

Climate Account 2022





- Key figures
- Climate action plan
- Emissions factors
- Greenhouse gas emissions
- Changes between years
- Electricity generation
- Carbon intensity
- Avoided emissions
- GHG emissions

- Climate accounting methodology

- External Certification

Climate Account 2022

I hereby confirm Landsvirkjun’s climate account and carbon footprint for 2021.

Hörður Arnarson , CEO Landsvirkjun

Release Date
20th of February 2023

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Our vision is a sustainable world powered by renewable energy. We take climate change very seriously and believe that taking responsibility is the most important contribution we can make to sustainable development.

The Climate Account contain numerical information on Landsvirkjun’s carbon footprint, greenhouse gas emissions, and carbon sequestration for 2022, as well as information on the status of the Company’s climate targets.



↓ Key figures

Carbon footprint	Net carbon intensity
16,955 t CO ₂ -eq ↑2%	1.1 g CO ₂ -eq/kWh ↓2%
Total GHG emissions	Carbon intensity
52,107 t CO ₂ -eq ↑2%	3.5 g CO ₂ -eq/kWh ↓2%
Carbon sequestration	Carbon intensity of electricity generation
35,152 t CO ₂ -eq ↑2%	2.8 g CO ₂ -eq/kWh ↑1%
Electricity generation	Avoided emissions
14,755 GWst ↑4%	2,664,328 t CO ₂ -eq ↓16%



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Climate action plan

The path to carbon neutrality is outlined
in our climate action plan

Action prioritisation

Prevent new emissions

Priority

Reduce current emissions

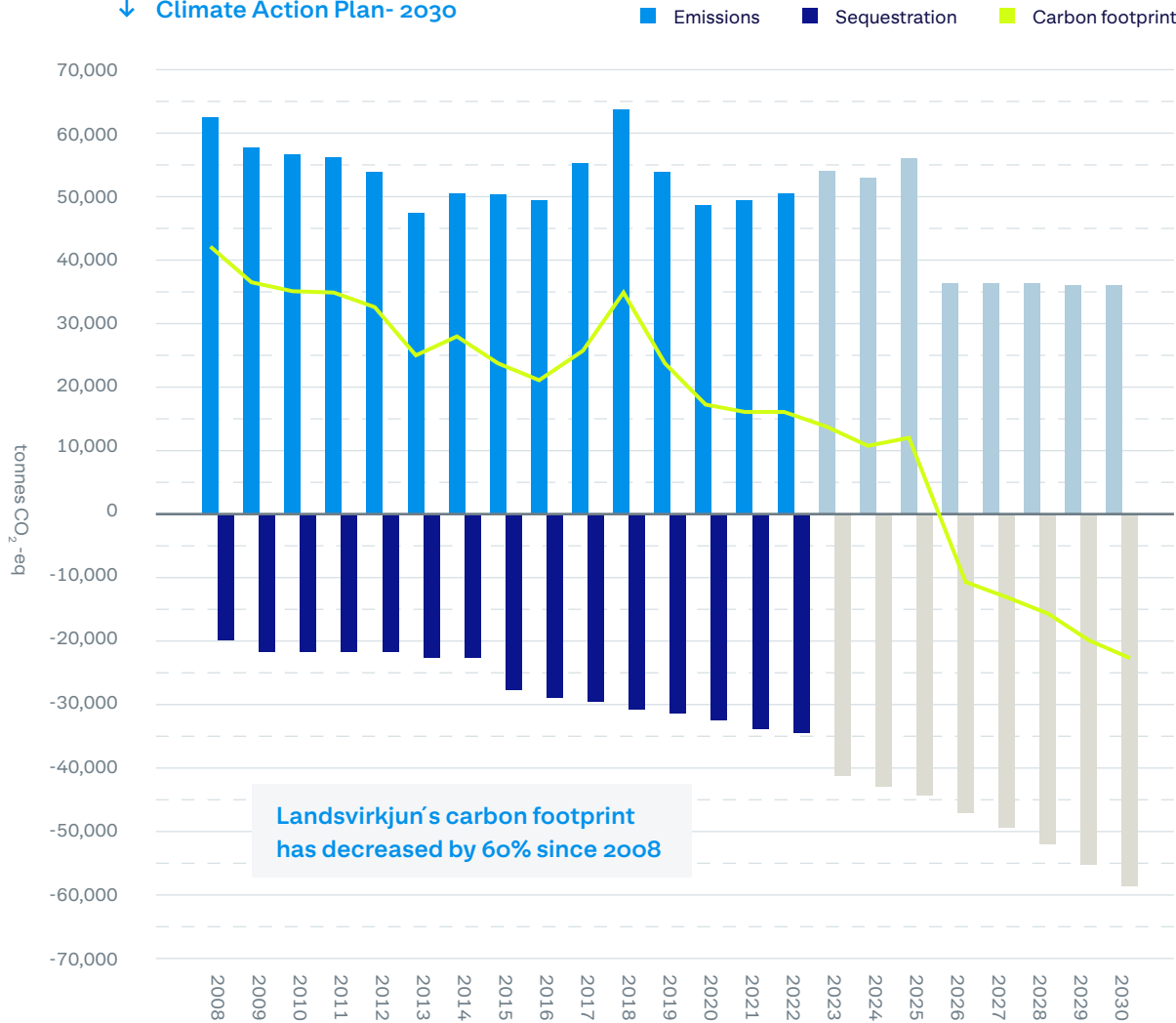
Priority

Implement mitigation measures

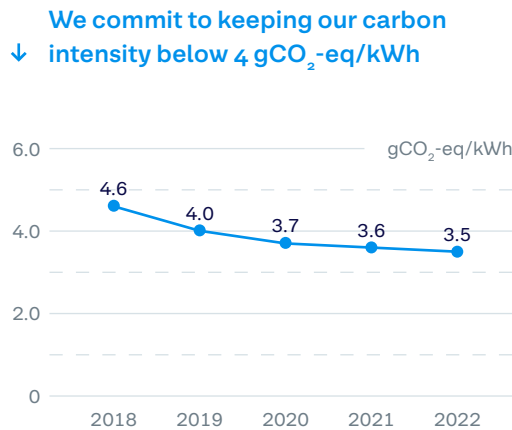
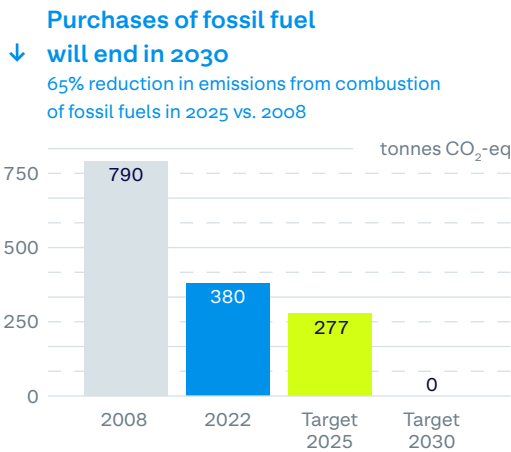
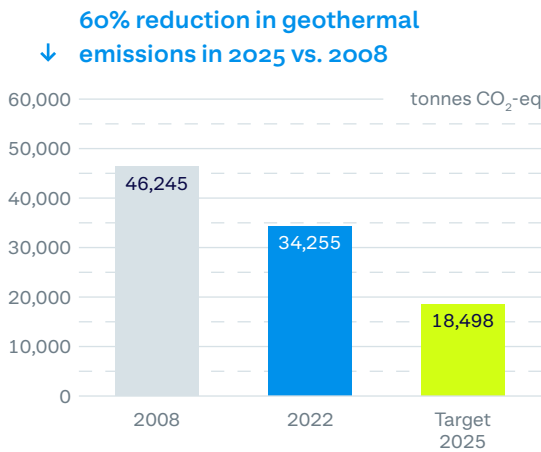
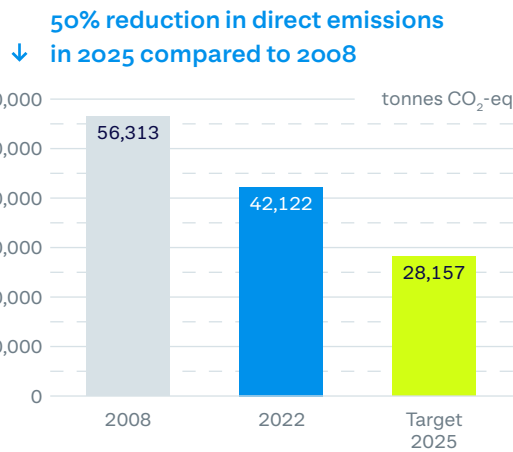
[Our Climate Action Plan](#) →

