Iceland offers power security: An increasingly important aspect of commercial site selection

Site selection for industrial and commercial facilities is a complex and multi-faceted process, and incorrect siting can have significant negative long-term financial repercussions for companies. For power-intensive facilities, reliable and foreseeable electricity availability and pricing are often the primary drivers in the decision on siting. There has been a world-wide increase in power price volatility in recent years, which industry experts expect to continue. Volatility is expensive and makes long-term planning and investments challenging. Power prices are also often subject to variations in carbon costs caused by either shifts in the market or new laws and regulations. Insulating power-intensive operations from the costs of power outages and price fluctuations has become a goal for companies seeking to make strategic long-term decisions focused on achieving sustainable competitiveness.

Power Costs Affect Competitiveness

For many companies, electricity is one of the largest line items in the operating budget. As such, it warrants considerable management attention. The aluminum industry exemplifies this well; according to the metals and mining analyst firm CRU, power accounts for over 30% of the total cost of producing aluminum. Other power-intensive manufacturing processes include the production of silicon metal, ferro-silicon and polysilicon. Depending on location, power costs for these processes typically range between 20-30% of the overall operating expenses.

Further examples of companies that benefit from secure power pricing and availability can be drawn from the data center industry, which does not directly engage in the production of goods, but relies on power security to ensure the continuity and competitiveness of its service offering. Power represents between 20-40% of operating cost in a typical data center and, as computing activity grows, the power bill increases, highlighting the importance of a secure price for the operation.

What these industries, and many more, have in common is the need for electricity that is reliable in terms of pricing and availability. In Iceland, companies also have the opportunity to capitalize on the fact that it is all generated from renewable energy sources.

Three Pillars Of Power Security

During the polar vortex of January 2014, day-ahead, on-peak power prices at the Massachusetts Hub reached $237.75/MWh. There were a number of factors at play, including weather, the electricity transmission system, natural gas pipeline capacity, and huge growth in the use of natural gas.

These factors are at the heart of volatility in a number of areas globally, and with increasing utilization of intermittent energy sources and the pressure to decarbonize electricity production, the landscape of the energy sector has changed. Power security addresses the challenges that have arisen from this new landscape and can be divided into the following categories: Physical security, price security, and carbon security.

Physical security

Physical supply insecurity is becoming more prevalent on a global scale due to increasing fuel and geopolitical risks. The continuous availability of electricity in a region can be a product of many factors. For fuel-based generators, fuel supplies must be delivered as expected,
The Longest River

The Thjórsá and Tungnaá rivers form Iceland’s longest waterway and are the backbone of Landsvirkjun’s electricity generation. Six hydroelectric power stations harness the flow of water from reservoirs in the highlands (elevation approx. 800 metres above sea level) to the lowest and oldest station at Búrfell (200m a.s.l.). The total installed capacity is 935MW. Three stations with a total capacity of 265MW are in various stages of planning further down Thjórsá River.
whether by pipeline, train, truck or tanker. Any interruption might reduce or disrupt power availability. Similarly, the power transmission grid linking the generator to the customer’s site must stay up at all times. Both fuel supplies and the transmission grid can be compromised by a wide variety of events, including natural disasters (weather, flooding, earthquakes, etc.), accidents, equipment failures and geopolitical acts. A 2013 US Government report [1] estimated that weather-related power outages between 2003 and 2012 cost the U.S. economy an inflation-adjusted annual average of $18 billion to $33 billion.

Increasing power dependence on gas leaves market players more vulnerable to price spikes due to delivery disruptions, according to a 2013 report by the North American Electric Reliability Corporation [2], because, unlike coal, gas is not easily stored on site. Although solar and wind generators are not dependent on fuel supplies, neither sunlight nor wind are continuously available, so customers directly connected to these installations typically need to supplement them with a connection to the grid in order to ensure continuous power.

