Case Number 1968.0

Iceland's Energy Policy: Finding the Right Path Forward

It was 2011 and Mrs. Katrín Júlíusdóttir, the Minister for Industry, Energy and Tourism had just prepared legislation for the National Parliament outlining a Master Plan, identifying which hydro and geothermal locations in Iceland could be developed and which ones should be preserved. She hoped that this new law would decrease the number of disputes between competing stakeholders including the power industry, environmental groups, local governments, the aluminum industry, tourism, and the general public.[1] While the legislation was a step in the right direction, she feared that tensions between these groups would continue.

Admittedly the Master Plan provided some clarification, but it did not answer the question of what would be the best way to manage Iceland's resources in order to maximize the long-term returns to the country. Landsvirkjun, the nation's state-owned electricity producer had offered a new plan to double the country's power production. Opponents had begun to organize, against the plan, arguing that the long-term benefits to Iceland would be limited and the environmental costs too high. The task of carefully evaluating the different options was a demanding responsibility. Should Iceland continue down a path of producing and selling its energy resources to export intensive industries or would it gain more from an alternative path, e.g. developing these energy resources at a slower and more sustainable pace, and thus protecting its unique natural resource base for future generations?

Background

Iceland is an island situated in the North Atlantic Ocean, midway between North America and Europe. It was the last country to be settled in Europe when Nordic and Celtic Vikings arrived around 870 AD. The country has been a colony for the better part of its history, first under the rule of Norway and then Denmark. It gained full independence in 1944, but was peacefully occupied during the World War II by the British. After the war, the U.S. army retained a military base in the country, which it operated it until 2006.[2]

In 2011, Iceland had a population of 318,000 living in a country of 39,768 square miles or approximately 2.5 times larger than Switzerland. Two thirds of the population lives in the Reykjavík area, as many people moved

[1] Interview with Mrs. Katrín Júlíusdóttir, the Minister for Industry, Energy and Tourism, August 2011.
[2] "Þingvellir," http://www.thingvellir.is/saga/landnam/, and *The National Parliament,* 2010, http://www.althingi.is/pdf/Althingi2010_english.pdf.

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to the capital, from farming and fishery communities on the coastline (see exhibit 1a).[3] The reason for this demographic shift was twofold. First, farming became less labor intensive, forcing farmers to move to the city in search of higher paying jobs. Second, the Icelandic fishing industry, the main source of employment for many rural families, was impacted by increased mechanization and strict quotas on the size of annual catch.

Iceland is a democracy, represented by 63 parliamentarians that come from the six constituencies representing Iceland's 75 municipalities. The nation is extremely homogeneous, having one state religion (Protestant), one spoken language (Icelandic), and relatively little cultural or economic differences among regions.[4]

Economy

Iceland, once one of the poorest countries in Europe, has developed into one of the highest income per capita countries in the world. In 2007, the country ranked second on the UNDP´s Development Report - after Norway.[5] The backbone of its economy was fisheries, but in the last few decades other industries have been increasing their share of the economy.

The most dramatic increase took place in Iceland's banking sector, which was privatized between 1998 and 2003. The sector increased twenty-fold between 2000 and 2008, accessing capital in Europe and the U.S. bond markets that exceeded Iceland's annual GDP. In 2007, the three largest Icelandic banks were operating in over twenty countries and had assets that totaled nine times Iceland's GDP.[6]

In 2008, the banking industry collapsed, causing a complete meltdown of the economy. The crash was caused by the international liquidity crisis, combined with the banks' risky lending practices. Subsequently, the Icelandic currency, the Króna, dramatically depreciated and unemployment rose (see exhibits 2 and 3). The government took over the banking system, and public debt increased to approximately 23% of Iceland's GDP, forcing the government to borrow from the International Monetary Fund. This large-scale economic downturn (see exhibit 4) affected most Icelandic families, especially those who had real estate loans in foreign currencies. Public demonstrations, which had not taken place for decades, became frequent occurrences.[7]

In response to the crisis, some elected officials believed investing in new energy production would stimulate the economy and create jobs, both in the energy sector itself and in the large exporting industries that would buy the power.[8] These industries had benefited from the depreciation of the Króna, which made their products more competitive in foreign markets. However, harnessing new energy projects was dependent on

[3] CIA, The World Factbook, Iceland, https://www.cia.gov/library/publications/the-world-factbook/geos/ic.html, accessed October 12, 2012.
[4] *The National Parliament*, pp. 4-15, http://www.althingi.is/pdf/Althingi2010_english.pdf.
[5] Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided World, Table 1, UNDP, 2007/2008.
[6] Report of the Special Investigation Commission (SIC), Chapter 21, Alþingi, 2010.
[7] Report of the Special Investigation Commission (SIC), Chapter 21, Alþingi, 2010.
[8] Sigurðsson, Björgvin, "Orkunýting og endurreisn," www.pressan.is, September 26, 2011, and The Icelandic Federation of Industries, "Yfirlýsing framkvæmdastjórnar Samtaka Atvinnulífsins," April 24, 2011, http://www.sa.is/frettir/almennar/nr/5197/.

foreign financing. When the banking crisis hit, Landsvirkjun's credit rating fell from an A+ in 2006, to BBB- in 2008, making financing new projects much more expensive.[9]

Iceland's Energy Resources

Iceland is one of the most volcanically active places in the world with more than 200 volcanoes and 600 hot springs. The complex nature of geothermal resources makes it impossible to precisely measure, a priori, the production capacity of an area. However, a rough estimate of Iceland's geothermal resources for electricity production is 25,000 to 30,000GWh per year.[10]

Geothermal resources, such as those found in Iceland, are usually referred to as renewable although there is no consensus on this definition. In reality most geothermal resources deplete over time, since the stored rock energy erodes quicker than the heat conductivity from the underground magma can replace it. How quickly depletion takes place differs from one geothermal system to another. The depth of the borehole also matters, as well as the water permeability of the underground rocks.[11]

To maximize the efficiency of a geothermal system, operators must be able to adapt quickly to changes in pressure in each borehole. Overly aggressive harnessing can cause the pressure to drop too fast, limiting long-term production levels. The Icelandic Energy Authority defines sustainable production as producing from a geothermal system for at least 100 years.[12]

To maximize the efficiency of a geothermal system, the operator will use the waste heat in the form of hot water to heat buildings within 10-35 miles of the facility. In fact, early facilities were used exclusively to produce hot water for heating; electricity production came in much later. Today approximately 90% of buildings in Iceland are heated by hot water from geothermal facilities.[13]

Iceland's hydropower potential stems from the melting of the island's glaciers, which cover around 11% of the country, and the country's high volume of rainfall. The lifespan of the glacier fed hydro system is less than that of a fresh water system. The estimated potential of Iceland's hydropower is 30,000 to 35,000GWh per year or slightly larger than the geothermal resource.[14]

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[9] "Aðdragandi og orskakir falls íslensku bankanna 2008 og tengdir viðburðir," Rannsóknarnefnd Alþingis, 2010, http://rna.althingi.is/html/8kafli.html, Chapter 8, 2011 and Landsvirkjun´s Website, "Lánshæfni," http://www.landsvirkjun.is/fjarmal/lanshaefismat/.

[10] The Master Plan´s Website, "Orkubúskapur á Íslandi," http://www.rammaaaetlun.is/um-rammaaaetlun/verkefnisstjornir-og-faghopar/.

[11] "Geothermal Development and Research in Iceland," p. 10. Orkustofnun, 2010, and Ketilsson et al, *Eðli jarðhitans og sjálfbær nýting hans,* p. 19, Orkustofnun, 2011, and Pálmason, Guðmundur, *Jarðhitabók. Eðli og nýting auðlindar*, pp. 16-24. Hið íslenska bókmenntafélag, 2005.

[12] Ketilsson et al, *Eðli jarðhitans og sjálfbær nýting hans,* p. 17. Orkustofnun, 2011.

[13] "Orkustefna fyrir Ísland," p. 23. Iðnaðarráðuneyti, 2011, http://www.nea.is/media/gagnasofn/Orkustefna-fyrir-Island.pdf.

[14] The Master Plan´s Website, "Orkubúskapur á Íslandi," http://www.rammaaaetlun.is/um-rammaaaetlun/verkefnisstjornir-og-faghopar/.

Iceland's green energy resources are of significant economic value for the country, especially since the 1970s oil crisis, which forced Icelanders to replace oil with local energy. It was estimated that that the cumulative savings between 1970 and 2009 from using geothermal water for heating instead of oil was around $11 billion.[15]

Iceland's Unspoiled Nature

Iceland's biospheres, ecosystems, and landscapes are unique. Its moss and vascular plant flora is unusual in composition, comprising around 485 of the 605 species that exist worldwide. Furthermore, Iceland's bird fauna is of European and global significance, including a number of rare and endangered species.[16] Its stark volcanic landscapes are unparalleled anywhere on the globe. The contrast between the volcanoes, hot springs, black sands, moss green lava fields, grasslands, rivers, large-scale waterfalls, and the many glaciers, form a diverse and different landscape with striking features. Today it is Europe's largest remaining untouched wilderness besides Svalbard and part of Russia.[17]

Mrs. Þóra Þórhallsdóttir, a professor in biology and a faculty member at the University of Iceland, explained the island's diversity, "You can find volcanoes and lava in Kamchatka as well as in Iceland. You can also find high plateaus in Altiplano, South America, or Mongolia. Water springs in relatively unspoiled environment exists in Yellowstone National Park in the United States. But nowhere on earth, except in Iceland, can you see all these things in the same place."[18] While few strong environmental organizations operate in the country, there is a large informal network of citizens who support environmental protection. They argued that Iceland's unique landscape provides an unparalleled resource around which the nation can build a growing ecotourism industry. Rapid development of new power projects would place Iceland's environment at risk.

Environmental Impact of Harnessing Energy Resources

Developers of large-scale industrial projects in Iceland must produce an environmental impact assessment. The National Planning Agency is legally mandated to coordinate and issue its opinion on this assessment and comment on the scope and magnitude of these impacts. Its comments, however, are only advisory, and the agency cannot stop a project by itself.[19]

Historically, the environmental impacts of hydro projects have been quite substantial. They include loss of farmland, reduced grazing land for reindeer and nesting area for birds. Water is repeatedly being stored behind the dam or released to produce electricity, and this release causes land erosion and aggravates water conditions in bounded rivers and lakes. Additionally, the hydro projects have a large-scale visual impact by permanently changing the landscape.

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[15] Haraldsson, et al, *Efnahagslegur samanburður húshitunar með jarðvarma og olíu árin 1970-2009,* p. 14, Orkustofnun, 2010.
[16] Þórhallsdóttir, Þóra, "Environment and Energy in Iceland: A Comparative Analysis of Values and Impacts," pp. 523-526, Volume 27, Issue 26, Institute of Biology, Iceland, 2007, and Þórhallsdóttir, "Strategic Planning at the National Level: Evaluating and Ranking Energy Projects by Environmental Impact," pp. 547-548, Volume 27, Issue 26, Institute of Biology, Iceland, 2007.
[17] Þórhallsdóttir, Þóra, "Environment and Energy in Iceland: A Comparative Analysis of Values and Impacts," pp. 523-526, Institute of Biology, Iceland, August 2006 and "Strategic Planning at the National Level: Evaluating and Ranking Energy Projects by Environmental Impact," pp. 547-548, Institute of Biology, Iceland, 2007.
[18] A quote from the film "Dreamland - A Self-Help Guide For a Frightened Nation," by Andri Snær Magnason and Þorfinnur Guðnason, 2009.
[19] Informal information interview, the National Planning Agency, June 2011, and "Mat á umhverfisáhrifum," The National Planning Agency, 2005.

