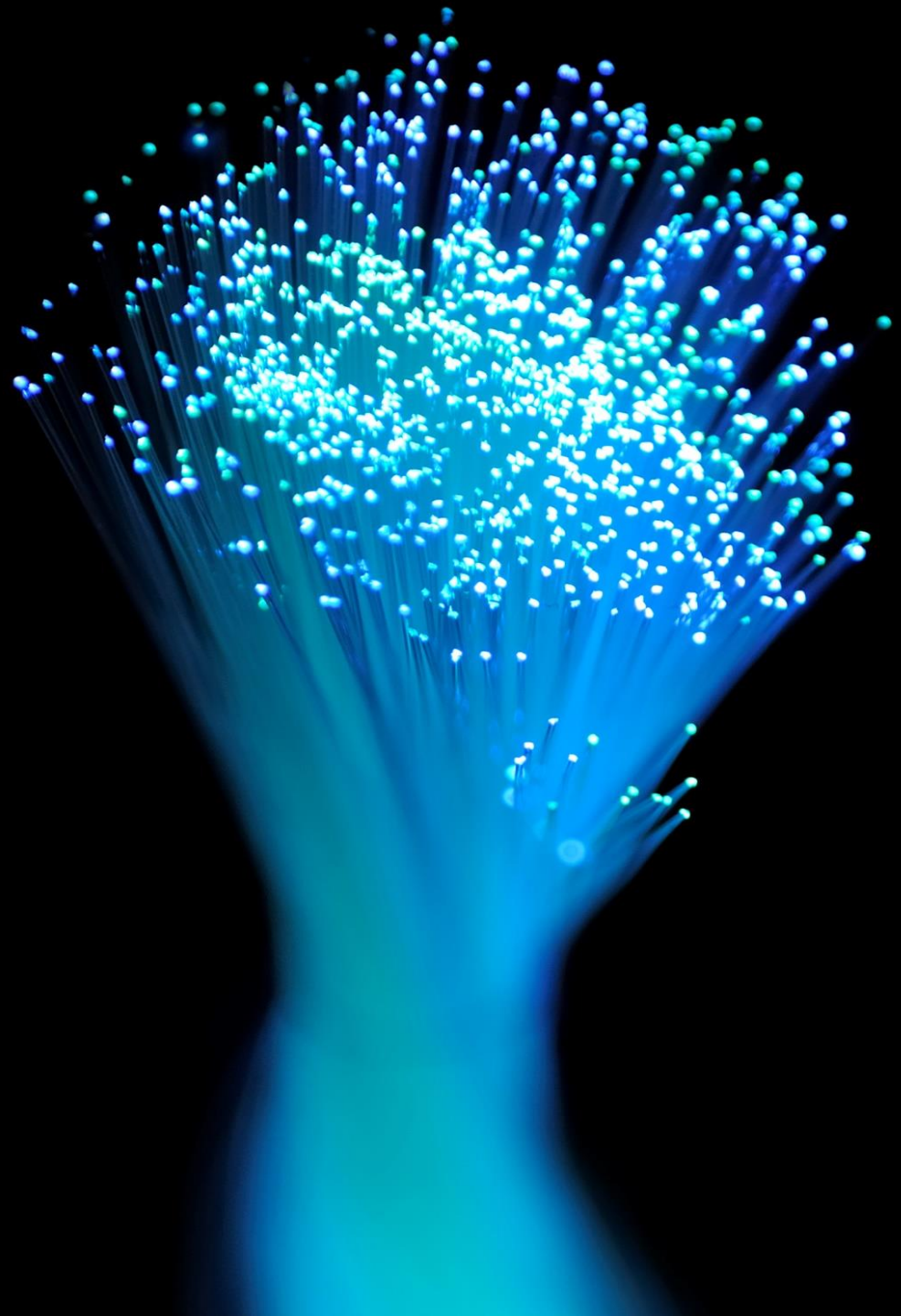
KPMG

The Icelandic Data Center Industry



Report for DCI

—

March 2018

Abbreviations

AI	Artificial Intelligence	**GPP**	Geothermal power plant	**NOC**	Network operations center
AWS	Amazon Web Services	**GW**	Giga Watt	**OECD**	The Organisation for Economic Co-operation and Development
CAGR	Compound annual growth rate	**GWh**	Giga Watt hour	**OPEX**	Operating expenses
CO2	Carbon Dioxide	**HPC**	High performance computing	**OTT**	Over the top
DC	Data center	**HPP**	Hydro-electric power plant	**PE**	Permanent establishment
DSO	Distribution system operator	**HV Connection**	High voltage connection	**PoP**	Point of Presence
EEA	European Economic Area	**ICT**	Information and communication technology	**PPA**	Power purchase agreements
EFTA	European Free Trade Association	**IoT**	Internet of Things	**PSO**	Public Service Obligation (Tariff)
EMEA	Europe, Middle East and Africa	**IP**	Internet protocol	**PUE**	Power usage effectiveness
ESA	EFTA surveillance authority	**kV**	Kilo Volt	**RFP**	Request for proposal
ETS	The EU Emissions Trading System	**kW**	Kilo Watt	**SMACC**	Social media and critical care
EU	European Union	**kWh**	Kilo Watt hour	**TBps/Tbit/s**	Terabit Per Secon
FTE	Full time equalent	**LLC**	Limited liability company	**TCO**	Total cost of ownership
FTTH	Fiber to the home	**MBps/Mbit/s**	Megabit per second	**TSO**	Transmission system operator
GBps/Gbit/s	Gigabit per second	**MPLS**	Multi protocol label switching	**VAT**	Value added tax
GDP	Gross domestic product	**MTDC**	Multi tenant data center	**WB**	World Bank
GDPR	General data protection regulation	**MW**	Mega Watt		
GGE	Gross grant equivalent	**MWh**	Mega Watt hour		

KPMG

Advisory
Borgartún 27
105 Reykjavík

Private and confidential **March 15th 2018**

DCI Association of Data Centers in Iceland
Borgartún 35
105 Reykjavík
Iceland

Report on the Data Center Industry in Iceland

In accordance with our Engagement Contract and its attachments dated September 22 2017 ("our Engagement Contract"), we have produced a comprehensive report on the Data Center Industry in Iceland.

This report has focus on the current and future competitive advantages and disadvantages of Iceland as a location for Data Centers from an international perspective.

In our report we have made recommendations on how Iceland's competitive advantages may be maintained and increased and competitive disadvantages may be managed and reduced based upon our key findings.

Yours sincerely,

Benedikt K. Magnússon
Partner, KPMG Iceland

Mark de Groot
Partner, KPMG Holland

Important notice

This draft report is confidential and has been prepared on the basis of an Engagement Contract with Íslandsstofa and DCI Iceland ("the Client"). This draft report cannot be copied, referred to or disclosed, in whole or in part, to other parties without KPMG's prior written approval.

The report is based on information gathered at meetings with the Client and other information provided by firms in the industry. KPMG makes no representation or warranty, expressed or implied, as to the accuracy, reasonableness or completeness of the information contained in this document. KPMG expressly disclaims any and all liability for any information contained in, or errors in or omissions from this document or based on or relating to the recipients' use of the information contained within it.

Details of principal information sources are set out within the report and KPMG has satisfied itself, so far as possible, that the information presented in the report is consistent with other information which was made available during the course of the work. KPMG has not, however, sought to establish the reliability of the information.

This report is not suitable to be relied on by any party wishing to acquire rights against KPMG (other than the Client) for any purpose or in any context. Any party other than the Client that obtains access to this report or a copy and chooses to rely on this Report (or any part of it) does so at its own risk. To the fullest extent permitted by law, KPMG does not accept any responsibility or liability in respect of this report to any party other than the Client, (including potential investors' legal and other professional advisors).

Table of Contents

KPMG contacts in connection with this report are:

Benedikt K. Magnússon
Partner,
KPMG Reykjavík

Tel:+ 354 545 6000
bmagnusson@kpmg.is

Mark de Groot
Partner,
KPMG Holland

Tel:+ 31 6 232 18228
deGroot.Mark@kpmg.nl

Gunnar Tryggvason
Senior Manager,
KPMG Reykjavík

Tel:+ 354 545 6206
gtryggvason@kpmg.is

Árni Þ. Jónsson
Senior Manager,
KPMG Reykjavík

Tel:+ 354 545 6206
arnijonsson@kpmg.is

Methodology and approach

Making this report, we accounted for somewhat special nature of the Data Center Industry in our approach. It is quite new, but has grown rapidly in recent years. The business model's of companies in the industry we looked at are very different, and are constantly changing due to rapid technological advances. A comparison between periods can therefore be difficult. Consequently, we used a variety of methods to achieve our goals in diagnosing the competitiveness of the Icelandic Data Center Industry compared to its neighboring countries.

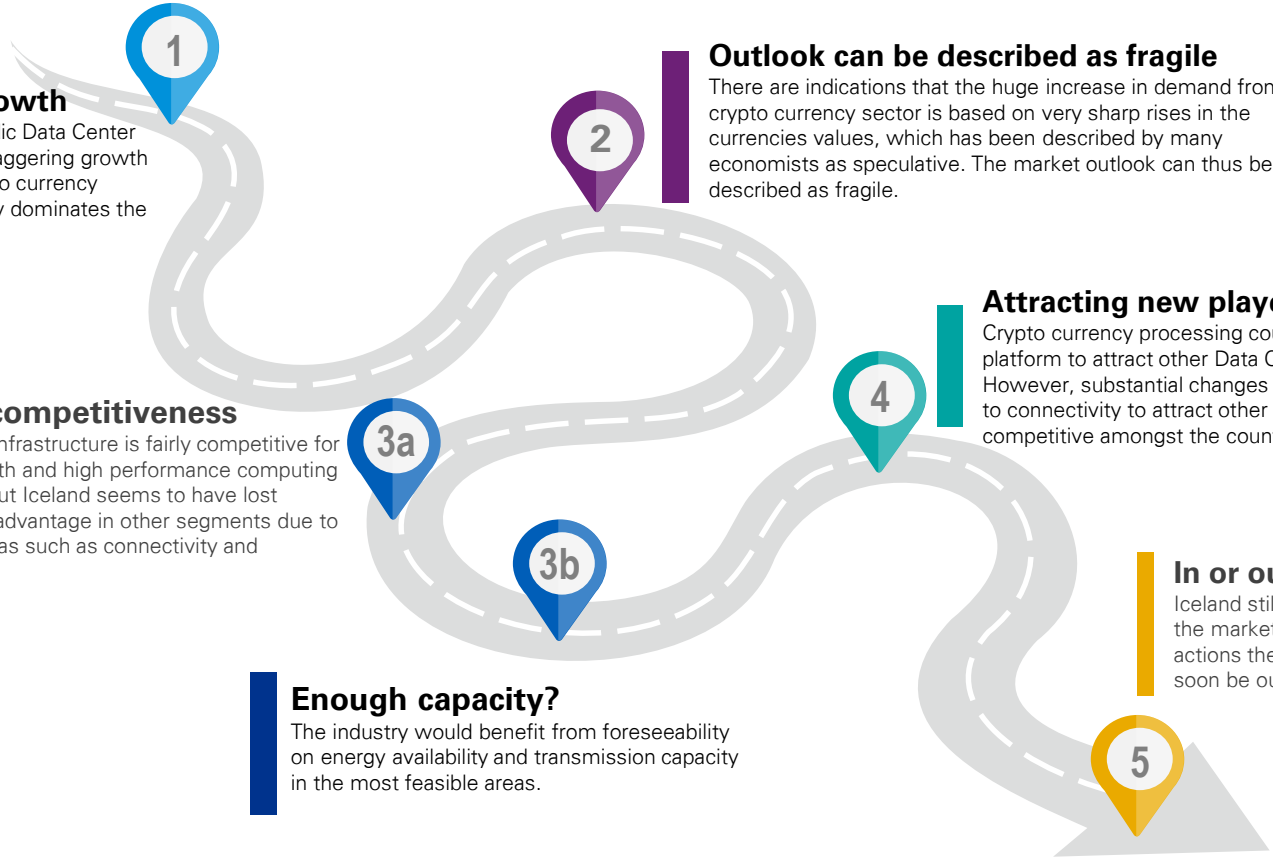
The project team included experienced subject matter consultants from the Icelandic, Dutch, and UK member firms to further establish an international perspective.

The scope of the RFP was to compare Iceland internationally to the following European countries: Norway, Sweden, Finland, Denmark, and Ireland. Much of the data we gathered from various databases contain symmetrical information about the northern countries, but not Ireland.

We emphasized on reviewing various analysts researches on the comparing countries, gathering and using public information, interviewing and gathering information from stakeholders within the industry. It soon became evident that available information on the Icelandic market was limited. We therefore carried out an informal study amongst major stakeholders providing very informative data on the position of the market and industry expectations for the coming years.

We utilized various databases with statistics of European countries and data from exchange markets for latest information trying to be as forward looking as possible.

Key Findings



Homogenous growth

Key players in the Icelandic Data Center industry are expecting staggering growth predominantly from crypto currency processing, which already dominates the sector.

Outlook can be described as fragile

There are indications that the huge increase in demand from the crypto currency sector is based on very sharp rises in the currencies values, which has been described by many economists as speculative. The market outlook can thus best be described as fragile.

Losing competitiveness

The current infrastructure is fairly competitive for low bandwidth and high performance computing workloads, but Iceland seems to have lost competitive advantage in other segments due to pricing in areas such as connectivity and electricity.

Attracting new players

Crypto currency processing could be an valuable platform to attract other Data Center operations. However, substantial changes are needed in regards to connectivity to attract other players and be competitive amongst the countries of scope.

Enough capacity?

The industry would benefit from foreseeability on energy availability and transmission capacity in the most feasible areas.

In or out?

Iceland still has an opportunity in the market but without decisive actions these opportunities could soon be out of reach.

Background

Iceland as a location for Data Centers

Iceland has been recognized as an appropriate location for international Data Centers due to several factors. For example, Iceland is on top of the Cushman & Wakefield Data Center risk index for 2016, and was considered the least risk inclined country. Iceland's strengths and weaknesses as addressed in that report, are listed in the table to the right.

These strengths are likely to have contributed to a rather fast growth rate of the sector over the last five years, with industry players giving more weight to cold climate, clean, reliable and economical energy. The growth rate, measured in annual electrical energy usage, has increased from 0 to 218 GWh from 2012 trough 2016. The compound annual growth rate (CAGR) in Iceland over the last three years was above 100% compared to roughly 10% growth world wide, as the Icelandic Data Center Industry managed to attract a number of clients in crypto currency processing, as well as some in the fields of colocation and HPC.

Fierce competition

Despite favorable ranking and high growth in terms of electrical energy usages, Iceland has to date, failed to attract the top 10 MTDC's and the large international Hyperscale providers such as Facebook, Amazon, Apple, Google and Microsoft. These companies have announced their decision to build large Data Centers in all the other Nordic countries except for Norway and Iceland which are not members of the EU.

There are strong indicators that countries which have recently succeeded in attracting the Hyperscale providers and MTDC'S have been launching tailored initiatives such as providing special financial incentives, tax breaks, and lower prices for both electricity and connectivity, in order to make their locations more attractive.

Iceland's ranking in 10 subcategories

Highest five	Rank
Share of renewables in total energy supply (%)	1
World risk assessment vulnerability and coping capacity (Natural disaster/ Economic & political challenges in urban areas)	2
Water availability	2
Political stability	6
Energy - Electricity (Cost per Kwh)	6
Lowest five	**Rank**
Corporation Tax	9
International bandwidth (Megabits per second)	10
GDP per capita	13
Ease of doing business	14
Energy security	22

Source: Cushman & Wakefield

Economic growth

Economic impact from the IT and Telco sectors

The information technology sector in Iceland has been growing at a steady pace since the beginning of the century. The annual growth in both the IT and Telco sector in Iceland is represented in the graph on the right. During a six year period, from 2010 to 2016, the sectors has experienced growth of 63% in total or 18% annually resulting in a 2.8% contribution to the total gross domestic product of the country.

Economic impact from the Data Center sector

There have been several studies conducted covering the impact the Data Center sector has had on the Swedish[1] (2015) and Finnish[2] (2016) economies. No similar data is currently available for the Icelandic Data Center Industry, however, if the same methodology can be used to create a rough estimate of the size and growth of the industry by using electrical consumption as a scaling factor.

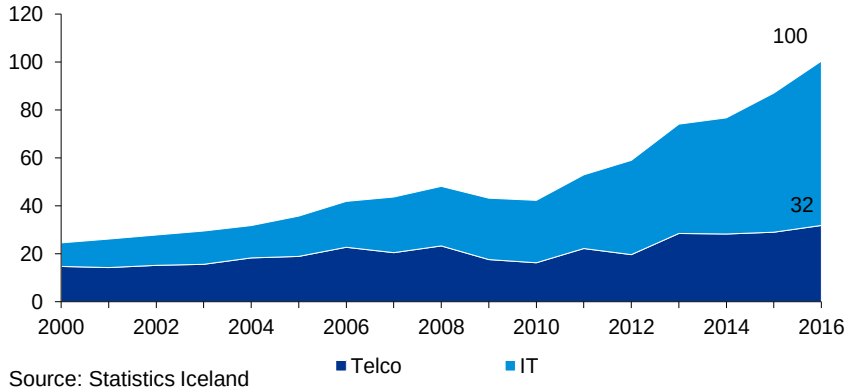
The result of that scaling indicates that the total direct, indirect, and induced contribution of the sector to the Icelandic economy is 178 m.EUR or 0.97% of the country's GDP in 2016. Similarly, in correlation with the Finnish findings, the sector may be creating roughly 850 jobs (FTE) in construction and operation. The unusually high proportion of crypto currency processing in the Icelandic market indicates that these estimates are in the higher range of actual industry contribution.

Participants

The Data Center Industry needs many types of services as evident by the value chain chart on next page. The chart includes the different suppliers, service companies, and contractors that benefit from the existence and growth of the Data Center Industry in Iceland.

1) Boston Consulting Group
2) Copenhagen Economics

Development of GDP from the IT and telco sector (bn.ISK)



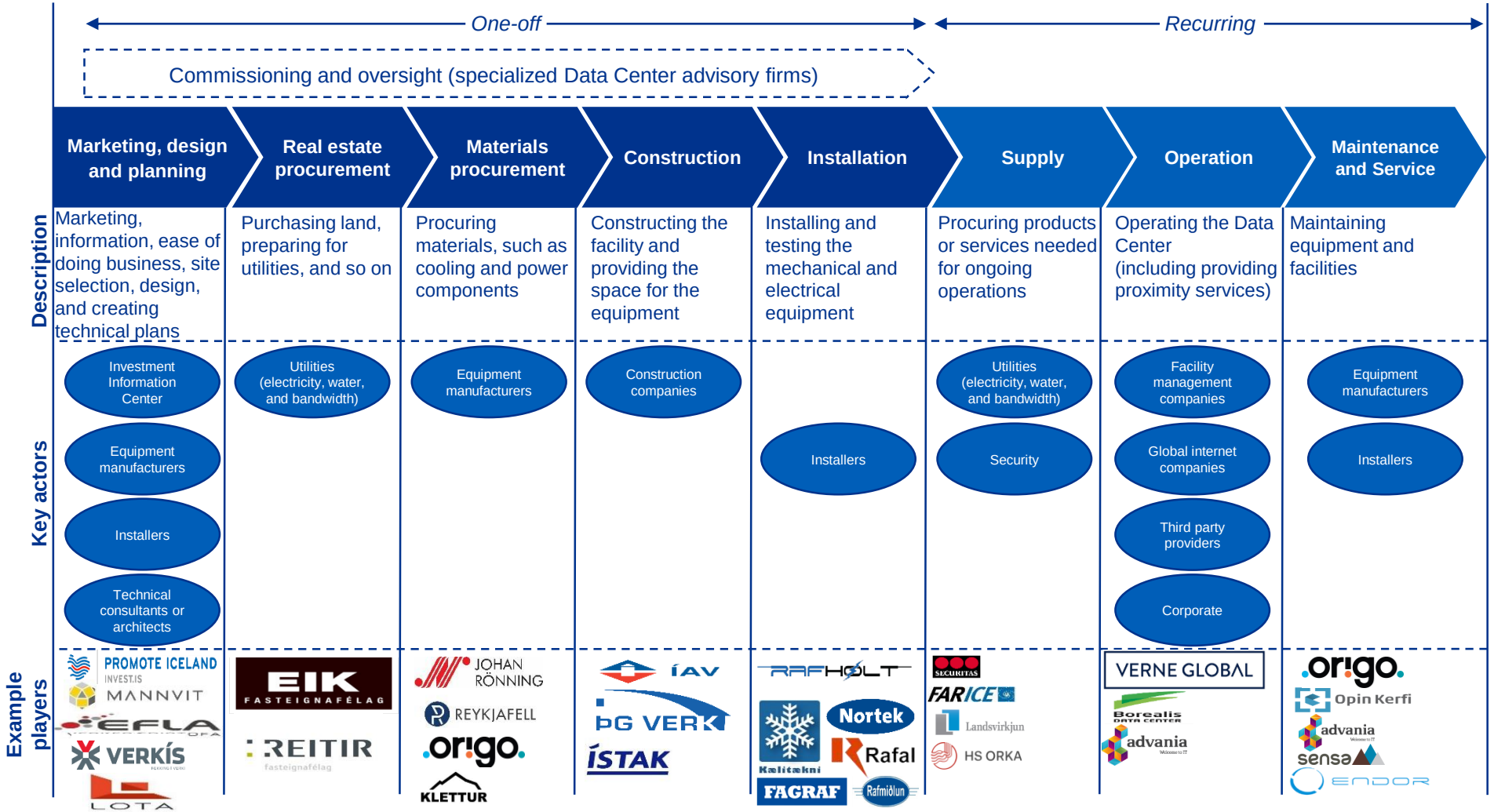
Source: Statistics Iceland

Contribuition of the Data Center Industry to GDP

	Sweden 2015		Finland 2016		Iceland 2016*	
Assumptions						
Electric use of DCs [MW]	110		70			34
FX average year	9,35		1,00			133,6
GDP [mEUR]	449.015		215.615			18.331
Cost index scaling*						42%
Economic impact of DC	**[m.EUR]**	**% GDP**	**[m.EUR]**	**% GDP**	**[m.EUR]**	**% GDP**
Direct from constuction	299	0,07%	150	0,07%	39	0,21%
Direct from operation	364	0,08%	220	0,10%	47	0,26%
Indirect and induced	706	0,16%	400	0,19%	92	0,50%
	1.368	**0,30%**	**770**	**0,36%**	**178**	**0,97%**

Source: Boston Consulting Group, Copenhagen Economics, Central Bank of Iceland, Eurostat & KPMG analysis using scaling from power usage

The Icelandic Data Center Value Chain



Source: BCG analysis and KPMG analysis.

High but fragile growth

Nordics expected to capture increased market share

Technology trends like Data & Analytics, IoT, AI, blockchain and video streaming are driving demand and ongoing growth in the Data Center Industry, but are highly dependent on connectivity.

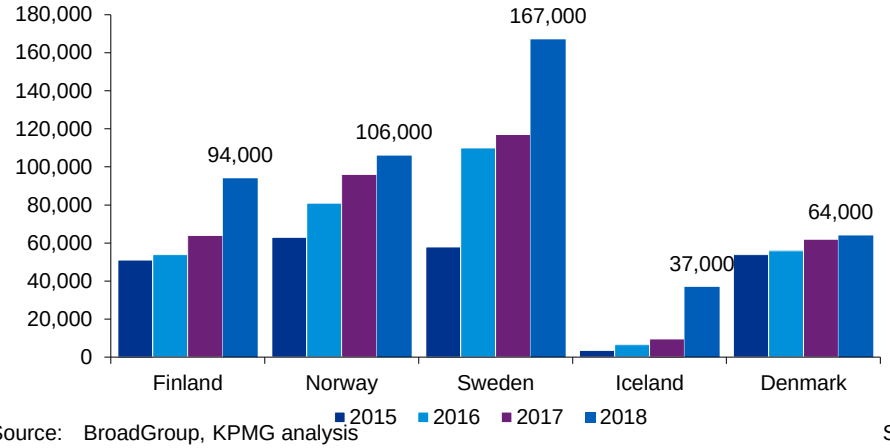
Global growth is expected to be around 10% for the coming years, but due to the fact that companies are becoming more location agnostic, market analysts predict faster growth in the Nordics, where annual growth is expected by analyst to be in the range of 12-15%.

The Nordics countries and Ireland are striving to capture their share of the growth of the Data Center Industry, not only for the direct economical impact, but also to benefit from the ripple effects that operations of Data Centers are believed to have on the economy

Industry survey

An industry survey of the Icelandic Data Center market was conducted and shows expectations of staggering growth in the coming years, especially in regards to services in crypto currency processing. Current status and composition of the growth raises questions about increased fragility of the sector, as further outlined in the market chapter.

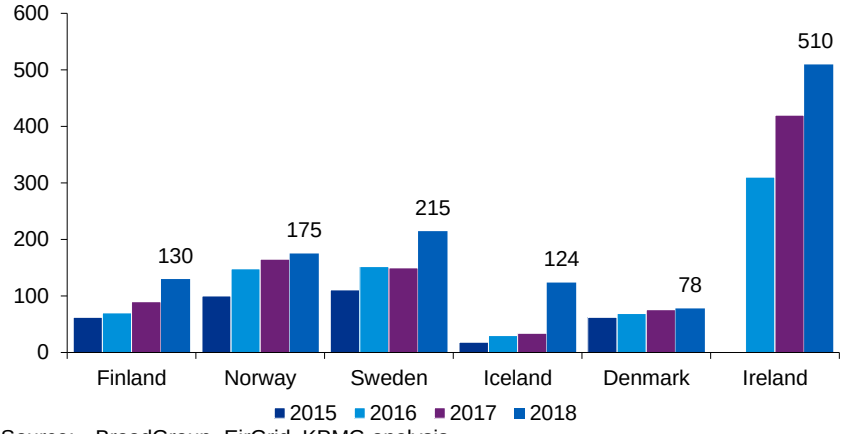
Forecast m² to end 2018



Source: BroadGroup, KPMG analysis

Note: Square meters for Iceland has been scaled

Forecast MW to end of 2018



Source: BroadGroup, EirGrid, KPMG analysis

Opportunities vs. challenges

The opportunity

Some Hyperscale sized Data Centers are being built in sparsely populated areas. This development could create an opportunity for Iceland as a potential location. According to a study[1] recently done for Statkraft and several communes in Norway a 90 MW Hyperscale Data Center build in three even phases could create 200 jobs if built in a larger community (>100.000).

A recent study by Boston Consulting group estimates jobs created by the Swedish Data Center Industry. The results of that calculation roughly scaled to the Icelandic environment, indicates that the sector is directly and indirectly supporting 850 jobs, as can be seen on the chart to the right.

Apart from the indirect and induced contribution to the country's production, additional effect often named ripple effect is likely to occur once Data Center Industry grows. In a recent study prepared for Google, the potential ripple effect in Finland is described as follows:

- Data Centers enable cloud based digitalization, enhancing GDP
- The Data Center Industry is key to the full adoption of cloud and emerging technologies
- Benefits of a strong domestic Data Center Industry for low latency services
- A domestic Data Center Industry can promote further public sector digitalization
- A domestic Data Center Industry enhances digital skills

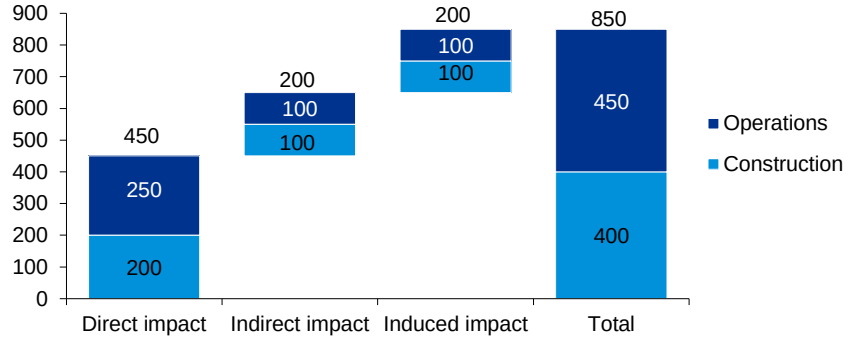
Attracting a Hyperscale or large MTDC provider to Iceland in the near future is most likely far fetched task due to various reasons outlined in the report. It would however, considerably enhance the overall perception of Iceland being considered a viable location for Data Center operations.

The challenge

The current Data Center Industry market is constantly evolving, moving and adapting, as the technology environment in general. Even though important steps are taken to improve the Icelandic investment environment, there is a chance that Iceland will not be able to catch up to the continuously improving competitors. The gap will thus only be increasing while no major improvements take place.

If Iceland is to become a compelling location for new Data Center operations, improvements will be needed in infrastructure supporting Data Center operations, and marketing for Iceland as a location.

