DIGEST OF BUSINESS INDEX NORTH. CONNECTIVITY IN THE NORTH (2018-2020)

A periodic report with insight to business activity and opportunities in the Arctic

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ABSTRACT

Business Index North (BIN) is a project that contributes to sustainable development and value creation in the Arctic. The overall goal is to set up a recurring, knowledge-based, systematic information tool for stakeholders. This is the second issue of the "Business Index North" analytical report that focuses on the BIN area, including ten northern regions of Norway (Finnmark, Troms, Nordland), Sweden (Norrbotten and Vдsterbotten), Finland (Lapland, Northern Ostrobothnia and Kainuu), and North-West Russia (Murmansk Region and Arkhangelsk Region without the Nenets Autonomous Okrug). For the third issue of the report we would like to include more territories of the Russian High North, as well as Alaska and the Northern territories of Canada. The main implementing partner is the High North Center for Business and Governance at Nord University Business School. Nordland County Council and The Norwegian Ministry of Foreign Affairs provide basic funding for the BIN project.

Chapter Connectivity

– Basic fixed broadband is available to 95% of households in the Nordic BIN regions and to 75% of households in the Russian BIN regions.

– The regions of Troms, Nordland (Norway) and Norrbotten (Sweden) lag behind their country averages in 100 Mbps fixed broadband availability by 8 percentage points and 7 percentage points respectively, while the Finnish regions of Northern Ostrobothnia, Kainuu and Lapland outperform Finland's average by 8 percentage points.

– Mobile broadband coverage (3-4G) is good over all populated places in the BIN area. In terms of territorial coverage in 2016 the BIN regions in Norway had the best coverage lagging behind the national average by only 3 percentage points, Swedish BIN regions lagged behind by 14 percentage points and the Russian BIN regions lagged 21 percentage points behind their respective national averages.

– The BIN area has no direct connection to Europe and North America via subsea data cables. A number of landing points of data cables to Europe are on the coast of South Norway, South Sweden and South Finland. North-West Russia has one subsea data cable to Finland. Direct trans-Atlantic data traffic between Europe and North America proceeds through 12 submarine data cable systems landing in Denmark, UK, The Netherlands, Germany, France, Spain and Portugal.

This chapter covers the living conditions of people in the BIN area and business infrastructure in terms of access to fixed and mobile broadband. The results reveal common needs for broadband statistic information and make recommendations and highlight implications for policy-makers and investors. This chapter reveals that basic fixed broadband is available to 95% of households in the Nordic BIN regions and to 75% of households in the Russian BIN regions. The BIN regions in Norway and Sweden exhibit higher levels of fixed broadband availability than do the BIN regions in Finland, although the levels in these regions differ with respect to performance in comparison to the respective national levels in each case. Fixed broadband is affordable, with costs ranging from 1.6 to 3% of annual disposable income. When it comes to mobile broadband, 4G coverage with reliable backup of 3G is provided everywhere people live in all the BIN regions. Territory coverage is significantly lower than average for the BIN countries. Further, the BIN area has no direct connection to Europe, North America or Asia via subsea data cables. There are cable project initiatives, including Havfrue, Midgerdsormen and Arctic Connect, which may directly affect the BIN area and play an enabling role in its development.

KEYWORDS: *Connectivity in the North, broadband, subsea data cables, Arctic region.*

Information about BIN Project Board (www.businessindexnorth.com)

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Connectivity is recognized as a prerequisite for economic development in the Arctic. Finland's Chairmanship of the Arctic Council 2017-2019 sets connectivity as one of the priority areas. Access to broadband is essential for connectivity as it serves the needs of business, communities and research.

Telecommunication tower and Aurora Borealis.
Photo: shutterstock

Access to broadband facilitates the development of e-health and digital education. Business opportunities in the Arctic involving shipping, oil and gas, data centres, mining and service industries all need reliable connectivity solutions. The Nordic BIN – countries Norway, Sweden and Finland – have developed broadband plans and digital agendas; however, connectivity in the Arctic regions requires separate attention.

The Arctic Economic Council reports provide an overview of the challenges and ways forward to develop Arctic broadband infrastructure. In this chapter the focus is on the measurable and comparable development of connectivity in the Arctic in terms of the availability, quality and affordability of fixed broadband (including all the main fixed-line broadband access technologies). Furthermore, availability of mobile broadband is reported. Analysis of broadband development projects in the Arctic further highlights drivers and success factors for improving connectivity in the Arctic.

We address connectivity for people and for business in the BIN area. The indicators used in this chapter come from broadband statistics on households. The use of such statistics is well suited for purposes of highlighting people's universal access to basic infrastructure and Internet. The needs of businesses for Internet might vary, but basic household broadband offerings would suffice for small and medium enterprises (SMEs) as the speeds also satisfy the needs of these customers. Broadband speed is usually measured in Mbps (megabits per second), where a high number means faster downloads and uploads when using cloud services, rapid streaming of music or video and smoother video calls. A broadband speed of 100 Mbps would be considered sufficient for SMEs, but larger firms require higher speeds and bandwidths.

Analysis of subsea cable projects explores new potential for increased connectivity for business in the BIN area. This chapter describes living conditions of people in the BIN area in terms of access to fixed and mobile broadband, identifies universal needs for broadband statistic information and presents implications for policy makers and investors.

Indicators used:

Availability of fixed broadband (1) shows the proportion of households with easy Internet access, whether they use it or not. It shows investments in basic infrastructure and people's universal Internet, without measuring actual usage. Quality of fixed broadband is measured in terms of the availability of speeds of 30 Mbps(2) and 100 Mbps. This indicator demonstrates how well the BIN area meets the broadband coverage objectives of the EU Member States: universal broadband coverage with speeds of at least 30 Mbps by 2020 and broadband coverage of 50% of households with speeds of at least 100 Mbps by 2020.

Affordability of fixed broadband is measured by price level and by its percentage of average national income per capita. This indicator shows how well BIN area meets the targets of the UN Broadband Commission, namely that by 2025, entry-level broadband services should be made affordable in developing countries at less than 2% of monthly Gross National Income (GNI) per capita. Availability of mobile broadband demonstrates mobile broadband availability in terms of population and area coverage. Map of potential subsea cable projects illustrates subsea cable initiatives with a potential effect on the BIN area.

1. A ording to Eurostat, broadband refers to telecommunications in which a wide band of frequencies is available to send data. Broadband telecommunication lines or connections are defined as those transporting data at high speeds, with a speed of data transfer for uploading and downloading data (also called capacity) equal to or higher than 144 kbit/s (kilobits per second). In the Russian statistics minimum speed of broadband is 256 kbit/s.
2. Mbps and Mbit/s are used interchangeably.