Icelanders originally favored geothermal projects as opposed to hydro facilities because they were considered to have less visual and irreversible impacts. However, this is not always the case. Often the plant´s building, roads, and thick pipes can be seen for miles and can be a blight on some wilderness areas. In addition, geothermal boreholes can be noisy, the water emissions include materials such as salts and sulfur which change the color of the power plant´s surroundings.[20] Finally, recent experience suggests that injecting geothermal run-off water into boreholes in order to avoid polluting the ground water might stimulate small earthquakes. This is less of a concern in the geothermal areas located in the highlands, far away from cities or towns.[21]

Roughly thirty hydropower projects exist in Iceland, producing over 12,000GWh per year of electricity, most of which is consumed by the aluminum industry. In addition, many small hydropower projects exist, producing electricity for individual farms. By comparison, the seven geothermal power plants produce a bit over 4,000GWh.[22]

The Tourism Industry

According to polls, tourists visit Iceland for its beautiful, unspoiled nature and rare and diverse geological attributes. The tourism industry values Iceland's image of natural beauty. In the past, the tourism industry and the power industry co-existed in relative harmony, but the aggressive increase in harnessing solely to produce electricity for heavy industries has put pressure on this relationship. "…As soon as area has been harnessed (for energy development) its value for the tourism industry declines," claimed Mrs. Anna Sverrisdóttir, a representative of the government´s Tourism Board.[23] "When people go on holidays it is because of emotions, and it is hard calculating the emotional value of beauty," Sverrisdóttir explained.[24] The impact of building power facilities on Iceland's landscape is perceived by many as a threat to a strong ecotourism industry.

Tourism is the fastest growing industry in the country. Almost 500,000 tourists visited Iceland in 2010 – a 63% increase from 2000 (see exhibit 5). In 2008, 16.9% of Iceland's total foreign exchange earning was from tourism and in 2009 the industry counted for around 5.9% of Iceland's GDP. The number of jobs that the industry provided was substantial; 5,400 people worked directly in the industry and around 3,000 more worked in sectors closely linked to it, such as entertainment and culture.[25] By 2011, the tourism industry and its long-term potential growth had become major stakeholders in the ongoing debate on whether and how fast to expand Iceland's power industry.

[20] Þórhallsdóttir, Þóra, "Environment and Energy in Iceland: A Comparative Analysis of Values and Impacts," p. 523, Institute of Biology, Iceland, August 2006 and "Rannsóknir á mosa við jarðvarmavirkjun Orkuveitu Reykjavíkur á Hellisheiði," http://rafhladan.is/bitstream/handle/10802/259/Skyrsla%20um%20mosaskemmdir.pdf?sequence=3 and "Stækkun Hellisheiðarvirkjunar, mat á umhverfisáhrifum," 2005, http://www.or.is/media/PDF/Matssk%C3%BDrsla.pdf.
[21] "Ekki manngerðir skjálftar þó tímasetningin sé af völdum manna," http://www.os.is/orkustofnun/frettir/nr/1074.
[22] The National Energy Authority´s Website, "Jarðvarmi," http://www.orkustofnun.is/jardhiti/jardhitanotkun/jardvarmavirkjanir/.
[23] Interview with Mrs. Anna Sverrisdóttir, Tourism´s Representative in the Master Plan, August 2011.
[24] Interview with Mrs. Anna Sverrisdóttir, Tourism´s Representative in the Master Plan, August 2011.
[25] "Ferðaþjónusta á Íslandi í tölum," Ferðamálastofa, 2010 and 2011.

The Energy Policy in the Past

The conservative Independence Party and the farmer´s Progressive Party, which ran the government from 1995 to 2006, strongly supported increasing electricity production and building new large-scale power projects. The actual number of jobs created by these power projects varied in size and type. Most of these jobs were connected to the construction phase. Sixteen to eighteen people were operating the largest geothermal power plant in Iceland, Hellisheiðavirkjun (213MW) while thirteen people operated in Iceland's largest hydropower plant, Kárhnjúkavirkjun (690MW). The number of temporary workers needed during the construction period for both projects was much larger. Around 200 workers were hired at the peak of the construction of Hellisheiðarvirkjun, about 80% were Icelandic, while up to 1,120 workers worked at Kárahnjúkar dam, but only around 50 were Icelandic. The remainder were from Portugal and Central Europe.[26] However Iceland's experience with building and operating both geothermal and hydro facilities has spawned a robust engineering sector, which is now involved with building and advising projects around the world.

The political goal of creating jobs through power projects and supporting the siting of energy intensive industries, such as aluminum, originated in the 1960s. At that time, Iceland was poor and lacked solid infrastructure. The economy was also very dependent on fisheries, counting for more than half of Iceland's foreign currency earnings. Creating another export industry was seen by the government as an opportunity to balance the economy. However, Iceland had little foreign investment experience or reputation, making it hard to attract foreign investors. The government therefore offered foreign energy intensive industries cheap electricity prices in exchange for bringing capital and employment into the economy.[27]

In Iceland, electricity producers do not have the option to sell excess power to neighboring utilities. This constraint means that investors must find a buyer for their electricity before financing a new power project assuring lenders that there will be a revenue flow from the new facility. This challenge is exacerbated by slow growth in domestic consumption. If local households and commercial buildings do not need additional energy, developers have to persuade new companies to locate in Iceland in order to assure investors and the banks that the project is economically viable.

Attracting the Aluminum Industry

Knowing of Iceland's interest and attracted by its location halfway between Europe and North America, Alusuisse (now Rio Tinto Alcan) came to Iceland in the early 1960s. In exchange for a long-term contract for low cost electricity, Alusuisse agreed to build a plant. The Parliament passed a new law, allowing the state utility Landsvirkjun to sell power at special rates to companies in heavy industries. Landsvirkjum subsequently signed a 45-year agreement to provide low cost power to the Alusuisse smelter. Spurred by the company's experience, other aluminum firms began to look at Iceland as a possible location for a future plant.

The development of the Icelandic aluminum industry did, however, not happen overnight. Even though the country offered cheap electricity, its distance from foreign markets, high taxes, lack of necessary inputs, and a

[26] "Mannaflaþörf við stóriðju- og virkjanaframkvæmdir á árunum 2006-2007. Þörf fyrir erlent vinnuafl og útgáfa atvinnuleyfa," pp. 10, 11, 15. Vinnumálastofnun, 2006.
[27] An interview with Mr. Andrés Svanbjörnsson, the former chief engineer of Icelandic Energy Marketing Agency, June 2012.

general lack of skilled workers, deterred investors. Following several failed efforts, the Icelandic Energy Marketing Agency was established in 1988 by Landsvirkjun and the Ministry of Industry. According to Mr. Andrés Svanbjörnsson, the agency´s former chief engineer, attracting the aluminum industry was not the main target, "From 1988-2003 numerous discussions with over 30 different industries took place, not to mention all the informal meetings and requests. The agency focused on all types of energy demanding industries as potential buyers, but the aluminum industry turned out to be the most favorable one. The aluminum industry was prepared to make a commitment and their needs were in line with what we could offer." Regarding the low electricity price Mr. Svanbjörnsson explained, "We offered the lowest electricity price for industries in Europe, but aimed to be no lower than the average world price for power sold to the aluminum industry."[28]

Over the years the government provided investment incentives that gave aluminum smelters special terms and rights related to lower taxes, fees and other financial obligations.[29] The most important components of those agreements, in regard to the primary aluminum industry, were four: First, the agreements froze income taxes for the smelters, usually at rates between 15 and 18%. Second, the agreements allowed the smelters to fully depreciate their assets down to 0% instead of 10%. Third, the smelters paid lower real estate fees to the municipality in which they were located than other industries. Fourth, the agreement guaranteed that the smelters did not have to pay any fees or tariffs on imported inputs either for the construction of their facilities or operations of the smelters.[30]

In addition, the government offered low electricity prices (see exhibits 6, 7a and 7b), which accounted for approximately 30% of the input costs to produce the aluminum.[31] These prices were contracted for 20 to 45 years (see exhibit 8) and linked to the world price of aluminum as registered at the London Metal Exchange (LME). This meant that the aluminum industry paid a lower price for electricity when the world price of aluminum was low and vice versa, transferring most of its cost risks to Icelandic energy suppliers. The key input, alumina, was mainly imported from Australia, the United States, Brazil and Surinam, and almost 100% of the final product was sold to European markets: UK, Netherlands, Switzerland, and Germany. Because Iceland is a member of the European Economic Area, Icelandic aluminum producers pay no tariffs on their exports to the EU.[32]

The aluminum companies became valuable customers—since their demand was large and steady, and contracts committed them to buy a fixed number of MWhs per year for decades. However, the low rate of return to the society became a source of controversy.

[28] An interview with Mr. Andrés Svanbjörnsson, the former chief engineer of Icelandic Energy Marketing Agency, June 2012.
[29] Originally the government negotiated each agreement directly with each project but recently a framework legislation had been put in place which allowed aluminum smelters, and other industries to negotiate such an agreement – as long as the foreseen investment "is nationally beneficial for the Icelandic economy and community, e.g. in terms of job creation, regional development, exports, tax revenues, innovation and increased knowledge." Act on Incentives for Initial Investments in Iceland, http://eng.idnadarraduneyti.is/media/Acrobat/Translation-of-Act21juni.pdf.
[30] Invest in Iceland – informal briefing, June 10, 2011, and "Act on Incentives for Investments in Iceland," http://eng.idnadarraduneyti.is/media/Acrobat/Translation-of-Act21juni.pdf, and "Lög um heimild til samninga um álbræðslu á Grundartanga," and "Frumvarp um heimild til samninga um álverksmiðju í Reyðarfirði."
[31] "Þróun íslensks raforkumarkaðar og framtíðarsýn Landsvirkjunar," http://www.landsvirkjun.is/media/samradsfundir/arsfundur_LV_2010_hordur_arnarson.pdf.
[32] Statistic Iceland´s Website, www.statice.is.