Estimated employment impact of Icelandic Data Centers 2017 (# Jobs created)



Source: Boston Consulting, KPMG analysis

1) Menon Economics

Peer countries at a glance

		 Iceland	 Norway	 Denmark	 Sweden	 Finland	 Ireland
DC sector	Size MW (2017):	34 MW	165 MW	76 MW	150 MW	90 MW	420 MW
	Size m² (2017):	10,000 m²	80,000 m²	55000 m²	100,000 m²	55,000 m²	N/A
	GAGR (2014-2016):	91%	21%	8%	25%	28%	28%
	Risk ranking:	No. 1	No. 2	N/A	No. 5	No. 4	No. 20
	Max avg. temp:	13.6°C (Reykjavík)	26°C (Kristiansand)	21.2°C (Copenhagen)	20°C (Lulea)	20.2°C (Hamina)	19.3°C (Dublin)
	Δ Temp (Daily max-min)	16.7°C (Reykjavík)	38°C (Kristiansand)	23.1°C (Copenhagen)	34.8°C (Lulea)	29.3°C (Hamina)	16.7°C (Dublin)
Power sector	Size:	2,646 MW	32,083 MW	15,525 MW	39,406 MW	17,011 MW	10,108 MW
	Renewables:	100%	100%	52%	62%	35%	25%
	TSO:	Landsnet	Statnett	Energinet	Svenska kraftnät	Fingrid	Eirgrid
	Number DSO's (>100k)*:	1	150	76	170	85	1
	Exchange balance 2016:	0%	15%	6%	-12%	-19%	-0,7%
Connectivity	Submarine cables:	3	5	28	23	12	14
	Latency: NYC	40.6ms (Reykjavík)	35 ms (Oslo)	37.4 ms(Copenhagen)	52.5ms (Lulea)	51.3ms (Hamina)	33,3ms (Dublin)
	Latency: London	18.4ms (Reykjavík)	6 ms (Oslo)	8.4ms (Copenhagen)	18.7ms (Lulea)	18.3ms (Hamina)	4.3ms (Dublin)
GDPR		Will be implemented	Will be implemented	Will be implemented	Will be implemented	Will be implemented	Will be implemented
Significant strenghts		-Long term energy contracts -Renewable energy -Low risk	-Low engergy prices -Renewable energy -Low risk	-Close to market -Low latency	-Technical skills -Renewable energy -Low energy prices	-Close to Russian market -Low risk	-Low taxes -Technical skills -Close to market
Significant weaknesses		-Bandwidth price -Limited engergy availability -Size of supply market	- Not a member of EU				-Electricity prices

Sources: BroadGroup Data Center Nordics II, October 2016 & EirGrid

Note: Number of distribution system operators (DSO) in Iceland is 6 but only one has more than 100,000 customers

Summary of key results

Market		Page
International market and demand 	— The Data Center market will grow significantly in the coming years but due to consolidation and cloudification, most growth is expected in the top 10 Multi Tenant Data Center's and Hyperscale providers. Those players are currently well-positioned in West-Europe, moderately in the Nordics, but not in Iceland nor Norway. — Exogenous growth is most likely to come from a small number of companies (AWS/Azure/Google) who have very targeted strategies and are well connected with many governments. There could be a highly targeted strategy to achieve their business but it would require significant intervention. — Today, the other Nordic countries have a competitive advantage over Iceland and Norway, but most of the market focus is on Western Europe. The Nordics fit the key selection criteria for Data Centers but Iceland is neither perceived as a major player, nor an attractive location for Data Centers due to diminishing competitiveness. — Iceland is and could be more competitive within in specific niche markets for enterprises with location independent workloads such as: HPC, crypto currency processing, storage, backup, blockchain and disaster recovery. — Increasing datafication, Internet of Things and increased Video Streaming are Megatrends driving the need for increased connectivity, which might make an additional submarine cable from Iceland to Europe an attractive investment in the near future when combined with other improvement measures.	**24**
Domestic market 	— As of year end 2017, 90% of the local Data Center power consumption is crypto currency processing but is lower when measured in square meters. — Industry stakeholders expect a staggering 300% growth in the year 2018, predominantly due to growth of crypto currency processing. — The high ratio of crypto currency processing is a huge risk factor for the local industry, due to vulnerability to market developments of this new form of currency and less predictable future compared to other Data Center services.	**41**

Summary of key results

Power & Connectivity		Page
Power	— Wholesale electricity prices in Northern Europe have decreased over the past years and the market is expected to remain stagnant over the next five years. In addition, energy intensive industries in most countries in Northern Europe have been partly or totally exempted from non recoverable taxes on energy. — During the same time, the pricing policy of Landsvirkjun, the market leader in Iceland, has remained constant, which has led to Iceland's competitive advantage of low electricity prices disappearing. Industries in Iceland such as Data Centers thus seem to be offered similar price levels as in Northern Europe, but higher than Denmark and Sweden. — Price transparency has increased over the last decades in the comparison countries but has not in Iceland, at least from an outsiders perspective, e.g. doing desktop analysis. — The pricing structure of transmission and distribution of electricity in Iceland makes it even more difficult for smaller Data Centers in Iceland to be competitive. — According to industry stakeholders, delays and uncertain time plan for improved HV-connection to the Reykjanes peninsula might jeopardize the growth plans of the Data Center Industry. — Growth plans for the most attractive Data Center areas in southwestern Iceland can be a challenging task for the power generation industry over the next three years.	**44**
Connectivity	— As the competitiveness in electricity decreases, bandwidth cost is becoming an obstacle also for low bandwidth workloads. High bandwidth cost is obstructing bandwidth intensive workloads to enter the market. — Current network is economically inefficient with expensive third party backhaul routes, limiting the ability to mitigate bandwidth cost. — With Farice in a dominating market position, lack of carrier diversity is a negative factor for the market, as well as being more expensive than competing regions. — Although, total bandwidth capacity utilization to and from the country is marginal, a majority of industry stakeholders claim that the third submarine cable is needed for high availability routing to Europe.	**61**

Summary of key results

Infrastructure and operation		Page
Labor	— Eighty percent of the available workforce of Iceland lives within an hours commute to the capital and surrounding optimal Data Center locations. — Even though Iceland has a high percentage of ICT specialists, Iceland's population is so small that the number of available ICT specialists is only 13,500. This can negatively affect large players and Hyperscale operators studying the location. — Cost of labor has become more expensive in Iceland than in the other Nordic countries and Ireland.	74
Logistics	— Iceland is well located between two of the worlds biggest markets in terms of logistics for Data Centers and has good shipping terminals, and one of the busiest airports in the Nordics. — Data Centers in Iceland and Data Center sites are located close to the international airport and shipping ports. — Getting people and equipment to Data Centers in Iceland can be easier compared to other remote locations e.g. Lulea in Sweden as the selected and prospected sites in Iceland are situated close to the international airport and container terminals.	78
Construction environment	— Iceland's construction costs have increased substantially over the last 10 years, meanwhile construction costs in the Nordic have remained relatively stable.	83

Summary of key results

Enabling Environment		Page
ICT environment 	— Iceland ranks number one in ICT Development Index 2017 global ranking. — Despite the relatively low population, there is a high density of service providers in the capital area able to provide ICT services to local Data Center companies.	**85**
Perception of operation 	— In general, Iceland is considered to be a prominent location for Data Center operations with many benefits. — The country is said to be suitable for storage, high compute, backup and disaster recovery. — Potential customers view Iceland as a low cost energy location, with green energy. — Iceland is considered to be remote and described as an ultra safe repository of last resort. — Possible customers name high latency as the key disadvantage of Iceland.	**88**
Country Risk 	— Iceland has been considered by experts as an ultra safe location, ideal for archiving, and is ranked number one in the Cushman & Wakefield Risk Index, that is a key reference in the market. — Iceland has been ranked as having very low political risk. — Despite the favorable ranking Iceland is often perceived as having high risk profile due to natural hazards.	**90**

Summary of key results

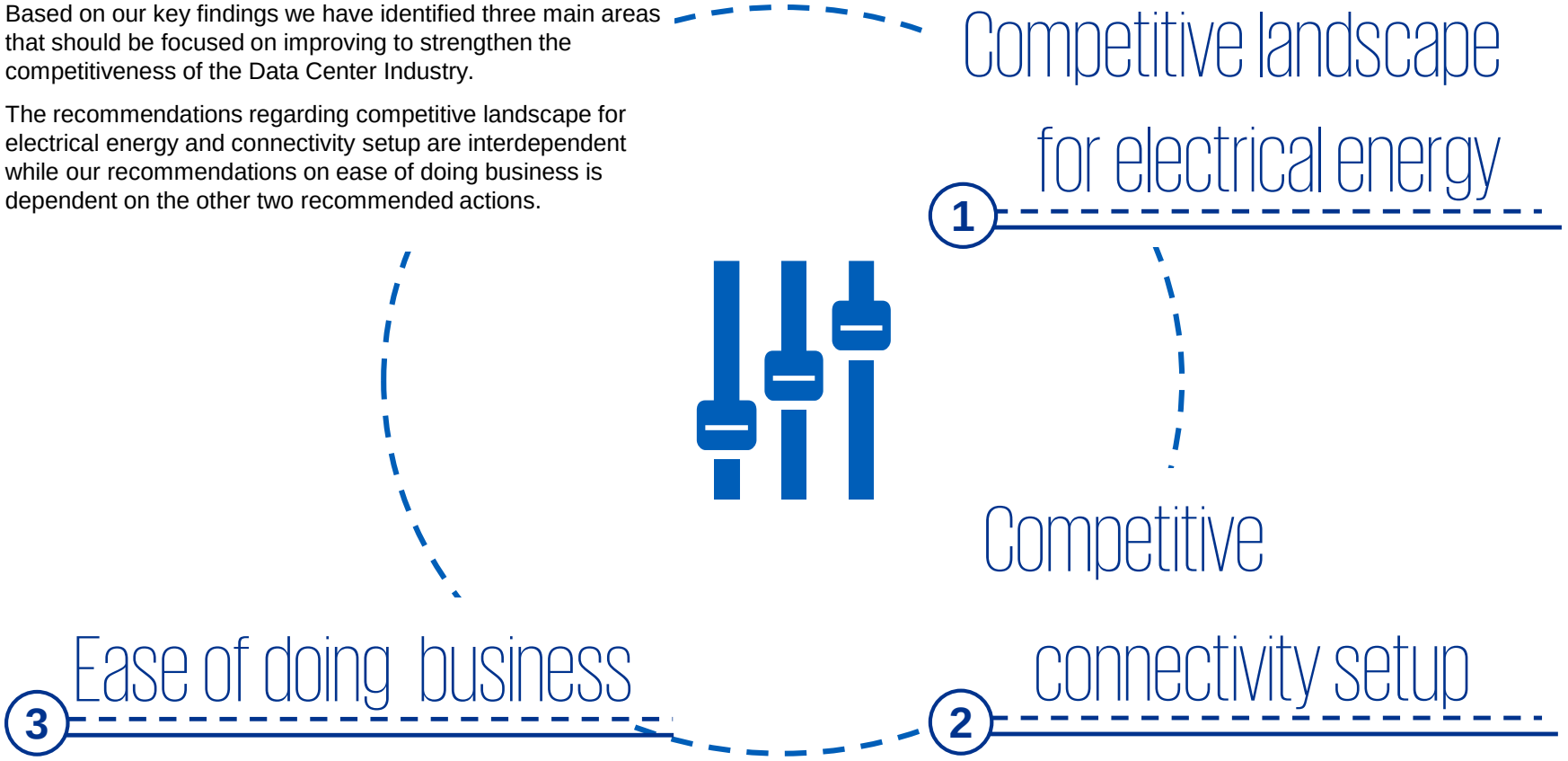
Business Environment		Page
Business environment 	— Taxes are generally competitive with corporate tax currently at 20% and VAT main rate at 24%. — No custom duties on IT equipment and no non recoverable tax on electricity. — Establishing a company in Iceland is simple and registration fees are moderate. — Iceland ranks no. 23 out of 190 countries in World Bank (WB) list of “Ease of doing business”, but is however in the lower range of its peers. — Improving the ease of doing business could be important to increase overall competitiveness, since the country is ranked below all the comparison countries.	**96**
Data privacy 	— Data privacy laws are very similar in the comparison countries as they all are built on the same regulations within the EEA and EU. — Each of the comparison countries are in the process of implementing the General Data Protection Regulations. — However, EU countries are generally perceived as safe location, while the EEA countries require more background checking.	**101**
Government Support 	— The Data Center Industry has become strategic to several countries and resulted in increased level of governmental support to the industry. The support is diverse, ranging from tax deductions to direct financial incentives. — Most countries and regions have put together teams consisting e.g. of municipalities, governmental agencies, power companies and key players in the private sector aimed at attracting new Data Center operations.	**103**

Recommendations to Government

We recommend actions in three key areas

Based on our key findings we have identified three main areas that should be focused on improving to strengthen the competitiveness of the Data Center Industry.

The recommendations regarding competitive landscape for electrical energy and connectivity setup are interdependent while our recommendations on ease of doing business is dependent on the other two recommended actions.



Recommendations to Government

1 Competitive landscape for electrical energy

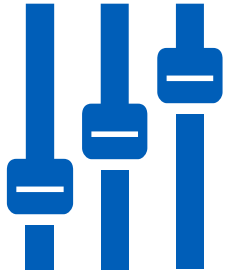
Strengthen competitive landscape for electrical energy

To stimulate increased competition and price transparency of the electricity market, we recommend that the government considers the following options:

I. Strengthening and streamlining the Master Plan for Nature Protection and Energy Utilization (i. Rammaáætlun) and license procedure for new power plants to increase predictability and transparency of available new power.

II. Reduce the 80 GWh distribution cost barrier for newcomers to make it easier to setup smaller Data Centers built for endogenous growth.

III. Consider stimulating the creation of an electrical energy exchange market to foster increasing competition, more price transparency and liquidity.



Recommendations to Government

2 Competitive connectivity setup

Stimulate competition and high availability

If the current state of the connectivity setup remains unchanged it will become increasingly difficult for Icelandic Data Centers to compete internationally. We therefore suggest the following actions.

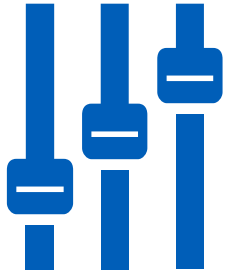
I. An optimal solution would be to have two privately operated cables with a third cable owned by the government securing reliable and cost-effective backup connections. This setup would support high availability, mitigate latency and eliminate the single carrier issue.

II. The second best option would be to facilitate a private sector investment in a third submarine cable to Europe. Such a cable would need optimal routing to highly connected regions and cost efficient backhaul.

III. In the absence of the third cable and a possible short term solution:

   I. Transfer one of the Farice submarine cables to a private party to address the current single carrier issue.

   II. Improve the backhaul setup, e.g. third party contracts, of current cables to reduce operational costs.



Recommendations to Government

3 Ease of doing business

Increase investment in sales and marketing

Sourcing of Data Center services is a complicated process where Data Center customers strive to search for the best options with the least risk. There seem to be gaps in market facts and perceptions.

With an effective synchronized message to the market, there could be an opportunity to increase Iceland's share of the Data Center market.

Holistic investment guidance

In order to capture the Data Center opportunity, the comparing countries have increased their market effort significantly. Iceland needs to respond and invest more heavily in marketing effort.

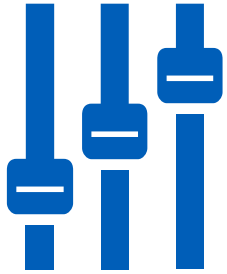
It would be beneficial to have a dedicated entity able to introduce complete solutions to potential newcomers entering the Data Center market to further reduce barriers of entry and increase transparency.

This entity should have the objective to create a compelling value proposition and have prepared connections with local suppliers:

- Indicative terms, contracts, and pricing for power and connectivity.
- Data Center service contracts.
- Able to connect new entrants with companies that can construct new Data Centers.
- Offer a clear view of Icelandic regulations and laws concerning Data Centers and new entrants.
- Stimulate the creation of a Data Center park or parks where plans for main infrastructure is readily available.

Initiatives from other countries such as Data Center by Sweden and Node Pole can be used as models. Invest in Iceland (i. Íslandsstofa) is partly covering this function currently and have been regarded professional and knowledgeable[1]. It could therefore be reinforced to further cover this role.

1. MCJ Lemagen



International market and demand

View on the international Data Center market

In this chapter, we will focus on the international Data Center market. There will be a focus on the following countries, which are most comparable and competitive to Iceland:

- Norway
- Sweden
- Finland
- Denmark
- Ireland

In addition, the following countries are traditionally well developed Data Center markets. They are included in some parts of the market analysis as well:

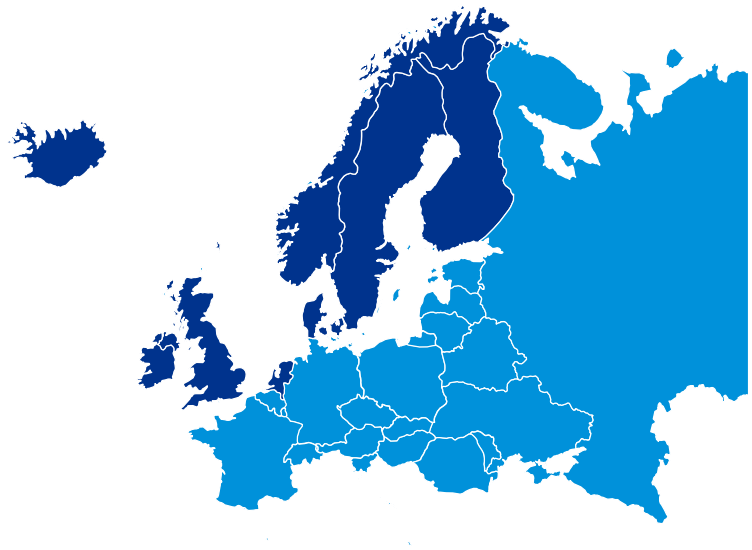
- UK
- The Netherlands

Topics

In this chapter the European Data Center market is analyzed based on a number of selected topics.

First the emerging international Data Center trends, technology trends, and demand will be discussed. Second, a comparison will be made between these trends and the current fit of the different countries providing these Data Center services.

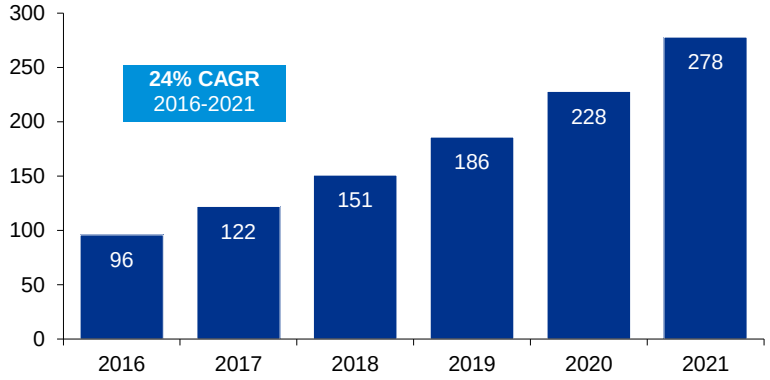
In the end, a growth scenario will be discussed, where we see possibilities and opportunities to grow and invest.



General ICT demand forecast

In a white paper by Cisco Visual Networking Index (VNI), it forecasts projected global IP traffic to increase by 24% until 2021. Based on the ICT trends and an analysis of the current state of the IP traffic, the white paper concludes that the data generated from all different types of sources, will multiply over the period of the next 5 years. Some of the factors indicated, will influence the Data Center market, as well as the connectivity requirements.

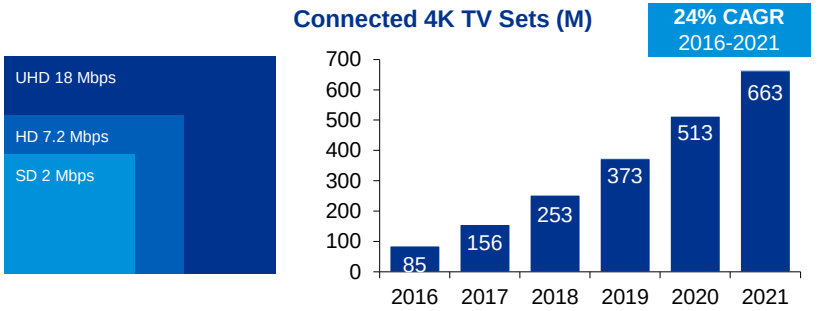
Exabytes per month



Source: Cisco VNI Global IP Traffic Forecast 2016-2021

Globally, IP video traffic will increase to be 82% of all IP traffic (both business and consumer) by 2021, up from 73% in 2016.

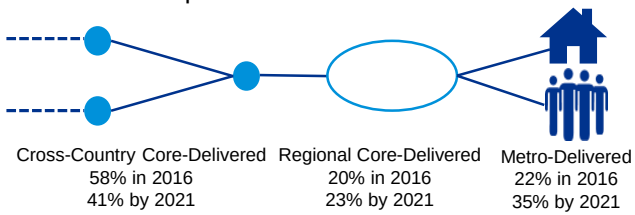
Global IP video traffic will grow threefold from 2016 to 2021, a CAGR of 26 percent. Internet video traffic will grow fourfold from 2016 to 2021, a CAGR of 31 percent. Live Internet video will account for 13 percent of Internet video.



Source: Cisco VNI Global IP Traffic Forecast 2016-2021

Internet traffic is moving closer to the edge

Speed is a critical factor in Internet traffic. When speed increases, users stream and download greater volumes of content, and adaptive bit-rate streaming increases bit rates automatically according to available bandwidth. Service providers find that users with greater bandwidth generate more traffic. In 2016, households with high-speed fiber connectivity generated 28 percent more traffic than households connected by DSL or cable broadband globally. The average FTTH household generated 84 GB per month in 2016, and will generate 183 GB per month in 2021.



Source: Cisco VNI Global IP Traffic Forecast 2016-2021

Hyperscale demand forecast

Cisco's Global Cloud Index forecasts a very clear growing picture – clouds and Hyperscale providers will continue to grow rapidly: The Cisco Global Cloud Index (GCI) forecasts traffic within the Data Center, from Data Center to Data Center, and from Data Center to user.

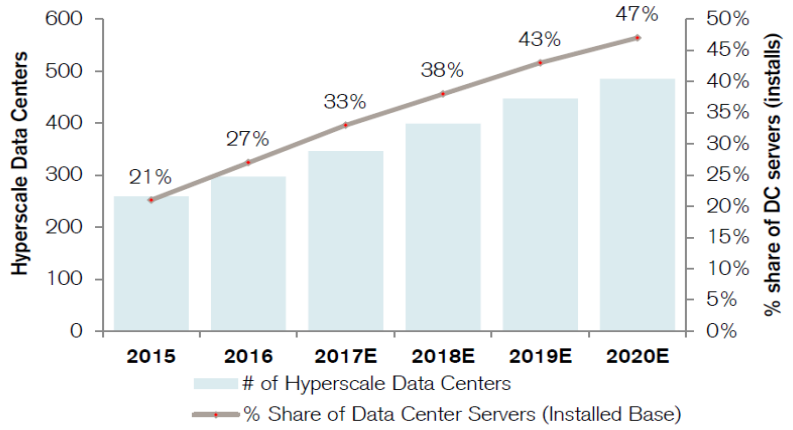
Hyperscale Capex Will Remain a Significant Driver

Global cloud workloads are growing significantly with Hyperscale Data Centers taking 47% share of workload servers.

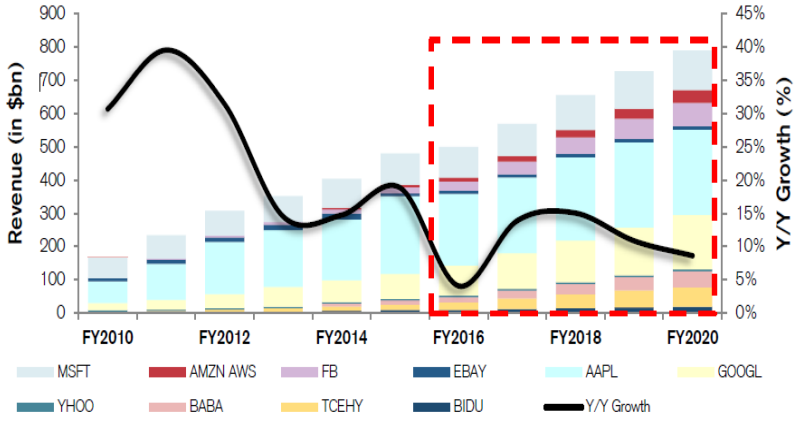
According to Credit Suisse, in the long term, they expect to see Hyperscale providers continue significant capex investments in physical facilities and Multi Tenant Data Centers. This is largely driven by end-market growth for cloud service provider products, services, and connected devices.

Source: Credit Suisse.

Hyperscale share of workload servers



Hyperscale revenue growth



Source: Credit Suisse.

Emerging Data Center Trends

Five trends in the Data Center market:

The following five main Data Center trends have been identified, in the Global Data Center Market Report – A Market Briefing.

1. Global Policy

The global policy results in Data Center location selections for stable countries with a long term favorable business climate.

2. The third IT platform

The increase of Hyperscale Data Center providers imply a *win-it-all* or *loose-it-all* scenario. Once the site selection has been announced, Hyperscale providers tend to attract a large amount of customers, and create an ecosystems of IT related businesses. This creates major spin-off effects for the economy.

Source: C. Malachy, A. Gourinovich, T. Lynn, 2017.

> ***1. Global Policy***
>
> *Due to its global footprint, energy consumption, and dependency and interaction with data, the global Data Center market is disproportionately impacted by a number of global policy and economic trends. These include issues related to taxation, energy, pricing and regulation, planning laws, data sovereignty and data protection. Uncertainty in relation to Brexit and data protection regimes (such as GDPR and privacy shield) are raising serious questions within the industry*
>
> *(JLL, 2017).*

> ***2. The third IT platform***
>
> *Continued growth and adoption of third IT platform technologies i.e. social media, mobile, big data/analytics, IOT and cloud computing are driving data volumes, IP traffic, cloud storage, and processing. This is driving the need for Hyperscale Data Centers and shifting market growth away from enterprise Data Centers and colocation Data Centers to the Hyperscale segment of the market. By 2020, cloud workloads are forecast to represent 92% of all Data Center workloads*
>
> *(IDC, 2011) .*
> *(Cisco, 2016. Cisco Global Cloud Index: Forecast and Methodology, 2015–2020; Gartner, 2016. Top 10 Technology Trends Impacting Infrastructure & Operations; JLL, 2017. Data Center Outlook. A wave of global momentum).*
> *(JLL, 2017; IDC, 2017)*
> *(Cisco, 2016).*

Emerging Data Center Trends

3. Consolidation

The consolidation of the Data Center market will result in a limited number of large players, having a significant buying power. Especially Hyperscale providers and large colocation providers are expected to dominate the market. When such players choose to locate their Data Center(s) in specific country, this will create a huge demand. Countries need to have close connections to the large players in order to understand their needs, so they can attract those players.

4. Technology-related catalyst

In addition, the world is becoming more digital. New services are released every day, using more processing power, storage capacity and intensive connectivity than before. Service providers need to be able to quickly connect to other services, in order to stimulate innovation. It is important that countries stimulate ecosystems of such service providers, so they will create the demand for Data Center services.

5. The rise of the rest

The emerging markets create incredible new demands for IT services. To fulfill those demands from a global perspective, there needs to be connectivity to those markets. Having a fast and reliable connection to the emerging markets is therefore key. The new submarine cable between Finland and Asia is an example of this new demand.

Source: C. Malachy, A. Gourinovich, T. Lynn, 2017.

> ***3. Consolidation***
>
> *In addition to consolidation around a small number of large Hyperscale Data Centers, a combination of technology innovation combined with M&A activity will consolidate the number of market participants, Data Centers and square footage occupied by Data Center*
>
> *(Gartner, 2016; JLL, 2016; IDC, 2017)*

> ***4. Technology-related catalysts***
>
> *General cloud and as-a-service readiness, greater Data Center virtualization, software defined everything, interconnect fabrics, edge and fog computing, modular and prefabricated Data Centers and related technologies are all emerging technology trends. Those will impact IT operations, corporate strategy and planning and, as a result, will increase Data Center investments*
>
> *(Cisco 2016; Gartner, 2016).*

> ***5. The Rise of the Rest***
>
> *While North America and the key international Data Center hubs in Dublin, Montreal and Tokyo will continue to expand, there will be faster growth in emerging markets (Eastern Europe, Latin America, Middle East and Africa) and Asia-Pacific, in particular. As well as the domestic growth of Chinese companies such as Baidu, Apple and Microsoft have committed to investing in regional mega-centers in emerging markets*
>
> *(JLL, 2017)*
> *(ZdNet, 2017; Fortune, 2016).*

Data Center segments

The Data Center market worldwide can be segmented into three types of Data Centers:

- Hyperscale Data Centers for data storage and hosting of services
- Distributed Data Centers that require proximity to their customers
- Enterprises that want to create economies of scale

Hyperscale Data Centers

Hyperscale providers often choose locations in well developed economical areas, locations that are close to their customer, and sites that have good connectivity to their other Data Centers.

Proximity to customers

For distributed Data Centers that require the best performing connections for their clients, Iceland is not an optimal location. Since the largest part of European clients are located in central and northern Europe, it enables Data Center countries such as UK, Ireland, The Netherlands, Germany, and France to be the dominant players for this market segment.

Enterprises with economy of scale

Within this type, we distinguish between two major workloads:

- Data Centers that host applications that require to be close to their customers
- Data Centers used for storage, backups, and high performance computing which can be seen as a potential investor in the Icelandic Data Center landscape. Icelandic Data Centers are predominantly focusing on this segment

Technology megatrends

Technology megatrends will strongly influence the international demand for Data Center capacity and thus we have highlighted the 5 most important megatrends:

1. The increasing datafication of our lives: Big Data and Analytics

The worldwide revenues for big data and business analytics will grow from USD130.1 billion in 2016 to more than USD 203 billion in 2020, at a CAGR of 11.7%. In addition to being the industry with the largest investment in big data and business analytics solutions (nearly USD 17 billion in 2016), banking will see the fastest spending growth.

