is a 51 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Regulatory	Planned	Ministry of Transport and Local Government (SRN)	Estimate of impact not available.			
Infrastructure for active mobility (205)	The quantified objective of policies 205 and 209 combined is a 10 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Fiscal, Planning	Implemented	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Encouraging public transport (206)	16 kt CO_2e reduction in emissions from road transport in 2030, compared to a baseline scenario in the Climate Action Plan	CO_2, CH_4, N_2O	Economic, Regulatory, planning	Implemented	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Low emission vehicles in government and state enterprises (207)	900 t CO_2e reduction in emissions from ships road transport in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Fiscal, Regulatory, planning	Implemented	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Energy transition of ferries (208)	4 kt CO_2e reduction in emissions from ferries in 2030, compared to a baseline scenario in the Climate Action Plan	CO_2, CH_4, N_2O	Fiscal, Planning	Implemented	Ministry of Transport and Local Government (SRN)	5.6	6.5	6.5	6.5

Transport policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Incentives for active mobility (209)	The quantified objective of policies 205 and 209 combined is a 10 kt CO_2e reduction in emissions in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Economic, Fiscal, Information, Planning	Implemented	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Energy transition in heavy transport (210)	Transitioning 15-25% of heavy transport vehicles to clean fuels in 2030 and achieving a corresponding 14 kt CO2e reduction in emissions from heavy transport in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Fiscal, Planning	Implemented	Ministry of Industries and Innovation (ANR)	Estimate of impact not available.			
Low emission rental cars (211)	Transitioning 30-50% of rental cars to sustainable fuels in 2030 and achieving a corresponding 28-46 kt CO_2e reduction in emissions from rental cars in 2030, compared to a baseline scenario in the Climate Action Plan.	CO_2, CH_4, N_2O	Economic, Fiscal, Planning	Implemented	Ministry of Industries and Innovation (ANR)	Estimate of impact not available.			
Energy transition of state-owned vessels (212)	The action aims to reduce the use of fossil fuel in state owned vessels other than ferries.	CO_2, CH_4, N_2O	Fiscal, planning	Adopted	Ministry of Industries and Innovation (ANR)	Estimate of impact not available.			

IPPU policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Regulation on F-gases (301)	Stepwise reduction of import of HFCs from 271 kt CO_2e/year (baseline) to 32.5 kt CO_2e/year in 2036 (=12% of baseline).	HFC, PFC	Economic, Regulatory	Implemented	Ministry of the Environment, Energy and Climate	49	61	27	1.0
MAC Directive 2006/40/EC (302)	From 1 January 2017, the use of fluorinated greenhouse gases with a GWP higher than 150 in all new vehicles put on the EU market will be totally banned.	HFC, PFC	Regulatory	Implemented	Ministry of Infrastructure	Estimate of impact not available.			
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).	GHGs	Regulatory	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
BAT for Manufacture of Glass (304)	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).	GHGs	Regulatory	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Taxation of F-gases (305)	Reduction of amount of import of F gases, no quantified objective available.	HFC, PFC	Fiscal	Implemented	Ministry of Finance and Economic Affairs	Estimate of impact not available.			
Carbon capture from heavy industry (306)	CO_2 emissions from heavy industry will be reduced through carbon capture, for example using the Carbfix method.	CO_2	Regulatory	Adopted	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			

IPPU policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Updated Regulation under the Emission Trading System (ETS) (307)	43% decrease of emissions within ETS in 2030 compared to 2005.	CO_2, PFC	Regulatory	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Environmental data reporting (708)	Regulation will be issued for better environmental data reporting, on, e.g., material use, GHG emissions among other pollutants.	GHGs	Regulatory	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			

Agriculture policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2eq)			
						2025	2030	2035	2040
Climate-friendly agriculture (401)	Participation of 15 farms in 2020, participation of 100 farms in 2023.	CO_2, CH_4, N_2O	Information, Education, Planning	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Improved feeding of livestock to reduce enteric fermentation (402)	Research shows that supplements can reduce enteric fermentation in livestock, that results in methane emissions; these possibilities will be explored in the Icelandic context.	CO_2, CH_4, N_2O	Research	Adopted	Ministry of Food, Agriculture and Fisheries	Estimate of impact not available.			
Improved use and handling of fertilisers (403)	Use of N-fertilizer, -10% in 2030 compared to a BAU scenario.	CO_2, CH_4, N_2O	Education, Planning, Regulatory	Adopted	Ministry of Food, Agriculture and Fisheries	3.8	5.6	7.3	9.0
Carbon-neutral beef production (404)	Carbon neutrality of beef farms by 2040.	CO_2, CH_4, N_2O	Education, Planning, Regulatory	Implemented	Ministry of Food, Agriculture and Fisheries	Estimate of impact not available.			
Increased domestic vegetable production (405)	Increase of vegetable production by 25% from 2020 to 2023, carbon neutrality of horticulture in 2040.	CO_2, CH_4, N_2O	Planning, Regulatory	Implemented	Ministry of Food, Agriculture and Fisheries	Estimate of impact not available.			

LULUCF policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2eq)			
						2025	2030	2035	2040
Enhanced action in forestry (601)	134 kt CO_2e increased carbon sequestration due to increased afforestation 2030, compared to a baseline scenario; 258 kt CO_2e increased carbon sequestration in 2040, compared to a baseline scenario.	CO_2, CH_4	Fiscal	Implemented	Ministry of the Environment, Energy and Climate	13	75	84	158
Expanding revegetation (602)	137 kt CO_2e increased carbon sequestration due to revegetation 2030, compared to a baseline scenario; 273 kt CO_2e increased carbon sequestration in 2040, compared to a baseline scenario.	CO_2, CH_4	Planning	Implemented	Ministry of the Environment, Energy and Climate	64	133	200	266
Wetlands Conservation (603)	The objective is to ensure that emissions from drained wetlands do not increase.	CO_2, CH_4	Regulatory, Voluntary Agreement	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Restoration of wetlands (604)	107 kt CO_2e reduction in emissions due to the restoration of wetlands in 2030, compared to a baseline scenario; 210 kt CO_2e reduction in emissions in 2040, compared to a baseline scenario.	CO_2, CH_4	Research, Planning	Implemented	Ministry of the Environment, Energy and Climate	57	113	169	225
Improved mapping of grazing land and land use (605)	The state of grazing land will be mapped and used for grazing management	CO_2, CH_4	Information, Research, Planning	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			

LULUCF policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2eq)			
						2025	2030	2035	2040
Improvement plan for the LULUCF inventory (606)	Increased capacity in the LULUCF inventory and increased research to improve the foundation for estimating emissions and sequestration from the LULUCF sector.	CO_2, CH_4	Research	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			

Waste policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2eq)			
						2025	2030	2035	2040
Ban on landfilling of organic waste (501)	Decrease amount of waste landfilled: amount of biological waste landfilled 2021 = 0 kt, amount of biodegradable waste landfilled 2023 = 0 kt.	CH_4	Regulatory	Implemented	Ministry of the Environment, Energy and Climate	45	103	143	174
Landfill tax (502)	Decrease in amount of waste sent to landfill, a quantified objective is not available.	CH_4	Fiscal	Planned	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Reduction in food waste (503)	Reduction of food waste throughout entire value chain by 50% in the next 10 years.	CH_4	Education, Information	Implemented	Ministry of the Environment, Energy and Climate	Estimate of impact not available.			
Gas and compost plant (504)	25.000 tonnes of organic waste/ year (max capacity: 35.000 tonnes) and produce 12.000 tonnes of compost and 3 million Nm^3 of CH_4 each year.	CH_4	Regulatory, Voluntary Agreement	Implemented	SORPA Municipal Association	Estimate together with ban on landfilling of organic waste (501) above			
Pay-as-you-throw system (505)	Encourage increased recycling.	CO_2, CH_4, N_2O	Economic, Regulatory	Adopted	Local government	Estimate of impact not available.			

Waste policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2eq)			
						2025	2030	2035	2040
Extended manufacturer's warranty (506)	Extended manufacturer's warranty introduced to all packaging	CO_2, CH_4, N_2O	Regulatory	Adopted	Local government	Estimate of impact not available.			

Cross-cutting policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2eq)			
						2025	2030	2035	2040
Climate fund (703)	Climate education and innovation will be supported through the new Icelandic Climate fund	GHGs	Economic	Implemented	Ministry of Finance and Economic Affairs (FJR), Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Climate strategy of Government Offices (704)	The goal is to reduce emissions from public agencies, primarily by reducing international travel. The target is to reduce emissions by 165 kt CO_2e in 2030 compared to a baseline scenario.	GHGs	Economic	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Climate education in schools (706)	Climate education in schools will be reinforced.	GHGs	Education	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Information on climate change for the public (707)	Information on climate issues, the effects of climate change, mitigation and adaptation will be supported through various means.	GHGs	Economic, Education	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			

Cross-cutting policies and measures	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO2eq)			
						2025	2030	2035	2040
Climate action planning (709)	Climate issues will be addressed through Iceland's National Planning Strategy.	GHGs	Planning	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Issuing of green bonds (711)	Evaluation will be made on the feasibility of issuing green bonds in order to raise green investor interest in traditional state loans.	GHGs	Economic	Implemented	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Sustainable public procurement (712)	Environmental and climate issues will be evaluated in all government purchasing with a new policy on sustainable public procurement.	GHGs	Economic	Implemented	Ministry of Finance and Economic Affairs (FJR)	Estimate of impact not available.			
Climate strategy of other public agencies (713)	All other public agencies will need to set a Climate Strategy. The same applies to local government.	GHGs	Regulatory, Voluntary/ Negotiated agreements	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			
Climate impact assessment of legislation (714)	The climate impact of all new legislation will be evaluated.	GHGs	Regulatory	Implemented	Ministry for the Environment, Energy and Climate	Estimate of impact not available.			

See further information in the National Communication, Chapter 4.

5 Projection

Iceland's total historical and projected emissions of GHGs excluding LULUCF are presented in Figure 5.1 below, for the WEM scenario. The total emissions are expected to have reached their peak in 2018 and to follow a downward trend until 2040. Iceland's GHG emissions will be 1% lower in 2040 than they were in 1990, but they will be 24% lower than they were in 2015.

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

Iceland's total historical and projected emissions of GHGs including LULUCF emissions are presented in Figure 5.2. The total emissions incl. LULUCF are expected to have decreased by 8% in 2030 and 9% in 2040 compared to emissions in 1990. Carbon sequestration due to forest land has increased 17-fold in 2020 compared to 1990 levels and is expected to change from -510 kt CO2 p.a. in 2020 to -794 kt CO2 p.a. in 2040.

Only WEM (with existing measures) projections are reported in these National Communications, as was done in Iceland's submission on policies, measures and projections to the EU. Work is in progress to produce WAM (with additional measures) projections for the next report to the EU, due in March 2023; These will be included in Iceland's first biennial transparency report. Currently there are no plans to produce WOM (without measures) projections, due to lack of reliable information on how emissions would evolve if no measures were set in place.

See further information in the National Communication, chapter 5.

6 Provision of financial, technological and capacity-building support

International Development Cooperation is one of the key pillars of Iceland's foreign policy, with the main goal of contributing to the fight against poverty in the world's poorest countries and guided by the Sustainable Development Goals (SDGs).

Iceland endeavours to follow best practices in international development cooperation and important efforts to that end have been made in recent years. In 2012, Iceland began the process of implementing the OECD Development Assistance Committee (DAC) statistical reporting methods (Creditor Reporting System, CRS), including the usage of the Rio Markers as a methodology for tracking finance for adaptation, mitigation, desertification and biodiversity. While the Rio Markers have guidelines and technical eligibility criteria agreed within OECD-DAC, the process of assigning markers to projects and programs is subjective and can vary between institutions and the quantification of climate relevant contribution can equally vary between countries. Iceland currently reports all programs or projects as 100% climate relevant finance if it has been marked with either Rio-marker 1 ('Significant") or Rio-marker 2 ("Principal"). While core funding to multilateral institutions is not marked with Rio Markers or accounted for in the OECD DAC marker, Iceland puts forth these contributions in BR-CTF 7a. Contributions to multilateral agencies which main mandate is climate actions such as UNCCD, SEforALL and Green Climate Fund are included in this report.

BR5 Table 4 Summary information climate categories

Type of support, division of total ODA	2019	2020
Adaptation	10%	8%
Mitigation	7%	4%
Cross – cutting	8%	8%

Type of support, division of climate ODA	2019	2020
Adaptation	40%	41%
Mitigation	29%	21%
cross - cutting	31%	38%

BR Table 5, provides a summary of both bilateral and multilateral projects with a marked focus on mitigation, adaptation and cross-cutting environmental issues.

