Landsvirkjun

Climate Account 2021

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I hereby confirm Landsvirkjun's climate accounts and carbon footprint for 2021.

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Hörður Arnarson , CEO Landsvirkjun

Table of contents

Key Figures

Landsvirkjun's vision is a sustainable world driven by renewable energy. The Company fosters its vision by being at the forefront of climate action and leading by example. Landsvirkjun is a state-owned energy company, generating 72% of all electricity produced in Iceland. Landsvirkjun uses 100% renewable energy sources for its electricity generation, such as hydropower, geothermal- and wind energy. The carbon footprint from the Company's electricity generation is exceptionally low, and the energy sources are returned to nature.

Climate change is a key concern for Landsvirkjun, and we consider shouldering responsibility for climate issues to have been the Company's largest contribution to sustainability. After all, energy is a climate issue.

↓ Key Figures

Carbon footprint

16.644 tCO_2e ↓3%

Net carbon intensity

1,2 gCO_2e/kWh ↓8%

GHG emissions

51.044 tCO_2e ↑2%

Carbon intensity

3,6 gCO_2e/kWh ↓3%

Avoided GHG emissions by electricity generation

3.155.696 tCO_2e ↑15%

Carbon sequestration

34.400 tCO_2e ↑4%

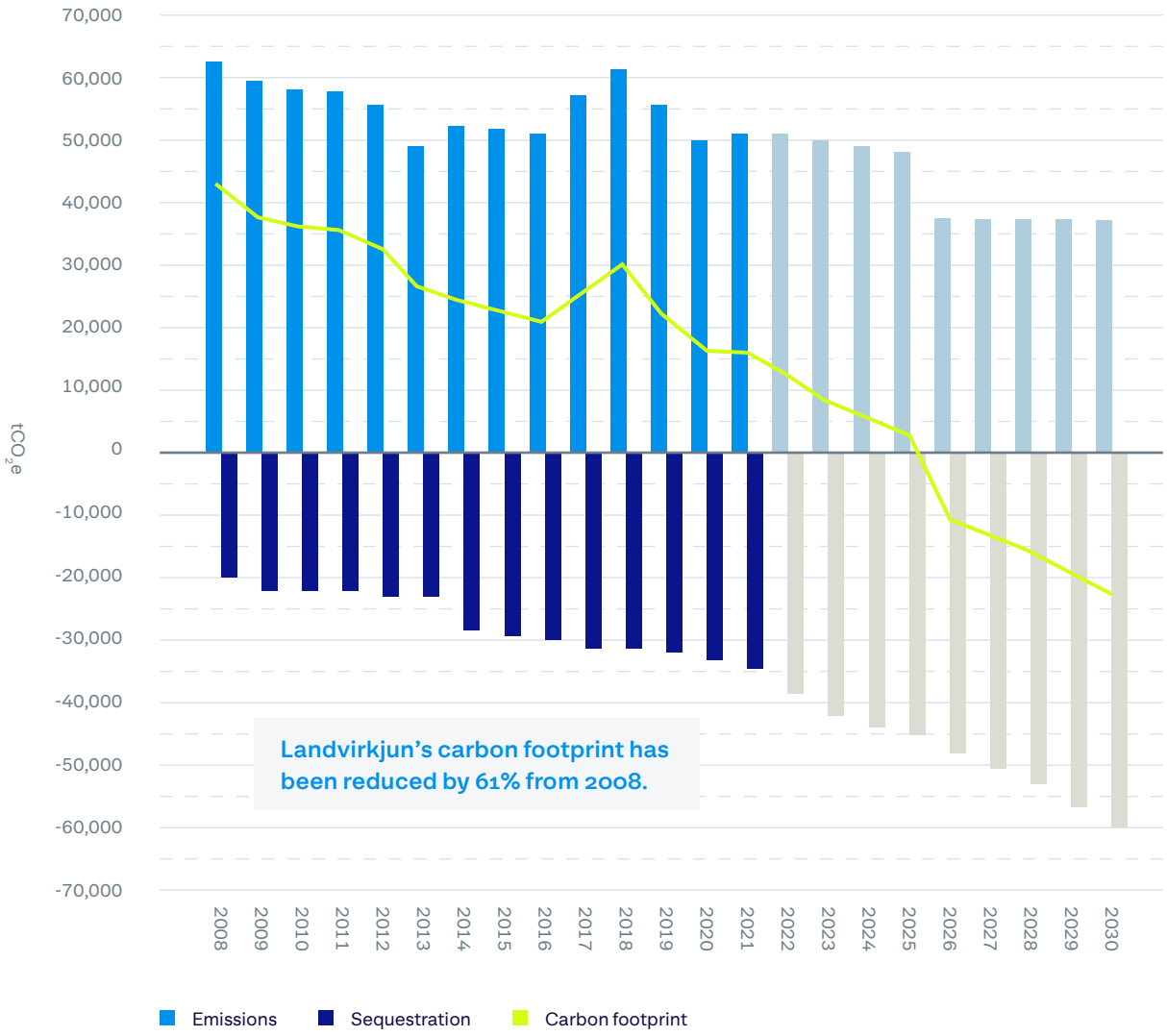
The Climate Account contains statistical information on Landsvirkjun's carbon footprint, greenhouse gas emissions, and carbon sequestration for 2021, as well as information on the status of the Company's climate targets.

Landsvirkjun emphasises fair and transparent disclosure. The Company's Climate Account is based on the methodology of the Greenhouse Gas Protocol (GHGP)[1] and has been inspected and verified by Bureau Veritas, one of the world's leading certification bodies, using the international standard ISO-14064-3, with limited assurance. This will ensure that Landsvirkjun's findings are consistent with emissions from its operations. Assurance statements from Bureau Veritas are in the last chapter of the Climate Account.

Detailed information on Landsvirkjun's methodology for computing its carbon footprint can be found in the the Annex (Climate Account Methodology).

Landsvirkjun to Become Carbon Neutral in 2025

↓ Climate Action Plan by 2030



1 The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard Revised Edition. World Resources Institute and World Business Council For Sustainable Development, 2004.

Landsvirkjun's Climate Action Plan provides guidance towards carbon neutrality.

Measures ranked by priority

1. Prevent new emissions
2. Reduce current emissions
3. Countermeasures

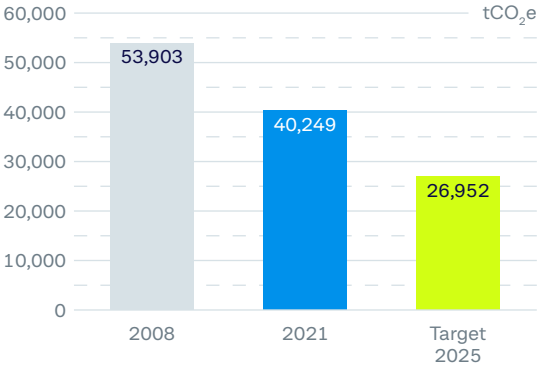
Landsvirkjun's Climate Action Plan →

Climate targets and progress

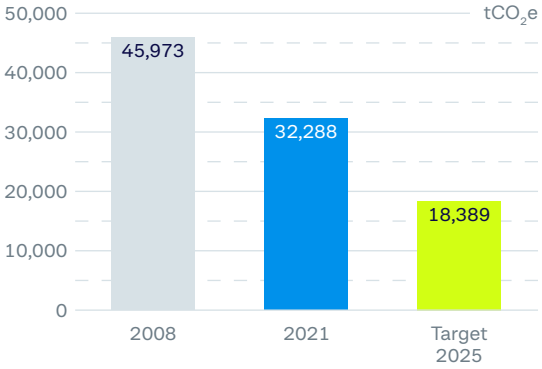
We commit to keeping our carbon intensity below 4 gCO_2e/kWh

Carbon intensity was 3.6 gCO_2e/kWh in 2021.

50% reduction in direct emissions in 2025 vs. 2008

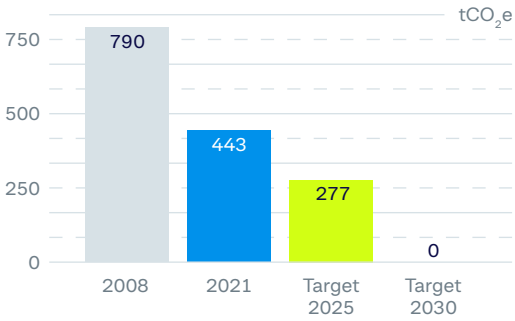


60% reduction in geothermal emissions in 2025 vs. 2008

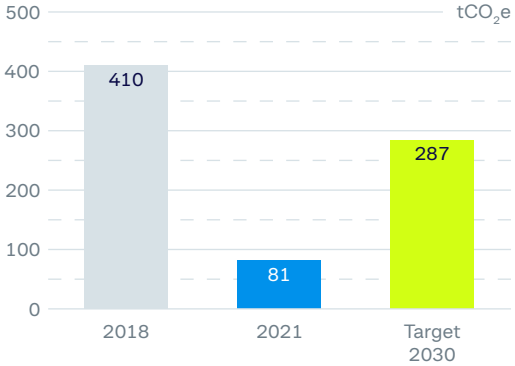


Purchases of fossil fuel will end in 2030

65% reduction of emissions from combustion of fossil fuels in 2025 vs. 2008

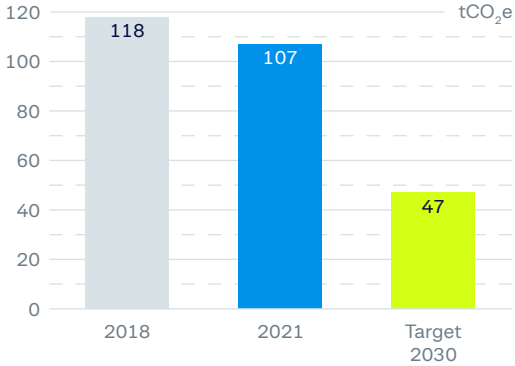


30% reduction in employee air travel emissions in 2030 vs. 2018



The target will be updated considering change in travel habits in the wake of COVID-19.

60% reduction in emissions from commute in 2030 vs. 2018



Carbon Footprint

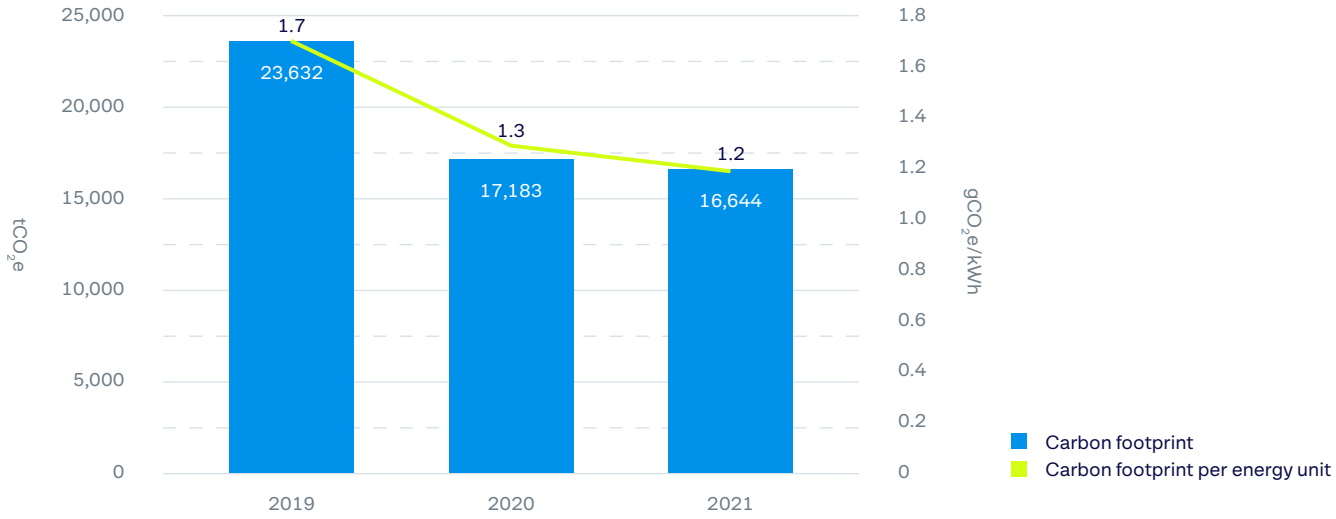
Landsvirkjun's carbon footprint was approximately 16.6 thousand tCO_2e in 2021 but was approximately 17.2 thousand tCO_2e in 2020. The carbon footprint has been reduced by 2% from 2020. Total emissions increased by 860 tCO_2e from the year before. However, carbon sequestration in soil and vegetation increased by 1,400 tCO_2e in 2021.

Landsvirkjun's carbon footprint accounts for annual emissions from the Company's operations, using the GHGP methodology, net of carbon sequestration.

A carbon footprint = greenhouse gas emissions – sequestrated carbon

Landsvirkjun's carbon footprint accounts for emissions from its operations, resulting either from direct emissions (scope 1), or indirect emissions (scope 2 and 3). In addition, the Company accounts for biogenic CO_2 emissions from reservoirs and from biodiesel combustion which fall outside of scopes, according to the GHGP methodology.

