

Finland's Giant Data Center Opportunity

From the Industrial Heartland to Digital Age



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About the report

This report is prepared by Oxford Research and commissioned by Google. The objective of the report is to contribute to the national debate over the future and the potential of an emerging data center cluster in Finland.

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Executive summary

Finland, battered by recession, enjoys a giant opportunity for a positive injection of economic growth by becoming a major European hub for digital infrastructure.

- The country benefits from world-class energy infrastructure, developable land, network connections and available workforce for the location of data centers. In addition, its regulatory environment remains superior to its competitors.
- The data center opportunity is immense: powered by an explosion in data flows, global data center demand is expected to increase exponentially, with 60 new large data centers expected in Western Europe by 2020.
- In a country which so far has received relatively little inward investments compared to its competitors, data centers represent a major new opportunity. Google purchased an abandoned 60-year old paper mill in Eastern Finland in March, 2009, and so far has invested EUR 800 million transforming it into one of the world's most modern data centers. This represents Finland's largest ever greenfield foreign investment.
- Data centers often are located in areas that face economic restructuring - in Finland's case, a region long powered by paper plants. The skills used in traditional industry such as mechanical engineering still have a role in the new digital infrastructure. Factors that attracted the old industry - good supplies of land, water, and energy - are required for the new digital infrastructure hubs.
- Data centers are not homes just to stacks of computers. They are employment hubs, home to the "unsung heroes of the Internet," the men and women who run the data centers. At the peak of construction, the Google data center in Hamina employs 1800 engineering and construction workers. Around 230 employees operate, maintain and secure the center, while generating millions in wages locally and boosting employment throughout the data center value chain.
- Finland already is attracting other big data center investments. A total of five investments already have been announced, including marquee names such as Microsoft and Yandex. So far, the three largest announced data center investments reach an impressive EUR 1.3 billion.
- Over the next decade, the Finnish data center cluster could create an estimated 32,000 – 50,000 years of employment and generate a total economic impact of EUR 7 – 11 billion.

This report is designed to illustrate the Finland's still little understood giant data center opportunity. In order to reap the full upside, the country will need to engage in a heightened discussion about how to preserve and market its present advantages, mobilize its impressive innovation and education systems to build an effective data center ecosystem and minimize the risk that legislation in Finland and in the European Union would deter further data center investments.

1. Looking for growth

Finland needs new motors of economic growth. Foreign direct investments represent an untapped opportunity for creating such growth, and attracting data center investments offers a particularly promising opportunity for Finland.

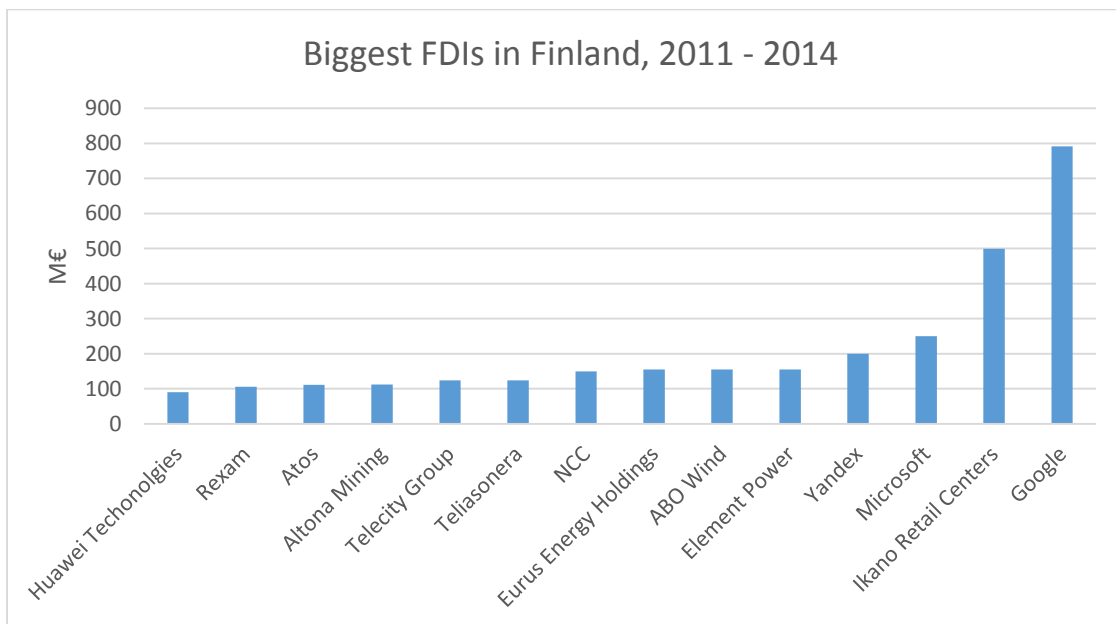
1.1 FINLAND'S ECONOMY NEEDS NEW MOTORS

Finland's economy is facing severe challenges. The country's GDP has fallen over the past two years and remains 5% below its pre-crisis peak of 2008¹. The country's traditional paper industry has to a large degree moved offshore and contracting. Its flagship technology company Nokia has lost its mobile phone

leadership, while sanctions are reducing sales to the important Russian market.

Since the beginning of the century, more than 20,000 forestry jobs have vanished. In the past six years, the country's tech industry has shed 40,000 jobs, with 14,000 layoffs caused just by the implosion of the Nokia cluster². Furthermore, the diminishing trade with Russia could cause the loss of 5,000 – 10,000 jobs in the next years³.

Amid these circumstances, digital infrastructure stands out as a rare bright light. Google's EUR 800 million data center in Hamina represents the largest foreign investment in a greenfield project in the country. All told, a good number of Finland's largest



The Google Hamina data center constitutes as the largest single foreign greenfield investment in the recent history of Finland, with close to EUR 800 million invested in the several building phases. The next on the list, Ikano Retail Centers, has made three investments to retail centers in Finland. The importance of the data centers and related industries are highlighted by the fact that many other major investments, Microsoft, Yandex, TeliaSonera, Atos and TelecityGroup, are related to digital infrastructure and services. Source: fDi Markets and figures published in newspapers.

foreign direct investments (FDI) in recent years concern digital infrastructure and services (see the chart above).