Although certain types of companies can ride through power reductions with reduced operations, for many, the reliability of secured and continuous power is vital to the operation. An aluminum smelter can, for example, not survive a power outage for longer than a few hours before key parts of its infrastructure are damaged, and after six hours the vital parts of its billion-dollar infrastructure will need to be replaced. The importance of continuous power is also exemplified in the data center industry, where the facilities are partly graded on their ability to ensure continuous power to essential IT systems, and each minute of downtime can amount to significant financial damage to the operation. Costs are threefold for companies experiencing power reductions including the cost of repairs, lost revenues and the long-lived consequences of business disruption.

World-Class Reliability

Iceland has consistently ranked in the top ten worldwide by the World Economic Forum for quality of electricity supply.
According to a recent Ponemon [3] study of 41 U.S. data centers, power outages cost over $11,000 per minute if the data center is integral to the business, such as for e-commerce companies. The same study also revealed how common outages are with 95% of participants reporting at least one unplanned outage in the past 24 months, with complete blackouts occurring once a year on average. Ponemon estimated the average cost per outage incident at over $1 million.

**Price Security**

In general, electricity markets have become more volatile in recent years [Figure 1] and many experts expect the trend to continue [4]. For a power-intensive user such as a metal processing plant or a data center, unstable power prices make operating expenses difficult to predict, which can negatively impact productivity, pricing decisions and ultimately companies’ profitability and competitiveness. What power-intensive industries need is price security, represented by electricity price that is not influenced by external market factors such as fuel price increases or fuel delivery problems. [Figure 2]

**Carbon Security**

Power prices are often subject to variations in the carbon taxes or costs now in place in about 40 national and
over 20 subnational jurisdictions that have adopted emissions trading schemes or carbon taxes [5]. Carbon emissions are an unavoidable byproduct of traditional fossil-fuel electric generation and have a negative impact on the environment. To curb emissions more and more countries are introducing cap-and-trade schemes or taxes on emissions. Tax rates on carbon emissions in member countries of the Organization for Economic Co-operation and Development (OECD) range from below 5% to over 100%. For power-intensive users, the reduction or avoidance of emissions has become an important part of cost control. Demonstrating overall sustainability has also become a growing component of overall brand management.

The Benefits of Power Security

The aluminum industry has historically been able to lower production cost [Figure 3] via technology development, but as the industry matures the main source of reduced production cost has been through competitive energy price contracts. Consequently, the aluminum industry has migrated towards power security. According to CRU, Iceland and Norway gained market share in primary aluminum production in Western Europe over the last fifteen years by 17 and 7 percentage points respectively - whereas other countries either did not increase production or lost market share. The aluminum industry in Europe is moving north, where power security is available. [Figure 4]

Is Your Company Seeking Power Security?

In mature, power-intensive industries power price determines competitiveness and assured power pricing allows companies to achieve long-term power-related competitive advantage. The lower price and low CO2 emissions from Iceland’s power generation translate to significant savings. Nearly 100% of electricity in Iceland is generated from hydro and geothermal energy sources. The power available from these renewable resources far exceeds the country’s own needs – Iceland effectively “exports” over 80% of its electricity in the form of products like smelted aluminum and by powering data centers serving clients around the world.

Fig. 3. Historical Year Average Aluminum Price
Because hydroelectric and geothermal generators do not require fuel, Landsvirkjun’s electricity price is not affected by the aforementioned risks that power generation from conventional energy sources typically faces, allowing the company to offer long-term electricity contracts at a fixed rate. Currently, Landsvirkjun offers electricity contracts at a fixed real price of 43 USD/MWh, available for up to 12 years with discounts for selected greenfield projects.

The fuel-free nature of Iceland’s power also avoids the vulnerabilities of fuel delivery. Further, unlike solar or wind power sources, hydro and geothermal energy are continuously available. The transmission grid in Iceland has historically been built around power-intensive users, such as aluminum smelters, that require a high level of power transmission security. The country’s power grid is regularly ranked within the world’s top three in reliability. Notably, the World Economic Forum has consistently ranked Iceland in the top ten countries with the greatest power quality, and in its 2014–2015 Global Competitiveness Report, the Forum gave Iceland a power quality rating of 6.6 out of 7.

