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Arctic 2050

Mapping the Future of the Arctic

arctic2050

SKOLKOVO
Institute for Emerging
Market Studies (IEMS)

2020

Ruben VARDANYAN,
Impact Investor and
Venture Philanthropist

«The world has never been as dynamic as it is today: technological disruptions, demographic shifts, economic turbulence, and political unrest bring challenges on an unprecedented scale. Twenty years ago nobody could have imagined that the combined GDP of the top seven emerging markets could exceed that of the G7 countries. These markets offer both a great opportunity and a major challenge for any business. By establishing IEMS we wanted to contribute our views and insights to the dialog of business with policy-makers and NGOs in all emerging markets. We believe that open multi-stakeholder dialog will eventually help businesses and politicians come up with better-informed decisions that make a positive impact and drive change for better.»

Karl JOHANSSON,
former Managing Partner,
EY Russia & CIS,
Chairman of the Analytical
Credit Agency of Russia (ACRA)

«Studying emerging markets from within – that is the idea behind bringing together the research teams in Moscow, Hong Kong, and Hyderabad into the international and interdisciplinary research network. These are the most effective means to deal with the dynamics and complexity of the changing nature of emerging markets. Assisting international businesses better understand emerging markets and operating businesses in emerging markets expand globally – those are the strategic aims of the research initiatives at IEMS.»

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Dear Readers,

The coronavirus pandemic has given us many reasons to rethink our business as usual. We have all lived through the personal impact on our communities and are starting to look to, and redefine, the future. However the economic consequences of COVID-19 are of such a magnitude that they are yet to be fully understood.

We, at EY, are committed to building a better working world. Despite the fragmentation and isolation that we have all experienced during this global pandemic, we believe that the better world is one that is interconnected and collaborative. We have also seen how fragile the world is and understand that we need to put sustainability at the heart of our planning in order to reframe our future.

The Arctic is one of the greatest economic opportunities of the 21st century. This territory, rich with natural resources, is becoming more accessible due to climate change. At the same time, the Arctic is very fragile both as an ecosystem and as a geopolitical phenomenon. The region needs both strategic sustainability thinking and international cooperation to succeed.

We appreciate the bold intellectual efforts that have been undertaken by our long-term strategic partner, Moscow School of Management SKOLKOVO in cooperation with Nord University Business School, to explore the multiple futures of the Arctic as a function of breakthrough innovations and enabling international policies. The future remains uncertain. The good news, however, is that we can build it working together. Research, like the piece you are about to read, helps to map routes to a better working world.

I join the authors of this report in hoping that it will help business and policymakers define strategies for the Arctic that help solve for today's challenges in reframing our future to protect and create long-term sustainable value for all stakeholders.

Jay NIBBE
Global Vice Chair - Markets
EY

Dear Friends and Colleagues,

I hope you are reading this report in good health and spirits.

As many organizations and societies around the world are going through unprecedented challenges due to the coronavirus crisis, the role of the forward-looking educational institutions and independent stakeholder dialog platforms, just like the Moscow School of Management SKOLKOVO, is getting increasingly important. Our daily job is to develop ideas, guide reflections and facilitate public debate on the most pressing issues of the leadership agenda of today and tomorrow.

An increasingly VUCA (Volatile, Uncertain, Complex, Ambiguous) environment reminds us of the greater importance of looking at the longer-term perspective beyond business-as-usual. Seeing the bigger picture enables leaders to navigate multiple uncertainties and better shape strategies and policies for a more sustainable future and building and using scenarios is the first step towards getting the future under control.

I am very pleased to introduce you to the Arctic-2050 report which explores alternative futures for the Arctic region and tipping points that leaders need to pay attention to.

As Russia is holding the chairmanship for the second time in 2021-2023 of the Arctic Council, this report comes at the right time. Moscow School of Management SKOLKOVO has already produced a series of publications focused on the current state of the Arctic, its opportunities and challenges that key players are facing today. This Arctic-2050 report presents alternatives and plausible scenarios for the Arctic region that leaders need to think about as they progress towards shaping a more sustainable future.

The report is informed by a series of deep-dive interviews and experts' brainstorming sessions. It aims to find common ground for strategic dialogue and the joint actions of diverse stakeholders – businesses, governments, cities, academia, NGOs, and international organization – to help them tap into new opportunities that emerge in the region while preserving the local environment and enhancing social development.

This work would never be possible without continuing support and inspiration from our long-term strategic partner – EY. For this work, we also joined forces with the leading international experts on Arctic from Nord University Business School, Bodo, Norway. Together, this helped us to make this work truly international and multi-dimensional, just as the Arctic is itself.

Please visit arctic2050.info for more insights into the future of the Arctic.

Dr. Andrei Sharonov
President
Moscow School of Management SKOLKOVO

The Arctic has attracted increasing attention over the past 20 years or so on a global scale. There are several reasons for this. Two of the most prominent are the climate change that has had a significant effect on living conditions and the living environment for people, animals and biological production in the Arctic area. Changes in air and sea temperatures alter the conditions of life for many inhabitants of the Arctic. The other reason relates to the economic exploitation of the natural resources of the Arctic. The warming of the seas and the reduction of the ice cover over the polar area have paved way for new opportunities. Extraction of known and less known biological and mineral resources is one dimension, but transportation opportunities are also significant enough that many global and regional actors are investigating them.