↓ Carbon footprint



Carbon intensity of electricity generation was 3.6 gCO_2e/kWh in 2021, which is below the emissions' limit value of 4 g/kWh, as defined in Landsvirkjun's Climate and Environment Policy.[2] Emissions from electricity generation using geothermal energy exceeded emissions from electricity produced using hydropower, 31 gCO_2e/kWh for geothermal energy vs. 1.1 g/kWh for hydropower. In comparison, the EU defines electricity generation as climate change mitigation, when carbon intensity is below 100 gCO_2e/kWh.[3]

Carbon intensity was 1.2 gCO_2e/kWh, compared to 1.3 gCO_2e/kWh in 2020, a 6% reduction.

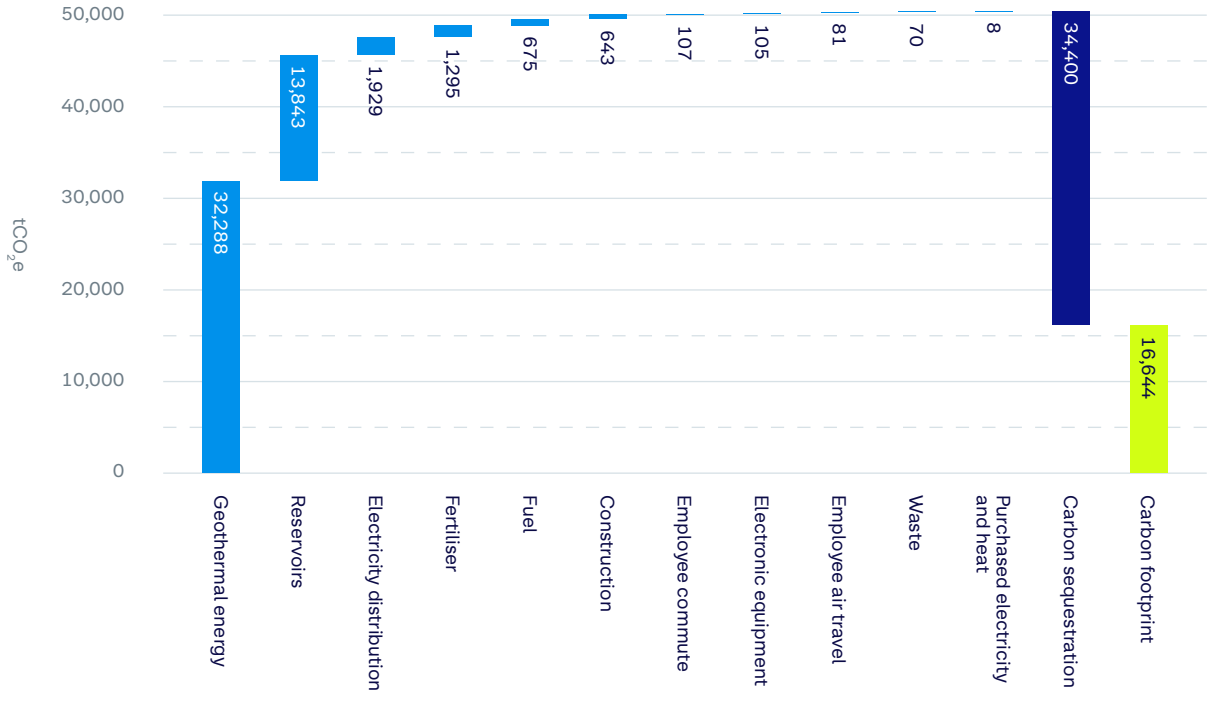
↓ Carbon intensity by energy source (gCO_2e/kWh)

	2019	2020	2021	Change from 2020
Geothermal energy	30	32	31	-2.6%
Hydropower	1.3	1.1	1.1	-4.7%
Total emissions from electricity generation	3.5	3.3	3.3	-1.4%
Other emissions	0.51	0.42	0.35	-18%
Total emissions	**4.0**	**3.7**	**3.6**	**-3.3%**
Carbon sequestration	**2.3**	**2.5**	**2.4**	**-0.88%**
Carbon footprint	**1.7**	**1.3**	**1.2**	**-7.9%**

This table allocates emissions from energy sources, linking emissions directly from generation to the energy source used. Thus, direct geothermal emissions result from the release of gases into the atmosphere, whereas direct hydropower emissions consist of emissions from reservoirs. The total sum of other factors, e.g., fossil fuel consumption, SF_6 leakage, employee air travel and waste, plus other emissions, is recorded in the table as "other emissions".

All calculations are based on whole decimal notations. Due to rounding to a decimal place, a slight difference in the total is possible, also in charts demonstrating proportional change year on year.

↓ Carbon footprint



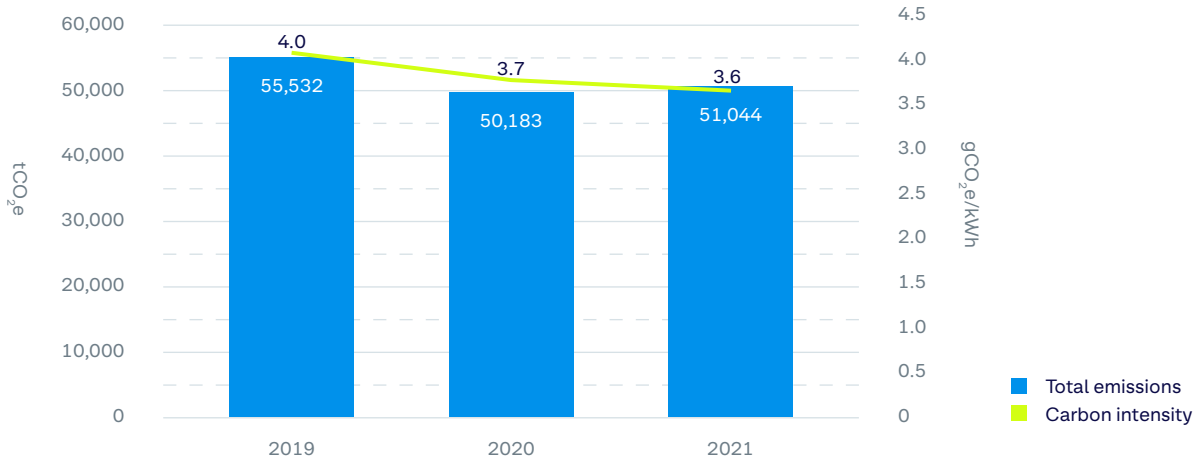
2 Landsvirkjun's Climate and Environment Policy. Landsvirkjun, 2021.
3 Supplementing Regulation 2020/852. EU, 2021.

Greenhouse Gas Emissions

Landsvirkjun's greenhouse gas emissions from its operations in 2021, defined within scopes, were 44.6 thousand tCO_2e. Whereas 90% of emissions within scopes are included in direct emissions (scope 1), and 10% are indirect emissions (scope 3).

Total emissions from Landsvirkjun's operations in 2021 were approximately 51 thousand tCO_2e, with emissions from geothermal energy comprising the major share, or 32.3 thousand tonnes, and emissions from reservoirs, which were approximately 13.8 thousand tonnes, thereof 6.4 thousand tonnes from organic carbon dioxide emissions, which are defined outside of scopes. Total emissions increased slightly from 2020, by approximately 2%, but carbon intensity has been reduced from 3.7 gCO_2e/kWh in 2020 to 3.6 g/kWh in 2021. However, total emissions have been reduced by 8%, compared to 2019.

↓ Emissions from Landsvirkjun's operations

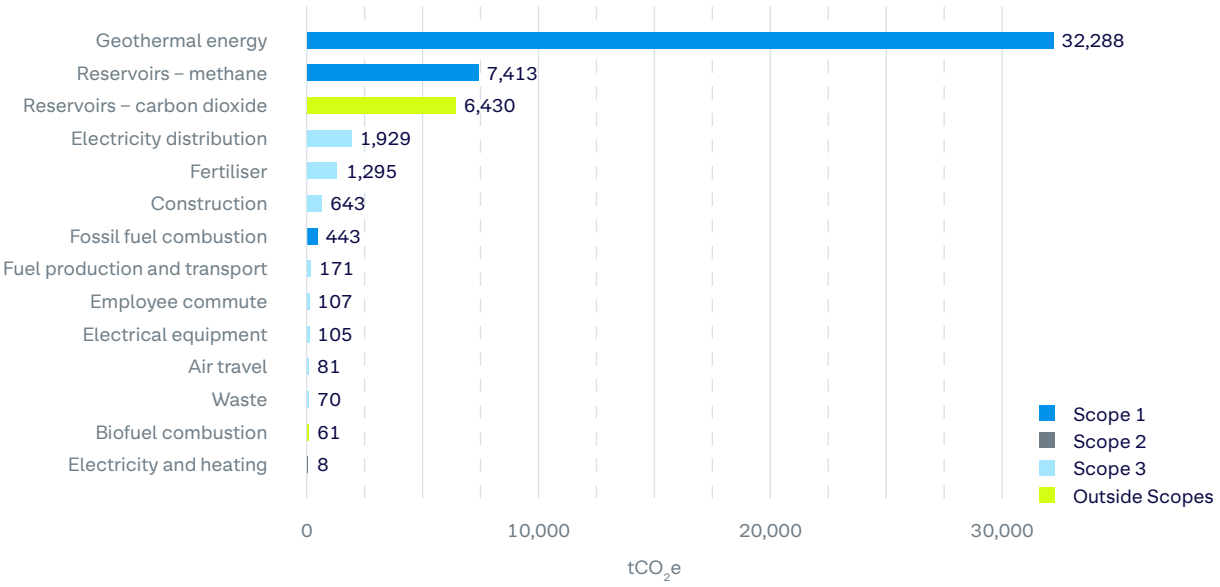


The largest part of increased emissions stems from increased electricity generation from geothermal power stations, these emissions are categorised as direct emissions (scope 1). On the other hand, indirect emissions (scope 3) continued to decrease.

↓ Emissions from Landsvirkjun's operations (tCO_2e)

	2019	2020	2021	Change from 2020
Direct emissions (scope 1)	41,550	38,422	40,249	4.8%
Electricity and heating (scope 2)	8.9	11	8.3	-26%
Indirect emissions (scope 3)	6,346	5,268	4,296	-18%
Total emissions (scope 1–3)	**47,905**	**43,700**	**44,553**	**2.0%**
Total emissions including Emmissions outside scopes	**55,532**	**50,183**	**51,044**	**1.7%**

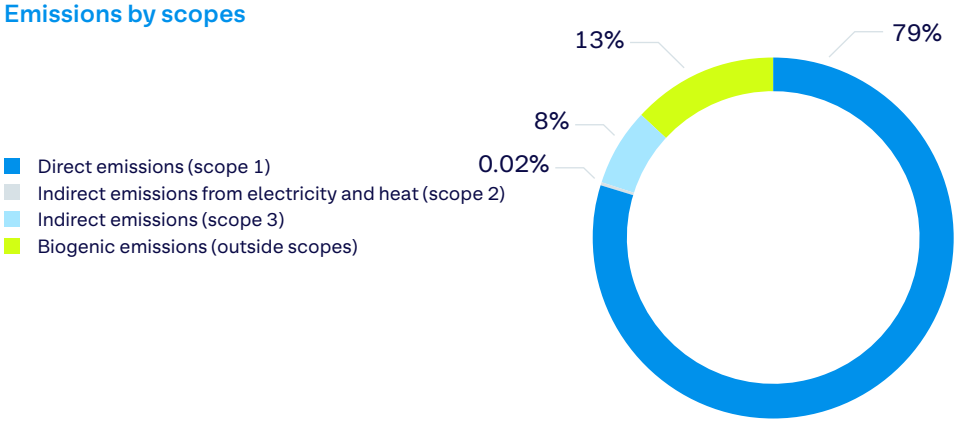
Emissions by Sources



Electricity generation from geothermal sources produces the largest share of emissions. Methane emissions from reservoirs are also a large part of total emissions. These two factors are defined as direct emissions (scope 1). In addition, biogenic carbon emissions from reservoirs constitute a large share of emissions, but those are defined outside of scopes, according to the GHGP methodology, and do not fall under the Company's direct climate impact. Emissions from combustion of fossil fuels do not constitute a significant share of direct emissions. Furthermore, emissions from production and transport of fuel are a small share of total emissions, but those are categorised as indirect emissions (scope 3).

Emissions from electricity distribution constitute the largest part of indirect emissions (scope 3). These are emissions from the insulating medium SF_6 used at Landsnet's (the Icelandic transmission system operator) power grid but are recorded as indirect emissions at Landsvirkjun. The amount is proportional to the Company's share of total electricity generation in Iceland. Emissions from the use of fertiliser in land reclamation and afforestation projects, followed by emissions from fossil fuel combustion and waste management in the Company's construction projects. However, it is worth noting that the use of fertiliser impacts the climate favourably by increasing vegetation growth and carbon sequestration. Employee commute, either by air or private cars, and waste management do not constitute a significant proportion of Landsvirkjun's total emissions.