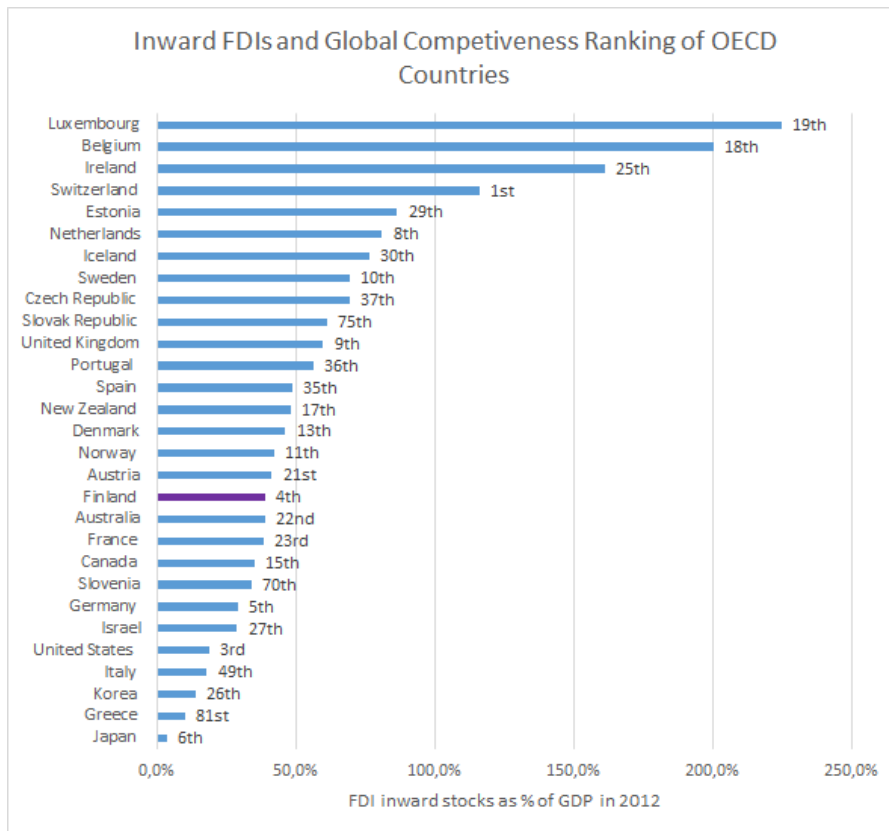
These big data center investments often are concentrated in areas first powered by traditional industries that now face economic structural change. For example, Google's St. Ghislain facility in southern Belgium sits in the heart of a traditional coal mining region. In Finland, the region around Hamina data center was a military capital for the country and the heart of the now struggling paper industry.

Once one takes a close look, the reasons are easy to understand. Skills used in traditional industry often

can be reused for this new digital infrastructure. Factors that attracted the old industry - good supplies of land, water, and energy - are required for the new digital hubs.

1.2 UNTAPPED FOREIGN INVESTMENTS

Finland often ranks top in global standings for business and innovation studies such as the World Economic Forum Global Competitiveness Report⁴, while failing to attract foreign investments compared to competitors with lower ranking (see the chart below). Thanks to the history of export-led growth, Finns long focused on exports and less on attracting foreign direct investment. Entry into the European



Finland ranks high in World Economic Forum Global Competitiveness Index 2014-2015 (4th), but has received relatively little inward foreign direct investments related to GDP (39%) compared to other OECD countries such as Sweden (10th place and 70% respectively) or Estonia (29th place, 87% respectively). Source: World Economic Forum and EuroStat.

Union and the adoption of the euro have opened up the country. Foreign investment represent a promising and relatively untapped opportunity for the Finns. FDI means new flows of capital into Finland, with direct positive effects on employment and on growth.

Finnish governments are beginning to realize that they must work hard to attract foreign funds. Over the past three years, the central government in Helsinki has strengthened the Finland investment promotion effort and placed foreign investment at the top of national priorities. In 2013, then Prime Minister Jyrki Katainen emphasized Finland's commitment to pave the way for new investments, saying "Our job from the government side is to create and enable good infrastructure for various fields of business"⁵. The new government program introduced by Prime Minister Alexander Stubb specified Finland's interest in attracting data center investments⁶.

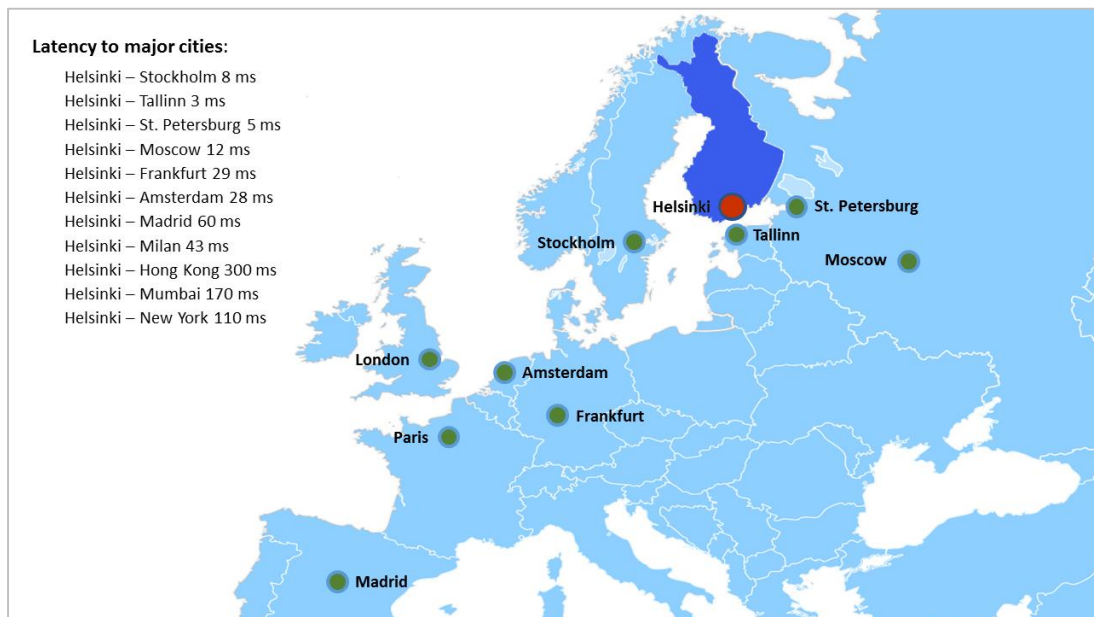
Although foreign investors perceive Finland as a country with high taxes and a small home market,

Finland enjoys advantages for data centers: solid infrastructure, cheap energy, a high-skilled labor force and a secure business environment⁷. Improved marketing of these advantages could lead to further investments.