Findings:

AVAILABILITY

– asic fixed broadband was available to 95% of households in the Nordic BIN regions and in 75% of households in the Russian BIN regions.

QUALITY

– T e target of the EU Digital Agenda for broadband with at least 100 Mbps per second for at least 50% of households by 2020 was already achieved in the Nordic BIN regions in 2016. The target of 30 Mbps for all is yet to be achieved.

– The IN regions in Norway and Sweden exhibit higher levels of quality fixed broadband availability than in Finland

– The regions of Troms, Nordland (Norway) and Norrbotten (Sweden) lag behind their country averages in 100 Mbps fixed broadband availability by 8 percentage points and 7 percentage points respectively, while the Finnish regions of Northern

Ostrobothnia, Kainuu and Lapland outperform Finland's average by 8 percentage points.

AFFORDABILITY

- Fixed broadband is affordable in the BIN area, with broadband expenses constituting from 1.6 to 3% of annual disposable income. Norway has the most expensive

broadband, followed by Sweden and Finland. There is no significant price disparity between the Finnish BIN regions and Finland as a whole.

– urmansk Region has more expensive fixed broadband than the Northwestern Federal District in Russia.

MOBILE BROADBAND

– In 2016 the BIN regions in Norway had the best mobile broadband coverage lagging behind the national average by only 3 percentage points, Swedish BIN regions lagged behind by 14 percentage points and the Russian BIN regions lagged 21 percentage points behind their corresponding national averages.

SUBSEA CABLE INITIATIVES

– The BIN region requires improved connectivity with the USA and Asia by subsea fibre cable. Capital-intensive projects demand careful consortium building and secured financing from the initial stage outset. The role of the governments should be considered in securing connectivity in the Arctic BIN area.

3. In the Russian statistics, broadband is defined as access to internet with download speed of at least 256 kbit per second. In the statistics for the Nordic countries, according to Eurostat, the minimum broadband speed is 144 kbit per second.

Availability of fixed broadband in the BIN area Figure 1 shows the country specific shares of households with fixed broadband access. While Norway was the first to reach the 95% threshold in 2016, Sweden and Finland approached it in 2017. Russia is lagging behind by 20 percentage points as of 2016. Figure2 shows that there is no disparity between BIN regions and their country averages (the share for both North-West Russia and the Murmansk and Arkhangelsk region is about 75%; for the Nordic countries and their corresponding BIN regions the shares are close to 95%). The development in North-West Russia in 2016 was at the 2009-10 level of the neighboring Nordic countries and their BIN regions. Today the difference in the share of households with broadband access between the Nordic BIN regions and North-West Russia is about 20 percentage points. In Russia, priority in extending Internet availability of at least 10 Mbps is given to settlements with a population of at least 250 people.

When interpreting the results in Figures 1 and 2 one should remember that availability of fixed broadband meeting the minimum speed requirement is considered (access to internet with download speed at least 256 kbit per second in Russia and with minimum speed is 144 kbit per second in Nordic BIN area). See Table 1 for speed comparisons.

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The Digital Agenda presented by the European Commission proposes to better exploit the potential of information and communication technologies (ICTs) in order to foster innovation, economic growth and progress.

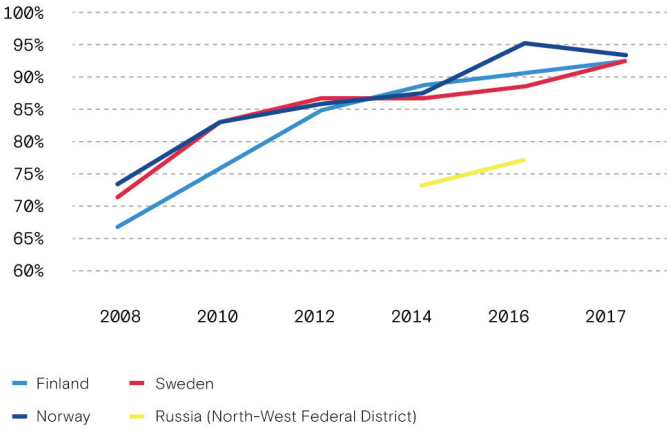

Figure 1. BIN countries-share of households with broadband access, %
Data sources: Eurostat, Rosstat

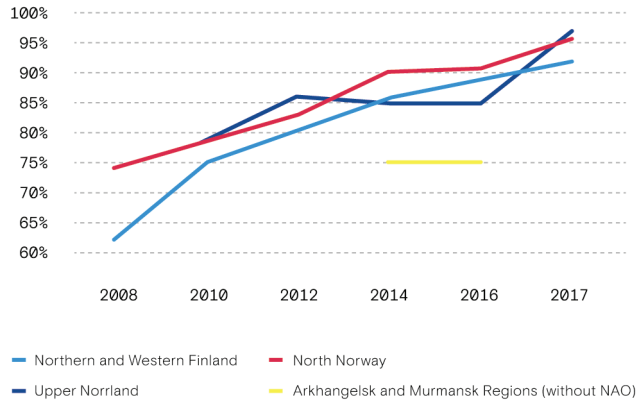

Figure 2. BIN regions-share of households with broadband access, %
Data sources: Eurostat, Rosstat

When it comes to broadband, the Digital Agenda has the following targets:

– All in Europe hall have access to internet with speed over 30Mbps per second by 2020 as the latest.

– 0% of all households in Europe shall have internet subscription with speed more than 100 Mbps by 2020.

In order to give some indication of what these speeds mean for the user, Table 1 compares the broadband speed required for downloading a 5-minnute video and a 2-hour movie over internet by using theoretical calculation. When using an internet connection with 100 Mbps it takes 1.5 min to download a 2-hour movie, while using 256 kbits it would take 9 h and 19 minutes.

Broadband speed comparison

Content	Size	256 kbits	1Mbps	20 Mbps	100 Mbps
5 min video	30 MB	16 min	3 min	13 s	2.5 s
2 h movie	1-1.5 GB	9 h 19 min	2 h	10.5 min	1.5 min

(Source: fastmetrics.com)

Availability of fixed broadband, % of households

Figure 3.1 shows the quality of fixed broadband availability in the BIN area. The target of the EU Digital Agenda for broadband with at least 100 Mb per second for at least 50% of households by 2020 was already achieved in the BIN regions of Nordic countries in 2016. The target of 30 Mbps second for all was yet to be achieved.