Emissions by scopes



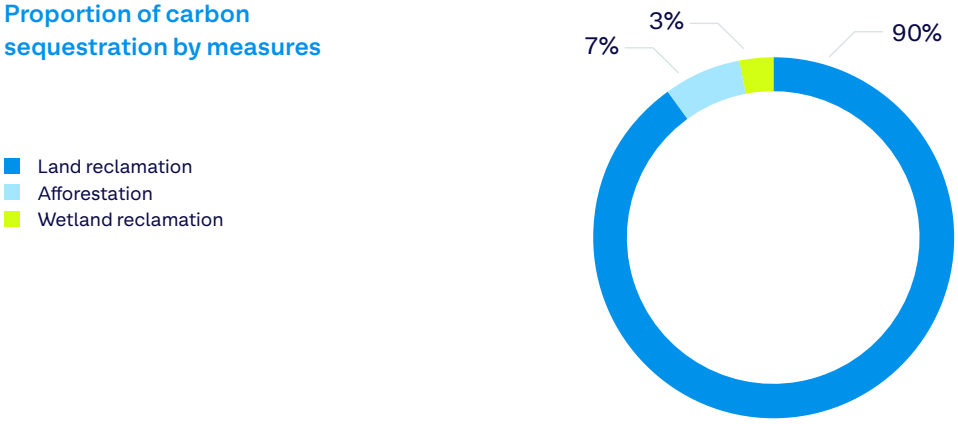
Carbon Sequestration

Landsvirkjun's total carbon sequestration for 2021 was at 34,400 tCO_2e, an increase of 4% from 2020. Carbon sequestration in the Company's projects was 31,100 tCO_2e in land reclamation, 2,350 tCO_2e in afforestation, and 950 tCO_2e in wetland restoration.

Carbon sequestration (tCO_2e)

	2019	2020	2021	Change from 2020
Land reclamation	-28,800	-29,400	-31,100	5.8%
Afforestation	-2,000	-2,100	-2,350	12%
Wetland reclamation	-100	-500	-950	90%
Carbon funds	-1,000	-1,000	0	-100%
Total carbon sequestration	**-31,900**	**-33,000**	**-34,400**	**4.2%**

Proportion of carbon sequestration by measures



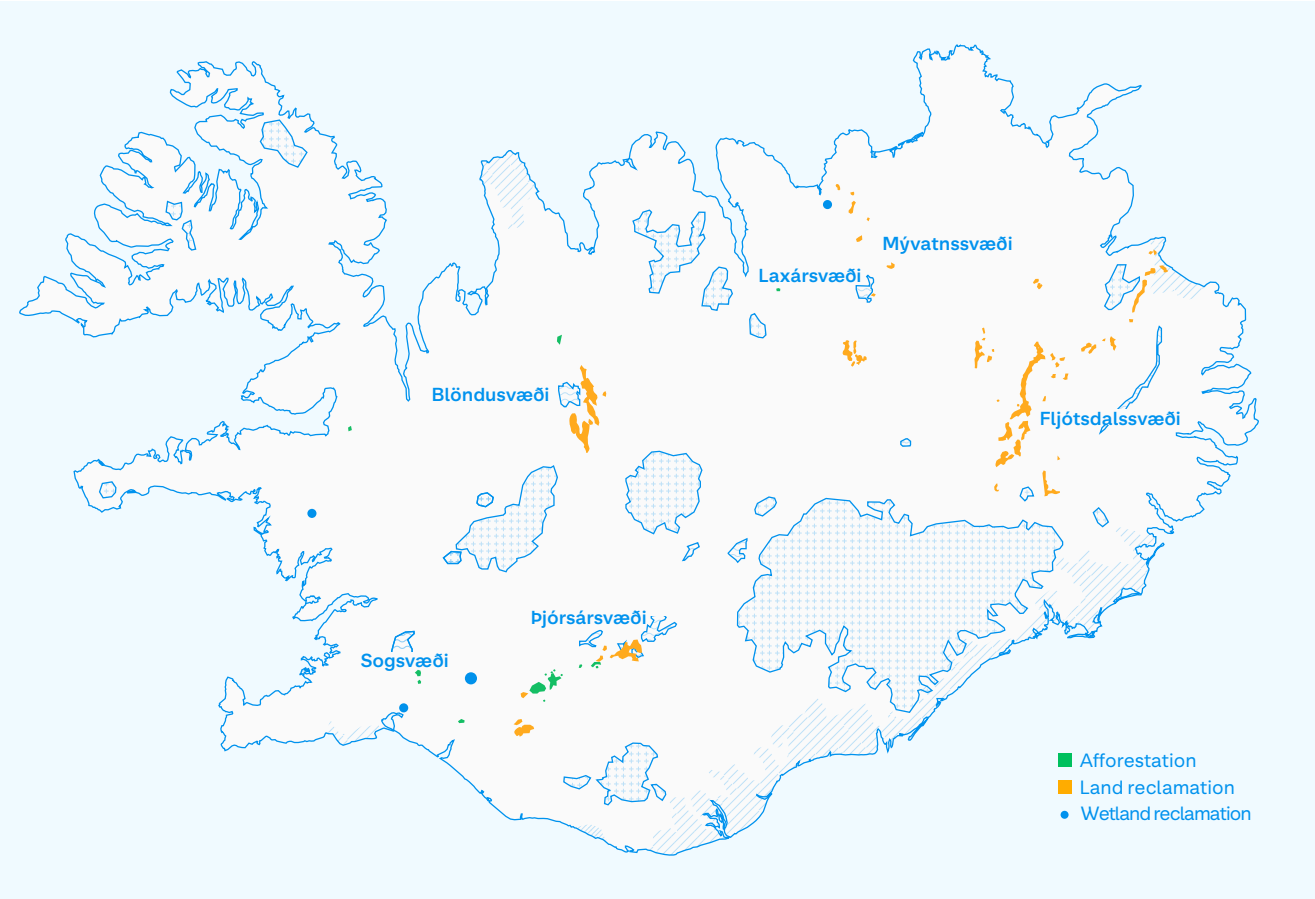
The frame of reference are measurements from 2016-2017, conducted by the Soil Conservation Service of Iceland and the Icelandic Forest Service, on carbon sequestration in land reclamation and afforestation projects carried out by Landsvirkjun or in cooperation with the Company, taking into account new projects, which were not part of the previous assessment. Calculations for reduced carbon emissions, where wetlands have been restored to reduce emissions, are based on a reduction factor. No sequestration was purchased from carbon funds in 2021.

Starting in 2020, Bureau Veritas eviewed and certified Landsvirkjun's data for carbon sequestration. Bureau Veritas has conducted a review for the Company for 2021 and issued a certification. Thus, the methodology for the assessment of Landsvirkjun's carbon sequestration has been confirmed.

Land reclamation, afforestation, and wetlands restoration are in part countermeasures due to constructions, land improvements in the vicinity of the Company's power stations, and the newly launched project aimed at carbon sequestration in soil and vegetation. Carbon sequestration is proportionally most intense in the extensive land reclamation sites.

Land reclamation projects, with carbon sequestration as a main objective, are located at Rangárvellir and Hólasandur. Similar afforestation projects are located at Eiðsstaðir, in the vicinity of Blanda power station, at Belgsá in Fnjóskadalur, at Laxaborg in Haukadalur, at Skarfanes in Landsveit, and at Skálmholtshraun in Flóahreppur. Furthermore, wetlands have been restored at Sogn in Ölfus and Ytri-Hraundalur at Mýrar, and the project at Skálholt is now accounted for in the Climate Account, for the first time. These projects have been carried out in cooperation with landowners and professionals, such as the Soil Conservation Service of Iceland, the Icelandic Forest Service and forestry associations.

↓ A map of Landsvirkjun's sequestration projects



Electricity Generation

Landsvirkjun's energy generation in 2021 was 14,132 GWh, of which 13,966 GWh were delivered to the grid, an increase of 5%. The Company generated 72% of electricity delivered to the grid in 2021.

Summary of Landsvirkjun's electricity generation, energy losses, and own energy use 2019-2021 (GWh)

	2019	2020	2021	Change from 2020
Total electricity generation	13,957	13,437	14,132	5.2%
T&D losses	51	49	50	1.5%
Own electricity use	91	87	85	-1.2%
Electricity delivered to the grid	**13,816**	**13,302**	**13,996**	**5.2%**

The electricity generated by Landsvirkjun has exceptionally low carbon footprint, and use of the Company's electricity avoids the use of electricity with a higher carbon footprint. Avoided emissions are a derivative from Landsvirkjun's operations and are part of the Company's contribution to the fight against climate change.

In accordance with Landsvirkjun's Green Finance Framework,[4] the climate impact of the Company's Eligible Green Assets is quantified and reported annually. The climate impact is expressed as avoided greenhouse gas emissions. In 2021, avoided emissions from Landsvirkjun's operations were 3.2 million tonnes, from 2.7 million tonnes in 2020, an increase of 15%. Further information on avoided emissions and the methodology for calculations is available in the Green Finance Impact Report,[5] which is part of disclosure for green finance.

Avoided emissions from Landsvirkjun's operations

	2020	2021
Energy sales, GWh	13,305	14,052
Benchmark emission factor gCO_2e/kWh	209	227.4
Emissions scope 1, tCO_2e	38,422	40,249
Avoided emissions, tCO_2e	**2,742,309**	**3,155,696**

Further information on avoided emissions and the methodology for calculations is available in the Green Finance Impact Report.[5]

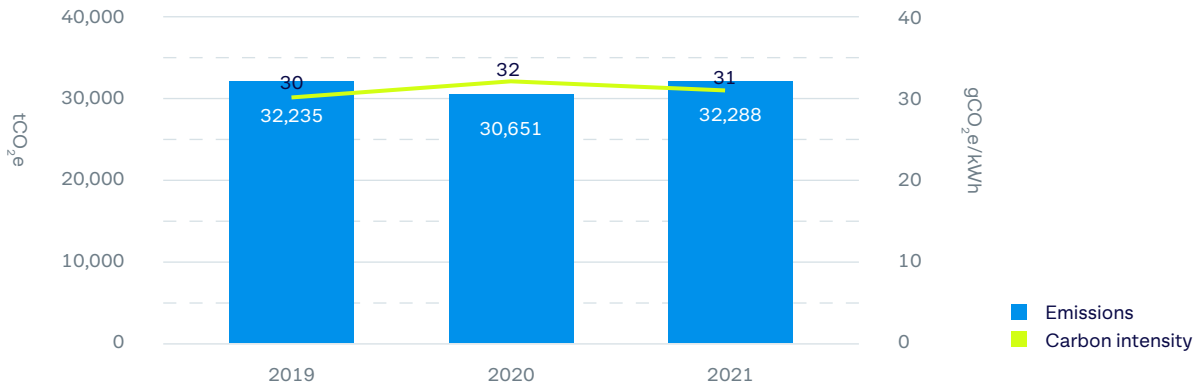
4 Green Finance Framework. Landsvirkjun, 2020.
5 Green Finance Impact Report. Landsvirkjun, 2021.

Emissions by Sources
A detailed level of outcome

Geothermal Energy

GHG emissions from geothermal power stations increased by 5% year on year and were 32,288 tCO_2e in 2021. Carbon intensity was reduced by 3%, from 31.5 gCO_2e/kWh in 2020, to 30.7 g/kWh in 2021.

↓ GHG emissions from geothermal power stations



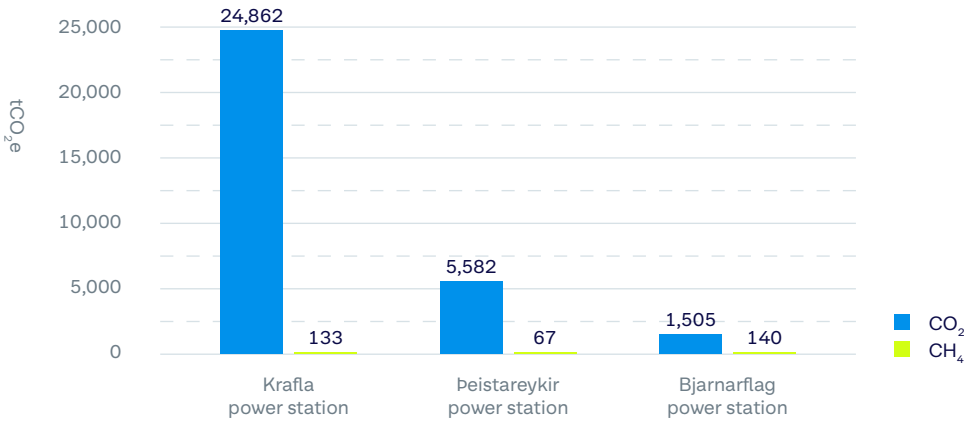
The increase in emissions from 2020 to 2021 is explained by an increase in electricity generation from geothermal energy in 2021. To minimise total emissions from the electricity generation, Landsvirkjun prioritises electricity generated from hydropower when water levels in the reservoirs are good. Due to low water levels in 2021 and increased demand for electricity, more electricity was generated from geothermal energy than in 2020.

Total emissions from geothermal energy are mainly from geothermal power generation, in additions to emissions from boreholes, where research and development projects are conducted. The largest share of emissions from Landsvirkjun's operations comes from Krafla power station, even if the energy generation at the Þeistareykir power station surpasses that of Krafla. The difference in emissions from these geothermal areas is due to unique attributes characterising the geothermal systems that each power station uses. Furthermore, machine efficiency impacts emissions.