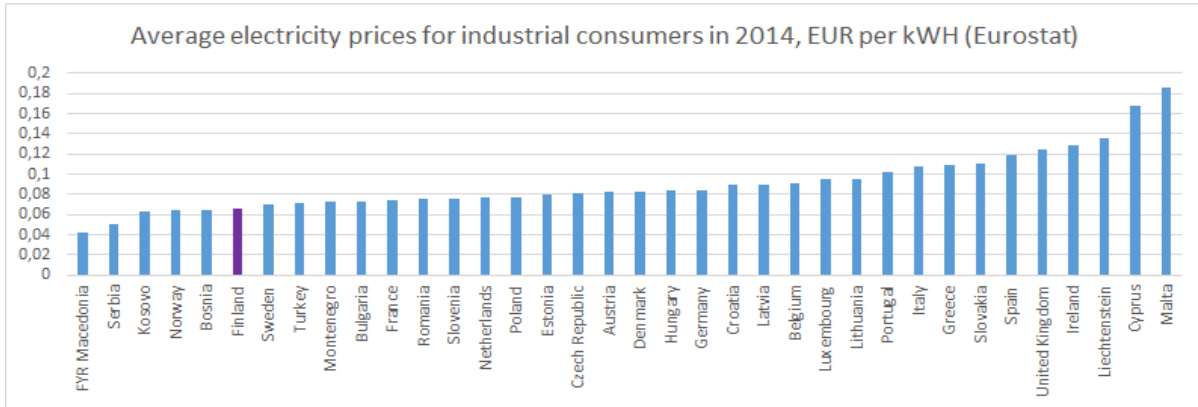
1.3 ATTRACTING DATA CENTERS

Modern data centers require several main ingredients: strong internet connectivity, abundant and secure energy supplies, favorable weather and geography, and a supportive political and regulatory environment.

Internet connectivity: Data centers need to be well connected with the users of cloud services and with other data centers. The most important factor is network speed, which is measured with latency and bandwidth. Though Finland now stands only in 22nd place for international bandwidth⁸, connections with Europe will be improved by the laying of a submarine fiber cable to Germany⁹. In addition, direct links to Asia via Northeast Passage could pass through



Finland is well connected with the European cities and the submarine cable to Germany further improves its position, but investment is needed to improve its internet connectivity with the rest of the world. Source: Invest in Finland.



Finland. Data traffic between Europe and Asia is expected to grow with 278% in the next five years¹⁰ and the new cable could reduce the latency of traffic by 94 microseconds¹¹.

Energy: Data center operations rely on reliable and affordable energy supplies. Energy consumes at least half the operating costs of large-scale data centers¹². Finland benefits from one of Europe's lowest energy prices (see chart above). Since April 2014 large-scale data centers have also enjoyed lower energy tax rates similarly to other energy-intensive industries¹³. Finland's national electricity network boasts an average 99,9998% transmission reliability¹⁴.

Environmental conditions: Weather plays a big part in data center location decisions. Data centers are built in northern latitudes because the cool weather helps keeping the computer equipment from overheating. Finland is one of the northernmost and coldest countries in the world. Data centers in Finland consume less air conditioning, which saves energy. Finland also boasts a safe geological location and solid bedrock soil, which reduces the risk of disasters that could damage data centers. The Data Center Risk Index rates Finland as the safest data center location from natural disasters¹⁵.

Natural resources: Modern data centers require large amount of free land and water. Finland is

Strengths of Finland as a data center location

- Number one country in Networked Readiness Index with the best digital infrastructure in the world, as ranked in the Global Information Technology Report published by World Economic Forum and IN-SEAD.
- Global connectivity will be further improved with the announced underwater fiber cable connection to Germany and the envisioned cable linking Europe and Asia via the Northeast Passage.
- One of the best and most reliable electricity networks in the world with very competitive energy prices, thanks to the lowered electricity tax since April 2014 for data centers with a total power usage of at least 5 MW.
- Cool climate and plenty of water sources that reduce the need for electricity based cooling systems.
- Plenty of free land to expand operations in 36 readily-identified brownfield and greenfield sites with more than 5 million square meters of building rights.
- Skilled and relatively cheap labor, including best availability of scientists and engineers and the best education and training system according to the Global Competitiveness Report published by World Economic Forum.
- Overall stable and safe environment for living and business operations and a regulatory environment that respects online privacy.

blessed with both. There are more than 160,000 lakes in Finland¹⁶. It enjoys plenty of free land to expand operations in 36 readily-identified brownfield and greenfield sites with more than 5 million square meters of building rights¹⁷.

Regulation: Data centers require stable and predictable regulation. They will head to jurisdictions which allow easy cross-border data flows, since they depend on the ability to back up data around the globe. Finland starts with a strong advantage. It enjoys strong legal protections over government surveillance of data (particularly when compared to neighboring Sweden) and works hard to find a transparent and proper balance between the privacy of users and interests of security. Keeping this proper balance is a

key factor in strengthening Finland's competitive edge in attracting data center investments - and ensuring Finland's sterling reputation as the Switzerland of data.

1.4 PROMISING FUTURE

Finland's push to attract new digital foreign investments is beginning to pay off. According to Ernst & Young's European attractiveness survey¹⁸, Finland attracted the 9th most investment among European countries in 2013, with investments rising 44 percent over the previous year. ICT was the source of Finland's success and has been identified as the key driver for growth in coming years. The survey recommends that governments need to act quickly to



Finnish Prime Minister Alexander Stubb and Chinese Vice Prime Minister Wang Yang enter the Slush startup conference in Helsinki in November 2014. In his speech, Stubb emphasized Finland's commitment to becoming an international data traffic center. Photo by Jussi Ratilainen.

create policies and ICT infrastructures that can support advanced technologies, which are needed for a “European industrial renaissance” called for by the European Commission.

Data centers are getting prioritized at the national level. Prime Minister Alexander Stubb’s Government program announced in August 2014 recommends turning Finland “into an international data traffic center. Following on from the decision on the Baltic Sea submarine cable, the construction of a Northeast Passage Arctic submarine cable will be actively promoted. Data center investments, which in future will form a skills ecosystem extending from the design of data centers all the way to their use and maintenance, will be actively attracted to Finland.”¹⁹

NOTES

¹ Source: Statistics Finland.

² 21 polkua kitkattomaan Suomeen – ICT 2015 työryhmän raportti. Ministry of Employment and the Industry, 2013.

³ Range of estimates provided by different Finnish expert organizations.

⁴ Global Competitiveness Report 2014-2015. World Economic Forum, 2014.

⁵ Speech available at: <http://vnk.fi/ajankohtaista/puheet/puhe/en.jsp?oid=398747>

⁶ Programme of Prime Minister Stubb’s Government.

⁷ Investointeja Suomeen. Ministry of Employment and the Industry, 2012.