Percentages just represent the possibility to acquire broadband (infrastructure in place). The total level of broadband accessibility in Finland is significantly lower than in Sweden and Norway, lagging by 22% for 30 Mbps and 25.5% for 100 Mbps compared to the average for Norway and Sweden. The regions of Västerbotten, Finnmark and Kainuu are among the best performing regions in their respective countries in terms of access to internet with at least 100 Mbps. The differences across countries are explained by country-specific initiatives to support fibre enabled Internet availability. In Finland, the commercial bias has been more toward mobile network development. In Sweden state aid coupled with regional broadband coordinators acting as the link between the regional and municipal level and the market actors deploying broadband infrastructure proved to be efficient in achieving availability of high quality broadband. In Norway there have been more public financial support schemes available in order to cover the costs of the "last mile" of infrastructure in rural areas (5). No comparable statistics are available for Russia.

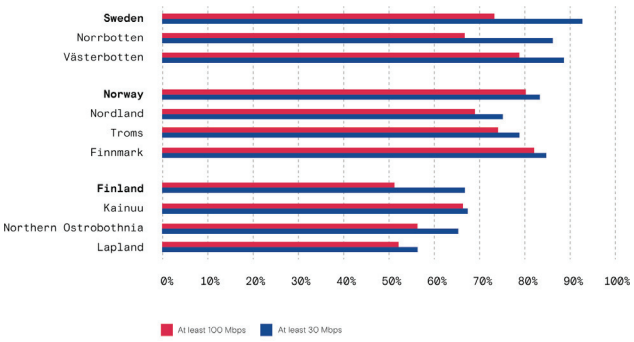

Figure 3.1. Data sources: Finnish Communications Regulatory Authority, Norwegian Communications Authority, Swedish Post and Telecom Authority 5.
ACS Telecoms REPORT

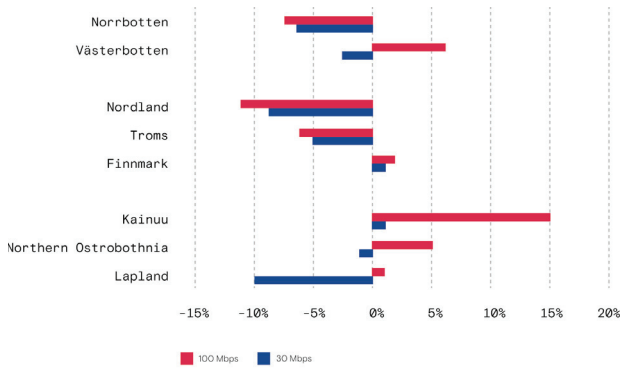

Figure 3.2. Difference in fixed broadband availability by speed compared to country average, %

Figure 3.2 shows that six out of the eight BIN regions underperform in 30 Mbps availability compared to their respective country averages, ranging from a 10 percentage points gap in availability in Lapland to a 1 percentage point gap in Northern Ostrobothnia.

In Sweden, Norrbotten region underperforms in both 30 Mbps and 100 Mbps availability, while Västerbotten outperformed by 6 percentage points in 100 Mbps compared to the Swedish average (see Figure 3). In Norway, both regions of Nordland and Troms underperformed in fixed broadband availability, especially in 100 Mbps speed Nordland lags behind by 11 percentage points and Troms by 6 percentage points. Finnmark region performed slightly better than the Norwegian average. In Finland the BIN regions of Kainuu (15 percentage points), Northern Ostrobothnia (5 percentage points) and Lapland (10 percentage points) outperform Finland's average in 100 Mbps broadband availability equaling 51%, which is considerably lower than for the Swedish and Norwegian BIN regions. There is need to address fixed broadband disparities in the BIN regions.

Subscription price per month, minimum 100 Mbps, lowest price offer in EUR

Figure 4 demonstrates that subscription prices for fixed broadband with at least 100 Mbps second differ widely among the BIN countries. Norway has the highest price and Russia has the lowest. Prices in Sweden and Finland fall in between. Unfortunately, we could not find detailed statistics for the Norwegian and Swedish BIN regions. However, according to the experts, there is no significant difference between regions within the countries. In addition to the subscription price, users often have to pay an opening fee (not shown in the figure). The average level of the opening fee differs greatly between the countries. While in Norway the opening fee is around 564 EUR, in Sweden and in Finland, it is about 1,750 EUR. This means that for first-time users of high speed broadband (100 Mbps is available on fibre lines), the total cost in Norway is lower than in Sweden and Finland if considering a two-year plan. The opening fee in Russia can be up to 500 EUR if there is no fibre cable connected to a house. However, there is a connection to most of blocks, and if there is none people normally do not go for it but opt for a wireless connection plan.

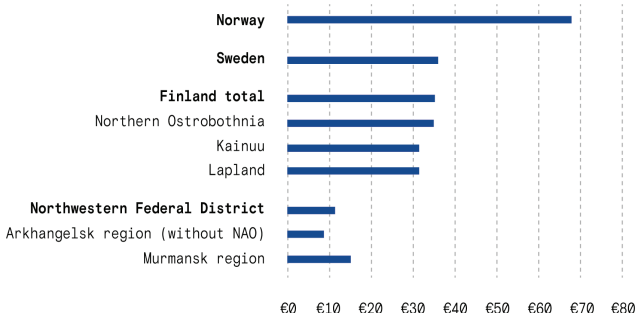

Figure 4.
Data sources: Finnish Communications Regulatory Authority, Swedish Post and Telecom Authority, Internet providers

Affordability of fixed broadband by speed: annual subscription price as % of annual net income

Broadband of 100 mbps is most affordable in Finland, and amounting to 1.9 % of annual net income, followed by Sweden (2%). The most expensive high-speed broadband is in Norway, 3% of annual net income. Affordability of 30 Mbps broadband was under 2% in all BIN regions and their corresponding countries. The greatest affordability disparities are in the Murmansk region.

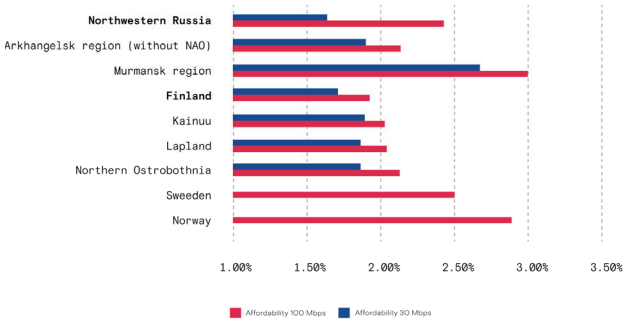

Figure 5. Affordability of fixed broadband as percentage of annual net income

Data sources: Finnish Communications Regulatory Authority, Swedish Post and Telecom Authority, Internet providers, Statistics offices in Norway, Sweden, Finland, Russia.