BR5 Table 5 Summary information climate-specific projects (%)

	2019	2020
Total bilateral climate related funds	1.434.351.028	1.184.975.046
Total multilateral climate related funds	439.873.468	394.766.790
total climate ODA	1.874.224.496	1.579.741.836
Grand Total ODA	**7.530.368.125**	**7.838.014.734**
Total share of climate ODA of total ODA	25%	20%

BR5 Table 6 provides a summary from table 7 which enlist both bilateral and multilateral projects with a marked focus on mitigation, adaptation, and cross-cutting environmental issues. The following tables represent BR-CTF Tables 7a and 7b[172]. All detailed information is also found on the www.openaid.is website.

BR5 Table 6 Summary information climate-specific bilateral projects (ISK) categorized by type of support.

Mitigation	2019	2020
GRÓ training programs		
GRÓ Geothermal Training Program	251.000.002	130.615.750
GRÓ Land Restoration Training Program	141.449.999	105.000.000
Geothermal projects		
Expertise Geothermal Technical Advice - Fiji	1.820.286	
Expertise Geothermal Technical Advice - Kazakhstan	4.436.037	1.037.500
Technical Assistance Program in Geothermal Development - El Salvador	10.483.773	26.908.009
Geothermal Exploration Project in cooperation with the Nordic Development Fund (NDF)	38.872.862	38.260.338
Support to African Rift Geothermal Development Facility (ARGeo)	12.271.600	
Sustainable energy		
Energising Development, Mangochi District, Malawi	61.190.780	
ABC Children's Aid - Solar cells and batteries for ABC Burkina Faso		5.350.978
Total mitigation funds	**521.525.339**	**307.172.575**

Adaptation	2019	2020
WASH projects		
WASH Sierra Leone	167.587.707	119.627.000
Wash Liberia	25.134.000	12.468.600
Wash Uganda	94.920.000	
Wash Mozambique		99.097.327
Water and sanitation bilateral support - Uganda	61.830.414	47.395.152
Water and sanitation bilateral support - Malawi	84.823.466	85.818.057
Support to fisheries		
SDG Fund - Ocean Excellence - Sub-cooling technology for artisanal fisheries in Sierra Leone		1.000.000

[172] See Iceland´s fifth biennial Reporting Common Tabular Format (BR CTF)

Fund for collaborating with businesses - Marel - Improved quality of Vietnamese pangasius	2.839.400	
SDG Fund - Atmonia - Sustainable and Self-sufficient Production of Nitrogen Fertilizer in Cameroon		1.000.000
Buikwe, Uganda, school feeding program in response to COVID-19		58.839.000
SDG Fund - Aurora Seafood - Blue growth through new utilization of resources from the ocean		1.000.000
Technical assistance for the Lake Victoria Fisheries Management Improvement Project in Uganda	1.642.066	
Grants for participants from SIDS & W-Africa in the Rhodes Academy of Oceans Law and Policy study course on the law of the sea.	2.800.000	
Community Based Integrated Resiliency Program, Sierra Leone (BRIDGE)	26.086.396	15.373.785
Technical Assistance Program in Fisheries - Vietnam	8.116.703	932.017
Icelandic Consultancy work on seaweed aquaculture in the Philippines	3.973.403	
Icelandic consultancy work on aquaculture in Indonesia	4.133.470	
Expert advice to World Bank fisheries program for Albania		15.167.407
Operation of projects in regional cooperation - West Africa	26.583.073	21.642.420
GRÓ training programs[173]		
GRÓ Fisheries Training Program	222.000.001	166.221.000
Total adaptation funds	732.470.099	645.581.765

Cross cutting	**2019**	**2020**
GRÓ training programs		
GRÓ Gender Equality Studies and Training Program	120.049.999	137.993.563
Gender and climate change		
Kebribeyah Climate Resilient Livelihood Project II		18.120.000
Community Resilience Project in Malawi	30.400.000	15.160.000
The Red Cross - Community Resilience Program II		35.710.000
Kebribeyjah Sustainable Livelihood Project, Ethiopia	27.157.334	13.578.667
Support for the participation of the National Rescue Representative in the international consultation with UNDAC / INSARAG	2.748.257	940.755
The Icelandic Red Cross and the International Federation of National Red Cross and Red Crescent Societies		10.717.721
Total Cross-cutting funds	**180.355.590**	**232.220.706**

[173] GRÓ – International Centre for Capacity Development, Sustainable use of Natural Resources and Societal Change, that operates under the auspices of UNESCO.

BR5 Table 7 Summary information climate specific multilateral projects (ISK) categorized by type of support

Mitigation	2019	2020
SeForALL	25.168.000	25.809.600
Total mitigation funds	**25.168.000**	**25.809.600**

Adaptation	2019	2020
Least Developed Countries Fund	12.308.100	
DOALOS	3.000.000	6.000.000
Total adaptation funds	**15.310.119**	**6.002.020**

Cross cutting	2019	2020
World Bank		
Word Bank´s Blue Economy Programme (PROBLUE)	44.299.892	51.024.000
Energy Sector Management Assistance Program (ESMAP)	36.803.100	51.386.000
PROBLUE - Word Bank´s Blue Economy Program	48.688.800	
Energy Sector Management Assistance Program (ESMAP) - additional funding because of COVID-19		25.000.000
Donor Funded Staffing Program (DFSP), World Bank Group	117.933.050	8.272.588
AWEEF	18.685.500	
UNEP	521.928	428.634
FAO		
Food and Agricultural Organization of the United Nations (FAO) - PSMA Global international exchange system	20.507.806	-
The Food and Agricultural Organization (FAO)	9.441.589	13.005.197
WFP		
World Food Program (WFP) implementation of the School meal program in Mangochi, Malawi	42.523.614	41.291.420
World Food Program (WFP) framework agreement - core funding	49.976.555	49.977.731
UN Common agenda		2.567.600
UNCCD	508.015	
WEDO	9.505.500	
Multi-Partner Trust Fund (MPTF)		100.002.000
UNHCR		20.000.000
Total Cross-cutting funds	**399.395.349**	**362.955.170**

See further information in the National Communication, Chapter 7, and BR-CTF tables 7-9.

Annex II Greenhouse gas inventories 1990-2020

1990

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1990
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	7975.10	4045.85	356.32	0.34	494.64	1.10	NO,NA	NO,NA	12873.35
1. Energy	1800.29	8.73	26.54						1835.56
A. Fuel combustion (sectoral approach)	1738.93	8.05	26.54						1773.51
1. Energy industries	13.48	0.01	0.03						13.53
2. Manufacturing industries and construction	237.47	0.31	0.66						238.43
3. Transport	698.64	5.83	19.71						724.19
4. Other sectors	789.22	1.90	6.13						797.25
5. Other	0.12	0.00	0.00						0.12
B. Fugitive emissions from fuels	61.36	0.68	NO,NA						62.04
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	61.36	0.68	NA,NO						62.04
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	407.76	1.62	52.58	0.34	494.64	1.10	NO,NA	NO,NA	958.03
A. Mineral industry	52.26								52.26
B. Chemical industry	0.36	NO,NA	46.49	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	46.85
C. Metal industry	348.01	1.57	NO	NO	494.64	NO	NO	NO	844.22
D. Non-energy products from fuels and solvent use	7.13	NA	NA						7.13
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				0.34	NO	NO	NO	NO	0.34
G. Other product manufacture and use	0.00	0.05	6.09		NO	1.10			7.24
H. Other	NA	NA	NA						NA
3. Agriculture	0.52	390.26	270.75						661.53
A. Enteric fermentation		326.31							326.31
B. Manure management		63.95	22.25						86.20
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	248.50						248.50
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.46								0.46
H. Urea application	0.06								0.06
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5759.25	3439.43	0.19						9198.87
A. Forest land	-30.16	0.11	0.12						-29.94
B. Cropland	1884.40	94.83	NO,NA						1979.23
C. Grassland	5001.40	374.02	0.07						5375.50
D. Wetlands	-1118.24	2970.47	NO,NA						1852.24
E. Settlements	21.84	NE,NA	NO,NE,IE,NA						21.84
F. Other land	NA	NA	NA						NA
G. Harvested wood products	NO,NA								NO,NA
H. Other	IE	IE	IE						IE
5. Waste	7.30	205.81	6.26						219.36
A. Solid waste disposal	NO,NA	149.73							149.73
B. Biological treatment of solid waste		NO,NA	NO,NA						NO,NA
C. Incineration and open burning of waste	7.30	6.09	1.67						15.06
D. Waste water treatment and discharge		50.00	4.58						54.58
E. Other	NA	NO	NO						NO,NA
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	247.25	0.10	2.05						249.41
Aviation	219.44	0.04	1.83						221.31
Navigation	27.81	0.07	0.22						28.10
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO,IE,NA								NO,IE,NA
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3674.48
Total CO_2 equivalent emissions with land use, land-use change and forestry									12873.35
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for
[2] See footnote 7 to table Summary 1.A.
[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

1991

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1991
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	7859.91	4044.53	348.85	0.69	410.61	1.24	NO,NA	NO,NA	12665.84
1. Energy	1715.48	8.62	25.82						1749.92
A. Fuel combustion (sectoral approach)	1645.53	8.02	25.82						1679.37
1. Energy industries	15.08	0.01	0.04						15.13
2. Manufacturing industries and construction	166.50	0.23	0.48						167.21
3. Transport	699.68	5.95	19.38						725.01
4. Other sectors	764.13	1.83	5.93						771.89
5. Other	0.14	0.00	0.00						0.14
B. Fugitive emissions from fuels	69.95	0.59	NO,NA						70.54
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	69.95	0.59	NA,NO						70.54
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	373.35	1.31	50.54	0.69	410.61	1.24	NO,NA	NO,NA	837.74
A. Mineral industry	48.63								48.63
B. Chemical industry	0.31	NO,NA	45.00	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	45.31
C. Metal industry	317.42	1.26	NO	NO	410.61	NO	NO	NO	729.29
D. Non-energy products from fuels and solvent use	6.98	NA	NA						6.98
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				0.69	NO	NO	NO	NO	0.69
G. Other product manufacture and use	0.00	0.05	5.54		NO	1.24			6.83
H. Other	NA	NA	NA						NA
3. Agriculture	0.24	378.80	265.97						645.01
A. Enteric fermentation		316.85							316.85
B. Manure management		61.95	21.20						83.16
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	244.76						244.76
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.18								0.18
H. Urea application	0.06								0.06
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5763.60	3442.14	0.25						9205.99
A. Forest land	-31.59	0.15	0.17						-31.27
B. Cropland	1884.47	94.81	NO,NA						1979.28
C. Grassland	5000.24	374.38	0.08						5374.70
D. Wetlands	-1111.34	2972.79	NO,NA						1861.45
E. Settlements	21.83	NE,NA	NO,NE,IE,NA						21.83
F. Other land	NA	NA	NA						NA
G. Harvested wood products	NO,NA								NO,NA
H. Other	IE	IE	IE						IE
5. Waste	7.24	213.67	6.28						227.18
A. Solid waste disposal	NO,NA	154.75							154.75
B. Biological treatment of solid waste		NO,NA	NO,NA						NO,NA
C. Incineration and open burning of waste	7.24	6.04	1.66						14.94
D. Waste water treatment and discharge		52.87	4.62						57.49
E. Other	NA	NO	NO						NO,NA
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	235.64	0.07	1.96						237.67
Aviation	221.77	0.04	1.85						223.66
Navigation	13.87	0.03	0.11						14.01
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO,IE,NA								NO,IE,NA
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3459.85
Total CO_2 equivalent emissions with land use, land-use change and forestry									12665.84
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for
[2] See footnote 7 to table Summary 1.A.
[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

1992

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1992
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	7998.60	4049.45	334.18	0.70	183.04	1.24	NO,NA	NO,NA	12567.21
1. Energy	1858.39	8.91	26.14						1893.44
A. Fuel combustion (sectoral approach)	1790.77	8.26	26.14						1825.17
1. Energy industries	14.08	0.01	0.03						14.13
2. Manufacturing industries and construction	229.65	0.27	0.60						230.52
3. Transport	703.76	5.96	18.95						728.66
4. Other sectors	842.49	2.01	6.56						851.06
5. Other	0.79	0.00	0.00						0.80
B. Fugitive emissions from fuels	67.62	0.65	NO,NA						68.27
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	67.62	0.65	NA,NO						68.27
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	376.61	1.41	45.22	0.70	183.04	1.24	NO,NA	NO,NA	608.23
A. Mineral industry	45.67								45.67
B. Chemical industry	0.25	NO,NA	40.23	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	40.48
C. Metal industry	323.55	1.36	NO	NO	183.04	NO	NO	NO	507.94
D. Non-energy products from fuels and solvent use	7.14	NA	NA						7.14
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				0.70	NO	NO	NO	NO	0.70
G. Other product manufacture and use	0.01	0.05	4.99		NO	1.24			6.29
H. Other	NA	NA	NA						NA
3. Agriculture	0.56	371.38	256.19						628.12
A. Enteric fermentation		313.01							313.01
B. Manure management		58.36	20.04						78.41
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	236.14						236.14
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.50								0.50
H. Urea application	0.06								0.06
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5756.00	3441.50	0.31						9197.81
A. Forest land	-36.23	0.21	0.23						-35.79
B. Cropland	1883.91	94.80	NO,NA						1978.71
C. Grassland	4997.44	374.74	0.08						5372.26
D. Wetlands	-1110.95	2971.76	NO,NA						1860.81
E. Settlements	21.83	NE,NA	NO,NE,IE,NA						21.83
F. Other land	NA	NA	NA						NA
G. Harvested wood products	NO,NA								NO,NA
H. Other	IE	IE	IE						IE
5. Waste	7.04	226.25	6.32						239.61
A. Solid waste disposal	NO,NA	168.15							168.15
B. Biological treatment of solid waste		NO,NA	NO,NA						NO,NA
C. Incineration and open burning of waste	7.04	5.90	1.62						14.56
D. Waste water treatment and discharge		52.20	4.70						56.90
E. Other	NA	NO	NO						NO,NA
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	223.70	0.08	1.86						225.64
Aviation	203.42	0.04	1.70						205.15
Navigation	20.28	0.05	0.16						20.49
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO,IE,NA								NO,IE,NA
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3369.40
Total CO_2 equivalent emissions with land use, land-use change and forestry									12567.21
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