↓ Carbon dioxide (CO_2) and methane (CH_4) emissions from geothermal power stations (tCO_2e)

	2019			2020			2021		
Power Station	CO_2	CH_4	**Total emission**	CO_2	CH_4	**Total emission**	CO_2	CH_4	**Total emission**
Krafla	23,738	163	23,901	22,833	140	22,973	24,862	133	24,994
Þeistareykir	6,612	68	6,680	6,086	32	6,118	5,582	67	5,649
Bjarnarflag	1,503	151	1,654	1,364	196	1,560	1,505	140	1,645
Total	**31,853**	**382**	**32,235**	**30,283**	**368**	**30,651**	**31,949**	**339**	**32,288**

Emissions from Landsvirkjun's geothermal power stations in 2021

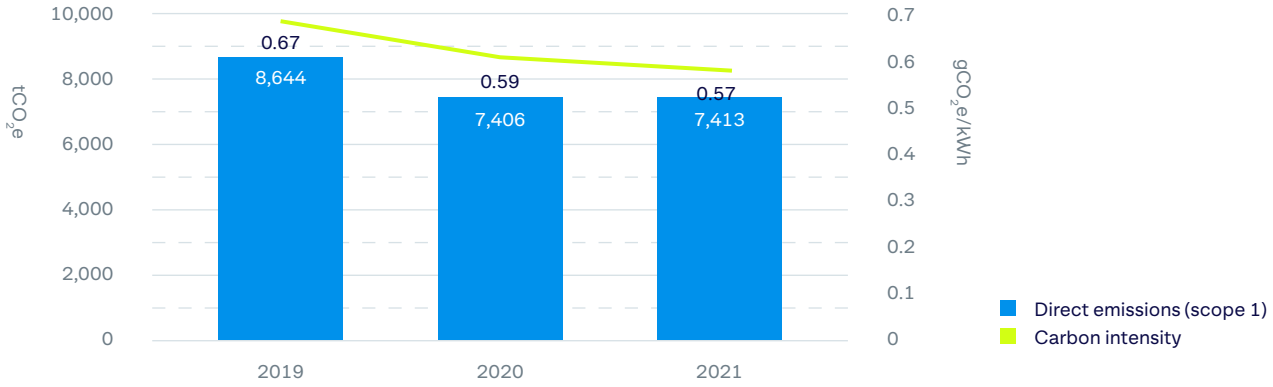


Bjarnarflag power station

Hydropower

Direct emissions (scope 1) from Landsvirkjun's reservoirs were 7,413 tCO_2e in 2021 and remained unchanged from 2020. Carbon intensity (scope 1) decreased by 5% year on year.

↓ Direct emissions from reservoirs



If emissions outside of scopes are included, the carbon intensity for 2021 is 1.1 g CO_2e/kWh.

Emissions from reservoirs in 2019 were considerably higher compared to 2020 and 2021, due to unusually early thaw in the reservoirs at Blanda power station and Fljótsdalur power station in 2019.

↓ Number of days without ice

Area	Reservoir	2019	2020	2021
Blanda area	Blöndulón	189	156	158
	Gilsárlón	189	160	159
Fljótsdalur area	Hálslón	191	171	155
	Kelduárlón	156	141	124
	Ufsarlón	158	135	127

The criterion is 215 days without ice for Landsvirkjun's other reservoirs.

The largest share of emissions from Landsvirkjun's reservoirs can be traced to Blanda power station, where a relatively large amount of organic matter was submerged when the reservoirs were formed.

↓ Emissions of CO_2 and CH_4 wfrom reservoirs (tCO_2e)

	2019			2020			2021		
Area	CO_2	CH_4	**Total emission**	CO_2	CH_4	**Total emission**	CO_2	CH_4	**Total emission**
Blanda	6,250	7,169	13,419	5,185	5,991	11,176	5,231	6,049	11,280
Fljótsdalur	526	603	1,129	471	543	1,014	426	493	918
Þjórsá	773	872	1,645	773	872	1,645	773	872	1,645
Total	**7,549**	**8,644**	**16,193**	**6,428**	**7,406**	**13,835**	**6,430**	**7,413**	**13,843**

Biogenic CO_2 emissions from reservoirs were 6,430 tCO_2e in 2021 and remain unchanged from 2020. These emissions are outside of scopes. Total emissions from reservoirs were 13,843 tCO_2e in 2021.

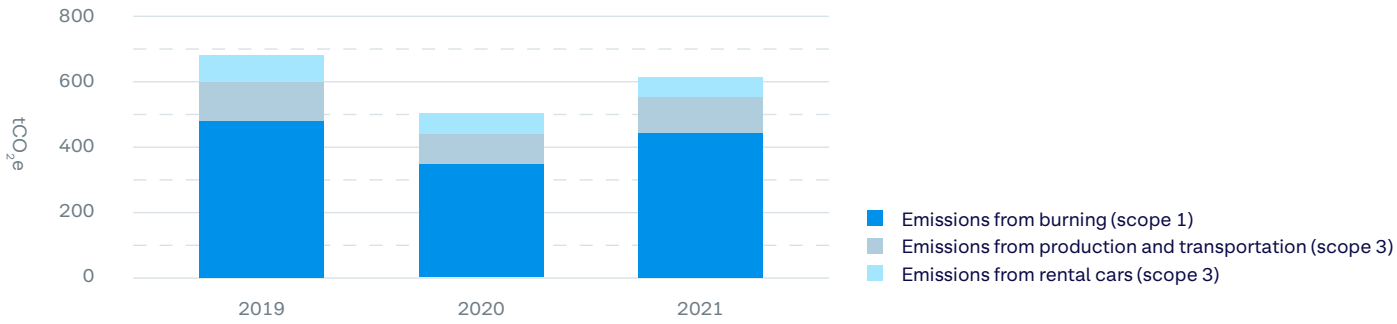
↓ Emissions from Landsvirkjun's reservoirs in 2021

The dam and intake of Steingrímsstöð power station

Fuel

Total emissions from fuel combustion, categorised within scopes, increased by 23% from 2020, and were 614 tCO_2e in 2021, an increase of 23%, year on year. Emissions were 10% lower than in 2019.

GHG emissions from fuel consumption



The impact from COVID-19 on the Company's operations was not as severe in 2021 as in 2020, which explains to a large extent the increase in emissions from fuel consumption. However, emissions in 2021 were lower than in 2019, which is in part due to the pandemic, but also because of the Company's measures towards fossil fuel free operations.

Fuel consumption (litres)

	2019	2020	2021	Change from 2020
Petrol for vehicles	13,103	16,152	22,263	38%
Diesel for vehicles	144,065	112,035	125,953	12%
Diesel for generators	20,656	2,032	17,297	751%
Biodiesel for vehicles	32,284	22,478	25,126	12%
Hydrogen for vehicles	324	81	672	733%
Total	**210,431**	**152,777**	**191,312**	**25%**

Diesel generators are used to operate equipment which is located outside the grid and reserve power generators.

In 2021, 191,312 litres of fuel were purchased, thereof 165,513 litres of fossil fuel, 25,126 litres of biodiesel, and 672 litres of hydrogen. Landsvirkjun's fossil fuel consumption increased by 27% from 2020, consumption of biodiesel increased by 12%, and consumption of hydrogen increased by more than sevenfold.

Emissions from fuel consumption (tCO_2e)

	2019	2020	2021	Change from 2020
Petrol for vehicles	31	38	52	38%
Diesel for vehicles	392	305	343	12%
Biodiesel for vehicles	1.1	0.80	0.89	12%
Diesel for generators	56	5.5	47	751%
Emissions from fuel combustion (scope 1)	**480**	**349**	**443**	**27%**
Emissions from production (scope 3)	**119**	**86**	**110**	**27%**
Emissions from rental cars (scope 3)	**82**	**64**	**61**	**-4.5%**
Emissions outside scopes	**78**	**55**	**61**	**12%**

Diesel generators are used to operate equipment which is located outside the grid and reserve power generators.

Emissions from fuel combustion for vehicles and equipment increased by 27% from 2020 and were 443 tCO_2e in 2021. Emissions from fuel combustion are categorised as direct emissions (scope 1). Emissions from production and transport of fuel needed for vehicles and equipment were 110 tCO_2e in 2021, an increase of 27% from 2020, and are categorised as indirect emissions (scope 3). Emissions from combustion of fossil fuel in rental cars for employees, as well as its production and transport, amounted to 61 tCO_2e, a reduction of 5%. These emissions fall under the category indirect emissions (scope 3).

Landsvirkjun has systematically used biodiesel in its operations, as its climate impact is more favourable than that of fossil fuel. Emissions from biodiesel were 62 tCO_2e, thereof 61 tonnes from biogenic carbon dioxide, which is not considered to increase greenhouse gases in the atmosphere and is categorised outside of scopes (according to the GHGP).

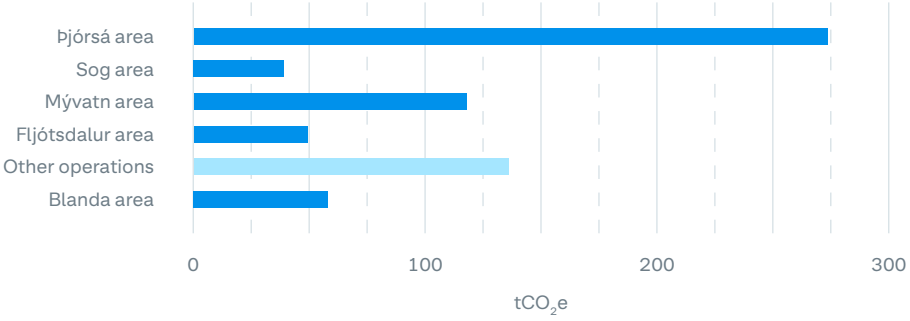
GHG emissions from the use of diesel oil in generators were 47 tCO_2e, a vast increase from the year before, or approximately 750%. The reason for the increase is mainly that accounting methods for emissions assume they are produced from the quantity of fuel purchased that year, but the difference may also be distorted by the nature of the use in motor generators and reserve power generators.

↓ Emissions from fossil fuel consumption for 2021, itemised by GHG types

	2021
Fossil carbon dioxide, CO_2 in tonnes	434
Methane, CH_4 in tonnes	0.20
Nitrous oxide, N_2O in tonnes	5.5
Biogenic carbon dioxide, CO_2 in tonnes	61
CH_4 and N_2O from combustion of biodiesel, CO_2e in tonnes	0.89

Separate itemisation of CH_4 and N_2O from combustion of biodiesel is not available, as emissions factors in the Company's calculations do not provide such itemisation.

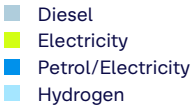
↓ Emissions from fuel consumption in Landsvirkjun's operating areas

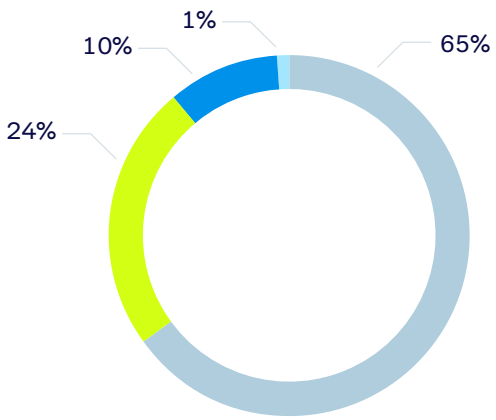


"Other operations" refer to operations which are not part of daily operations of Landsvirkjun's power stations, e.g., construction and research projects, as well as rental cars used by the Company in various projects.

Landsvirkjun's car fleet consisted of 103 cars in 2021, thereof 65% diesel cars, electric cars 24%, plug-in hybrids 10%, and hydrogen cars 1%. Thus, 35% of Landsvirkjun's car fleet was run on domestic source of energy, either partly or wholly. In comparison, the Company's car fleet consisted of 107 cars in 2020, of which 31% was run on domestic source of energy, either partly or wholly.

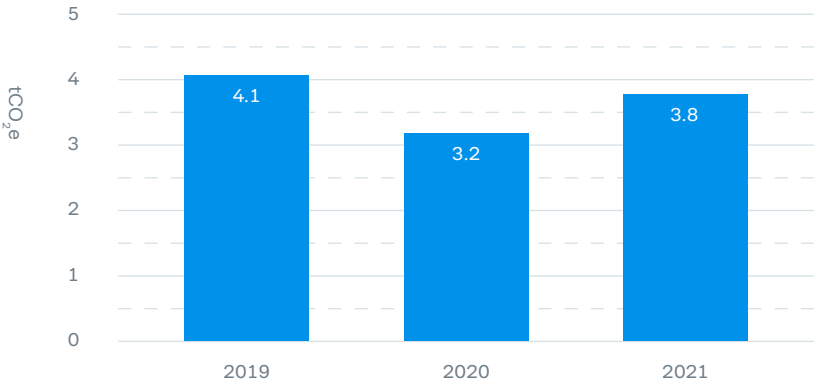
Landsvirkjun's car fleet





Average emissions per car in the car fleet were 3.8 tCO_2e in 2021, an increase from 2020 even though the ratio of cars running on domestic source of energy increased. This is mainly due to lower impact from COVID-19.

Average emissions per car in Landsvirkjun's car fleet (scope 1)



Emissions from fuel consumption vary between Landsvirkjun's operating areas. The highest fuel consumption is in the Company's largest operating area, Þjórsá area, containing seven hydropower stations and two wind turbine farms.

Electrical Equipment

Emissions from sulphur hexafluoride (SF_6) leaks from electrical equipment in the Þjórsá area and Fljótsdalur area were 4.5 kg in 2021. Due to SF_6 being a highly powerful greenhouse gas, these emissions are equal to 105 tCO_2e, an increase of 585% from 2020.