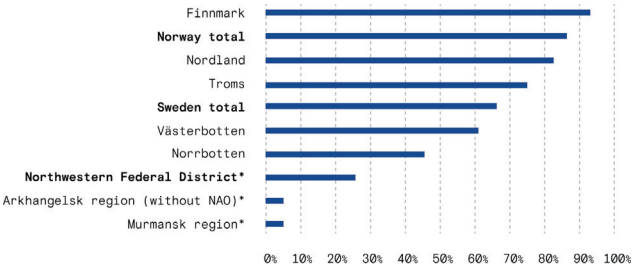

Figure 6. 4G area coverage in the BIN regions, % of own territories *(3-4G coverage for Russian regions)*

Mobile broadband in the BIN area

The estimated share of the population with access to mobile data based on 4G (all mobile networks, outdoor coverage) is close to 100% in all BIN regions in Norway, Sweden and Finland. In the Russian BIN regions of Murmansk, Arkhangelsk and Northwestern District in Russia as a whole most households are covered with 3G and some have 4G. While population coverage with mobile broadband is nearly complete, the area coverage in the BIN regions is much less (Figure 6). The northern territories of Norway, Sweden, Finland are much less covered with 2G, 3G, 4G than the southern parts of these countries.

The situation on the Russian side is even more dramatic – most of the Northwestern Federal District Territory remains uncovered. On the Nordic side, most of the territory covered has 4G and a secure 3G back-up. In Russia most of the territory covered has 2-3G, while 4G is available only in more densely populated places. Mobile networks are developed first in populated areas (see Figure 7). The higher percentage of territory covered – the more dispersed the population in the region is and vice versa. Finnmark in northern Norway has the largest share of own territory covered with 4G – 93%. In general, regions in Norway have a higher share of own territory covered than do Swedish regions. The Russian regions have the lowest share. No comparable Finnish data available.

Area covered with 4G (in 1000s km2) and number of citizens per 1 km2 of this area

Figure 7 shows that Finnmark has the largest area covered with 4G – 45.2 thousand square kilometers. At the same time, the region has the lowest number of people per square kilometer of the area covered with 4G – 2. Figure 7 clearly shows that the BIN regions with the largest 4G covered areas have the lowest number of population per square kilometer of this covered area, and viceversa. Murmansk region has 105 people per square kilometer of the area covered with 3-4G, while this area is only 7. 2 thousand square kilometers. No comparable Finnish data available.

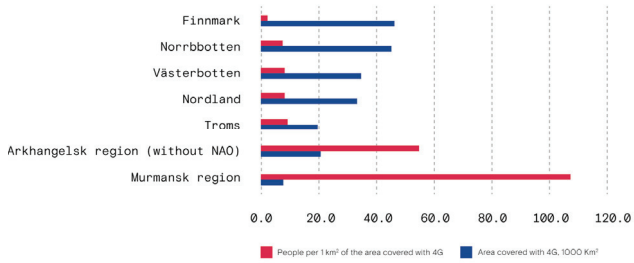

Figure 7.

International subsea fibre initiatives in the Arctic

The needs of modern internet users require fast internet with low latency, meaning short delays in data transmissions. The driving factors behind the need for higher bandwidth are among others increasing cloud driven traffic, IoT developments, Industry 4.0, autonomous vehicles, emergence of 5G technology which offers data transfer up to 150 times faster than the current 4G networks. Subsea fibre cables carry close to 100% of transoceanic voice and data communication.

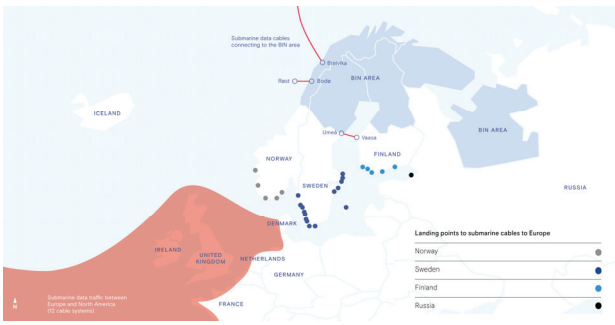

Figure 8.1. The BIN area on the Submarine. Cable Map
Data source: https://www.submarinecablemap.com/
The Submarine Cable Map is a free and regularly updated resource from TeleGeography

Figure 8.1 shows that on the global scale the BIN area has no direct international subsea fibre cables connecting it to the USA or Asia. The lines on the map show the routes of the cables and territories they connect. As of early 2017, there are approximately 428 submarine cables in service around the world. The total number of cables is constantly changing as new cables enter service and older cables are decommissioned. Historically, these cables were built as commercial projects financed by private enterprises rather than governments. The BIN area has no direct subsea cables to the USA or Asia; Direct transatlantic data traffic proceeds through 12 cable systems connecting regions in North America to Denmark, Netherlands, Germany, United Kingdom, Ireland, France, Spain and Portugal. Major subsea cables that connect Finland, Sweden and Norway with the rest of the world have interconnects in continental Europe, which introduces latency into data traffic. All landing points for these cables are in the south of Norway, Sweden, Finland and none in the BIN area; South Sweden has the highest number of landing points for these cables to continental Europe.

Figure 8.2. International subsea fibre initiatives in the Arctic

The opening of the Arctic sea and operational Northern Sea Route create preconditions for northern subsea cables (see Figure 8.2). The growing business potential of the Arctic requires new subsea cable solutions to improve Arctic connectivity with the rest of the world. In the BIN area, the need for fast connectivity is driven especially by:

– Interest n the BIN area as an attractive place for opening data centres (see datacenters on the map) (*There are datacenter initiatives at initial stage in North-West Russia that are not displayed on the map*) running on low cost green energy, benefitting from cold climate and taxation incentives

– Offshore wind industry

– ining

– O l and gas industries

– ncreased demands of local businesses in cloud computing services

– Tourism and transport industry connectivity needs

– BIN area being a frontrunner in 5G research (*The University of Oulu has a 5G Test Network https://5gtn.fi*)

In our analysis we investigate three BIN area related subsea cable initiatives originating in different countries and at different stages of completion. Attention is paid to how projects are organized and their sources of investment. As a benchmark we investigate two reference projects with potential impact on the BIN area. The main development and success drivers are identified.