Iceland’s added Benefits for many Industries: Cooling and Heating

The electricity used for computing racks ultimately ends up as heat. Some in the generation and transmission process, the rest as the processors, storage and network components perform their tasks. This heat has to be wicked away from computing components, and then removed from the cabinets and the rooms the cabinets are in, to avoid damaging heat-sensitive components and to prevent system shut-downs.

Traditionally, the chillers, air conditioning and other cooling solutions used to extract this heat require anywhere from 30% to 100% as much power as computing systems, adding significantly to the electrical bill and to the cost and complexity of facilities.

Because of its latitude and being surrounded by chilly waters, Iceland has a cool climate – one that data center planners and builders and their customers can take advantage of. The average daily high temperature in Reykjavík during July (the city’s warmest month) is
13.5°C/56°F, and on a very warm summer day the temperature can climb to 20°C/68°F. During the coldest months the average temperature is -2°C/28°F, which is cool enough for data centers to use the already cold air and water to provide cooling. For example at the Thor Data Center, which houses the Nordic High Performance Computing (NHPC) data center, chilling can be done by simply opening up windows to let in cool air. In fact, the NHPC data center reported a 50% decrease in energy costs by moving the system to Iceland [6].

In addition to cool air, naturally cold water is available in many parts of Iceland, providing another very low-cost cooling option. For example the Verne Global’s data center buildings in Iceland’s “Ásbrú Enterprise Park” have access to a natural water aquifer, which can be used for water cooling solutions.

At the same time Iceland offers heat from several sources, ranging from geothermal heat as a byproduct of power generation to excess heat from data centers. In addition to being used to heat offices and residences, this heat can be used to help create ambient controlled environment for exportable products such as fish farming, growing algae for food products and generating renewable fuel.

There are even more extreme examples of cost reductions by moving HPC operations to Iceland. Notably, BMW Group reported an impressive 82% reduction of operating cost in their HPC clusters compared to operating in Germany. Shifting the computer load to Iceland’s hydro and geothermal based power furthermore reportedly saved BMW around 3,750 tons of CO₂ emissions annually.

Savings to this degree add up. According to Tate Cantrell, CTO at Verne Global, which owns and operates a major data center in Iceland, “Savings for large installations over a ten to twenty-year period can be in nine digits, without sacrificing anything.”

Certified Renewables
A renewable resource is not enough to guarantee sustainable operations overall, which requires much more effort and requires looking at all aspects of company operations. The quality of Landsvirkjun’s environmental mitigation and power plant management are certified by external auditors such as Tüv Süd and receive acclaim by initiatives such as the Hydropower Sustainability Assessment Protocol, which is a tool for assessing the sustainability of hydropower projects against a comprehensive range of social, environmental, technical and economic considerations.

The marginal levels of emissions that are the byproduct of renewable electricity generation: methane emissions from reservoirs and marginal CO₂ emissions from geothermal power production will eventually be offset entirely, as Landsvirkjun aims to become 100% carbon neutral by 2030.

Power Security in Iceland
As the landscape of the energy sector continues to change, power-intensive companies need to explore solutions that address stable pricing, highly reliable availability, and renewability.

Iceland offers power security to power-intensive manufacturing, data centers and other industries. Thanks to Iceland’s hydroelectric and geothermal resources, Landsvirkjun can provide you with competitively-priced reliable power with long-term, fixed-price power purchase agreements with no carbon costs.
About Landsvirkjun:
Landsvirkjun generates renewable energy at competitive prices. The company is owned by the Icelandic State and has over 45 years of experience generating electricity from hydro and geothermal power sources. Landsvirkjun is Iceland’s largest generator of electricity, currently operating 16 renewable hydro- and geothermal power stations. Landsvirkjun’s mission is to maximize value creation from energy sources entrusted to the company in a sustainable and efficient manner. If interested in knowing more, contact us at power@landsvirkjun.com

Works cited:


[6] Nordic HPC – How four universities work together to maximize computing power by offshoring to Iceland.
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