⁸ Data Center Risk Index 2013. Cushman & Wakefield, 2013.

⁹ Press release: <http://valtioneuvosto.fi/ajankoh-taista/tiedotteet/tiedote/en.jsp?oid=402176>

¹⁰ Source: Telegeography.

¹¹ Source: PricewaterhouseCoopers, Ministry of Transport and Communications.

¹² Digital Infrastructure and Economic Development. Boston Consulting Group, 2014.

¹³ Press release: http://www.vm.fi/vm/en/03_press_releases_and_speeches/01_press_releases/20140227ActionE/name.jsp

¹⁴ Source: Fingrid.

¹⁵ The Data Center Risk Index 2013. Cushman & Wakefield, 2013.

¹⁶ Source: Statistics Finland.

¹⁷ Data center locations on Invest in Finland website: <http://www.investinfinland.fi/datacenter/sites/all-sites/4>

¹⁸ Attractiveness survey Europe 2014, EY 2014.

¹⁹ Programme of Prime Minister Stubb’s Government.

2. The global data center boom

The digital revolution changing the entire world, as we know it today, has begun. This transformation creates huge amount of data. The emerging European single market is one of the key drivers behind this growth. Numerous new data centers are built to serve the growing need for digital infrastructure. Finland's emerging data center cluster can grow and generate a massive economic impact.

2.1 WHERE DATA CENTERS FIT IN

As the world goes online, the amount of data being generated is expanding exponentially, creating a huge increase in required digital infrastructure. Five years ago, eight hours of video was being uploaded to YouTube each minute. Today, it is 300 hours a minute¹. More than three billion people now are online². More than 250,000 words - two and a half books - are published on Google's Blogger platform - per minute³. Some 1,000 million websites⁴ now are up and running. By the end of 2020, some 50 billion devices will be connected around the world, double the amount today. Total internet traffic is expected reach 1000 exabytes (1000 billion gigabytes) by 2015 - an astounding 3300% more than a decade before⁵.

Massive new data centers are required to cope with this explosive growth. Instead of being stored on computer hard discs, traffic and storage is moving onto the cloud. Around the world, about 200,000 data centers exist today, with a combined server space capacity of 64 million square meters⁶. These range from dedicated computer facilities than can occupy anything from small rooms to industry-size buildings.

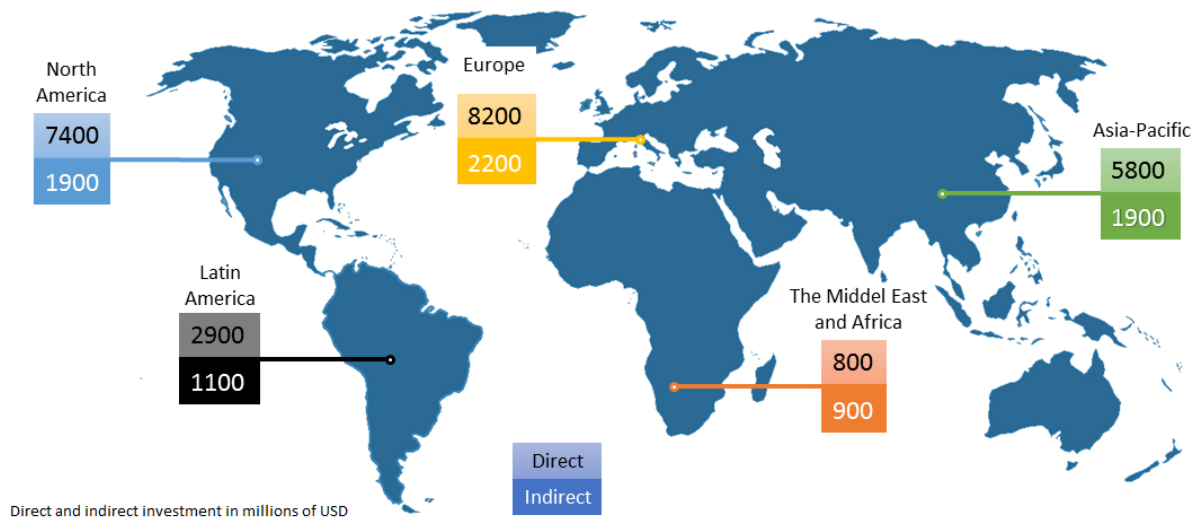
Over the coming decade, the capacity will grow 10% each year⁷. The structure of the cloud will also

change. Instead of being processed in small centers, the rise in data will be treated by large one billion euro or bigger sized centers. IDC forecasts that by 2018 large data centers will account for 72.6% of all data center construction in terms of space⁸.

Globally, a total of EUR 110 billion was invested in data centers in 2013⁹. Europe could win a large part of these data center investments, if it manages to provide a competitive investment environment. It enjoys large population of internet users and it is a hub of global internet traffic. Since big modern data centers are so capital intensive, most of the growth will come from the global web giants, not from telecoms or local companies. Analysys Mason estimates¹⁰ that content and application providers, including Google, Amazon and Facebook, already invest a total of EUR 26.4 billion (USD 33 billion) in the networks, facilities and equipment of the Internet per annum. The majority of the investments are spent on developing hosting infrastructure.

The continued growth of data center demand is dependent on the pace of Europe adopting digitization. In this perspective one needs to bear in mind that data centers built in Finland don't serve the Finnish market but rather the greater European market. It is therefore in Finland's very best interest to be the Internet's best friend in the European debate; both in terms of promoting the European single market, but also in terms of working against regulation limiting or hindering digitization. Europe is lagging behind in terms of adoption of digitization, and Finland can take a vocal stance against those who believe that Europe can catch up by stopping the adoption process or by pursuing it slower.

The regulatory environment is under debate also in Finland. A working group set by the government has



Content and application providers alone invest USD 33 billion annually to networks, facilities and equipment, majority of that to hosting infrastructure. Europe grasps the largest share (USD 10.4 billion or 31%) of those investments. 60 new large data centers expected in Western Europe by 2020. Source: Analyses Mason, Boston Consulting Group.

proposed new legislation that would grant the Finnish authorities a mandate for increased intelligence gathering. However, ministries of the Finnish government are at odds over the issue of online surveillance that is feared to undermine citizens' rights and online business¹¹.

2.2 FINLAND'S EMERGING DATA CENTER CLUSTER

In 2012, Finland hosted 2800 data centers, only five which consumed more than five megawatts of electricity, considered the threshold for a modern storage site¹². Larger modern data centers can consume more than 20 times more power. These large data centers require huge investments. According to interviews, Finnish government officials¹³ target these large data center investments as “leader products” (*sisäänbeitotuote*, literally “throw-in products” in Finnish), expected to bring an injection of not only direct jobs and capital, but also boost the growth of the Finnish digital economy.