In the midst of all this global interest and the race for opportunities, are the local inhabitants and local and regional governments. Being "rich and famous" related to all economic and strategic opportunities is, however, not automatically a guarantee for success. Exploitation of resources and opportunities may have many motives and may also take many different forms. The challenge is, thus, to balance different goals, aims and intentions among the different parties.

One of the greater challenges that Russian governmental bodies at different levels are facing is the decreasing population of the Arctic. Populating the area and securing a positive social and economic development for its inhabitants is a critical issue in all respects. Development may take many different forms, depending on the opportunities, institutional environment and other considerations. One of the key challenges for the Russian government is therefore to prepare for different possible scenarios.

The main aim of this document is to stimulate a debate that addresses this important question. In order to generate interest and engagement, the authors have developed a set of possible scenarios that may eventuate. Some may look extreme, or perhaps unlikely. But it will be important to bear in mind while reading the text that the scenarios are presented mainly to stimulate more open thought around "what if..." rather than locking the mindset around a few issues, positive or negative.

The good, positive and sustainable development of the Arctic is in any case important, and it is my hope that this document will contribute to that.

Frode Nilssen
DSc and Professor in Marketing
Nord University Business School

Content

Executive summary

The Arctic region is going through a serious transformation as it faces the disruptive challenges of climate change and shifting global political, social and economic patterns.

The harsh environmental conditions of the Arctic have long constrained economic activity in the region. The climate crisis, while having a negative impact on the region in some senses, opens up new prospects for development in others. The Arctic has become a geopolitical hot spot where global and regional players seek to increase their influence. Demographic shifts, transformative urbanisation and sustainable indigenous communities are at the core of regional social development.

Understanding the driving forces that will influence the business and political landscape of the Arctic in the coming decades is crucial for policymakers and businesses in order to come up with mutually beneficial approaches for exploiting opportunities without harming the unique Arctic natural and social ecosystem.

The Arctic is far from being an open book for everyone to read. There is a variety of critical uncertainties that might have unpredictable but significant impacts on regional development – the pace of climate change, the trajectory of economic and social development, the dynamics of geopolitics and others. Two specific **dimensions of uncertainties** are the most critical and could lead to a significant shift in the Arctic region.

- **Quality of institutional environment**, including the effectiveness of environmental, social and demographic policies and regulations, the availability of financial incentives and the quality of governance,

- **Pace of technology and innovation development**, including the level of digitalisation and connectivity, the commercialisation of technologies, and the cost of doing business.

Different combinations of those critical uncertainties provide very different scenarios of how the Arctic might look in 2050 and what might be the implications for the sustainable development of the region from the economic, social and environmental perspectives. Each scenario has been associated with one of four distinctive historical periods to make it more self-explanatory.

These periods applied metaphorically to the Arctic scenarios can be characterised as follows:

- **Dark Ages.** A lack of coordinated national and supranational frameworks and governance and the low pace of innovations and deployment of new technologies literally freeze Arctic development, which remains static for a decade and then quickly deteriorates, leaving the Arctic a depopulated and devastated industrial site for the ruthless exploitation of exhausted fossil resources.

- **Age of Discovery.** Fierce competition for the resources of the Arctic, fuelled by state-funded innovations, reaps the Arctic riches, making the economy grow and attracting opportunity-seekers to the region. Fragmented environmental regulation and weak disaster response fail to slow the degradation. Natural habitats and the livelihoods of the indigenous people deteriorate amidst an accelerating climate crisis.

- **Romanticism.** The world of successful environmentalism has made the Arctic a showcase for all things good for the ecosystem. There is only sustainable energy and transport, no mining and extracting, going back to nature. Money stops flowing to

the Arctic. What once was a global magnet for business has turned out to be just like a film location for the National Geographic.

- **Renaissance.** In this scenario, nations agree to make exploration of the Arctic – just as much as space exploration – a symbol of international cooperation and humanity's eternal striving for progress and innovation. Governments agree on standards for doing business in the Arctic, incentivizing the use of best available technologies, and innovating to prove decoupling is possible. Ambitious dreams attract talent and the Arctic becomes a magnet for those willing to prove that "impossible" is just fake news.

All four scenarios have different social, environmental, and economic implications, and illustrate the urgent necessity for transformative, collective action in order to help shape better policies and design progressive strategies that will benefit local community, strengthen the region's strategic position in the global arena, and drive new opportunities to advance sustainable development goals.

This report is aimed at inspiring, guiding, and supporting policymakers and business and NGO leaders, especially those in the Arctic states, in their search of a new agenda for the Sustainable Future of the Arctic.

Dark Ages – a period of European history commonly related to the 5th-15th centuries. The name comes from the fact that few historical records have survived from this period, and therefore modern knowledge of it is limited. The other meaning is less literal: that after the decline of the Roman Empire, Europe was static with little progress made in any aspect of life. Instead, there were constant wars and unrest.

Age of Discovery – is a period of European history usually associated with the 15th-17th centuries. Starting with the Portuguese, and later followed by the Spanish, French, and English, explorers undertook ocean-going voyages in search of expensive commodities, mostly spices, which were found in the East, but incidentally involved discovering the New World in the West. Some countries were already adopting rules and what we would call 'business ethics', though they were of little use overseas, where everything that could make money would do – from bribing to genocide.