[The climate action plan dashboard](#) →

Climate Action Plan- 2030



Climate goals and their progress





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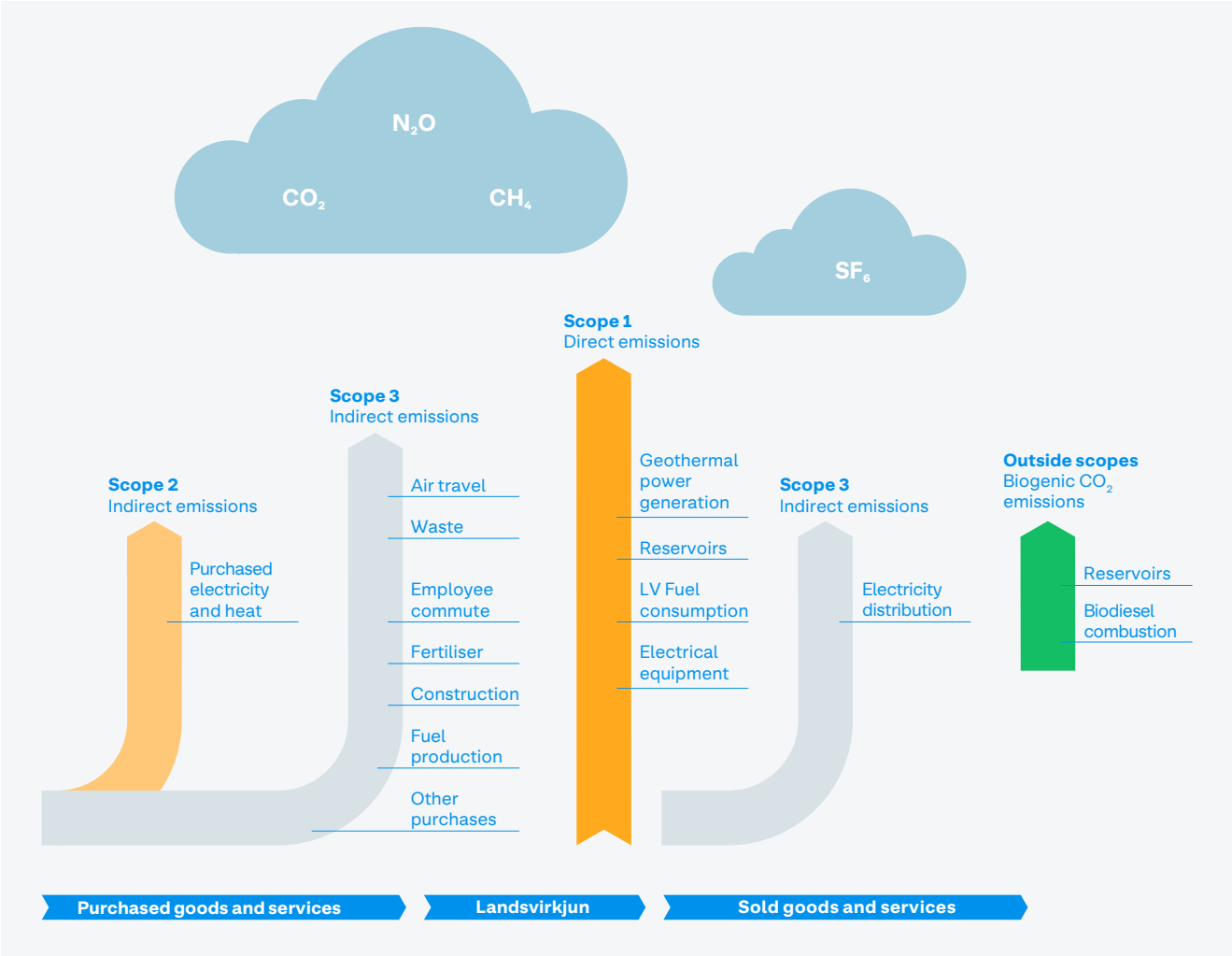
Emissions factors

We use the *Greenhouse Gas Protocol (GHGP)* methodology, a well-renowned international standard designed to measure greenhouse gas emissions and sequestration measures, for our Climate Account.

We include emissions from our operations and our subsidiaries i.e., **Landsvirkjun Power** and **Icelandic Power Insurance**. The accounts do not cover Landsvirkjun Power projects elsewhere in the world or businesses that Landsvirkjun owns shares in but does not directly control. More detailed information about the methodology we use to calculate the Company’s carbon footprint can be found in the Appendix (Landsvirkjun’s climate accounting methodology).

We are committed to providing correct and transparent information. Our climate account have been reviewed and confirmed by the international audit company Bureau Veritas, according to ISO 14064-3, with limited assurance (see below).

↓ Landsvirkjun’s emissions factors categorised by scopes





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Greenhouse gas emissions

↓ GHG emissions (t CO₂-eq)

	2018	2019	2020	2021	2022	Change since 2021
Scope 1						
Geothermal energy	40,805	32,235	30,651	32,288	34,225	6.0%
Reservoirs (CH ₄)	7,366	8,644	7,406	7,417	7,449	0.4%
Fuel consumption	565	480	349	443	380	-14%
Electrical equipment	136	192	15	105	68	-35%
Total Scope 1	48,872	41,550	38,422	40,252	42,122	4.6%
Scope 2						
Purchased electricity & heating*	11	8.9	11	8.3	8.2	-0.6%
Total Scope 2	11	8.9	11	8.3	8.2	-0.6%
Scope 3						
Electricity transmission	2,430	1,434	2,262	1,929	1,518	-21%
Fertiliser	826	958	1,657	1,295	1,091	-16%
Construction	6,314	3,277	1,009	643	304	-53%
Fuel	249	206	153	174	162	-7.2%
Commute to work	118	94	69	107	95	-11%
Air travel	452	315	67	82	190	132%
Waste	78	72	56	70	71	1.4%
Classification rate	82%	84%	87%	86%	89%	3.3%
Total Scope 3	10,466	6,355	5,273	4,299	3,430	-20%
Outside Scopes						
Reservoirs (CO ₂)	6,386	7,549	6,428	6,433	6,462	0.5%
Biodiesel combustion (CO ₂)	17	80	56	62	85	36%
Total outside Scopes	6,403	7,628	6,484	6,495	6,547	0.8%
Total emissions	65,753	55,542	50,190	51,055	52,107	2.1%
Carbon sequestration	-31,285	-31,900	-33,000	-34,400	-35,152	2.2%
Carbon footprint	34,468	23,642	17,190	16,655	16,955	1.8%

*Emissions due to purchased electricity and heating are the same for location-based, and market-based.





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Changes between years

Scope 1

Geothermal energy

Greenhouse gas emissions from geothermal power stations increased by 6% between years. Geothermal electricity production increased in 2022 compared with 2021 due to a greater demand for electricity and low reservoir levels at hydropower stations at the beginning of the year.