1993

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1993
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8143.03	4063.22	342.77	1.58	88.24	1.24	NO,NA	NO,NA	12640.08
1. Energy	1961.43	8.88	28.19						1998.50
A. Fuel combustion (sectoral approach)	1876.05	8.22	28.19						1912.46
1. Energy industries	14.44	0.03	0.10						14.57
2. Manufacturing industries and construction	248.33	0.30	0.65						249.27
3. Transport	714.08	5.75	20.41						740.24
4. Other sectors	897.77	2.14	7.03						906.94
5. Other	1.44	0.00	0.00						1.44
B. Fugitive emissions from fuels	85.38	0.66	NO,NA						86.03
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	85.38	0.66	NA,NO						86.03
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	425.56	1.73	47.23	1.58	88.24	1.24	NO,NA	NO,NA	565.58
A. Mineral industry	39.65								39.65
B. Chemical industry	0.24	NO,NA	42.32	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	42.56
C. Metal industry	378.27	1.68	NO	NO	88.24	NO	NO	NO	468.20
D. Non-energy products from fuels and solvent use	7.39	NA	NA						7.39
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				1.58	NO	NO	NO	NO	1.58
G. Other product manufacture and use	0.01	0.04	4.91		NO	1.24			6.20
H. Other	NA	NA	NA						NA
3. Agriculture	0.50	371.03	260.87						632.40
A. Enteric fermentation		312.71							312.71
B. Manure management		58.32	20.13						78.45
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	240.74						240.74
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.44								0.44
H. Urea application	0.06								0.06
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5749.55	3440.84	0.33						9190.72
A. Forest land	-41.39	0.22	0.24						-40.93
B. Cropland	1883.38	94.78	NO,NA						1978.16
C. Grassland	4996.29	375.10	0.08						5371.47
D. Wetlands	-1110.56	2970.74	NO,NA						1860.18
E. Settlements	21.83	NE,NA	NO,NE,IE,NA						21.83
F. Other land	NA	NA	NA						NA
G. Harvested wood products	NO,NA								NO,NA
H. Other	IE	IE	IE						IE
5. Waste	6.00	240.75	6.15						252.90
A. Solid waste disposal	NO,NA	179.69							179.69
B. Biological treatment of solid waste		NO,NA	NO,NA						NO,NA
C. Incineration and open burning of waste	6.00	5.11	1.41						12.51
D. Waste water treatment and discharge		55.95	4.75						60.70
E. Other	NA	NO	NO						NO,NA
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	225.02	0.10	1.87						226.99
Aviation	195.45	0.03	1.63						197.11
Navigation	29.57	0.07	0.24						29.88
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	3.14								3.14
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3449.37
Total CO_2 equivalent emissions with land use, land-use change and forestry									12640.08
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

1994

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1994
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8087.95	4069.72	348.54	2.03	52.53	1.24	NO,NA	NO,NA	12562.01
1. Energy	1909.88	8.66	28.84						1947.38
A. Fuel combustion (sectoral approach)	1839.76	7.99	28.84						1876.60
1. Energy industries	14.30	0.03	0.09						14.43
2. Manufacturing industries and construction	227.84	0.27	0.60						228.72
3. Transport	716.94	5.58	21.25						743.78
4. Other sectors	880.57	2.10	6.89						889.57
5. Other	0.10	0.00	0.00						0.10
B. Fugitive emissions from fuels	70.12	0.67	NO,NA						70.79
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	70.12	0.67	NA,NO						70.79
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	426.66	1.70	47.09	2.03	52.53	1.24	NO,NA	NO,NA	531.25
A. Mineral industry	37.35								37.35
B. Chemical industry	0.35	NO,NA	42.61	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	42.97
C. Metal industry	381.64	1.65	NO	NO	52.53	NO	NO	NO	435.82
D. Non-energy products from fuels and solvent use	7.31	NA	NA						7.31
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				2.03	NO	NO	NO	NO	2.03
G. Other product manufacture and use	0.01	0.05	4.48		NO	1.24			5.77
H. Other	NA	NA	NA						NA
3. Agriculture	0.07	372.84	266.17						639.08
A. Enteric fermentation		315.19							315.19
B. Manure management		57.65	20.20						77.84
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	245.98						245.98
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.01								0.01
H. Urea application	0.06								0.06
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5745.81	3439.70	0.35						9185.86
A. Forest land	-44.25	0.23	0.26						-43.76
B. Cropland	1882.87	94.76	NO,NA						1977.63
C. Grassland	4995.27	375.69	0.09						5371.05
D. Wetlands	-1109.90	2969.01	NO,NA						1859.11
E. Settlements	21.83	NE,NA	NO,NE,IE,NA						21.83
F. Other land	NA	NA	NA						NA
G. Harvested wood products	NO,NA								NO,NA
H. Other	IE	IE	IE						IE
5. Waste	5.53	246.82	6.10						258.44
A. Solid waste disposal	NO,NA	190.34							190.34
B. Biological treatment of solid waste		NO,NA	NO,NA						NO,NA
C. Incineration and open burning of waste	5.53	4.74	1.30						11.57
D. Waste water treatment and discharge		51.74	4.79						56.53
E. Other	NA	NO	NO						NO,NA
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	247.06	0.12	2.05						249.23
Aviation	213.41	0.04	1.78						215.23
Navigation	33.65	0.08	0.27						34.00
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	3.14								3.14
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3376.16
Total CO_2 equivalent emissions with land use, land-use change and forestry									12562.01
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

1995

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1995
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8196.18	4067.80	343.27	3.43	69.36	1.24	NO,NA	NO,NA	12681.30
1. Energy	2010.57	8.57	33.53						2052.67
A. Fuel combustion (sectoral approach)	1928.33	7.88	33.53						1969.74
1. Energy industries	15.12	0.04	0.11						15.27
2. Manufacturing industries and construction	215.90	0.25	0.55						216.69
3. Transport	753.16	5.34	25.47						783.97
4. Other sectors	942.54	2.25	7.39						952.18
5. Other	1.62	0.00	0.00						1.63
B. Fugitive emissions from fuels	82.24	0.69	NO,NA						82.93
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	82.24	0.69	NA,NO						82.93
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	444.06	1.83	45.01	3.43	69.36	1.24	NO,NA	NO,NA	564.94
A. Mineral industry	37.84								37.84
B. Chemical industry	0.46	NO,NA	40.53	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	40.98
C. Metal industry	397.93	1.79	NO	NO	69.36	NO	NO	NO	469.08
D. Non-energy products from fuels and solvent use	7.83	NA	NA						7.83
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				3.43	NO	NO	NO	NO	3.43
G. Other product manufacture and use	0.01	0.05	4.48		NO	1.24			5.78
H. Other	NA	NA	NA						NA
3. Agriculture	0.06	359.96	258.17						618.19
A. Enteric fermentation		303.23							303.23
B. Manure management		56.73	19.21						75.95
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	238.96						238.96
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.00								0.00
H. Urea application	0.06								0.06
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5736.62	3438.11	0.39						9175.12
A. Forest land	-54.04	0.27	0.30						-53.47
B. Cropland	1882.33	94.75	NO,NA						1977.08
C. Grassland	4995.48	376.52	0.09						5372.09
D. Wetlands	-1108.98	2966.57	NO,NA						1857.59
E. Settlements	21.83	NE,NA	NO,NE,IE,NA						21.83
F. Other land	NA	NA	NA						NA
G. Harvested wood products	NO,NA								NO,NA
H. Other	IE	IE	IE						IE
5. Waste	4.87	259.33	6.17						270.37
A. Solid waste disposal	NO,NA	201.09							201.09
B. Biological treatment of solid waste		0.20	0.14						0.34
C. Incineration and open burning of waste	4.87	4.23	1.16						10.27
D. Waste water treatment and discharge		53.80	4.86						58.66
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	239.25	0.05	1.99						241.30
Aviation	235.92	0.04	1.97						237.93
Navigation	3.33	0.01	0.03						3.37
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	3.90								3.90
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3506.18
Total CO_2 equivalent emissions with land use, land-use change and forestry									12681.30
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for
[2] See footnote 7 to table Summary 1.A.
[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

1996

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1996
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8247.29	4087.96	359.37	10.65	29.64	1.24	NO,NA	NO,NA	12736.16
1. Energy	2065.44	8.47	34.18						2108.09
A. Fuel combustion (sectoral approach)	1984.17	7.70	34.18						2026.05
1. Energy industries	12.14	0.05	0.13						12.31
2. Manufacturing industries and construction	262.88	0.28	0.65						263.81
3. Transport	739.49	5.05	25.82						770.36
4. Other sectors	969.28	2.32	7.58						979.18
5. Other	0.39	0.00	0.00						0.39
B. Fugitive emissions from fuels	81.27	0.78	NO,NA						82.04
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	81.27	0.78	NA,NO						82.04
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	443.42	1.86	52.29	10.65	29.64	1.24	NO,NA	NO,NA	539.11
A. Mineral industry	41.76								41.76
B. Chemical industry	0.40	NO,NA	47.38	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	47.78
C. Metal industry	393.47	1.81	NO	NO	29.64	NO	NO	NO	424.93
D. Non-energy products from fuels and solvent use	7.78	NA	NA						7.78
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				10.65	NO	NO	NO	NO	10.65
G. Other product manufacture and use	0.01	0.05	4.91		NO	1.24			6.20
H. Other	NA	NA	NA						NA
3. Agriculture	0.41	365.21	266.41						632.03
A. Enteric fermentation		307.86							307.86
B. Manure management		57.35	19.44						76.79
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	246.97						246.97
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.35								0.35
H. Urea application	0.07								0.07
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5733.65	3438.53	0.41						9172.59
A. Forest land	-58.13	0.29	0.32						-57.52
B. Cropland	1881.78	94.73	NO,NA						1976.51
C. Grassland	4994.80	377.22	0.09						5372.12
D. Wetlands	-1106.63	2966.29	NO,NA						1859.65
E. Settlements	21.83	NE,NA	NO,NE,IE,NA						21.83
F. Other land	NA	NA	NA						NA
G. Harvested wood products	NO,NA								NO,NA
H. Other	IE	IE	IE						IE
5. Waste	4.37	273.90	6.07						284.34
A. Solid waste disposal	NO,NA	204.96							204.96
B. Biological treatment of solid waste		0.20	0.14						0.34
C. Incineration and open burning of waste	4.37	3.83	1.05						9.25
D. Waste water treatment and discharge		64.92	4.87						69.79
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	290.26	0.09	2.41						292.76
Aviation	271.24	0.05	2.26						273.55
Navigation	19.02	0.05	0.15						19.21
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	4.97								4.97
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3563.57
Total CO_2 equivalent emissions with land use, land-use change and forestry									12736.16
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

1997

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1997
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8344.14	4089.25	353.49	16.89	97.08	1.24	NO,NA	NO,NA	12902.08
1. Energy	2101.99	8.24	38.42						2148.65
A. Fuel combustion (sectoral approach)	2035.14	7.44	38.42						2081.00
1. Energy industries	7.01	0.04	0.12						7.17
2. Manufacturing industries and construction	301.02	0.34	0.76						302.11
3. Transport	780.41	4.80	30.08						815.30
4. Other sectors	946.66	2.26	7.46						956.39
5. Other	0.04	0.00	0.00						0.04
B. Fugitive emissions from fuels	66.85	0.80	NO,NA						67.65
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	66.85	0.80	NA,NO						67.65
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	502.63	1.83	44.44	16.89	97.08	1.24	NO,NA	NO,NA	664.12
A. Mineral industry	46.52								46.52
B. Chemical industry	0.44	NO,NA	39.51	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	39.95
C. Metal industry	448.00	1.79	NO	NO	97.08	NO	NO	NO	546.87
D. Non-energy products from fuels and solvent use	7.67	NA	NA						7.67
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				16.89	NO	NO	NO	NO	16.89
G. Other product manufacture and use	0.01	0.05	4.93		NO	1.24			6.23
H. Other	NA	NA	NA						NA
3. Agriculture	0.76	361.72	264.13						626.61
A. Enteric fermentation		305.41							305.41
B. Manure management		56.31	19.51						75.82
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	244.62						244.62
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.69								0.69
H. Urea application	0.06								0.06
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5734.55	3435.98	0.43						9170.96
A. Forest land	-65.04	0.30	0.34						-64.40
B. Cropland	1881.26	94.71	NO,NA						1975.97
C. Grassland	5001.63	378.57	0.10						5380.30
D. Wetlands	-1105.14	2962.40	NO,NA						1857.26
E. Settlements	21.83	NE,NA	NO,NE,IE,NA						21.83
F. Other land	NA	NA	NA						NA
G. Harvested wood products	0.00								0.00
H. Other	IE	IE	IE						IE
5. Waste	4.21	281.48	6.06						291.74
A. Solid waste disposal	NO,NA	208.76							208.76
B. Biological treatment of solid waste		0.20	0.14						0.34
C. Incineration and open burning of waste	4.21	3.67	1.01						8.89
D. Waste water treatment and discharge		68.85	4.91						73.76
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	329.95	0.14	2.74						332.83
Aviation	291.83	0.05	2.43						294.31
Navigation	38.12	0.09	0.31						38.51
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	4.97								4.97
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3731.12
Total CO_2 equivalent emissions with land use, land-use change and forestry									12902.08
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