The Finnish government aims to develop Finland to an international data traffic center, with a strong cluster of data centers. After Google invested in North Carolina and in Oregon, other companies built

nearby data centers. The Netherlands has fostered a strong data center cluster, thanks to its hub of internet networks, as well as their competitive regulatory and tax environment. According to a recent Deloitte report¹⁴, the Dutch Digital Infrastructure sector generates annual investments of EUR 380 million, adding up to 7,600 jobs, with an additional 11,700 jobs created in sectors supplying inputs for production and construction.

Finland's data center cluster similarly is expected to grow. Based on interviews of key industry experts and public information sources, we estimate that the total investment by the three largest data center investors (Google, Yandex, Microsoft) is already around EUR 1.3 billion.

More new investments are on their way. A company called DC-ROI-Helsinki is planning a data center investment in the capital region with ABB as a key industrial partner. The plan was announced in June 2014 and the estimated investment is exceeding EUR 1 billion¹⁵. If the total capacity doubles or even triples as the government estimates¹⁶, the total of data center investments could reach EUR 2.9 – 4.5 billion in the near future.

Does Finland see the full digital opportunity?

Finland enjoys high internet penetration and strong broadband access. In a study carried out by Research Institute of the Finnish Economy,¹⁷ the Internet contributed as much as one tenth of the gross domestic product in Finland before the 2008 global economic crisis. Yet Finnish business uses the Internet less than businesses in other comparable developed countries. This failure comes despite the fact that Finnish companies have perhaps the best conditions to make use of Internet and its services, according to a study commissioned by the Finnish technology industry¹⁸.

It can be questioned whether Finland sees the full digital opportunity. Often, this opportunity is associated with mobile phones or digital gaming. The country is strong in both fields, historically with Nokia phones, and more recently with the rise of dynamic game companies such as Rovio, maker of Angry Birds, and Supercell, maker of Clash of Clans.

But much more potential exists. Three quarters of the Internet's value is generated by non-high tech industries.¹⁹ It is created as every part of the economy is digitized and brought online, from the local flower shop to the small B&B owner. Digitization is behind the Third Industrial Revolution, with an impact similar to steam-powered engines and electricity had during the First and Second Industrial Revolutions.

Finnish SMEs invest little in digital marketing. According to a study by Boston Consulting Group, Finnish consumers are one of the most active online users in the world. In contrast, Finnish companies have not yet discovered the power of the Internet in their marketing arsenal. "The good news is, that this is a huge opportunity for the Finnish companies to utilize the Internet for growth," adds Google Finland's marketing manager Sami Kankkunen. "There aren't many success stories of B-to-C companies who have been able to hit the global markets through a strong online based business model, like Skype or Spotify in Sweden."

The country's long term growth potential is enormous. Invest in Finland has mapped potential sites for data centers investments and currently there are altogether 36 sites with more than 5 million square meters of building rights and total power capacity of 1500MW.

According to a report by Boston Consulting Group, a data center investment of EUR 400 million could create as many as 4,500 full-year-equivalent jobs over the course of a decade and generating a total economic impact²⁰ of approximately EUR 1 billion²¹. If the government's estimates of the data center cluster growth are proven to be correct, we can estimate that data center investments could generate some 32,000 — 50,000 full-year-equivalent jobs and a total economic impact of EUR 7 — 11 billion in Finland over the next decade.

For Finland to maximize the benefits of its data center gold rush, it should construct an effective data

center supply chain. When Google began building in Hamina, the majority of the workers and work went to non-Finnish companies²². This is now changing. Finnish companies are revving up to serve the emerging industry. Vesa Weissmann from a consulting company Gearshift Group emphasizes that Finnish companies are too small to operate alone at giant global-size data centers, and so they should and could partner with countrymen and foreigners to win large shares of data center construction contracts²³.

Numerous other opportunities exist. According to Kimmo Koski, the director of IT Center for Science CSC, the knowledge learned by designing and building efficient and eco-friendly data centers may be used in innovating other types of in engineering, environmental and energy industries²⁴. A data center cluster in Finland may attract new players such as large public research infrastructure operators like CERN (European Council for Nuclear Research) and ESA (The European Space Agency). The goal for Finns, Koski suggests, is to leverage data centers

into a significant comparative advantage in related big data fields.

Finland has all the elements to go beyond data center infrastructure business and leverage these huge investments to encourage the growth of a larger digital economy.

NOTES

¹ YouTube statistics:

<https://www.youtube.com/yt/press/statistics.html>

² Global internet user statistics: <http://www.internetlivestats.com/internet-users/>

³ OECD Internet Economy Outlook 2012. OECD, 2012.

⁴ Total number of websites statistics: <http://www.internetlivestats.com/total-number-of-websites/>

⁵ Delivering Digital Infrastructure - Advancing the Internet Economy. World Economic Forum, 2014.

⁶ Digital Infrastructure and Economic Development. Boston Consulting Group, 2014.

⁷ Ibid.

⁸ Worldwide Datacenter Census and Construction 2014-2018 Forecast. IDC, 2014.

⁹ 2013 Census Report. DCD intelligence, 2013.

¹⁰ Investment in Networks, Facilities, and Equipment by Content and Application Providers. Analysys Mason Report, September 2014.

¹¹ Summary of the debate by YLE: http://yle.fi/uutiset/report_puts_foreign_intelligence_gathering_online_surveillance_on_the_agenda/7736822

¹² Konesalit Suomessa 2012. Market Visio, 2012.

¹³ Several government officials from the Ministry of Finance, Ministry of Transport and Communications and

Ministry of Employment and the Industry were interviewed during the report research process.

¹⁴ Digital Infrastructure in the Netherlands. Deloitte, November 2014.

¹⁵ The investment has been discussed in various Finnish newspapers.

¹⁶ Estimates presented in the government's proposal for the amendment of the electricity tax law.

¹⁷ Internet in the Finnish economy: http://www.lvm.fi/c/document_library/get_file?folderId=1986562&name=DLFE-15219.pdf&title=Julkaisu%208-2012

¹⁸ Digibarometri Survey, Research Institute of the Finnish Economy, 2014.

¹⁹ Internet matters - The Net's sweeping impact on growth, jobs, and prosperity. McKinsey and Company, May 2011.

²⁰ The total economic impact is derived from direct, direct and induced spending, which takes into account direct investment expenditure, expenditure in the supply chain and services bought by employees in the whole supply chain.

²¹ Digital Infrastructure and Economic Development. Boston Consulting Group, June 2014.