Reservoirs (CH₄)

Methane emissions from reservoirs remained unchanged from last year since the number of ice-free days at our reservoirs remained relatively constant between years. Emissions from reservoirs are determined by the number of ice cover days.

Fuel

Emissions from fuel consumption decreased by 14% between years. We are systematically working towards the energy transition of our vehicle and equipment fleet. We met our goal this year of operating 75% of our passenger vehicles on clean energy. Our energy transition plan is crucial to achieving fossil fuel-free operations by 2030.

Electrical equipment

SF₆ emissions from Landsvirkjun’s electrical equipment in the Þjórsá and Fljótsdalur power station areas amounted to 2.9 kg. SF₆ is a particularly potent GHG, and the amount is equivalent to 68 tonnes of CO₂-eq, or 35% less than in 2021. The amount differs between years because some of our electrical equipment requires an SF₆ refill due to slow leakages. The refill is registered in the year it is used.

Scope 2

Purchased electricity & heating

Emissions from purchased electricity and heating remained the same between years. The amount varies between operational areas and fluctuates based on the scope of our projects. Most electricity and heating are consumed in our office buildings and other smaller units but represent only a small part of our total energy consumption. Most of the electricity we use comes from our own production.

Scope 3

Electricity transmission

Emissions from electricity transmission decreased by 21% year-on-year. These emissions are from SF₆ used to isolate substations for Landsnet’s transmission system. The decrease can be attributed to increased monitoring and preventive maintenance equipment at Landsnet.

Fertiliser

Emissions from using fertilisers in our land reclamation and afforestation projects decreased by 16% year-on-year. The difference in fertiliser purchases between years can be explained by the scope of projects each time, as fertiliser use depends on vegetation growth. The carbon footprint of fertiliser used in 2022 was less than in 2021. We use internal carbon prices when assessing fertiliser purchases, thereby assessing emissions in the procurement process.

Construction

Emissions from fuel consumption and waste treatment in our construction projects decreased by 53% between years. Emissions from construction can fluctuate between years, depending on the scope of projects.

Fuel

Emissions from fuel consumption (Scope 3) decreased by 7% between years. These emissions can mainly be attributed to rental cars and the production and transportation of the fuel we use in our vehicles and equipment.

Commute to work

Emissions from the commute to work decreased by 11% year-on-year. Employees who commute to work in an eco-friendly manner are offered a transport allowance. The percentage of permanent employees who took advantage of the transport allowance increased from 20% in 2021 to 24% in 2022.

Air travel

Emissions from employee air travel increased by 130% year-on-year due to the reduced impact of COVID-19. Despite this, air travel emissions were 40% lower than in 2019 before the epidemic began.

Waste

Emissions from waste treatment remained the same between years. The difference between years mostly depends on the number of renovation and maintenance projects in progress at any given time. There was an increase in sorted waste from 86% in 2021 to 89% in 2022.

Outside Scopes

Reservoirs (CO₂)

CO₂ emissions from reservoirs remained unchanged from last year, as the number of ice-free days at our reservoirs remained relatively constant between years. Emissions from reservoirs are determined by the number of ice cover days.

Biodiesel combustion (CO₂)

Emissions of CO₂ from biodiesel combustion increased by 36% between years. We have purposefully used biodiesel in our operations, as it has less impact on the climate than fossil fuels. The use of biodiesel increased by 36% between years.

Carbon sequestration

Sequestration measures increased by 2% between years. The increase is based on the Icelandic Forest Service’s new assessment of our afforestation areas, but also on more binding in land reclamation areas related to the expansion of these areas and projects that began after the last assessment was completed on land reclamation areas.



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Electricity generation

↓ Electricity generation (GWh)

	2018	2019	2020	2021	2022	Change since 2021
Geothermal energy	1,141	1,084	972	1,052	1,255	19%
Hydropower	13,172	12,867	12,458	13,074	13,494	3%
Wind energy	3.5	6.6	6.7	6.1	5.7	-6%
Total electricity generation	14,317	13,957	13,437	14,132	14,755	4%
Own use	93	91	87	85	95	11%
Losses	52	51	49	50	55	10%
Electricity delivered to grid	14,172	13,816	13,302	13,996	14,605	4%

Landsvirkjun’s electricity generation in 2022 was 14,755 GWh, of which 14,605 GWh went to the grid, a 4% increase from 2021. Landsvirkjun’s share of electricity delivered to the grid during the year was 76%.

Carbon intensity

↓ Carbon intensity (gCO₂-eq/kWh)

	2018	2019	2020	2021	2022	Breyting frá 2021
Geothermal energy (Scope 1)	36	30	32	31	27	-11%
Hydropower (Scope 1)	0.56	0.67	0.59	0.57	0.55	-3%
Total emissions from energy generation (Scope 1)	3.4	2.9	2.8	2.8	2.8	0.5%
Other	0.78	0.51	0.42	0.80	0.71	-12%
Carbon intensity	4.6	4.0	3.7	3.6	3.5	-2%
Net carbon intensity	2.4	1.7	1.3	1.2	1.1	-2%

Carbon intensity was 3.5 gCO₂-eq/kWh in 2022. It decreased by 2% between years and remained below the 4 gCO₂-eq/kWh emission ceiling defined in our climate and environmental policy.¹ Emissions from geothermal electricity generation were 27 gCO₂-eq/kWh, a decrease of 11% year-on-year, which can be attributed to lower concentrations of CO₂ in geothermal fluid, increased production of low-temperature geothermal wells and improved efficiency. Emissions from hydropower were 0.6 gCO₂-eq/kWh and remained the same between years. The European Union defines electricity generation as a contribution to climate change mitigation if carbon intensity is below 100 gCO₂-eq/kWh.²

Our net carbon intensity was 1.1 gCO₂-eq/kWh, a decrease of 2% between years.

1 Landsvirkjun’s Climate and Environmental Policy 2022.
2 Taxonomy Regulation (EU) 2020/852 2021.



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Avoided emissions

↓ **Avoided emissions from Landsvirkjun’s operations**

	2020	2021	2022
Energy sold, GWh	13,305	14,052	14,629
Benchmark factor, gCO ₂ -eq/kWh	209	227.4	185
Direct emissions (Scope 1), tCO ₂ -eq	38,422	40,248	41,928
Avoided emissions, tCO₂-eq	2,742,309	3,155,696	2,664,328

We generate electricity with a very low carbon intensity. The avoided emissions due to the use of our electricity are a part of our climate contribution. The climate impact or avoided emissions of our eligible green assets is assessed annually in accordance with our green financing framework. In 2022, avoided emissions were estimated at 2.7 million tonnes of CO₂-eq and decreased by 16% year-on-year, despite increased energy production. The decrease can be attributed to decreasing benchmark factors. A more detailed discussion on avoided emissions and calculation methods can be found in the Green Finance Impact Report.³

GHG emissions

↓ **Emissions in Scope 1 separated by GHGs (tonnes)**

	Geothermal energy	Hydropower	Fossil fuel	Electrical equipment	Biodiesel	Total 2022
CO ₂	33.345	6.462	372			40,178
CH ₄	25	266	0.17			291
N ₂ O			4.7			4.7
SF ₆				0.0029		0.0029
CH ₄ & N ₂ O*					1.2	1.2

*A separate itemisation of CH₄ and N₂O from biodiesel combustion is unavailable: Emission factors in the Company’s calculations do not provide such itemisation. These emissions are recorded as CO₂-eq.



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Climate accounting methodology

Landsvirkjun is leading the way in climate action and actively participates in the international fight against climate change. We produce 100% renewable energy with a negligible carbon footprint, will become carbon neutral in 2025 and work according to an ambitious action plan.⁴ Our action plan is based on the detailed mapping of our carbon footprint. We are dedicated to knowing our emissions, monitoring our results, and providing information about our climate impact in a responsible manner.