↓ Emissions from SF_6 leaks from electrical equipment (tCO_2e)

	2019	2020	2021	Change from 2020
Sulphur hexafluoride SF_6	192	15	105	585%

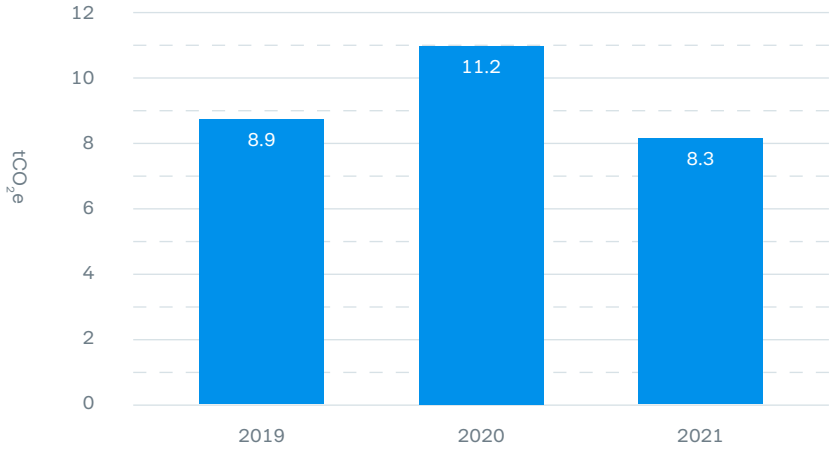
The reason for the considerable difference in emissions year on year, is that every few years the insulating medium sulphur hexafluoride (SF_6) must be added to the electrical equipment on account of a slow leakage of SF_6 from the equipment and the emissions are recorded in the year that the refuelling takes place. The supply and level of SF_6 are monitored, to provide overview of emissions.

Fljótsdalur area

Purchased Electricity and Heating

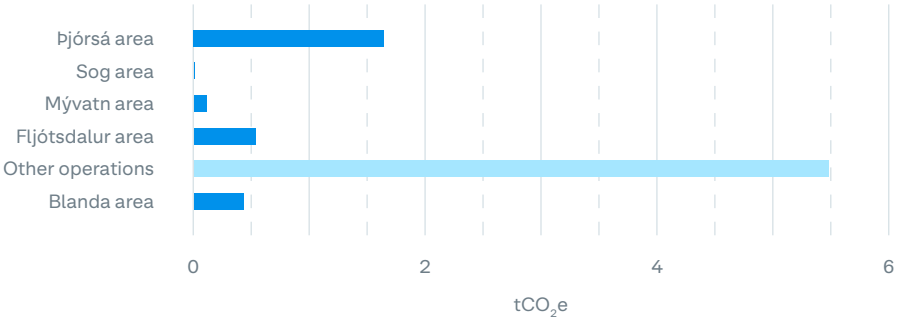
Emissions from purchased electricity and heating were 8.3 tCO_2e in 2021, a reduction of 26%.

↓ Emissions from purchased electricity and heating



Electricity usage varies between areas of operations, and fluctuates from year to year, in tune with Landsvirkjun's miscellaneous projects. A major portion of purchased electricity and heating is for office buildings and other smaller buildings, but purchased electricity and heating is only a small portion of Landsvirkjun's total energy use. The largest share of electricity used by Landsvirkjun is generated by the Company, see the chapter "Landsvirkjun's Electricity Generation".

↓ Emissions from purchased electricity and heating in Landsvirkjun's operations areas

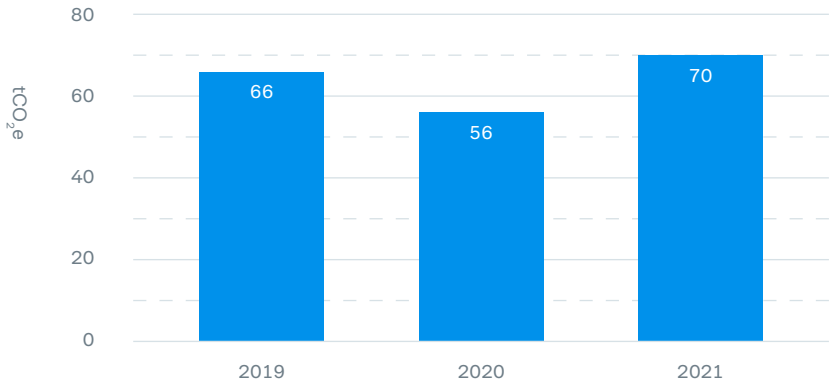


"Other operations" refer to operations which are not part of daily operations of Landsvirkjun's power stations, e.g., offices in Reykjavík and Akureyri.

Waste

Greenhouse gas emissions from processing waste, generated from Landsvirkjun's operations, were 70 tCO_2e in 2021, an increase of 25% from 2020. The proportion of sorted waste was 86% in 2021 but was 87% in 2020.

↓ Emissions from waste



↓ Proportion of sorted waste

	2019	2020	2021
Sorted waste	84%	87%	86%
Unsorted waste	16%	13%	14%

Total waste amounted to 249 tonnes in 2021, an increase of 6% year on year. The quantity of unsorted general waste increased by 17% from 2020. A noticeable fluctuation in the quantity of bulky and inert waste, metals, and wood in recent years is to a degree due to different levels of repair and maintenance projects undertaken each year. The increase in emissions year on year is mainly due to a large amount of disposed painted wood in 2021, an increase of 10 tonnes CO_2e, or 65%.

↓ Quantity of waste (in tonnes)

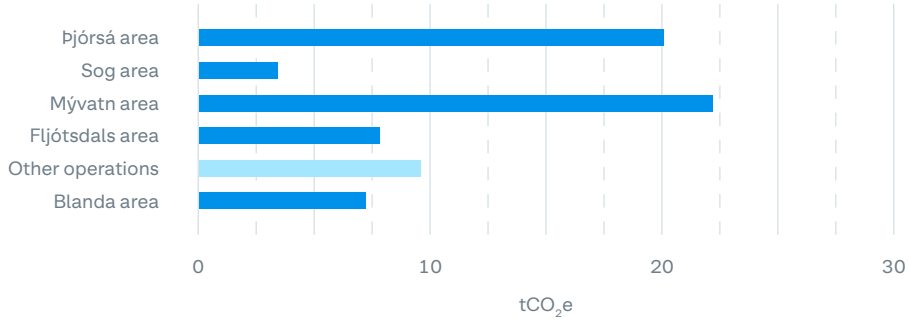
	2019	2020	2021	Change from 2020
General waste, unsorted	39	30	35	17%
Recyclable (paper)	15	23	17	-24%
Recyclable (plastics)	2.0	1.2	1.6	31%
Bulky waste	7.1	13	14	5.5%
Organic waste	18	32	27	-14%
Metals and scrap	109	57	94	63%
Inert waste (glass, soil, and rocks)	0	14	0.41	-97%
Electronic devices	0	4.7	3.8	-19%
Electronic devices (batteries)	0.021	0.13	0.037	-72%
Hazardous waste	11	28	12	-56%
Wood (painted)	27	18	30	65%
Wood (unpainted)	18	13	13	2.9%
Total	**246**	**234**	**249**	**6.3%**

Emissions from waste (tCO_2e)

	2019	2020	2021	Change from 2020
General waste, unsorted	34	26	31	17%
Recyclable (paper)	0.32	0.48	0.37	-24%
Recyclable (plastics)	0.043	0.026	0.034	31%
Bulky waste	3.3	6.2	6.6	5.5%
Organic waste	3.1	5.5	4.7	-14%
Metals and scrap	2.3	1.2	2.0	63%
Inert waste (glass, soil, rocks)	0	0.018	0.00051	-97%
Electronic devices	0	0.10	0.082	-19%
Electronic devices (batteries)	0.00044	0.0028	0.00079	-72%
Hazardous waste	0.23	0.59	0.26	-56%
Wood (painted)	22	15	25	65%
Wood (unpainted)	0.38	0.27	0.28	2.9%
Total	**66**	**56**	**70**	**25%**

In 2021, emissions from processing waste were greatest in the areas at Mývatn and Þjórsá. GHG emissions from waste differ between Landsvirkjun's various operations areas and are in part explained by number of repairs and maintenance projects in each area, at any given year. Further information on emissions from waste from the Company's larger construction projects can be found in the chapter "Construction projects".

Waste emissions from Landsvirkjun by operating areas



"Other operations" refer to operations which are not part of daily operations of Landsvirkjun's power stations, e.g., offices in Reykjavík and Akureyri.

Employee Air Travel

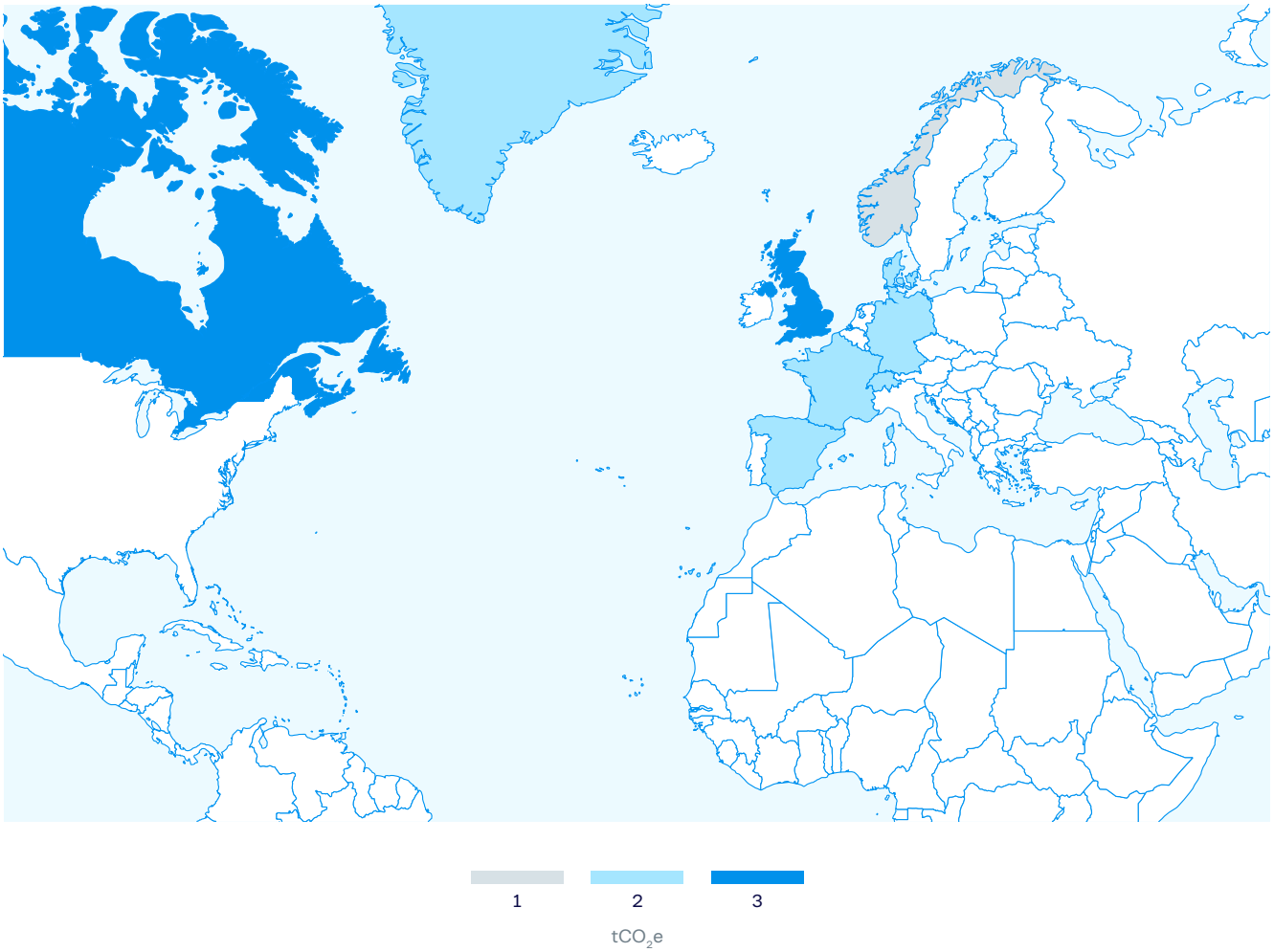
Employee air travel emissions were 81 tCO_2e in 2021, an increase of 26% from 2020. Emissions from international flights decreased by 43% from 2020, but emissions from domestic flights increased by 68%. However, emissions from employee air travel are still considerably lower than in 2019, before the pandemic started.

↓ Emissions from employee air travel (tCO_2e)

	2019	2020	2021	Change from 2020
International flights	158	24	14	-42%
Domestic flights	158	40	67	68%
Total	**315**	**64**	**81**	**27%**

Emissions from domestic flights increased year on year, due to a lower impact from COVID-19. However, the pandemic still impacted international air travel, which continued to decrease.

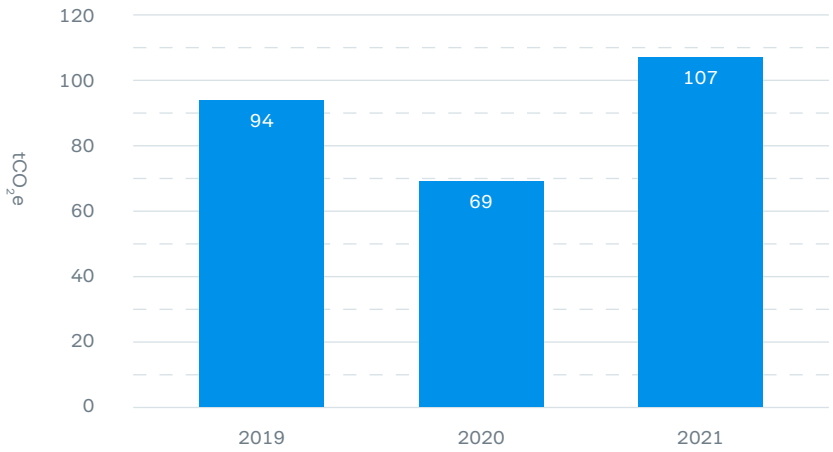
↓ Employee international air travel emissions by destination in 2021



Employee commute

Emissions from employee commute increased considerably year on year, or by approximately 55%. It is estimated that emissions from commute were 69 tCO_2e in 2020, but approximately 107 tCO_2e in 2021.