²² Source: Google.

²³ Interview with Vesa Weissmann on 8 October 2014.

²⁴ "Datakeskusten ekosysteemiä rakentamassa", blogpost by Kimmo Koski on The Communication Policy GIDE Project blog: <https://kideblogi.wordpress.com/>

3. From paper mill to internet factory

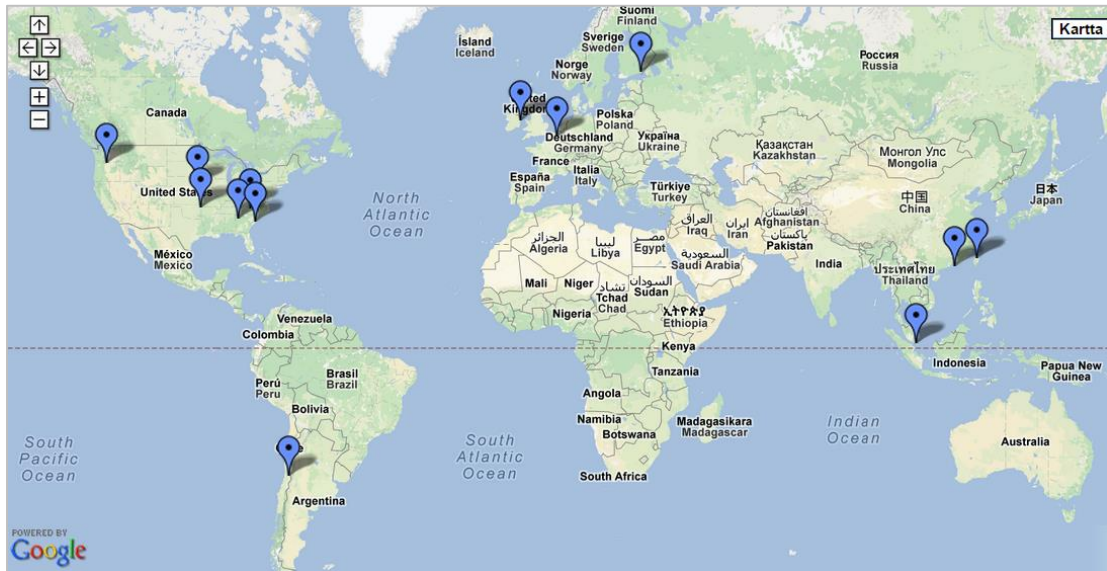
Google turned a closed paper mill in Hamina, Finland, into a modern data center. The data center construction and operation generates a significant impact on the local economy through employment, increased consumption and tax revenue.

Google's ownership it was transformed into a modern data center and started operations in 2011.

At first, Google didn't release much information about its operation in Hamina, producing some misperceptions. Many underestimated the size of the investment. Few jobs seemed to be created. Few local companies secured contracts and the main impact seemed limited to filling the city's hotels and bars with foreign workers. The idea grew that Google would only be hiring PhD computer scientists - or that the majority of the work would end at the completion of construction.

3.1 USING THE OLD INDUSTRY FOR SOMETHING NEW

In 2009, Google purchased the former Summa paper mill in Hamina to build a major data center. It was the second major investment in European infrastructure, following the purchase of a data center site in Belgium. Hamina is a small town of little more than 20,000 citizens in South-Eastern Finland, hard hit by the contraction of the region's paper industry. The Summa paper mill was closed in 2008. Under



Locations of Google's large-scale data centers in 2014. In September 2014 Google announced that it would build a new data center in Eemshaven, Netherlands. Construction is set to begin in 2016.

3.2 IMPACT ON THE LOCAL ECONOMY

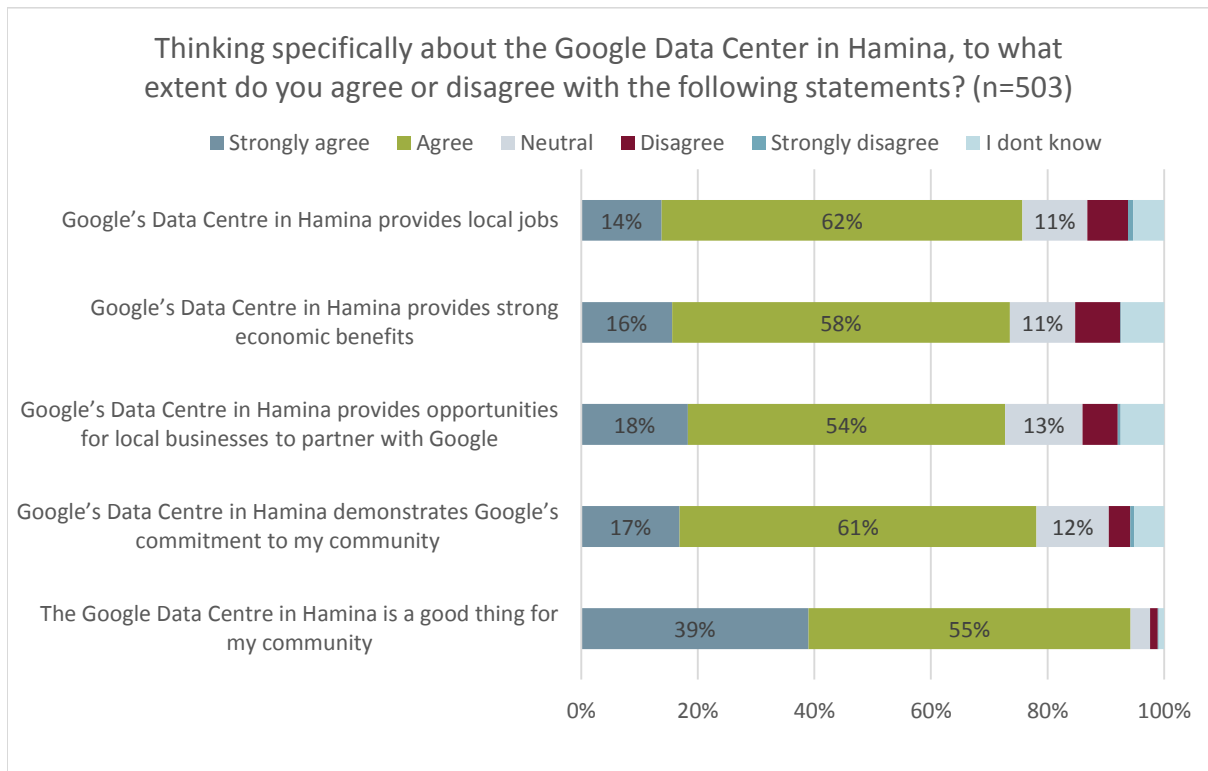
Over the past few years, though, the company has reached out to the community and attempted to change this mistaken first perception. Many of the available jobs are in construction and use technical skills. Google needs electricians, plumbers and basic hardware technicians.