Because of the investment-friendly environment in Iceland, the aluminum industry had grown significantly since the first smelter opened and consequently so had Iceland's electricity grid. In 2010, the three smelters operating in the country purchased over 70% of Iceland's total electricity. Two out of the three smelters are located in rural areas and the other near the capital, Reykjavik. Together they currently produce around 800,000 tons, or about 2% of the world´s aluminum.[33] Slightly more than 1,500 people are employed in the industry. In addition, according to the Icelandic Institute of Economic Studies, each job in the industry is estimated to yield around 1.4 additional indirect jobs. The industry thus creates around 3,400 to 3,600 direct and indirect jobs, amounting to about 2% of Iceland's workforce. In general, the smelters pay higher salaries than other manufacturing companies and do not have difficulty attracting employees.[34] In 2009 the aluminum industry accounted for 1.9% of Iceland's GDP while its dependent industries, such as electricity suppliers and some service companies provided an additional 2.4-3.3%.[35]

The Power Industry

In 2003, Iceland allowed competition in its electric generation sector. There are currently three key players operating in the market. The smallest, HS Orka, produces and supplies hot water and electricity from geothermal sources. The company was recently acquired by Magma Energy, a Canadian firm, which now owns 66% of the company. The remaining percentage is owned by several Icelandic pension funds.[36] The second largest company is Reykjavík Energy, which produces and supplies water and electricity from hydro and geothermal sources. Reykjavík municipality owns around 99% of Reykjavík Energy.[37] The largest producer is Landsvirkjun, the state-owned company, which produces around 75% of all electricity in Iceland. Less than 20% of the total energy produced by these three suppliers is consumed by the commercial and residential sectors.[38]

Landsnet is the public operator of the country's transmission system (see exhibit 1b) and is regulated by the Icelandic Energy Authority, a regulatory institution under the jurisdiction of the Ministry for Industry, Energy and Tourism.[39] It also regulates the distribution system. By law, all electric distributors must be owned by the public sector.[40] The Iceland State Electricity Company, RARIK, is the largest in terms of miles covered. It builds and operates distribution systems in rural areas. Reykjavik Energy distributes power within the capital and serves about

[33] Association of Icelandic Aluminum Industries´ Website, "Hagkerfið," http://www.samal.is/hagkerfid/.
[34] Given the size of the labor force in 2010, according to www.statice.is, and *Áhrif stóriðjuframkvæmda á íslenskt efnahagslíf*, p. 17. Hagfræðistofnun Háskóla Íslands, 2009.
[35] *Beint og óbeint framlag áliðnaðar til landsframleiðslu*. Skýrsla nr. C11:06, appendix B. Hagfræðistofnun Háskóla Íslands, February, 2012.
[36] HS Orka´s Website, "Raforka, Hitaveituvatn og jarðsjór með jarðgufu," http://hsorka.is/HSProduction/HSProductionStartPage.aspx.
[37] Reykjavík Energy´s Website, "About Orkuveita Reykjavíkur,"http://www.or.is/English/About/, and *Regulations on Reykjavík Energy*, http://www.reglugerd.is/interpro/dkm/WebGuard.nsf/0/6712eb8eda0adc4e0025715a00542d27?OpenDocument.
[38] Landsvirkjun´s Website, "About Us" (Landsvirkjun), http://www.landsvirkjun.com/about-us/, and "Raforkutölfræði, "www.os.is.
[39] Landsnet´s Website, "Flutningsgjaldskrá," http://www.landsnet.is/raforkukerfid/flutningsgjaldskra/.
[40] The National Energy Authority´s Website, "Leiðbeiningar vegna umsóknar um leyfi til að reisa og reka dreifikerfi," http://www.orkustofnun.is/orkustofnun/leyfisveitingar/raforka/dreifikerfi/.

65% of the nation's population. Both the transmission and distribution system in Iceland experience very low losses. [41]

Electricity Pricing and its Impact on the Power Industry

The power producers' main goal has been to provide cheap electricity in order to attract jobs to the country. The electricity prices paid by heavy industries were kept confidential for decades, leading to questions as to whether Iceland was underpricing its resources. In 2010 Landsvirkjun opened up its books and revealed that it was charging the aluminum companies approximately $26.2 per MWh (see exhibit 7b), a tariff which was considerably lower than that charged to local residential consumers. In comparison, the average electricity price to industries within the OECD member states was much higher, over $100/MWh (see exhibit 9).[42] The aluminum industry argued that the nature of their industry, as a large scale and steady (day and night) electricity buyer justified the lower tariffs.[43]

In 2011, Landsvirkjun provided financial statements dating back to its establishment in 1965. The figures showed that the company's total dividend payments to the government between 1965 and 2010 were $66 million and its total resource fees payments were $44 million. The company during that 45-year period was exempted from the value added tax.[44] Foreign rating companies, such as Moody´s, described the energy companies as being "…restricted by high indebtedness and low profitability and subject to fluctuations in aluminum prices."[45]

Estimated average returns on invested capital (ROIC) in the Icelandic energy sector was 2.4%, according to a report written for the Minister of Finance. The report asserted that the ROIC in the Icelandic energy sectors were considerably lower than in other parts of the western world; returns in the United States were around 10.8% and in Europe around 7%. Supporters of the past policy argued that the goal of Landsvirkjun, as a public utility, had not been to maximize ROIC and ROE, rather it was to support job creation and offer electrical energy at low prices while maintaining optimum delivery stability to the public.[46] They argued that the company's success should therefore not be measured solely against its return on investment. Environmentalists asserted that the returns would be even lower if environmental costs had been included in the calculations. The Kárahnjúkar Power Project changed the tenor and scope of the energy debate between environmental and business interests.[47]

The Dramatic Impact of the Kárahnjúkar Project

In 2002, Landsvirkjun and the aluminum producer Alcoa broke ground on a dam and a smelter at Kárahnjúkar, a rural area next to Egilsstaðir village in eastern Iceland. As in the past, the main political argument for the project was the potential to create jobs and improve the local economy.

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[41] Rarik´s Website, "Um RARIK," http://www.rarik.is/umRARIK and Reykjavík Energy´s Website, "About," http://www.or.is/English/About/.
[42] "Orkustefna fyrir Ísland," p 39. Iðnaðarráðuneyti, 2011, http://www.nea.is/media/gagnasofn/Orkustefna-fyrir-Island.pdf.
[43] An Interview with Mr. Þorstein Víglundsson, Managing Director of the Association of Icelandic Aluminum Producers, June 2012.
[44] Landsvirkjun´s Annual Accounts 2000-2010, and Landsvirkjun's Renewable Energy Potential and its Impact on Iceland's Economy, p.62-63. Gam Management Hf, 2011, and "Lög um umhverfis og auðlindaskatta." Alþingi, 2009.
[45] Landsvirkjun´s fall meeting in 2011. Presentation by its CEO, Mr. Hörður Arnarson.
[46] An interview with Mr. Andrés Svanbjörnsson, the the former chief engineer of Icelandic Energy Marketing Agency, June 2012.
[47] "Mat á arðsemi orkusölu til stóriðju. Fyrsta áfangaskýrsla." Gert af Sjónarrönd fyrir Fjármálaráðuneytið, p. 11, 2009.

The project was the biggest construction project in Iceland's history. It involved hundreds of foreign workers. Eight dams in several different rivers were built, the largest one being 650 ft wide and 2,297 ft high. The dams created two lagoons in the highlands, one 29.2 mi^2 (see exhibit 10) and one 0.62 mi^2. This created a large artificial reservoir in what was one of Iceland's last untouched wilderness areas.

The environmental impact assessment showed that the project would lead to deteriorating water conditions in local rivers and lakes and would negatively impact biodiversity. Also, it would reduce the nesting area for pink-footed geese and other birds, and less grazing land for reindeer and sheep.[48] When the facility began operations, more problems emerged. "The building of the Kárahnjúkar dam changed a lot around here," Mr. Örn Þorleifsson, a local farmer explained. "The birds, for example the loon, didn't lay eggs here this spring. The river carried a lot of moraine that stuck to the sandbanks. This has created problems for men and animals, obstructing the view so you can't really see the farmsteads nearby."[49]

Opponents of the Kárahnjúkar project argued that the power was to be sold at a subsidized price to foreign companies, which would export its profits and yield little long-term economic benefit to Iceland. In fact, an impact assessment of the Kárahnjúkar project carried out by the National Economic Institute estimated that the project's long-term impact on GDP was less than 1%. The Progressive Party and the Independence Party, which led the government at this time, were accused of running a very expensive job creation project for less than 0.5% of Iceland's workforce.[50] The proponents of the policy argued that the aluminum industry created long-term jobs in areas where there previously was a lack of economic activity. Moreover, these jobs were more stable, and usually better paid than seasonal jobs in the tourism sector.[51] "Progress doesn't happen automatically. Stopping means delaying progress," asserted the Prime Minister at the time, Mr. Geir H. Haarde. "Fear of change will get us nowhere."[52]

Overall, the Kárahnjúkar project stimulated an intense debate about developing Iceland's energy resources, electricity pricing, and the value of the environment, making it a key subject of debate in the lead up to the parliamentary elections in 2007 and again in 2009.[53] Despite its magnitude, the Kárahnjúkar Project has been often referred to as having harmed rather than helped the Icelandic economy, because unlike some of previous

[48] "Úrskurður skipulagsstofnunar um mat á umhverfisáhrifum," 2001, http://www.skipulagsstofnun.is/focal/webguard.nsf/5ed2a07393fec5fa002569b300397c5a/f17b54c04fb3593700256e2a003e5ef4/$FILE/2000110003.PDF.

[49] Quotes from the film "Dreamland - A Self-Help Guide For a Frightened Nation," by Andri Snær Magnason and Þorfinnur Guðnason, 2009.

[50] Sigurðsson, Jón, Minister of Industries, October 12, 2006, http://www.idnadarraduneyti.is/utgefid-efni/skyrslur/nr/2155, and "Helmingur Reykvíkinga á móti Kárahnjúkavirkjun," April 10, 2005, http://www.mbl.is/mm/gagnasafn/grein.html?grein_id=1011227, and "64% vilja atkvæðagreiðslu um Kárahnjúka," February 15, 2003, http://www.mbl.is/mm/gagnasafn/grein.html?grein_id=714501.

[51] Interview with Mr. Ragnar Guðmundsson, the CEO of Nordurál, June 2012, and Mr. Þorstein Víglundsson, Managing Director of the Association of Icelandic Aluminum Producers, June 2012.

[52] Quotes from the film "Dreamland - A Self-Help Guide For a Frightened Nation," by Mr. Andri Snær Magnason and Mr. Þorfinnur Guðnason, 2009.

[53] Sigurðsson, Jón, former Minister of Industries, October 12 2006, http://www.idnadarraduneyti.is/utgefid-efni/skyrslur/nr/2155, and "Helmingur Reykvíkinga á móti Kárahnjúkavirkjun," April 10, 2005, http://www.mbl.is/mm/gagnasafn/grein.html?grein_id=1011227, and "64% vilja atkvæðagreiðslu um Kárahnjúka," February 15, 2003, http://www.mbl.is/mm/gagnasafn/grein.html?grein_id=714501.

energy and aluminum smelter projects constructed in the past, it was constructed during times of economic boom when Iceland had almost no unemployment.[54]

The Kárhnjúkar project, including the Alcoa smelter, did not receive high grades for creating new jobs. A study by the University of Iceland found that given the low unemployment rate that existed when the project was executed, the jobs created in the area had more likely been "transferred jobs" from other areas in Iceland rather than "new jobs" in the local economy. When the project began in 2002 the unemployment rate in the region was 2.4% and 2.7% in the capital area. However, in 2009, a year after the peak of the crisis, the unemployment rate was up to 3.6% and 8.8% in the capital.[55]

The Post-Crisis Government and the Master Plan

The Left Green Movement won the 2009 parliamentary election. Together with a larger party, the Social Democratic Alliance, it formed a coalition government that embraced a greener energy policy and aimed to complete the Master Plan on how Iceland's energy resources should be managed. The project renewed a decade-long debate about whether Iceland's electricity policy, with its emphasis on job creation, was sustainable.