1998

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1998
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8369.61	4085.25	354.40	26.31	212.33	1.24	NO,NA	NO,NA	13049.15
1. Energy	2094.58	8.15	39.55						2142.28
A. Fuel combustion (sectoral approach)	2010.86	7.14	39.55						2057.55
1. Energy industries	9.04	0.04	0.12						9.20
2. Manufacturing industries and construction	271.86	0.32	0.71						272.89
3. Transport	785.50	4.52	31.34						821.36
4. Other sectors	939.48	2.25	7.36						949.09
5. Other	4.99	0.00	0.01						5.00
B. Fugitive emissions from fuels	83.72	1.01	NO,NA						84.73
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	83.72	1.01	NA,NO						84.73
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	530.48	1.60	39.53	26.31	212.33	1.24	NO,NA	NO,NA	811.51
A. Mineral industry	54.36								54.36
B. Chemical industry	0.40	NO,NA	34.45	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	34.85
C. Metal industry	467.90	1.56	NO	NO	212.33	NO	NO	NO	681.79
D. Non-energy products from fuels and solvent use	7.81	NA	NA						7.81
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				26.31	NO	NO	NO	NO	26.31
G. Other product manufacture and use	0.01	0.04	5.08		NO	1.24			6.38
H. Other	NA	NA	NA						NA
3. Agriculture	0.08	369.27	268.88						638.23
A. Enteric fermentation		311.28							311.28
B. Manure management		57.99	19.98						77.98
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	248.90						248.90
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.00								0.00
H. Urea application	0.08								0.08
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5740.90	3432.27	0.48						9173.65
A. Forest land	-73.51	0.34	0.38						-72.78
B. Cropland	1880.73	94.69	NO,NA						1975.43
C. Grassland	5014.65	380.52	0.10						5395.27
D. Wetlands	-1102.80	2956.71	NO,NA						1853.91
E. Settlements	21.83	NE,NA	NO,NE,IE,NA						21.83
F. Other land	NA	NA	NA						NA
G. Harvested wood products	-0.01								-0.01
H. Other	IE	IE	IE						IE
5. Waste	3.57	273.95	5.96						283.48
A. Solid waste disposal	NO,NA	214.88							214.88
B. Biological treatment of solid waste		0.20	0.14						0.34
C. Incineration and open burning of waste	3.57	3.16	0.87						7.59
D. Waste water treatment and discharge		55.72	4.95						60.67
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:[2]									
International bunkers	389.32	0.18	3.23						392.73
Aviation	337.80	0.06	2.82						340.67
Navigation	51.52	0.12	0.41						52.06
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	4.97								4.97
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2[3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3875.50
Total CO_2 equivalent emissions with land use, land-use change and forestry									13049.15
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

1999

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1999
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8584.98	4087.41	363.38	37.98	204.17	1.24	NO,NA	NO,NA	13279.16
1. Energy	2148.81	8.31	41.80						2198.92
A. Fuel combustion (sectoral approach)	2037.53	6.94	41.80						2086.27
1. Energy industries	6.69	0.04	0.12						6.85
2. Manufacturing industries and construction	279.05	0.32	0.72						280.09
3. Transport	823.76	4.35	33.69						861.80
4. Other sectors	923.65	2.22	7.26						933.13
5. Other	4.38	0.00	0.01						4.40
B. Fugitive emissions from fuels	111.27	1.37	NO,NA						112.64
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	111.27	1.37	NA,NO						112.64
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	679.36	1.86	40.01	37.98	204.17	1.24	NO,NA	NO,NA	964.62
A. Mineral industry	61.41								61.41
B. Chemical industry	0.43	NO,NA	34.78	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	35.21
C. Metal industry	610.13	1.81	NO	NO	204.17	NO	NO	NO	816.11
D. Non-energy products from fuels and solvent use	7.37	NA	NA						7.37
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				37.98	NO	NO	NO	NO	37.98
G. Other product manufacture and use	0.02	0.05	5.23		NO	1.24			6.55
H. Other	NA	NA	NA						NA
3. Agriculture	0.09	367.59	275.19						642.87
A. Enteric fermentation		310.01							310.01
B. Manure management		57.58	20.08						77.66
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	255.11						255.11
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.02								0.02
H. Urea application	0.07								0.07
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5753.80	3427.93	0.51						9182.24
A. Forest land	-79.81	0.36	0.41						-79.04
B. Cropland	1880.25	94.68	NO,NA						1974.93
C. Grassland	5031.88	382.69	0.10						5414.67
D. Wetlands	-1100.34	2950.20	NO,NA						1849.86
E. Settlements	21.82	NE,NA	NO,NE,IE,NA						21.82
F. Other land	NA,NE	NA	NA						NA,NE
G. Harvested wood products	0.00								0.00
H. Other	IE	IE	IE						IE
5. Waste	2.92	281.71	5.88						290.51
A. Solid waste disposal	NO,NA	221.65							221.65
B. Biological treatment of solid waste		0.20	0.14						0.34
C. Incineration and open burning of waste	2.92	2.64	0.73						6.28
D. Waste water treatment and discharge		57.23	5.01						62.24
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	401.93	0.16	3.34						405.42
Aviation	363.01	0.06	3.03						366.10
Navigation	38.92	0.09	0.31						39.32
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	5.07								5.07
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4096.92
Total CO_2 equivalent emissions with land use, land-use change and forestry									13279.16
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2000

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2000
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8694.52	4080.98	342.87	43.96	149.89	1.31	NO,NA	NO,NA	13313.54
1. Energy	2131.11	8.10	42.14						2181.34
A. Fuel combustion (sectoral approach)	1977.96	6.58	42.14						2026.68
1. Energy industries	6.40	0.04	0.12						6.56
2. Manufacturing industries and construction	225.35	0.27	0.60						226.22
3. Transport	830.58	4.08	34.22						868.89
4. Other sectors	911.00	2.18	7.19						920.37
5. Other	4.62	0.00	0.01						4.64
B. Fugitive emissions from fuels	153.15	1.51	NO,NA						154.66
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	153.15	1.51	NA,NO						154.66
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	789.17	2.76	22.84	43.96	149.89	1.31	NO,NA	NO,NA	1009.94
A. Mineral industry	65.45								65.45
B. Chemical industry	0.41	NO,NA	17.91	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	18.32
C. Metal industry	715.56	2.72	NO	NO	149.89	NO	NO	NO	868.17
D. Non-energy products from fuels and solvent use	7.74	NA	NA						7.74
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				43.96	NO	NO	NO	NO	43.96
G. Other product manufacture and use	0.02	0.05	4.93		NO	1.31			6.30
H. Other	NA	NA	NA						NA
3. Agriculture	0.12	355.13	271.40						626.65
A. Enteric fermentation		297.83							297.83
B. Manure management		57.31	19.43						76.74
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	251.96						251.96
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.04								0.04
H. Urea application	0.07								0.07
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5771.38	3422.10	0.58						9194.06
A. Forest land	-90.16	0.43	0.48						-89.25
B. Cropland	1879.75	94.66	NO,NA						1974.41
C. Grassland	5060.60	385.61	0.10						5446.32
D. Wetlands	-1097.02	2941.39	NO,NA						1844.38
E. Settlements	18.21	NE,NA	NO,NE,IE,NA						18.21
F. Other land	NA	NA	NA						NA
G. Harvested wood products	0.00								0.00
H. Other	IE	IE	IE						IE
5. Waste	2.74	292.89	5.92						301.55
A. Solid waste disposal	NO,NA	227.18							227.18
B. Biological treatment of solid waste		0.20	0.14						0.34
C. Incineration and open burning of waste	2.74	2.58	0.71						6.03
D. Waste water treatment and discharge		62.94	5.07						68.00
E. Other	NA	NO	NO						NA,NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	461.20	0.20	3.83						465.23
Aviation	407.33	0.07	3.40						410.80
Navigation	53.86	0.13	0.43						54.43
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	5.07								5.07
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4119.48
Total CO_2 equivalent emissions with land use, land-use change and forestry									13313.54
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for
[2] See footnote 7 to table Summary 1.A.
[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2001

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2001
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8643.11	4086.48	338.21	40.81	108.04	1.31	NO,NA	NO,NA	13217.95
1. Energy	2021.25	7.60	41.11						2069.96
A. Fuel combustion (sectoral approach)	1877.48	6.07	41.11						1924.66
1. Energy industries	5.99	0.04	0.12						6.14
2. Manufacturing industries and construction	262.25	0.33	0.71						263.28
3. Transport	837.02	3.88	34.32						875.22
4. Other sectors	752.45	1.80	5.93						760.18
5. Other	19.77	0.02	0.05						19.84
B. Fugitive emissions from fuels	143.77	1.53	NO,NA						145.30
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	143.77	1.53	NA,NO						145.30
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	831.40	2.87	20.20	40.81	108.04	1.31	NO,NA	NO,NA	1004.63
A. Mineral industry	58.66								58.66
B. Chemical industry	0.49	NO,NA	15.53	NA,NO	NA,NO	NA,NO	NO,NA	NO,NA	16.02
C. Metal industry	765.37	2.82	NO	NO	108.04	NO	NO	NO	876.24
D. Non-energy products from fuels and solvent use	6.85	NA	NA						6.85
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				40.81	0.00	NO	NO	NO	40.81
G. Other product manufacture and use	0.02	0.05	4.68		NO	1.31			6.06
H. Other	NA	NA	NA						NA
3. Agriculture	0.10	356.47	270.33						626.90
A. Enteric fermentation		299.53							299.53
B. Manure management		56.94	19.38						76.32
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	250.95						250.95
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.02								0.02
H. Urea application	0.08								0.08
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5787.77	3418.41	0.63						9206.81
A. Forest land	-95.66	0.47	0.52						-94.68
B. Cropland	1879.30	94.64	NO,NA						1973.94
C. Grassland	5080.63	387.64	0.11						5468.38
D. Wetlands	-1094.70	2935.67	NO,NA						1840.97
E. Settlements	18.20	NE,NA	NO,NE,IE,NA						18.20
F. Other land	NA	NA	NA						NA
G. Harvested wood products	0.00								0.00
H. Other	IE	IE	IE						IE
5. Waste	2.58	301.13	5.93						309.64
A. Solid waste disposal	NO,NA	235.47							235.47
B. Biological treatment of solid waste		0.20	0.14						0.34
C. Incineration and open burning of waste	2.58	2.31	0.64						5.53
D. Waste water treatment and discharge		63.15	5.15						68.30
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	407.79	0.20	3.38						411.37
Aviation	348.78	0.06	2.91						351.75
Navigation	59.01	0.14	0.48						59.63
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	5.07								5.07
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4011.14
Total CO_2 equivalent emissions with land use, land-use change and forestry									13217.95
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2002