BIN area subsea fibre cable projects

Arctic Connect is a cooperative opportunity for PolarNet and Cinia Group Oy to relaunch Polar Net's Russian Optic Trans Arctic Submarine Cable System (Arctic Connect). The Russian Optical Trans-Arctic Submarine Cable System ("R.O.T.A.C.S.") is a Russian-led project that began in the year 2000 and was developed by PolarNet. Midgårdsormen Norwegian-led project seeking to design, build and operate a Norway-centric transatlantic 7,500 kilometre cable system to connect Norway and Sweden to the East Coast of the United States. Specifically, Midgårdsormen proposes to connect Virginia Beach, Virginia to Blaabjerget, Denmark, with a possible connection to Mo i Rana, Norway.

NXTVN´S Oulu Nordic Express Europe proposes a cross-border, Nordic-centric, Gulf of Bothnia bridge connecting cities in the Nordic regions of Finland and Sweden to Norway with onward connections to mainland Europe via submarine and terrestrial networks. NXTVN specializes in Data Center Parks solutions.

Reference subsea fibre cable initiatives

For reference, we use two projects that are in the operational stage and that are likely to affect connectivity in the BIN area. Quintillion brings high-speed Internet access to the North American Arctic through subsea cable. Quintillion is a private operator that contracts to sell capacity on a wholesale basis on its network.

Havfrue subsea cable will run through the North Atlantic connecting mainland Northern Europe to the USA. Optional branch extensions to northern and southern Norway are also included in the design. The first new transatlantic cable in almost two decades.

The analysis served to identify the following success drivers of subsea cable projects:

– Se ured finances

– S rong consortia

– Growing role of OTT players (over-the-top), e.g.

Facebook, Google and Amazon as initiators of subsea cable investments.

Recommendations

Overall, connectivity of the BIN area should be addressed at the government level, including the interests of different stakeholders such as communities, businesses and academia.

For Policy

– Providing all hous holds with access to internet with speeds over 30 Mb per second by 2020.

– Improving mobile broadband availability in the BIN area.

– Decreasing discrepancies in broadband affordability in the Russian BIN regions.

– Address ng the needs for increased connectivity by means of subsea cables connecting the BIN area with the USA and Asia.

– Addre sing the needs for increased connectivity using the mix of technologies including satellite solutions.

Next we address the following questions:

• What are the levels of fast bro dband accessibility of 100 Mbps and over in the BIN area?

• What are the levels of ultrafast broadband accessibility of 1 Gbps in the BIN area?

• What technologies are emp oyed in providing fast broadband accessibility?

• Is there any differ nce in broadband accessibility between households and businesses?

• H w is the data centre industry developing in the BIN area?

To address these questions, we collect and analyse comparable data across Finland, Sweden and Norway, but do not include the Russian BIN regions for which such detailed data is not available. Levels of broadband accessibility are compared by using an indicator of fast fixed broadband access of 100 Mbps and more. The EU broadband objectives for 2020 include providing half of European households with connectivity rates of 100 Mbps and by 2025 with access to connectivity offering at least 100 Mbps for all European households.

To assess ultrafast broadband accessibility we collect data on 1 Gbps in the BIN area. Connectivity of 1 Gbps or Gigabit connectivity is needed for educational services online, digitally intensive enterprises, manufacturing systems, ordering and delivery processes, data storage and analytics.

The EU's strategic objective for 2025 is to provide Gigabit connectivity to all main socio-economic drivers such as schools, transport hubs and main providers of public services, as well as digitally intensive enterprises. Additionally, we provide data on broadband accessibility for households and businesses to access how these two groups of users benefit from connectivity in the BIN area. Finally, we collect data to map existing and planned data centre activity in the BIN area.

Key findings:

• Di ital infrastructure in the BIN area is good for supporting the needs of households.

• On aver ge 75% of households in the BIN area have access to high speed broadband of 100Mbs and higher.

• Ultrafast int rnet of 1 Gigabit via fiber optic access is available to 58% of households in the BIN area.

• Sweden leads in providing very highspeed broadband via fiber access to 82% of households in the BIN regions.

• Digital infrastructure acce sibility for business users in Sweden and Norway is on average 10 percentage points lower than for households.

• Data ce tre activity is on the rise in the north.

• Physical digital infrastructure and countries' national support for data centre activity are among the most crucial factors for the future of this industry.

Figure 9 demonstrates that high-speed broadband access is available to an average of 71% of households in the BIN area, which is five percentage points lower than the totals for Sweden, Norway and Finland (76%).

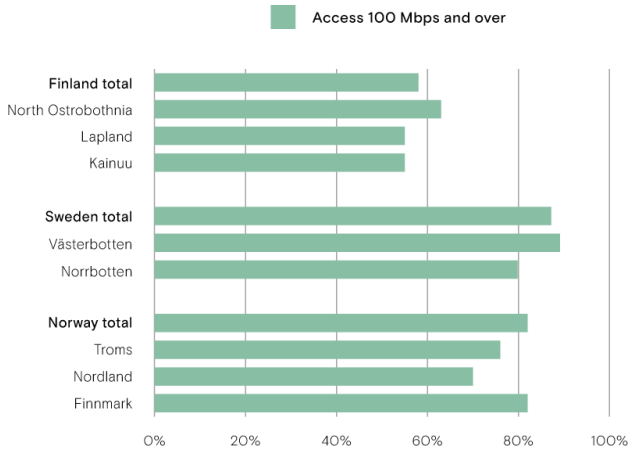

Figure 9. Fixed broadband access 100 Mbps and over, % share of households
Data sources: NKOM, PTS, FICORA (Traficom).

In Norway, Finnmark has the highest fixed broadband access at 82%, with Troms and Nordland reaching respectively 76% and 70%. The topography of the place contributes to the ease of creating infrastructure, reflected in higher accessibility rates in the flat landscape of Finnmark compared to the mountainous terrain in Nordland and Troms.

The low figures for Finland do not necessarily tell the whole story since 89% of households (10% of the area) are covered with at least one mobile network capable of providing 100 Mbps in ideal circumstances. Therefore, in Finland, the lower fixed broadband accessibility is compensated by access to highspeed mobile broadband. All BIN regions have already achieved the EU target of 50% of households with connectivity rates of 100 Mbps by 2020.

Figure 10 demonstrates infrastructural readiness for the provision of very high-speed internet of 1Gbps and more. The data is available for the provision of very high internet access via hybrid fiber-coaxial TV cable (HFC) or via fiber-optic cable (FTTx-fiber to the home).