2. The Internet of Things (IoT) and how everyday devices are becoming more 'smart'

McKinsey estimates the total IoT market size in 2015 was up to USD 900M, growing to USD 3.7B in 2020 attaining a 32.6% CAGR. McKinsey estimated that some 30 billion objects may be connected to the Internet of Things by 2020, compared to 8-10 billion objects in 2013. This will result in a huge increase of the data produced and the computational requirements.

3. The rise of artificial intelligence (AI)

Artificial Intelligence has potential to increase corporate profitability in 16 industries by an average of 38 percent by 2035, according to a report from Accenture. The introduction of AI could lead to an economic boost of USD 14 trillion in additional gross value added (GVA) across 16 industries in 12 economies.

4. Blockchain: driving new disruptive business models

The global Blockchain market size is expected to grow from USD 411.5 million in 2017 to USD 7,683.7 million by 2022, at a CAGR of 79.6%. The demand for distributed ledger technology, reduced total cost of ownership, rising crypto currencies market cap and initial coin offerings, increasing demand for simplified business processes, transparency and immutability, faster transactions, and Blockchain-as-a-Service are said to fuel the growth of this market.

5. Video streaming

The video streaming market is estimated to grow from USD 30.29 billion in 2016 to USD 70.05 billion by 2021. The market is expected to grow at an impressive CAGR of 18.3% because of the rising usage of online streaming. The users have started adopting pay TV and OTT solutions for streaming videos. The online streaming has provided many advantages to users such as ability to skip advertisements, access to episodes anytime, and ability to watch events and shows with flexibility in time. The online video streaming has also increased the viewership up to 60%, which includes young individuals.

Source: Forbes

Based on the trends, we see an increasing demand in several areas. This demand will be outlined in the next pages.

Data Center Trends: Winners and Losers

Risk for Iceland

Opportunity for Iceland

	Winners	Losers
DCIM (Data Center Infrastructure Management) will move further up in the IT stack	Suppliers that can combine and analyze DCIM data with numerous IT – and financial – management tools	Suppliers of DCIM platforms that do not at least promise to meet future DCSO (Data Center Software) requirements
Prefabricated data centers will come of age	Suppliers with messaging clarity and the right balance of design optimization and deployment flexibility	Suppliers that do not (or cannot) develop product enhancements and invest in effective marketing
Hyperscales and the open compute project will disrupt	Well-resourced suppliers that have global reach and that can create strategic relationships with hyperscales and rival suppliers	Suppliers that lack the scale, global presence and resources to rapidly innovate
Cloud will drive technical and business change	Colocators, hosting and cloud companies that operate effectively and flexibly; suppliers of most classes of data center management software, suppliers that develop a strategy to work with larger commercial operators	Suppliers wedded to the enterprise data center market, and whose growth is predicted on physical infrastructure redundancy and over-provisioning for availability; software suppliers that don't participate in the cloud ecosystem.
Data centers will evolve from energy customers to active energy planners	Suppliers capable of combining utility, data centers, construction resources and/or dynamic energy management software to support energy-smart infrastructures.	Suppliers of legacy energy storage, such as diesel generators, as well as traditional AC power gear and traditional power generation.

Source: 2016 Trends in Data Center Technologies

Data Center demand drivers

What is driving demand?

We looked at each major group of workloads in four typical Data Centers (strategic, archival and content servicing) and identified common drivers for demand.

Driver 1: Workload outsourcing and enterprise cloud computing

For the workloads ‘strategic’, ‘transactional’ and ‘archival’, it is expected that workload outsourcing from traditional enterprises to cloud services will have a major impact. This will increase the demand for Data Center services.

Driver 2: Digital economy

In the additional rise of eCommerce services, it is expected that more parts of the economy will be ‘digitized’, e.g. in streaming services, the increasing use of IoT-devices, and the use of mobile applications.

Driver 3: Regulatory drivers

Regulations, especially financial services, healthcare, and public services are increasingly dictating long retention of information. This increases the demand for storage services.

Data Center workload	Key industries	What is driving demand?
Strategic (data analysis, trend mining, computational)	All industries	Workload outsourcing Big data analytics Cloud computing Blockchain
Transactional (recording and posting)	Financial services eCommerce & retail Mobile applications	Workload outsourcing eCommerce adoption Mobile internet adoption
Archival (storage and retrieval)	Financial services Healthcare Government	Data sovereignty laws Increased global and local regulations Workload outsourcing
Content servicing (common content storage and delivery)	S.M.A.CC eCommerce Mobile applications	Increased online video streaming High cloud adoption

The current market share

Market share in Europe by square meter

The European Data Center market is dominated by four large countries: United Kingdom, Germany, France, and Netherlands. Combined, they have an estimated market share of 59% based on square meters of Data Center floor space, according to the BroadGroup study performed in 2015.

Within those big-4 countries, the majority of Data Centers are located in Frankfurt, London, Amsterdam, Paris, and are often referred to as the FLAP-cities.

The Nordics have a combined market share of 9.5% of the European Data Center floor space while Ireland has 3.3% and Iceland with 0.4%.

In the BroadGroup Data Center market growth research, the expectation for the years 2016 – 2020 is that market shares for the big-4 countries, Finland, and Sweden will increase while others remain roughly the same.

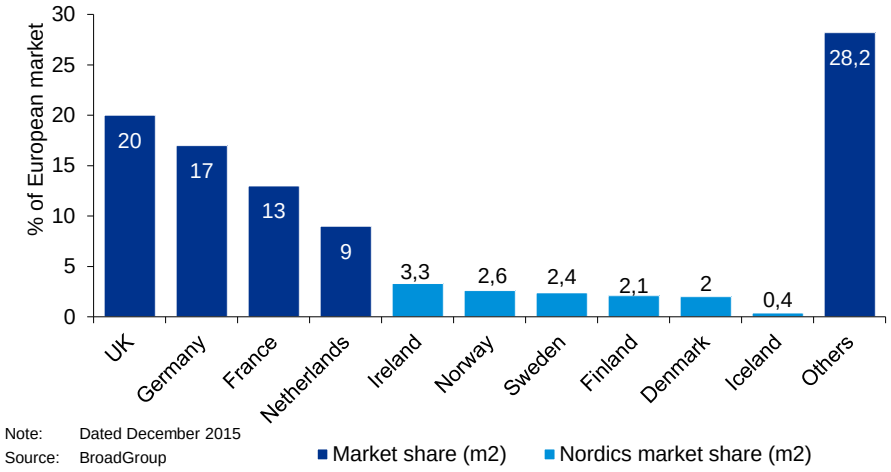
Nordics and Ireland

In order to gain overview of the Icelandic landscape, KPMG conducted a survey on growth plans and forecast among the existing Data Center operators. The combined result of that survey is shown along with data from BroadGroup in the right.

As evident by the plans for 2018 a big jump in electrical power is expected this year. Most of this growth is foreseen in the crypto currency mining sector, which could add to the fragility of the sector.

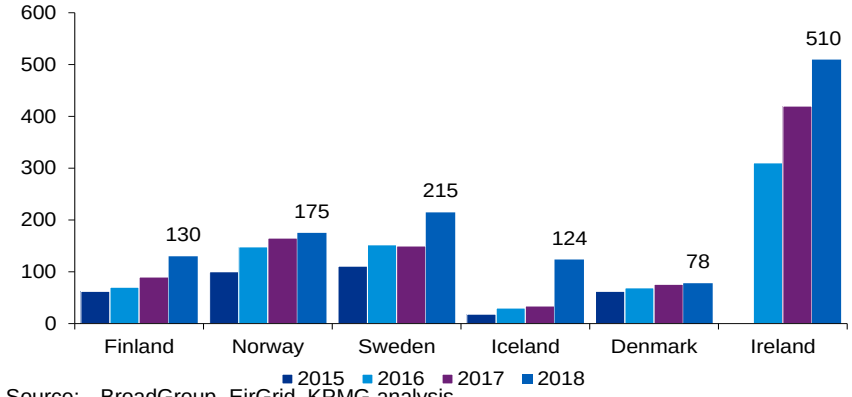
Further details of the survey result is outlined later in this chapter.

European market share by country (compared by square meter)



Note: Dated December 2015
Source: BroadGroup

Forecast MW to end of 2018



Source: BroadGroup, EirGrid, KPMG analysis

Global Data Center Operators

10 major players control ~52% of the market

The top 10 Multi Tenant Data Centers (MTDC's) made up roughly 52% of global market Data Center revenues in 2016 as can be seen in the pie chart to the right. The remaining ~1,490 vendors were making up the remainder of revenues.

The Americas has ~650 different MTDC operators, followed by EMEA with ~620 and Asia-Pacific with ~200.

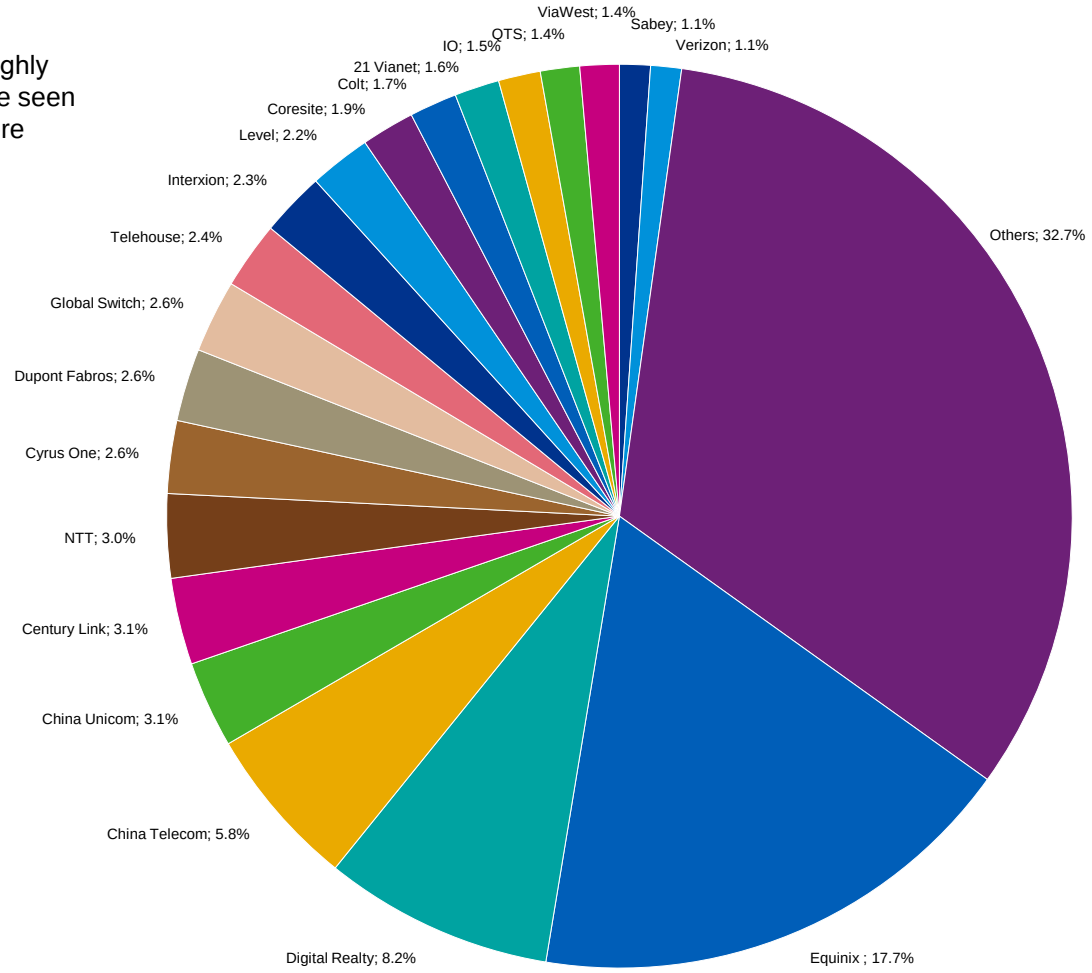
The MTDC market is consolidating

Every year, the total number of MTDC operators declines as the industry consolidates globally. Smaller players are being absorbed by the larger MTDC operators.

Attract the major players in the market to establish an eco-system

The consolidation of the MTDC's leads to increased demands due to fewer players having more buying power. For countries wanting to stay relevant in the Data Center market, it is critical to have close connections to the top 10 MTDC's in order to be able to fulfill their demands.

Source: I.H.S. Markit, Credit Suisse



Recent site selections

Norway

In May 2017 one of the largest Data Centers in Europe has opened in Norway. The Lefdal Mine Data Center is located in an old mine and is drawing all its power from hydraulic and wind power energy produced locally. One of the first partners of the project is IBM, who is already hosting part of their services in the Data Center.

One of the most important reasons for the investment is the green energy that is able to facilitate the operation of the Data Center. Norway provides a good combination of weather conditions, excess of renewable energy mainly from hydraulic and wind power, in addition to low industrial energy prices and a skilled work force. All the above in combination with close proximity to the rest of Europe, result in competitive position in the European Data Center market.

Sweden

Amazon is planning to open three Hyperscale Data Centers in the Stockholm area in 2018. These will be the first privately built Data Centers of Amazon and their first investment in the Nordic European countries. Recently Facebook chose Lulea in Sweden for its newest Data Center.

One of the more important reason for the placement of these Data Centers in the area is the competitive position of Sweden in the European Union in terms of industrial energy prices, renewable energy, and digital services. Sweden is one of the lowest prices zones of Industrial energy in Europe. Additionally Sweden is an Innovator Leader according to the European Innovation Scoreboard, possessing the highest rank among all European countries.

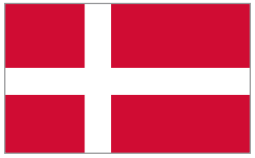
Another important reason for the investment of Amazon in Sweden is the density of successful startups such as iZettle, King, Mojang and Supercell, as well as established enterprises such as IKEA, Nokia, Scania and Telenor, which are AWS clients.

Recent site selections

Finland

Finland has emerged as one of the primary Nordic countries for foreign investments. Google, Microsoft, Yandex and IBM, are already operating privately owned Data Centers, or hosting their data in Finnish Data Centers.

The primary reasons for foreign investments in Finland, are the climate, which provides and ideal environment for cooling the servers, the excess in renewable energy and the geographical structure. With over 180.000 lakes in the country, the Data Center providers are able to use the cold water to cool their servers in an energy efficient and sustainable manner. A great example is the cooling system used in Google's site in Hamina. In addition to the above Finland has low energy prices and has recently lowered the energy prices for Data Center to become more competitive in the international market. The attention point for Finland is data privacy. The reason for that is that the connection with Europe goes through Sweden. Finland is planning to build their own cable connecting them to Germany to solve the privacy issues.



Denmark

Apple is operating a Data Center near the town Viborg in Denmark and has chosen Denmark to place their second Data Center. The new Data Center is located near the town of Aabenraa, and runs fully on renewable energy. Facebook has also announced their plans to build a second Data Center in Denmark near the town of Odense. The facility is expected to start its operations in 2020. Sources mention that Google has also purchased a large piece of land near the German boarders with the purpose of building a new Data Center.

The main reasons for Facebook's investment in Denmark is the amount of renewable energy produced in the country, the stability of the grid and the low latency with Europe as well as the US. Denmark is a leader in wind power, has abundant supplies of wind energy as well as biomass energy. The large renewable energy production is supported by a very reliable grid which serve as an advantage when it comes to foreign investments. Another important factor is the connectivity of Denmark to US and Europe. The geographical position, really close to Amsterdam, London and Frankfurt, allows for low latency to Europe. Additionally the proximity to the direct sea fiber to the US from the German boarder provides low latency to the US as well.

Recent site selections

Ireland

During the last ten years Ireland has emerged as a prominent country for IT investments in general and Data Center investments in particular. Most of the international Hyperscale providers have built or are planning to build Data Centers in the area near Dublin. These providers include Amazon, Google, Microsoft, Equinix, EMC(IBM) and Facebook.

In order to attract these investments Ireland initially took advantage of its locations being close to the US, as well as the rest of Europe. Ireland has very good connectivity with the US with low latency of 36ms, as well as Europe with a direct line surpassing the UK, and a large number of providers (approximately 50) providing competitive prices. In addition to the above Ireland has a very large fiber and dark fiber network within the country, allowing for data to move fast and reliably through the trans-atlantic cables.

Ireland has also large amount of renewable energy and ideal conditions to allow for more efficient cooling of the Data Centers, in combination with small environmental footprint. The industrial energy prices in Ireland are also considered low, something that allows in reduced operational costs.

Another important factor that helps attract investments is the available, highly specialized workforce. With the number of IT companies located in Ireland, it is easy for the investors to find skilled employees for the operation of the Data Centers.

All the above results in a very good reputation in the European Data Center market, making Ireland one of the first choices for international investments.

Key market challenges for Iceland

Adequate bandwidth and low latency

Recently, new submarine cables have been activated between US and Europe and within Europe connecting Finland and Germany. As a result, the competitive position of the competing regions has improved accordingly.

Further details on the challenges related to pricing of bandwidth is outlined in the connectivity chapter of this report.

Challenging energy landscape

Both wholesale prices of electricity and non recoverable electricity taxes have been lowering in the comparing countries. Meanwhile publicly offered prices in Iceland have remained constant for some years now.

This adds to the uncertain development of new power through the Master Plan for Nature Protection and Energy Utilization (i. Rammaáætlun)

Further details on this challenges is outlined in the power chapter of this report.

Development of IT eco-system

Another important factor in the choice of a Data Center location is the development of an IT eco-system that supports Data Center services. As an example Microsoft engaged with a Data Center provider already hosting hundreds of Microsoft's clients and as evident in Ireland the location of many ICT organizations in one place, leads to attracting more investments, and can serve as a booster for a local economy.

Demand

Global IP traffic is projected to increase by 24% until 2021. Speed of connections will remain critical in most of the business areas and connections are moving closer to the end-consumers, further driven by growing IoT solutions.

Global cloud workloads are growing significantly with Hyperscale Data Centers taking 47% share of workload servers.

The consolidation of the Data Center market will result in a limited number of large players, having a significant buying power.

Comparison

59% of the European market is dominated by 4 countries. The Nordics in total have a market share 9.5%, with Iceland having a market share of less then 1%. This means that Iceland is not top-of-mind for Data Center location selections.

The top 10 MTDC's hold a market share of 52%. Those top 10 are positioned in the other Nordics, but not in Iceland. The other Nordics, excluding Norway, have also successfully attracted Hyperscale providers. The existence of top 10 MTDC's and Hyperscale providers in a country establishes an eco-system and an attractive market position for those countries.

Key market challenges for Iceland

Growth: endogenous versus exogenous

Most countries are experiencing strong organic Data Center growth.

— Endogenous growth in Data Center usage is when the year-on-year increase in technology storage and compute, combined with normal economic growth, results in growing Data Center consumption in the locations where those services have typically been sourced. The significance of this distinction is that endogenous growth requires little or no stimulus.

— Exogenous growth is when Data Center locations & service providers attract new business which was previously located in another location or via another (e.g. non-cloud) means of provision. It is associated with step change in spend in a specific country, is highly competitive and typically requires formal or informal state intervention to create the environment for success (Ireland being the classic example).

Hyperscale and public cloud versus traditional models

The primary area of exogenous growth lies in Hyperscale public cloud from AWS, Microsoft and Google (some other providers, including Apple and Facebook, operate Hyperscale Data Centers, but these are exceptional and thus an unreliable basis of a broad-based strategy).

Traditional Data Centers have significantly lower levels of net growth as they lose customers to public cloud, but are aggressively redressing their economic models. Nevertheless, there are few signs of geographic expansion in the traditional market.

Implications for Iceland's strategy

The consequences of this to Iceland's strategy is:

— Endogenous growth may be poor value for money to pursue. Endogenous growth as high as 10-15% could occur naturally without intervention.

— Exogenous growth is most likely to come from a small number of companies e.g. Hyperscale providers and MTDC's who have very targeted strategies and are well connected with many governments, there could be a highly targeted strategy to achieve their business but it would require significant intervention.

— Some moderate growth may be achievable by attracting the more limited but broader-based growth in the traditional sector.

Source: KPMG analysis

Trends and takeaways

Trends:

- It is expected that the international Data Center market will consolidate in the coming years, with a majority of the market share dedicated to Hyperscale providers.
- This tends to win-it-all or lose-it-all scenario's, when one is able to attract or not to attract the Hyperscale players.
- Large and Hyperscale providers tend to locate their Data Center's in the proximity of large economies, connectivity hubs and their customers (the so-called eco-system).
- Technology innovations will drive further demand in connectivity and cloud based platform solutions.
- Speed of connections will remain critical in most of the business areas.
- Connections are moving closer to the end-consumers, also driven by growing IoT solutions.
- Datafication will drive up the need for computational power, storage and bandwidth.
- A stable and compelling business climate is key for large and Hyperscale providers to make the necessary investments.
- Technology trends like Data & Analytics, IoT, AI, blockchain and video streaming are driving demand.

Key Findings

- The Data Center market will grow significantly in the coming years but due to consolidation and cloudification, most growth is expected in the top 10 Multi Tenant Data Center's and Hyperscale providers. Those players are currently well-positioned in West-Europe, moderately in the Nordics, but not in Iceland nor Norway.
- Exogenous growth is most likely to come from a small number of companies (AWS/Azure/Google) who have very targeted strategies and are well connected with many governments. There could be a highly targeted strategy to achieve their business but it would require significant intervention.
- Today, the other Nordic countries have a competitive advantage over Iceland and Norway, but most of the market focus is on Western Europe. The Nordics fit the key selection criteria for Data Centers but Iceland is neither perceived as a major player, nor an attractive location for Data Centers due to diminishing competitiveness.
- Iceland is and could be more competitive within in specific niche markets for enterprises with location independent workloads such as: HPC, crypto currency processing, storage, backup, blockchain and disaster recovery.
- Increasing datafication, Internet of Things and increased Video Streaming are Megatrends driving the need for increased connectivity, which might make an additional submarine cable from Iceland to Europe an attractive investment in the near future when combined with other improvement measures.

Competitive landscape

Dedicated Data Centers

Three entities operate four purposed built Data Centers targeting international workloads. While Verne Global and Advania -Thor Data Center offer Tier III level infrastructure, Borealis Data Center and Advania - Mjölnir are Tier I level focusing on less availability intensive HPC workloads. Advania as a profound service provider and Verne Global partnering with local service providers contain substantial share of the domestic colocation market.

Service providers

Number of service providers operate their own computer rooms, usually a customized facility of less than 0,5 MW and 100 racks. Providing a stack of IT services ranging from colocation hosting those entities compete for the local hosting market with limited focus on international workloads. Some large service providers have made a strategic decision to team up with a dedicated Data Center phasing out their own computer rooms.

TCO in Iceland

Total Cost of Ownership (TCO)

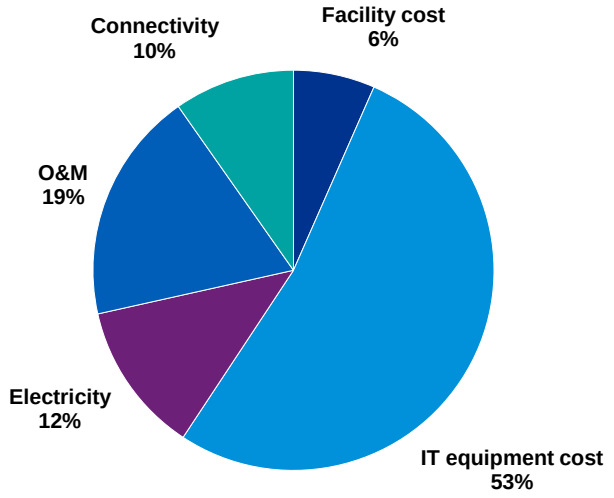
When analyzing cost of acquisition of an asset and operating it, normally a distinguish is made of the two. The former is a one time cash outlet while the later is a continuous one, often presented on annual basis.

In order to analyze what cost elements impact the total cost the most, both of these cost factors must be normalized. This is can be done by calculating the total cost over a time period of the longest lasting asset, normally the real estate or by annualizing all cost, including the acquisition, adding them together to have the Total Cost of Ownership on annual basis. We chose to calculate TCO by annualizing cost.

Traditional Tier III colocation Data Center in Iceland

TCO calculations are based on set scenarios, we base our calculation on a 15 MW Tier III design Data Center operating traditional colocation workloads. The table below defines main assumption for the calculation of the TCO.

TCO of 15 MW, Tier III DC in Iceland



Assumptions		
Size	15	MW
Power/Area ratio	1.4	kW/m2
Lifetime facility	15	years
Lifetime IT-equipment	6	years
Electricity cost	43	EUR/MWh
Cost of capital	5%	
Connectivity	75	x10 GB

Annualized cost		
	mEUR	
Facility cost	3.0	*6.6%*
IT equipment cost	24.4	*52.7%*
Electricity	5.7	*12.2%*
O&M	8.7	*18.8%*
Connectivity	4.5	*9.7%*
Total:	**46.2**	***100.0%***

US Chamber of Commerce C_TEC, KPMG Analysis

Market dynamics

Market growth

Most regions have been experiencing strong organic Data Center growth. Hence an endogenous growth as high as 10- 15% can be expected with little intervention. In order to surpass average growth rate an exogenous growth attracting new customers is needed.

The primary area of exogenous growth is expected to lie in Hyperscale public cloud from AWS, Microsoft and Google with IBM, Oracle and others also seeking to compete in this space. Traditional Data Centers have generally experience lower levels of net growth as they lose customers to public cloud and there are few signs of geographic expansion in the traditional market.

A crypto currency industry

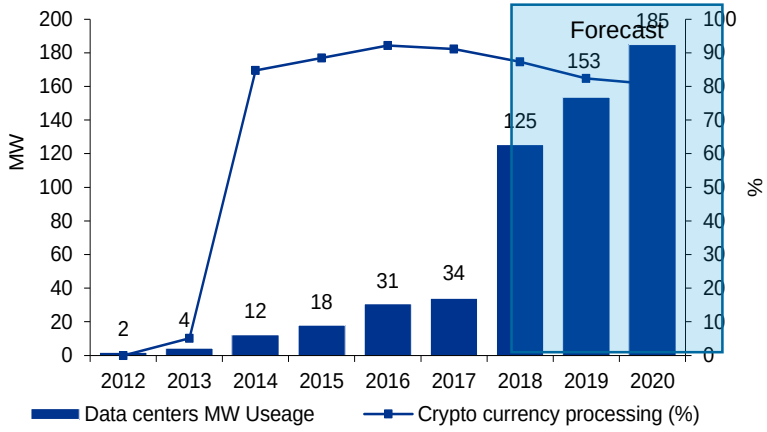
A study on the local market reveals that a fairly steady growth of 100% year over year 2012 – 2016, with crypto currency processing having a huge impact blasting the market in 2014. Looking forward market stakeholders expect another blast during the year 2018 with power consumption increasing by almost 300% from 34 MW to 125 MW followed by 20% annual growth through 2020.

While stakeholders expect to see the crypto currency processing ratio drop slightly they still expect to see the crypto currency processing dominate the market with over 80% of power consumption by 2020.

These growth plans can be challenging to the Data Center operators due to constraints in delivering new electricity and transmission bottlenecks. In addition to that, there is a likelihood that individual Data Centers are expecting contracts from the same clients, thus potentially overestimating the growth forecast.

Cisco Global Cloud Index: Forecast and Methodology, 2015-2020, Cisco

Data centers power usage and percentage of crypto currency processing



Source: KPMG Analysis

Key Findings

- As of year end 2017, 90% of the local Data Center power consumption is crypto currency processing but is lower when measured in square meters.
- Stakeholders expect a staggering 300% growth in the year 2018, predominantly due to growth of crypto currency processing.
- The high ratio of crypto currency processing is a huge risk factor for the local industry, due to vulnerability to market developments of this new form of currency and less predictable future compared to other Data Center services.

Electricity needs

One of the biggest cost factors in Data Center operations relates to electricity consumption. Servers require considerable amounts of electricity for data processing and calculations resulting in heating of the servers and processors. To prevent overheating of the servers, it is often necessary to run various cooling equipment. Cooling units within a Data Center are typically electricity intensive which can result in considerable costs. In some cases, total electricity costs for a Data Center amount to over half of its operating costs.

Natural cooling is valuable

Depending on location and ambient temperature, cooling is responsible for around 39% of total electricity usage of an average Data Center.

In colder locations such as the Nordics, this figure can be much lower and in the case of Iceland, only fans without chiller are needed for sufficient cooling. Four cities are compared in the table to the right. Notably, Luleå in Sweden does not need any chiller hours.

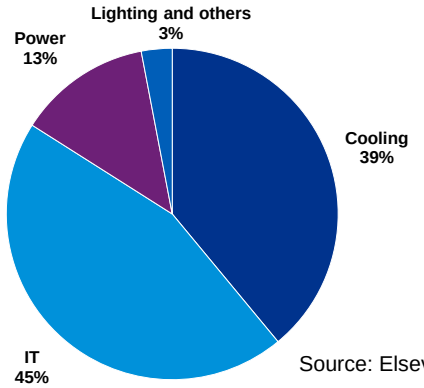
As mentioned in the introduction chapter, Iceland compares directly to Luleå where cooling is not needed except in very rare occasions in tier three or tier four Data Centers. Data Centers where 100% uptime is not critical can operate without even installing cooling equipment.

PUE

The industry has defined a factor called power usage effectiveness (PUE) as a ratio of how efficiently a Data Center uses energy. PUE is the ratio of total amount of energy used by the Data Center to the energy delivered to the computing equipment.

The main variable controlling the PUE is the electricity needed to power the Data Centers cooling equipment.