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2002
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8796.15	4087.48	313.33	45.68	85.51	1.31	NA,NO	NA,NO	13329.47
1. Energy	2131.24	7.58	40.87						2179.69
A. Fuel combustion (sectoral approach)	1983.83	6.04	40.87						2030.74
1. Energy industries	6.87	0.04	0.12						7.03
2. Manufacturing industries and construction	278.36	0.32	0.72						279.40
3. Transport	828.37	3.62	33.26						865.26
4. Other sectors	847.61	2.03	6.72						856.36
5. Other	22.61	0.02	0.05						22.69
B. Fugitive emissions from fuels	147.41	1.54	NO,NA						148.95
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	147.41	1.54	NA,NO						148.95
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	848.71	3.02	4.36	45.68	85.51	1.31	NA,NO	NA,NO	988.60
A. Mineral industry	39.31								39.31
B. Chemical industry	0.45	NO,NA	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.45
C. Metal industry	801.83	2.97	NO	NO	85.50	NO	NO	NO	890.30
D. Non-energy products from fuels and solvent use	7.10	NA	NA						7.10
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				45.68	0.01	NO	NO	NO	45.69
G. Other product manufacture and use	0.01	0.05	4.36		NO	1.31			5.73
H. Other	NA	NA	NA						NA
3. Agriculture	0.14	349.84	262.11						612.10
A. Enteric fermentation		294.11							294.11
B. Manure management		55.74	19.15						74.88
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	242.97						242.97
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.06								0.06
H. Urea application	0.08								0.08
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5813.66	3413.30	0.67						9227.63
A. Forest land	-104.66	0.50	0.56						-103.60
B. Cropland	1878.86	94.62	NO,NA						1973.48
C. Grassland	5112.95	390.48	0.11						5503.55
D. Wetlands	-1091.69	2927.70	NO,NA						1836.00
E. Settlements	18.20	NE,NA	NO,NE,IE,NA						18.20
F. Other land	NA	NA	NA						NA
G. Harvested wood products	0.00								0.00
H. Other	IE	IE	IE						IE
5. Waste	2.40	313.74	5.32						321.46
A. Solid waste disposal	NO,NA	236.29							236.29
B. Biological treatment of solid waste		0.20	0.14						0.34
C. Incineration and open burning of waste	2.40	2.15	0.60						5.15
D. Waste water treatment and discharge		75.09	4.58						79.67
E. Other	NA	NO	NO						NA,NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	394.53	0.26	3.27						398.06
Aviation	309.54	0.05	2.58						312.18
Navigation	84.99	0.20	0.69						85.88
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	5.07								5.07
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4101.84
Total CO_2 equivalent emissions with land use, land-use change and forestry									13329.47
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2003

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2003
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8793.71	4074.19	307.68	46.19	70.48	1.31	NA,NO	NA,NO	13293.56
1. Energy	2121.89	7.32	39.45						2168.66
A. Fuel combustion (sectoral approach)	1985.54	5.83	39.45						2030.82
1. Energy industries	5.00	0.04	0.11						5.16
2. Manufacturing industries and construction	257.10	0.30	0.67						258.06
3. Transport	907.28	3.55	32.20						943.03
4. Other sectors	808.85	1.93	6.44						817.23
5. Other	7.31	0.01	0.02						7.34
B. Fugitive emissions from fuels	136.34	1.49	NO,NA						137.84
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	136.34	1.49	NA,NO						137.84
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	849.58	3.02	4.32	46.19	70.48	1.31	NA,NO	NA,NO	974.89
A. Mineral industry	32.98								32.98
B. Chemical industry	0.48	NO,NA	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.48
C. Metal industry	809.34	2.98	NO	NO	70.47	NO	NO	NO	882.78
D. Non-energy products from fuels and solvent use	6.77	NA	NA						6.77
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				46.19	0.01	NO	NO	NO	46.19
G. Other product manufacture and use	0.02	0.04	4.32		NO	1.31			5.69
H. Other	NA	NA	NA						NA
3. Agriculture	2.65	345.41	257.87						605.92
A. Enteric fermentation		290.56							290.56
B. Manure management		54.85	18.96						73.81
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	238.90						238.90
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.19								0.19
H. Urea application	0.08								0.08
I. Other carbon-containing fertilizers	2.37								2.37
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5817.54	3410.13	0.71						9228.38
A. Forest land	-115.39	0.54	0.60						-114.25
B. Cropland	1878.42	94.61	NO,NA						1973.02
C. Grassland	5126.15	392.21	0.11						5518.47
D. Wetlands	-1089.84	2922.78	NO,NA						1832.94
E. Settlements	18.20	NE,NA	NO,NE,IE,NA						18.20
F. Other land	NA	NA	NA						NA
G. Harvested wood products	0.00								0.00
H. Other	IE	IE	IE						IE
5. Waste	2.05	308.30	5.34						315.70
A. Solid waste disposal	NO,NA	237.09							237.09
B. Biological treatment of solid waste		0.30	0.21						0.51
C. Incineration and open burning of waste	2.05	1.87	0.52						4.45
D. Waste water treatment and discharge		69.04	4.61						73.65
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	351.89	0.10	2.93						354.92
Aviation	332.67	0.06	2.77						335.50
Navigation	19.22	0.05	0.15						19.42
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	5.87								5.87
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4065.17
Total CO_2 equivalent emissions with land use, land-use change and forestry									13293.56
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2004

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2004
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8923.27	4065.75	309.35	53.33	45.48	1.31	NA,NO	NA,NO	13398.48
1. Energy	2216.69	7.51	43.76						2267.96
A. Fuel combustion (sectoral approach)	2093.79	5.88	43.76						2143.43
1. Energy industries	3.16	0.04	0.11						3.31
2. Manufacturing industries and construction	239.07	0.31	0.66						240.04
3. Transport	992.39	3.52	36.30						1032.21
4. Other sectors	832.82	1.99	6.62						841.43
5. Other	26.35	0.03	0.06						26.44
B. Fugitive emissions from fuels	122.90	1.63	NO,NA						124.53
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	122.90	1.63	NA,NO						124.53
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	873.32	3.01	4.05	53.33	45.48	1.31	NA,NO	NA,NO	980.50
A. Mineral industry	50.81								50.81
B. Chemical industry	0.39	NO,NA	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.39
C. Metal industry	814.54	2.96	NO	NO	45.47	NO	NO	NO	862.98
D. Non-energy products from fuels and solvent use	7.55	NA	NA						7.55
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				53.33	0.00	NO	NO	NO	53.33
G. Other product manufacture and use	0.02	0.05	4.05		NO	1.31			5.43
H. Other	NA	NA	NA						NA
3. Agriculture	4.95	340.47	255.48						600.90
A. Enteric fermentation		286.73							286.73
B. Manure management		53.74	18.72						72.46
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	236.76						236.76
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	2.46								2.46
H. Urea application	0.08								0.08
I. Other carbon-containing fertilizers	2.41								2.41
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5823.13	3406.63	0.74						9230.49
A. Forest land	-121.44	0.55	0.62						-120.27
B. Cropland	1877.94	94.59	NO,NA						1972.53
C. Grassland	5136.37	394.00	0.12						5530.49
D. Wetlands	-1087.84	2917.48	NO,NA						1829.64
E. Settlements	18.09	NE,NA	0.00						18.09
F. Other land	NA	NA	NA						NA
G. Harvested wood products	0.00								0.00
H. Other	IE	IE	IE						IE
5. Waste	5.17	308.14	5.33						318.64
A. Solid waste disposal	NO,NA	244.83							244.83
B. Biological treatment of solid waste		0.30	0.21						0.51
C. Incineration and open burning of waste	5.17	1.14	0.47						6.78
D. Waste water treatment and discharge		61.87	4.64						66.51
E. Other	NA	NO	NO						NA,NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	400.47	0.12	3.33						403.92
Aviation	379.62	0.07	3.16						382.85
Navigation	20.84	0.05	0.17						21.06
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	5.74								5.74
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4167.99
Total CO_2 equivalent emissions with land use, land-use change and forestry									13398.48
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2005

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2005
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8798.05	4049.78	311.38	58.46	30.76	2.52	NO	NO	13250.94
1. Energy	2103.24	7.14	44.23						2154.61
A. Fuel combustion (sectoral approach)	1985.08	5.40	44.23						2034.71
1. Energy industries	3.26	0.04	0.11						3.40
2. Manufacturing industries and construction	184.66	0.22	0.47						185.34
3. Transport	1015.17	3.33	37.62						1056.12
4. Other sectors	753.09	1.79	5.95						760.83
5. Other	28.91	0.03	0.07						29.01
B. Fugitive emissions from fuels	118.16	1.74	NO,NA						119.90
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	118.16	1.74	NA,NO						119.90
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	856.27	2.82	3.88	58.46	30.76	2.52	NO	NO	954.70
A. Mineral industry	54.98								54.98
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	793.98	2.77	NO	NO	30.76	NO	NO	NO	827.52
D. Non-energy products from fuels and solvent use	7.27	NA	NA						7.27
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				58.46	0.00	NO	NO	NO	58.46
G. Other product manufacture and use	0.03	0.04	3.88		NO	2.52			6.47
H. Other	NA	NA	NA						NA
3. Agriculture	4.21	343.95	257.10						605.26
A. Enteric fermentation		289.03							289.03
B. Manure management		54.92	18.83						73.75
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	238.27						238.27
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	1.84								1.84
H. Urea application	0.07								0.07
I. Other carbon-containing fertilizers	2.29								2.29
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5829.60	3401.74	0.77						9232.11
A. Forest land	-140.89	0.58	0.64						-139.67
B. Cropland	1877.53	94.57	NO,NA						1972.10
C. Grassland	5159.88	396.55	0.12						5556.55
D. Wetlands	-1085.03	2910.04	NO,NA						1825.01
E. Settlements	18.11	NE,NA	0.00						18.12
F. Other land	NA	NA	NA						NA
G. Harvested wood products	0.00								0.00
H. Other	IE	IE	IE						IE
5. Waste	4.73	294.13	5.41						304.27
A. Solid waste disposal	NO,NA	234.38							234.38
B. Biological treatment of solid waste		0.50	0.36						0.86
C. Incineration and open burning of waste	4.73	0.44	0.30						5.47
D. Waste water treatment and discharge		58.81	4.75						63.56
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	422.96	0.08	3.52						426.56
Aviation	421.23	0.07	3.51						424.81
Navigation	1.74	0.00	0.01						1.75
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	5.91								5.91
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4018.84
Total CO_2 equivalent emissions with land use, land-use change and forestry									13250.94
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2006

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2006
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9035.45	4079.48	326.92	67.62	392.79	2.61	NO	NO	13904.86
1. Energy	2171.72	7.78	36.87						2216.37
A. Fuel combustion (sectoral approach)	2044.29	5.36	36.87						2086.53
1. Energy industries	9.06	0.07	0.20						9.33
2. Manufacturing industries and construction	188.79	0.23	0.50						189.52
3. Transport	1137.51	3.42	30.70						1171.62
4. Other sectors	682.14	1.62	5.40						689.16
5. Other	26.80	0.03	0.06						26.90
B. Fugitive emissions from fuels	127.43	2.42	NO,NA						129.84
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	127.43	2.42	NA,NO						129.84
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	965.28	2.77	4.13	67.62	392.79	2.61	NO	NO	1435.20
A. Mineral industry	62.17								62.17
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	895.02	2.72	NO	NO	392.79	NO	NO	NO	1290.53
D. Non-energy products from fuels and solvent use	8.05	NA	NA						8.05
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				67.62	0.00	NO	NO	NO	67.62
G. Other product manufacture and use	0.04	0.05	4.13		NO	2.61			6.83
H. Other	NA	NA	NA						NA
3. Agriculture	2.87	352.16	273.88						628.92
A. Enteric fermentation		294.56							294.56
B. Manure management		57.60	19.05						76.65
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	254.83						254.83
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	1.15								1.15
H. Urea application	0.08								0.08
I. Other carbon-containing fertilizers	1.64								1.64
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5890.78	3398.90	6.30						9295.98
A. Forest land	-147.15	0.60	0.67						-145.88
B. Cropland	1877.14	94.57	0.02						1971.72
C. Grassland	5221.98	405.78	4.48						5632.24
D. Wetlands	-1080.08	2897.95	1.13						1819.00
E. Settlements	18.89	NE,NA	0.00						18.89
F. Other land	NA	0.01	0.01						0.01
G. Harvested wood products	0.00								0.00
H. Other	IE	IE	IE						IE
5. Waste	4.79	317.86	5.74						328.39
A. Solid waste disposal	NO,NA	265.32							265.32
B. Biological treatment of solid waste		0.80	0.57						1.37
C. Incineration and open burning of waste	4.79	0.43	0.31						5.53
D. Waste water treatment and discharge		51.31	4.86						56.16
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	516.57	0.13	4.30						520.99
Aviation	499.40	0.09	4.16						503.65
Navigation	17.16	0.04	0.13						17.34
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	9.01								9.01
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4608.88
Total CO_2 equivalent emissions with land use, land-use change and forestry									13904.86
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for
[2] See footnote 7 to table Summary 1.A.
[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2007