Our real-time monitoring of greenhouse gas emissions from our operations enables us to make informed decisions, analyse the effectiveness of actions and track our progress steadily throughout the year. We compile information about greenhouse gas emissions, sequestration, and carbon footprint in our climate account, where emission sources, changes in emissions, and progress toward goals are detailed.

We use the Greenhouse Gas Protocol (GHGP)⁵ methodology for our climate account, the leading global corporate standard for reporting greenhouse gas emissions and carbon sequestration. Our climate account have been audited and confirmed by independent certification bodies since 2018, and Landsvirkjun was the first Icelandic company to be audited by an external certification body.

Climate accounting methodology and assumptions are discussed below.

Defining the Company’s impact

We include emissions from our own operations and any emissions from our subsidiaries (such as Landsvirkjun Power and Icelandic Power Insurance). However, the accounts do not cover Landsvirkjun Power projects elsewhere in the world or businesses that Landsvirkjun owns shares in but does not directly control.

Greenhouse gases in Landsvirkjun’s operations

Landsvirkjun’s operations produce the greenhouse gases carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), as well as sulphur hexafluoride (SF₆).

CO ₂	Carbon dioxide is emitted by burning fossil fuels, the decomposition of organic matter in reservoirs and is also a geothermal gas. GHG emissions are expressed in carbon dioxide equivalents (CO ₂ -eq).
CH ₄	Methane is emitted by the decomposition of organic matter in reservoirs, landfill, burning of fossil fuels and is also a geothermal gas. Methane is a greenhouse gas 28 times more potent than carbon dioxide.
N ₂ O	Nitrous oxide is emitted by the burning of fossil fuels and the use of fertilisers. Nitrous oxide is a greenhouse gas 265 times more potent than carbon dioxide.
SF ₆	Sulphur hexafluoride is a manufactured gas used in Landsvirkjun’s and Landsnet’s operations to insulate electrical equipment. It can be released into the atmosphere when it leaks from electrical equipment. SF ₆ is a greenhouse gas 23,500 times more potent than carbon dioxide.

Scope of operations

When we talk about the scope of the activity, we mean the definition of factors involved in the emission of greenhouse gases from our operations. These can be “direct emissions” (Scope 1) or “indirect emissions” (Scopes 2 and 3), according to GHGP definition.

Scope 1- emissions that the Company is directly responsible for, i.e., emissions from operations under its control. Emission reduction measures such as capturing and ceasing fossil fuel consumption from operations would reduce these emissions.

Scope 2- indirect GHG emissions from purchased electricity and heating consumption.

Scope 3- emissions not produced by the Company itself, i.e., from other products or services used by us or from waste disposal (waste). We can affect our use, but cannot control how production, services or disposal takes place. Emissions in Scope 2 and 3 are from operations we do not directly manage. However, we can indirectly influence these emissions by choosing whom we do business with and requiring our suppliers and service providers to incorporate climate change measures.

According to the GHGP methodology, biogenic carbon dioxide emissions, such as those from biodiesel combustion, are considered ‘**outside of scopes**’.

See figure on page 5 of Climate Account:
Emission sources in Landsvirkjun’s operations classified according to scope

⁴ Landsvirkjun’s Climate Action Plan 2022.
⁵ The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard Revised Edition. World Resources Institute og World Business Council for Sustainable Development, 2004.



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Reasons for categorisation

The disclosure of direct emissions (Scope 1) from the Company alone would only include emissions from geothermal energy generation, reservoirs, own fuel consumption, and SF₆ emissions from its electrical equipment. Our Climate Account would not include emissions from the value chain, and there would be no incentive to require contractors to minimise fuel consumption or buy less products with a high carbon footprint. The results would be misleading as our Climate Account would show lower emissions when actual emissions are higher.

Disclosing Scope 2 and 3 emissions gives us a clear picture of our total emissions, including our value chain, motivating us to choose like-minded suppliers and encouraging companies throughout our value chain to do better.

Certification

Landsvirkjun’s emissions for 2018 to 2020 (in accordance with the GHGP Scopes 1, 2 and 3) were reviewed and verified by Bureau Veritas, one of the world’s leading international certification bodies, in accordance with the international standard ISAE 3000, with limited assurance. The Company’s carbon sequestration projects in 2020 were also reviewed and verified in accordance with the same standard. Both emissions and carbon sequestration have been reviewed and verified for 2021 and 2022, in accordance with ISO 14064-3, with limited assurance. Bureau Veritas also reviewed and verified direct emissions (Scope 1) in 2008, in accordance with ISAE 3000, with limited assurance. The year 2008 is used as a reference point with which current emissions can be compared and verification from Bureau Veritas confirms our reduced emissions.

Bureau Veritas’ suggestions for improvement and their verification of our emissions and sequestration measures support our journey towards carbon neutrality and are a major factor in achieving carbon neutrality in 2025.

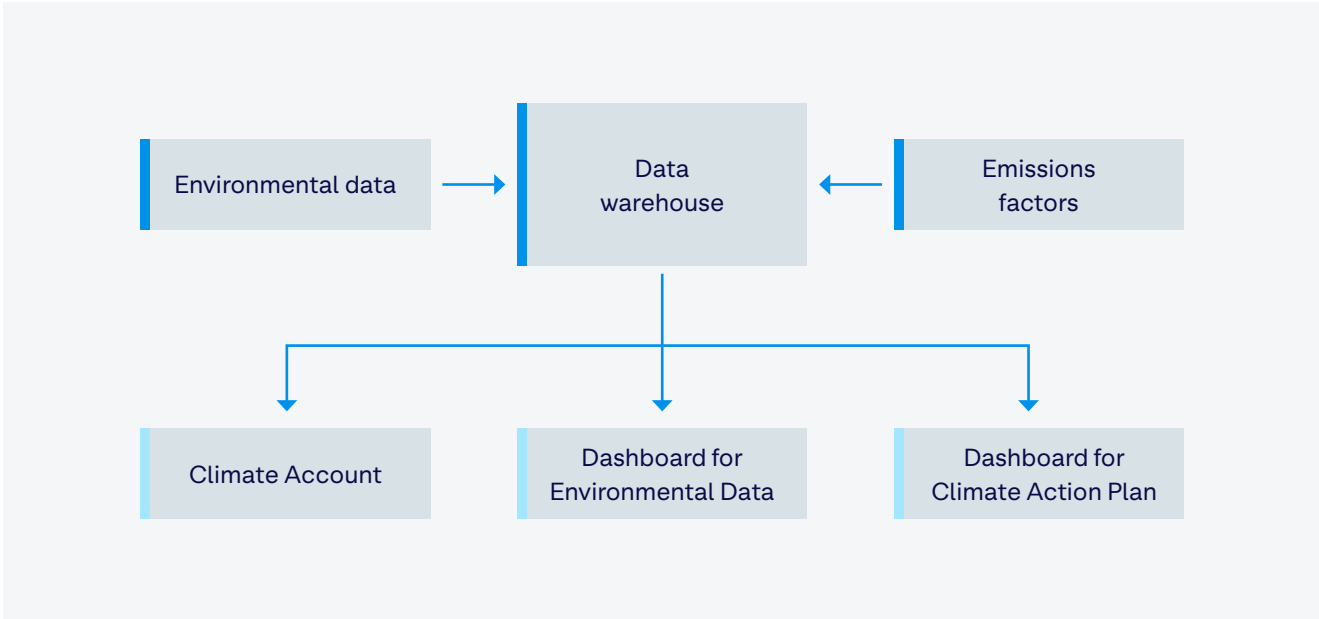
Further information on the verification of Landsvirkjun’s GHG emission and carbon sequestration is provided in Bureau Veritas’ Independent Limited Assurance Statement, included in our Climate Account.