The Master Plan was jointly initiated in 1999 by the Ministry for Industry, Energy and Tourism and the Ministry for the Environment, following disputes between the energy sector and environmentalists on building new energy projects in the highlands. Its purpose was to evaluate and rank potential and pending hydro and geothermal facilities based on their environmental, social, and economic values. Consequently, options were categorized into three groups: (1) facilities proposed for areas in which power options could be built; (2) locations that should be left untouched; and (3) proposed new facilities where decisions should be set aside and revisited at a later date. The development of the Master Plan was carried out in two phases. The first, ending in 2003, consisted of preparing a preliminary ranking of 19 hydropower options and 24 geothermal options. The second phase, which was completed in 2010, ranked 69 of 84 potential power options (see exhibit 11).[56]

The Master Plan's participants were both subject experts and relevant stakeholders. While the evaluation process had been demanding, it was mostly welcomed and seen as a step towards more clarity for all stakeholders. The tourism industry wanted to know which areas in the highlands it could safely invest in ecotourism, without worrying that the power industry would impact the area, while the power industry needed a guarantee that it could site new facilities in some areas.

The key criticism on the Master Plan's process was that one stakeholder, the power industry and its biggest customers, were better funded and had more access to information than the environmental advocates and the tourism industry. Also, critics pointed out that the Master Plan neither considered nor compared the future revenue potentials of an area, i.e. developing the area as a tourist attraction versus using it for energy production.

[54] An interview with Dr. Þórólfur Matthíasson, Chairman of the Department of Economics of the University of Iceland, September 2011.
[55] "Þjóðhagsleg áhrif álverksmiðju Fjarðaáls á Reyðarfirði," pp. 15-17, Hagfræðistofnun Háskóla Íslands, 2005.
[56] "Tillaga til þingsályktunar um áætlun um vernd og orkunýtingu landsvæða," Ministry of Industries, Energy and Tourism, 2011, and an interview with Svanfríður Inga Jónasdóttir, the Chair of the Master Plan's Workgroup, August 2011.

The outcome of the Master Plan process was published in the summer of 2011. The plan recommended building 11,911GWh or approximately 1,500 MW of power.[57] By comparison, generators produced 18,223GWh in 2010. Half of the new power was to be developed from geothermal sources and half from hydro resources. Decisions were still pending on several additional projects which had an estimated capacity of 9,106 GWh. Based on the outcome of the Master Plan, the Ministry for Industry, Energy and Tourism and the Ministry for the Environment were prepared to jointly deliver a legislative proposal to the National Parliament for approval. Both Ministers understood that some of the power options in the plan were controversial, and therefore they expected that Parliament would want to make some changes.

While the Master Plan was an important step towards resolving the tensions between environmental advocates and the energy and aluminum companies, the Parliament retained the right to review and change the plan every four years. Also, the plan was silent on the rate of power development. Should all 1,500 MW be built at once or should the development be extended over many years? The plan made no effort to differentiate between capacity built to serve export industries and capacity built to meet domestic needs.

Landsvirkjun´s Strategy for the Future

In 2010, Hörður Arnarson, a successful businessman, was hired as CEO of Landsvikjun. Mr. Arnarson was determined to bring the lessons and skills that he had acquired in the private sector to his new responsibilities. His first task was to develop a new business plan for the company that would guide the company's investments over the next five years.

His strategy was to take advantage of the world´s growing focus on low carbon energy resources by increasing the development and use of Iceland's supply of green power. The EU had set a goal of reducing carbon emissions to 20% below 1990 levels, and increasing the share of renewable energy to 20% before 2020.[58] Arnarson argued for accelerating the development of Iceland's hydro and geothermal resources, but in a way that increased Landsvirkjun´s returns and dividend payments from these new projects. "Landsvirkjun´s goal is to maximize the value of the nation's resources, in a sustainable way," Mr. Arnarson argued. "Can we call a resource a resource if its returns do not cover the cost of capital?"[59] He emphasized that Landsvirkjun should be a market-driven company and embark on an investment strategy to place the company and the country on a firmer financial foundation (see exhibit 12).

To maximize its returns, Landsvirkjun´s needed to 1) increase its tariffs; 2) undertake more rather than fewer power projects; and 3) sell the additional energy produced to a more diverse portfolio of buyers.

Increase tariffs. In recent years, electricity prices had been increasing in Europe, widening the price difference between electricity sold to industries in Iceland and that sold in the rest of Europe. Landsvirkjun conservatively estimated that the price difference per MWh was $50 in 2011, and over $75, if compared to the average price paid by industries within the OECD and the EU. The company estimated that energy prices on the mainland would

[57] Capacity factors were calculated on a plant by plant basis and ranged from a high of 93% for geothermal facilities to a low of 68% for some hydroelectric plants.
[58] European Commission Climate Action, "Roadmap for Moving to a Low Carbon Economy in 2050," http://ec.europa.eu/clima/policies/roadmap/index_en.htm.
[59] Interview with Mr. Hörður Arnarson, Landsvirkjun´s CEO, August 2011.

continue to increase as the EU implemented its plan to reduce carbon emissions. Mr. Arnarson believed that Landsvirkjun should take advantage of this development by increasing electricity prices in Iceland in proportion to the price increase in Europe. He used the Kárahnjúkar Project's low returns on its investment from 2008-2011 (see exhibit 13) to support his argument that existing tariffs were too low. He pointed out that increases would also be required to cover the higher costs of capital stemming from Landsvirkjun´s lower bond ratings.

Undertake new projects. Because most electricity sold to the aluminum industry was covered by long-term contracts, it would be difficult to amend the contracts in order to increase tariffs in the near term. Therefore Landsvirkjun´s strategy involved building over fifteen new power projects, doubling the company's electricity production. This additional production would be sold at higher prices and thus earn a higher rate of return. The majority of the additional production was supposed to come from geothermal resources and the cost per MWh was estimated to be considerably lower than that for power in the EU. Mr. Arnarson believed that "one of the reasons people have been against harnessing in the past is because it has not been profitable enough. The companies were sacrificing valuable, beautiful places and not making money; it is not enough to just create jobs."[60]

Diversify the buyers group. The additional electricity production was also meant for a more diverse group of buyers. The Icelandic power sector was over-dependent on revenues from the aluminum companies. The industry consumed over 70% of the electricity produced in Iceland. This reliance was exacerbated by the historical decision to link tariffs to fluctuations in the world price of aluminum. This meant that if the world price dropped, power companies received less revenue. Attracting other higher paying energy consuming industries, such as data centers and carbon fiber producers, would decrease Landsvirkjun´s revenue risk. These alternative industries had the possibility of receiving special investment concessions from the government, involving tax and fee discounts, which likely reduced their initial investment by 3 to 5%. Several data and internet companies had already shown interest in using Iceland as a base to serve Europe. The good news for the politicians was that according to Iceland's investment agency, these companies usually provided more jobs per megawatt hours produced than the aluminum industry.[61]

Landsvirkjun argued that now was the time to implement this new strategy because it would help combat the global economic downturn. Given access to reasonable foreign financing, Landsvirkjun estimated the amount of total investment would be $3.5bn over the next 10 years. Furthermore, according to Landsvirkjun´s forecast, its power projects would lead to an additional $4.5bn investment in dependent industries. Based on its calculations Landsvirkjun could eventually be paying 3-6% of Iceland's GDP back to the society in the form of dividends, taxes, both direct and indirect, reaching around the same level as the tourism industry, which counted for 5% of the GDP in 2008. Furthermore Landsvirkjun argued that implementing its strategy would create hundreds or even thousands of new jobs, while also strengthening its current knowledge cluster around green energy, which could by itself become an export product.[62]

[60] Interview with Mr. Hörður Arnarson, Landsvirkjun´s CEO, August 2011, and Landsvirkjun's Renewable Energy Potential and its Impact on Iceland's Economy, pp. 61-65. Gam Management Hf, 2011.
[61] Interview with Mr. Kristinn Hafliðason, Invest in Iceland, September 2011, and Landsvirkjun's Renewable Energy Potential and its Impact on Iceland's Economy, pp. 61-65. Gam Management Hf, 2011.
[62] Landsvirkjun had already started implementing some changes to its business. In late 2010, when it had the opportunity to renegotiate the smelter agreement with Rio Tinto Alcon, it decreased the proportion of the electricity tariff linked to London

Stakeholders debated whether Landsvirkjun´s premises were solid enough to support its expected outcome and what the returns would be if the environmental costs were included. One of the big questions was whether Landsvirkjun´s strategy was in line with the government´s goal of utilizing Iceland's resources in an economical, societal, and environmentally sustainable manner, giving future generations the same benefits from the country's resource as enjoyed by today's generation.[63]

Gaining More with a Submarine Interconnector?

Arnarson also suggested the construction of a 700-1200MW submarine interconnector to Europe, which would allow the company, and other Icelandic electricity producers, to sell additional green power to the mainland (see exhibit 14). Again, he referred to the EU´s strong focus on renewables and carbon emissions reductions and argued that there would be a strong market for Iceland's "green power" on the mainland.

According to Landsvirkjun´s estimates, the interconnector would be using a maximum of 15-25% of the country's electricity in 2020. The company argued that Iceland could buy cheaper energy for its industries during the night from the mainland, when its hydro reservoirs were filling up, and supply green energy at a higher price to Europe during the day.

The profitability of this proposed project rests on the assumption that the price of green energy on the mainland will continue to increase. Building such a line would be challenging because of its length and the strong ocean currents. Many questions remain to be answered: Will this plan be cost effective? How will it impact domestic customers who might have to bear higher tariffs? Opponents worry that the existence of a transmission line to Europe will only put more pressure on the country to approve additional hydro facilities and accelerate the development of Iceland's geothermal resources, while making them unavailable to meet domestic needs. Finally keeping the cable full will be challenge unless EU utilities agree to enter into long-term take or pay contracts with Landsvirkjun.

Landsvirkjun has begun to explore Iceland's wind energy potential. The country has several competitive advantages. Most of its regions have steady wind speeds; there is ample land available and its vast hydro facilities give it a built-in resource to provide backup power in the days when the wind speeds are low. Using assumptions produced by the World Wind Energy Association—the industry's trade group— Landsvirkjun predicted that the cost of onshore wind generators will continue to decrease and will become a competitive option for Iceland within the decade. The company concluded that between 100-200MW can be produced by 2022 (see exhibit 15). A significant portion of this electricity could be sold to Europe through the proposed interconnector.[64]

Metal Exchange. Landsvirkjun had also entered into negotiations with some smaller energy-intensive companies offering a 12-year contract at a price $43/MWh. Landsvirkjun's Renewable Energy Potential and its Impact on Iceland's Economy, pp. 61-65. Gam Management Hf, 2011.

[63] *Skýrsla iðnaðarráðherra um kostnað við Kárahnjúkavirkjun, samkvæmt beiðni,* 2007-2008, http://www.althingi.is/altext/135/s/0751.html.

[64] According to Mr. Óli Grétar Blöndal Sveinsson, Landsvirkjun´s Executive Vice President of Research and Development, June 2012.