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2007
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9299.05	4071.71	333.98	68.39	331.39	2.89	NO	NO	14107.42
1. Energy	2311.18	8.61	37.75						2357.55
A. Fuel combustion (sectoral approach)	2163.81	5.52	37.75						2207.08
1. Energy industries	24.96	0.09	0.26						25.31
2. Manufacturing industries and construction	183.18	0.34	0.66						184.17
3. Transport	1174.48	3.26	30.71						1208.45
4. Other sectors	774.36	1.82	6.11						782.30
5. Other	6.83	0.01	0.02						6.86
B. Fugitive emissions from fuels	147.37	3.09	NO,NA						150.46
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	147.37	3.09	NA,NO						150.46
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1163.09	2.91	4.59	68.39	331.39	2.89	NO	NO	1573.26
A. Mineral industry	64.33								64.33
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	1091.13	2.85	NO	NO	331.38	NO	NO	NO	1425.37
D. Non-energy products from fuels and solvent use	7.58	NA	NA						7.58
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				68.39	0.00	NO	NO	NO	68.39
G. Other product manufacture and use	0.05	0.06	4.59		NO	2.89			7.59
H. Other	NA	NA	NA						NA
3. Agriculture	1.55	357.81	284.78						644.14
A. Enteric fermentation		298.84							298.84
B. Manure management		58.97	19.39						78.36
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	265.38						265.38
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.53								0.53
H. Urea application	0.13								0.13
I. Other carbon-containing fertilizers	0.89								0.89
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5815.36	3384.53	0.83						9200.72
A. Forest land	-255.32	0.61	0.69						-254.02
B. Cropland	1876.76	94.53	NO,NA						1971.29
C. Grassland	5250.31	405.33	0.13						5655.77
D. Wetlands	-1074.54	2884.05	NO,NA						1809.51
E. Settlements	18.15	NE,NA	0.01						18.16
F. Other land	NE,NA	NA	NA						NE,NA
G. Harvested wood products	0.00								0.00
H. Other	IE	IE	IE						IE
5. Waste	7.86	317.85	6.04						331.75
A. Solid waste disposal	NO,NA	262.42							262.42
B. Biological treatment of solid waste		1.00	0.72						1.72
C. Incineration and open burning of waste	7.86	0.42	0.33						8.62
D. Waste water treatment and discharge		54.01	4.99						59.00
E. Other	NA	NO	NO						NA,NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	522.97	0.12	4.35						527.44
Aviation	511.03	0.09	4.26						515.38
Navigation	11.94	0.03	0.09						12.06
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	10.69								10.69
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4906.70
Total CO_2 equivalent emissions with land use, land-use change and forestry									14107.42
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2008

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2008
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9665.18	4050.72	341.00	70.01	411.38	3.01	NO	NO	14541.29
1. Energy	2185.51	8.10	35.76						2229.37
A. Fuel combustion (sectoral approach)	1999.57	4.98	35.76						2040.32
1. Energy industries	10.18	0.07	0.20						10.44
2. Manufacturing industries and construction	159.92	0.30	0.58						160.79
3. Transport	1113.84	2.94	29.36						1146.14
4. Other sectors	708.52	1.67	5.61						715.80
5. Other	7.11	0.01	0.02						7.14
B. Fugitive emissions from fuels	185.94	3.12	NO,NA						189.06
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	185.94	3.12	NA,NO						189.06
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1604.75	2.45	4.09	70.01	411.38	3.01	NO	NO	2095.70
A. Mineral industry	61.80								61.80
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	1536.09	2.41	NO	NO	411.38	NO	NO	NO	1949.88
D. Non-energy products from fuels and solvent use	6.84	NA	NA						6.84
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				70.01	0.00	NO	NO	NO	70.01
G. Other product manufacture and use	0.02	0.04	4.09		NO	3.01			7.16
H. Other	NA	NA	NA						NA
3. Agriculture	4.74	361.11	294.07						659.92
A. Enteric fermentation		301.85							301.85
B. Manure management		59.26	19.27						78.53
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	274.80						274.80
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	2.17								2.17
H. Urea application	0.15								0.15
I. Other carbon-containing fertilizers	2.42								2.42
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5864.04	3376.45	0.94						9241.43
A. Forest land	-259.45	0.64	0.71						-258.10
B. Cropland	1876.40	94.52	NO,NA						1970.92
C. Grassland	5298.75	409.44	0.20						5708.39
D. Wetlands	-1069.93	2871.86	0.02						1801.95
E. Settlements	18.28	NE,NA	0.01						18.29
F. Other land	NA	0.00	0.00						0.00
G. Harvested wood products	-0.01								-0.01
H. Other	IE	IE	IE						IE
5. Waste	6.13	302.61	6.13						314.87
A. Solid waste disposal	NO,NA	252.08							252.08
B. Biological treatment of solid waste		1.06	0.76						1.82
C. Incineration and open burning of waste	6.13	0.40	0.30						6.83
D. Waste water treatment and discharge		49.07	5.07						54.14
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	474.94	0.18	3.93						479.05
Aviation	427.40	0.07	3.56						431.04
Navigation	47.53	0.11	0.37						48.01
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	8.83								8.83
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									5299.87
Total CO_2 equivalent emissions with land use, land-use change and forestry									14541.29
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2009

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2009
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9576.80	4041.62	317.35	83.18	180.05	3.04	NO	NO	14202.02
1. Energy	2094.03	7.54	28.88						2130.45
A. Fuel combustion (sectoral approach)	1923.92	4.69	28.88						1957.48
1. Energy industries	7.76	0.05	0.15						7.96
2. Manufacturing industries and construction	116.36	0.17	0.36						116.89
3. Transport	1029.35	2.66	22.31						1054.32
4. Other sectors	765.61	1.80	6.05						773.46
5. Other	4.84	0.01	0.01						4.86
B. Fugitive emissions from fuels	170.11	2.85	NO,NA						172.96
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	170.11	2.85	NA,NO						172.96
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1616.18	2.49	3.59	83.18	180.05	3.04	NO	NO	1888.53
A. Mineral industry	28.69								28.69
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	1582.10	2.45	NO	NO	180.05	NO	NO	NO	1764.60
D. Non-energy products from fuels and solvent use	5.38	NA	NA						5.38
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				83.18	0.00	NO	NO	NO	83.18
G. Other product manufacture and use	0.02	0.04	3.59		NO	3.04			6.69
H. Other	NA	NA	NA						NA
3. Agriculture	3.44	366.03	277.62						647.08
A. Enteric fermentation		306.14							306.14
B. Manure management		59.89	19.61						79.50
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	258.01						258.01
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.77								0.77
H. Urea application	0.16								0.16
I. Other carbon-containing fertilizers	2.51								2.51
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5857.08	3374.95	0.88						9232.91
A. Forest land	-272.91	0.66	0.74						-271.51
B. Cropland	1876.07	94.50	NO,NA						1970.57
C. Grassland	5304.52	410.34	0.13						5714.99
D. Wetlands	-1068.86	2869.45	NO,NA						1800.59
E. Settlements	18.28	NE,NA	0.01						18.28
F. Other land	NA	0.00	0.00						0.00
G. Harvested wood products	-0.01								-0.01
H. Other	IE	IE	IE						IE
5. Waste	6.06	290.61	6.38						303.05
A. Solid waste disposal	NO,NA	242.79							242.79
B. Biological treatment of solid waste		1.27	0.91						2.18
C. Incineration and open burning of waste	6.06	0.37	0.26						6.69
D. Waste water treatment and discharge		46.18	5.21						51.39
E. Other	NA	NO	NO						NA,NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	351.15	0.08	2.92						354.15
Aviation	343.01	0.06	2.86						345.92
Navigation	8.15	0.02	0.06						8.23
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	6.57								6.57
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4969.12
Total CO_2 equivalent emissions with land use, land-use change and forestry									14202.02
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2010

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2010
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9438.62	4028.73	306.04	111.32	171.66	4.66	NO	NO	14061.03
1. Energy	1985.36	9.35	24.95						2019.66
A. Fuel combustion (sectoral approach)	1795.71	4.29	24.95						1824.95
1. Energy industries	8.38	0.05	0.15						8.58
2. Manufacturing industries and construction	84.15	0.13	0.27						84.55
3. Transport	959.50	2.38	18.73						980.61
4. Other sectors	729.76	1.71	5.76						737.23
5. Other	13.93	0.01	0.03						13.98
B. Fugitive emissions from fuels	189.64	5.07	NO,NA						194.71
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	189.64	5.07	NA,NO						194.71
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1623.27	2.59	3.88	111.32	171.66	4.66	NO	NO	1917.39
A. Mineral industry	10.40								10.40
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	1607.25	2.56	NO	NO	171.66	NO	NO	NO	1781.47
D. Non-energy products from fuels and solvent use	5.59	NA	NA						5.59
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				111.32	0.00	NO	NO	NO	111.32
G. Other product manufacture and use	0.02	0.04	3.88		NO	4.66			8.60
H. Other	NA	NA	NA						NA
3. Agriculture	2.09	359.57	269.77						631.43
A. Enteric fermentation		303.06							303.06
B. Manure management		56.51	19.43						75.95
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	250.34						250.34
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.30								0.30
H. Urea application	0.13								0.13
I. Other carbon-containing fertilizers	1.66								1.66
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5822.00	3373.22	0.90						9196.11
A. Forest land	-296.30	0.68	0.76						-294.87
B. Cropland	1875.75	94.48	NO,NA						1970.23
C. Grassland	5306.74	411.31	0.14						5718.19
D. Wetlands	-1067.84	2866.75	0.00						1798.90
E. Settlements	3.68	NE,NA	0.01						3.68
F. Other land	NA	NA	NA						NA
G. Harvested wood products	-0.03								-0.03
H. Other	IE	IE	IE						IE
5. Waste	5.91	284.00	6.54						296.45
A. Solid waste disposal	NO,NA	242.69							242.69
B. Biological treatment of solid waste		1.52	1.09						2.61
C. Incineration and open burning of waste	5.91	0.35	0.25						6.51
D. Waste water treatment and discharge		39.43	5.20						44.63
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	377.14	0.07	3.14						380.35
Aviation	376.89	0.07	3.14						380.09
Navigation	0.25	0.00	0.00						0.25
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	7.31								7.31
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4864.92
Total CO_2 equivalent emissions with land use, land-use change and forestry									14061.03
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2011

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2011
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9291.96	4008.19	302.79	136.25	74.52	3.05	NO	NO	13816.76
1. Energy	1867.26	7.94	22.83						1898.03
A. Fuel combustion (sectoral approach)	1687.74	3.93	22.83						1714.50
1. Energy industries	6.43	0.04	0.12						6.59
2. Manufacturing industries and construction	98.34	0.15	0.31						98.80
3. Transport	915.50	2.17	17.17						934.84
4. Other sectors	660.59	1.55	5.21						667.35
5. Other	6.90	0.01	0.02						6.92
B. Fugitive emissions from fuels	179.51	4.01	NO,NA						183.52
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	179.51	4.01	NA,NO						183.52
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1617.76	2.67	3.99	136.25	74.52	3.05	NO	NO	1838.24
A. Mineral industry	20.14								20.14
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	1591.77	2.63	NO	NO	74.52	NO	NO	NO	1668.92
D. Non-energy products from fuels and solvent use	5.82	NO,NA	NO,NA						5.82
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				136.25	0.01	NO	NO	NO	136.26
G. Other product manufacture and use	0.02	0.04	3.99		NO	3.05			7.10
H. Other	NA	NA	NA						NA
3. Agriculture	2.60	360.81	268.54						631.95
A. Enteric fermentation		302.59							302.59
B. Manure management		58.23	19.56						77.79
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	248.98						248.98
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.90								0.90
H. Urea application	0.15								0.15
I. Other carbon-containing fertilizers	1.54								1.54
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5797.79	3371.51	0.91						9170.22
A. Forest land	-323.42	0.69	0.77						-321.96
B. Cropland	1875.42	94.46	NO,NA						1969.88
C. Grassland	5308.95	412.28	0.14						5721.36
D. Wetlands	-1066.82	2864.08	NO,NA						1797.27
E. Settlements	3.68	NE,NA	0.01						3.69
F. Other land	NA	NA	NA						NA
G. Harvested wood products	-0.03								-0.03
H. Other	IE	IE	IE						IE
5. Waste	6.55	265.26	6.51						278.32
A. Solid waste disposal	NO,NA	221.37							221.37
B. Biological treatment of solid waste		1.43	1.02						2.45
C. Incineration and open burning of waste	6.55	0.33	0.26						7.14
D. Waste water treatment and discharge		42.12	5.24						47.36
E. Other	NA	NO	NO						NA,NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	471.13	0.19	3.90						475.22
Aviation	421.51	0.07	3.51						425.10
Navigation	49.62	0.11	0.39						50.12
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	8.65								8.65
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4646.54
Total CO_2 equivalent emissions with land use, land-use change and forestry									13816.76
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2012

