



Summary 2013

Landsvirkjun operates according to an ISO 14001 certified Environmental Management System. The Company is committed to environmental leadership in all its business activities and to preventing any negative impact that might come as a direct result of its operations.

Blanda meets 'Proven Best Practice'

- > In 2013, an assessment was carried out on operations at the Blanda Hydropower Station, in accordance with the Hydropower Sustainability Assessment Protocol (HSAP).
- > The results of the assessment show that Blanda meets 'Proven Best Practice' on 14 out of 17 topics assessed, using the Protocol. Blanda exceeds 'Basic Good Practice' on all 3 remaining topics, each of these with only one significant gap against 'Proven Best Practice'.
- > The assessment was carried out by three international experts. The assessment was comprehensive and included interviews with Landsvirkjun employees and over 30 individual representatives from the various stakeholder groups: agencies, municipalities, companies and organizations.

One environmental incident this year

- > Landsvirkjun is committed to operating without environmental incident. In 2013, there was one environmental incident during road construction in the Þeistareykir area. Fifty litres of oil leaked from a road grader onto the road area. There was no danger of pollution entering the groundwater or surface water in the area.

The utilisation of natural resources

Hydropower – total electricity generation in 2013 was 12,337 GWh

- > In 2013, 12,337 GWh of electricity was generated utilising hydropower. Hydropower accounts for approx. 96% of Landsvirkjun's total electricity generation. Meteorological conditions are a key factor in hydropower as the natural water cycle is utilised to generate electricity. Hydropower stations are operated with the aim of utilising the natural resource in the most efficient manner

possible. This is mainly achieved by steering the water flow. Landsvirkjun also conducts extensive research on glaciers including any long-term changes and ablation.

- > In 2013, the water supply for the reservoirs was unlike that of previous years and the water supply for the generation of electricity was therefore less. Reservoir levels were low during the spring and the summer was cold and dry. Approximately 600 GJ (approx. 13%) of water was needed to fulfil the Company's needs and the remainder of the year proved to be difficult as a result of the reduced water supply. There was therefore minimum spillover.
- > The energy generation sector in Iceland is an isolated one and is not connected to any other systems. It is therefore of utmost importance that the water reserve in the reservoirs is substantial enough to ensure a secure supply of electricity. The water supply is, on average, 10% more than energy generation. Subsequently, 10% of the water supply to the reservoirs flows past the power stations and is not utilised for power generation. This has been the case for 15 years of the 17 years that have passed.
- > Landsvirkjun monitors aspects that could affect erosion and sedimentation in the affected areas of the power stations. Erosion mitigation measures have been taken on the eastern coast of the Hálslón Storage Reservoir. Sand encroachment first became an issue in the area in 2013 and these mitigation measures proved successful.

Geothermal energy – total electricity generation in 2013 was 500.5 GWh

- > In 2013, 500.5 GWh of electricity was generated from geothermal energy. Geothermal energy accounts for approx. 4% of Landsvirkjun's total electricity generation. Geothermal fluid, a blend of steam and water, was utilised for the process. Approximately 5,634 thousand tonnes of steam were utilised to generate 500 GWh of electricity and the process produced 5,190 thousand tonnes of condensed and separated water.

- > The re-injection of separated water can support the efficient utilisation of the geothermal system. Re-injection reduces the quantity of contaminating compounds, e.g. heavy metals released into surface waters. In 2013, 3,067 thousand tonnes were re-injected back into the geothermal reservoir.
- > Figures for the research drilling carried out at Þeistareykir by the company Þeistareykir ehf. are included in the carbon accounts, for the first time this year, as the company is now fully owned by Landsvirkjun. In 2013, the scope of research drilling in the area was much less than that of previous years.
- > Monitoring in the Mývatn and the Kelduhverfi area between 2012 and 2013 showed no extensive changes to geothermal activity when compared with previous years. Results on the monitoring of solutes in groundwater between 1997 and 2013 show that water in springs by Mývatn and in the groundwater to the west of the Námafjall Mountain has not been affected by the geothermal water from the Bjarnarflag or Krafla Stations with regard to the concentration of arsenic and aluminium. The concentration of mercury is under or at the detection limit and well within the environmental limits at all monitoring stations and the concentration of arsenic was below environmental limits at the monitoring stations in Langivogur and Vogafloi in 2012 and 2013.

Fresh winds – total electricity generation in 2013 was 5.5 GWh

- > In 2013, Landsvirkjun erected two wind turbines in the Hafið area, to the north of Búrfell, for research purposes. Their combined capacity is 5.5 GWh or approx. 0.04% of Landsvirkjun's total generation capacity.
- > The wind turbines have been successfully operated since the end of January, 2013 and the results indicate that Hafið is an unusually advantageous area for electricity generation via wind power.

Fossil fuel consumption

- > Diesel consumption increased in the proportional division of the consumption of fossil fuels by Landsvirkjun in 2013 and accounted for 96% of consumption compared with 90% in previous years. The number of petrol run vehicles has decreased and petrol consumption has therefore decreased by 4% this year.
- > Landsvirkjun's total consumption of fossil fuels (diesel and petrol) increased by 7% in 2013. This is mostly due to the operations of the Project Planning and Construction Division and the Research and Development Division which varies between years according to the number and scale of projects.
- > Changes to consumption levels at the power stations between years have not been significant. However, the amount of diesel oil consumption has increased slightly when compared with that of the previous year.