Data collection and handling

As part of our climate accounting process, we follow a clearly defined procedure to ensure data quality. The data we use (environmental data and emission factors) are read into a database, a so-called data warehouse. This data is either read automatically from our accounting system and direct data from suppliers or manually recorded based on obtained information. Climate accounting data and how it is obtained are detailed in the section *Emissions calculated by source*.

The data is published in an environmental data dashboard, where it can be accessed, and the progress of climate action and other environmental issues can be monitored in real-time. We monitor our climate action plan goal progress using a climate dashboard accessed on our website.⁶

↓ Model for Environmental Data



- Data
- Publication

6 Climate dashboard. Landsvirkjun, 2022.



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Carbon footprint calculations

Landsvirkjun’s carbon footprint is calculated using the GHGP methodology, which calculates its total emissions - less carbon sequestration.

Carbon footprint = GHG emissions - carbon sequestration

We include biogenic CO₂ emissions in our total greenhouse gas emissions. The GHGP methodology excludes these emissions, categorising them as ‘outside of scopes’. Often, these emissions are not included in company carbon footprints because they are not thought to increase the greenhouse effect overall. Our decision to include biogenic emissions in the carbon footprint is based on best practice standards in corporate carbon neutrality assessment.⁷

Emission factors can change between years with new information or methodology updates. We always use the most recent emission factors for our climate account. Whenever emission factors change, previous years’ calculations are updated accordingly to ensure appropriate comparisons from year to year.

7 Science Based Targets Initiative, Net-Zero Standard

Emissions calculations by source

Geothermal energy
Both international and domestic research has shown that most geothermal gases are released naturally, seeping out of the soil in geothermal areas. Geothermal fluid is extracted from high-temperature geothermal areas at a depth of 2000 metres during the utilisation process. The fluid contains the GHG gases CO₂ and methane, which are released into the atmosphere during utilisation. The impact of geothermal utilisation on the natural release of GHG from geothermal areas is still relatively unclear. However, we have conducted various studies in recent years in our utilisation areas to shed more light on the effects.

Emissions from geothermal power stations are calculated for each geothermal well. The wells are either active (in production) or idle. Chemical composition tests are carried out annually in each well to assess the concentration of GHGs in the geothermal fluid. Annual well testing is carried out using the tracer dilution method, and monthly tests are carried out to estimate well output and temperature. The results show the production capacity for each well. The concentration of GHGs in each well is multiplied by the total amount of steam and liquid released from each well to show the total emissions from geothermal energy production. An appropriate emission factor is used to convert methane emissions into CO₂-eq. Emissions from geothermal production are direct emissions from our operations and fall under Scope 1.

↓ Emission factor for Methane

	Emission factor (gCO ₂ -eq/g)	Reference
Methane (CH ₄)	28	IPCC, 2013 ⁸

8 Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, 2013.



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Hydropower

Vegetation and soil are submerged when a reservoir is filled. These organic materials decompose and subsequently release the greenhouse gases carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). Greenhouse gas emissions can vary between reservoirs, but the amount of vegetation and organic matter initially submerged has the most significant impact on emissions. Nitrous oxide emissions have not been detected in reservoirs in Iceland and are therefore not included in Landsvirkjun’s climate account (the same is true for Iceland’s National Inventory Report, NIR).

We use the IPCC guidelines⁹ to calculate GHG emissions from our hydropower station reservoirs, also used for Iceland’s NIR. Carbon dioxide is usually not emitted from reservoirs when an ice layer covers them because the water temperature is too low for microorganism activity, and gas formation is negligible.

Ice cover and the number of ice-free days are monitored at the Blanda and Fljótisdalur Reservoirs. Ice-free days are not recorded in reservoirs, where less organic matter was submerged during filling. The estimated number of ice-free days in these reservoirs is 215. CO₂ and methane emissions from reservoirs are calculated using specific emission factors compiled by experts at the Icelandic University of Agriculture based on several studies and peer-reviewed articles.

No conclusive evidence exists on how much biogenic carbon is released into the atmosphere or how much is bound in reservoirs. These emissions are, therefore, registered as atmospheric emissions until more data becomes available.

According to the GHGP methodology, the release of methane from reservoirs falls under Scope 1. In contrast, the release of carbon dioxide is considered ‘outside of scopes’ because vegetation (during growth) binds as much carbon dioxide as it releases during decomposition.

↓ Emission factors for reservoirs

Reservoirs	CO ₂ Ice-free (kgCO ₂ /ha*d)	CO ₂ Ice (kgCO ₂ /ha*d)	CH ₄ Ice-free (kgCH ₄ /ha*d)	CH ₄ Ice (kgCH ₄ /ha*d)
Bórísvatn	0.162	0	0.0065	0.000051
Sauðafellslón	0.162	0	0.0065	0.000051
Krókslón	0.230	0	0.0092	0
Hrauneyjalón	0.106	0	0.0042	0
Bjarnalón	0.076	0	0.0030	0
Blöndulón	4.67	0	0.187	0.0040
Gilsárlón	12.9	0	0.524	0.012
Hágöngumiðlun	0.162	0	0.0065	0.000052
Kvíslavatn 1	0.162	0	0.0065	0.000052
Kvíslavatn 2	2.11	0	0.085	0.0018
Dratthalavatn 1	0.162	0	0.0065	0.000052
Dratthalavatn 2	2.11	0	0.085	0.0018
Eyvindarlón	0.162	0	0.0065	0.000052
Hreysislón	0.162	0	0.0065	0.000052
Þjórslón	0.162	0	0.0065	0.000052
Sultartangalón	0.083	0	0.0033	0
Háslón	0.392	0	0.016	0.00036
Ufsarlón	0.902	0	0.036	0.00080
Kelduárlón	0.770	0	0.031	0.00071
Grjótárlón	0.247	0	0.0099	0
Vatnsfellsveita	0	0	0	0
Sporðöldulón 1	0.162	0	0.0065	0.000052
Sporðöldulón 2	2.11	0	0.085	0.0018



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Fuel consumption

We use fuel for our vehicles and other equipment, power stations, backup power stations and rental cars. GHGs are emitted from burning fossil fuels (Scope 1) and during the production and transportation of fuel (Scope 3). We keep a detailed record of our fuel consumption and purchases. Emissions are calculated per litre of fuel based on relevant emission factors. Emissions from each vehicle and all electric and mechanical equipment are calculated.

↓ Emission factors for fuel consumption (kgCO₂-eq/l)

Fuel type	Scope	Emission factor (kgCO ₂ -eq/l)	Reference
Diesel	1	2.72	UST, 2022 ¹⁰
Diesel	3	0.63	DEFRA, 2022 ¹¹
Petrol	1	2.34	UST, 2022 ¹⁰
Petrol	3	0.60	DEFRA, 2022 ¹¹
Biodiesel	1	0.036	DEFRA 2022 ¹¹
Biodiesel	3	0.35	DEFRA, 2022 ¹¹
Biodiesel	Outside Scopes	2.47	DEFRA, 2022 ¹¹
Hydrogen	3	1.78	Zhao et al., 2018 ¹²

↓ Emission factors for fuel consumption by fuel type

Fuel type	Diesel	Petrol	Biodiesel	Reference
Carbon dioxide (kgCO ₂ /l)	2.66	2.33	2.47	DEFRA, 2022 ¹¹
Methane (kgCH ₄ /l)	0.00026	0.0073	-	DEFRA, 2022 ¹¹
Nitrous oxide (kgN ₂ O/l)	0.037	0.0067	-	DEFRA, 2022 ¹¹
Methane & nitrous oxide (kgCO ₂ -eq/l)	-	-	0.036	DEFRA, 2022 ¹¹

Emission factors from DEFRA do not differentiate between methane and nitrous oxide emissions from biodiesel combustion, which is why these emissions are expressed in CO₂ equivalents.