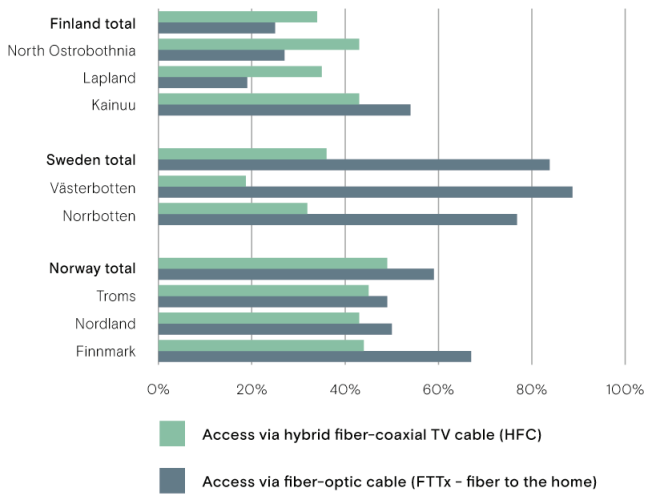

Figure 10. Digital readiness for very high speed broadband 1 Gbps+, by technology, 2017–2018
Data sources: NKOM, PTS, FICORA (Traficom)

The difference between these solutions lies mainly in the upload speed, with fiber-optic cable solutions providing high-speed symmetrical services in both downloading and uploading. Different patterns emerge in the choice of technological solutions across countries, e.g. Sweden has invested heavily in fiber-optic cable (82% of households have accessibility via Access via FTTx-fiber to the home), hence this option leads in readiness to provide very highspeed broadband to households in the BIN area. On average 58% of households in the BIN area have access to fiber-optic cable vs. 56% in the whole of Sweden, Norway and Finland. The high percentage of fiber cable in the BIN area is skewed by the Swedish regions of Norrbotten and Västerbotten with accessibility of 77% and 89% respectively.

Access via hybrid fiber-coaxial TV cable is available to 37% of households in the BIN area vs. 40 % in the whole of Sweden, Norway and Finland. The question of technical solutions is also important to keep in mind when thinking in the long- term; fiber-optic is currently the recommended medium for the link between the core network and the final sub-networks for 5G wireless, so the role of fiber-optical cables is crucial in the uptake of 5G. All BIN regions apart from Finnmark and Västerbotten underperform compared to the country averages in the digital readiness via fiber-optic solutions.

Figure 11 compares fixed broadband accessibility of 100 Mbps and over in households and enterprises in the Swedish and Norwegian BIN regions.

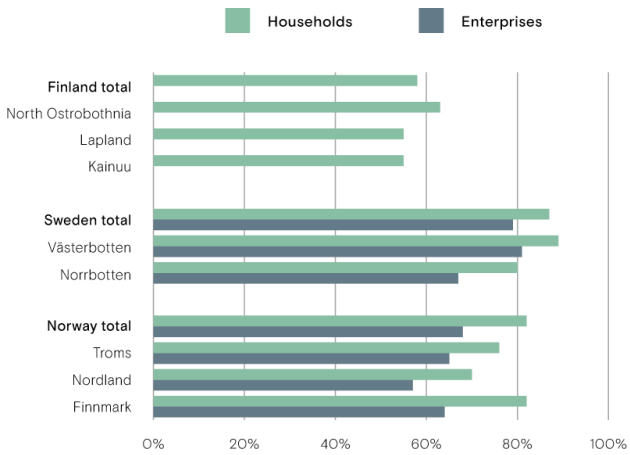

Figure 11. Fixed broadband access by households and enterprises, 100 Mbps and over

The Finnish broadband statistics does not provide data on the enterprise level, but the household statistics serve as a proxy for enterprise broadband accessibility. We observe that on the country level in Norway and Sweden fixed broadband accessibility is on average 12 percentage points lower for enterprises as opposed to households in the same countries, compare 67% vs. 79%. The Norwegian BIN regions have 100 Mbps broadband accessibility for enterprises in the range of 57%-65%.

The difference between 100 Mbps broadband accessibility between households and enterprises on country level as on the BIN regional level can be attributed to the infrastructure installed ready to use within the reach of households, while for enterprises located outside available infrastructure some additional investments may be necessary.

Additionally, smaller enterprises of less than ten employees (i.e. 93% of all enterprises in Finland) can be better represented by using statistics of lower speed internet accessibility.

Data centres in the BIN area

By 2030, the number of devices connected to the internet will have reached 125 billion, up from 27 billion in 20172. These devices rely on the data stored in data centres. The growth in data centres is driven by demand in digital content, mobile computing, Internet of Things (IoT) and cloud computing. Firms worldwide rely more and more on big data and data analysis by external service providers. In 2018 of all Finnish firms using big data 45% relied on external services. In our overview, we examine types of data centres and their capacity. As a measure of capacity we use MW as it best describes power available at data centres.

In our data centre mapping activity in the BIN area we focus on the following types of data centres:

2 ESPAS (2019) Global Trends to 2030: Challenges and Choices for Europe.

3 Definition from Nordic Council of Ministers (2018). Data centre opportunities in the Nordics.

Cloud

Cloud facilities are owned and operated by the cloud companies, which deliver an array of computing services. The larger cloud providers build multisite regional setups with a range of availability zones to ensure low latency and high reliability in the service. The client bases for the cloud companies are all corporate, governmental and individual's applications.

Colocation

A data centre owner sells space, power and cooling to multiple customers in a specific location. The customer typically provides server equipment and the collocation provider hosts it in their data centre by providing space, power and cooling.

Hyperscale

These are large data centre facilities above 20 MW, owned and typically operated by the company they support. They are usually service platforms for social media, search engines, communication & entertainment, artificial intelligence, machine learning and e-commerce5. These data centres are normally located close to the power grid. An example of a hyperscale data centre is the Facebook data centre in Luleå.

Greenfield/brownfield

Greenfield deployment refers to the installation of data centres where previously there was no infrastructure in place, hence necessitating building from scratch. Brownfield development refers to using existing infrastructure not in operation (e.g. old warehouses, factories etc.). Brownfield developments may benefit from existing electricity links. For both types of development brownfield and Greenfield offer specifications of the data centre (e.g.

cloud or hyperscale) determined by the future owner or customer. Table 1 reports data centre development activity in the BIN area by looking at the types of data centres and their operating and planned maximum capacities (where such data is available). All types of data centres are currently being developed in the BIN area, while future sites are mostly greenfield developments. Out of 10 future greenfield development sites, at least four are specifically suitable for hyperscale data centres with electricity capacity expansion of 100 MW up to 300 MW and four planned data centres with expansion capacity above 35 MW.