The Future of the Aluminum Industry

While Landsvirkjun´s future strategy called for more electricity production, it also meant higher prices for the aluminum industry for any additional or renegotiated electricity. All of the three existing smelters operating in Iceland had increased their production or aimed to increase it in the future. Smelters have a high fixed capital cost, thus its unit costs can be reduced through economies of scale.[65]

Most rural areas were in favor of building additional smelters, focusing on the number of jobs that these projects would create and attracting young people back to these areas. According to polls, around 50-70% of people in the areas where the new smelters might be built were in favor of the projects, while the majority of Icelanders living in Reykjavik were opposed.[66]

The Helguvík Smelter

The most controversial of the new aluminum projects was the Helguvík smelter on the Reykjanes peninsula or as Mrs. Svandís Svavarsdóttir, the Minister for the Environment, put it, "The Helguvík case has in many ways become a symbol of the problems that Iceland is dealing with in deciding its path forward."[67] The project crystallizes the tensions in place between the different stakeholders, i.e. the power industry, the environmentalists, the public, the aluminum sector, and the political parties, when discussing Iceland's future energy policy.

The Helgavík smelter was proposed in 2005 by Century Aluminum, the current owner of Norðurál smelter operating in the west of Iceland. Currently the smelter's future is uncertain due to its inability to obtain government approval for the new power projects that would have to be built to supply it.

The saga began in 2005 when Árni Sigfússon, a mayor in Reykjanesbær, along with Garður, a neighboring municipality, offered land and harbor facilities for a new smelter in Helguvík. The United States had recently closed its large military base, throwing 600 people out of work. This project was marked as an opportunity to bring back some of these jobs. Norðurál planned to construct a smelter in four 90,000 ton phases, reaching an annual production capacity of 360,000 tons, which would start operating in September 2010. Proponents argued that over a thousand jobs could be created during the construction period and once up and running the smelter could employ around 600 people and create another 800 indirect jobs. Century Aluminum negotiated with HS Orka and Reykjavík Energy to buy electricity for the Helguvík smelter from facilities that the two companies would build.[68] Despite the uncertainty on electricity supply, construction began in 2008.

The financial crises changed the assumptions on which the deal was based and put the energy suppliers in financial difficulty. HS Orka, which had originally been 43% owned by Reykjanesbær, was sold to a Canadian company Magma Energy. Opposition to both the sale of HS Orka to foreigners and to the Helgavik project grew.

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[65] *Áhrif stóriðjuframkvæmda á íslenskt efnahagslíf*, p. 18, Hagfræðistofnun Háskóla Íslands, 2009.
[66] "Aukinn stuðningur við álver á bakka," May 25, 2005, http://www.atthing.is/forsida/nr/451/. http://www.idnadarraduneyti.is/frettir/frettatilkynningar/nr/1903, and "Þrír af hverjum fjórum á Húsavík og í nágreni Bakka hlyntir álveri," February 25, 2006, http://www.mbl.is/frettir/innlent/2008/07/17/fleiri_a_moti_en_med_alveri_i_helguvik/.
[67] Interview with Mrs. Svandís Svavarsdóttir, Minister for the Environment, August 2011.
[68] Interview with Mr. Ragnar Guðmundsson, the CEO of Nordurál, June 2012.

Demonstrations were led by the Icelandic pop star, Björk, who argued, "We already have aluminum smelters. We don't need more of them."[69]

Smelters supporters argued that as long as there was a demand for aluminum it would have to be produced somewhere in the world and by allowing production to take place in Iceland the country was actively contributing to less pollution worldwide. In fact, the lifecycle emissions from a smelter in Iceland was between 1.4-1.7 tons of carbon dioxide (CO_2) because it did not use fossil fuels.[70]

By 2009, much higher costs of capital forced Magma to increase the costs of power that it would sell to Helgavik. Century Aluminum responded by taking Magma to court, accusing it of breaching its contract.[71]

Spurred by these troubles, Century Aluminum reached out to Landsvirkjun as an alternative supplier, in the belief that the smelter fit into the utility's new strategy. Mr. Arnarson's response was lukewarm stating that, "Landsvirkjun has only the possibility of playing a minor role in supplying energy to the Helguvik smelter and the increased cost has to be reflected in the price of power."[72]

Century Aluminum had already invested $126 million in the smelter's construction and was growing increasingly frustrated at the government's inability to provide the support that it needed.[73] The delay was also challenging for Reykjanessbær, which was carrying high debts and had the highest unemployment rate in the country at over 12%. Was the era of new aluminum smelters in Iceland over? The controversy put more pressure on the government to create a clearer energy policy in order to limit the uncertainty facing investors participating in new projects.

Katrín Júlíusdóttir knew that her Ministry was under pressure to help the smelter obtain power and not let the investment opportunity drift away. She would also have to decide whether to support Mr. Hörður Arnarson and Landsvirkjun's plan to accelerate the construction of additional power facilities to attract new energy intensive export industries, creating jobs and additional revenue. Finally, she understood that whichever path she chose in the short- and mid-term would significantly influence the long-term character of the country. Should she opt for jobs and economic development, or put Iceland on a path characterized by slower economic growth with an emphasis on building up the ecotourism industry – an industry that heretofore only flourished in the three summer months? Despite these challenging decisions, Júlíusdóttir also knew that she would have to convince the Minister of the Environment, her co-chair of the Master Plan, and the members of the Icelandic parliament that her choices were in Iceland's best interest. Given the debate of the previous ten years, she had no illusions about how difficult it would be to arrive at a consensus and to ensure that this policy was sustainable in light of the market opportunities to sell Iceland's green power to Europe at margins that might grow over time.

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[69] "Stóryrt Björk, Magma Energy vill kaupa alla þá orku sem í boði er hér á landi," August 3, 2010, http://www.pressan.is/Frettir/LesaFrett/storyrt-bjork-magma-energy-vill-kaupa-alla-tha-orku-sem-er-i-bodi-her-a-landi?page=2&offset=50.

[70] *Áhrif stóriðjuframkvæmda á íslenskt efnahagslíf*, p. 13, Hagfræðistofnun Háskóla Íslands, 2009.

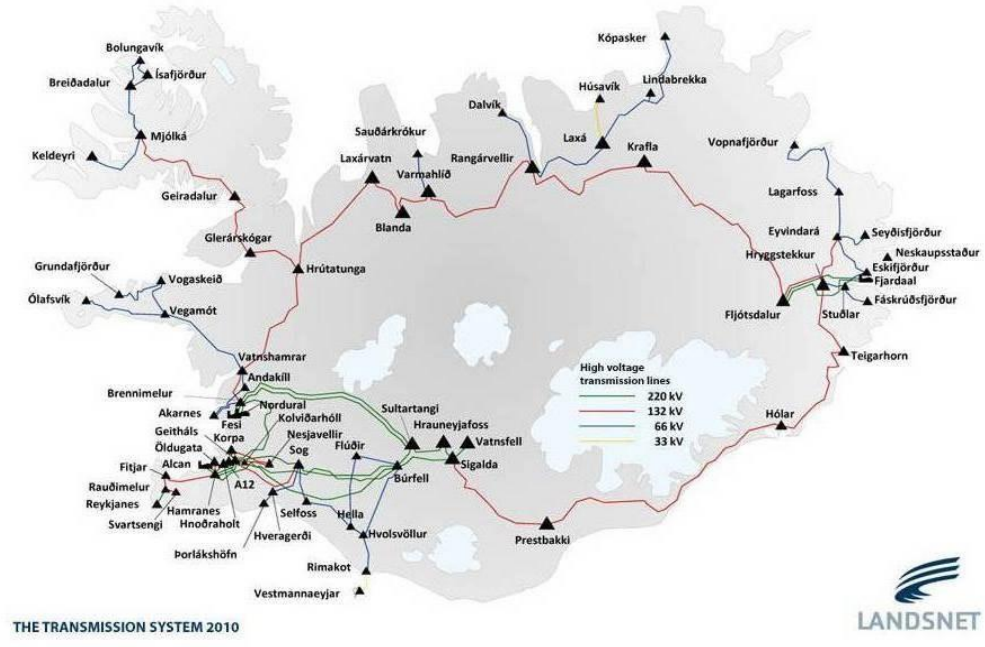
[71] *Um kaup Magma Energy Sweden AB á eignarhlutum HS Orku.* Forsætisráðuneyti, 2010, ATH

[72] "Hverfandi líkur á að álver rísi í Helguvík," October 27, 2010, http://www.mbl.is/frettir/innlent/2011/10/26/hverfandi_likur_a_ad_alver_risi_i_helguvik/.

[73] "Álverið í Helguvík hefur kostað 15 milljarða dollara hingað til," March 17, 2011, http://www.visir.is/alverid-i-helguvik-hefur-kostad-15-milljarda-hingad-til/article/2011110319135.

EXHIBIT 1: Iceland's a) Municipalities and b) Transmission System

Reference: Landmælingar Íslands, Atlas, http://atlas.lmi.is/sveitarfelog/, accessed September 19, 2012.

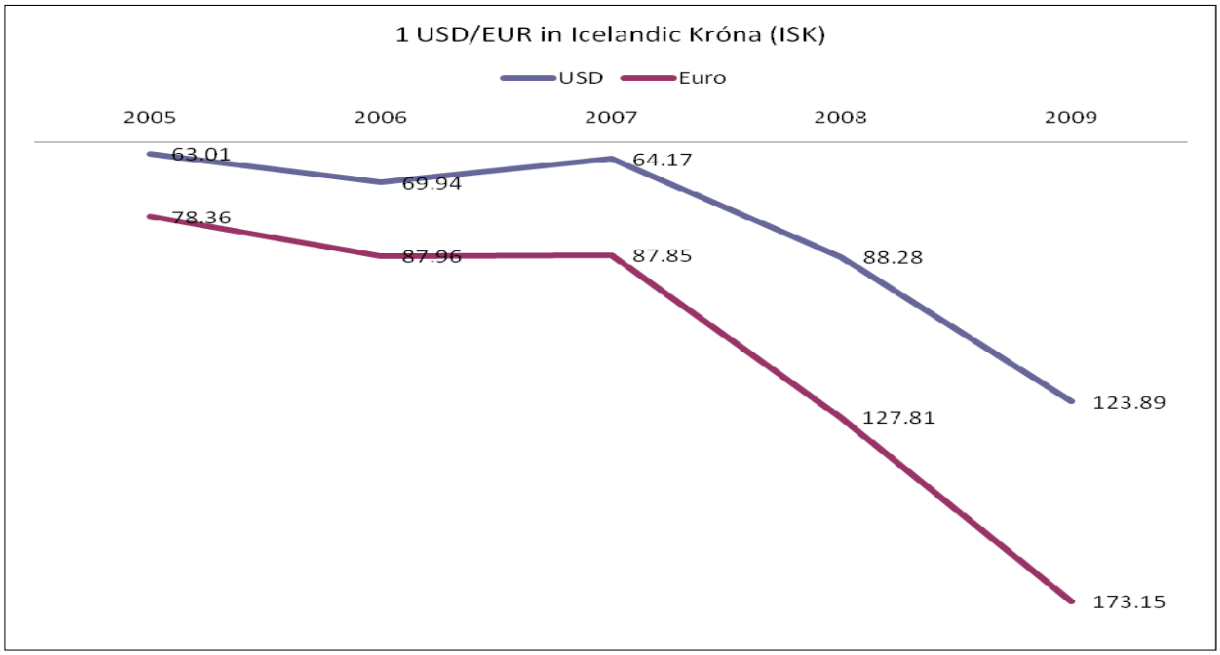


Reference: Landsnet, Power System, http://www.landsnet.is/raforkukerfid/, accessed September 19, 2012.