Data Center power consuption distribution



Source: Elsevier Ltd

Economizer hours and chiller hours to air-side economizer

	New York City, USA	Seattle, USA	Houston, USA	Luleå, Sweden
Total yearly hours	8,760	8,760	8,760	8,760
Economizer hours	8,215	8,704	7,049	8,760
Chiller hours (T>27°C)	551	62	1,717	0

Source: Elsevier Ltd

On average the Data Centers of the world are believed to be operated at PUE of 1.7

Google publishes the PUE of their 14 large Data Centers around the world. Hamina in Finland and St. Ghislain in Belgium are the Data Centers with lowest PUE or 1.09 in annual average, but Singapore has the highest or 1.18.

As a comparison one of the Icelandic Data Center unofficially claims they have reach PUE of 1.03.

Source: Goggle, Uptime Institiue and verbal information

Electricity consumption

Data Centers are energy intensive

Data Centers are considered to be electricity intensive operations. It is estimated that Data Centers consume between three to five percent of the world's generated electricity.

Improving efficiency reduces electricity demand

The US Data Center market is the largest and the leader in terms of technology and electrical consumption. US Data Centers have consumed on average 70 TWh annually for the last years, which is close to four times the entire electricity consumption of Iceland.

However, the market has been showing signs of stagnation in terms of energy use. This is mainly due to the development of more efficient server technologies which lower direct electricity consumption, and also decreases PUE due to more efficient chilling technologies.

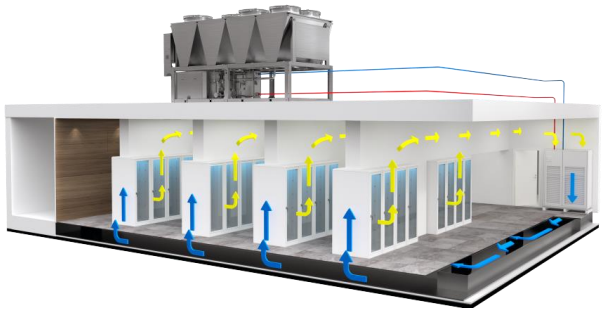
Using the reporting of Google as earlier, their average PUE has come down from 1.22 to 1.12 in 10 years.

Growth in Iceland

Development of the electricity consumption of the Data Center Industry in Iceland is shown in the graph to the right, along with the forecast for the next three years.

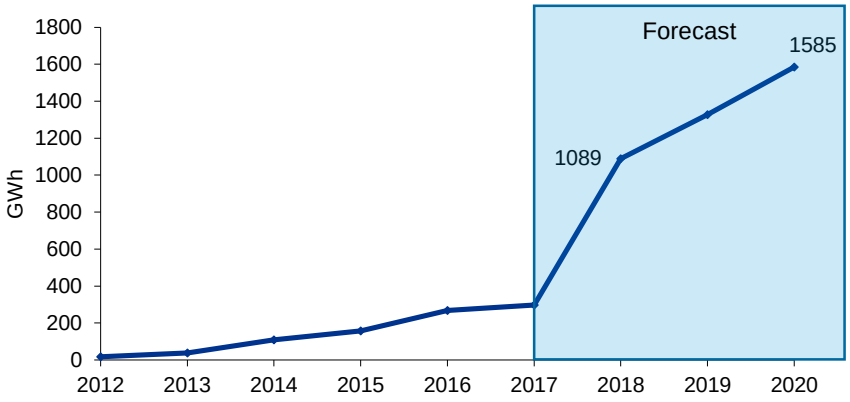
The consumption has grown from 16 to roughly 300 GWh at in 2017, which is slightly under 2% of the total consumption in Iceland, but will be close to 8% in 2020 if projections realizes.

The average growth for the last five years has therefore been over 75% annually on average.



Cooling arrangement in a typical Data Center.
Source: Systemair

Development of electricity usage of Icelandic Data Centers



Source: KPMG Analysis

Historical End User Prices

Price development in N-Europe

Electricity prices for Data Centers can vary quite significantly depending on location and the size of the Data Center. Average prices to industries in EU member countries and Norway are reported by Eurostat.

The graph below shows the development of the reported average prices including the cost of transmission and non recoverable taxes for the last 10 years, according to Eurostat.

As evident in the graph, the prices have been on the decline for the last five years or so and the price difference between countries has diminished.

Iceland has only recently started to share limited information on electricity prices with Eurostat and only for smaller users.

Merit order effect and taxes

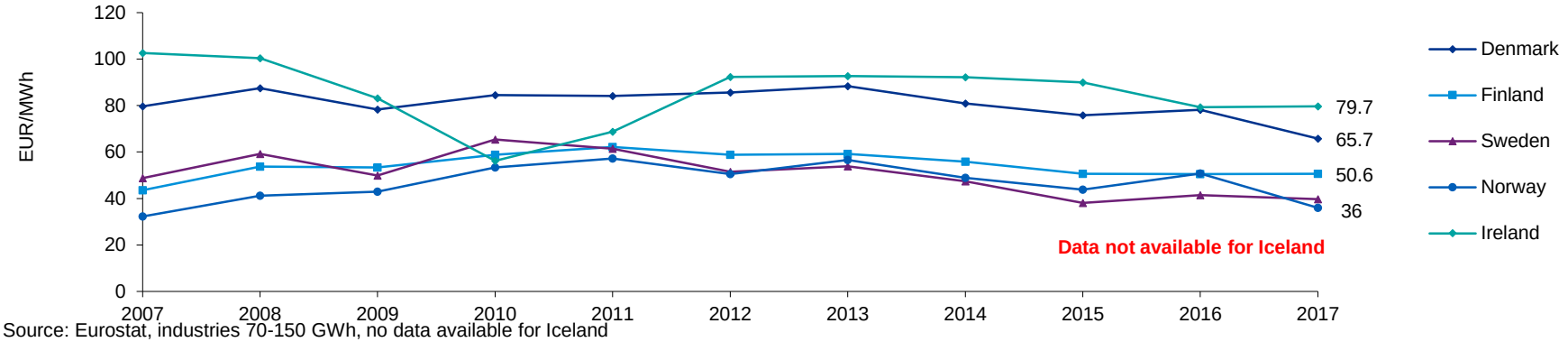
This price development can be explained with the so-called merit order effect, whereby renewable energies, with little or almost non operation cost replace higher opex generation such as coal or lignite.

To finance the cost of renewable energies different tax schemes have been adopted by the European countries, whereby the end user is set to pay for the transition.

However, energy intensive users and in some countries Data Centers are exempted from these taxes partly or fully. They therefore enjoy the lowering of the prices through the merit order effect but do not carry the burden of its creation.

Whole sale prices, i.e. not including recoverable taxes and retailers fees are shown on next page. They show a slightly different development the last three years in the Nordics which can be explained mainly with tax reductions in some of the countries.

Electricity prices in selected European countries [70-150 GWh], including non recoverable taxes.



Source: Eurostat, industries 70-150 GWh, no data available for Iceland

Wholesale Prices

NordPool – wholesale prices

Nord Pool splits the Nordics into 12 price areas as shown on the map. The percentages refer to the average deviation in system prices over the last three years.

Average price for the last three years was 25,7 EUR/MWh. Prices differ to some extent due to transmission limitation.

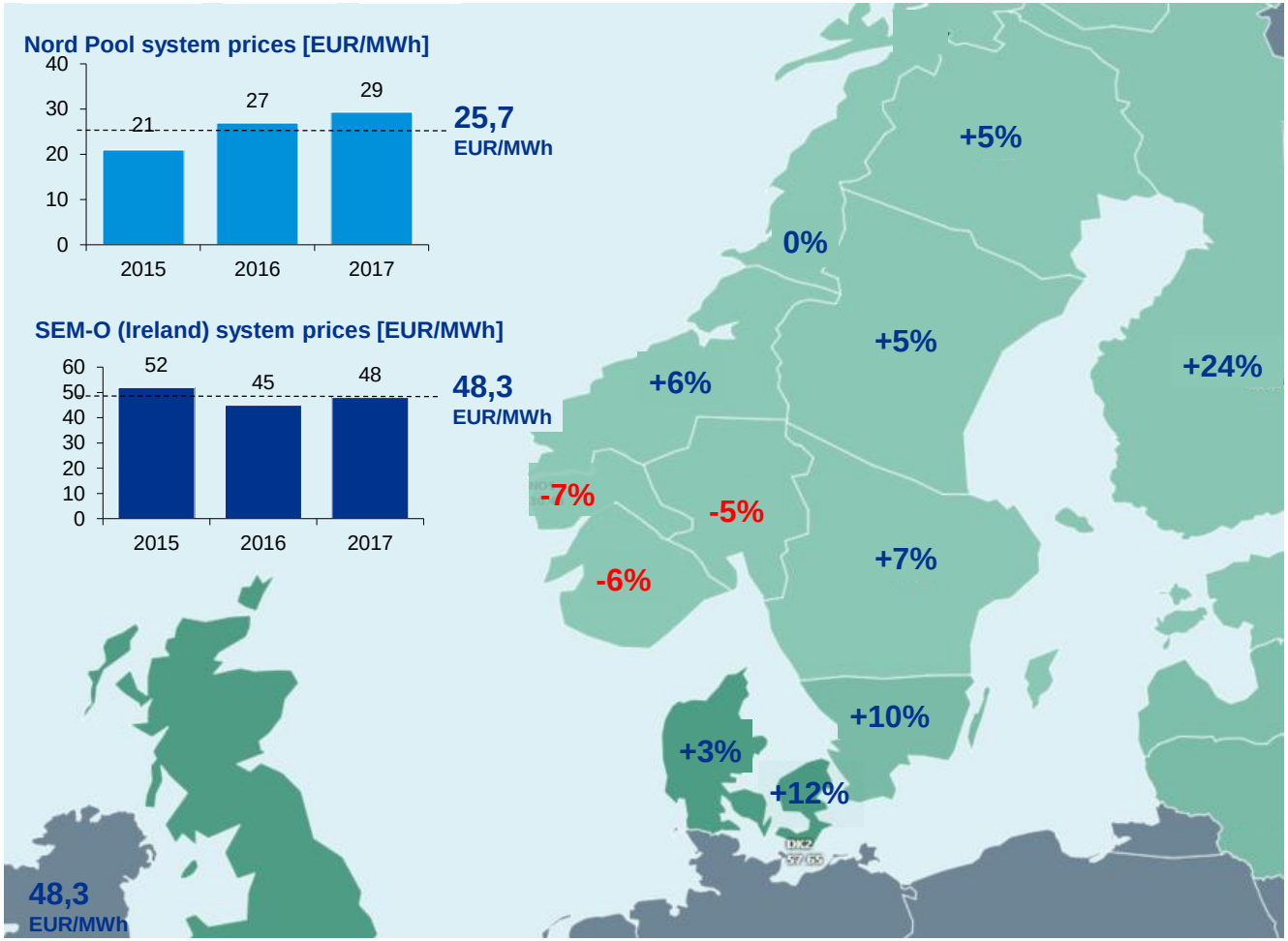
Average prices in Finland have been 24% higher than the system average, and the Copenhagen region 12% higher.

Other regions have had +-10% deviations.

Ireland, wholesale prices

The common electricity market in Ireland and N-Ireland, with single system price is called SEM-O. Average price over the last three years has been 48.3 EUR/MWh, or 88% higher than the NordPool system price.

Source: RBC Capital Markets



Wholesale Prices and Futures

Wholesale markets

In European markets, wholesale electricity is traded on transparent exchange markets. In the Scandinavian countries, Nordpool Spot is the main market for day-ahead electricity trade. EEX is the main market in Germany, APX in the Netherlands and the UK, and Sem-O in Ireland.

Wholesale price development of these markets for the last 15 years can be seen on the graph below. Notably, Nordpool prices have lowered recognizably since the year 2011.

— SEM-O prices are only available since 2013

Iceland does not operate wholesale exchange market, even though several proposals for the establishment of such have been made.

Futures

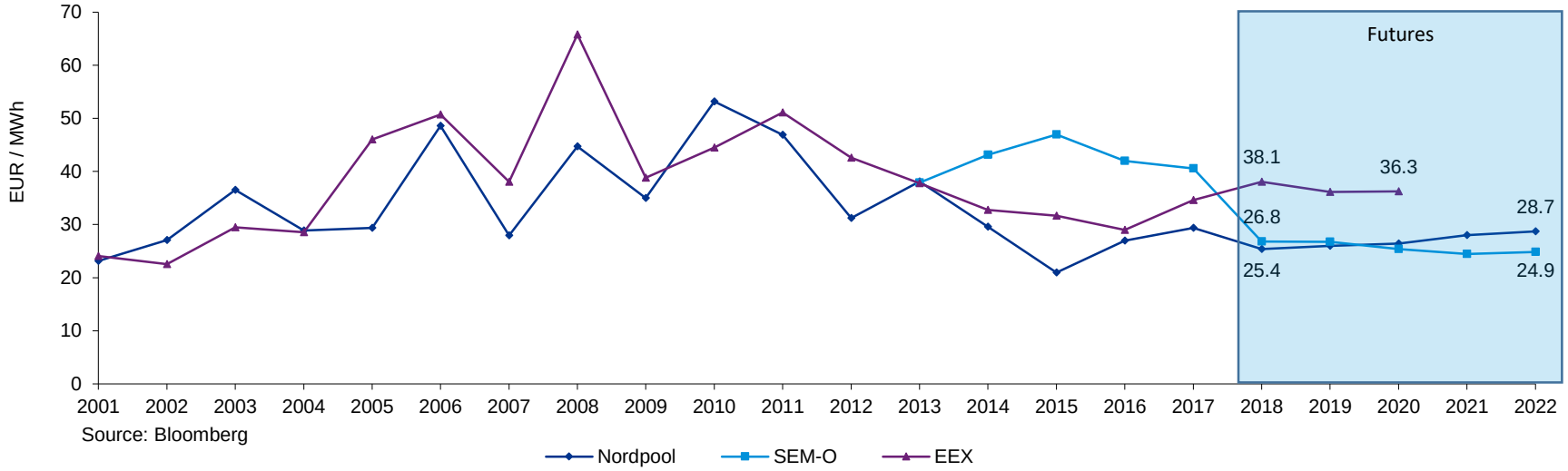
Futures are also traded 3-5 years ahead, depending on markets. Participants are expecting prices to remain steady at current level during that period.

Average prices to industries using 70-150 GWh annually are therefore likely to remain at similar levels as the 2015-2017 prices.

Despite of this flat forward curve, some market analysts predict soaring prices in the Nordic market at the end of the curve, due to higher price of coal and emission allowances. MK Online, a Norwegian electricity market analysts predicts the price of 43 EUR/MWh in 2022.

Source: Email from Olav Johan Boten

Price development of major N-European wholesale markets



Source: Bloomberg

Overview of the Energy Market in Iceland

Price development in Iceland

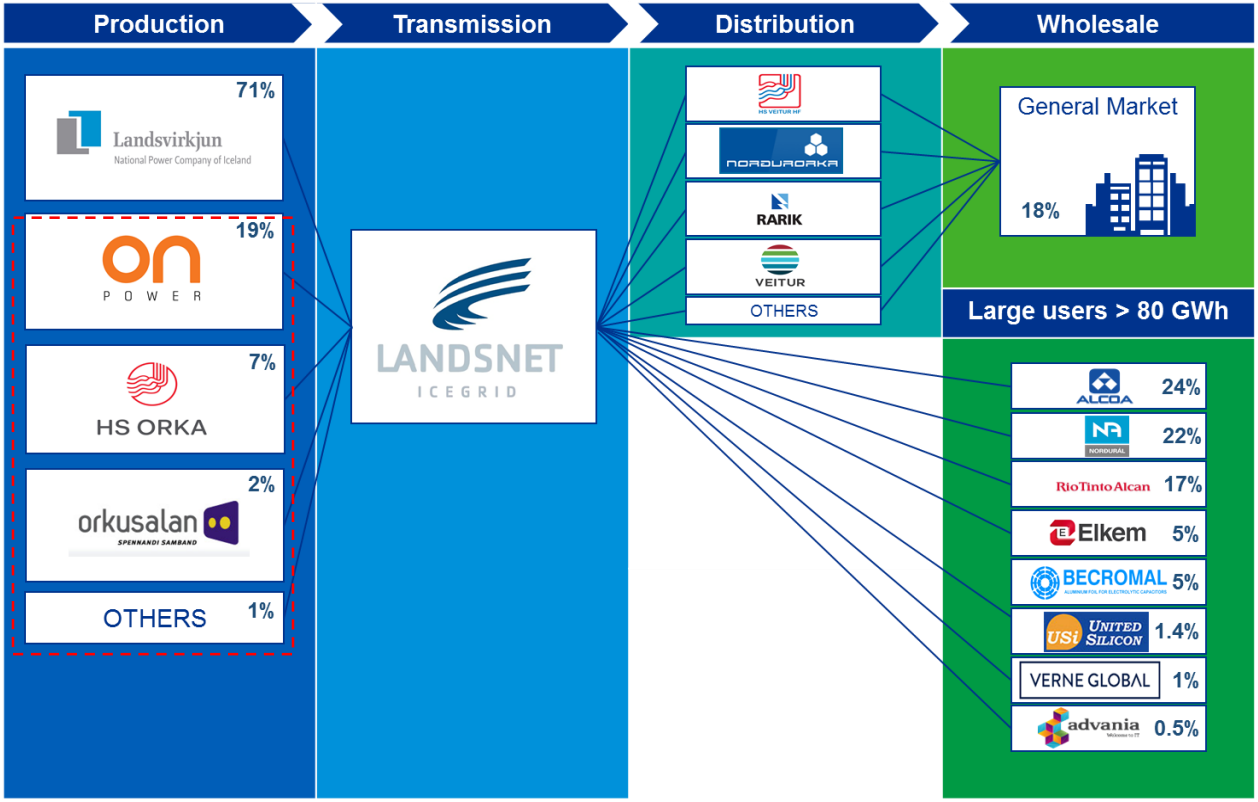
Iceland has no operating electrical exchange market, market participants are few and pricing is not as transparent as in other neighboring markets. Over 80% of energy is sold through long term Power Purchase Agreements with large users.

The market landscape is presented on the chart to the right.

Large users

The total cost of electricity normally comprises of three elements i.e. Energy, Transmission, and Distribution. Only 24% VAT is added on top of that but no unrecoverable taxes.

However, large users, i.e. those who use more than 80 GWh of electricity annually can connect directly to the nearest transmission substation and are not obligated to use distribution services.



Source: KPMG analysis, Landsnet 2017.

Generators also acting as retailers on the General Market

Power Availability in Iceland

Development of capacity

Currently installed electricity generation in Iceland amounts to 2,729 MW, now as the first out of two geothermal power turbines in Þeistareykir NA-Iceland, has been commissioned as can be seen on the graph here below.

Four further projects, totaling to 158 MW in power, are under construction and are planned to be operational in 2019 as listed in the table below.

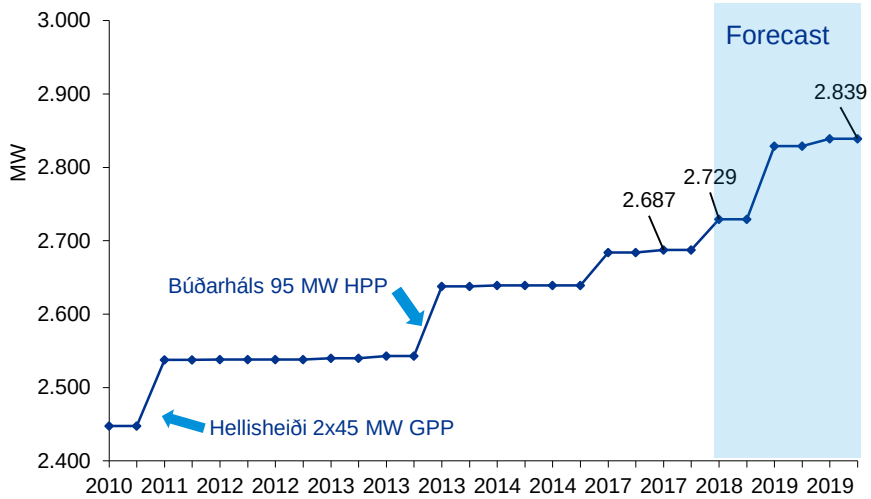
The Þeistareykir GPP is located in the NE corner of Iceland, and a majority of the power has already been sold to the new silicon smelter in the area.

Notably, the Burfell II hydro project is only planned to generate 300 GWh to the grid annually, despite of having 100 MW capacity i.e. utilization rate is 35%. This equals to a 35 MW plant with 100% utilization.

Due to transmission bottlenecks only the new power plants coming online in the SW-area of Iceland can realistically add power to the existing Data Center Industry in that part of the country.

As earlier mentioned the Data Center Industry in Iceland is planning for 90 MW growth in the SW-corner of Iceland in 2018 and further 30 MW in 2019. This can be very challenging, especially if the United Silicon's smelter in Helguvik goes back online with 32 MW consumption.

Installed generation capacity in Iceland



Source: Orkustofnun

Power plants under construction or active development

	Type	Developer	Area	[MW]	Comments
Under construction [1-2 years]				**158.2**	
Þeistareykir	GPP	Landsvirkjun	NA	45.0	First 45 MW phase online
Búrfell II	HPP	Landsvirkjun	SW	100.0	Low utilization [300 GWh]
Brúarvirkun	HPP	HS Orka	SW	9.9	
Glerárvirkjun II	HPP	Fallorka	NA	3.3	
In advanced development stage [2-4 years]				**1.8**	
Kaldárvirkjun	HPP	AB-Fasteignir	NW	0.4	
Þverárvirkjun	HPP	AB-Fasteignir	NW	0.4	
Urðarfellsvirkjun	HPP	F.Þj.Húsafelli	SW	1.0	
Under preparation [>4 years]				**184.0**	
Helluvirkjun	HPP	O.bú Vestfj.	SW	3.0	
Djúpadalsvirkjun III	HPP	Fallorka	NA	3.0	
Hvalárvirkjun	HPP	HS Orka	NW	55.0	Utlilization category
Hvammsvirkjun	HPP	Landsvirkjun	SW	93.0	Utlilization category
Stóra Laxá	HPP	Landsvirkjun	SW	30.0	Waiting category

Source: Orkustofnun

Transmission bottlenecks in Iceland

Where can electricity be delivered?

Only the SW-corner of Iceland and part of the east cost has a transmission system with voltage at 220 kV and over. The ring connection consists of 132 kV lines, whose transmission capacity generally lies in the vicinity of 100 MW.

The map shows the current defined delivery points of Landsnet, and the colors represent the estimated potential load increase in current transmission system.

Notably, the green and yellow points are outnumbered by the red ones.

The SV-line 2 project

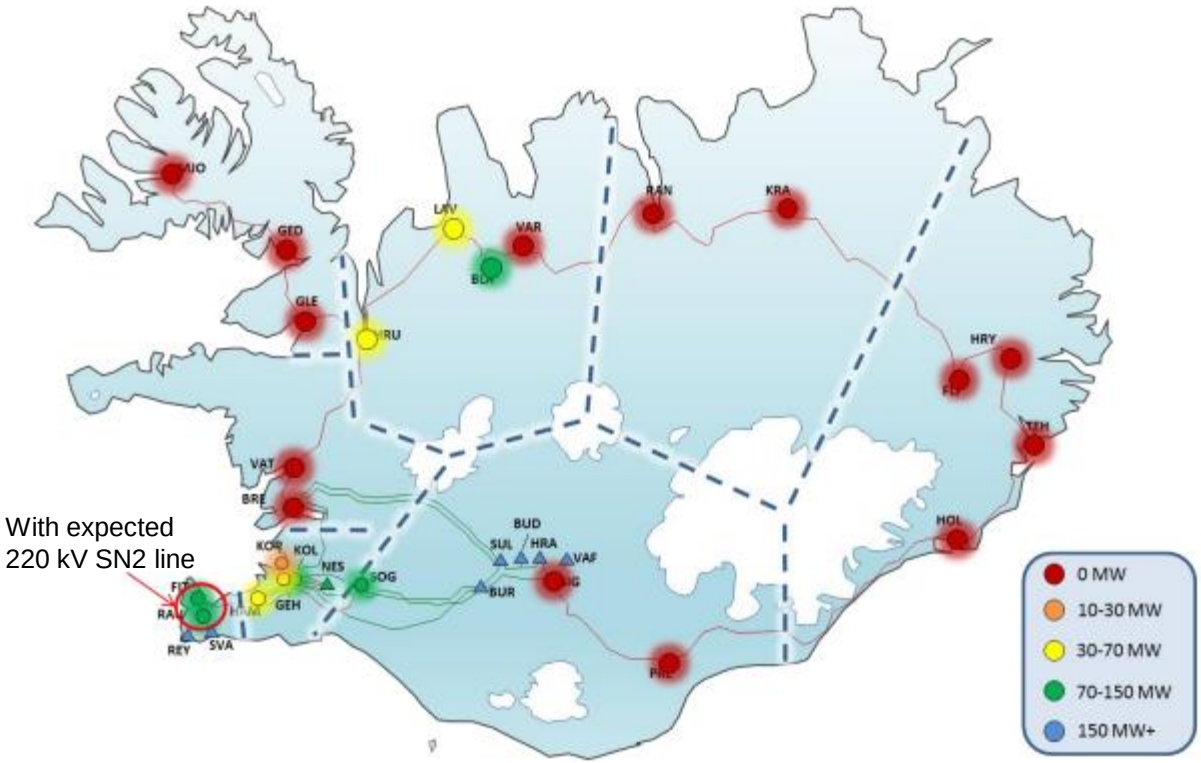
Most of the Data Center Industry is located in the Reykjanes peninsula. The prerequisite for the green dot there, is the construction of a new 220 kV line SN2.

That project currently finds it self in a legal dispute with no foreseeable outcome.

All power generation in that area is done at Geothermal power stations, which are not optimal for running in a grid island when the current SN1 drops out.

This situation might jeopardize the buildup of the Data Center Industry in the area.

Estimated potential load increase in current transmission system



Source: Landsnet

Transmission prices in the Nordics

Pricing mechanism

In most countries, both power generators and users pay fees to their transmission company. In Iceland, the network operator charges are paid in full by the users, which is different from other countries, as can be seen in the table to the right. The generators pay part of the cost directly to the TSO and then recharge it to the user through the electricity price.

At the end of the day however, the users will bear all the cost of transmission as the generator passes his cost through the electricity price.

Average transmission prices

In the chart to the right, you can see a comparison of the average cost of high voltage transmissions, according to a comparative study by the European Network of Transmission System Operators (ENTSO-E)

Costs and profits from so-called congestion management is included in the price for all countries expect Iceland and Sweden. Denmark and Ireland carry high costs due to connection of offshore wind parks, but the Norwegian TSO enjoys revenues for power price arbitrage of HV-interconnectors.

Large users

Most countries pricing mechanisms favor large users, this is not the case in Iceland's pricing mechanism. For example, up 90% discounts can be rewarded to large users in Norway which is far more than Iceland as explained on next page.

The unit price of Iceland as reported by ENTSO-E of 8.5 EUR/MWh, is an average of all users, including homes and small industries, while the prices on next page are only for medium and large industries.

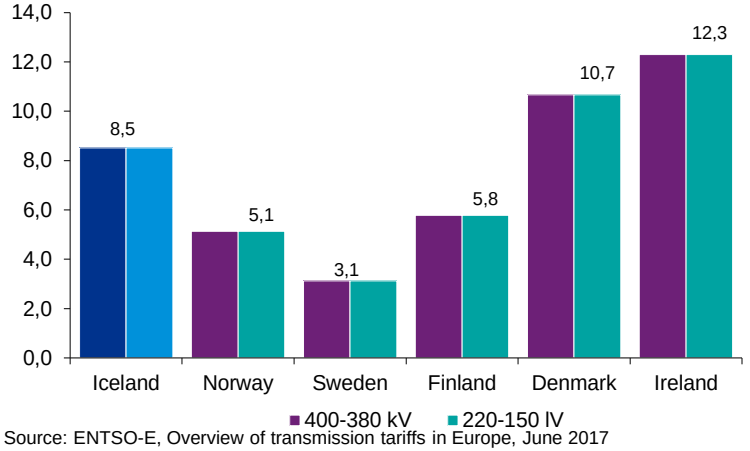
Unit prices of transmission operators in the comparison countries

	Sharing of network operator charges		Price signal		Losses included?	Service fees incl.?
	Generators	Users	Seasonal	Location		
Iceland		100%	No	No	Yes	Yes
Norway	38%	62%	X	Yes	Yes	Yes
Sweden	36%	64%	No	Yes	Yes	Yes
Finland	19%	81%	X	No	Yes	Yes
Denmark	3%	97%	No	No	Yes	Yes
Ireland	25%	75%	No	Yes	No	Yes

Source: ENTSO-E

X: Time differation.

Comparison of unit price for high voltage transmission cost ENTSO-E EUR/MWh



Source: ENTSO-E, Overview of transmission tariffs in Europe, June 2017

Transmission cost

Large user or not?

Landsnet, the Icelandic TSO, operates the transmission grid in Iceland and acts in accordance with energy law (No. 65/2003). The law stipulates that all users connected to the grid must purchase transmission services from Landsnet, and be charged according to a publicly introduced tariff.

Only users using more than 80 GWh annually (10 MW) can connect directly to Landsnet's HV-grid. Smaller users must connect to the local distribution network and purchase distribution service from them.

Cost of transmission

Landnet's tariff is a combination of energy and power fees. The tariff causes the unit price per delivered energy becoming lower with an increase in the size of the customer, starting from around 6 EUR/MWh and levels out at around 5,5 EUR/MWh, as can be seen on the graph to the right.