Employment is created in the construction of the data center. Construction looks set to continue for the foreseeable future, and if anything is increasing. The first phase of construction began in 2009 totaled EUR 200 million. A second phase worth EUR 150 million began in 2012. In November, 2013, then Finnish Prime Minister Jyrki Katainen came to Hamina to announce an additional EUR 450 million

expansion, bringing the total amount of investment to Hamina data center to EUR 800 million.

At the time, Google estimated approximately 800 engineering and construction workers, most of whom will be Finnish, will be engaged on the site. Today, the company says it seriously underestimated the number of workers required - up to 1800 workers are on the site each day. At the moment 20% of the construction work goes to Finnish companies, but already 55% of the workers are Finns and the number is increasing.

Google is moving fast to increase local participation. Few companies in the Kotka-Hamina region were used to dealing with a global multinational and few knew how to bid for work on such a giant project. Google has joined the local Chamber of Commerce and begun reaching out to increase the number of



Oxford Research and Taloustutkimus analyzed the perception of the Google data center among the local citizens in December 2013. A majority of the locals believe that the data center project has boosted the local economy and created opportunities for local companies.

local subcontractors. The first building was to a large degree bought from outside, but after that more and more services have been bought from Finnish companies.

Employment in running the data center is also increasing. Today some 230 people are employed at the datacenter in full time and contractor roles across engineering, technical work, security, food service, and buildings and grounds maintenance. These are people living mostly in the Hamina region.

The impact on local and national economy is considerable. The steady jobs that are created in the data center operations generate an estimated EUR 11.8 million in wages annually, boosting the local economy through consumption and tax revenue. Furthermore, the project-based construction work generates

an annual wage sum that is estimated to vary from EUR 38.5 million to EUR 69.3 million¹. In comparison, the city of Hamina spent around EUR 48 million in wages in 2013².

The construction of the data center also generates jobs, not only for the workers who are building the data center on the site, but also in the supply chain providing goods and services for the construction. Based on industrial input-output statistics³, employment of 1800 workers in construction generates employment for an additional 1800 people in the supply chain. The impact of the EUR 800 million data center investment on the local and the national economy goes beyond the direct wage sums.

NOTES

¹ Estimations based on Google data and statistics from Statistics Finland.

² City of Hamina budget figures for 2013.

³ Statistics from Statistics Finland.

4. Catalyzing a region

Google's presence in Hamina has catalyzed a regional transformation making the region more international, sparking the curriculum development for the next generation of engineers and providing growth opportunities for local companies.

4.1 INCREASINGLY INTERNATIONAL

The establishment of the Google data center has placed the Kotka-Hamina region on the global map. "Google has paved the way for other foreign investments and international collaboration in general. Just mentioning Google operations in Hamina creates an interest towards the region," says

Hannu Karavirta, the CEO of the regional development company Cursor Oy¹.

The data center's construction has boosted the demand for accommodation, restaurants and leisure activities. In 2013, the number of Brits and Irishmen exceeded Russians in overnight stays in the region's biggest hotel. While the details are not public information, Karavirta says other foreign investors are investigating building their own data centers in the region.

In April, 2013, Google joined with Finland's leading innovation university Aalto University and the regional development agency Cursor to launch an outreach program to find ways to leverage the Internet for growth. Local educational institutes have now begun to develop the curriculum for the emerging data



Chief Internet Evangelist Vint Cerf inspiring local students of Kymenlaakso region in the spring of 2014: "You don't have to have a PhD in computer science to work at a Google data center. We look for the right attitude and willingness to learn new things and explore," he said. Photo by Jukka Koskinen.

center cluster and local companies are becoming equipped to pitch their services to the multinational project.

4.2 BUILDING THE NEXT GENERATION OF ENGINEERS

Finland is world famous for its engineering skills and the education system. As the data center cluster grows, so does the need for professionals to operate and maintain these enormous facilities. Through the outreach program and partnerships with local educational institutes, the region is promoting data center skills. Over the past two years, a series of road shows have been organized to inspire students and fill open job vacancies. At the roadshows, Google data center officials have spoken to students in Kymenlaakso University of Applied Sciences, Etelä-Kymenlaakso Vocational College and Lappeenranta University of Technology.

The prestigious Aalto University and the regional development agency Cursor are working with Google to bolster promising startups and to improve the use of the Internet by local small and medium sized industries. The effort supports the region's growing Playa Game Industry Hub, as well as the region's Kaakko 135 online travel and tourism initiative. Already, over 800 students and 700 participants from local companies have participated in Aalto-Cursor workshops, not only in the region, but also in Helsinki, London and Cambridge.

In April 2014, the inventor of the Internet's packet-switching protocol, Vint Cerf appeared at Kotka's Maritime Center Vellamo. "You don't need to have a PhD in computer science to work at a Google data center," the father of the Internet told more than 200 students. He described data center workers as "the unsung heroes of the Internet."

The Kymenlaakso University of Applied Sciences has begun to redesign its curriculum to fit the needs

of the data center cluster. "We want to teach our students the future skills for the future jobs. An active dialogue with Google and other players in the data center cluster enables us to educate the next generation of engineers for the emerging industry," says Rector Petteri Ikonen from University of Applied Sciences.

4.3 OPPORTUNITIES FOR LOCAL COMPANIES

Data centers are large investments providing business opportunities for local companies. Regional development agencies Cursor and Kouvola Innovation joined with the Kymenlaakso Chamber of Commerce to organize a series of matchmaking events for local companies to meet with Google and its main construction contractor ISG. "We met face to face with approximately 100 companies during 20 minute pitching sessions. The overall conclusion of sessions was that Finnish companies have great expertise, but do not necessarily know how to pitch their sell within a large scale multinational project environment," says Google's Facility Manager Arni Jonsson.

If Finnish companies work hard to break into the data center supply chain, they could win contracts inside and outside of the country. Consider water cooling. Finnish companies have a competitive advantage. "Just think about all the water in the lakes, rivers and the seaside in Finland," says Google's Jonsson. "Combining cooling technologies and water expertise could be a very interesting field for the Finns to capitalize on within the emerging industry".



Oxford Research conducted a survey in the spring of 2014 to map out the use of digital marketing tools of the local SMEs in the Kotka-Hamina region prior to the training program. The results follow a national trend, also apparent in the Digibarometri survey - the SMEs do not yet fully utilize online tools or services in their businesses.