↓ Emissions from employee commute



Emissions from employee commute are estimated from a survey on commuting habits, sent to every employee and conducted annually. In 2021, Landsvirkjun conducted the survey inhouse for the first time, and estimated emissions. Previously the survey had been conducted by outside consultants. The Company's methodology was differed somewhat from that of the consultants, which in part explains the increase in recorded emissions. Furthermore, COVID-19 has affected employees' commuting habits and reduced carpooling on longer road trips, such as drives to power stations.

Fertiliser

Emissions from using fertiliser in land reclamation and afforestation were 1,295 tCO_2e in 2021, a decrease of 22% from 2020.

↓ Emissions from use of fertiliser (tCO_2e)

	2019	2020	2021	Change from 2020
Fertiliser	958	1,657	1,295	-22%

Purchases of fertiliser differ year on year, which can be explained by different projects being undertaken each year. It is not necessary to distribute the same amount of fertiliser every year, and the use of fertiliser ceases as the vegetation grows. In general, the carbon footprint from the type of fertilisers used in 2021 was lower than the ones used in 2020. Internal carbon fee is used when estimating offers for fertiliser purchases.

Electricity Distribution

Emissions from the insulating medium SF_6 when distributing electricity decreased by 15% from 2020 and were 1,875 tCO_2e in 2021.

↓ Emissions from SF_6 when distributing electricity (tCO_2e)

	2019	2020	2021	Change from 2020
Electricity distribution	1,434	2,262	1,929	-15%

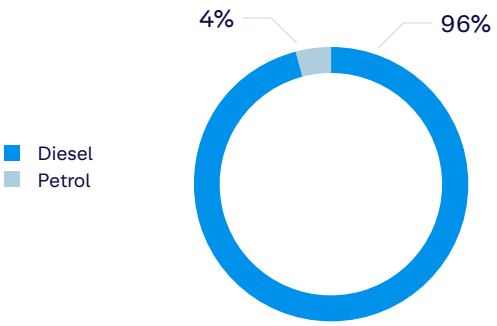
Emissions from electricity distribution are one of the largest indirect emissions factors from Landsvirkjun's operations. Information on emissions from electricity distribution comes from Landsnet.

Construction Projects

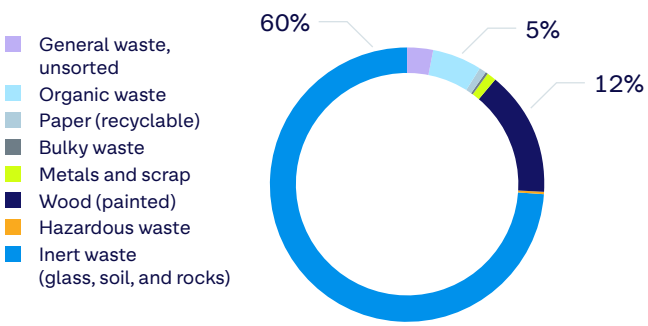
Emissions from fossil fuel combustion in Landsvirkjun's construction projects were 630 tCO_2e in 2021, a reduction of 37% year on year. Emissions from waste produced from the Company's construction projects were 13 tCO_2e in 2021, unchanged from 2020.

↓ Fossil fuel consumption and waste production during construction in 2021

	Quantity (litres)	Emissions (tCO_2e)
Fossil fuel	232,837	630



	Quantity (tonnes)	Emissions (tCO_2e)
Waste	81	13



Emissions from Landsvirkjun's construction projects

	2019	2020	2021	Change from 2020
Total emissions from construction projects	3.277	1.009	643	36%

Landsvirkjun accounts for emissions from fossil fuel combustion and waste processing during its construction projects. These emissions are categorised as scope 3. Emissions from various waste processing in different smaller repair and maintenance projects are counted with other waste produced from Landsvirkjun's operations, see the chapter "Waste".

Landsvirkjun continually strives to better account for emissions from the Company's construction projects. Emissions from construction projects in 2019 and 2020 were underestimated, when the calculations are based on the current methodology, thus, emissions are recorded higher now than in Climate Account 2020.

The main construction projects for 2021 were maintenance projects at power stations that are in operation, as well as the final construction phases of Búrfell II and Þeisatreykir power stations.

Landsvirkjun's main construction projects in 2021

- **Þeistareykjavegur syðri – road work**
- **Sultartangaskurður – maintenance**
- **Grjótárstífla – maintenance**
- **Þjófafoss – new footbridge**
- **Sporðöldulón – stone wall supporting the reservoir reinforced**
- **Krafla power station – drilling for injection borehole**
- **Búrfellsstöð II– sedimentary trap in gullies near Trjáviðarlækur**
- **Búrfellstöð II – construction completion and finishing**

Landsvirkjun has conducted life cycle assessments on five power stations and wind turbines (intended for research purposes at the lava field Hafið), where detailed information on emissions over their life cycle are available, including the construction phase.

Landsvirkjun's Life cycle assessments
Búrfell II power station
Þeistareykir power station
Búðarháls power station
Fljótsdalur power station
Blanda power station
Hafið wind farm

External Certification
Independent Limited Assurance Statement

Introduction and objectives of work
Bureau Veritas UK Limited ('Bureau Veritas') has been engaged by Landsvirkjun to provide limited assurance of its Greenhouse Gas (GHG) emissions data for inclusion in its Climate Account 2021 report ('the Report'). This Assurance Statement applies to the related information included within the scope of work described below.

Scope of Work
The scope of our work was limited to assurance over the following GHG information included within the Report for the period January 1st to December 31st 2021 ('the Selected Information'):

- Scope 1 emissions
- Scope 2 emissions (location-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 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 any verification of information relating to:

- Activities outside the defined verification period;
- Positional statements (expressions of opinion, belief, aim or future intention by Landsvirkjun) and statements of future commitment;
- Any other information included in the Report not listed in the Scope section above

This limited assurance engagement relies on a risk based selected sample of sustainability data and the associated limitations that this entails. The reliability of the reported data is dependent on the accuracy of metering and other production measurement arrangements employed at site level, not addressed as part of this assurance. 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 issued by the International Auditing and Assurance Standards Board.

Summary of work performed
As part of our independent verification, our work included:

1. Conducting interviews with relevant personnel and external Consultants 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. Reperforming a selection of aggregation calculations of the Selected Information;
8. Reperforming greenhouse gas emissions conversions calculations;
9. Comparing the Selected Information to the prior year amounts taking into consideration changes in business activities, acquisitions and disposals.

The scope of a limited assurance engagement is substantially less than for reasonable assurance both in terms of the risk assessment procedures and in performing the procedures to address the identified risks.

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

Verified 2008 GHG Emissions

Scope 1:	Scope 2 (Location-based):	Scope 3: 4,296 tonnes of CO_2e
40,249 tonnes of CO_2e Out of Scope (Biofuel and Biogenic emission from Hydropower reservoirs): 6,491 tonnes of CO_2e Total Scope 1 and Out of Scope: 46,740 tonnes of CO_2e	8.29 tonnes of CO_2e	Waste: 70 tonnes of CO_2e Business Travel: 81 tonnes of CO_2e Rental Cars: 61 tonnes of CO_2e Commuting: 107 tonnes of CO_2e Transmission and Distribution: 1,929 tonnes of CO_2e Fertilisers: 1,295 tonnes of CO_2e Construction (Fuel & Waste): 643 tonnes of CO_2e Production Fuel: 110 tonnes of CO_2e

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 certified[6] 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 and applicable legal and regulatory requirements.

Bureau Veritas has implemented and applies a Code of Ethics, which meets the requirements of the International Federation of Inspections Agencies (IFIA),[7] 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.
The assurance team for this work does not have any involvement in any other Bureau Veritas projects with Landsvirkjun.

Bureau Veritas UK Limited
London
07 March, 2022

6 Certificate available on request
7 International Federation of Inspection Agencies – Compliance Code – Third Edition

Independent Limited Assurance Statement

Introduction and objectives of work
Bureau Veritas UK Limited ('Bureau Veritas') has been engaged by Landsvirkjun (the 'Company') to provide a limited level of assurance over Sequestered Carbon data included within their Climate Accounts 2021 (the 'Report'). This Assurance Statement applies to the related information included within the scope of work described below.

Scope of Work
The scope of our work was limited to assurance over the sequestered carbon for the period January 1 to December 31 2021 as part of the following carbon sequestration projects split by land use category reported in tonnes of CO_2e (the 'Selected Information'):

Land reclamation

- Auðkúluheiði
- Þeistareykjaland
- Eyvindarstaðaheiði
- Jörundargrjót
- Dimmuborgir
- Fljótsdalsstöð
- Landbótasjóður Norður-Héraðs
- Landbótasjóður Fljótsdalshrepp
- Sporðöldulón
- Víkingslækur
- Hrútatorfur
- Þjórsársvæði
- Bolholt
- Kot-Steinkross
- Hólasandur
- Krárkárbotnar
- Krárkárbotnar og Katlar

Reforestation

- Búrfellsstöð
- Búrfell
- Bjarnalón
- Ljósafossstöð
- Blöndustöð
- Laxárstöð
- Belgsá
- Laxaborg
- Skarfanes
- Skálmholtshraun
- Steingrímsstöð
- Kaldárhöfði

Wetland reclamation

- Sogn í Ölfusi
- Ytri Hraundal
- Skálholt

Reporting criteria
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 Use[8] and the IPCC Guidance for Land Use Change and Forestry.[9]

Limitations and Exclusions
Our verification conclusion is subject to a number of limitations and exclusions.
The following limitations apply:

- 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 factor provided in year 2019 by the Natural Resources Conservation Service (NRCS) formerly known as the Soil Conservation Service (SCS) to the Company;
  - Growth rate projections of reforestation areas per year, provided by the following study commissioned by the Company to the Icelandic Forest Service experts: 'Önnur úttekt á kolefnisbindingu skógræktar á vegum Landsvirkjunar', 2017;
  - Carbon sequestration factor used for wetlands, provided by the Natural Resources Conservation Service (NRCS) to the Company, and based on IPCC's factors for rich boreal grassland and for rewetted area.

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;
- Positional statements (expressions of opinion, belief, aim or future intention by Landsvirkjun) and statements of future commitments;
- Any other information included in the Report not listed in the Scope section above, including the amount of carbon offset by the Company through the purchase of carbon funds.

This limited assurance engagement relies on a risk based selected sample of projects and the associated limitations that this entails. The reliability of the reported data is dependent on the accuracy of metering and other production measurement arrangements employed at site level, not addressed as part of this assurance. This independent statement should not be relied upon to detect all errors, omissions or misstatements that may exist.

8 Good Practice Guidance for Land Use
9 IPCC Guidance for Land Use Change and Forestry

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 verification, 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, estimation/extrapolation methodologies adopted for reporting, 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. Reperforming a selection of aggregation calculations of the Selected Information;
6. Comparing the Selected Information to the prior year amounts taking into consideration expansion of projects and changes in the internal methodology used for accounting carbon sequestered;

The scope of a limited assurance engagement is substantially less than for reasonable assurance both in terms of the risk assessment procedures and in performing the procedures to address the identified risks.

Conclusion
On the basis of our methodology and the activities 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 2021: 34,400 tonnes of CO_2e.
Total increase in Carbon Sequestration from 2020 to 2021: 2,400 tonnes of CO_2e.

Statement of Independence, Integrity and Competence
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The assurance team for this work does not have any involvement in any other Bureau Veritas projects with Landsvirkjun.

Bureau Veritas UK Limited
London
10 March, 2022

10 Certificate available on request
11 International Federation of Inspection Agencies – Compliance Code – Third Edition

Climate Account Methodology

Landsvirkjun is at the forefront of climate action and is an active participant in the international fight against climate change. Landsvirkjun uses 100% renewable energy for its electricity generation, with a negligible carbon footprint, the Company will be carbon neutral by 2025, and it adheres to an ambitious Climate Action Plan.[12] The Climate Action Plan is based on a thorough mapping of the Company's carbon footprint. Emphasis is placed on having information on the Company's emissions, monitoring results, and disclosing information on the climate impact from Landsvirkjun's operations, in a responsible manner.

Landsvirkjun monitors its greenhouse gas emissions in real time, which aids informed decision making, and continually analyses the results from measures and the status of targets. GHG emissions, carbon sequestration and carbon footprint are recorded annually in the Climate Account, where emissions factors from the Company's operations, changes in emissions and sequestration, and the status of targets, are minutely analysed. Landsvirkjun's Climate Account follows the methodology of the Greenhouse Gas Protocol (GHGP),[13] a leading international corporate standard for information disclosure on GHG emissions and carbon sequestration. The Company's Climate Account has been inspected and verified by an independent certification authority from 2018, and Landsvirkjun was the first company in Iceland to report outside certification for the Climate Account.

The subsequent discussion is an analysis of the methodology and the premises for which the Climate Account is based on.