EXHIBIT 2: Unemployment in Iceland

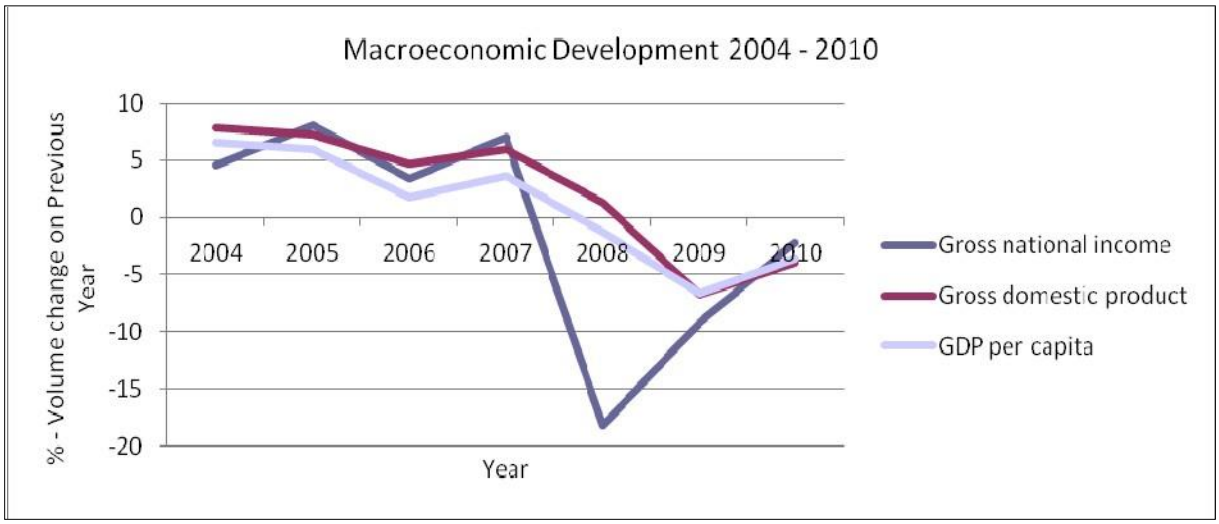
Reference: Statistics Iceland, www.statice.is.

EXHIBIT 3: The Icelandic Króna´s Exchange Rate Development 2005-2009



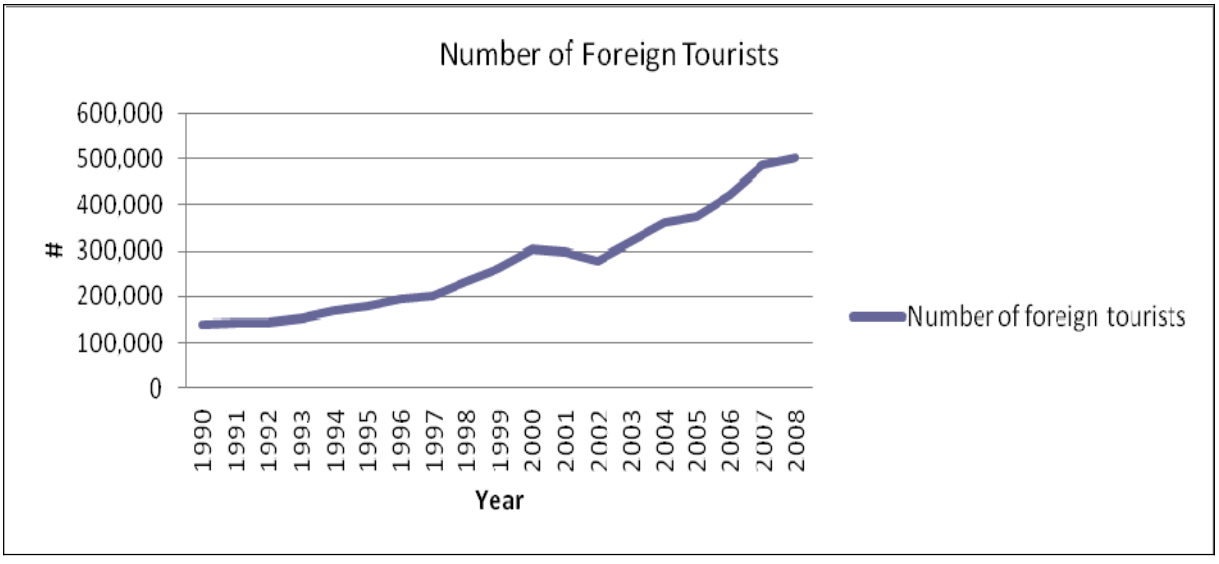
Reference: Statistics Iceland, www.statice.is.

EXHIBIT 4: Development of Iceland's GDP



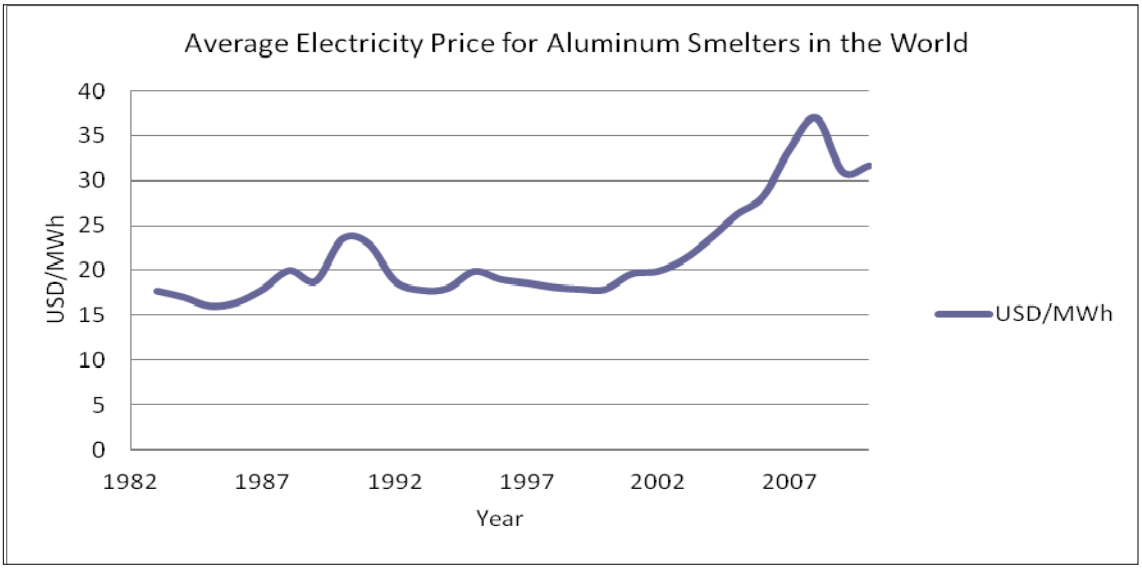
Reference: Statistics Iceland, www.statice.is.

EXHIBIT 5: Number of Foreign Tourists



Reference: Statistics Iceland, www.statice.is.

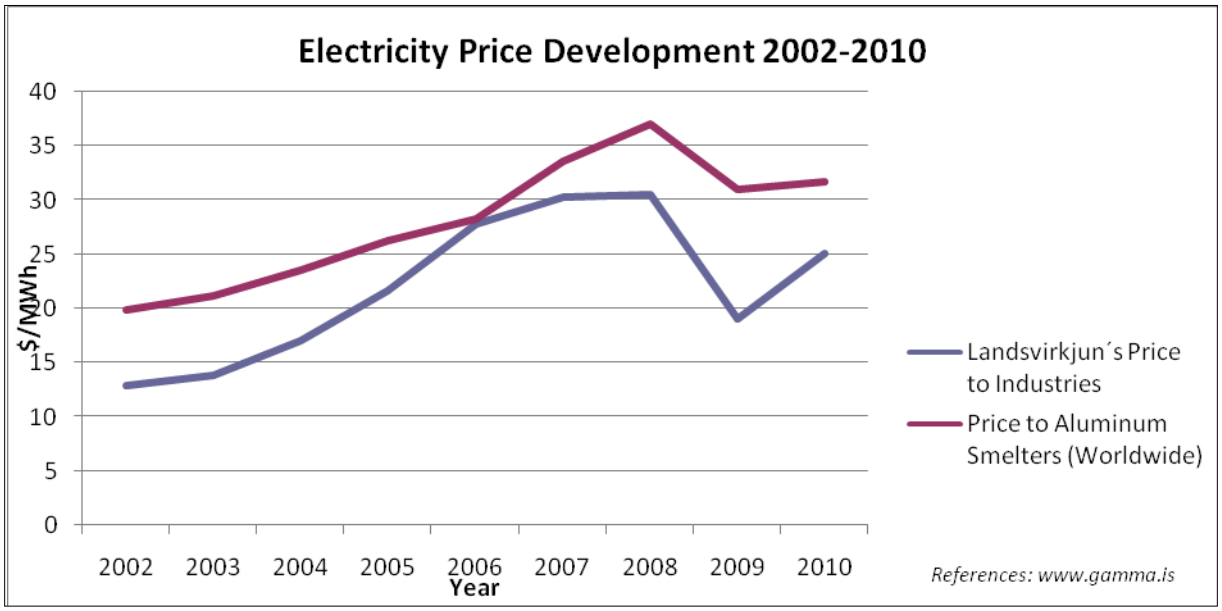
EXHIBIT 6: Average Electricity Price to Aluminum Smelters



Reference: Landsvirkjun, *"*Improved Profitability*:* Unrealistic or Necessary Demands*?"* Presentation by Mr. Hörður Arnarsson, CEO. Landsvirkjun´s Annual Meeting, November 2011.