Romanticism – is a relatively short period in European history that emerged in the late eighteenth century and lasted less than a century. The core ideas emphasised individuals, their emotions and feelings, and especially their interaction with nature. Broadly seen as a reaction to the Industrial Revolution, romanticism was eventually superseded by realism.

The Renaissance – to date, it is the most beautiful period in European history. It started in Italy in the 14th century and lasted for more than three centuries, spreading across the whole continent. This period gave humanity the greatest names in the arts and sciences, such as Leonardo da Vinci, Petrarch, or Copernicus. Europe reconnected with its roots in the Classical world and built upon them, developing ideas of humanism, beauty, knowledge, and mercy.

Source: SKOLKOVO Institute for Emerging Market Studies

Introduction

EXPLORING ALTERNATIVE AND PLAUSIBLE FUTURES FOR THE REGION

To discuss different futures of the Arctic on a 2050 time horizon it is necessary to identify key developments, forces and processes which will affect the global landscape and the Arctic in particular.

In doing so it is important to separate what we know is about to happen, which might be called **certainties**, from developments that cannot be foretold but which might impact the development of the Arctic in the next 30 years. These we call **uncertainties**. These groups of factors will be key to outlining the context for the region's development and will map possible **scenarios** for the Arctic.

In this report we will explore different plausible futures for the Arctic region which offer a starting point, or common ground, for leadership discussions that will shape recommendations for businesses and policy-makers.

RESEARCH SPECIFICS

In this report we have applied a scenario planning approach, which includes scoping, framing and building steps (see the Methodology section for more details on the approach). We combined desktop research with a series of in-depth interviews and seminars with key stakeholders, including business, government, local administrators, and social and environmental non-governmental organizations.

As previously noted,[1] thinking of a scenario as a certain development narrative between two conditions of a system, 2050 is probably the most difficult time horizon for mapping plausible scenarios. It lies exactly half-way between 'now' and 'then': shorter-term scenarios, like by 2035, can be built based mainly on what is available today in terms of technologies, infrastructures, policies and practices.

Although climate change is clearly accelerating, 10-15 years is a short period of time in which to expect radical change. On top of that, a combination of relatively long innovation and modernization cycles of the urban, industrial, and transport infrastructure, the state of international affairs, and general institutional inertia, protect the Arctic from short-term disruptions.

On the contrary, extremely long-term scenarios, to 2075-2100, are closer to futuristic exercises. Given the accelerating pace of technological development and innovation, the changing natural environment, and geopolitical dynamics, there will inevitably be a completely different Arctic in 2075+ from the one we have now. In other words, while scenarios to 2035 could be considered continuations of the present, those extending to 2075 and beyond are better thought of in reverse, as projecting from the future back to the present.

We believe this is the major difficulty with 2050 scenarios. At that point, the Arctic will be half-way through a transition from its today's structures to something completely different. It will most likely contain features of both of them at once, the old and the new Arctic together. That is what makes this exercise so compelling and creative.

In this report, no scenario modelling has been included. All numbers are presented for illustration only and reflect the magnitude and direction of change under different scenarios rather than specific, defined projections.

Finally, we present the plausible futures neutrally, and do not mean to suggest objectives of any kind. These scenarios are not predictions, they are instruments which will help to imagine the future, and to understand turning points, emerging opportunities and potential challenges. They are designed to present an exaggerated picture of possible developments. However, the actual future might contain elements of different scenarios, or a mix of them, or it might take a very different turn.

Arctic Today

In this chapter we will revisit key challenges, patterns and trends which historically have affected the regional landscape and will likely remain the strongest factors for Arctic development until 2050, regardless of which development pathway is chosen.

Those factors reflect a wider context, and include the climate crisis, social and economic development, geopolitics, the innovation landscape and an enabling environment. We will also map the key stakeholders who are driving the regional development today to better understand how their interest will change in different scenarios.

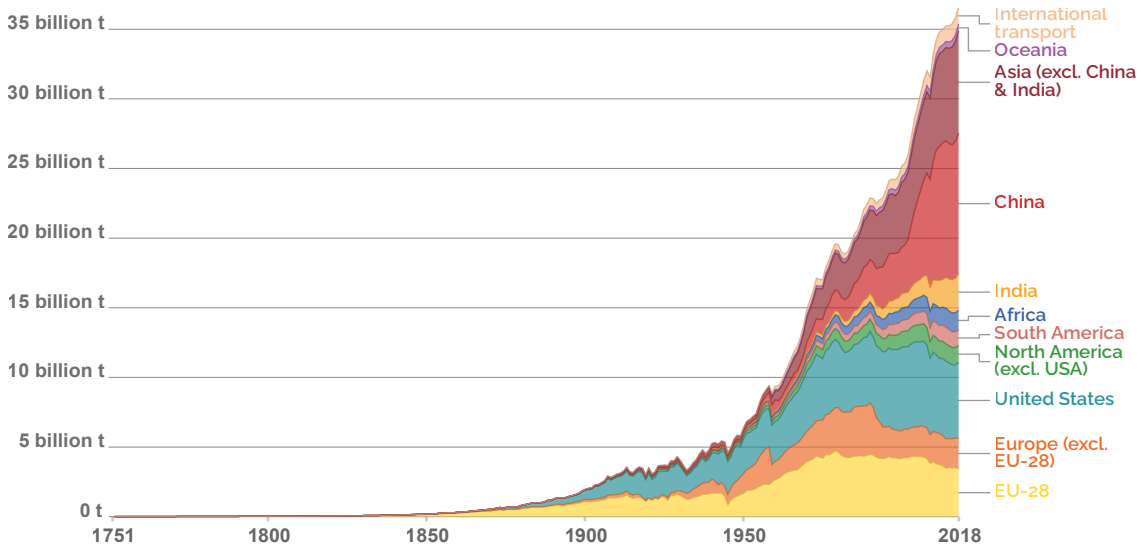
Regional landscape

CLIMATE CRISIS

Over the past decades the world has started to experience a climate crisis driven by an increased volume of the greenhouse gas emissions into the atmosphere. There is a global consensus over the **climate change emergency**. Almost 97% of scientists believe the climate crisis is caused by human activity.