Emissions, effluents and waste

Sorting of waste materials

- > Approximately 276 tonnes of waste were sent away for recycling or reuse, approx. 35 tonnes were sent away for disposal (mostly landfilled) and approx. 6 tonnes of hazardous materials were sent away for disposal.

Greenhouse gas emissions reduced between years

- > The largest source of greenhouse gas (GHG) emissions can be traced to Landsvirkjun's geothermal power stations which account for 68% of emissions. The reservoirs at the Company's hydropower stations account for 30% and another 2% is caused by the burning of fossil fuels, air travel and waste disposal.
- > The total quantity of GHG emissions from Landsvirkjun's operations in 2013 was approx. 49 thousand tonnes CO₂ equivalent. This is 12% less than in 2012 and 20% less than in 2009.
- > Landsvirkjun has been involved in the extensive land reclamation and re-forestation of the areas surrounding their power stations for over forty years and estimates the total carbon binding to be 22,000 tonnes CO₂ eq per year. Landsvirkjun has worked in cooperation with the Iceland Forest service and the Soil Conservation Society of Iceland on carbon binding projects. An agreement was reached with Kolviður, in 2013, on the neutralisation of all carbon emissions as a result of Landsvirkjun's use of petrol and diesel for transportation purposes, the international and domestic air travel of employees and finally the disposal of waste. These emissions were equal to approx. 1,027 tonnes of CO₂-eq and have now been neutralised via carbon binding in the forested areas of the country.
- > Landsvirkjun's carbon footprint was estimated to be approx. 26 thousand tonnes CO₂ equivalent in 2013 (including carbon binding measures). The Company's carbon footprint has decreased by 22% since 2012 and by 33% since 2009.
- > Greenhouse gas emissions (GHG) from Landsvirkjun's operations in 2013 were approx. 3.7 tonnes CO₂-eq/GWh if carbon binding is not in-

cluded. Emissions are 1.9 tonnes CO₂-eq/GWh if carbon binding is included. Landsvirkjun's carbon footprint per GWh generated was therefore reduced by 16% when compared with 2012 and by 28% when compared with 2009.

- > The GHG emissions for every GWh, generated by geothermal stations, was approx. 65 tonnes CO₂-eq/GWh, if carbon binding is not included and approx. 63 tonnes CO₂-eq/GWh if carbon binding is included.
- > The GHG emissions for every GWh generated by hydropower stations was approx. 1.25 tonnes CO₂-eq/GWh, if carbon binding is not included and is negative (by -0.54 tonnes CO₂-eq/GWh) if carbon binding is included. Landsvirkjun has therefore completed carbon binding measures beyond emissions in the amount of 0.54 tonnes CO₂-eq for every GWh generated via hydropower.
- > Hydrogen sulphide emissions are an unavoidable factor in the utilisation of geothermal energy in Iceland. The concentration of hydrogen sulphide, measured in Reykjahlíð, did not surpass public health limits in 2013.

Noise monitoring

- > The Icelandic regulation on noise specifies a reference limit for industrial zones of 70 dB (A) at site boundary. Landsvirkjun has set strong reference limits for popular tourist destinations within the industrial zones at Lake Mývatn, ensuring that sound levels do not exceed 50 dB (A).
- > In 2013, noise levels in tourism areas did not generally exceed 50 dB (A), with the exception of the information area close to the old bathing area.

Effects on the natural environment and visual aspects

Extensive monitoring on the ecosystem

- > Disturbance to the surroundings is unavoidable in Landsvirkjun's operations. The Company carries out extensive monitoring and research on the affected areas of its power stations with the objective of assessing any environmental impact from its operations. The most extensive research is carried out on the ecosystem including river biota and birdlife, alongside reindeer monitoring. The research is carried out by various universities, research institutes and independent experts in cooperation with Landsvirkjun. Some of the more interesting results included the following:
 - > Reindeer: Reindeer numbers decreased in the Vesturöræfi wilderness at the turn of the century (in the area affected by the Káranhjúkar Hydropower Project) and later on in the entire Snæfell area. However, it is now clear that numbers have increased in the last few years and are growing in the east (Suðurfirðir) and north (Vopnafjarðarheiði).
 - > Lagarfljót: The Arctic char population has decreased continually and consistently since 1998 and had decreased before the Fljótsdalur Hydropower Station began operations. Data collected has not shown any indications of a decrease in the Brown trout population. The fish in Lagarfljót are smaller in size and are not as well nourished. The realistic effects of the power station will become clearer in the next few years.
 - > Sog area: Salmon fishing in the Sog area in 2011 was well above the average recorded for the previous 10 years but was well below average in 2012. This is consistent with generally low angling numbers and salmon numbers in the country's river system that year. There has also been a decrease in Arctic char numbers in the Sog area since 2000. The decrease reflects the decrease in population in the Sog area and is consistent with an overall decrease in the population in Icelandic rivers. The number of midges found in traps in the Sog area was consistent with the average between 2007-2011.

- > Þjórsá area: The density of salmon juveniles in their first and second year (above the fish ladder by Búði Waterfall) was the highest level recorded. This is testament to the increase in salmon numbers above the ladder.

Visual impact and landscape

- > In 2012, a landscape architect was employed by Landsvirkjun. The work focuses on landscaping, the appearance of the environment, the design of structures and work in connection with new projects and landscape analysis.
- > A number of projects, pertaining to visual aspects, were active in 2013. These included landscape analysis of the waterway for the potential power project at Blanda, alongside research projects on landscaping and the visual impact of construction work on power projects at Bjarnarflag and Þeistareykir.