Emissions from fossil fuel combustion are included in Scope 1. Emissions of methane and nitrous oxide from biodiesel combustion are included in Scope 1, but emissions of CO₂ are outside Scopes. Emissions from the production and transportation of all fuel types are included in Scope 3.

¹⁰ Emission Factors. Environmental Agency of Iceland, 2022.
¹¹ Greenhouse gas reporting: conversion factors 2022. DEFRA, 2022.
¹² Zhao, Pedersen. Life Cycle Assessment of Hydrogen Production and Consumption in an Isolated Territory. Procedia CIRP, 69, 529-533, 2018.

Electrical equipment

Sulphur hexafluoride (SF₆) is used as an insulator and must be added to electrical equipment every few years because SF₆ slowly leaks from equipment. The supply and status of SF₆ refilling are monitored to provide an overview of emissions from SF₆ leakages. The appropriate emissions factor is used to convert emissions into CO₂ eq. SF₆ leakage emissions are included in Scope 1.

↓ Emission factor for SF₆

	Emission factor (gCO ₂ -eq/g)	Reference
Sulphur hexafluoride (SF ₆)	23,500	IPCC, 2013 ¹³

Purchased electricity & heating

Electricity and heating emissions from the Company’s operations are calculated based on invoiced amounts for purchased electricity and heating. This is done by multiplying the amount of electricity and hot water with emission factors issued by the Environment Agency of Iceland based on average emissions from energy production in Iceland. These emissions fall under Scope 2.

↓ Emission factors for electricity & heating

Type	Emission factor (gCO ₂ -eq/kWh)	Reference
Electricity	10.3	UST, 2022 ¹³
Hot water	0	UST, 2022 ¹⁴

The Environment Agency of Iceland records combined emissions from geothermal power, i.e., from the generation of electricity and heating. The emission factor for hot water is 0. Emissions factors for electricity and heating from 2021 were used In the Climate Account for 2022, as the Environment Agency of Iceland has not updated emissions factors for 2022.

¹³ Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, 2013.
¹⁴ Emission Factors. Environmental Agency of Iceland, 2022.



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Waste

Waste generated from company operations is categorised, and its quantity is recorded. Information on waste quantities is obtained from invoices or data connections with service providers. Information on waste disposal is obtained from suppliers. Emissions resulting from waste treatment are calculated by multiplying the amount of waste with appropriate emission factors. These emissions fall under Scope 3.

↓ Emission factors for waste

Waste category	Emission factor (kgCO ₂ -eq/t)	Reference
General unsorted waste	880	UST, 2022 ¹⁵
Bulky waste	467.01	DEFRA, 2022 ¹⁶
Inert waste (glass, soil & minerals)	1.23	DEFRA, 2022 ¹⁶
Organic waste	171.5	UST, 2022 ¹⁵
Metals and scrap metal	21.28	DEFRA, 2022 ¹⁶
Other electrical equipment	21.28	DEFRA, 2022 ¹⁶
Batteries	21.28	DEFRA, 2022 ¹⁶
Paper (recyclable)	21.28	DEFRA, 2022 ¹⁶
Plastic (recyclable)	21.28	DEFRA, 2022 ¹⁶
Hazardous waste	21.28	DEFRA, 2022 ¹⁶
Timber, unpainted	21.28	DEFRA, 2022 ¹⁶
Timber, painted (landfill)	828.01	DEFRA, 2022 ¹⁶
Timber, painted (recyclable)	0	DEFRA, 2022 ¹⁶

Employee air travel

Flight numbers, departure locations, and destinations are kept track of.

Our domestic flight emissions are calculated based on emission factors prepared by a consultant and a study on aircraft emissions. Air travel emissions are measured using seat kilometres, which vary depending on the length of the flight and the type of aircraft; short flights with fewer passengers produce higher emissions per seat kilometre than flights with a higher number of passengers travelling longer journeys. The effect of distance on emissions per seat kilometer is explained by the increase in emissions during take-off and landing. These emissions are not dependent on flight distance.

Emissions from international flights are automatically included in invoices from our travel agency and are based on the ICAO carbon calculator.¹⁸

Emissions from employee air travel fall under Scope 3.

¹⁵ Emission Factors. Environmental Agency of Iceland, 2022.
¹⁶ Greenhouse gas reporting: conversion factors 2022. DEFRA, 2022.
¹⁷ Cox, et al. Life cycle assessment of air transportation and the Swiss commercial air transport fleet. Transport and Environment, 58, 1-13, 2018.
¹⁸ ICAO Carbon Emissions Calculator. ICAO, 2022.

Employee commuting

Employee commuting GHG emissions are estimated through a survey on commuting habits sent to all employees annually. Employees are asked how they commute, how far, and how often they work from home. Annual commuting trips are calculated by subtracting the number of working days from home and the average number of holidays and sick days from the total number of working days each year. Emissions are calculated by multiplying the trips by the distance between home and the workplace and the appropriate emissions factor. The average emissions of survey participants are multiplied by the total number of full-time employees at the Company. Emissions from employee commuting fall under Scope 3.

Some of our employees commute using company cars. These emissions are accounted for in emissions from fuel consumption that fall under Scope 1.

↓ Emission factors for employee commuting

Transportation	Emission factors (gCO ₂ -eq/km)	Reference
Private vehicle – electric	0	UST, 2022 ¹⁹
Private vehicle – petrol	208	UST, 2022 ¹⁹
Private vehicle – diesel	191	UST, 2022 ¹⁹
Private vehicle – hybrid	136	UST, 2022 ¹⁹
Private vehicle – methane	2.5	UST, 2022 ¹⁹
Motorbike	96	UST, 2022 ¹⁹
Bus*	49.6	-

*Emission factors from bus travel are estimated from real figures on fuel consumption and the distance driven by the bus, as reported by Strætó in its annual report 2021. Landsvirkjun assumes an average of 20 passengers per trip.

¹⁹ Emission Factors. Environmental Agency of Iceland, 2022.



Fertiliser

Landsvirkjun purchases inorganic fertiliser for land reclamation use, afforestation, fields and gardens, as well as general maintenance in areas surrounding our power stations. We record our purchases and our project partners’ use of fertiliser in collaborative projects. Emissions are based on production, transport, and soil release. When purchasing fertiliser, we ask about the greenhouse gas emissions related to its production, transport, and use.

If information from the fertiliser manufacturer is unavailable, then emissions from a similar fertiliser is used, or average emission factors for 2022. Information on emissions from fertiliser for 2022 was based on emission factors from the Ecoinvent database 3.5 and World Food LCA and the Environment Agency of Iceland. Emissions from fertiliser fall under Scope 3.

↓ Emission factors for fertiliser

	Emission factor	Reference
Production N (kg CO ₂ -eq/kg N)	3.7	Yara, 2020
Production N (kg CO ₂ -eq/kg N)	3.88	World Food LCA
Production K (kg CO ₂ -eq/kg K ₂ O)	0.36	Ecoinvent database 3.5
Production P (kg CO ₂ -eq/kg P ₂ O ₅)	1.86	Ecoinvent database 3.5
Soil release NP 26-4 (kg CO ₂ -eq/kg fertiliser)	1.46	Yara, 2020
Soil release NPK 12-4-18 (kg CO ₂ -eq/kg fertiliser)	0.67	Yara, 2020
Soil release (kg CO ₂ -eq/kg N)	4.16	UST, 2022
Transport by land (kg CO ₂ -eq/kg fertiliser)	0.02	SCSI, 2021
Transport by sea (kg CO ₂ -eq/kg fertiliser)	0.07	SCSI, 2021
Transport by sea (kg CO ₂ -eq/kg*km)	0.000011	Ecoinvent database 3.5

Electricity transmission

Sulphur hexafluoride (SF₆) is used for insulation purposes at Landsnet’ s substations. Reports on SF₆ leakages in Landsnet’ s operations are requested annually. Landsvirkjun’ s emissions from electricity distribution are calculated by multiplying Landsnet’ s total SF₆ emissions with Landvirkjun’ s portion of transmitted electricity within Landsnet’ s transmission system (published annually by the National Energy Authority). The appropriate emission factor is used to convert emissions into CO₂-eq. Emissions from electricity distribution fall under Scope 3.