Moreover, more than 190 countries signed a landmark environmental pact to limit global warming, to well below 2˚C degrees above pre-industrial levels. In 2016 this so-called Paris Agreement came into force.[2] Despite the experts' view that the world community should decrease emissions and cut its impact on the environment, holding warming to 1,5˚C degree to avoid significant damage, recent statistics show that greenhouse emissions have not declined yet (figure 1).

FIGURE 1: GREENHOUSE GAS EMISSIONS TREND

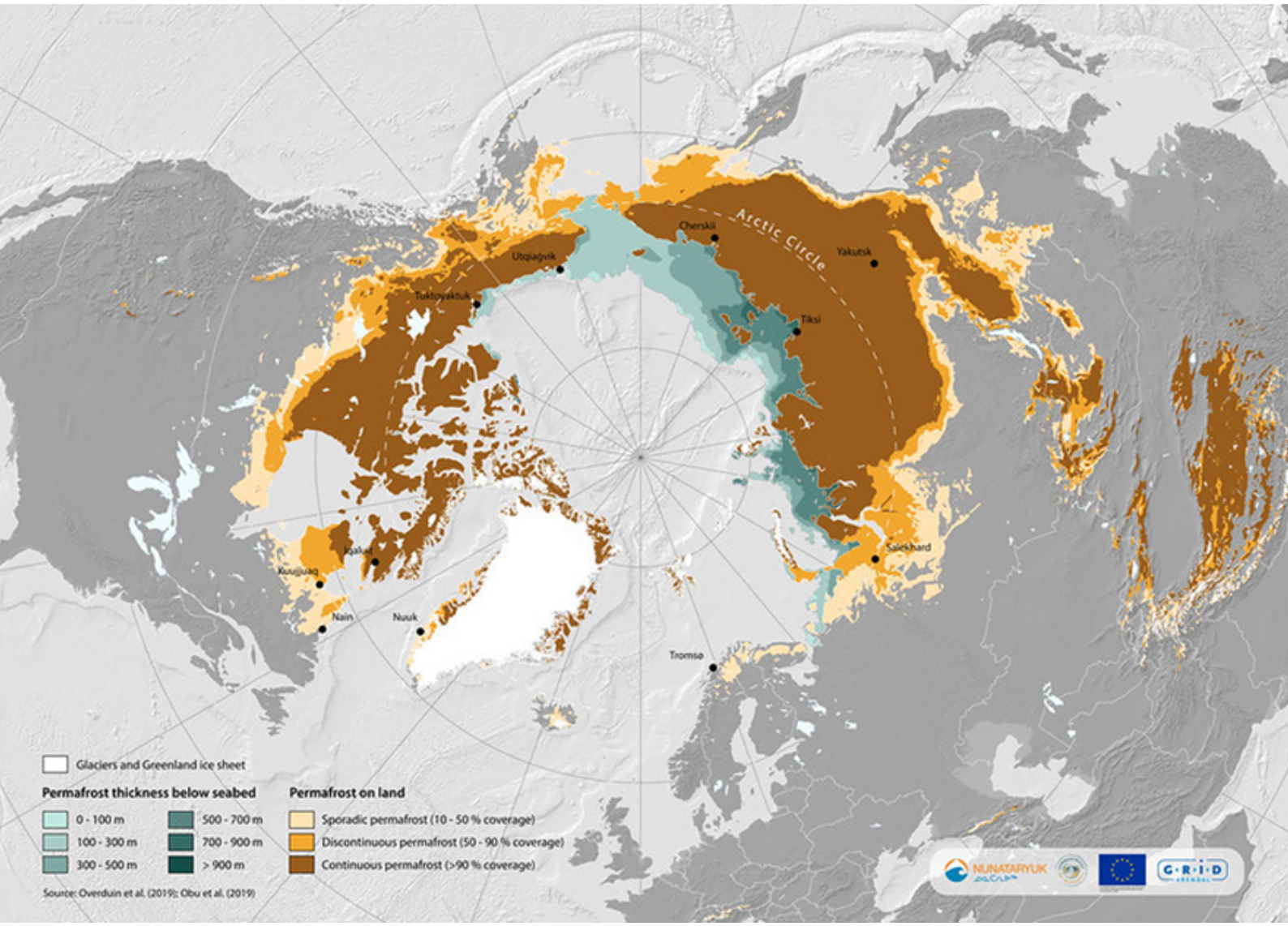


Source: Our World in Data

Climate change poses an urgent and serious threat to traditional ways of life, jeopardizing not only the planet's unique environment, but also the economy. It will affect stability around the globe, causing massive natural disasters, refugee flows and tensions over key resources. There will be many long-lasting impacts of progressive climate change, including increasing temperatures, rising sea levels, droughts, floods and storms. There will also be major impacts on wildlife and ecosystems, as well as political and security risks and risks to human health.[3]

Climate change will affect the Arctic too, with the average surface air temperature increasing at twice the rate of the rest of the world.[4] Ice-covered surfaces reflect about 80% of the Sun's energy back into the space, preventing warming.[5] Melting ice in the Arctic is already responsible for the 25% of global warming, causing the so-called albedo-effect as the ice-covered area diminishes. By contrast, the darker surfaces of land and ocean absorb up to 90% of solar energy, thus intensifying global warming. According to the Carbon Brief research, Arctic ice-sheet disintegration and melting permafrost are listed among the nine 'tipping points' which could "push parts of the Earth system into abrupt or irreversible change"[6] (figure 2).