Landsnet delivers electricity at high voltage or 132 kV.

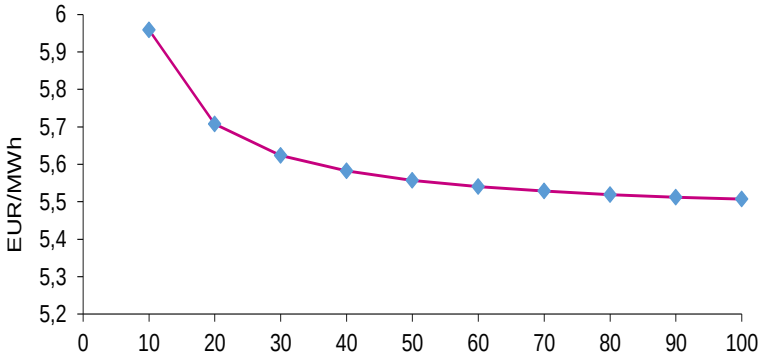
The size threshold

Due to this one size step in the legislation, smaller Data Center developers end up with paying higher distribution cost until they reach the 10 MW (85 GWh/h) threshold.

However, the law stipulates that new projects have three years to reach up to the threshold.

Users not reaching the threshold must purchase service from the local distribution company (DSO). HS-Veitur is the local DCO in the service area where most of the Data Center Industry in Iceland is located to day. As illustrated in the table to the right the cost of delivery for a 5 MW Data Center at 11 kV calculates at 20,4 EUR/MWh, or more than 3x the cost for 10 MW Data Center.

Transmission cost of large users, 8,500 h/year



Source: Landsnet

DSO charge for 5 MW Data Center at HS-Veitur [5 MW, 8760h]					
Tariff BD7 - 11 kV		**DSO**	**TSO**	**Tax**	**Total**
Fixed fee	ISD/day	11.726			4.279.990
Power fee	ISK/kW/year	4.280	5.333		48.065.000
Energy fee	ISD/kWh	0,47	0,58	0,30	59.191.320
					111.536.310
				Total [ISK/MWh]	2.546
				Total [EUR/MWh]	**20,4**

Source: HS-Veitur

Energy market and prices in Iceland

As earlier stated there is a lack of pricing transparency on the Icelandic electricity market.

Landsvirkjun prices

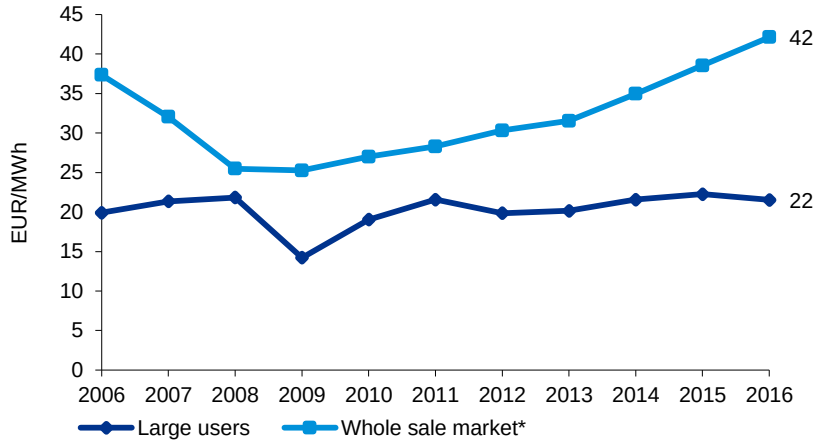
Landsvirkjun, the largest producer of electricity in the country, reports average power prices to industries and the wholesale market through annual reports.

The largest share of energy produced is sold to large users through long term Power Purchase Agreements (PPAs). Some of these PPAs are priced with a linkage to the market price of aluminum, and therefore the average price development correlates with the price development of that metal.

Both price curves can be seen on the chart to the right. The official price quoted by Landsvirkjun today is to offer energy to large users at EUR 37 per MWh (43 USD) excluding transmission costs. By adding 5 EUR for the transmission cost, the final delivered price of electricity becomes 42 EUR.

However, Landsvirkjun has stated that they offer new customers lower pricing for the first year of operation.

Landsvirkjun average prices with transmission cost



*) Transmission cost of EUR 6 per MWh is added to reported wholesale price

Source: Landsvirkjun annual accounts

Non recoverable taxes on electricity

Most European countries impose non recoverable taxes on electricity in one form or another. This is mainly done for the purpose of financing incentive programs for renewable energy investments.

ETS and carbon taxes

Additionally, fossil based generators must purchase green house gas emission allowances through the European ETS system to cover their CO2 emission. The prices of those Emission Unit Allowances (EUA) have the nature of carbon tax on electricity generation, but the cost is borne by the generator, i.e. it is already included in the consumer prices shown earlier.

The price of one EUA has recently been around 7 EUR per ton, which then adds around the same cost to a MWh generated by coal power plant and approximately 4 EUR for a MWh produced in a gas power plant.

VAT and recoverable taxes

Recoverable taxes such as VAT are imposed on electricity in most countries. As these taxes are passed to the end consumer, their effect is to have negative impact on the demand of service, but not to add to the operation cost of the industry such as Data Centers.

VAT taxation is covered in a special chapter of this report.

Energy intensive industries and Data Centers

In most countries, the taxation reduces with increased electricity consumptions of the industry. This is done in order to reduce the effect of the taxation on business competitiveness, but the European Energy Tax Directive (2003/96/EC) stipulates a minimum tax of EUR 0.5 per MWh.

In most countries, Data Centers enjoy the lowest tax rate applied.

Country comparison

The following two pages compare electricity taxation for different sizes of industries. The graphs are presented in annual energy usage, using data from Eurostat. As Data Centers typically use power all year round (8760 hours a year), the industry normally uses power consumption for comparison purpose.

In the table below, power is calculated from the relevant annual energy consumption for each of the consumption bands defined by Eurostat.

Annuan energy consumption v.s. Power							
Energy	MWh/year	20	500	2.000	20.000	70.000	250.000
Power equal	MW	0,002	0,059	0,24	2,4	8,2	29,4

Source: KPMG analysis

Non recoverable taxes -country comparison

Iceland

Since 2014, Iceland has not imposed any non recoverable taxes on electricity.

Utilities however, pay so-called adjustment taxes (i. jöfnunargjald) on distribution of electricity. The tax is now around EUR 2.5 per MWh (ISK 300) and is included in the total price of transmission and distribution the utilities charge industries and Data Centers using less that 80 GWh/year.

Iceland just recently started to report prices to Eurostat, but only for smaller users.

Norway

The general electricity tax in Norway is set at 16 EUR/MWh. However, a reduced rate of 0.5 EUR/MWh is levied on certain industrial users, such as Data Centers exceeding 5 MW in usage.

Additionally, end users pay a so-called Enova fee of 1.0 EUR/MWh, and cost of procuring electricity certificates in order to finance buildup of renewable energy production. A typical cost for the certificate is 2.08 EUR/MWh.

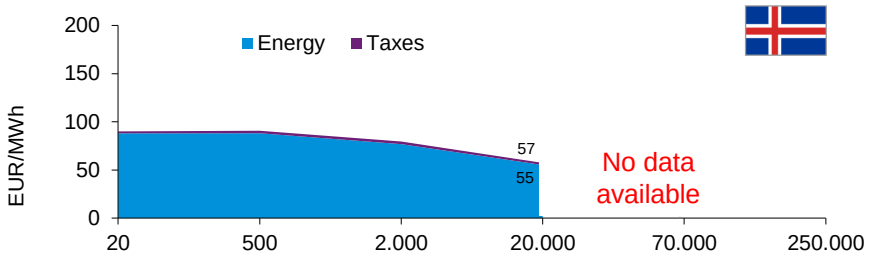
Source: Energy Norway

Sweden

Sweden levies electricity taxes of 33 EUR/MWh on consumer prices. However, Data Centers exceeding 0.1 MW in size and many other industrial operations pay 0.5 EUR/MWh in energy tax.

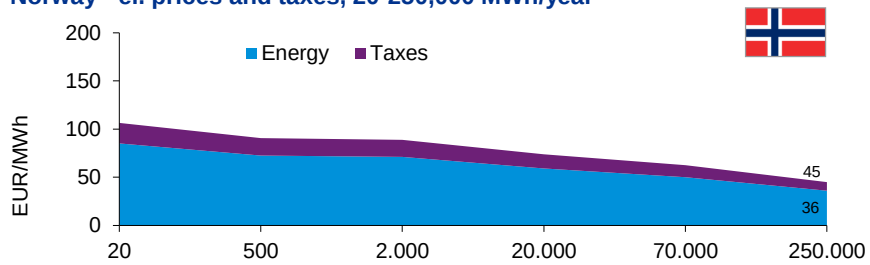
Source: Vattenfall

Iceland - el. prices and taxes, 20-250,000 MWh/year



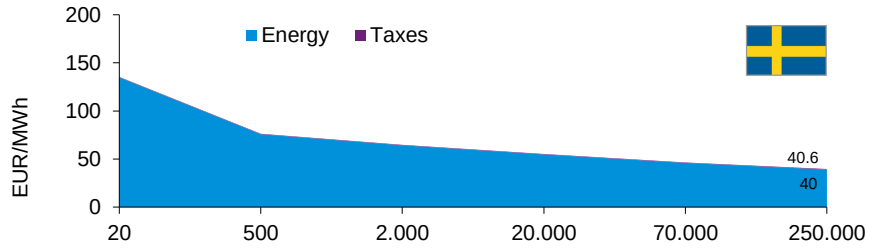
Source: Eurostat

Norway - el. prices and taxes, 20-250,000 MWh/year



Source: Eurostat

Sweden - el. prices and taxes, 20-250,000 MWh/year



Source: Eurostat

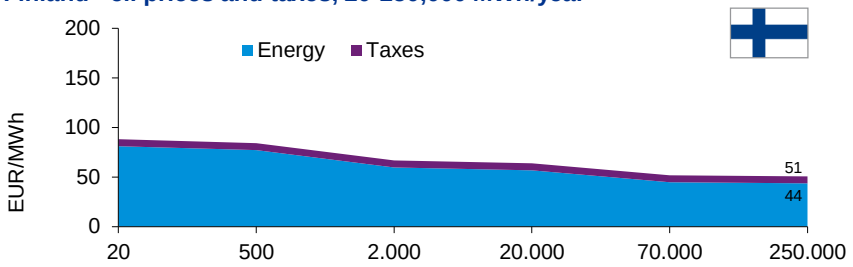
Non recoverable taxes -country comparison

Finland

Finland levies electricity tax on consumer in two categories. Tax on sectors in category I is 22.5 EUR/MWh, and 7.0 EUR/MWh on sectors in Category II, which Data Centers belong to.

Source: Vero

Finland - el. prices and taxes, 20-250,000 MWh/year



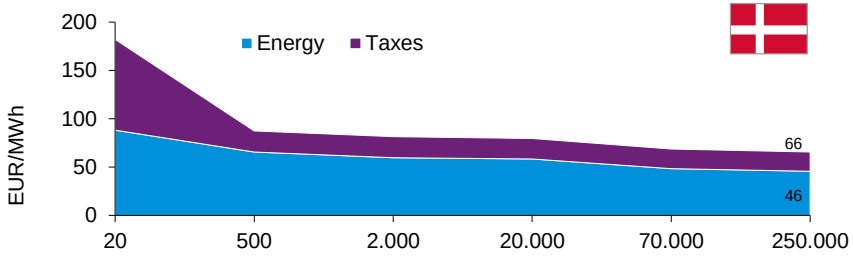
Source: Eurostat

Denmark

In Denmark, financing of the renewable energy incentives program is done by special taxation through the transmission and distribution charge, called Public Service Obligation (PSO Tariff). The PSO tariff is now 20.0 EUR/MWh, but the government has announced its intention to eliminate that charge gradually over the next 6 years.

Source: Energinet

Denmark - el. prices and taxes, 20-250,000 MWh/year



Ireland

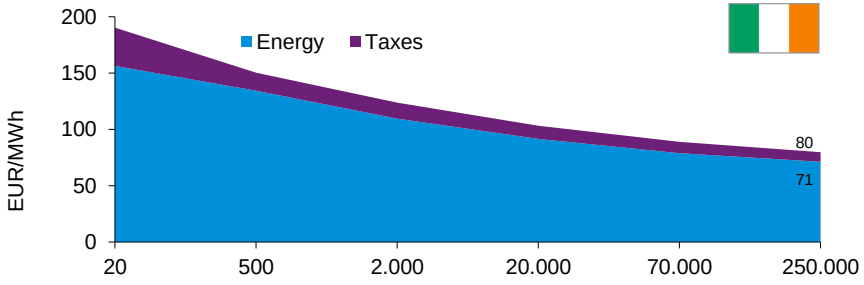
Ireland charges two types of non recoverable taxes on electricity. A Public Service Obligation charge of 3.64 EUR/kVA per months is levied on industries. For Data Centers with 8.500 hours annual usage, this will equate to a 5.0 EUR/MWh energy charge. The revenue from the PSO is used to finance Ireland‘s feed in tariff program.

Additionally, an electricity tax of 0.5 EUR/MWh is charged.

Source: Commission for Energy Regulation, Office of the revenue commissioners

Ireland - el. prices and taxes, 20-250,000 MWh/year

Source: Eurostat



Source: Eurostat

Total price comparison for Data Centers

Comparison

In the two colored boxes below, a comparison is made for two different sizes of Data Centers in the six countries in question.

For the smaller case, data from Eurostat is used in order to incorporate the average charge from the 486 DSOs operating in the region.

Result

Notably, prices for an average small Data Center are lowest in Iceland and Sweden or 57 and 56 EUR/MWh respectively.

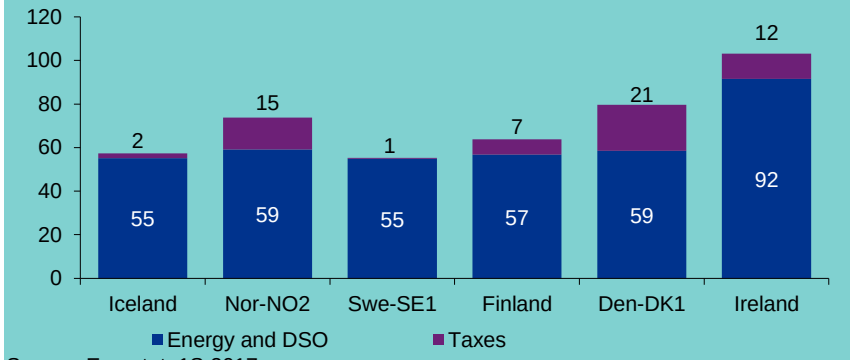
However, when looking at larger Data Centers, the energy content of the total price decreases more in Norway and Sweden, making the total cost of electricity 26% and 24% lower than in Iceland.

Smaller Data Centers – Eurostat data

By using looking at the newest data set from Eurostat (1st semester 2017), average energy prices for a 2,5 MW Data Center can be assessed.

Smaller users connect to the grid through the local distribution service operator (DSO). Eurostat published prices per delivered MWh of electricity, i.e. with DSO/TSO service included.

Price indications for <2.5 MW Data Center, [EUR/MWh]



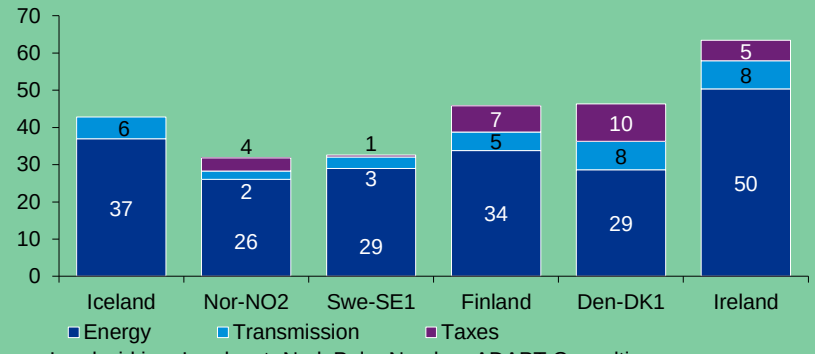
Source: Eurostat, 1S 2017

Larger Data Centers – market data and TSO tariffs

For larger Data Centers, the all inclusive prices can be calculated by adding three components:

1. Energy: Landsvirkjun offering for Iceland, with 3 year historical average of wholesale market plus sellers margin (2 EUR).
2. Transmission tariff.
3. Relevant non recoverable taxes.

Price indications for 15 MW Data Center, [EUR/MWh]



Source: Landsvirkjun, Landsnet, NodePole, Nasdaq, ADAPT Consulting

Price transparency

Transparency

Most European electricity markets have developed towards increasing transparency for prices. This is mainly due to the establishment of electricity exchanges. Even though bilateral PPAs still exist and are still available, many of them use the exchange price as a reference.

Another positive effect of the exchange markets, is the security it gives companies with short term investment horizons like Data Centers. They can always be certain to source power at market prices once their current contract runs out and to fulfill short term additional needs.

But longer PPAs

This lack of transparency to some extent, results in reduced operational security when the user approaches the end of his PPA. Instead, the power companies like Landsvirkjun, offer longer contracts that are available in other markets, or up to 15 years term.

Development of technology and services happen in fewer sectors in more pace than the IT industry. Due to this nature, it is debatable weather the existence of long PPAs does count as a positive factor for the Data Center sector at all.

Key Findings

- Wholesale electricity prices in Northern Europe have decreased over the past years and the market is expected to remain stagnant over the next five years. In addition, energy intensive industries in most countries in Northern Europe have been partly or totally exempted from non recoverable taxes on energy.
- During the same time, the pricing policy of Landsvirkjun the market leader in Iceland has remained constant, which has led to Iceland's competitive advantage of low electricity prices disappearing. Industries in Iceland such as Data Centers thus seem to be offered similar price levels as in Northern Europe, but higher than Denmark and Sweden.
- Price transparency has increased over the last decades in the comparison countries but has not in Iceland, at least from an outsiders perspective, e.g. doing desktop analysis.
- The pricing structure of transmission and distribution of electricity in Iceland makes it even more difficult for smaller Data Centers in Iceland to be competitive.
- According to industry stakeholders, delays and uncertain time plan for improved HV-connection to the Reykjanes peninsula might jeopardize the growth plans of the Data Center Industry.
- Growth plans for the most attractive Data Center areas in southwestern Iceland can be a challenging task for the power generation industry over the next three years.

Connectivity

Connectivity is king

Connectivity is a critical element in the Data Center Industry. Operating in an increasingly globalized market requires secure access and continuous communications making connectivity a major concern for businesses considering Data Center services.

Defining the market

Connectivity defines the market available to the Icelandic Data Center Industry. Bound by geographical latency and high bandwidth cost, Iceland has mostly been successful in attracting high energy – low bandwidth workloads such as HPC (High Performance Computing) and crypto currency processing.

Pricing is pain

Feedback from local stakeholders and lost Data Center prospects strongly states connectivity to be the number one obstacle for further success; naming bandwidth pricing, lack of carrier diversity, and network reliability as primary factors.

And it's getting worse

As energy price declines bandwidth cost is becoming a relevant factor even for low bandwidth customers.

Non-competitive backhaul

Landing locations of FARICE-1 and DANICE require backhaul routes through third party landline network at both ends. Lack of provider diversity at landing points place Farice in a non-competitive backhaul environment limiting the negotiations leverage.

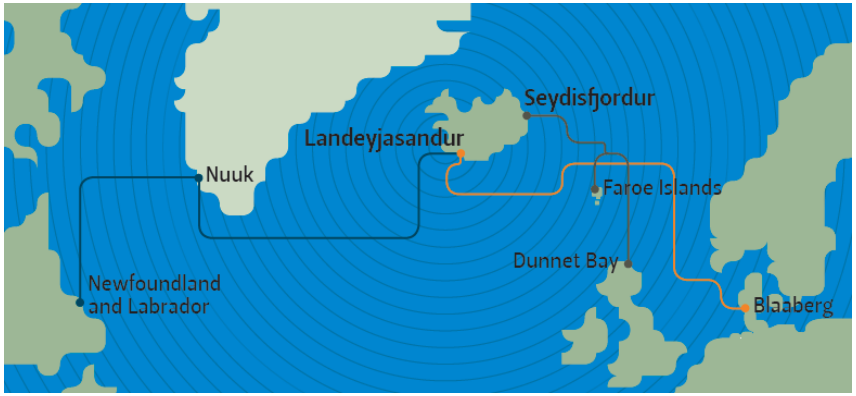
Single carrier market

Despite Tele Greenland operating the Greenland connect cable, the Icelandic market is generally regarded as a single carrier market operated by Farice. Operating both cables connecting Iceland to Europe places Farice in a dominant position as the Greenland connect route fails to be a viable option.

Perceived monopoly

The dominant position Farice holds on network infrastructure is regarded by many local stakeholders as the primary obstacle the Icelandic Data Center Industry faces. With Farice serving extensive debt from past financial crisis while operating in a cost-inefficient backhaul network, creates the perception of a monopoly market with limited ability to engage in completive network pricing.

Submarine landing stations



Source: Farice website

The network

FARICE-1

Operated from 2004 by Farice the 1,205 km cable has proved highly reliable without a single outage but has suffered troubled landlines with numerous outages within the UK backhaul. With a traditional design of 25 year lifespan, FARICE-1 is at the later half of its lifespan looking for renewal within the next 10 years. While the cable may function well beyond 25 years the operation cost and failure rate should be expected to rise.

DANICE

The 2,300 km cable operated from 2009 by Farice is also without an outage and supported with fairly stable landlines through the Danish backhaul to Copenhagen. The cable crosses FARICE-1 producing conditions for single point of failure. Appropriate measures are made at site to mitigate that risk but it still leaves the notion of uncomfortable weak spot within the system.

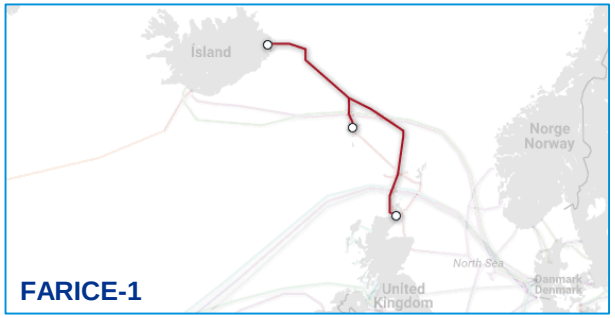
Greenland Connect

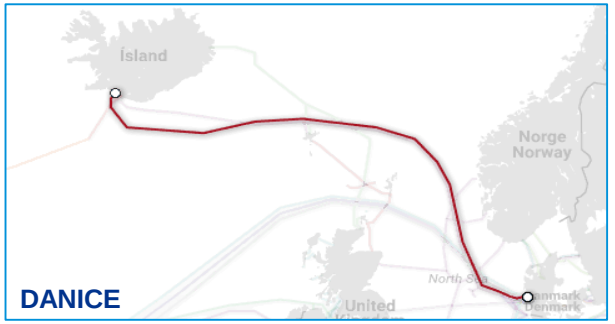
Operated by TELE Greenland since 2009 the 4,800 km cable provides a route to north America through Greenland and Canada sharing a landing station with DANICE at Landeyjasandur. The Greenland connect route has been criticized for frequent disruptions, long route to the US, high price, and low carrier service level. Thus often regarded as an expensive backup route at best, even as a connection to the US.

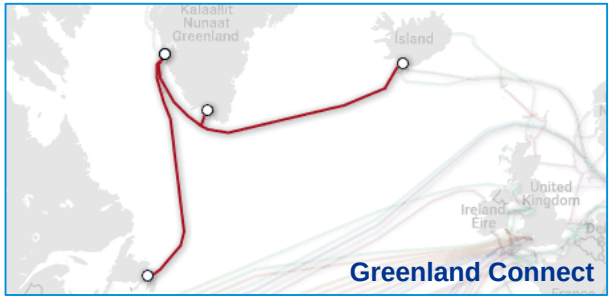
Submarine cables in Iceland

Submarine cable	Operator	Fiber pair	Capacity
FARICE-1	Farice ehf.	2	11.0 Tbps
DANICE	Farice ehf.	4	34,3 Tbps
Greenland Connect	Tele Greenland	2	12.8 Tbps

Source: International Data Connectivity in Iceland - Landsvirkjun white paper







Source: Submarinecablemap.com

Pricing

The European hotspot

In global perspective bandwidth pricing in Iceland could be viewed as fairly competitive but it lines up with central Europe providing one of the most connected and price competitive region in the world.

Competitive pricing

Carriers operating their own end-to-end network offer prices as low as 500 EUR for 10G wavelength within the condensed area of central Europe reaching the capital are of Norway, Sweden, Denmark and Ireland. Reaching out to more rural area like Lulea and Hamina a price range of 2,000 – 2,500 EUR is presented. Operating at a target Data Center price of roughly 5,000 EUR Farice will reach out for large strategic opportunities towards the 2,500 EUR benchmark.

Trans-Atlantic connection

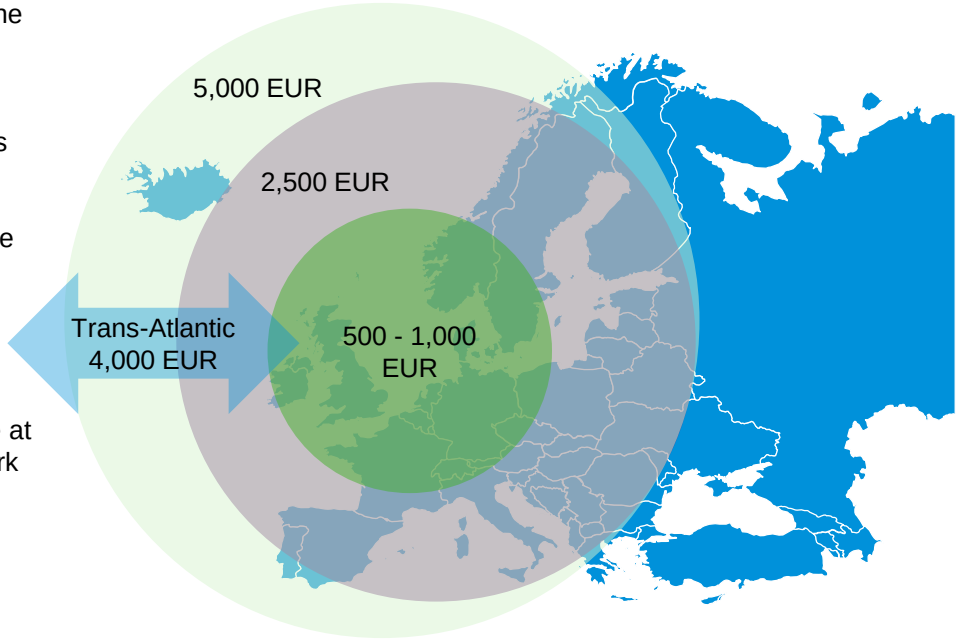
Trans-Atlantic connection between New York and London is available at 4,000 EUR. Tele Greenland offer a 10G connection between New York and Reykjavík at 12,000 – 14,000 EUR.

Target price range

With bandwidth pricing constantly decreasing throughout the world a decisive action is needed to address the connectivity pricing factor. Looking at the countries in scope the Icelandic market needs to be able to provide 10G connection at a price below 2,500 EUR, even as low as 1,000 EUR just to even out or mitigate the connectivity pricing factor.

Reaching the 1,000 EUR benchmark will be a tough business case to reach and will most likely require a global Tier 1 carrier acquire and connecting a new or existing submarine cable and backhaul with their own network or an operator using connectivity to facilitate other more profitable business.

Monthly recurring price for 10 G Wavelength



Source: KPMG Analysis

Pricing

Dual price model

Farice introduced a dual pricing model in 2012 to secure the condition of operation and facilitate the Data Center Industry. Domestic telco bandwidth is priced by a target factor of 5 – 10 times the cost of international Data Center bandwidth. Farice stated that the dual pricing model is vital to be able to provide reasonable pricing to the Data Center Industry pointing out they still strive to stay competitive despite cutting Data Center unit price by a total of 66% during past five years. With roughly 50% of total bandwidth utilization the Data Center revenue constitutes for mere 15% of bandwidth revenue in 2016.

Low bandwidth market

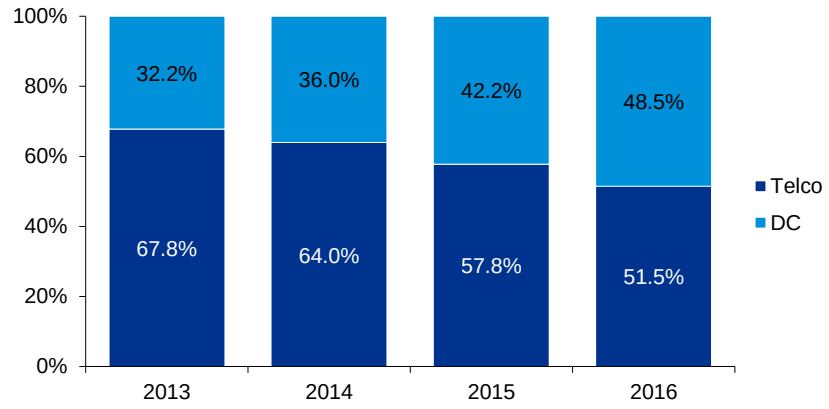
Bandwidth pricing has defined the Icelandic market as a low bandwidth market limiting the market share to low bandwidth workloads like HPC and crypto currency processing. A notable exception to this scenario was the presence of Opera Software hosting their bandwidth intensive workloads in Iceland for years. Despite being an exceptional case it supports that Iceland being a low bandwidth market is mostly based on financial factors rather than geographical or technical limitations.