Definition of Landsvirkjun's operational boundaries

Landsvirkjun's Climate Account encompasses the Company's total operations, including that of its subsidiaries, directly under the Company's management, i.e., Landsvirkjun Power and Icelandic Power Insurance. Companies, where Landsvirkjun is a partial owner but has no direct control over, are not included in the Climate Account.

Greenhouse gases in Landsvirkjun's operations

Landsvirkjun's operations produce the following greenhouse gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), as well as sulphur hexafluoride (SF_6).

CO_2	Landsvirkjun's operations produce carbon dioxide mainly through fossil fuel combustion and decomposition of organic matter in reservoirs, but carbon dioxide is also geothermal gas. CO_2 emissions are quoted as carbon dioxide equivalent (CO_2e).
CH_4	Methane is produced by Landsvirkjun's operations through the decomposition of organic matter in reservoirs, landfill waste disposal, and fossil fuel combustion. CH_4 is also a geothermal gas. As a greenhouse gas, methane is 28 times more powerful than carbon dioxide.
N_2O	Nitrous oxide is produced by Landsvirkjun's operations through fossil fuel combustion and the use of fertilisers. As a greenhouse gas, nitrous dioxide is 265 times more powerful than carbon dioxide.
SF_6	Sulphur hexafluoride is a manmade gas used as an insulating medium for electrical equipment. SF_6 can be released into the atmosphere by leakage from electrical equipment used by Landsvirkjun and Landsnet. As a greenhouse gas, sulphur hexafluoride is 23,500 times more powerful than carbon dioxide.

12 Climate Action Plan. Landsvirkjun, 2021.
13 The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard Revised Edition. World Resources Institute og World Business Council for Sustainable Development, 2004.

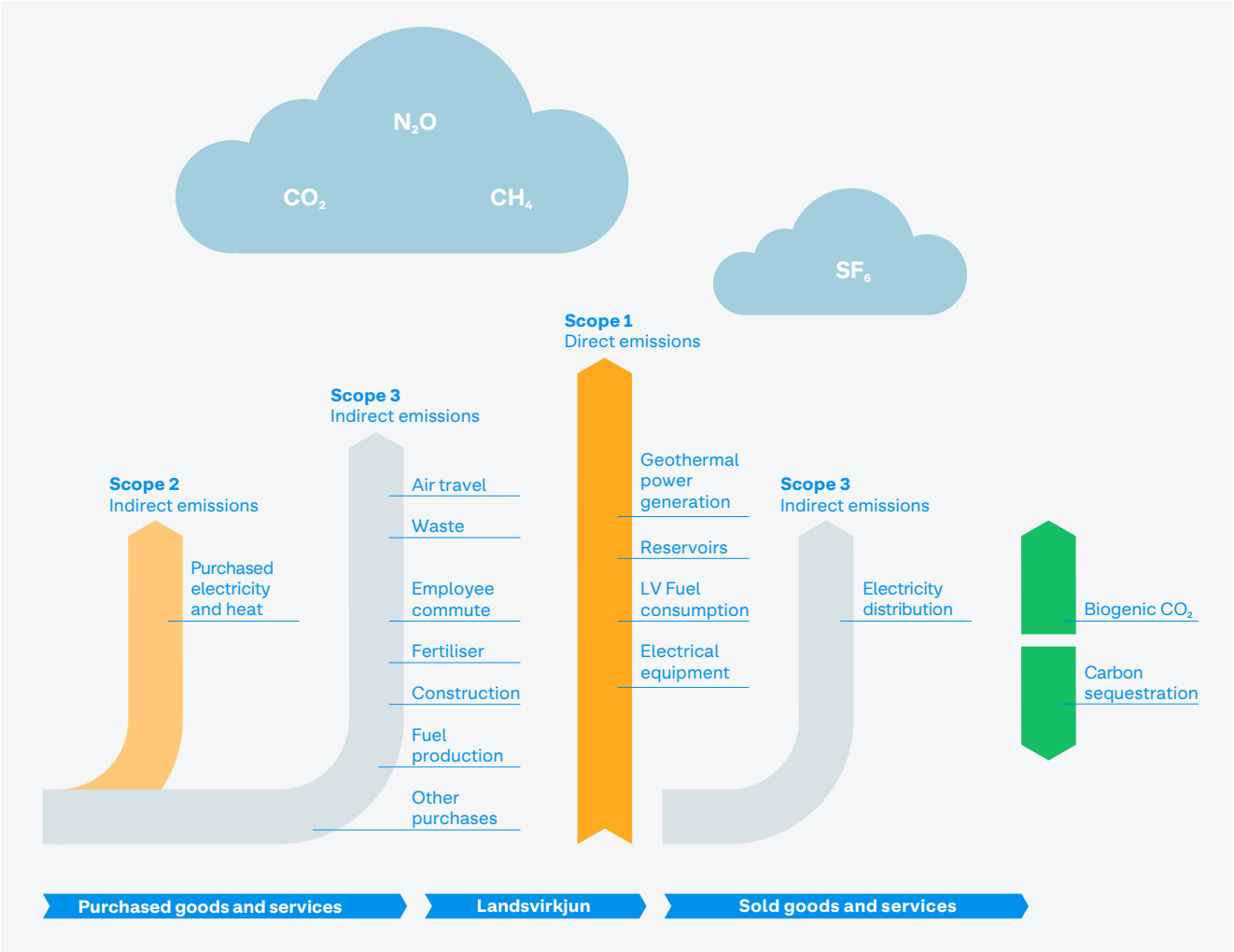
Scopes of Landsvirkjun's operations
'Scopes of operations' refer to the definition of the factors that produce Landsvirkjun's greenhouse gas emissions. The scope can either be 'direct emissions' (scope 1), or 'indirect emissions' (scope 2 and 3), in accordance with the definitions by the GHGP.

Scope 1 includes emissions that the Company is directly responsible for, i.e., emissions from operations it controls. If Landsvirkjun decides to reduce emissions under scope 1, i.e., by stopping using fossil fuel, or if equipment is installed to capture carbon dioxide from geothermal fluid, this would directly lead to reduced emissions.

Scope 2 includes emissions from electricity generation and geothermal water, which is purchased. **Scope 3** includes emissions from production of other goods or services, which the Company's uses or sends for disposal (waste). Landsvirkjun can impact how various products purchased are used within the Company, but it cannot control the production, service, or disposal. Emissions in scope 2 and 3 occur in operations by a third party and are not under the control of Landsvirkjun. On the other hand, the Company chooses with whom it does business, and can set criteria for climate issues for its suppliers and service providers, thus, indirectly benefitting lower emissions.

In accordance with the GHGP methodology, biogenic carbon dioxide emissions, e.g., emissions from biodiesel combustion, are categorised **outside of scopes**.

↓ **Landsvirkjun's emissions factors categorised by scopes**



Grounds for different scopes

If Landsvirkjun would only assess and disclose information on direct emissions from the Company (scope 1), only emissions from geothermal power generation, reservoirs, combustion from own vehicles, and emissions of sulphur hexafluoride (SF_6) from own electrical equipment would be accounted for. This would mean that other emissions in the value chain, such as from suppliers and service providers, would not be accounted for in Landsvirkjun's Climate Account. Hence, no motivation would be in place to sort waste or reduce air travel, and emissions could be reduced by using rental cars instead of cars owned by the Company. This would result in a Climate Account that stated lower emissions, nevertheless, emissions would not be lower.

By disclosing information on emissions in scope 2 and 3, Landsvirkjun not only shoulders responsibility for the Company's direct emissions but all emissions from the value chain, creating a clear perspective of its total GHG emissions. Thus, creating a motivation to be selective when suppliers are chosen, while encouraging other companies in Landsvirkjun's value chain to make improvements.

Certification Body's Assurance Statement

Landsvirkjun's emissions which are categorised in scope 1, 2, and 3, in accordance with the GHGP, have been reviewed and verified by Bureau Veritas, one of the leading international certification bodies, for 2018 to 2020, in accordance with the international standard ISAE-3000, with limited assurance. The carbon sequestration in the Company's projects for 2020 has been reviewed and verified in accordance with the same standard. In 2021, both emissions and carbon sequestration have been reviewed and verified in accordance with ISO 14064-3, with limited assurance. Thus, Landsvirkjun ensures that its findings are in accordance with emissions from its operations. Furthermore, Bureau Veritas has reviewed and verified direct emissions (scope 1) in 2008, in accordance with ISAE 3000, with limited assurance. Landsvirkjun uses 2008 as base year for target reduction and the verification positively confirms that the Company has reduced its emissions.

Bureau Veritas' verification on emissions and carbon sequestration and suggestions for improvement support the Company journey towards carbon neutrality and are a major factor in achieving a verification for carbon neutrality in 2025.

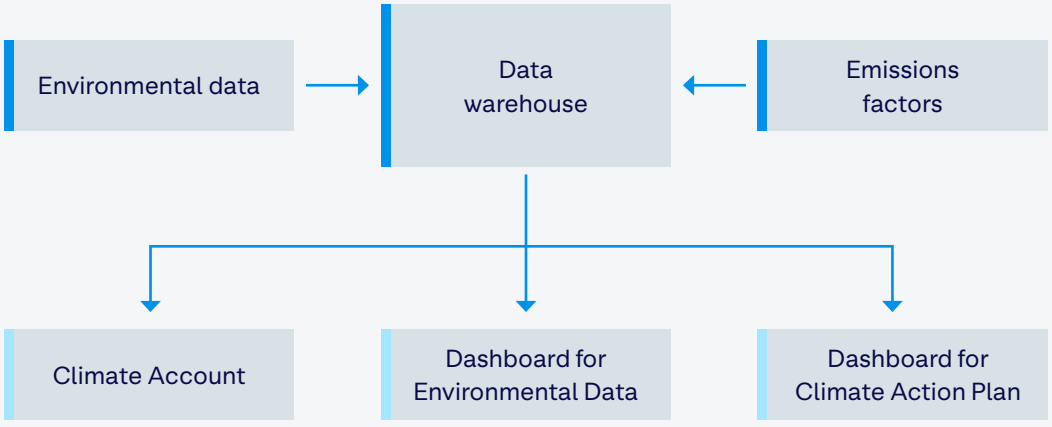
Further information on verifications on GHG emissions and carbon sequestration in Landsvirkjun's operations are in Bureau Veritas' Independent Limited Assurance Statement, which is included in each year's Climate Account.

Data Collection and Analysis

Landsvirkjun follows a clear and concise procedure to ensure data quality in the Climate Account. The data (environmental data and emissions factors) are entered into a data base, a so-called data warehouse. The data are either automatically inputted from the Company's accounting system and directly from suppliers, or manually entered from the information gathered. Further details for the data used in the Climate Account and how the information is gathered can be found in the chapter "Calculations for emissions by sources".

The data are published in the Dashboard for Environmental Data, with a convenient user interface, where environmental progress and other information are available, in real time. Target reaching in accordance with the Climate Action Plan is monitored on the Dashboard for Climate Action Plan, published at Landsvirkjun's website.[14]

↓ Model for Environmental Data



14 Dashboard for Climate Action Plan. Landsvirkjun, 2021.

Carbon Footprint Calculations

Landsvirkjun's carbon footprint reports total annual greenhouse gas emissions from the Company's operations, calculated in accordance with the GHGP methodology, minus annual carbon sequestration' projects. Emissions outside of scopes are included in the Company's total emissions.

Carbon footprint = total GHG emissions – sequestered carbon

Emissions of biogenic CO_2 are included in Landsvirkjun's total GHG emissions. However, according to the GHGP methodology, these emissions fall outside of scopes, and are usually not included in the companies' carbon footprint, as they are generally not considered to contribute to increased greenhouse effects. Best practises for assessing companies' carbon footprint[15] dictate that biogenic emissions of CO_2 are to be accounted for in the carbon footprint and Landsvirkjun follows that lead.

15 The Net-Zero Standard. Science Based Targets initiative, 2021.

Calculations for Emissions by Sources

Geothermal energy
When geothermal energy is used to generate electricity in high temperature areas, the geothermal fluid is extracted through boreholes from a geothermal reservoir, at approximately 2000 m depth. The geothermal fluid contains, e.g., the greenhouse gases carbon dioxide and methane, which are emitted into the atmosphere after the geothermal fluids have been used. Emissions are calculated from each borehole at geothermal power stations and the boreholes are categorised either as in production or exhausting. Every year, a chemical analysis is performed on all producing boreholes, to get an indication of the level of greenhouse gases in the geothermal fluid. The borehole's flow measurement is conducted monthly, revealing the total production volume from each borehole. The level of greenhouse gas in each borehole is multiplied by the total volume of geothermal fluids (steam and brine) extracted through the borehole, providing information on GHG emissions from the geothermal energy generation. Appropriate emissions factor is used to convert methane emissions to CO_2e. Emissions from geothermal power generation are direct emissions and are included in scope 1.

↓ Emissions factor for methane

	Emissions factor (gCO_2e/g)	Source
Methane (CH_4)	28	IPCC, 2013[16]

Emissions factors can change between years on account of new information or updated methodology. Landsvirkjun always uses the most recent emissions factors in the Climate Account each year. When emissions factors change, calculations from prior years are updated accordingly, to ensure that base numbers are correct for comparison year on year.

16 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.