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2012
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9284.79	3982.39	309.46	141.73	94.00	5.35	NO	NO	13817.72
1. Energy	1820.31	7.00	22.05						1849.36
A. Fuel combustion (sectoral approach)	1648.26	3.73	22.05						1674.03
1. Energy industries	7.73	0.04	0.11						7.87
2. Manufacturing industries and construction	83.36	0.11	0.24						83.71
3. Transport	903.01	2.04	16.53						921.58
4. Other sectors	654.08	1.54	5.17						660.78
5. Other	0.09	0.00	0.00						0.09
B. Fugitive emissions from fuels	172.05	3.28	NO,NA						175.33
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	172.05	3.28	NA,NO						175.33
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1660.64	3.00	3.90	141.73	94.00	5.35	NO	NO	1908.61
A. Mineral industry	0.51								0.51
B. Chemical industry	NO,NA	NO,NA	NO	NO	NO	NO	NO	NO	NO,NA
C. Metal industry	1654.33	2.96	NO	NO	94.00	NO	NO	NO	1751.28
D. Non-energy products from fuels and solvent use	5.77	NO,NA	NO,NA						5.77
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				141.73	0.00	NO	NO	NO	141.74
G. Other product manufacture and use	0.03	0.04	3.90		NO	5.35			9.31
H. Other	NA	NA	NA						NA
3. Agriculture	3.58	355.18	276.29						635.05
A. Enteric fermentation		299.58							299.58
B. Manure management		55.60	19.28						74.87
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	257.02						257.02
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	1.80								1.80
H. Urea application	0.03								0.03
I. Other carbon-containing fertilizers	1.75								1.75
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5793.92	3369.66	0.94						9164.53
A. Forest land	-334.06	0.71	0.79						-332.56
B. Cropland	1875.09	94.44	NO,NA						1969.54
C. Grassland	5314.99	413.25	0.15						5728.39
D. Wetlands	-1065.75	2861.26	NO,NA						1795.51
E. Settlements	3.70	NE,NA	0.01						3.71
F. Other land	NA	0.00	0.00						0.00
G. Harvested wood products	-0.06								-0.06
H. Other	IE	IE	IE						IE
5. Waste	6.35	247.55	6.28						260.17
A. Solid waste disposal	NO,NA	195.93							195.93
B. Biological treatment of solid waste		1.12	0.80						1.92
C. Incineration and open burning of waste	6.35	0.33	0.23						6.90
D. Waste water treatment and discharge		50.18	5.25						55.43
E. Other	NA	NO	NO						NA,NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	465.47	0.13	3.87						469.46
Aviation	441.72	0.08	3.68						445.48
Navigation	23.75	0.05	0.18						23.99
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	9.94								9.94
CO_2 captured	0.06								0.06
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4653.19
Total CO_2 equivalent emissions with land use, land-use change and forestry									13817.72
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2013

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2013
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9261.51	3982.76	303.32	172.32	88.17	3.23	NO	NO	13811.30
1. Energy	1785.16	7.53	21.30						1813.99
A. Fuel combustion (sectoral approach)	1612.02	3.54	21.30						1636.86
1. Energy industries	4.39	0.01	0.03						4.43
2. Manufacturing industries and construction	74.46	0.13	0.25						74.85
3. Transport	914.80	1.95	16.14						932.90
4. Other sectors	617.60	1.45	4.87						623.92
5. Other	0.76	0.00	0.00						0.77
B. Fugitive emissions from fuels	173.14	3.99	NO,NA						177.13
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	173.14	3.99	NA,NO						177.13
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1686.64	3.03	3.45	172.32	88.17	3.23	NO	NO	1956.83
A. Mineral industry	0.55								0.55
B. Chemical industry	NO,NA	NO,NA	NO	NO	NO	NO	NO	NO	NO,NA
C. Metal industry	1680.35	2.99	NO	NO	88.16	NO	NO	NO	1771.50
D. Non-energy products from fuels and solvent use	5.72	NO,NA	NO,NA						5.72
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				172.32	0.00	NO	NO	NO	172.33
G. Other product manufacture and use	0.02	0.04	3.45		NO	3.23			6.73
H. Other	NA	NA	NA						NA
3. Agriculture	2.89	346.30	271.00						620.19
A. Enteric fermentation		292.90							292.90
B. Manure management		53.40	18.92						72.32
C. Rice cultivation		NO							NO
D. Agricultural soils		NE,NA,NO	252.08						252.08
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	1.08								1.08
H. Urea application	0.06								0.06
I. Other carbon-containing fertilizers	1.75								1.75
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5781.43	3367.87	0.97						9150.27
A. Forest land	-352.80	0.71	0.79						-351.30
B. Cropland	1874.77	94.42	NO,NA						1969.19
C. Grassland	5320.59	414.24	0.17						5735.00
D. Wetlands	-1064.71	2858.49	NO,NA						1793.79
E. Settlements	3.65	NE,NA	0.01						3.66
F. Other land	NA	NA	NA						NA
G. Harvested wood products	-0.07								-0.07
H. Other	IE	IE	IE						IE
5. Waste	5.39	258.02	6.61						270.02
A. Solid waste disposal	NO,NA	208.11							208.11
B. Biological treatment of solid waste		1.50	1.07						2.57
C. Incineration and open burning of waste	5.39	0.33	0.25						5.97
D. Waste water treatment and discharge		48.09	5.29						53.37
E. Other	NA	NO	NO						NO,NA
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	576.65	0.27	4.77						581.69
Aviation	498.57	0.09	4.16						502.81
Navigation	78.08	0.18	0.62						78.88
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	13.19								13.19
CO_2 captured	NO,NA								NO,NA
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4661.03
Total CO_2 equivalent emissions with land use, land-use change and forestry									13811.30
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for
[2] See footnote 7 to table Summary 1.A.
[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2014

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2014
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9199.24	3991.95	328.56	170.28	99.03	2.39	NO	NO	13791.43
1. Energy	1771.91	7.91	23.10						1802.92
A. Fuel combustion (sectoral approach)	1588.96	3.37	23.10						1615.42
1. Energy industries	5.13	0.01	0.01						5.15
2. Manufacturing industries and construction	31.83	0.05	0.10						31.98
3. Transport	935.72	1.86	18.17						955.74
4. Other sectors	613.63	1.44	4.80						619.88
5. Other	2.66	0.01	0.01						2.67
B. Fugitive emissions from fuels	182.95	4.54	NA,NO						187.50
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	182.95	4.54	NA,NO						187.50
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1655.13	2.73	3.19	170.28	99.03	2.39	NO	NO	1932.75
A. Mineral industry	0.55								0.55
B. Chemical industry	NO,NA	NO,NA	NO	NO	NO	NO	NO	NO	NO,NA
C. Metal industry	1648.76	2.69	NO	NO	99.03	NO	NO	NO	1750.48
D. Non-energy products from fuels and solvent use	5.80	NO,NA	NO,NA						5.80
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				170.28	0.00	NO	NO	NO	170.28
G. Other product manufacture and use	0.02	0.03	3.19		NO	2.39			5.63
H. Other	NA	NA	NA						NA
3. Agriculture	2.22	369.57	294.05						665.83
A. Enteric fermentation		311.38							311.38
B. Manure management		58.20	20.01						78.21
C. Rice cultivation		NO							NO
D. Agricultural soils		NA,NE,NO	274.03						274.03
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.54								0.54
H. Urea application	0.14								0.14
I. Other carbon-containing fertilizers	1.53								1.53
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5762.88	3366.09	1.00						9129.97
A. Forest land	-376.71	0.72	0.81						-375.19
B. Cropland	1874.43	94.41	NO,NA						1968.84
C. Grassland	5324.90	415.22	0.18						5740.29
D. Wetlands	-1063.37	2855.74	0.01						1792.37
E. Settlements	3.71	NE,NA	0.01						3.72
F. Other land	NA,NE	NA	NA						NA,NE
G. Harvested wood products	-0.07								-0.07
H. Other	IE	IE	IE						IE
5. Waste	7.09	245.65	7.23						259.96
A. Solid waste disposal	NO,NA	204.59							204.59
B. Biological treatment of solid waste		2.01	1.44						3.45
C. Incineration and open burning of waste	7.09	0.34	0.41						7.84
D. Waste water treatment and discharge		38.70	5.37						44.08
E. Other	NA	NO	NO						NA,NO
6. Other ***(as specified in summary 1.A)***	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	651.25	0.27	5.40						656.91
Aviation	580.71	0.10	4.84						585.65
Navigation	70.53	0.16	0.56						71.26
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	18.11								18.11
CO_2 captured	2.38								2.38
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4661.46
Total CO_2 equivalent emissions with land use, land-use change and forestry									13791.43
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2015

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2015
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2[(1)]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[(1)]	9275.41	3995.66	313.45	163.33	103.69	1.59	NO	NO	13853.13
1. Energy	1816.21	8.01	23.59						1847.82
A. Fuel combustion (sectoral approach)	1653.08	3.46	23.59						1680.13
1. Energy industries	4.20	0.00	0.01						4.22
2. Manufacturing industries and construction	61.57	0.10	0.21						61.88
3. Transport	963.88	1.89	18.45						984.22
4. Other sectors	623.23	1.47	4.93						629.63
5. Other	0.19	0.00	0.00						0.19
B. Fugitive emissions from fuels	163.14	4.56	NA,NO						167.69
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	163.14	4.56	NA,NO						167.69
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1707.70	2.98	3.23	163.33	103.69	1.59	NO	NO	1982.53
A. Mineral industry	0.72								0.72
B. Chemical industry	NO,NA	NO,NA	NO	NO	NO	NO	NO	NO	NO,NA
C. Metal industry	1700.82	2.95	NO	NO	103.69	NO	NO	NO	1807.45
D. Non-energy products from fuels and solvent use	6.14	NO,NA	NO,NA						6.14
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				163.33	0.01	NO	NO	NO	163.34
G. Other product manufacture and use	0.03	0.03	3.23		NO	1.59			4.88
H. Other	NA	NA	NA						NA
3. Agriculture	3.48	373.11	278.20						654.79
A. Enteric fermentation		313.84							313.84
B. Manure management		59.27	19.91						79.18
C. Rice cultivation		NO							NO
D. Agricultural soils		NA,NE,NO	258.29						258.29
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	2.13								2.13
H. Urea application	0.17								0.17
I. Other carbon-containing fertilizers	1.18								1.18
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[(1)]	5741.56	3364.38	1.18						9107.11
A. Forest land	-401.12	0.72	0.81						-399.58
B. Cropland	1874.21	94.39	NO,NA						1968.60
C. Grassland	5327.18	416.31	0.31						5743.80
D. Wetlands	-1062.31	2852.95	0.04						1790.69
E. Settlements	3.72	NE,NA	0.01						3.73
F. Other land	NA	0.00	0.00						0.00
G. Harvested wood products	-0.12								-0.12
H. Other	IE	IE	IE						IE
5. Waste	6.46	247.18	7.25						260.89
A. Solid waste disposal	NO,NA	200.15							200.15
B. Biological treatment of solid waste		2.13	1.52						3.65
C. Incineration and open burning of waste	6.46	0.34	0.30						7.10
D. Waste water treatment and discharge		44.56	5.43						49.99
E. Other	NA	NO	NO						NO,NA
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[(2)]									
International bunkers	821.66	0.46	6.80						828.92
Aviation	673.99	0.12	5.62						679.73
Navigation	147.66	0.35	1.18						149.19
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	43.16								43.16
CO_2 captured	3.91								3.91
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2[(3)]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4746.02
Total CO_2 equivalent emissions with land use, land-use change and forestry									13853.13
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

(1) For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for
(2) See footnote 7 to table Summary 1.A.
(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2016

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2016
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9201.68	3984.88	311.47	181.24	91.86	1.34	NO	NO	13772.47
1. Energy	1791.19	6.78	25.25						1823.23
A. Fuel combustion (sectoral approach)	1642.23	3.25	25.25						1670.74
1. Energy industries	2.37	0.00	0.01						2.38
2. Manufacturing industries and construction	59.87	0.08	0.17						60.12
3. Transport	1058.66	1.94	20.95						1081.55
4. Other sectors	521.17	1.23	4.13						526.53
5. Other	0.16	0.00	0.00						0.16
B. Fugitive emissions from fuels	148.96	3.53	NO,NA						152.49
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	148.96	3.53	NO,NA						152.49
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1684.33	3.03	2.61	181.24	91.86	1.34	NO	NO	1964.42
A. Mineral industry	0.77								0.77
B. Chemical industry	NO,NA	NO,NA	NO	NO	NO	NO	NO	NO	NO,NA
C. Metal industry	1677.31	2.99	NO	NO	91.84	NO	NO	NO	1772.14
D. Non-energy products from fuels and solvent use	6.22	NO,NA	NO,NA						6.22
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				181.24	0.02	NO	NO	NO	181.27
G. Other product manufacture and use	0.03	0.03	2.61		NO	1.34			4.02
H. Other	NA	NA	NA						NA
3. Agriculture	2.91	378.50	275.19						656.59
A. Enteric fermentation		318.06							318.06
B. Manure management		60.44	20.17						80.60
C. Rice cultivation		NO							NO
D. Agricultural soils		NA,NE,NO	255.02						255.02
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	1.72								1.72
H. Urea application	0.07								0.07
I. Other carbon-containing fertilizers	1.12								1.12
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5716.49	3362.54	0.96						9079.99
A. Forest land	-424.51	0.73	0.81						-422.97
B. Cropland	1873.55	94.37	NO,NA						1967.92
C. Grassland	5325.12	417.12	0.13						5742.37
D. Wetlands	-1061.35	2850.33	NO,NA						1788.98
E. Settlements	3.71	NE,NA	0.01						3.72
F. Other land	NA	NA	NA						NA
G. Harvested wood products	-0.04								-0.04
H. Other	IE	IE	IE						IE
5. Waste	6.75	234.03	7.46						248.24
A. Solid waste disposal	NO,NA	191.97							191.97
B. Biological treatment of solid waste		2.28	1.63						3.91
C. Incineration and open burning of waste	6.75	0.35	0.33						7.43
D. Waste water treatment and discharge		39.43	5.50						44.93
E. Other	NA	NO	NO						NO,NA
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	1101.38	0.59	9.11						1111.07
Aviation	916.88	0.16	7.64						924.68
Navigation	184.50	0.43	1.46						186.39
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	45.18								45.18
CO_2 captured	6.64								6.64
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4692.48
Total CO_2 equivalent emissions with land use, land-use change and forestry									13772.47
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for
[2] See footnote 7 to table Summary 1.A.
[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2017