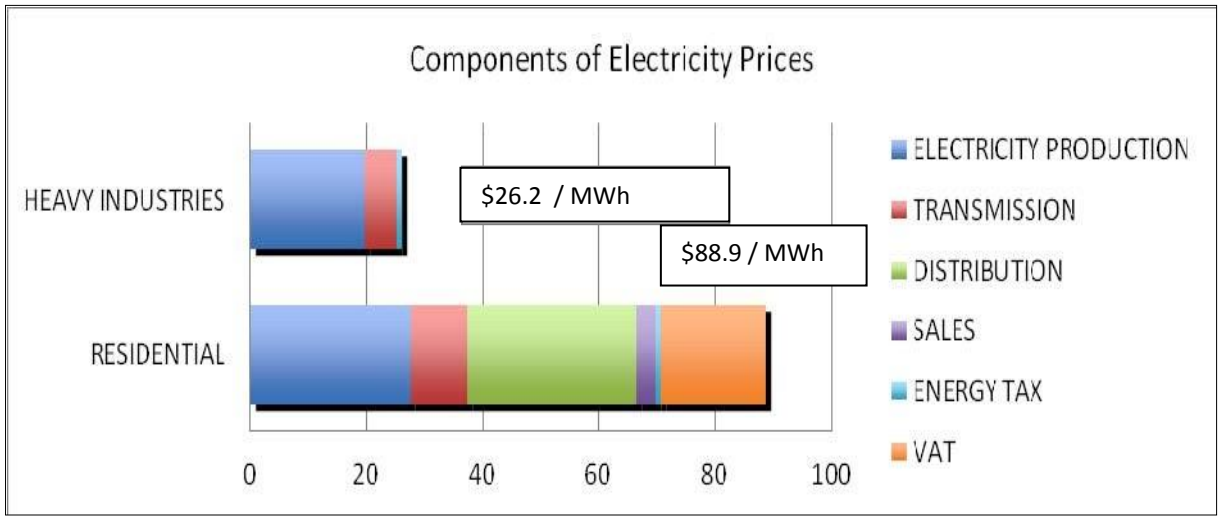
EXHIBIT 7: Electricity Prices

a) Landsvirkjun´s Electricity Prices Development



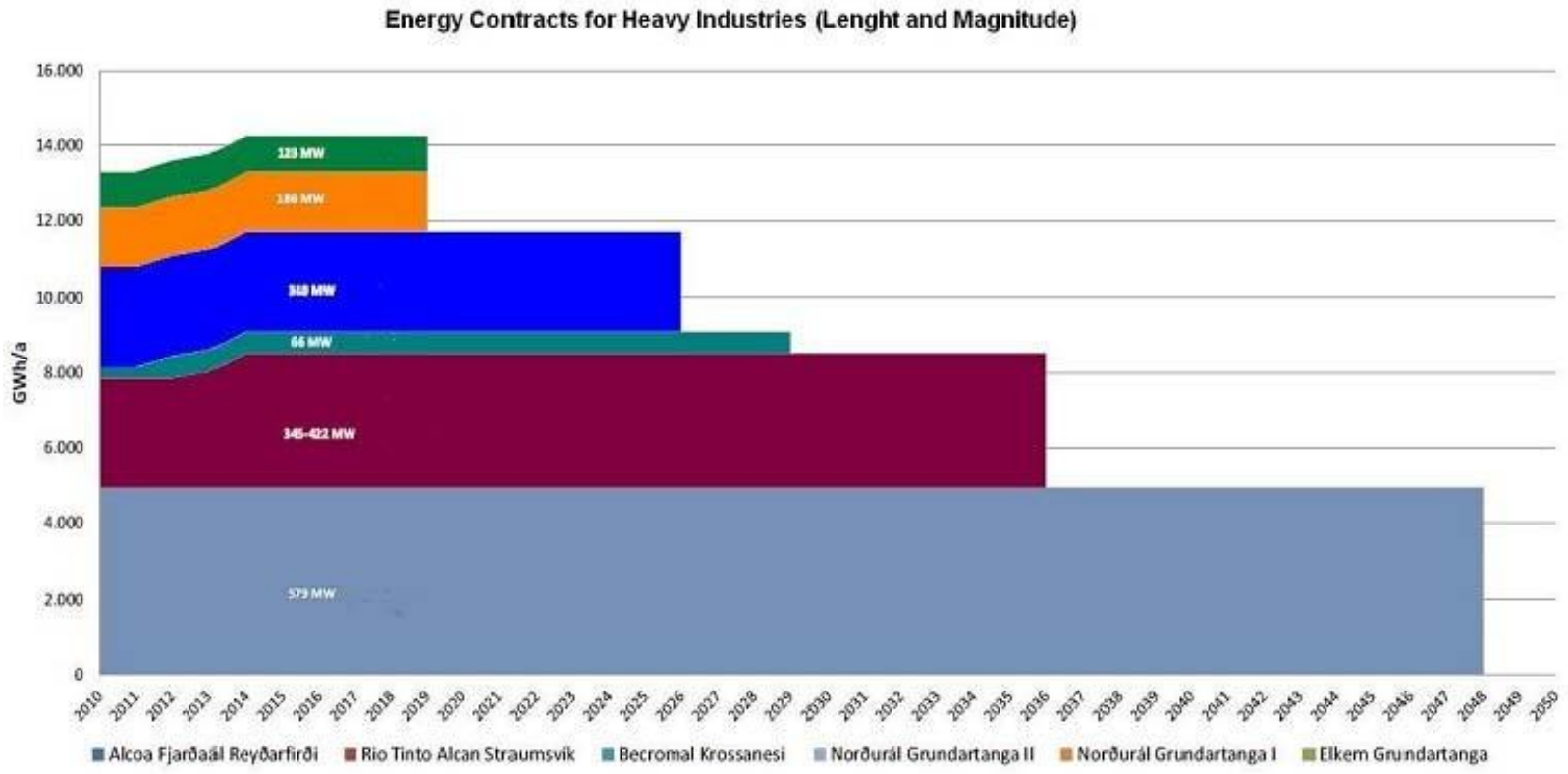
Reference: Landsvirkjun, "A Strategy for the Future, Profitability – Innovation _ Reconciliation." Presentation by Mr. Hörður Arnarson, CEO, Landsvirkjun´s Annual Meeting, November 2010.

b) Landsvirkjun´s Components of Electricity Prices



Reference: Landsvirkjun, "A Strategy for the Future, Profitability – Innovation _ Reconciliation." Presentation by Mr. Hörður Arnarson, CEO, Landsvirkjun´s Annual Meeting, November 2010.

EXHIBIT 8: Heavy Industry´s Electricity Contract Length and Magnitude



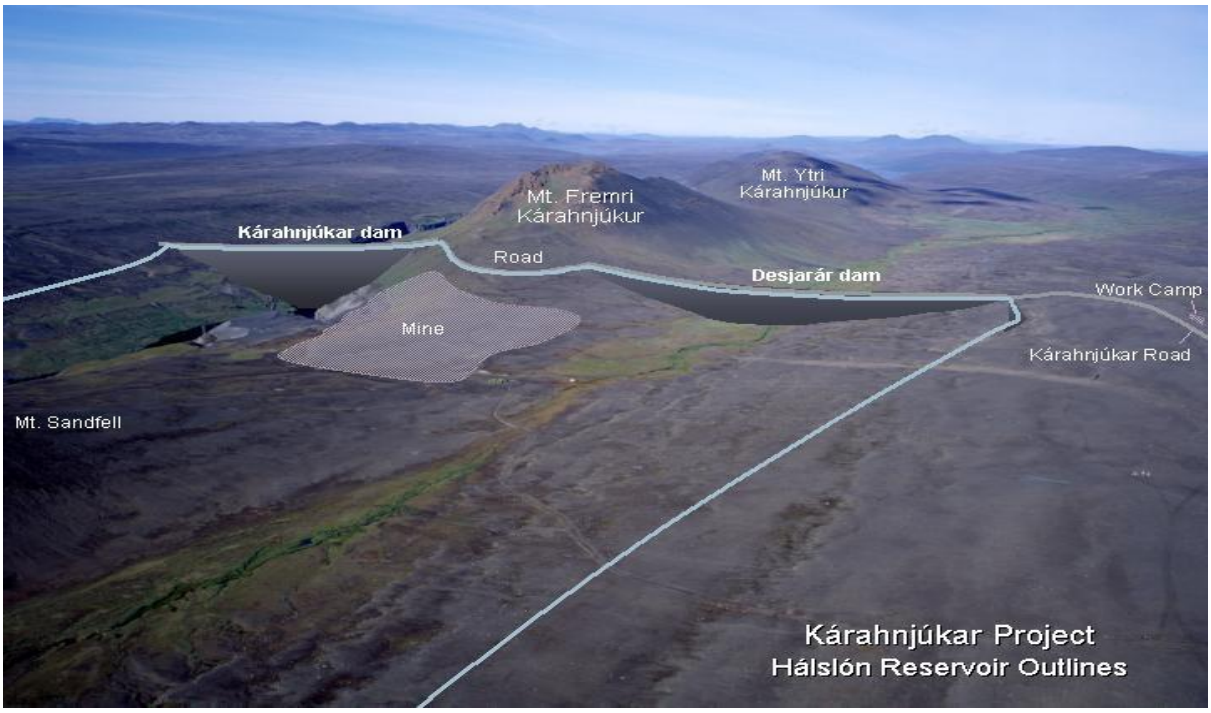
Reference: Ministry of Industries and Innovation, Iceland, “Orkustefna fyrir Ísland,” p. 57, 2011.

EXHIBIT 9: End User Electricity Prices for Industries in Europe

End User Electricity Prices for Industries (Consumption: 20 GWh/year)	
EU-member state	USD per MWh electricity
Austria	$145.42
Belgium	$145.56
Bulgaria	$93.56
Cyprus	$234.68
Czech Republic	$145.71
Denmark	$147.57
Estonia	$112.18
Finland	$104.87
France	$94.41
Germany	$164.62
Greece	$139.69
Hungary	$146.85
Ireland	$135.53
Italy	$190.69
Latvia	$130.66
Lithuania	$157.45
Luxembourg	$125.50
Malta	$229.52
Netherlands	$144.27
Poland	$134.39
Portugal	$125.50
Romania	$107.17
Slovakia	$167.91
Slovenia	$135.25
Spain	$139.69
Sweden	$105.88
United Kingdom	$139.12

Reference: Europe's Energy Portal, http://www.energy.eu/.

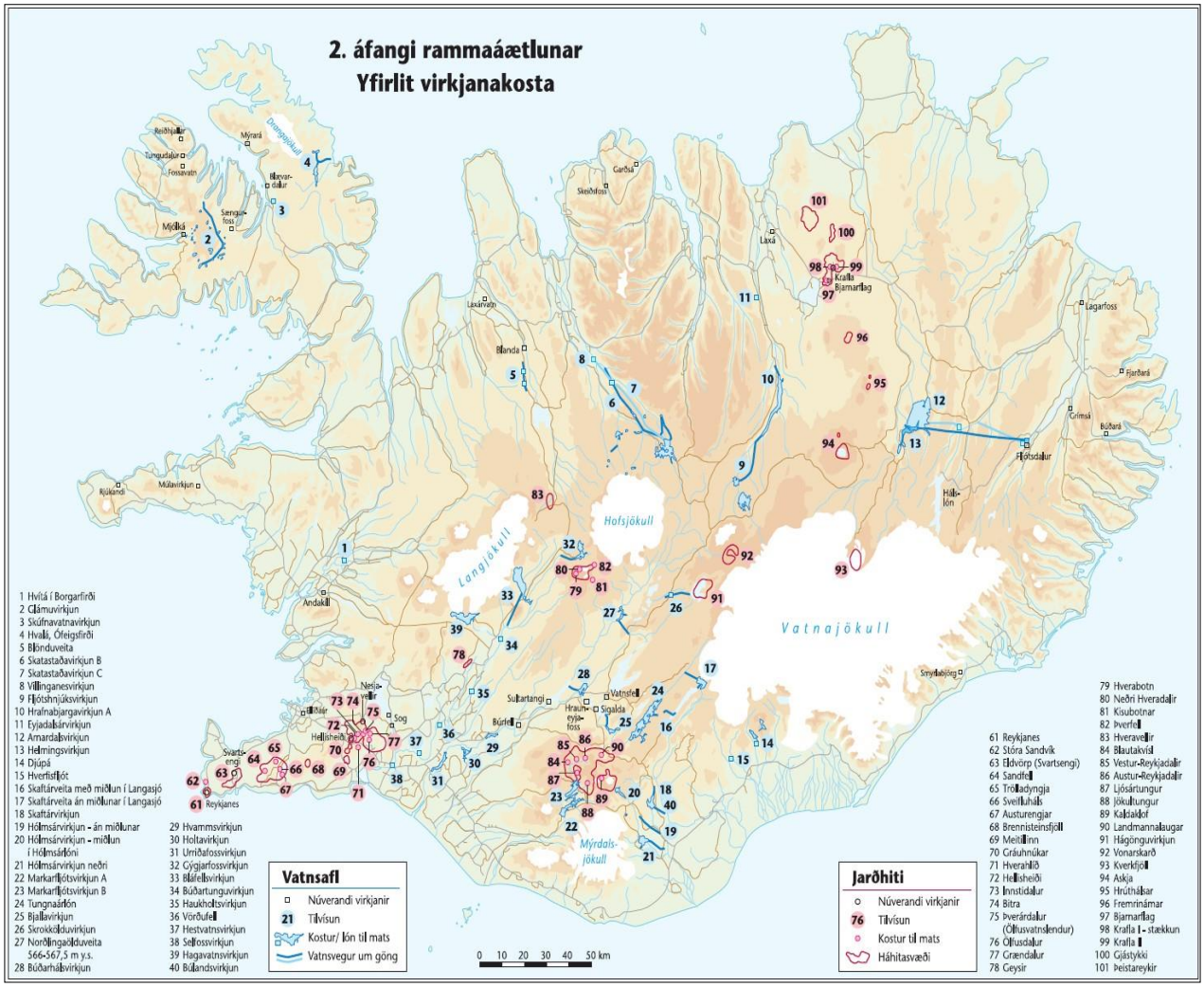
EXHIBIT 10: Land flooding caused by the Kárahnjúkar Dam



Reference: Landsvirkjun, Hreinn Magnússon, We Waste Time Blog, http://wewastetime.wordpress.com/2010/10/13/imported- landscape/.