Capacity data were available for 19 data centres out of 27 data centres, both planned and existing. Operating capacity of existing data centres amounts to 296 MW. If we include operating capacity of planned data centres the result amounts to a total of 635 MW available on short notice. Capacity for expansion data for 13 out of 27 both planned and existing data centres provide an estimate of 1.5 GW operating capacity in the next three years. In terms of energy consumption, it would equal an energy consumption of 13.1 TWh per year. In the chapter of the BIN report devoted to energy, the surplus of the electricity produced in the BIN area amounted to 30 TWh in 2017. Hence, if all planned data centres are built and expanded, the data centre industry may potentially consume up to 44% and more of all energy surplus in the BIN area. Electricity produced from renewable energy sources serves as one of the main attractions for data centre location in the BIN area.

Closeness to the grid and fiber, low cost of electricity, security and political stability and natural cooling conditions are among the selling points encouraging investment in the data centre business in the BIN area. Looking at the regional differences, the Swedish BIN regions are the most prolific in terms of existing and planned data centres compared to their Finnish and Norwegian counterparts.

This is due to the tax incentives introduced by the Swedish government in 2017 to stimulate the ICT sector. As a result newly introduced tax cuts reduced overall electricity prices by around 40 percent for any existing or new data centre greater than 0.5 MW from January 2017 . Additionally, the power companies Vattenfall and Skellefteå Kraft actively promote and facilitate data centre development in the Swedish BIN regions through a Node Pole jointly owned entity established in 2017 serving as a commercial investment and development hub providing dedicated support for investors within the cloud industry and other energy-intensive industries.

Connectivity in the digital age is important for both economic and social development. At the same time, it should not be isolated from the bigger picture, where both positive and negative impacts of increased connectivity are analysed. This type of analysis would intrinsically include environmental impact assessment of both physical infrastructure and future construction projects, e.g. data centres. Additionally, the social component of connectivity should be investigated further, whether better digital infrastructure is the solution to such social problems as loneliness and isolation.

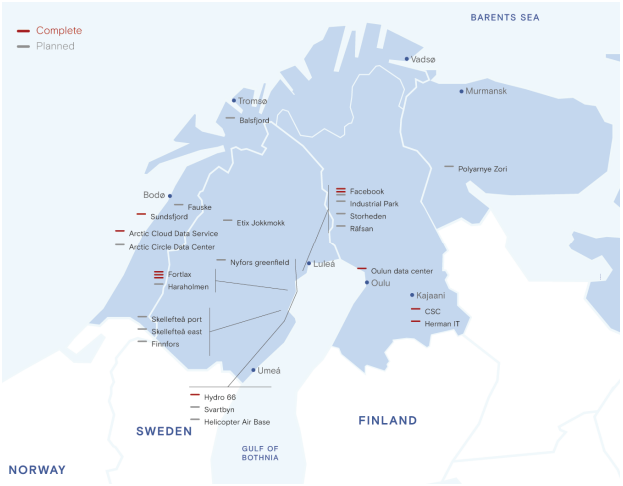

Figure 13. Locations of existing and planned data centres in the BIN area

Figure 13 shows data centre activity in the BIN area in terms of operating and planned data centres. There are currently 11 operational data centres in the BIN area, ranging from Facebook-owned hyperscale data centres in Luleå to the colocation Herman IT data centre in Kajaani. Facebook has confi rmed its additional data centre development in Luleå with at least the same capacity as the previous ones (120 MW) scheduled to be operational in early 2021.

The Norwegian BIN regions of Nordland and Troms have plans for data centre industry expansion in Fauske and Balsfjord, both of which can be used as hyperscale data centres due to the availability of high electricity capacity.

The Swedish BIN regions have seven operational data centres and the data collected reveals that there are 12 potential development sites that can be utilized for data centre industry purposes.

The Finnish regions of North Ostrobothnia and Kainuu collectively have three functioning data centres. Little data is available on the data centre development activity in the Russian BIN regions; in 2018 the administration of Polarnye Zory city signed a co-operation agreement with a Chinese high-tech fi rm for a hyperscale data centre development in the city.

BIN's comment on Covid-19 situation in the Arctic

In this report we assessed the sustainability of the Arctic regions before COVID-19 pandemic hit the world. The spread of the virus and efforts to bring it under control will definitely affect sustainability of the Arctic regions. The scale of the impact will largely depend on the existing conditions for sustainability and governments' responses to the crisis. Although COVID-19 was not the focus of this report, the indicators presented in this report along with previous BIN reports will help readers evaluate vulnerabilities and favourable conditions of the Arctic regions that are now facing pandemic outbreak.

Here we seek to illustrate how indicators can be used to assess vulnerabilities and conditions that may potentially weaken the impact of the virus. The Arctic regions with their low density of population and low urbanization (apart from larger cities in the Russian part of the Arctic) are less exposed to the risk of rapid virus spread. However, there are some places with higher proximity and dense living conditions (i.e. island communities, construction workers settlements) that pose higher infection risks.

Vulnerabilities of the Arctic regions stem from the demographic structure with ageing population and a high proportion of +65-yearolds that are most at risk. Moreover, high proportion of people with chronic diseases and obesity, and mental health issues create additional risks. Historically, the corresponding death rates in the Arctic were already rather high.

In the report we identified negative growth in agricultural and arable land, meaning higher dependency on food produced elsewhere. In the case of supply chain disruptions, this may have negative impact on food security. Tourism in the Arctic is likely to be negatively affected due to fall in demand and imposed travelling restrictions. In particular, hotels, catering, restaurants, entertainment and cultural and creative industries would suffer most from the crisis. Additionally, service providers, retailers are to be potentially negatively impacted. In local communities depending on larger companies, negative impact can be much stronger than in larger cities with distributed economy in the south.

Unemployment in the Arctic regions is expected to increase during the crisis. This will probably strain the Arctic economy. A relative lack of access to capital in the Arctic must be taken into consideration when designing measures for the restart of economic activity.

Broadband access shall be advanced further to meet the demand for remote work and teaching. As a result of pandemic outbreak as well as restrictions imposed by the governments, the Arctic regions are potentially at risk of high unemployment rates, lowering quality of life, depopulation, and less attractive opportunities for investments. On the other hand side, the Arctic regions are so far better off in terms of infection rates. In times of the crisis, we need to build partnerships and learn from each other. Countries have different exit strategies and support mechanisms to re-build the economy. Decisions made as part of the rebuilding plan will have long-lasting effects on all aspects of sustainability.