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2017
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	9280.22	3971.25	322.45	172.78	67.99	2.73	NO	NO	13817.42
1. Energy	1832.42	6.43	26.57						1865.42
A. Fuel combustion (sectoral approach)	1685.94	3.13	26.57						1715.64
1. Energy industries	2.33	0.00	0.01						2.34
2. Manufacturing industries and construction	31.25	0.06	0.12						31.42
3. Transport	1115.45	1.79	22.21						1139.45
4. Other sectors	536.75	1.27	4.24						542.26
5. Other	0.17	0.00	0.00						0.17
B. Fugitive emissions from fuels	146.48	3.31	NO,NA						149.79
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	146.48	3.31	NO,NA						149.79
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1759.73	3.16	2.42	172.78	67.99	2.73	NO	NO	2008.80
A. Mineral industry	0.90								0.90
B. Chemical industry	NO,NA	NO,NA	NO	NO	NO	NO	NO	NO	NO,NA
C. Metal industry	1752.78	3.13	NO	NO	67.98	NO	NO	NO	1823.88
D. Non-energy products from fuels and solvent use	6.03	NO,NA	NO,NA						6.03
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				172.78	0.01	NO	NO	NO	172.79
G. Other product manufacture and use	0.03	0.03	2.42		NO	2.73			5.20
H. Other	NA	NA	NA						NA
3. Agriculture	2.38	370.50	284.95						657.84
A. Enteric fermentation		311.01							311.01
B. Manure management		59.50	19.68						79.18
C. Rice cultivation		NO							NO
D. Agricultural soils		NA,NE,NO	265.28						265.28
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	0.87								0.87
H. Urea application	0.04								0.04
I. Other carbon-containing fertilizers	1.48								1.48
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5678.60	3360.85	1.01						9040.45
A. Forest land	-462.91	0.73	0.82						-461.36
B. Cropland	1873.43	94.35	NO,NA						1967.78
C. Grassland	5324.80	418.12	0.17						5743.09
D. Wetlands	-1060.33	2847.64	0.01						1787.32
E. Settlements	3.71	NE,NA	0.01						3.71
F. Other land	NA	0.00	0.00						0.00
G. Harvested wood products	-0.09								-0.09
H. Other	IE	IE	IE						IE
5. Waste	7.08	230.31	7.51						244.90
A. Solid waste disposal	NO,NA	184.80							184.80
B. Biological treatment of solid waste		2.17	1.55						3.72
C. Incineration and open burning of waste	7.08	0.36	0.36						7.80
D. Waste water treatment and discharge		42.98	5.60						48.57
E. Other	NA	NO	NO						NO,NA
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:[2]									
International bunkers	1357.98	0.69	11.23						1369.90
Aviation	1146.71	0.20	9.56						1156.47
Navigation	211.27	0.49	1.67						213.43
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	49.53								49.53
CO_2 captured	10.17								10.17
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NO,NE,NA						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4776.97
Total CO_2 equivalent emissions with land use, land-use change and forestry									13817.42
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2018

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2018
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2[(1)]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[(1)]	9314.59	3968.77	307.57	191.29	76.43	3.91	NO	NO	13862.56
1. Energy	1875.89	6.46	24.34						1906.69
A. Fuel combustion (sectoral approach)	1719.42	3.15	24.34						1746.91
1. Energy industries	2.37	0.00	0.01						2.38
2. Manufacturing industries and construction	37.80	0.07	0.13						38.01
3. Transport	1129.07	1.78	19.83						1150.68
4. Other sectors	549.65	1.30	4.37						555.32
5. Other	0.52	0.00	0.00						0.53
B. Fugitive emissions from fuels	156.46	3.32	NO,NA						159.78
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	156.46	3.32	NO,NA						159.78
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1773.72	3.19	2.94	191.29	76.43	3.91	NO	NO	2051.48
A. Mineral industry	0.91								0.91
B. Chemical industry	NO,NA	NO,NA	NO	NO	NO	NO	NO	NO	NO,NA
C. Metal industry	1766.12	3.16	NO	NO	76.39	NO	NO	NO	1845.66
D. Non-energy products from fuels and solvent use	6.67	NO,NA	NO,NA						6.67
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				191.29	0.04	NO	NO	NO	191.34
G. Other product manufacture and use	0.03	0.03	2.94		NO	3.91			6.91
H. Other	NA	NA	NA						NA
3. Agriculture	3.20	359.32	271.58						634.10
A. Enteric fermentation		301.10							301.10
B. Manure management		58.23	18.86						77.09
C. Rice cultivation		NO							NO
D. Agricultural soils		NA,NE,NO	252.71						252.71
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	1.56								1.56
H. Urea application	0.02								0.02
I. Other carbon-containing fertilizers	1.62								1.62
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[(1)]	5655.64	3358.87	0.97						9015.48
A. Forest land	-490.96	0.74	0.82						-489.40
B. Cropland	1873.10	94.33	NO,NA						1967.43
C. Grassland	5329.19	419.06	0.13						5748.38
D. Wetlands	-1059.24	2844.74	NO,NA						1785.50
E. Settlements	3.72	NE,NA	0.01						3.72
F. Other land	NA	NA	NA						NA
G. Harvested wood products	-0.15								-0.15
H. Other	IE	IE	IE						IE
5. Waste	6.15	240.92	7.75						254.82
A. Solid waste disposal	NO,NA	192.83							192.83
B. Biological treatment of solid waste		2.40	1.72						4.12
C. Incineration and open burning of waste	6.15	0.35	0.33						6.83
D. Waste water treatment and discharge		45.34	5.71						51.05
E. Other	NA	NO	NO						NO,NA
6. Other ***(as specified in summary 1.A)***									

Memo items:[(2)]									
International bunkers	1525.25	0.78	12.62						1538.65
Aviation	1285.04	0.22	10.71						1295.98
Navigation	240.21	0.56	1.91						242.67
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	58.47								58.47
CO_2 captured	12.20								12.20
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NE,NA						
Indirect CO_2 [(3)]	NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4847.09
Total CO_2 equivalent emissions with land use, land-use change and forestry									13862.56
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

(1) For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2019

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2019
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2[(1)]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[(1)]	9208.52	3927.13	295.51	202.64	97.05	2.27	NO	NO	13733.13
1. Energy	1820.17	6.57	21.88						1848.61
A. Fuel combustion (sectoral approach)	1657.06	2.79	21.88						1681.72
1. Energy industries	4.99	0.01	0.01						5.01
2. Manufacturing industries and construction	51.33	0.08	2.70						54.11
3. Transport	1060.29	1.44	13.02						1074.76
4. Other sectors	538.77	1.26	6.13						546.16
5. Other	1.69	0.00	0.00						1.69
B. Fugitive emissions from fuels	163.11	3.78	NO,NA						166.89
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	163.11	3.78	NO,NA						166.89
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1711.87	3.25	2.81	202.64	97.05	2.27	NO	NO	2019.90
A. Mineral industry	0.96								0.96
B. Chemical industry	NO,NA	NO,NA	NO	NO	NO	NO	NO	NO	NO,NA
C. Metal industry	1704.85	3.23	NO	NO	97.00	NO	NO	NO	1805.08
D. Non-energy products from fuels and solvent use	6.04	NO,NA	NO,NA						6.04
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				202.64	0.05	NO	NO	NO	202.69
G. Other product manufacture and use	0.02	0.03	2.81		NO	2.27			5.13
H. Other	NA	NA	NA						NA
3. Agriculture	5.87	353.89	261.59						621.34
A. Enteric fermentation		296.66							296.66
B. Manure management		57.23	18.35						75.57
C. Rice cultivation		NO							NO
D. Agricultural soils		NA,NE,NO	243.24						243.24
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	3.70								3.70
H. Urea application	0.22								0.22
I. Other carbon-containing fertilizers	1.95								1.95
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[(1)]	5662.26	3356.89	0.97						9020.12
A. Forest land	-491.58	0.74	0.83						-490.00
B. Cropland	1872.76	94.31	NO,NA						1967.07
C. Grassland	5335.57	420.03	0.13						5755.73
D. Wetlands	-1058.13	2841.81	NO,NA						1783.67
E. Settlements	3.72	NE,NA	0.01						3.73
F. Other land	NA	NA	NA						NA
G. Harvested wood products	-0.08								-0.08
H. Other	IE	IE	IE						IE
5. Waste	8.36	206.54	8.26						223.16
A. Solid waste disposal	NO,NA	161.85							161.85
B. Biological treatment of solid waste		2.39	1.71						4.09
C. Incineration and open burning of waste	8.36	0.39	0.63						9.37
D. Waste water treatment and discharge		41.92	5.93						47.84
E. Other	NA	NO	NO						NO,NA
6. Other ***(as specified in summary 1.A)***									

Memo items:[(2)]									
International bunkers	1159.90	0.64	9.60						1170.14
Aviation	956.38	0.17	7.97						964.52
Navigation	203.52	0.48	1.63						205.63
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	58.06								58.06
CO_2 captured	9.70								9.70
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NE,NA						
Indirect CO_2 [(3)]	NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4713.01
Total CO_2 equivalent emissions with land use, land-use change and forestry									13733.13
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

(1) For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

2020

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2020
Submission 2022 v4
ICELAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[1]	8980.23	3946.97	295.69	197.70	95.64	3.15	NO	NO	13519.40
1. Energy	1633.89	6.71	18.04						1658.63
A. Fuel combustion (sectoral approach)	1459.01	2.41	18.04						1479.46
1. Energy industries	1.78	0.00	0.00						1.78
2. Manufacturing industries and construction	43.64	0.06	1.44						45.14
3. Transport	876.38	1.11	9.77						887.25
4. Other sectors	536.86	1.24	6.82						544.93
5. Other	0.36	0.00	0.00						0.36
B. Fugitive emissions from fuels	174.87	4.30	NO,NA						179.17
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	174.87	4.30	NO,NA						179.17
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	1683.75	3.07	2.83	197.70	95.64	3.15	NO	NO	1986.15
A. Mineral industry	0.89								0.89
B. Chemical industry	NO,NA	NO,NA	NO	NO	NO	NO	NO	NO	NO,NA
C. Metal industry	1676.61	3.04	NO	NO	95.58	NO	NO	NO	1775.23
D. Non-energy products from fuels and solvent use	6.22	NO,NA	NO,NA						6.22
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				197.70	0.07	NO	NO	NO	197.77
G. Other product manufacture and use	0.02	0.03	2.83		NO	3.15			6.03
H. Other	NA	NA	NA						NA
3. Agriculture	5.49	347.49	265.34						618.31
A. Enteric fermentation		291.29							291.29
B. Manure management		56.20	17.82						74.02
C. Rice cultivation		NO							NO
D. Agricultural soils		NA,NE,NO	247.52						247.52
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NE,NA	NO,NE,NA						NO,NE,NA
G. Liming	3.86								3.86
H. Urea application	0.19								0.19
I. Other carbon-containing fertilizers	1.43								1.43
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry[1]	5651.36	3357.39	1.00						9009.76
A. Forest land	-511.78	0.75	0.84						-510.19
B. Cropland	1872.42	94.31	0.02						1966.76
C. Grassland	5344.88	421.00	0.14						5766.01
D. Wetlands	-1057.96	2841.33	0.00						1783.38
E. Settlements	3.83	NE,NA	0.01						3.84
F. Other land	NA	0.00	0.00						0.00
G. Harvested wood products	-0.04								-0.04
H. Other	IE	IE	IE						IE
5. Waste	5.76	232.30	8.48						246.54
A. Solid waste disposal	NO,NA	187.07							187.07
B. Biological treatment of solid waste		3.14	2.22						5.36
C. Incineration and open burning of waste	5.76	0.07	0.22						6.04
D. Waste water treatment and discharge		42.03	6.04						48.07
E. Other	NA	NO	NO						NO,NA
6. Other *(as specified in summary 1.A)*									

Memo items:[2]									
International bunkers	338.55	0.23	2.80						341.58
Aviation	261.36	0.05	2.18						263.59
Navigation	77.19	0.18	0.62						77.99
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	53.10								53.10
CO_2 captured	11.70								11.70
Long-term storage of C in waste disposal sites	NO								NO
Indirect N_2O			NE,NA						
Indirect CO_2 [3]	NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									4509.64
Total CO_2 equivalent emissions with land use, land-use change and forestry									13519.40
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

[1] For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

[2] See footnote 7 to table Summary 1.A.

[3] In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.