Low capacity utilization

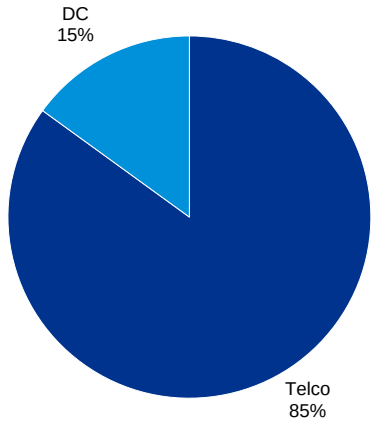
Loaded with low bandwidth workloads capacity utilization is marginal. With up to 50% of operational cost being capacity independent, marginal utilization inevitably influence pricing strategy.

Sources: Farice Memo, Farice Annual Financial Report

Farice bandwidth utilization split



Bandwidth revenue split



Source: KPMG analysis, Farice Annual Financial Report

Carrier diversity

Farice

Operates DANICE and FARICE-1. The shareholders of Farice consist of the Icelandic state holding 27,06%, Landsvirkjun (fully owned by the Icelandic state) with 33,16%, Arion Bank with 38,35%, and Farice itself holding 1,43%. Leaving the government with a controlling share of 60%. Primarily defining itself as a carriers carrier, Farice offers a catalog of IP/MPLS services overlapping the product portfolio of local and international service providers. Farice operates a 24/7/365 NOC service running the technical operations of their network in partnership with Míla ehf.

Tele Greenland

Tele Greenland, fully owned by the Greenland government, operates Greenland Connect. The route has a reputation of being uncompetitive due to high pricing and lack of reliability. Considerable measures have though been undertaken recently to improve cable reliability on both ends securing the submarine cable from rupture by icebergs at the coast of Greenland and raising trawler awareness of cable position in Newfoundland. Tele Greenland newly engaged with a backhaul provider in Canada expanding the service offering and plan for 24/7 NOC service to be established in 2018.

Tele Greenland operates through an expensive backhaul on both ends struggling with a base rate of 2,500 EUR per 10G connection in Iceland through Farice, even though it's negotiable on case-by-case basis especially when Data Center related. The Icelandic market share is marginal and is generally applied as a backup route for customers looking for high availability network setups. Tele Greenland is perceived by local stakeholders as a passive carrier doing little to nothing in building their market share.

International carriers

Some international carriers have deployed a PoP (Point of Presence) in Iceland, most notably CenturyLink one of the largest network carrier in the world, along with other large carriers like Colt, Epsilon and BT. But as all of these carriers operate their PoP on Farice network, customers don't benefit from aggressive pricing these carriers provide on their own network.

Carrier challenge

Financial strength

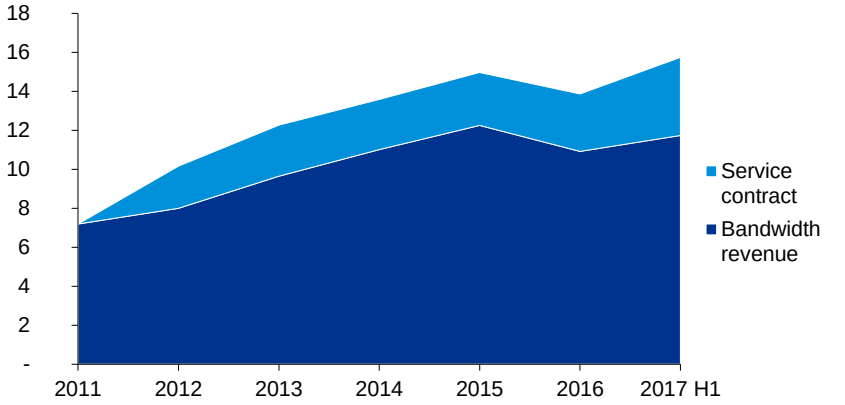
As a measure of financial restructuring, the Icelandic state issued a state guarantee on Farice bonds and signed a service contract, valid until year end 2018, providing Farice sufficient revenue stream to secure daily operation. A setup that somewhat limits the pricing model Farice is able to operate in order to comply with the ESA agreement involving limitation on government support. Being a dominant provider, Farice still has been struggling with heavy debts and uneconomic financing.

Introducing dual price model in 2012 favoring the DC industry Farice aimed to screen out the negative effect of the financials while building up the DC industry and with the public service contract expiring at year end 2018, Farice should become less restrained by the ESA agreement. Insisting the financial situation has no impact on DC pricing due to the dual pricing model it inevitably must limit Farice ability to engage in fierce international price competition.

Backhaul cost

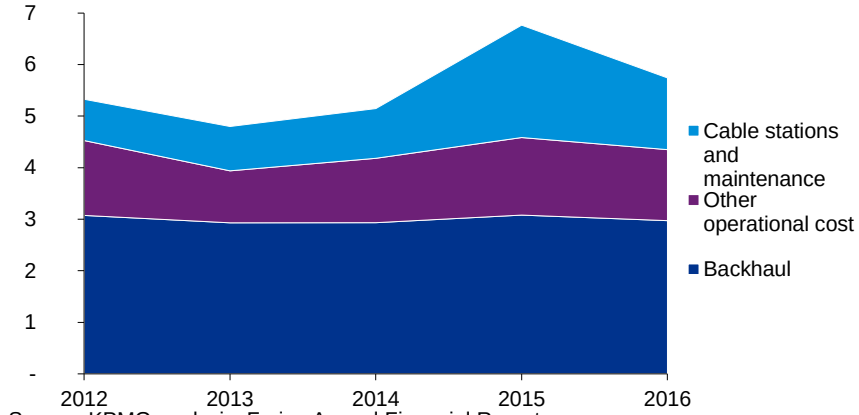
Cost of backhaul services constitutes for more than 50% of total operation network cost, while not being unique within the carrier market the setup has a serious impact on Farice ability to address the pricing issue. According to Farice management some opportunities to mitigate cost might open up with upcoming renewal on long term backhaul contracts in 2019 while investment in fiber connection to major connection hub, eliminating the third party backhaul, could be a true game changer.

Farice revenue (m.EUR)



Source: KPMG analysis, Farice Annual Financial Report

Bandwidth operation cost (m.EUR)



Source: KPMG analysis, Farice Annual Financial Report

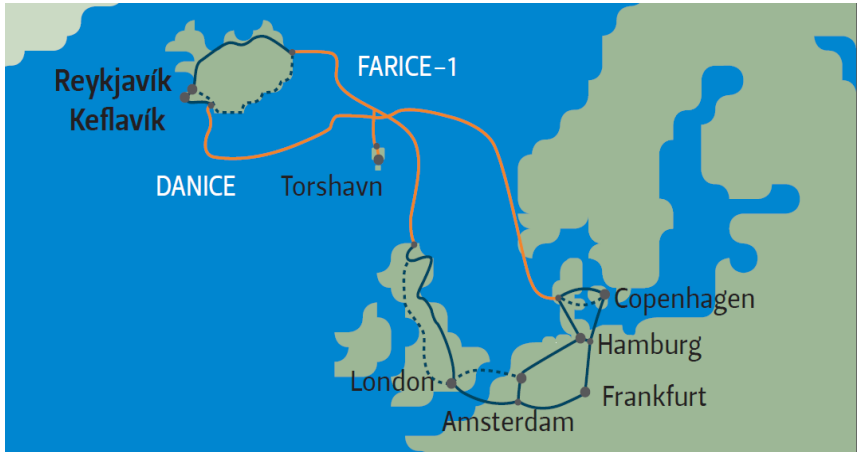
Backhaul providers

Míla

Míla ehf, a subsidiary of the publicly listed telco Síminn ehf, owns and operates the 1,800 km ring based main national fiber network, providing backhaul service for the three submarine cables. Total optical fiber in the trunk network is over 4,000 km with a capacity of 40x10Gbps. Despite parts of the network becoming over 30 years old, the domestic backhaul has been fairly reliant.

Tele Denmark

Danice submarine cable terminates at the Blaabjerg landing station alongside the TAT-14 trans-atlantic cable. Tele Denmark operates the backhaul routing from Blaabjerg to Interxion in Copenhagen, Hamburg, Frankfurt and Amsterdam. The Danice backhaul has been fairly reliant with up to 100% availability over last four years.



Source: Farice Website

Vodafone Carrier Service

Vodafone, originally known as Cable and Wireless, operates the backhaul from the FARICE-1 landing station at Dunnet bay to the London Telehouse. The backhaul routes have proved troublesome with outages through the years. In an attempt to increase backhaul reliability, Farice is contracting for the third routing option.

Source: Farice Website

Availability

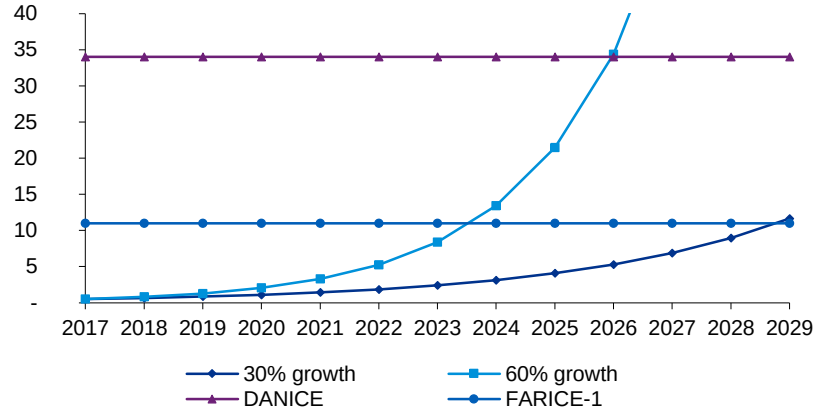
Sufficient capacity

As of years end 2017, Farice is selling 0,5 Tbps of dedicated bandwidth utilizing 3% of FARICE-1 and 1% of DANICE's total capacity leaving available capacity plentiful for the time being. Farice has experienced 30-40% growth year after year of bandwidth usage. Expecting similar or increasing growth, FARICE-1 might run out of capacity within 5 – 10 years based on current technology.

The lifeline

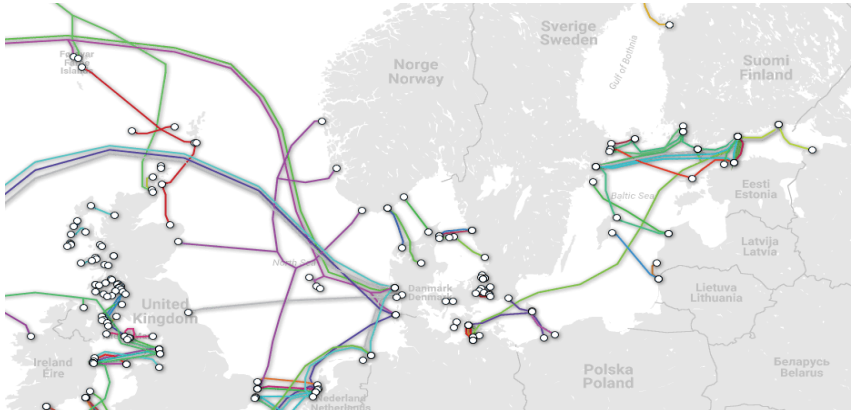
While the current setup of two cables setup connecting Europe might seem sufficient for current Data Center workloads and domestic usage, looking at future opportunities, a more robust network will be needed to support more diverse Data Center workloads. Entering the fourth industrial revolution, the submarine cable network has become the aorta for the Icelandic nation as the majority of businesses and the general public rely on various internationally hosted services. Therefore, increased reliability will be a critical factor for the Icelandic community as a whole not just a facilitating factor for the Data Center Industry.

Growth Scenario (Tbps)



Source: Farice presentation 2015, KPMG Analysis

Submarine cables



Source: Submarinecablemap.com

Availability

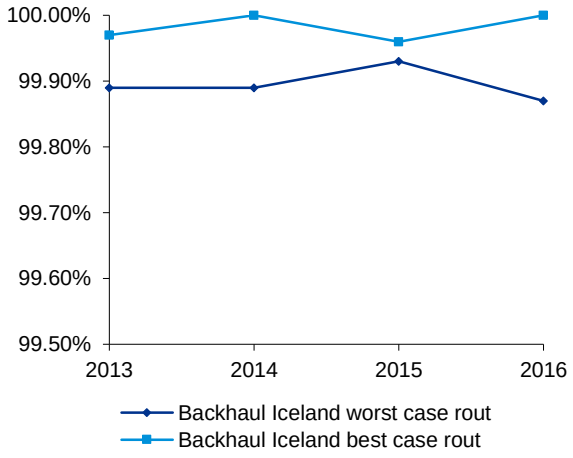
Short on nines

As capacity is not an imminent concern, providers point out that in order to claim an effective high availability routing with five nine reliability (99,999%) to Europe, excluding Greenland connect as a viable option, a third cable is needed. Looking at perfect streak for both Farice cables operating without a single rupture or malfunction below sea-level throughout their lifetime, an outage should be expected. In this regard Iceland falls short in comparison with most other Nordic countries who provide highly connected networks with dozens of submarine cables and landlines.

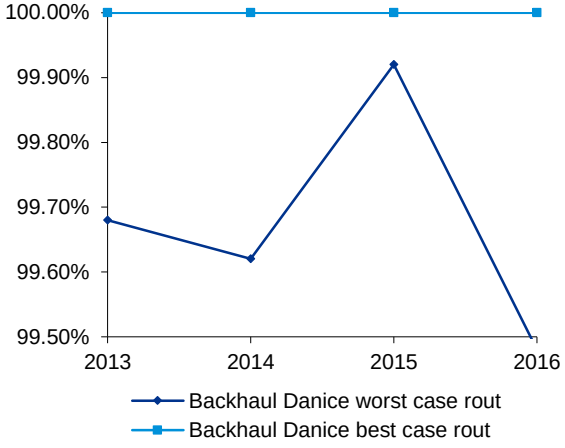
Backhaul route availability

Following graphs show the backhaul availability on single routes e.g. best and worst case single routes per year. Protected service on Farice network during 2013 – 2016 delivered 100% availability.

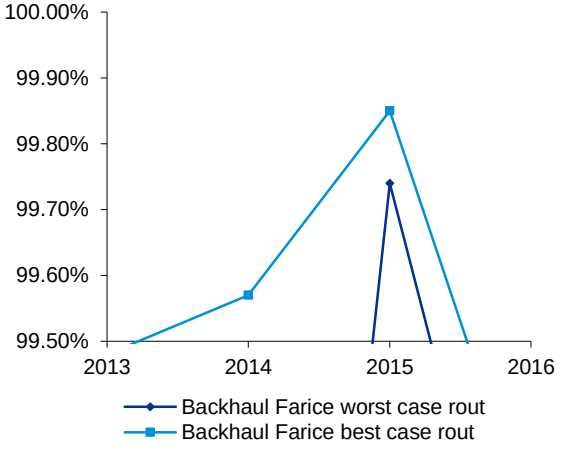
Backhaul in Iceland



Danice backhaul in DK



Farice-1 backhaul in UK



Source: KPMG analysis, Farice Annual Financial Report

Latency

Not for low latency

Iceland's geographical position entails natural latency towards any major markets inevitably limiting viable Data Center workloads. As Iceland is unsuitable for low latency workloads, the industry must focus on customers with less latency dependent workloads.

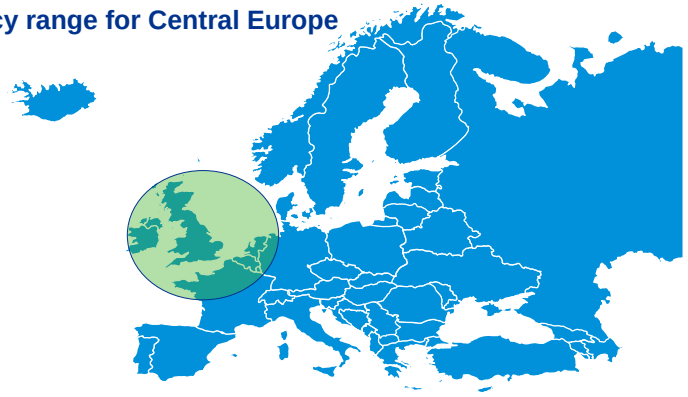
Not a problem

Market stakeholders roughly estimate true low latency application to be merely 10-15% of the total Data Center market. The geographically induced latency applies with similar effects in Norway, Sweden and Finland in regards of low latency workloads.

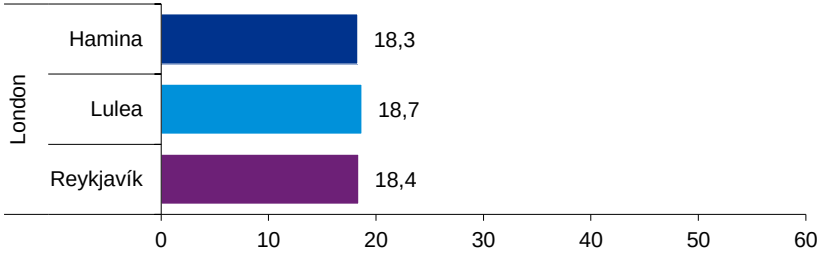
Mitigating action

A submarine cable between Iceland and Ireland with optimal routing could mitigate latency to London, UK by an estimate of 25% to roughly 14 ms. Such an arrangement would strengthen the current value proposition but hardly open up new markets.

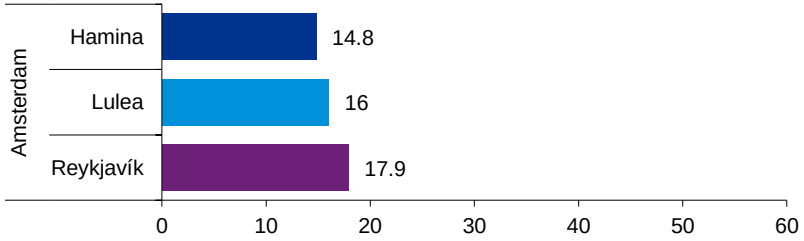
< 5 ms latency range for Central Europe



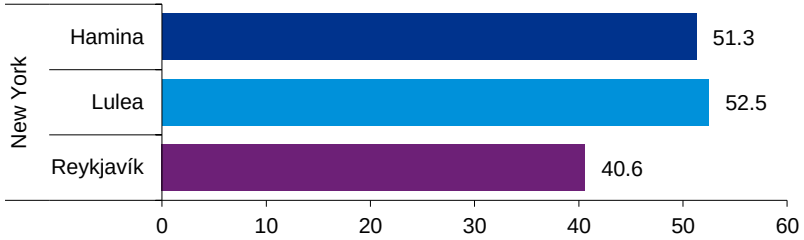
London latency (ms)



Amsterdam latency (ms)



New York latency (ms)



Source: International Data Center connectivity – Landsvirkjun white paper

Contract terms

Mitigating backhaul cost

In an effort to mitigate high backhaul cost, Farice looks to engage with potential customers in order to offer advice and tuning of bandwidth requirement to fit actual need. While strategic and an effective way to optimize pricing, it risks complicating the overall sales process. It can facilitate the impression of the Icelandic market being more complicated and primitive to enter than the competing regions.

Dual pricing

Due to the dual pricing model, contracts will contain provisions defining legitimate bandwidth usage not found in analogous contracts in competing regions. While not a significant factor in the overall process, it is likely to weigh in as a complicating factor.

Contract time

As bandwidth price tends to decrease over time, buyers generally will be reluctant to commit to long term contracts as they aim to capitalize on decreasing prices on a regular basis. Optimizing third party backhaul terms, Farice strive to meet customer requirements offering a minimum of one year contracts while pushing for three.

Key Findings

- As the competitiveness in electricity decreases, bandwidth cost is becoming an obstacle also for low bandwidth workloads. High bandwidth cost is obstructing bandwidth intensive workloads to enter the market.
- Current network is economically inefficient with expensive third party backhaul routes, limiting the ability to mitigate bandwidth cost.
- With Farice in a dominating market position, lack of carrier diversity is a negative factor for the market, as well as being more expensive than competing regions.
- Although, total bandwidth capacity utilization to and from the country is marginal, a majority of industry stakeholders claim that the third submarine cable is needed for high availability routing to Europe.

Workforce

Competitive education rankings:

The Global Competitiveness index ranks Iceland as 13th in the world in the quality of the education systems. Iceland ranks 10th in technological readiness. The rest of the comparison countries all score very highly and within top twenty in the factors considered in the global competitiveness rankings which is out of 137 countries.

Iceland's workforce is centered around the metropolitan area:

Iceland has a small population of roughly 338,000 people. However, Iceland is very densely populated around the capital. Eighty percent of the available workforce of Iceland lives within an hours commute of the capital and surrounding optimal Data Center locations.

Sources: Ramboll, Haukur Mar Helgason, KPMG Analysis, Directorate of Internal Revenue

Global competativeness report rankings 2017-2018

Country	GDP Per Capita	Quality of the education system	Higher education and training	Technological readiness	Labor market efficiency
Iceland	59,629	13	12	10	9
Denmark	53,744	17	6	12	10
Ireland	62,562	7	10	18	21
Sweden	51,164	20	18	5	20
Norway	70,391	11	8	11	12
Finland	43,169	3	2	16	23
USA	57,436	4	3	6	3
UK	40,095	22	20	4	6

Source: Global competitiveness report 2017-2018

Note: Currency has been changed from USD with an exchange rate of 0.9 and rankings are out of 137

Key aspects of workforce

Data Centers consider two key aspect of workforce before investing, skills and costs. ICT skills are listed as one of the Top 20 bottleneck vacancies within Iceland, with a predominate geographical emphasis on the capital region. The same further indicates that there is a perception of a lack of concerted effort on the behalf of national or municipal government to address this.

Expat legislation

Attracting talent from other European regions may be difficult to fill these bottlenecks, owing to the high cost of living in Iceland. However, Special rules apply to the taxation on remuneration to foreign experts that come to Iceland for work. As of January 1st 2017, a new legislation enables only 75% of the income of foreign experts to be taxed for the first three years from the start of employment. [4]

Workforce

Based on KPMG's previous work for international clients, the local market in Iceland did not contain sufficient cloud and ancillary technical skills for cloud to be supported locally. Specific roles, including Data Center auditors, cloud architects, information security professionals, require multiple years of training and experience to be effective and there may be insufficient of those skills in Reykjavik to expand.

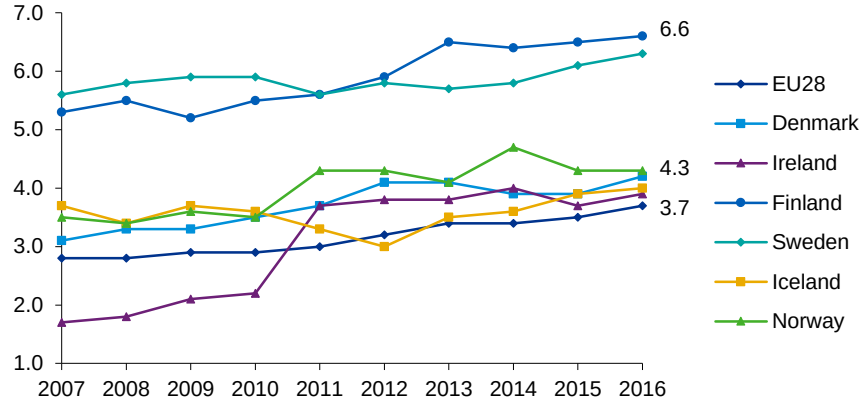
Available workforce

Particularly important for skills is that increasingly, companies are looking for capability from Data Centers as a key decision factor, rather than cost. The 2017 global Harvey Nash-KPMG survey of 4500 CIOs reveals, the number one reason for moving to the cloud is agility, with cost ranked only fifth. Whilst much of the capability development occurs remotely from the physical Data Centers, there is a faster pace of technology change and increasing specialism within the Data Center itself in the fastest growing sectors which places a premium on skills. The effect of Software Defined Infrastructure is to reduce the low-level system administration and physical interventions in favor of centralized, sophisticated tooling overseen by architect-level resources. These skills are scarce in Iceland.

Hyperscale workforce

The average Hyperscale Data Center will need roughly 50-200 specialists working for the Data Center. Due to Iceland's small population, the organization opening the Data Center will more than likely have to bring in specialists from neighboring countries to fill the vacancies.

Employed ICT Specialist (Percentage of population)



Source: Eurostat

Employed ICT specialists

According to Eurostat, Iceland has 4% of its population working as ICT Specialists. Finland has the highest percentage of ICT specialists with 6.6%, and Sweden is second with 6.3%.

However, we must keep in mind that the comparison countries have much larger populations. Four percent of Iceland's population amounts to roughly 13,500 being considered ICT Specialists, while Finland's 6.6% amounts to 365,000 ICT specialists when you consider a population of 5,542,000. Sweden has a population of 9,982,000 which will result in 628,000 ICT Specialists according to Eurostat. This results in more difficulty finding the best specialists in Iceland compared to the comparison countries. Notably, some of these ICT specialists will not have relevant skills to the Data Center Industry.

Sources: KPMG, Eurostat

Education level comparison

Iceland

78.0% attained at least upper secondary education, 25-64 year-olds

22.2% attained a Bachelor's or equivalent tertiary education degree, 25-64 year-olds

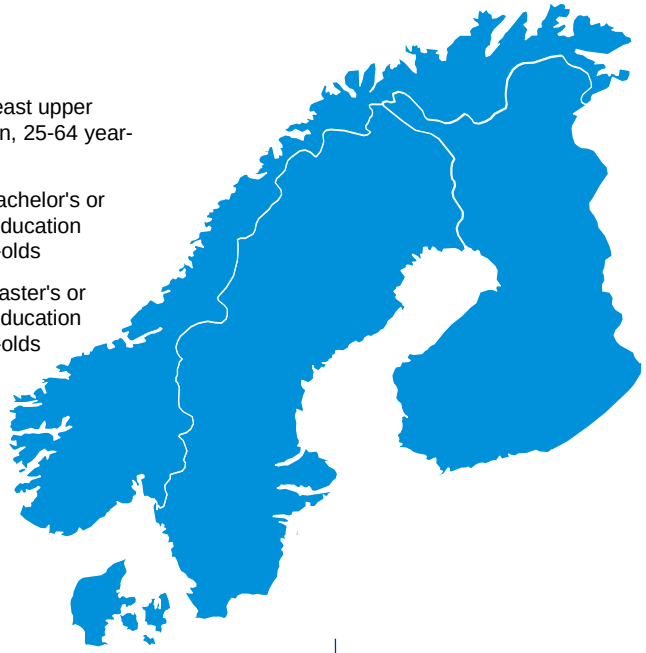
14.2% attained a Master's or equivalent tertiary education degree, 25-64 year-olds

Norway

82.2% attained at least upper secondary education, 25-64 year-olds

19.5% attained a Bachelor's or equivalent tertiary education degree, 25-64 year-olds

10.6% attained a Master's or equivalent tertiary education degree, 25-64 year-olds



Finland

87.9% attained at least upper secondary education, 25-64 year-olds (%)

16.3% attained a Bachelor's or equivalent tertiary education degree, 25-64 year-olds (%)

14.0% attained a Master's or equivalent tertiary education degree, 25-64 year-old

Ireland

79.8% attained at least upper secondary education, 25-64 year-olds

21.2% attained a Bachelor's or equivalent tertiary education degree, 25-64 year-olds

7.7% attained a Master's or equivalent tertiary education degree, 25-64 year-olds

Denmark

80.7% attained at least upper secondary education, 25-64 year-olds

20.3% attained a Bachelor's or equivalent tertiary education degree, 25-64 year-olds

12.0% attained a Master's or equivalent tertiary education degree, 25-64 year-olds

Sweden

82.7% attained at least upper secondary education, 25-64 year-olds

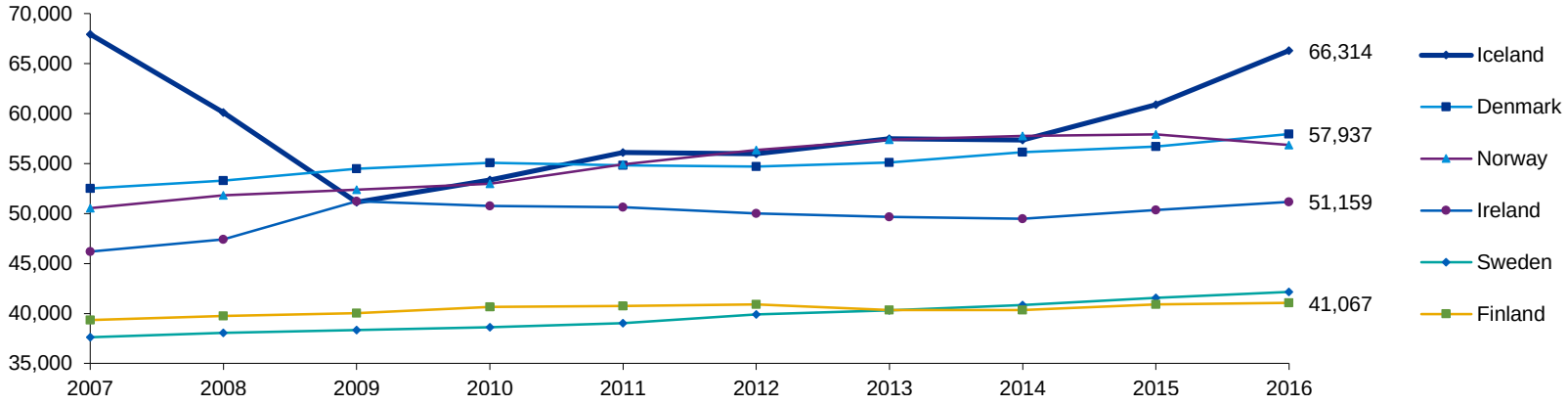
16.6% attained a Bachelor's or equivalent tertiary education degree, 25-64 year-olds

13.1% attained a Master's or equivalent tertiary education degree, 25-64 year-olds

Source: OECD

Cost of labor

Average annual wages by country in Euros



Source: The World Bank

Cost of labor is a top-three cost for Data Centers and thus Iceland may appear more expensive than European locations.