We therefore challenge authorities to develop a preparedness plan on how to address interconnected risks and achieve sustainability. Evidence from the Arctic regions can be used for targeted measures to build socially, environmentally and economically sustainable Arctic regions during and after the crisis.

Conclusion of the BIN report

We measured and analysed the level of sustainable development in 14 regions in the Arctic Europe including Norway, Sweden, Finland, and Russia. The United Nations Agenda 2030 of sustainable development goals was used as a measurement framework. We used 52 indicators selected from the UN framework under criteria of appropriateness and data availability for the Arctic.

The indicators were grouped into five interlinked pillars of sustainability: People, Society, Economy, Environment and Partnership.

We see big differences between the north and the rest in the four countries of Arctic Europe. Our analysis shows that the situation in the Arctic areas is better only in case of 21% of the indicators. For 34% of the indicators the situation is the same, and about 45% of the indicators describe a situation in the Arctic areas worse than that prevailing in the respective countries as a whole. Specifically, performance is worse on People, Society and Environment indicators. At the same time, Arctic regions in Norway and Sweden are performing better than their respective countries on economic indicators. At aggregate, with the exceptions of the regions of North Ostrobothnia in Finland, and Yamalo-Nenets in Russia, the Arctic areas lag behind their respective countries in terms of sustainable development.

For a more comprehensive view we developed maps and tables where the performance of the Arctic regions can be compared against each other and the corresponding countries.

The Nordic Arctic regions had a total of 29.3 TWh electricity surplus in 2017. There is a need for efficient local use of electricity produced predominantly from renewable sources. The Nordic Arctic region has potential to become attractive for establishing energy-intensive industries.

Business development measured in terms of stock in active enterprises shows growth in the sector of business activities and real estate, and in the hospitality sector, while the number of manufacturing firms is in decline.

The employment growth rate needs to be increased in most of the regions apart from Yamalo-Nenets Autonomous Okrug. The unemployment situation is very different across countries with challenges persisting in Finland and Russia. And now facing Corona, it is expected to reach record levels in all the BIN regions. Job creation, increasing innovative potential and fostering knowledge economy should be on the development agendas of the Arctic regions. Most of the Arctic regions, except North Ostrobothnia, lag behind their countries averages in terms of knowledge infrastructure. There is lack of large companies investing in R&D activities.

Emissions per capita are higher than the respective countries' averages in most of the Arctic Europe regions due to differences in industry structure larger presence of (mining, manufacturing, oil and gas) and climatic conditions. Economic activity conducive to increased emissions needs to be viewed hand-in-hand with wellbeing in the region. It is important to have regionally specific strategies and plans for climate change mitigation that take into consideration all pillars of sustainable development.

Macro-economic indicators stimulating partnership: GDP per capita is lower than the respective national averages for most of the Nordic Arctic regions, but growth rate is higher. For Russia there are big differences between regions in terms of GDP per capita. Regions relying more on natural resources have higher GDP per capita. Given the high inequality of incomes this is a trend limiting partnerships. High level and growth rate of GDP in the regions is associated with overconsumption at the macro-level, which in turn presents problems for envi-

ronment. Achieving partnerships through macroeconomic stability shall be done in conjunction to human development, sustainable consumption and environmental sustainability.

What brings value to development of the North?

The BIN report provides a comprehensive analysis of sustainable business development in the European north. The report is based on statistical data from multiple sources, using scientific methods, and provides factual and comparable indicators across a set of topics and geographic regions. Several implications and recommendations are presented at the end of each chapter.

We emphasize the value of the people who live in or deal with the north, their livelihoods, and the importance of quality education and job creation. At the same time, successful business activities and economic development are another vital component of value creation.

Thus, value creation involves activities beneficial to both persons and legal entities. In this regard, Business Index North seeks to trace both societal and economic developments in the Arctic and offers a nuanced considered view of how these evolve in combination.

Sometimes we observe success stories associated with positive trends for both, sometimes we face worrying contradictions.

The BIN report is a key tool to understand demographic and human development trends, business activities and opportunities, as well as core conditions such as connectivity, knowledge infrastructure and electricity production in the BIN area. By bringing the pieces of the puzzle together our report offers an intellectual insight into the process of value creation for business and society in the North.

What do we know?

Our report highlights worrying demographic trends whereby population growth in the BIN regions is well below national averages and even negative in the Russian BIN regions. The BIN area fails to attract young adults and families; hence the young population is declining.

Men in the regions are decidedly less well educated than women. Business shows positive trends, especially measured in terms of growth in turnover. Businesses rely on natural resources extracted from the region, but new opportunities in value-added business such as information and communications are on the rise.

Is business development in the BIN area socially sustainable? In the meantime, high economic growth in the BIN area is associated with negative job creation rates. Each year, every 100 new workplaces created in the BIN countries (Norway, Sweden, Finalnd, North West Federal District of Russia considered together) are associated with 15 workplaces lost in the BIN regions of these countries considered together.

The BIN area generates electricity from predominantly green energy sources that create attractive business opportunities for energy-intensive industries such as data centres. Broadband accessibility is good for the needs of households but requires further development for the needs of businesses. Research and development in the business sector is below national averages everywhere except North Ostrobothnia.

Thus, being advangeiously positioned in terms of energy and connectivity, businesses in the BIN area have limited capacity to contribute to a knowledge economy based on intellectuial resources, information and know-how.

What is next?

Interest in the Arctic and High North among globally operating businesses is driven by the demand for natural resources and the opening up of sea transportation routes. Knowledge about the past gives us some indication of what lies ahead. We expect the growth in economic activity in the north to continue. However, this growth needs to be supportive of the local people and local communities. Any major disruptions, such as the opening of new mines or manufacturing plants, need to be taken into consideration in terms of socio-economic impacts and demographic challenges to the region.

We also strive to show the image of the North not only as a source of extractible resources but as a place full of ideas and unique solutions, which we highlight in a separate BIN Innovations report. The BIN report can serve as a platform for creating a vision for sustainable business in the north that is respectful of nature, people and northern values.

The BIN report is produced in order to serve as an analytical tool for various stakeholders, including decision-makers, media, NGOs, academia and others. The report provides an impartial and independent analysis that can be used for benchmarking and as input for policy-making. It can be used for teaching and raising awareness of the BIN area to the wider world.

We continuously upload new reports to the web site www.businessindexnorth.com. Moreover, we develop data visualization tools and infrastructure maps which can be applied by users according to their specific interests. We believe that all people who would like to contribute to sustainable development of the Arctic will find BIN a practical and insightful tool.