FIGURE 2: PERMAFROST IN THE NORTHERN HEMISPHERE



Source: Nunataryuk project

The pace of climate change in the Arctic, and the melting of ice and permafrost, have been largely underestimated. It appears to be happening faster there than anywhere else in the world and having a significant impact on other regions' development. Only in 2007 did scientists first predict that Arctic waters could be ice-free within a century, while recent estimates show it might occur within 20 to 30 years.

On the one hand rising sea levels and changes in climate open up new opportunities for Arctic development, making its natural resources accessible and unlocking the transit potential. But on the other hand, increasingly severe weather events, loss of fish stocks and of unique mammals will profoundly affect the region's ecosystem and the traditional way of life of the indigenous people. Moreover, melting permafrost poses a growing threat to the existing industrial infrastructure and urban environment.

Melting ice and rising sea levels significantly affect the **ecosystems** of the region, putting more and more land and sea species on the endangered list, and destroying the natural living environment of indigenous peoples of the North. Arctic warming affects indigenous people by restricting their access to subsistence foods, and making it more hazardous to hunt and fish.[7]

The transformation of the Arctic environment by the climate crisis will result in profound changes to the usual habitats of its flora and fauna. Diminishing ice-cover will impact the core of the Arctic food-chain – algae which grow under the sea ice and are consumed by zooplanktons. This is a basic material for the whole food chain for the Polar region, from zooplankton to fish, baleen whales, seals and polar bears. The melting sea ice reduces the volume of algae and zooplankton needed to keep the region's wildlife safe and stable. The effects of climate change can be observed in tundra greening and extreme weather events. In summer 2020, the Arctic suffered unusually intense wildfires compared to other years since 2003.[8]

This is not the only threat that global warming poses to the Arctic. The Arctic ice sheet is critical for mammal migration routes. Getting together in large packs is essential for reproduction and the genetic well-being of polar wolves and foxes. With summers getting longer and with less ice, it becomes harder for them to travel. So they stay separated from each other, which leads to degradation of the population. Stable ice platforms are also very important for polar bears and harp seals. These species use the sea ice-sheets to hunt and live on. Moreover, harp seals give birth only on mounds of snow on sea ice and weakened ice platforms lead to population decline.

According to the WWF Arctic Programme, the population of polar bears will decrease by 30% by 2050.[9] But recent studies show that climate change due to greenhouse gasses poses an even more serious threat. By the end of this century, polar bears could become extinct[10] and be the dinosaurs of our era if greenhouse gas emissions do not decrease. Only those polar bears who live on the Queen Elizabeth Islands will manage to survive. But even if global warming slows down, the ice will still melt, and many groups of bears will begin to experience serious reproductive failure by 2040.[11]

Scientists state that for animals it is becoming harder to find proper nutrition due to global warming. Caribou, muskox and other mammals of the Arctic face danger as a significant seasonal shift in the Arctic ecosystem has been observed recently. Springs start earlier, bringing the crucial nutrition plants to bloom ahead of time, while the 'internal clocks' of the animals remain the same. Rain falls more often and then freezes, blocking the access to food and damaging species whose coats are not capable of protecting them from freezing rain.

In many ways, human activities, such as hunting, fishing, construction of infrastructure and the development of oil and gas fields, put additional pressure on the Arctic ecosystem. At the same time there are a number of programmes aimed at protecting the unique Arctic environment.

The success of these and similar programmes will largely depend on the quality of international cooperation and national regulatory frameworks. These elements are essential to help Arctic wildlife to adapt with minimal loss. Transforming the natural environment will be one of the most crucial processes that will shape the Arctic region over the next decades, as its ecosystem is becoming increasingly fragile.

SOCIAL DEVELOPMENT

Scientists usually define the Arctic as the region above the Arctic Circle, an imaginary line that circles the globe at approximately 66° 34' N.[12] The definition of the Arctic used in this report is broader and includes territories designated as Arctic by each Arctic state. For instance, in the Russian Federation the Arctic includes regions as part of the Arctic Zone of the Russian Federation. Arctic societies in the Nordic and Russian Arctic and are experiencing a demographic shift with a decreasing population of children and young adults, which will threaten sustainably functioning and resilient societies in the future.[13] In the Russian Arctic, the transition to a market economy after the collapse of the Soviet Union meant that the cost of Arctic development (based on a planned economy) became unaffordable as the wages and incentives for working there were not available any more.[14] Assessing how well the Arctic regions of Finland, Norway, Sweden and Russia are doing in achieving the three pillars of sustainability (economic, social and environmental), the latest Business Index North[15] report finds that performance is worse on social indicators, and the Arctic areas lag their respective countries in terms of sustainable development.