↓ Emission factor for SF₆

	Emission factor (gCO ₂ -eq/g)	Reference
Sulphur hexafluoride (SF ₆)	23,500	IPCC, 2013 ²⁰

Construction

All contractors hired by Landsvirkjun to carry out major groundwork provide information on waste and fuel consumption quantities. Emissions are calculated by multiplying the quantity of waste and fuel consumption with the appropriate emission factors. The emission factors used for Landsvirkjun’ s operations are also used for calculations on fuel consumption and waste quantities during construction projects. Emissions from construction fall under Scope 3.

20 Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, 2013.



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Carbon sequestration calculations

Carbon sequestration is assessed in areas where land reclamation, afforestation and wetland restoration measures are carried out by Landsvirkjun or in collaboration with partners. Among them are mitigation measures associated with construction, land improvements near the Company’s power stations, and a project to bind carbon in soil and vegetation.

Sequestration measures related to land reclamation and afforestation projects are measured by the Soil Conservation Service of Iceland (SCSI) and the Icelandic Forest Service and our Climate Account are based on this information. The Icelandic Forest Service first assessed Landsvirkjun’s sequestration measures in our afforestation areas in 2011 and most recently in 2021. The Soil Conservation Service of Iceland (SCSI) conducted their first assessment of sequestration measures in our land reclamation areas in 2011, which was subsequently updated in 2016. The results have not yet been made public. An emission factor is used for wetland areas reclaimed to reduce carbon emissions, assuming these measures will reduce emissions by 20 tonnes of CO₂-equivalents per hectare per year according to the SCSI’s recommendations. Their approach is based on the IPCC methodology.²¹

Land reclamation projects, carried out as carbon sequestration measures, are located at Rangárvellir and Hólasandur. Similar afforestation projects are located at Eiðsstaðir, close to the Blanda Hydropower Station, in Belgsá in Fnjóskadalur, in Laxaborg in Haukadalur, in Skarfanes in Landsveit, and in Skálmholtshraun in Flóahreppur. Wetlands have also been reclaimed in Sogn in Ölfus and Ytri-Hraundalur in Mýrar and in Skálholt. Other projects have been carried out in collaboration with landowners and relevant professionals, such as the SCSI, the Icelandic Forest Service and various afforestation associations.

↓ A map of Landsvirkjun’s sequestration projects



21 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. IPCC, 2014.



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Independent Limited Assurance Statement

Introduction and objectives of work

Bureau Veritas UK Limited (‘Bureau Veritas’) has been engaged by Landsvirkjun to provide limited assurance on its Climate Account 2022 report (the ‘Report’). The objective is to provide assurance to Landsvirkjun and its stakeholders over the accuracy and reliability of the reported information and data.

Scope of Work

The scope of our work was limited to assurance over the following information included within the Report for the period January 1st to December 31st 2022 (‘the Selected Information’):

- › Scope 1 emissions
- › Scope 2 emissions (location and market-based)
- › Selected Scope 3 emissions
 - Purchased goods and services
 - Fuel and energy related activities
 - Waste generated in operations
 - Business travel
 - Employee commuting
 - Downstream transportation and distribution
- › Performance compared to 2021, 2020, 2019 and 2018 as a percentage change for the above datasets listed in this section.

Reporting criteria

The Selected Information needs to be read and understood together with the methodology set out in the Report for each category of emissions.

Limitations and Exclusions

Excluded from the scope of our work is assurance of information relating to:

- › Activities outside the defined assurance period;
- › Positional statements of a descriptive or interpretative nature, or of opinion, belief, aspiration or commitment to undertake future actions; and

Other information included in the Report other than the Selected Information. Moreover, excluded from our scope of work and conclusion is:

- › The appropriateness of the Reporting Criteria for the Selected Information;
- › Any calculation input data provided by third parties, together with any potential errors, discrepancies or gaps identified in this input data by Bureau Veritas raised during the course of the engagement;

The following limitations should be noted:

- › This limited assurance engagement relies on a risk based selected sample of sustainability data and the associated limitations that this entails.
- › This independent statement should not be relied upon to detect all errors, omissions or misstatements that may exist.
- › Scope 3 SF₆: Landsvirkjun used an estimation methodology (reviewed as part of the verification), to calculate their 2022 value. The actual value for Scope 3 SF₆ 2022 was not available for review as their share of power to the electricity grid had not been published by the National Energy Authority.

Responsibilities

This preparation and presentation of the Selected Information in the Report are the sole responsibility of the management of Landsvirkjun.

Bureau Veritas was not involved in the drafting of the Report or of the Reporting Criteria. Our responsibilities were to:

- › Obtain limited assurance about whether the Selected Information has been prepared in accordance with the Reporting Criteria;
- › Form an independent conclusion based on the assurance procedures performed and evidence obtained; and
- › Report our conclusions to the Directors of Landsvirkjun.

Assessment Standard

We performed our work to a limited level of assurance in accordance with the ISO 14064-3:2019, Greenhouse gases - Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions.



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Summary of work performed

As part of our independent assurance, our work included:

- 1 Conducting interviews with relevant personnel of Landsvirkjun;
- 2 Reviewing the data collection and consolidation processes used to compile Selected Information, including assessing assumptions made, and the data scope and reporting boundaries;
- 3 Reviewing documentary evidence provided by Landsvirkjun;
- 4 Agreeing a selection of the Selected Information to the corresponding source documentation;
- 5 Reviewing Landsvirkjun systems for quantitative data aggregation and analysis;
- 6 Assessing the disclosure and presentation of the Selected Information to ensure consistency with assured information.
- 7 Comparing the Selected Information to the prior year amounts

A 5% materiality threshold was applied to this assurance. It should be noted that the procedures performed in a limited assurance engagement vary in nature and timing from, and are less in extent than for, a reasonable assurance engagement. Consequently, the level of assurance obtained in a limited assurance engagement is substantially lower than the assurance that would have been obtained had a reasonable assurance engagement been performed.

Conclusion

On the basis of our methodology and the activities and limitations described above nothing has come to our attention to indicate that the Selected Information is not fairly stated in all material respects.

Verified GHG Emissions

Scope 1:	Scope 2 (Location and market-based):	Scope 3: 3430 tonnes of CO ₂ e
42,122 tonnes of CO ₂ e	8.2 tonnes of CO ₂ e	Waste: 71 tonnes of CO ₂ e Employee Air Travel: 190 tonnes of CO ₂ e Commuting: 95 tonnes of CO ₂ e Fertilisers: 1,091 tonnes of CO ₂ e Construction (Fuel & Waste): 304 tonnes of CO ₂ e Fuel: 162 tonnes of CO ₂ e Transmission of electricity: 1,518 tonnes of CO ₂ e
Out of Scope (Biofuel and Biogenic emission from Hydropower reservoirs): 6,547 tonnes of CO ₂ e		
Total Scope 1 and Out of Scope: 48,669 tonnes of CO ₂ e		

Statement of Independence, Integrity and Competence

Bureau Veritas is an independent professional services company that specialises in quality, environmental, health, safety and social accountability with over 190 years history. Its assurance team has extensive experience in conducting verification over environmental, social, ethical and health and safety information, systems and processes.