Iceland has one of the highest costs of labor. Compared to Finland, the average annual wages are 61% higher in Iceland and almost 30% higher compared to Ireland. Due to recent strengthening of the Icelandic Krona, the labor costs have risen substantially.

Key Findings

- Eighty percent of the available workforce of Iceland lives within an hours commute to the capital and surrounding optimal Data Center locations.
- Even though Iceland has a high percentage of ICT specialists, Iceland's population is so small that the number of available ICT specialists is only 13,500. This can negatively affect large players and Hyperscale operators studying the location.
- Cost of labor has become more expensive in Iceland than in the other Nordic countries and Ireland.

Passenger Travel

Travelling to Iceland

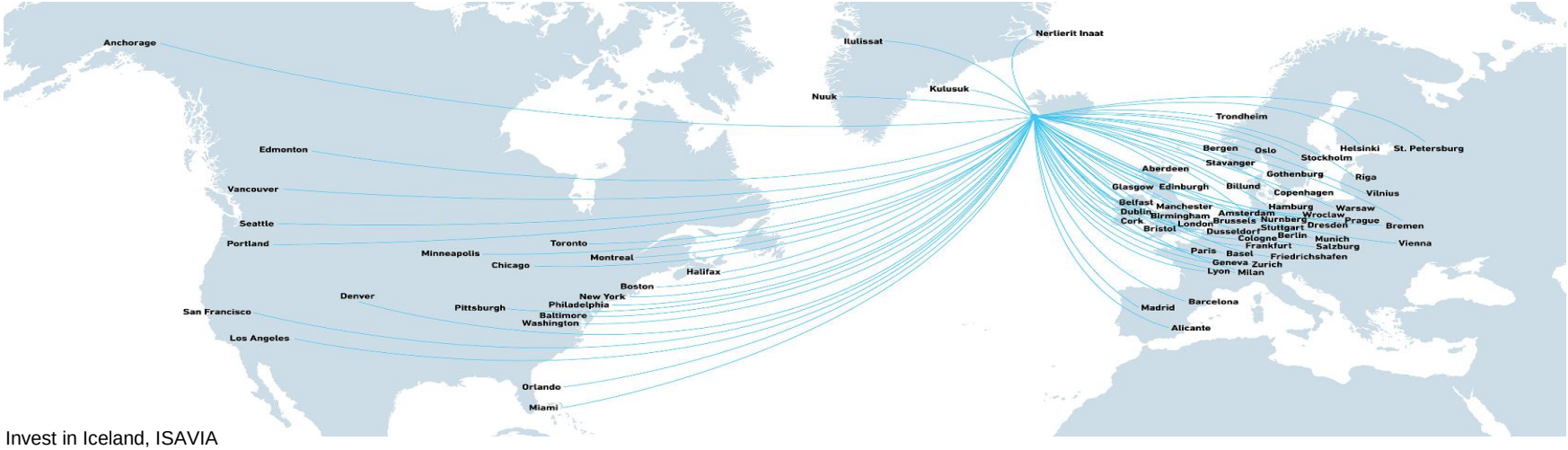
Iceland's international airport Keflavik Airport (KEF) is located 30 minutes away from the capital Reykjavik. The airport is known as one of the busiest flight connection hubs in Europe connecting Europe and the United States.

Keflavik airport has on average 216 flights a week to 23 locations in North America each week over the summer, and 129 flights a week to 20 locations over the winter. Keflavik airport has 503 flights a week to 75 different locations in Europe and 347 flights a week to 51 locations in the winter. The flight map below shows the destinations you can fly to and from Iceland's international airport.

Getting to the Data Center

Iceland's current Data Centers are all located within or closely surrounding areas. Many Data Center locations in Iceland are within a 10 minute drive from the airport while other prospected Data Center locations may be situated no more than an hours drive away.

Although Iceland is for the most part rural, it is very densely populated in the metropolitan area, and with all the different cities in both the United States and Europe offering direct flights to Iceland, getting people to and from a Data Center is not a challenge.



Invest in Iceland, ISAVIA

2016 Passenger Travel Comparison

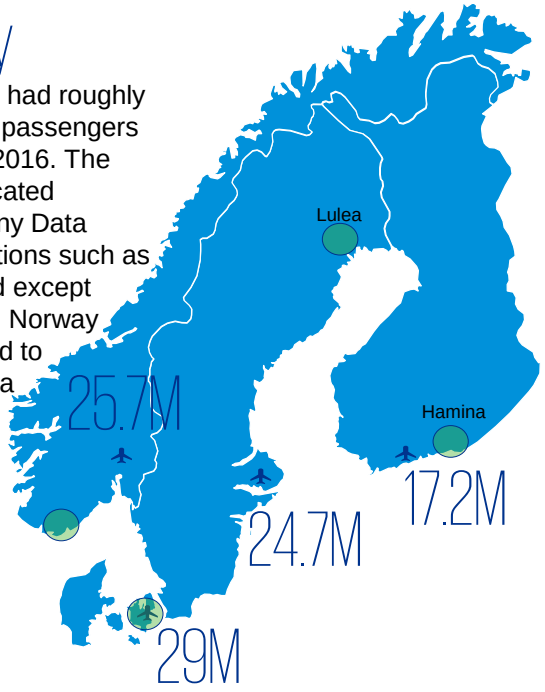
6.8M

Iceland

Keflavik International Airport had roughly 6.8 million passengers in the year 2016. The airport is also situated very close to the best Data Center locations.

Norway

Oslo Airport had roughly 25.7 million passengers in the year 2016. The airport is located close to many Data Center locations such as Kristiansand except for Northern Norway you will need to drive or get a connecting flight.



Finland

Helsinki-Vantaa Airport had roughly 17.2 million passengers in the year 2016. The airport is located close to many Data Center locations

27.7M

Ireland

Dublin Airport had roughly 27.7 million passengers in the year 2016. The airport is situated close to many Data Center locations.

Denmark

Copenhagen Airport had roughly 29 million passengers in the year 2016. The airport is located close to many Data Center locations.

Sweden

Stockholm Arlanda Airport had roughly 24.7 million passengers in the year 2016. To get to Lulea from most places in Europe and USA you will need a connecting flight to the local airport or drive.

Source: Eurostat

Freight

Shipping cargo to Iceland

Iceland has numerous firms which are able to deliver full container load deliveries by 20ft or 40ft containers. International shipments of goods will land in ports close to the capital and can be delivered to a specific location by truck. Iceland has numerous companies which deliver cargo to Iceland by air and sea which can be seen to the right.

Sea freight and air freight are close by

Out of the compared countries, Iceland does score the lowest on the logistics performance index. However, Iceland's main Data Center locations are located within an hours drive of both the international airport KEF and the international container terminal and hub in Reykjavík.

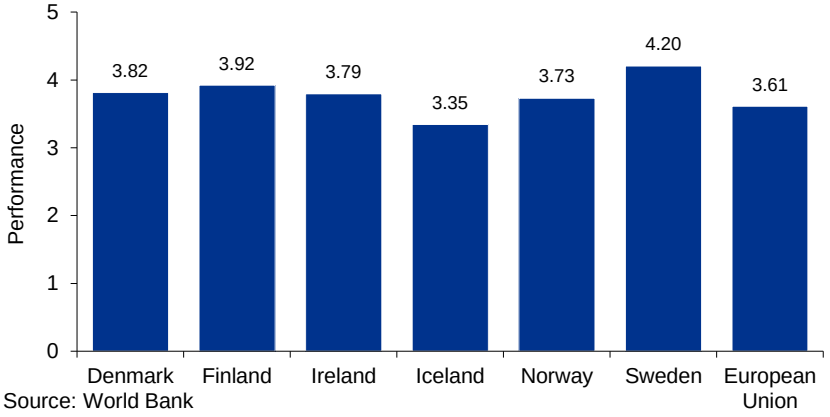
Air freight

Icelandair, DHL, Cargo Express

Sea freight

Samskip, Eimskip, Smyril Line Cargo, Frakt Flutningsmiðlun, Pelican Cargo

Logistics performance index: Overall (1=low to 5=high)



Source: World Bank

International freight comparison

Iceland

Keflavik International Airport is closely located to nearby Data Center locations. Two international container terminals and other domestic airports.

Norway

Norway has three container terminals and four of the busiest airports in the Nordics. Norway has multiple other ports and domestic airports.

Finland

Finland has one of the busiest airports in the Nordics Helsinki-Vantaa Airport. and many other domestic airports. Finland also has three container terminals.

Ireland

Ireland has two international airports which will handle cargo along with one international container terminal.

Denmark

Denmark has two international airports which will take cargo and one international container terminal.

Sweden

Sweden has three out of twelve of the most busiest airports in Europe. Sweden has three container terminals, however, they are not located close to Lulea and there is a need to haul cargo by truck or fly it with a connecting flight from another airport. However, Sweden has many container terminals and airports in south and west Sweden such as Göteborg Landvetter Airport, Malmö Airport, Port of Göteborg, and Copengagen Mamlö Port AB.

Map

- Top busiest airports
- Data Center locations
- Container terminal

Source: KPMG analysis

Key findings

Key Findings

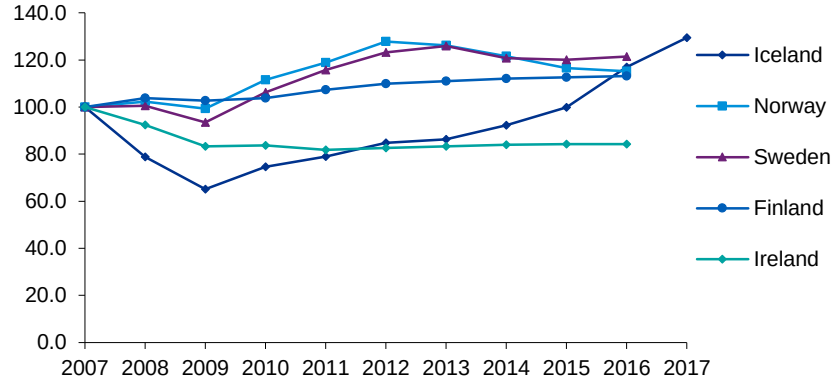
- Iceland is well located between two of the worlds biggest markets in terms of logistics for Data Centers and has good shipping terminals, and one of the busiest airports in the Nordics.
- Data Centers in Iceland and Data Center sites are located close to the international airport and shipping ports.
- Getting people and equipment to Data Centers in Iceland can be easier compared to other remote locations e.g. Lulea in Sweden as the selected and prospected sites in Iceland are situated close to the international airport and container terminals.

Construction environment comparison

Based on an interview with Friðrik Á Ólafsson at the Federation of Icelandic Industries, there are no comparative studies of construction costs between the six comparison countries available. However, the development of building costs over the last 10 years are represented in the graph on the right.

Conditions have been good for new construction projects in Iceland following the economic crisis, developments in recent years have been growing rapidly. This has lead to construction costs in Iceland increasing by roughly 98% from 2009 to 2017, due to the economic recession that took place in 2006. From 2009 to 2016, the comparison countries remained fairly constant and their combined costs only increased on average by roughly 15%.

Construction cost index, PPP, 2007 = 100



Source: Eurostat

Key Findings

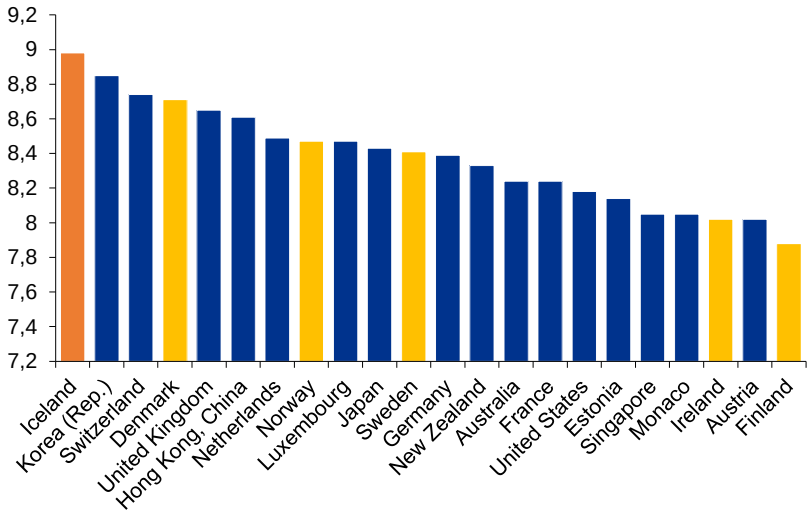
— Iceland's construction costs have increased substantially over the last 10 years, meanwhile construction costs in the Nordic have remained relatively stable.

ICT Environment

ICT Environment

Iceland ranks number 1 in the 2017 ICT Development Index published by the International Telecommunication Union measuring ICT access, use and skills. Illustrating the highly developed and adopted ICT environment in Iceland the comparing countries follow with high ranking identifying a generally advanced ICT environment of the Nordics.

IDI Global Ranking 2017



Source: International Telecommunication Union

ICT share of GDP

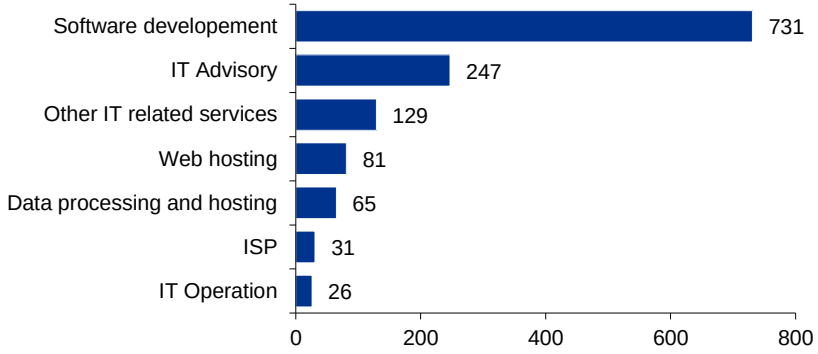
In 2014 the EU mean ICT share of GDP was 4,3% with Ireland leading by far with 12,1% followed by Sweden's 6.3%. Finland had 5.5% and Denmark 3,9.

Source: EU ICT Sector and R&D 2016

Icelandic ICT industry

Out of roughly 35 thousand businesses operated in Iceland over 75% is located within the Reykjavík capital area and nearest vicinity. Employing roughly 4% of active labor the ICT industry constitutes for 5,1% of the Icelandic GDP in 2016.

Icelandic ICT industry 2016



Sources: 1) Statistics Iceland
2) Federation of the Icelandic Industries
3) Directorate of Internal Revenue

Service Providers

Local service availability

Most of ICT service providers locate their headquarters within or near the capital area of Reykjavík close to current Data Center sites. Concentration of service providers promotes availability of service and competitive market.

Global vendors

Cisco and Microsoft operate a local branch office supporting number of certified service providers employing certified personnel.

The major server hardware providers HP, IBM/Lenovo, EMC Dell and Fujitsu operate a global partner network engaging certified service providers in Iceland just as in all the comparing countries.

International service providers like Atos (Sweden, Finland, Denmark, Ireland), Atea (Norway, Sweden, Finland, Denmark) partner up with local service providers extending their service to customers entering the Icelandic Data Center market.

Global support

Most major hardware suppliers provide warranties serviced by certified service providers and various service level agreements securing response time and stock of spare parts.

Global vendors

Microsoft, Hewlett Packard Enterprise, Atos, Cisco, Dell, Lenovo, Atea

Some local IT service providers

Opin Kerfi, advania, Þekking, TS, origo, sensa, Endor

Some local ISP

vodafone, Síminn, Nova, Símafélagið, Hringdu

Key findings

Key Findings

- Iceland ranks number one in ICT Development Index 2017 global ranking.
- Despite the relatively low population, there is a high density of service providers in the capital area able to provide ICT services to local Data Center companies.

Perception of operation

On every shortlist

Iceland is considered to offer low cost green energy, great connections to both Europe and North America in regards to flights, cool climate and other benefits. However the country is lacking in several factors, most notably with the availability of international telecoms and connectivity. Other factors vary between customers e.g. natural hazards, geographical location and workforce skills.

A large Hyperscale cloud company said, when asked about his general perception of Iceland: "Great cost of ownership. Connectivity might be a challenge and latency to existing locations (we are compute vs. storage).It's like having a Formula 1 car that goes at 250 mph but it's not much use on a country lane."

-Ref: MCJ Lemagnen for Promote Iceland July 2017

Critical factors i.e. what Data Center prospects say is more important to them	How Iceland is perceived on critical factors	Competitor locations in the same perceived group as Iceland
Low cost energy	✓	Quebec, Sweden, Finland, Nordics generally, USA
Green energy	✓	Norway, Sweden, maybe Denmark
International telecoms connectivity: service and cost	✗	USA, Canada, mainland Europe
Accessibility, flights	✓	Sweden, Denmark, Norway
Risk of natural disasters	Opinions vary on Iceland but some nervousness	Europe, N. America
Other risks	✓	Europe, N. America
Geographical location	Depends on customer's need, Iceland can be positive or negative	Quebec, Montreal, Ireland, UK, Paris, Amsterdam, New York
Workforce skills*	Opinions vary on Iceland, some concerns Iceland is too small	Other Nordics
Financial incentives, tax	✓	Ireland
Cooling/cold climate	✓	Other Nordics
Close to customers/size of local market	Depends if customer is looking for a large consumer market or not	USA, Canada, Ireland, Sweden, Denmark
Cost and availability of land	✓	None mentioned

Source: MCJ Lemagnen for Promote Iceland July 2017.)

Key findings

KPMG international specialists perceptions

Iceland is not known as a major player in the international Data Center market. The country is well known for its capacity of renewable energy and cooling as result of the climate, however it lacks good connectivity and a well known IT eco-system.

Although Iceland is ranked very well on lists of international low-risk countries, the perception from the Netherlands for example is that the country has some major risks due to the location, possible natural disasters, and availability of skilled work force.

Netherlands are used to close proximity of Hyperscale providers, a competitive landscape of local and international multi tenant Data Center providers and a wide range of connectivity. These are major criteria to keep IT within the country.

Another specialists from the UK perceived Iceland as an ultra safe repository of last resort and also having regulatory advantages making it a safe harbor from government interference but uncompetitive in the wider market outside these niches due to local cost, lack of Hyperscale Data Centers, possibly energy costs.

Key Findings

- In general, Iceland is considered to be a prominent location for Data Center operations with many benefits.
- The country is said to be suitable for storage, high compute, backup and disaster recovery.
- Potential customers view Iceland as a low cost energy location with green energy.
- Iceland is considered to be remote and described as an ultra safe repository of last resort.
- Possible customers name high latency as the key disadvantage of Iceland.

Why do we have to consider risk?

Data Centers can't afford downtime

Downtime is something most Data Centers cannot afford. Minor downtime can have a great impact on the reputation of a Data Center provider and their customers. If there is risk at hand, the important thing to consider is what mitigation efforts have been taken and what can be done to minimize the possible impacts of the risk factors. Different factors affect the considered risks, such as political stability, natural disasters, energy security, bandwidth and connections, energy cost fluctuations etc. The importance of each factor is different from one customer to another, and from one region and country to another.

How much risk is to much?

Data Center operators must account for risk in their operations. However, it's a balancing art. Despite high exposure to risk due to natural hazards, a large amount of Data Centers are being located in countries like Indonesia, Thailand and Hong Kong. Providers value proximity to the end markets higher than the calculated risk.

Cushman & Wakefield Index Weighing	
Criteria	**Weighting**
Energy (Cost per Kwh)	8,97%
International Internet Bandwidth (Mbit/s)	11,54%
Ease of Doing Business (World Bank Ranking)	11,54%
Corporation Tax	6,41%
Political Stability (EIU Instability Index)	12,82%
Sustainability (%Energy from alternatives)	8,97%
Natural Disaster	15,38%
Energy Security	12,18%
GDP per Capital	5,77%
Water (Availability per Capital)	6,41%

Source: Cushman & Wakefield report

Source: Cushman & Wakefield report

Iceland

Perception vs. Reality

When considering risk in the Icelandic Data Center Industry, the perceived risk is much higher than the actual risk. However, these natural factors have minimal effect on the operations of the Data Centers in Iceland who are mostly situated far from most natural hazards. Icelandic response teams are also experienced in dealing with natural hazards and have substantial recovery plans in place. Iceland ranks at the top of the list when it comes to political, natural, physical and political risk and is considered one of the safest places on earth to set up important industries.

Location for international energy sensitive companies

International industrial companies including Alcoa Corp., Century Aluminum, and Rio Tinto have all chosen Iceland as a location for large facilities such as aluminum smelters that can tolerate very little downtime. Iceland has been ranked in several reports through the last decade and has been among the top locations for Data Centers when considering possible risk factors. In 2016 the Cushman & Wakefield Company placed Iceland at the top of their Data Center Risk Index. Iceland scored high on factors such as “Share of renewables in total energy supply”, “World risk assessment vulnerability and coping capacity” and “Water availability” but was lacking when it comes to “Energy Security”, “Ease of doing business” and “GDP per capita”.

2016 Index Ranking			
Rank	**Country**	**Region**	**(100=Best)**
1	Iceland	EMEA	100
2	**Norway**	**EMEA**	**96,21**
3	Switzerland	EMEA	90,26
4	**Finland**	**EMEA**	**90,19**
5	**Sweden**	**EMEA**	**89,92**
6	Canada	Americas	85,07
7	Singapore	APAC	84,5
8	Korea, REP.	APAC	83,23
9	United Kingdom	EMEA	79,81
10	United States	Americas	78,73
11	Hong Kong	APAC	78,73
12	Netherlands	EMEA	78,06
13	Japan	APAC	76,48
14	Luxembourg	EMEA	74,98
15	Qatar	EMEA	74,73
16	Germany	EMEA	73,75
17	France	EMEA	73,61
18	Czech Republic	EMEA	73,31
19	Bulgaria	EMEA	71,53
20	**Ireland**	**EMEA**	**71,53**

Source: Cushman & Wakefield report

Source: Cushman & Wakefield report

Physical risk

Few natural hazards

According to the Icelandic Meteorological Office, there are few natural hazards that might affect the operations of Data Centers in Iceland, considering the most popular site locations. Due to Iceland's geographical location, tropical storms, tornados and hurricanes and severe storms never take place in Iceland. Blizzards and heavy snowfall are common during winter but have none to minor short term impact due to snow clearance. Thunderstorms only occur few times a year and there are no reports of any significant damages or disturbances. Chances of wildfire are very low, due to only 2% of Iceland's land area being covered by forest and woodland and the relatively high precipitation throughout the year.[1]

Natural hazards not in reach of Data Center locations

Iceland is known for seismic activity such as volcanic eruptions and earthquakes. However, volcanic eruptions in the last century have happened far away from the current Data Center locations in Iceland and have not affected operations in any way. Some areas in Iceland have no active volcanoes and where volcanic activity might be expected there are substantial recovery plans in place. Earthquakes have shaken Iceland through the centuries and happen every day in some regions of the country. What makes them less of a risk is the fact that their magnitude is minimal. Only six earthquakes larger than magnitude 5 have occurred in Iceland in the last one hundred years according to the US National Centers for Environmental Information (NOAA).[2] Only two of them caused any damage, mostly to old countryside residences.

Sources: 1) icelandicvolcanos.is
2) noaa.gov

Iceland is ranked 6th on the World Risk Index published by the United Nations University (UNU-EHS), followed by the other Nordic countries and Ireland far behind. The Index is comprised by four factors:

- Exposure to natural hazards
- Vulnerability as dependent on infrastructure etc.
- Coping capacities
- Adapting capacities

World Risk Index - Ranking

Country	Rank	Risk Ø
Iceland	**6**	**1,54**
Sweden	**10**	**2,19**
Finland	**11**	**2,25**
Norway	**12**	**2,29**
France	21	2,73
Denmark	**23**	**2,99**
Germany	26	3,09
Canada	28	3,13
United States	46	3,9
The Netherlands	122	8,41

Source: World Risk Index

Political risk

Political Stability		
Place	**Country**	**2014**
9	Finland	1,28
13	**Iceland**	**1,25**
16	Canada	1,18
23	Norway	1,12
26	Sweden	1,07
30	Netherlands	1,05
46	Denmark	0,95
47	Germany	0,93
73	United States	0,58
89	France	0,30

Political Stability		
Place	**Country**	**2015**
10	**Iceland**	**1,31**
11	Canada	1,27
19	Norway	1,16
28	Finland	1,04
41	Sweden	0,95
42	Netherlands	0,93
50	Denmark	0,90
67	Germany	0,70
70	United States	0,68
103	France	0,11

Political Stability		
Place	**Country Name**	**2016**
9	**Iceland**	**1,33**
15	Canada	1,24
19	Norway	1,17
38	Sweden	0,98
41	Finland	0,96
48	Netherlands	0,89
54	Denmark	0,85
62	Germany	0,76
88	United States	0,35
118	France	-0,06

Source: World Bank

In the last two decades, Iceland has gone through economic and social turbulence, especially in relations with the global financial crisis in 2008. However, this has not resulted in general disruption in the society. Continuity of government, law enforcement and daily operations of the three branches of government has not been interrupted. Regular general elections have been held peacefully and all political parties have respected their outcome each time and the formation of cabinets have been relatively swift.

When it comes to political stability, Iceland has been ranked by the World Bank in the top 4-6% of the 211 countries and territories surveyed in the last few years and currently holds the 9th place. Iceland is ranked above the other Nordic countries and all major competitors except for Luxembourg (6th). The ranking measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism.

Source: World Bank

Energy Price Risk

Long term contracts

Iceland has a highly stable and predictable electricity market with energy companies willing to make long term contracts with Power Intensive Users. Power Intensive Users can be served fixed price contracts with clearly predictable annual indexation over a long period of time. Landsnet hf., the National electricity system defines “Power Intensive Users” as customers that use at least 80GWh pr. year within three years from their initial connection [1]

As there is no functional electricity exchange market in Iceland, the market is however lacking transparency. The power companies offer long term power purchase agreements (PPAs) which then helps to increase consumers predictability during the duration of the PPA, but leaves the consumer vulnerable with little price security once the PPA runs out or the company intends to extend its operation. As Data Centers are typically gradually extended, but not constructed in very large phases as aluminum smelters, price predictability and energy availability is an bigger issue for them.

Landsvirkjun, the national power company states that:

“Power purchase agreements can be negotiated from between 5 to 12 years and are competitively priced in comparison with international markets. In support of “Greenfield” projects, Landsvirkjun can additionally offer increased contract flexibility and flexible discount periods.” [2]

Sources: 1) Landsnet
2) Landsvirkjun

Key Findings

- Iceland has been considered by experts as an ultra safe location, ideal for archiving, and is ranked number one in the Cushman & Wakefield Risk Index, that is a key reference in the market.
- Iceland has been ranked as having very low political risk.
- Despite the favorable ranking Iceland is often perceived as having high risk profile due to natural hazards.

Taxes

Tax system

The Icelandic corporate tax system is a classical system. Companies are subject to income tax on their worldwide income and double taxation may be avoided by means of unilateral relief or by applying a tax treaty.

Corporate tax

The corporate tax rate is 20%, which is in the mid range of the peer countries as seen on the bar chart to the right.

A non-resident company can be subject to income tax in Iceland if it is considered having a permanent establishment ("PE") in Iceland. The income attributable to such PE is subject to the same taxation as income of domestic companies, corresponding to the legal entity form of the non-resident company. No tax is on remittance of funds to head office.

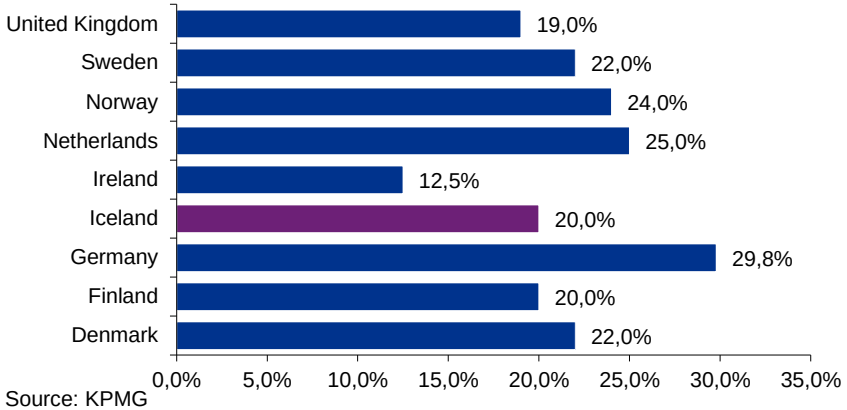
Distribution of dividends (or gains from disposal of shares) from Iceland are subject to 18% tax in case of non-resident limited liability company and interest payments are subject to 10% tax. Tax treaties can lower the tax (often to zero) especially in case of EEA recipient.

Custom, Value Added Tax and other levies

No custom duties are levied on IT equipment imported to Iceland.