Arctic communities have **disparities in levels of health and education** observed across regions and ethnic groups, where health (chronic diseases and mental health) and levels of education attainment are lower on average for the Arctic peoples than the states' national averages.[16]

While social development is affected by migration, trends in population, unemployment and dependency ratios, it is also impacted by the change in the physical environment such as changing sea ice levels, permafrost melting, coastal erosion. These changes lead to the inability to practice subsistence livelihoods, and damage community infrastructure and housing.[17]

Social development is closely linked to economic well-being. The future social development of the Arctic people will depend on the solutions which enable them to break away from **"the Arctic paradox"**, where local and indigenous people do not benefit from economic development.[18] The paradox implies that the Arctic regions have a high growth of GDP per capita, while the level of disposable income per capita is low and poverty rates are considerably higher than the corresponding national averages.

The document "Guidance for responsible investments in the Arctic"[19] outlines major principles that business needs to follow to promote sustainable and equitable economic growth in the region and to enhance community well-being. It includes promoting capacity-building for indigenous people and local communities, creating job opportunities and developing human capital, amongst other things.

Social development involves strategic planning for Arctic communities that includes long-term demographic policies, increasing the attractiveness of the region by providing education and work opportunities, securing housing and access to health services.

DEMOGRAPHIC CHANGES

Demographic projections in the Arctic show a very small population increase, in the range of 1%, until 2055.[20] Still, very big regional differences are expected to remain, with some regions having positive and some regions having negative trends. The Arctic is becoming more urbanized and more multicultural. Arctic cities are vulnerable to climate change and require adaptation policies to integrate indigenous and migrant workers.

The population of the Arctic is 4.5 -10 mil people depending on the definition of the Arctic used. The process of urbanization started in the 1950s-1960s, when population growth in the region occurred in urban centres due to both in-migration and natural increase.[21] Big cities during Soviet times were established in close proximity to places where natural resources were extracted. In addition to practical motivations, ideology played an important role in their emergence.[22]

The urbanization of the Arctic reflects its economic structure, where larger shares of population are employed in mining, manufacturing, and the service sector than in agriculture. The Arctic has large mining, forestry, or resource extraction sectors that tend to be concentrated in or near urban areas, or which in turn develop urban areas by their presence.[23] Urban areas in the Arctic grow because of their attractiveness for work, education and cultural life.

Population change in the Arctic has three identifiable patterns:

- growing population in the North American Arctic, Alaska and the three northern territories of Canada due to natural increase, and a growing population in Iceland due to positive net migration;
- moderately growing population in Sweden, Finland and Norway;
- declining population in the Russian Arctic (box 3).

BOX 1: DECLINE OF RUSSIAN ARCTIC POPULATION

The largest population decrease happened in the Russian Arctic, with 1.7 mil fewer people living there in 2018 than in the 1990s. The break-up of the Soviet Union and the transition to a market economy are the main drivers behind population decline. Russian Arctic cities are much larger than those in other Arctic regions as a result of the Soviet Union's central planning system. The population decline in the Russian part of the Arctic is a result of the adjustment to new economic conditions, through large-scale outmigration. Thus, nearly a quarter of the population and many settlements across the Russian Arctic were closed or abandoned when they became depopulated.

Population change 1990-2018
in the Arctic regions in absolute numbers

USA	191 986.00
Iceland	94 665.00
Norway	25 727.00
Finland	24 312.00
Canada	22 327.00
Sweden	6 788.00
Denmark	3 044.00
Russia	-1 710 616.00
TOTAL	**-1 341 767.00**

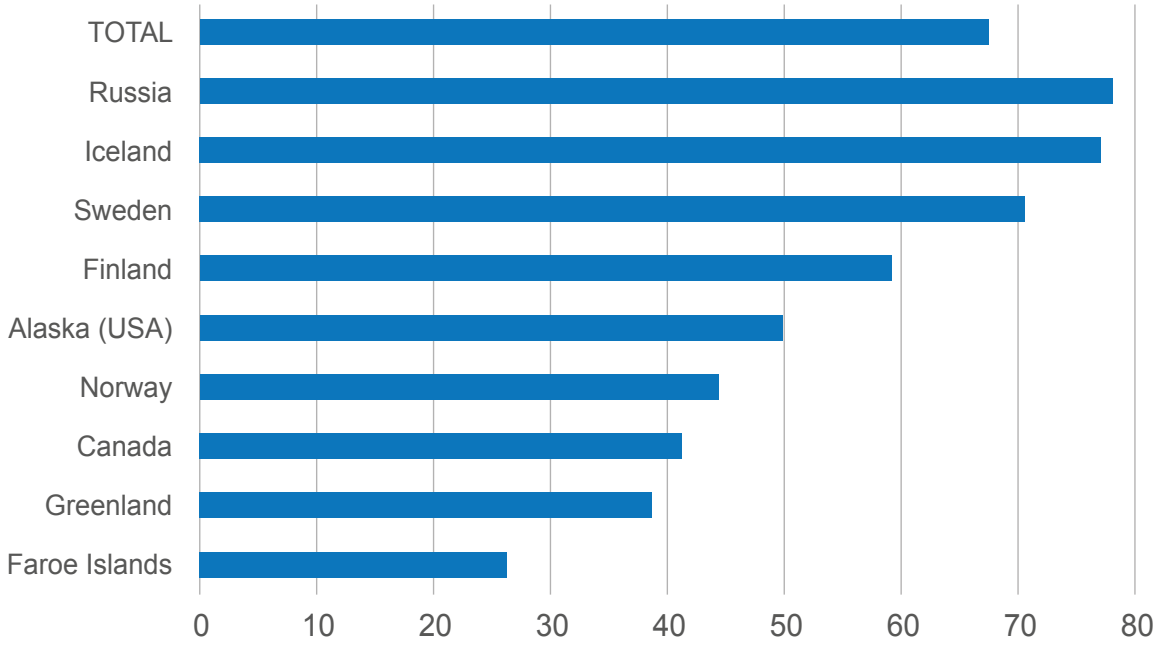
Source: calculated using data from Nordregio[24]