With Google’s aid, a pilot training program targeted small and medium sized enterprises around Hamina. The training program, consisting of seven modules, developed basic online marketing skills. More than a hundred participants from 60 different companies participated. “The training program around the data center community has been a positive wake up call for the local companies - one interesting opportunity

to explore in the future is the use of social media channels in marketing,” says Project Manager Heidi Sjögren from Cursor Oy. A survey² assessing the impact of the training program revealed that 74% of the participating companies had increased their domestic customer base and a 21% had gained new export contacts.

NOTES

¹ Interview with Hannu Karavirta on 23 September 2014.

² The survey research was carried out by Oxford Research in December 2014.

5. Concluding thoughts and recommendations

Large data center investments made by Google and other international companies present a giant opportunity for Finland. The story of Google's data center in Hamina shows that these investments have the potential to transform regions battered by recession and economic restructuring, bringing hope to the whole country. A cluster of data centers could provide Finland with thousands of new jobs and billions of investment capital, but also new innovations and opportunities to leverage the digital infrastructure.

Finland provides an excellent location for data centers. The country has good internet connectivity, abundant and secure energy supplies, favorable weather and geography, and a supportive political and regulatory environment. In order for Finland to reap full benefits of the giant data center opportunity, Oxford Research recommends the following five key action points for the Government to take in the near future:

Recommendation 1: A clear vision and an action plan for developing a data center cluster.

The Program of PM Stubbs Government from August 2014 clearly indicates that data centers are moving atop the national agenda. The investments on improving the country's internet connectivity are a clear signal of this. The country needs a clear vision and a concrete action plan to mobilize its impressive innovation and education systems to better serve the emerging data center cluster. Developing a "data center skills ecosystem" to serve the emerging cluster could also lead to innovations and growth in other related fields, such as big data analytics or water cooling technologies.

Recommendation 2: More ambition to leverage the full potential of digital economy.

As seen in the case of Google in Hamina, data center investments and active public-private partnerships can make a positive impact on local economies. However, Finland should raise its ambition level and put in place a concrete action plan to boost the bigger possibilities and the ripple effects of data center investments. This must include tailored educations, promoting digital startups, helping transformation of SMEs to the digital world and pushing digital innovation on both private and public sectors. This is where the big growth and employment possibilities can be found and this is where the key to Finland's future lies.

Recommendation 3: A bolder effort and more resources to FDI promotion.

If there is one ranking Finland has room for improvement, it is in attracting foreign direct investments. Google is Finland's largest greenfield foreign investment ever. By placing data centers and related industries at the top of the FDI agenda, allocating more resources to both national (Invest in Finland) and regional investment promotion agencies (IPAs), Finland could easily move up the European FDI rankings whilst creating more jobs and a new wave of growth.

Recommendation 4: Increase the capabilities of Finnish SMEs within the data center supply chain.

Data center investments are massive construction projects. At peak times there are over 1800 construction workers at the Google Hamina site. In order for Finnish SMEs to capture a bigger share of the data center supply chain, a national training programme to enhance the capabilities and knowhow about the

data center industry and related technologies should be put in place immediately.

Recommendation 5: Fostering an attractive regulatory environment.

Finland needs to foster data-center friendly regulatory environment nationally as well as in the European Union. The recent proposals on allowing more network surveillance in Finland represents a good example; it requires a transparent and proper balance

between the privacy of users and interests of security. Any new decisions should be carefully evaluated from the point of view of risking Finland's competitive advantage as a data center location. But Finland also needs be the Internet's best friend in the European debate. Both in terms of promoting the European Single market, but also in terms of privacy regulation and data flows within free trade agreements. Finland has the potential of branding itself as the "Switzerland of data" - its current regulatory framework is superior to competitors.

Annex 1: About the Google Hamina data center



Watch Google's Joe Kava talk about the Google Hamina Data Center at Youtube.com:
<http://youtu.be/VChOEvKicQQ>

The data center in Hamina is built into an existing building by the sea. Sea water is used for cooling the IT servers, an innovation never before used, and one that makes the Google Hamina plant one of the world's most efficient and environment-friendly cooling systems. The power usage effectiveness value (PUE) value describes the ratio of total facility energy consumption and IT equipment energy consumption. A theoretical ideal is 1.00 and industry average estimates have ranged from 1.70 to 2.90. Thanks to its cooling system, the Hamina data center boasts an outstanding PUE of 1.14.

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¹ More information on Google's energy policy:
<http://www.google.com/green/energy/use/#purchasing>

Wind powers the Hamina center. Since Google is keen to make sure that its data centers around the world use as much renewable energy as possible, it entered long-term agreements¹ with wind farm developers to increase the amount of renewable energy it consumes. At the beginning of 2014, it announced a new power purchase agreement² (PPA) in Sweden, its second such agreement there in less than 12 months. The company will buy the entire electricity output of four as-yet-unbuilt wind farms in southern Sweden, at a fixed price, for the next ten years.

² More information on the power purchase agreement:
<http://googlegreenblog.blogspot.be/2013/06/powering-our-finnish-data-center-with.html>

Annex 2: About the study methodology

The study presented in this report is based on a number of different data sources. Close to twenty qualitative expert interviews were conducted in September – November 2014, including data center operators, government officials, investment attraction actors, and regional development organizations. In addition, a desktop research was carried out, in which a large number of reports, publications and public information sources were reviewed and analyzed for relevant information. Google also provided figures which were used in calculations and estimations of the local economic impact.

The estimation of data center cluster development is based on publicly available information on the size of announced data center investments, estimation of the cluster growth provided by the government and estimation of the economic impact and the employment of data center investments rooted in the industrial input-output model. The industrial input-output model has been used in similar studies to estimate the direct, indirect and induced impact of investments. In this case, it refers to the direct impact resulting from investment and operation expenditure, the indirect impact resulting from activities in the supply chain servicing the data center, and to the induced impact resulting from household spending by employees in the whole supply chain. The employment generation estimates are based on national statistics indicating the amount of work required to produce the direct, the indirect and the induced impacts.

The local economic impact is calculated based on data provided by Google and Statistics Finland. The average salary of the information processing and digital infrastructure sector is used in calculating the annual wage sum in data center operation. The average salary of the construction sector is used in calculating the annual wage sum in data center construction. Due to unavailability of disaggregated spending data,

indirect and induced economic impact is not calculated for the Google Hamina data center investment. The estimated annual wage sums in data center operations and construction are provided to demonstrate the direct economic impact the investment creates on the local level. In addition, the ripple effects of the data center investment in terms of the outreach program are described to demonstrate the more qualitative impact in the region.



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