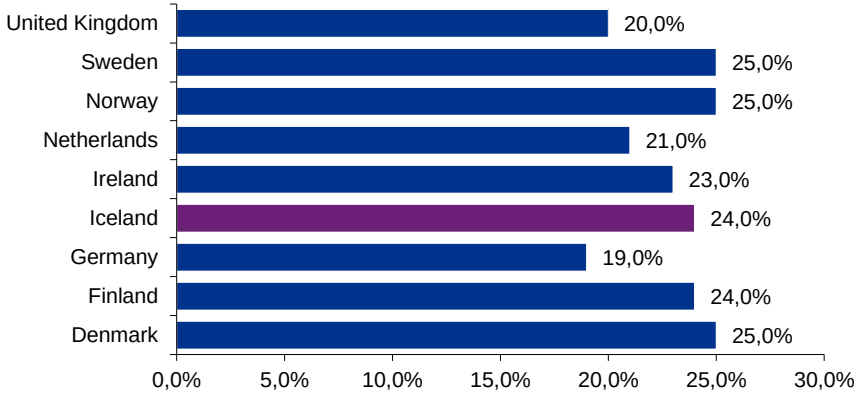
The standard rate of VAT is 24 percent. There are reduced rates of 11 percent and 0 percent. All IT related equipment and services are subject to the standard tax rate while the electricity is subject to the 11% rate. The standard rate is in line with other Nordic countries, but slightly higher than other N-European countries. In cases where IT services are rendered abroad (exported), the service provider can deduct input VAT on goods and supplies, while the export is not subject to output VAT in Iceland.
No non recoverable tax is levied on electricity in Iceland.

Corporate taxes 2017



Source: KPMG

VAT rates 2017*



Source: KPMG
*Standard VAT, all countries except Denmark and UK also have reduced rate.

Permanent establishment

Permanent establishment (“PE”)

Since the beginning of 2017, the Icelandic Income Tax Act contains a detailed definition of PE, which is broadly in line with the OECD model definition, as amended recently by the BEPS (Base Erosion and Profit Shifting) initiative.

There can be different types of PE´s, but the one which matters for Data Centers purposes is whether the non-resident company has ”fixed place of business through which the business of the enterprise is wholly or partly carried on”.

As the operation of the Data Center Industry revolves around remote access to IT equipment, it follows that the clients are often non-residents, with limited or no activity in Iceland apart from the use of an equipment located in Iceland. In the past it has been unclear whether an IT equipment alone would satisfy the criteria for a PE but the international consensus today seems to be that it can. From an Icelandic tax perspective its clear, from the recent change of the Income Tax Act and earlier tax practice, that IT equipment alone can constitute PE.

- A non-resident which has IT Equipment available at its disposal (by way of lease or ownership) and uses it for business purposes would in general constitute a PE of that non-resident.
- This applies unless the use of the IT Equipment is of ancillary or preparatory nature, i.e. is not part of the non-resident core business, then it´s deemed not having a PE.
    - An example of this could be IT Equipment in Iceland used by car manufacturer for virtual testing of its car parts or storing its data in a cloud.

Issues surrounding PE´s

There are some issues surrounding the PE of an IT Equipment, which are not Icelandic specific but issues on a global basis. Two of those issues are explained below:

- Non-resident uses IT Equipment in Iceland which constitutes core activity of that company but has no legal right over the IT Equipment, i.e. the physical equipment itself is not at its disposal but he has remote access to the capacity of the equipment. An example could be a non-resident which owns IT equipment in Iceland and leases remote access to third party clients. The non-resident would have a PE but the issues relates to whether his clients would also have PE.
- Assuming an IT Equipment alone constitutes an PE of a non-resident in Iceland, it is unclear how profits should be attributed to such PE. The method used to allocate profits to PE´s is “significant people functions”, but as far as IT Equipment PE is concerned, there are often no such functions performed at the location of the equipment. Therefore no income would be attributed to the PE. This issue is recognized by the OECD.

It can be said that the definition of PE does in general not comply well with the emerging digitalization of the economy which is the reason for the uncertainty. The OECD recently did make efforts to clarify the taxation on the digital economy with Action 1 of its BEPS project, but in the end it was decided not to go forward with that action at this stage.

It would be good if the legislator or the Icelandic tax authorities would provide clarification on the above issues, i.e. to confirm that remote access alone does not constitute PE and provide guidelines on how profits should be attributed to IT Equipment PE and what is acceptable markup on such profits.

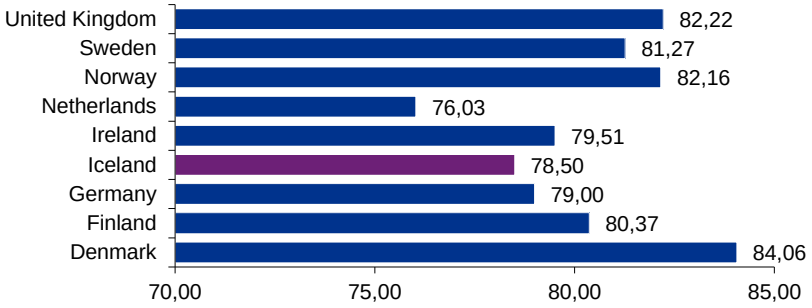
Business environment

Establishing a business

Establishing a company in Iceland is simple and registration fees are moderate. The procedure usually takes 5-10 days. Iceland ranks no. 23 out of 190 countries in World Bank (WB) list of “Ease of doing business”, but is however in the lower range of its peers as can be seen on the bar chart to the right. As can be seen in the rankings table to the right, starting a business and dealing with construction permits are among the tasks that the WB study consider Iceland not in good position compared to its peers. Below some general remarks on doing business in Iceland:

- The most common business form in Iceland is a limited liability company (LLC). Foreign companies may operate through branches in Iceland.
- Compliance requirements are moderate and would as minimum only consist of annual tax return and financial statements which is filed electronically. VAT liable operation must file return on bi monthly basis and salaries tax must be submitted on a monthly basis.
- Companies may keep their accounting records and prepare financial statements in foreign currencies subject to certain conditions and approval.
- Founders and Directors do not need to be resident in Iceland. Its sufficient that Directors are nationals or residents of any of the state of OECD, EES, EFTA or Faroe Islands.
- Iceland has concluded double tax agreements with 46 countries to avoid double taxation. Iceland has also free trade agreement with China.
- As of March 2017 there are no capital control restrictions.

Ease of doing business 2018



Source: World Bank
Note: Highest New Zealand 86.55 points, lowest Somalia 19.98 points

Iceland's ranking in 10 subcatigories	
Highest five	**Rank**
Getting electricity	11
Resolving insolvency	13
Registering property	15
Protecting minority investors	29
Enfocing contracts	29
Lowest five	**Rank**
Paying taxes	33
Starting a business	55
Dealing with constr. permits	64
Getting Credit	68
Trading across borders	69

Source: World Bank

Ease of doing business

Ease of doing business ranking											
Economy	Ease of Doing Business Rank	Starting a Business	Dealing with Construction Permits	Getting Electricity	Registering Property	Getting Credit	Protecting Minority Investors	Paying Taxes	Trading across Borders	Enforcing Contracts	Resolving Insolvency
New Zealand	1	1	3	37	1	1	2	9	56	21	32
Singapore	2	6	16	12	19	29	4	7	42	2	27
Denmark	3	34	1	16	11	42	33	8	1	32	7
Korea, Rep.	4	9	28	2	39	55	20	24	33	1	5
Hong Kong SAR, China	5	3	5	4	55	29	9	3	31	28	43
United States	6	49	36	49	37	2	42	36	36	16	3
United Kingdom	7	14	14	9	47	29	10	23	28	31	14
Norway	8	19	21	23	14	77	10	28	22	8	6
Georgia	9	4	29	30	4	12	2	22	62	7	57
Iceland	23	55	64	11	15	68	29	33	69	29	13

Source: WorldBank

Iceland at the bottom of the class

The world Bank measures the ease of doing business in 190 countries all over the world and ranks them. The rankings are made up of several equally weighted indicators such as starting a business, getting electricity, registering property etc.

The World Bank places Iceland in the 23rd place or in the top 12% of the list. However, Iceland is ranked below all the comparison countries and many other top competitors. Of the ten indicators used, Iceland does best when it comes to *getting electricity* (11th), *resolving insolvency* (13th) and *registering property* (15th). The factors weighing Iceland down are *trading across borders* (69th), *getting credit* (68th) and *dealing with construction permits* (64th).

Source: doingbusiness.org

Access to the European market

Sweden‘s, Finland‘s and Denmark‘s membership in the European Union is considered a benefit for the Hyperscale DCs. Legal alignment with the European market and direct access to the European market. Although Iceland and Norway are members of the EEA, the complications related to the site selection process and simplicity of locating within a EU member state are considered important.

Eurostat database

Inaccurate and/or lacking data regarding the Icelandic market in Eurostat databases is considered a disadvantage. Customers that have searched for information about Iceland have had a hard time finding comparable data and possibly ruled Iceland out in the site selection process in desktop studies. Serious possible customers have been provided.

Key findings

Key Findings

- Taxes are generally competitive with corporate tax currently at 20% and VAT main rate at 24%.
- No custom duties on IT equipment and no non recoverable tax on electricity.
- Establishing a company in Iceland is simple and registration fees are moderate.
- Iceland ranks no. 23 out of 190 countries in World Bank (WB) list of “Ease of doing business”, but is however in the lower range of its peers.
- Improving the ease of doing business could be important to increase overall competitiveness, since the country is ranked below all the comparison countries.

Data privacy comparison

		 Iceland	 Norway	 Denmark	 Sweden	 Finland	 Ireland
EEA/EU		EEA	EEA	EU	EU	EU	EU
Data privacy	**EU Data Protection Directive 95/46/EC**	In effect Iceland is a member of the European Economic Area and has implemented the EU Data Protection Directive 95/46/EC with Act No 77/2000 on the Protection and Processing of Personal Data ('Data Protection Act').	In effect Norway is a member of the European Economic Area and has implemented the EU Data Protection Directive 95/46/EC with the Personal Data Act (LOV-2000-04-14-31).	In effect Denmark is a member of the European Union and implemented the EU Data Protection Directive 95/46/EC with The Act on Processing of Personal Data (Act No. 429) of 31 May 2000	In effect Sweden is a member of the European Union and implemented the EU Data Protection Directive 95/46/E in 1998 with the Personal Data Act (SFS 1998:204 of 29.4.98 and regulation SFS 1998:1191 of 03.09.98).	In effect Finland is a member of the European Union and has implemented the EU Data Protection Directive 95/46/EC with the Personal Data Act 523/1999 in June 1999.	In effect Ireland is a member of the European Union and has implemented the EU Data Protection Directive (95/46/EC) ("Data Protection Directive") with the Data Protection Act in 2003
	GDPR	Implementing legislation in preparation. Entry into force expected during 2018.	Implementing legislation in preparation. Entry into force expected during 2018.	Will enter into force on 25 May 2018. New implementing legislation to be introduced early 2018.	Will enter into force on 25 May 2018.	Will enter into force on 25 May 2018. New implementing legislation to be introduced.	Will enter into force on 25 May 2018.

Source: KPMG analysis

General Data Protection Regulation

Data privacy

The General Data Protection Regulation (GDPR) will enter into force in the EU Member States on 25 May 2018, replacing the EU Data Protection Directive 95/46/EC. This new legislation is the most significant overhaul of European data protection rules for two decades and will have a substantial impact on how organizations approach data protection.

Due to the provisions of the Agreement on the European Economic Area (EEA), Iceland (and Norway) are obliged to transpose EU data protection rules into their national legislation. Thus, the data protection regime in Iceland is – and will remain – substantially similar to what applies in EU Member States. [This means that Icelandic requirements regarding data protection will be familiar to organizations already having an EU presence]

Data haven

Iceland has been named one of the most preferable location to host vulnerable data due to strict legislation favoring data privacy, freedom of speech and anonymity. With the EEA and EU member states operating harmonized data privacy legislations based on EU legislation a slight variation might be found in Media Act addressing freedom of speech and anonymity. But as the legislation coherence is strong between the countries in scope, especially the Nordics, the variation is minimal in effect.

Key Findings

- Data privacy laws are very similar in the comparison countries as they all are built on the same regulations within the EEA and EU.
- Each of the comparison countries are in the process of implementing the General Data Protection Regulations.
- However, EU countries are generally perceived as safe location, while the EEA countries require more background checking.

Hyperscale Providers - recent site selections

Ireland

Dublin
Investment: €75M

Clonee
Investment: €200M

(Athenry)
Investment: €1B

Dublin
Investment: €900M

Dublin
Investment: €900M

Dublin
Investment: €2500M

Sweden

Luleå
Investment: €505 m
Incentives: €14 m

Finland

Hamina
Investment:€350M

Denmark

Odense
Investment: €85M

Aabenraa
Investment: €800M

Sources: 1) Invest in Iceland
2) Official Journal of the European Union

In general

A Strategic Industry

The Data Center Industry has become a strategic industry for several countries around the world. This has led to increased efforts to attracting new Data Centers and increased levels of support for the already operating Data Centers. The levels of support ranges from direct incentives and grants, to tax deductions and discounts. Certain regions and municipalities have joined forces to offer Data Centers comprehensive assistance in order to attract their business. Data Center by Sweden is an example of this effort which is a partnership between selected regions and corporate partners in Sweden.

This has resulted in competition between areas and regions within certain countries. In the United States, for example, there is explicit competition between states to offer the best environment and incentives to Data Centers. [1]

State aid in the comparison countries in general varies dramatically. Ireland has for example focused on favorable conditions such as lower corporate taxes.[2] Total state aid in Ireland in the year 2015 was only 0,17% of GDP while at the same time the total state aid in Denmark was 1,17%.

Fierce competition in attracting technology companies such as Facebook, Google, Apple, Microsoft, and more have even resulted in illegal tax benefits. The European Commission has recently concluded that Luxembourg gave illegal tax benefits to Amazon worth around 250 m.EUR.

United States

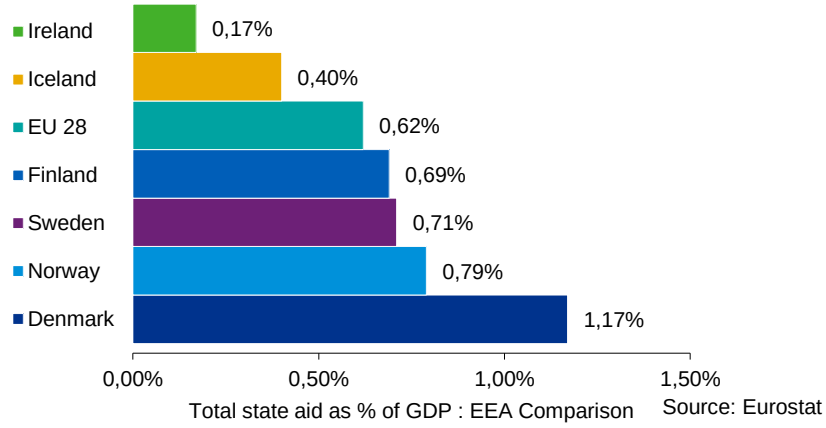
In the US many states provide tax incentives in order to attract investments from Data Centers

Arizona: 2013 exemption from sale and use tax on data center related equipment purchases for 10 years. Since the establishment of the incentives the period of tax exemption has been increased to 20 years

Arizona: For Data Center investments over $1.25 billion exemption on sales tax for electricity and natural gas. For example Apple gets exemption on electricity and natural gas tax on condition that Apple invests $100 in renewable energy.

Missouri offers exemption from state and local taxes for up to 15 years for data centers which bring in at least $25 million in new investment, and create ten new jobs with wages of at least 150 percent of the county average over a three-year period

Total state aid relative to GDP: EEA Comparison 2015



Sources: 1) DatacenterDynamics.com
2) Eurostat

European regulation and limitations

European Regulation

Most countries that compete with Iceland in attracting Data Centers offer some kind of incentives or grants. However, the EEA and EU countries are limited by European laws and regulation.

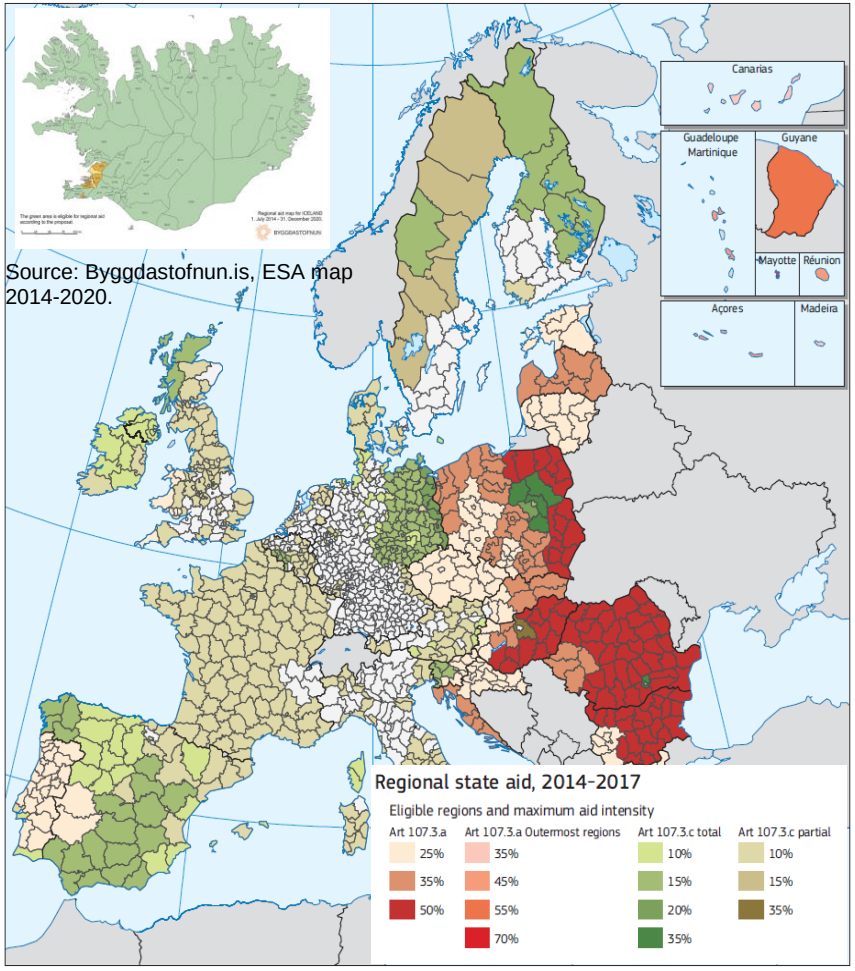
Governmental incentives cannot be implemented to create unfair profits for certain companies, or the production of a certain product. However, there are some exceptions to that rule, including regional incentives in areas with high unemployment or reduction in population.

The map on the right portrays the level of aid eligible regions can provide as a percentage of the total investment (GGE or Gross Grant Equivalent) as approved by the EFTA Surveillance Authority (ESA).

The map shows that regions in the southern part of Finland are not eligible for state aid (including the Google Hamina site). The same goes for Sweden where the south-eastern part of Sweden is not eligible. This is one of the reasons why sites like Luleå in the north-eastern part of Sweden have managed to attract companies like Facebook to operate a Data Center in the area. Facebook received a total of around 14 m.EUR in incentives from the Swedish government.

As seen on the map, all parts of Iceland except the capital area are applicable for regional incentives.

Source: EFTA Surveillance Authority



Source: Byggdastofnun.is, ESA map 2014-2020.

Source: Guidelines on regional State aid for 2014-2020 (2013/C 209/01)

Iceland

Support based on investment agreements

The regional incentives available in Iceland are implemented on a project basis. The incentives are aimed at promoting investments, and increasing the competitiveness of Iceland. They are made in the form of Investment Agreements (i. Fjárfestingasamningar) by the Minister of Industry and Commerce on behalf of the government of Iceland. Currently (13.11.2017), there are eight active agreements, most are in relation to silicon metal factories. [1]

The Investment Agreements are made on the basis of Icelandic Law, Act 41/2015.

The incentives include:

- Authorization to fix the rate of income tax down to 15% for 10 years.
- In the year when new assets are taken into operation, the company can elect to depreciate those assets with a proportional factor of the annual depreciation instead of full year depreciation.
- Real estate, equipment, and moveable assets can be depreciated fully, leaving no residual value.
- Authorization to reduce the rate of property tax by 50% for 10 years*.
- Authorization to reduce the rate of the general social security charge by 50% for 10 years**.
- Exemption from customs duties and excise duties on importation or domestic purchase of construction materials, machinery and equipment, and other capital goods, as well as spare parts for the building of the investment project and the operation thereof.
- Authorization for the state or the municipalities to sell or lease a site for the investment project, at a price which is regarded as below normal market price***.
- * Property tax is levied at a municipal level but has a ceiling of 1.65% of the property value. Registered sales contracts form the basis of new property valuations, where the sale prices are calculated to cash value. For large specialized industrial buildings market value is difficult to assess. Generally, the assessment value is based on the real construction cost.
- ** The general social security charge is currently 5.9% of the total salaries of employees.
- *** Lease of municipal- or state-owned land, for up to 99 years, is the general rule. Long term land-lease contracts enjoy the same protection as private property. [2.]

Sources: 1) Prime Ministers Office
2) Invest in Iceland

Norway

Invest in Norway

Invest in Norway, a part of Innovation Norway, provides comprehensive assistance to potential Data Center providers. One of the initiatives the organization has provided, is to map out the most prominent Data Center sites in Norway, from green- or brownfields to colocation Data Centers currently in operation. This is done to make the site selection process as easy as possible.

Considerable Tax Cut

The Data Center Industry is a strategic industry for Norway according to Reynir Jóhannesson, former State Secretary, Ministry of Transport and Communications for the Norwegian Government.

In January 2017, a new tax relief program was activated in Norway, reducing taxes and public fees by 97% on power provided to commercial Data Centers. Since energy costs constitute a high percentage of the total operating cost, this deduction can considerably lower the cost to the Data Center customers.

DigiPlex, the first Data Center operator in Norway to be approved for the Norwegian tax relief, says this results in a 25% decrease in power costs for the company. In a press release, the company claimed that it will forward the savings to their customers. „The new tax relief will improve the competitiveness of modern Data Center companies in Norway, both nationally and internationally. “ Was noted by DigiPlex CEO, Gisle M. Eckhoff. [1]

Currently, preparations are being made for one of the largest Data Centers in Europe in the remote Norwegian town of Ballangen. The US-Norwegian partnership named Kolos is heading to a record-setting 1000 MW of power. [2]

An artist impression of the proposed Kolos Data Center. www.kolos.com

Sources: 1) Digiplex
2) Kolos.com

Sweden

Data Centers by Sweden

Data Centers by Sweden is a one-stop-shop and single partner for support around investment and site selection for Data Centers in Sweden. It's a partnership between selected regions and corporate partners, offering support around the due diligence process and site selection for strategic or large-scale Data Centers. The project is managed by Business Sweden and partly financed by The Swedish Agency for Economical and Regional Growth. [1]

Node Pole

Node Pole is Sweden's commercial investment and development hub providing dedicated support for investors within the cloud industry, as well as other emerging energy intensive industries such as e.g. carbon production and battery production.

Known from Data Center establishment successes, such as Facebook in the northern Sweden, Node Pole is as of 2017 owned by power companies, Vattenfall and Skellefteå Kraft. The organization has the purpose of proactively attracting new business into Sweden and the European market. [2]

Regional Incentives to Large Players

In 2011, it was announced Facebook had received a direct grant from the Swedish government of just less than 11 million EUR (just over 100 million SEK). [3]The aid beneficiary was Pinnacle Sweden AB which operates as a Facebook Inc. subsidiary.

Later in 2014, Facebook received a grant of 35 million SEK (around 3,7 million EUR). In total, Facebook has received around 15 million EUR as a direct grant from the Swedish government. Both grants were awarded in regards to Facebook setting up and running a Data Center in Luleå in the Norrbotten region in north Sweden. The grant was considered a regional investment grant in one of the most rural areas of Sweden. The Data Center requires 120 MW of energy, and consists of three 28.000 m^2 buildings. [5]

Substantial tax cuts

The Swedish government introduced a 97% tax cut on energy taxes to Data Centers in 2016. The cut has reduced the energy tax paid by Data Centers from $0.02-$0.03 per kWh to $0.0006 per kWh. However, the Data Center must have at least 0,5MW capacity excluding energy used for cooling. [4]

Sweden also provides tax relief to highly skilled foreign key staff members, such as: international executives, experts, and researchers that work in Sweden. Employees who qualify for the tax relief, are only taxed on 75% of their income for the first three years of employment in Sweden. Companies with foreign R&D employees can also benefit from a special tax reduction which can lower their labor costs by up to 7,7%.

Sources: 1) Business Sweden
2) NodePole
3) Eurostat
4) DatacenterDynamics
5) Dailymail

Finland

Case-by-Case support

Finland discretionally engages financially in foreign investment subsidies. However, “major” investments that have either significant monetary value, considerable impact in employment, and/or significant impact on strengthening the Finnish workforce capability/skills, are examined on a case-by-case basis. Two recent examples, would be investments made by Rolls Royce and GE Healthcare’s establishment of large-scale R&D centers in Finland. Foreign companies may also be granted investment aid when they establish new units in predefined regional development areas. Incentives include: tax reliefs, higher depreciation rate on fixed assets, and transport aid for products from these areas. Energy subsidies can be granted to companies for investments in energy efficiency and conservation.

Those are the general examples of financial incentives, however, none of the foreign Data Center companies established in Finland have currently seized the opportunity for support. This is largely due to two facts concerning Data Center operations: the best sites do not lie in the development areas, and the most substantial investment incentives are granted based on the number and type of jobs created, and those jobs typical found in the Data Center landscape, are not particularly numerous nor the kind that would qualify for significant investment support.

The primary reasons for any Data Center operator to locate their Data Center operations in Finland would be found in the business environment: total cost of operation, reach of markets and/or legislation related to information/communication.

Source: Toni Mattlia – Invest in Finland

Denmark

Tailor-made solutions

Denmark has recently attracted two Hyperscale Data Center customers. Apple Inc. has decided to invest around 800 million EUR in a Data Center in Odense, Denmark followed with a 85 million EUR investment by Facebook Inc., in a similar location in Denmark.

Invest in Denmark assisted both of these companies in their selection process. Invest in Denmark provides substantial tailor-made solutions for foreign companies wanting to establish a business in Denmark. The firm focuses on industries such as ICT and cleantech, where they believe Denmark has competitive global strengths.

In 2014, the Danish Meteorological Institute (DMI) made an agreement with its Icelandic counterpart to host their HPC in Iceland. Due to favorable conditions with less power needed for cooling, the institution estimates that the savings made by moving, could be around 440 MWh per year.

Sources: 1) Invest in Denmark
2) Ars Technica
3) Version2.dk
4) Danish Ministry of Energy, Utilities and Climate

Ireland

Attracting environment – no grants

Ireland has attracted the most Hyperscale customers in the last few years compared to the Scandinavian countries. Google, Facebook, Apple, Amazon, Microsoft, and IBM have all set up or decided to invest in Data Center facilities in Ireland in the recent years. The total amount of investments is well over 3 billion EUR.

However, there is little information to be found about direct financial incentives. The tendency seems to be moving away from public monetary incentives to highlighting tax systems, and general attractiveness of the business environment.

„The days of supporting infrastructure through publicly funded capital investment are long gone, however – Ireland does not have the money for that. Instead, the IDA will highlight the country's talent pool, with a secondary nod to its attractive corporate tax system.

Ireland seems to be benefiting from its strategic geographical location. The ease of doing business is also attractive to potential customers.

"We deal directly with site selection people to help match the brief. For companies unfamiliar with Ireland, we can do the interaction with local authorities, utility power and telecom connectivity players. We're there for support," Donald Travers, manager of business services at the IDA, says."

Source: DatacenterDynamics.com

Key Findings

- The Data Center Industry has become strategic to several countries and resulted in increased level of governmental support to the industry. The support is diverse, ranging from tax deductions to direct financial incentives.
- Most countries and regions have put together teams consisting e.g. of municipalities, governmental agencies, power companies and key players in the private sector aimed at attracting new Data Center operations.

Appendix

Temperature comparison

Iceland

Average warmest temperature in Reykjavik: 6.9 °C

Average coldest temperature in Reykjavik: 1.9 °C

Average normal temperature in Reykjavík: 4 °C

Average warmest temperature in Keflavik: 6.9 °C

Average coldest temperature in Keflavik: 2.1 °C

Average normal temperature in Keflavík: 4.4 °C

Norway

Average warmest temperature in Oslo: 16.6°

Average coldest temperature in Oslo: -2.5°

Average normal temperature in Oslo: 5.3°

Average warmest temperature in Kristiansand: 18 °

Average coldest temperature in Kristiansand: -2.6 °

Average normal temperature in Kristiansand: 6.29 °

Finland

Average warmest temperature in Helsinki: 7.6°C

Average coldest temperature in Helsinki: 2.4°C

Average normal temperature in Helsinki: 4.9°C

Ireland

Average warmest temperature in Dublin: 13 °C

Average coldest temperature in Dublin: 6.3 °C

Average normal temperature in Dublin: 9.7 °C

Denmark

Average warmest temperature in Copenhagen: 11.45 °C

Average coldest temperature in Copenhagen: 4.9 ° C

Average normal temperature in Copenhagen: 8.2 °C

Sweden

Average temperatures

warmest in Stockholm: 10.3 °C

Average coldest temperature in Stockholm: 4.1 °C

Average normal temperature in Stockholm: 7 °C

Average warmest temperature in Lulea: 5.7 °C

Average coldest temperature in Lulea: -2.1 °C

Average normal temperature in Lulea: 1.9 °C

Source: yr.no

KPMG

kpmg.com/socialmedia

kpmg.com/app