In future projections to 2055, the population of the Arctic will change little, with a projected increase of just 1%. However, there will be considerable variations in growth rates among the Arctic regions.[25]

TRANSFORMING URBAN ENVIRONMENT AND SUSTAINABILITY

The population of the Arctic lives predominantly in urban areas, with some regional variations. In total the level of urbanization[26] in the Arctic equalled 67%, with Russia (78%) and Iceland (77%) having the highest level of urbanization and Faroe Islands (26%) and Greenland (40%) having the lowest ones (figure 3).

FIGURE 3: THE LEVEL OF URBANIZATION OF ARCTIC REGIONS BY COUNTRY, %



Source: Zamyatina, N & Goncharov, R, 2019. "Arctic urbanization: resilience in a condition of permanent instability – the case of Russian Arctic cities," Chapters, in Resilience and Urban Disasters, chapter 7, pages 136-153, Edward Elgar Publishing.

*The level of urbanization is calculated using urbanization levels according to common criteria (referring only to a city population with more than 5,000 inhabitants)

This urbanization process in the Arctic has been uneven: in North America and Scandinavia, while small settlements tend to lose population, large urban centres such as Anchorage, Whitehorse, Nuuk, Reykjavik, Akureyri, Tromsø, Bodø and Luleå are growing rapidly.[27] Nunavut in Canada, as well as the Faroe Islands, based on a more dispersed economy, are still mainly rural; the other Arctic regions have between two-thirds and three-quarters of their populations residing in urban areas.[28] In Russia, the population declined significantly in Murmansk and Arkhangelsk and continued to grow in cities with expanding oil and gas industries, e.g. Novyi Urengoy, Noyabrsk and Sabetta.

The accelerated urbanization of the Arctic creates significant challenges, i.e. **out-migration** from rural communities toward larger settlements and urban centres, and increased concentration of the population. Rural depopulation and "brain drain" are among the most visible challenges. A stable population is usually the result of a dynamic balance between large flows of incoming and outgoing migration. The Russian Arctic cities are characterized

by a constant "flowing" or "churning" mode of migration as compared to the southern cities, with a predominance of long-distance migration flows above other types of population flow.

In the Arctic, there is also a problem of **single-industry towns (mono-towns).**[29] These have employment structured around one industry, such as ferrous ore mining, hydrocarbon development, etc. In Russia, 18 such towns are located in the Arctic region. Mono-towns suffer harsh socio-economic consequences of production decline, out-migration, depletion of the mineral base and the environmental crisis.[30] Some solutions for the single-industry town problem in the Arctic include urban environmental improvement and investment promotion for the local business community.

Large cities in the Russian part of the Arctic maintain their population by the large incoming labour flows. This, on the one hand, introduces problems of migrant adaptation; on the other, new knowledge is introduced to these industrial cities, promoting urban resilience and creativity. Urbanism in the Arctic can be viewed in the context of a new phase of industrialization related to extractive industries and a changing geopolitical environment.