Hydropower

When reservoirs are formed, vegetation and soil are submerged and consequently decomposes. When organic matter decomposes, the greenhouse gases carbon dioxide, methane and nitrous oxide are produced. The number of emissions depends mostly on the total amount of organic matter in the soil and the vegetation submerged each time, thus the number of emissions varies between reservoirs. In Iceland, measurements have not revealed emissions of nitrous oxide, thus, no nitrous oxide emissions have been recorded in Landsvirkjun's Climate Account, just as in Iceland's National Inventory Report (NIR).[17]

Instructions from IPCC[18] are used when calculating greenhouse gas emissions from Landsvirkjun's hydropower stations' reservoirs, just as in Iceland's NIR. No carbon dioxide is accounted for when the reservoirs are under ice, as the temperature of the water is too low for microbial activity, thus, gassing is negligible.

The ice covers of the reservoirs at Blanda power station and Fljótsdalur power station are monitored, and days without ice are recorded. At other reservoirs, where very little organic matter was submerged, the number of days without ice are not recorded specifically, but the criteria is 215 days each year. Emissions of carbon dioxide and methane from reservoirs are calculated by using specific emissions factors, which are compiled by specialists at the Agricultural University of Iceland and are based on multiple research and peer-reviewed articles.[19]

↓ Emissions factors for Landsvirkjun's reservoirs

Reservoir	CO_2 w/o ice ($kgCO_2/ha*d$)	CO_2 ice ($kgCO_2/ha*d$)	CH_4 w/o ice ($kgCH_4/ha*d$)	CH_4 ice ($kgCH_4/ha*d$)
Þórisvatnsmiðlun	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
Þjórsárlón	0.162	0	0.0065	0.000052
Sultartangalón	0.083	0	0.0033	0
Hálslón	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
Sporöldulón 1	0.162	0	0.0065	0.000052
Sporöldulón 2	2.11	0	0.085	0.0018

17 Losun frá lónum, samantekt á niðurstöðum rannsókna og stöðu þekkingar (Emissions from Reservoirs, a Summary of Research and State of Knowledge). EFLA Consulting Engineers, 2021.
18 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4. IPCC, 2006.
19 Losun frá lónum, samantekt á niðurstöðum rannsókna og stöðu þekkingar (Emissions from Reservoirs, a Summary of Research and State of Knowledge). EFLA Consulting Engineers, 2021.

It is not yet known how much of the biogenic carbon, which degrades when vegetation and soil are submerged, is released into the atmosphere and how much is sequestered in the reservoir. Until this information is available, Landsvirkjun accounts for the total amount to be emitted into the atmosphere.

According to the GHGP methodology, methane emissions from reservoirs are included in scope 1, but carbon dioxide emissions are outside of scopes, as the vegetation absorbs the same amount of carbon dioxide, as is emitted during degradation.

Fuel consumption

Landsvirkjun uses fuel for own vehicles and other equipment, power generators, reserve power generators and rental cars. Greenhouse gas emissions occur during fuel combustion (scope 1), but also during its production and transport (scope 3). Landsvirkjun keeps detailed records of purchased and used fuel. Emissions are calculated per litre of fuel in accordance with appropriate emissions factors, in addition to calculating emissions from each vehicle, motors and machinery.

↓ Emissions factors for fuel consumption

Fuel type	Scope	Emissions factor ($kgCO_2e/L$)	Source
Diesel	1	2.72	UST, 2021[20]
Diesel	3	0.62874	DEFRA, 2021[21]
Petrol	1	2.34	UST, 2021[20]
Petrol	3	0.60283	DEFRA, 2021[21]
Biodiesel	1	0.03558	DEFRA 2021[21]
Biodiesel	3	0.2132	DEFRA, 2021[21]
Biodiesel	Outside of scopes	2.43	DEFRA, 2021[21]
Hydrogen	3	1.78	Zhao o.fl., 2018[22]

↓ Emissions factors for fuel consumption itemised by GHG types

Fuel type	Diesel	Petrol	Biodiesel	Source
Carbon dioxide ($kgCO_2/L$)	2.66807	2.32567	-	DEFRA, 2021[21]
Methane ($kgCH_4/L$)	0.00026	0.00732	-	DEFRA, 2021[21]
Nitrous dioxide (kgN_2O/L)	0.03720	0.00671	-	DEFRA, 2021[21]
Biogenic carbon dioxide ($kgCO_2/L$)	-	-	2.43	DEFRA, 2021[21]
Methane and nitrous dioxide ($kgCO_2e/L$)	-	-	0.03558	DEFRA, 2021[21]

The set of emissions factors from DEFRA does not separate emissions of methane and nitrous dioxide from biodiesel combustion, thus, these emissions are in the form of CO_2e.

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 CO_2 are outside of scopes. Emissions from production and transportation of all fuel types are included in scope 3.

20 Losunarstuðlar (Emissions Factors). The Environment Agency of Iceland, 2021.
21 Greenhouse gas reporting: conversion factors 2021. DEFRA, 2021.
22 Zhao, Pedersen. Life Cycle Assessment of Hydrogen Production and Consumption in an Isolated Territory. Procedia CIRP, 69, 529-533, 2018.

Electrical equipment

Every few years the insulating medium sulphur hexafluoride (SF_6) must be added to the electrical equipment on account of a slow leakage of SF_6 from the equipment. The quantity and level of SF_6 are monitored, to provide overview of emissions due to leakage from SF_6. The appropriate emissions factor is used to convert emissions into CO_2e. Emissions of SF_6 leakages from the Company's electrical equipment are included in scope 1.

↓ Emissions factor for SF_6

	Emissions factor (gCO_2e/g)	Source
Sulphur hexafluoride (SF_6)	23,500	IPCC, 2013[23]

Purchased electricity and heating

Emissions from purchased electricity and heating, used in the Company's operations, are calculated based on purchased amount as stated on the relevant invoices. This is done by multiplying the amount of electricity and heating with the emissions factors, which are issued by the Environment Agency of Iceland and based on average emissions from energy generation in Iceland. These emissions are included in scope 2.

↓ Emissions factors for electricity and heating

Type	Emissions factors (gCO_2e/kWh)	Source
Electricity	10.5	UST, 2021[24]
Heating	0	UST, 2021[24]

The Environment Agency of Iceland records combined emissions from geothermal power, i.e., from generating electricity and heating. Therefore, emissions from heating are recorded as nil.
In the Climate Account 2021 the emissions factors for electricity and heating are from 2020, as the Environment Agency of Iceland has not updated emissions factors for 2021.

23 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.
24 Losunarstuðlar (Emissions Factors). The Environment Agency of Iceland, 2021..

Waste

Waste generated from Landsvirkjun's operations is sorted and the quantity recorded. Information on the quantity of waste from Landsvirkjun is gathered either from invoices or through data link connection with service providers. Information on waste disposal is gathered from suppliers. Emissions from waste disposal are calculated by multiplying the quantity of waste with the appropriate emissions factors. These emissions are included in scope 3.

↓ Emissions factors for waste

Types of waste	Emissions factor ($kgCO_2e/t$)	Source
General waste, unsorted	880	UST, 2021[25]
Bulky waste	467.046	DEFRA, 2021[26]
Inert waste (glass, soil, and rocks)	1.239	DEFRA, 2021[26]
Organic waste	172	UST, 2021[25]
Metals and scrap	21.294	DEFRA, 2021[26]
Other electronic equipment	21.294	DEFRA, 2021[26]
Batteries	21.294	DEFRA, 2021[26]
Paper (recyclable)	21.294	DEFRA, 2021[26]
Plastic (recyclable)	21.294	DEFRA, 2021[26]
Hazardous waste	21.294	DEFRA, 2021[26]
Wood (unpainted)	21.294	DEFRA, 2021[26]
Wood (painted)	828.032	DEFRA, 2021[26]

Employee air travel

Landsvirkjun keeps a record on the number of flights made by employees, including point of departure and arrival for each flight.

Calculations on emissions due to employee domestic air travel use emissions factors which were made by a consultant and are based on recent findings from research on airplane emissions. Emissions are calculated on each seat-kilometre and are variable depending on the length of flights and the airplane type. Thus, shorter flights in airplanes with few passengers produce higher emissions per seat-kilometre than airplanes on longer routes with more passengers. The impact of distance per seat-kilometre is explained by high emissions during take-off and landing, but these emissions are not affected by the length of the flight.

Emissions from international flights are automatically included in invoices from Landsvirkjun's travel agency and are based on the ICAO carbon calculator.[27]

Emissions due to employee air travel is included in scope 3.

25 Losunarstuðlar (Emissions Factors). The Environment Agency of Iceland, 2021.
26 Greenhouse gas reporting: conversion factors 2021. DEFRA, 2021.
27 ICAO Carbon Emissions Calculator. ICAO, 2016.

Employee commute

Greenhouse gas emissions due to employee commute is estimated from a survey on commuting habits, which is sent to every employee annually. In the survey the employees are asked, e.g., how they commute, the commuting distance and number of days working from home. The number of commuting trips annually is calculated by deducting the number of days working 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 number of trips with the distance between home and the workplace and the appropriate emissions factor. Average emissions due to commute from the employees that answer the survey are multiplied by the total number of employees working full time at the Company. Emissions due to employee commute is included in scope 3.

↓ Emissions factors for employee commute

Transportation	Emissions factors (gCO_2e/km)	Source
Private vehicle – electric	0	UST, 2021[28]
Private vehicle – petrol	208	UST, 2021[28]
Private vehicle – diesel	191	UST, 2021[28]
Private vehicle – hybrid	137	UST, 2021[28]
Private vehicle – methane	2.3	UST, 2021[28]
Motorbike	96	UST, 2021[28]
Bus*	49	-

*Emissions factor from bus travel is estimated from real numbers of fuel consumption and the distance driven by the bus, as reported by the public bus transportation company Strætó, in its annual report 2020.[29] Landsvirkjun's calculations assume an average bus trip to include twenty passengers.

Fertiliser

Landsvirkjun purchases inorganic fertiliser, which is used, e.g., for land reclamation, afforestation, fields, and gardens, as well as general care for areas surrounding the Company's power stations. The Company's and its associated partners' fertiliser purchases are recorded. Prior to purchases being made, information on emissions from production, transport and the use of the fertiliser is requested. If the manufacturer of the fertiliser does not have this information, emissions from similar fertiliser are assessed, or average emissions factors used. This information is used to calculate emissions from fertiliser use. Emissions from fertiliser use are included in scope 3.

28 Losunarstuðlar (Emissions Factors). The Environment Agency of Iceland, 2021.
29 Annual Report 2020. Strætó, 2020.

Electricity distribution

Sulphur hexafluoride (SF_6) is used for insulation purposes in power stations' substations for Landsnet's transmission system. Reports on SF_6 leakages from Landsnet's operations are requested annually. Landsvirkjun's emissions from electricity distribution are calculated by multiplying Landsnet's total SF_6 emissions with Landvirkjun's portion of distributed electricity in Landsnet's transmission system, as published annually by the National Energy Authority. To convert emissions into CO_2e, the appropriate emissions factor is applied. Emissions from electricity distribution are included in scope 3.

↓ Emissions factor for SF_6

	Emissions factor (gCO_2e/g)	Source
Sulphur hexafluoride (SF_6)	23,500	IPCC, 2013[30]

Construction

Contractors in any of Landsvirkjun's major earthworks projects provide information on the quantity of waste and fuel consumption during the projects. Emissions are calculated by multiplying the quantity of waste and fuel consumption with the appropriate emissions factors. Same emissions factors are applied in calculations for fuel consumption and the quantity of waste during construction projects as is applied for Landsvirkjun's operations. Emissions due to Landsvirkjun's constructions are included in scope 3.

30 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.

Calculations on Carbon Sequestration

Carbon sequestration is assessed in areas where measures in land reclamation, afforestation and wetland reclamation have been implemented, either by Landsvirkjun or in collaboration with the Company. Land reclamation, afforestation, and wetlands restoration are in part countermeasures due to constructions, land improvements in the vicinity of the Company's power stations, and the newly launched project aimed at carbon sequestration in soil and vegetation.

An assessment of carbon sequestration in land reclamation and afforestation projects is conducted by the Soil Conservation Service of Iceland and the Icelandic Forest Service. The Icelandic Forest Service assessed carbon sequestration in Landsvirkjun's afforestation projects for the first time in 2011[31] and in 2016,[32] these findings are in the Climate Account. The Soil Conservation of Iceland also conducted an assessment on carbon sequestration for the first time in 2011. However, the findings have not been made public. Where wetland has been reclaimed to reduce emissions, an estimate using an emissions factor has revealed that these measures will lead to an annual reduction of 20 tonnes CO_2e per hectare, as advised by the Soil Conservation Service of Iceland. The institution's approach is based on IPCC's methodology.[33]

Land reclamation projects, with carbon sequestration as a main objective, are located at Rangárvellir and Hólasandur. Similar afforestation projects are located at Eiðsstaðir, in the vicinity of Blanda power station, at Belgsá in Fnjóskadalur, at Laxaborg in Haukadalur, at Skarfanes in Landsveit, and at Skálmholtshraun in Flóahreppur. Furthermore, wetlands have been restored at Sogn in Ölfus and Ytri-Hraundalur at Mýrar and at Skálholt.

31 Úttekt á kolefnisbindingu skógræktar á svæðum í eigu Landsvirkjunar (Assessment of Carbon Sequestration in Landsvirkjun's Afforestation Projects). The Icelandic Forest Service, 2012.
32 Önnur úttekt á kolefnisbindingu skógræktar á vegum Landsvirkjunar (Second Assessment of Carbon Sequestration in Landsvirkjun's Afforestation Projects). The Icelandic Forest Service, 2017.
33 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. IPCC, 2014.