Bureau Veritas operates a certified²² Quality Management System which complies with the requirements of ISO 9001:2015, and accordingly maintains a comprehensive system of quality control including documented policies and procedures regarding compliance with ethical requirements, professional standards, quality reviews and applicable legal and regulatory requirements which we consider to be equivalent to ISQM 1 & 2.²³

Bureau Veritas has implemented and applies a Code of Ethics, which meets the requirements of the International Federation of Inspections Agencies (IFIA)²⁴, across the business to ensure that its employees maintain integrity, objectivity, professional competence and due care, confidentiality, professional behaviour and high ethical standards in their day-to-day business activities. We consider this to be equivalent to the requirements of the IESBA code.²⁵ The assurance team for this work does not have any involvement in any other Bureau Veritas projects with Landsvirkjun.



Bureau Veritas UK Limited
London
17th February, 2023

²² Certificate available on request
²³ International Standard on Quality Management 1 (Previously International Standard on Quality Control 1) & International Standard on Quality Management 2
²⁴ International Federation of Inspection Agencies – Compliance Code – Third Edition
²⁵ Code of Ethics for Professional Accountants issued by the International Ethics Standards Board for Accountants



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Independent Assurance Report

Introduction and objectives of work

Bureau Veritas UK Limited (‘Bureau Veritas’) has been engaged by Landsvirkjun to provide limited assurance on its Climate Account 2022 report and Carbon Sequestration (the ‘Report’). The objective is to provide assurance to Landsvirkjun and its stakeholders over the accuracy and reliability of the reported information and data.

Scope of Work

The scope of our work was limited to assurance over the following information included within the Report for the period January 1st to December 31st 2022 (the ‘Selected Information’):

Carbon Sequestration Projects

Land reclamation

- | | | |
|----------------------|---|----------------|
| – Auðkúluheiði | – Fljótsdalsstöð (Hraunasvæði, Háslón, Húsey) | |
| – Eyvindarstaðaheiði | – Landbótasjóður Norður-Héraðs | – Vikingslækur |
| – Bolholt | – Kot-Steinkross | – Hrútaatorfur |
| – Hólasandur | – Krákárbotnar og Katlar | – Sporðöldulón |

Reforestation

- | | | |
|--------------|-------------------|----------------|
| – Blöndustöð | – Skarfanés | – Búrfell |
| – Laxárstöð | – Skálmholtshraun | – Búrfellsstöð |
| – Belgsá | – Kaldárhöfði | – Bjarnalón |
| – Laxaborg | – Sogsstöðvar | |

Wetland reclamation

- Skálholt
- Sogn
- Ytri Hraundalur

Reporting criteria

For the Carbon Sequestration, the Selected Information has been prepared in accordance with internal definitions and methodologies developed by Landsvirkjun with reference to relevant external guidelines, models and tools for carbon sequestration accounting, such as the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands and the IPCC Good Practice Guidance for Land Use²⁶ and the IPCC Guidance for Land Use Change and Forestry.²⁷

Limitations and Exclusions

Excluded from the scope of our work is assurance of information relating to:

- » Activities outside the defined assurance period;
- » Positional statements of a descriptive or interpretative nature, or of opinion, belief, aspiration or commitment to undertake future actions; and
- » Other information included in the Report other than the Selected Information, Carbon Sequestration: The Selected Information includes a number of estimation methodologies, as detailed in the Reporting criteria. It is understood that the dataset of areas and carbon sequestration factors, will continue to undergo improvement and refinement by Landsvirkjun further over the upcoming years. Bureau Veritas was not provided with full visibility of certain sources of data inputs and basis for assumptions to check for alignment and consistency. Instead, Bureau veritas relied on information relayed by third parties to Landsvirkjun in these cases. This includes information from the following:
 - Land reclamation areas and carbon sequestration provided is based on data from year 2019 provided by the Soil Conservation Service (SCS) to the Company. Since 2019 Landsvirkjun has estimated an increase along with additional reclamation operations
 - Growth rate projections of reforestation areas per year, provided by the following study commissioned by the Company to the Icelandic Forest Service experts: ‘Úttekt á kolefnisbindingu skógrækar Landsvirkjunar 2021, LV-2022-035’
 - Carbon sequestration factor used for wetlands, provided by the Soil Conservation Service (SCS) to the company, and based on IPCC’s factors for rich boreal grassland and rewetted area: “Endurheimt votlendis á tveimur jörðum og vöktun á árangri, LV-2022-036”.

²⁶ 2013 Supplement to the 2006 IPCC Guidelines. IPCC, 2014.

²⁷ Good Practice Guidance for Land Use, Land-Use Change and Forestry. IPCC, 2003.



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Moreover, excluded from our scope of work and conclusion is:

- » The appropriateness of the Reporting Criteria for the Selected Information;
- » Any calculation input data provided by third parties, together with any potential errors, discrepancies or gaps identified in this input data by Bureau Veritas raised during the course of the engagement;

The following limitations should be noted:

- » This limited assurance engagement relies on a risk based selected sample of sustainability data and the associated limitations that this entails.
- » This independent statement should not be relied upon to detect all errors, omissions or misstatements that may exist.

Responsibilities

This preparation and presentation of the Selected Information in the Report are the sole responsibility of the management of Landsvirkjun.

Bureau Veritas was not involved in the drafting of the Report or of the Reporting Criteria. Our responsibilities were to:

- » obtain limited assurance about whether the Selected Information has been prepared in accordance with the Reporting Criteria;
- » form an independent conclusion based on the assurance procedures performed and evidence obtained; and
- » report our conclusions to the Directors of Landsvirkjun.

Assessment Standard

We performed our work to a limited level of assurance in accordance with the ISO 14064-3:2019, Greenhouse gases - Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions.

Summary of work performed

As part of our independent assurance, our work included:

- 1 Conducting interviews with relevant personnel of Landsvirkjun;
- 2 Reviewing the data collection and consolidation processes used to compile Selected Information, including assessing assumptions made, and the data scope and reporting boundaries;
- 3 Reviewing documentary evidence provided by Landsvirkjun;
- 4 Agreeing a selection of the Selected Information to the corresponding source documentation;
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- 6 Assessing the disclosure and presentation of the Selected Information to ensure consistency with assured information.
- 7 Comparing the Selected Information to the prior year amounts

A 5% materiality threshold was applied to this assurance. It should be noted that the procedures performed in a limited assurance engagement vary in nature and timing from, and are less in extent than for, a reasonable assurance engagement. Consequently, the level of assurance obtained in a limited assurance engagement is substantially lower than the assurance that would have been obtained had a reasonable assurance engagement been performed.



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Conclusion

On the basis of our methodology and the activities and limitations described above nothing has come to our attention to indicate that the Selected Information is not fairly stated in all material respects.

Verified Carbon Sequestered

Landsvirkjun total Carbon Sequestration in 2022: 35,152 tonnes of CO₂e.
Total increase in Carbon Sequestration from 2021 to 2022: 752 tonnes of CO₂e.

Statement of Independence, Integrity and Competence

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Bureau Veritas operates a certified²⁸ Quality Management System which complies with the requirements of ISO 9001:2015, and accordingly maintains a comprehensive system of quality control including documented policies and procedures regarding compliance with ethical requirements, professional standards, quality reviews and applicable legal and regulatory requirements which we consider to be equivalent to ISQM 1 & 2.²⁹

Bureau Veritas has implemented and applies a Code of Ethics, which meets the requirements of the International Federation of Inspections Agencies (IFIA)³⁰, across the business to ensure that its employees maintain integrity, objectivity, professional competence and due care, confidentiality, professional behaviour and high ethical standards in their day-to-day business activities. We consider this to be equivalent to the requirements of the IESBA code.³¹ The assurance team for this work does not have any involvement in any other Bureau Veritas projects with Landsvirkjun.



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²⁹ International Standard on Quality Management 1 (Previously International Standard on Quality Control 1) & International Standard on Quality Management 2
³⁰ International Federation of Inspection Agencies – Compliance Code – Third Edition
³¹ Code of Ethics for Professional Accountants issued by the International Ethics Standards Board for Accountants