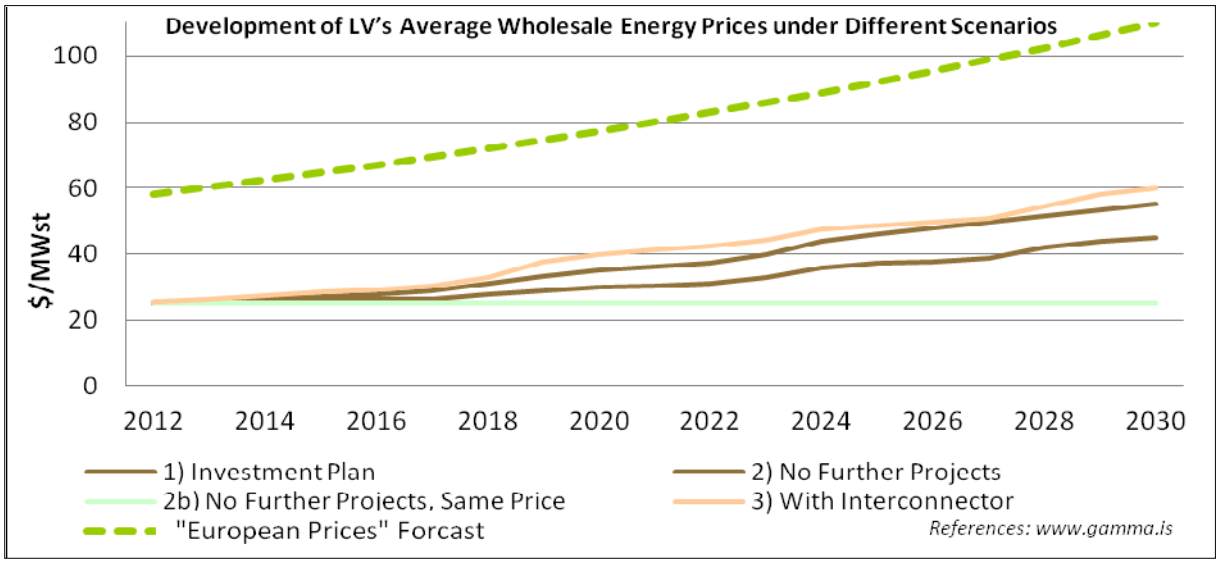
EXHIBIT 11: THE MASTER PLAN

The Power Options Evaluated under the Master Plan



Reference: Ministry of Industries and Innovation, Rammaáætlun, The Master Plan, www.rammaaaetlun.is/media/kort/Yfirlitskort.pdf.

EXHIBIT 12: Landsvirkjun´s Return Forecast Depending on Different Investment Scenarious



Reference: Gam Management, Landsvirkjun´s Renewable Energy Potentia and its Impact on Iceland´s Economy, 2011, http://www.gamma.is/media/skjol/Landsvirkjun-Renewable-Energy-Potential-and-its-Impact-on-Icelands-Economy.pdf.

. EXHIBIT 13: Operation of the Kárahnjúkar Power Station 2008-2011

Operation of the Kárahnjúkar Power Station 2008-2011

ITEMS	OUTCOME
Cost Value	2.3bn USD*
Average Revenue	123m USD*
- Average aluminum price	2.250 USD/tonne
- Average electricity price	27 USD/MWh
Average Cost of Debt	3.2%
Average Revenue / Cost Value	5.3%
Average ROE	3.5%
Cash Flow From Operations 2008-2011	250m USD
Equticy Ratio	33%

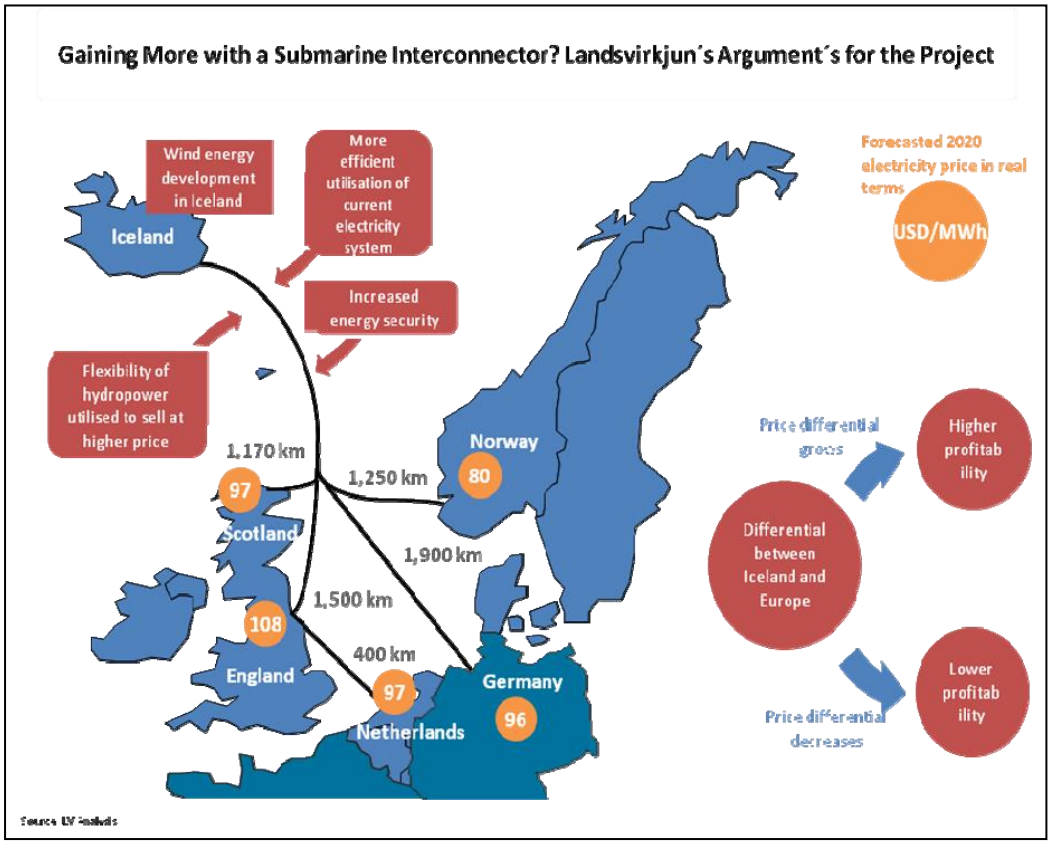
*Cost value and revenues include effects of transmission infrastructure

- Costs include direct costs only, not the plant's share in Landsvirkjun's overheads.
- Despite favorable interest rates, electricity price needs to be considerably higher.

Source: Landsvirkjun

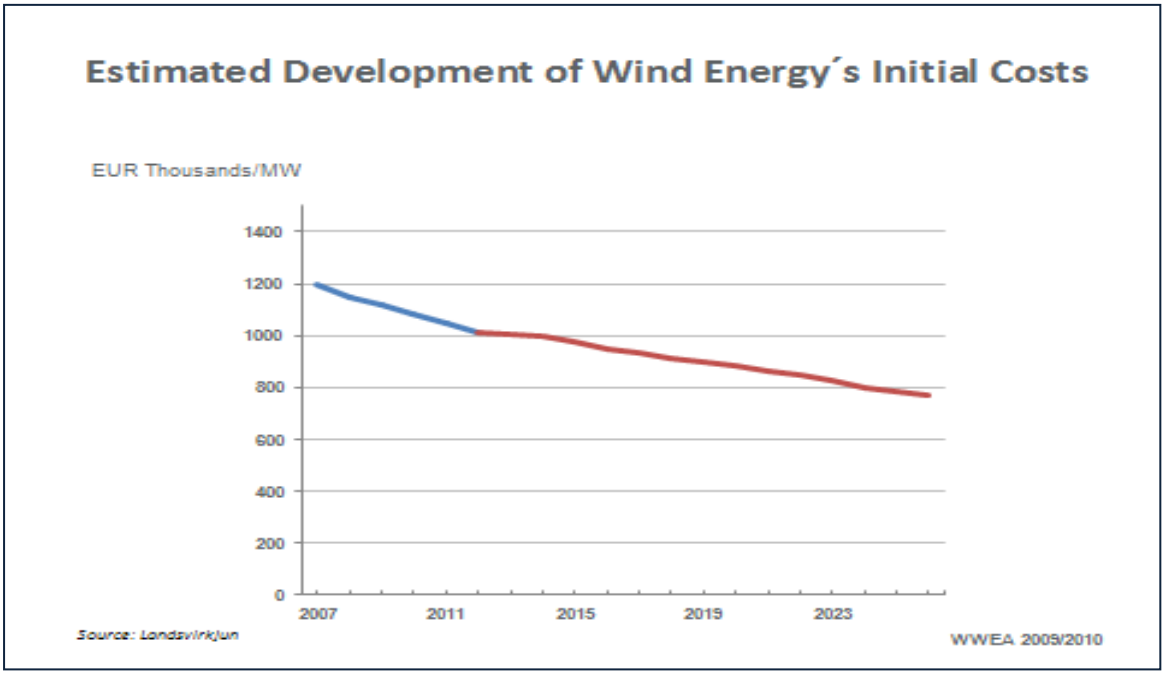
Reference: Landsvirkjun, *"*Improved Profitability*:* Unrealistic or Necessary Demands*?"* Presentation by Mr. Hörður Arnarsson, CEO. Landsvirkjun´s Annual Meeting, November 2011.

EXHIBIT 14: Landsvirkjun´s Submarine Interconnector Plans



Reference: Landsvirkjun, Presentation by Mr. Hörður Arnarsson, CEO. Landsvirkjun´s Annual Meeting, November 2012.

EXHIBIT 15: Estimated Development of Wind Energy's Initial Costs



Reference: Landsvirkjun, "Wind Energy – A Realistic Option in Iceland." Presentation by Mr. Óli Grétar Blöndal Sveinsson, Executive Vice President, Research and Development, Landsvirkjun´s Annual Meeting, November 2011.