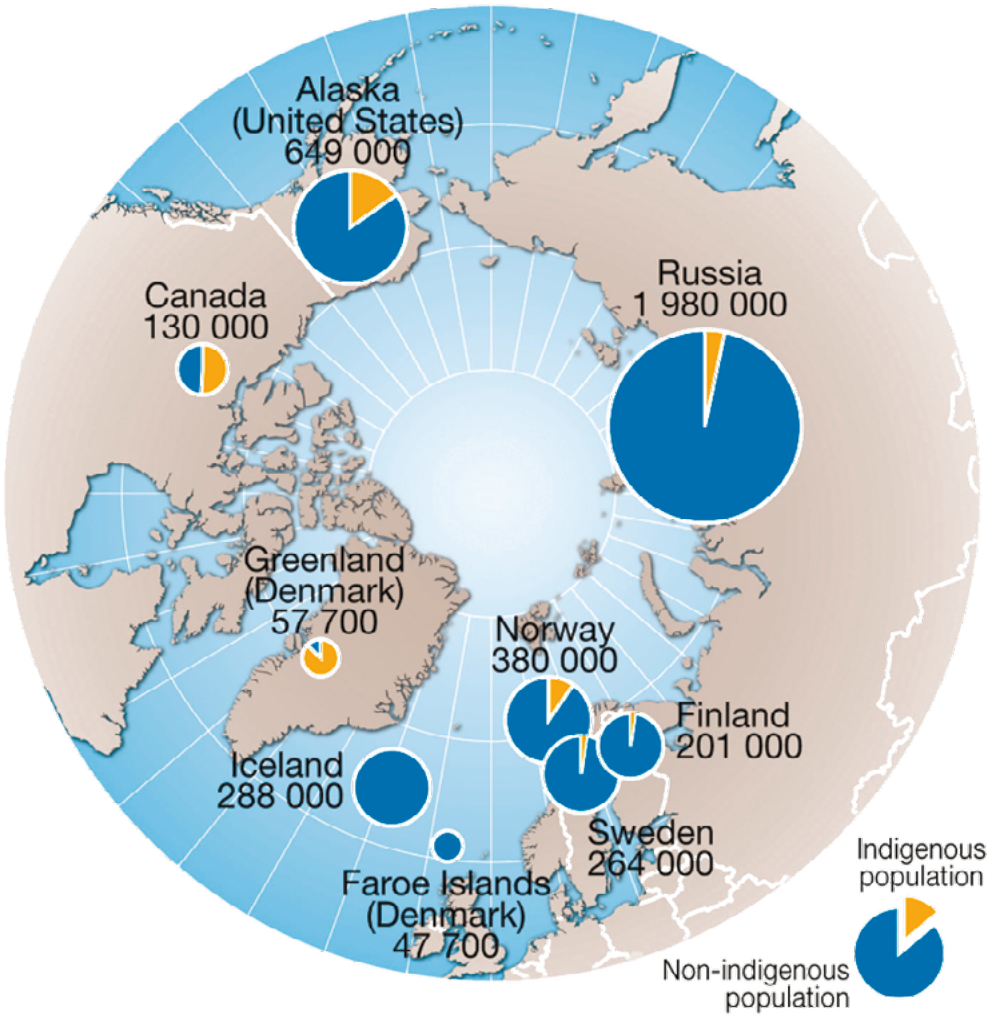
Indigenous people account for 9-10% of the Arctic population. Arctic indigenous people have inhabited the Arctic for thousands of years and have a specific connection to land that they inhabit. Other features, for example distinct language, culture and traditional livelihoods such as reindeer herding, fishing and hunting are characteristics of indigenous peoples in the Arctic.[33]

Almost all of them live today as minorities within the borders of nation-states (figure 4). There are over 40 different ethnic groups living in the Arctic. Only in Greenland is the Inuit population a majority, accounting for 88% of the population. In Canada half of the population in the northern regions is indigenous. In Scandinavia and north Russia, indigenous peoples represent only a small fraction of the population: around 4-5%, whereas Alaska has an indigenous population of around 20%.[34] Arctic indigenous population livelihoods are affected by the effects of climate change and increased industrial activities in the Arctic, while traditional ways of living are being compromised. Melting ice and permafrost limits the possibility of using bioresources as a result of hunting and reindeer herding, fishing, and gathering. Furthermore, the safe movement is impeded when the parameters of ice and weather conditions change significantly.[35]

BOX 2: NEW CULTURAL COMMUNITIES IN THE ARCTIC

In the Russian Arctic, there is the phenomenon of "Arctic Islam", which involves large migration flows of workers from the Caucasus and Central Asia. These migrants usually have essential and relatively low-paid jobs, such as street cleaners, workers on building sites, vendors in street kiosks, taxi and bus drivers, and waiters in cafes and restaurants.[31] There is also an emerging Chinese community in the Russian Arctic in such cities as Murmansk, where Chinese citizens have been buying real estate in the recent years. It is mostly connected to the growing interest of Chinese tourists to the region as well as increasing involvement of the Chinese companies in Arctic projects. Arctic communities no longer consist of local and indigenous population but are multicultural with large inflows of migrants. This leads to a blending of different theological traditions and religious practices and creates a new urban reality in the Arctic. In the Scandinavian Arctic, urban centres are multicultural and provide proximity to both culture and nature.[32]

FIGURE 4: INDIGENOUS AND NON-INDIGENOUS POPULATION IN THE ARCTIC



Source: Arctic Human Development Report (2004)

The urbanization of indigenous peoples started in the 1950s and 1960s, first in the Soviet Union and then in North America and Scandinavia, continuing into the 1990s and 2000s.[36] The most urbanized indigenous peoples are in Greenland, where the Greenlandic Inuit are 85% urbanized, followed by Alaskan natives at 60%, Canadian Inuit at 50%, and Sámi in the three Scandinavian countries at about 36%.[37] In Russia, several trends have appeared: the Nenets remain rural, while Mansy, Komi and Sámi are more urbanized. However, the Nenets are also becoming urbanized, with just 1000 people living in the tundra and engaged in traditional reindeer husbandry. The general trend demonstrates the rapid urbanization of indigenous peoples across all Arctic states.

The negative impacts of urbanization for the indigenous community include:[38]

- transformation of indigenous identity
- disconnection from a traditional subsistence economy
- loss of native languages and traditional ecological knowledge
- social marginalization, unemployment, suicide and alcoholism rates.

Recently, there have been some attempts made to take a more holistic view, in which indigenous

peoples are seen as part of the city and can benefit from both the traditional and the urban worlds. The aim is to shift perceptions of indigenous peoples from their being seen exclusively as victims. This includes an appreciation of both urban and traditional ways of living for indigenous peoples. In Russia, Nenets living in Yamalo-Nenets cities such as Salekhard consider, for instance, that every young person can choose freely between an urban and a rural way of life, which are both valued equally. Examples of successful ways of creating new indigenous identities include, e.g., young indigenous cultural entrepreneurs in the Arctic cities working with the authorities to create a city "brand" that builds on its indigenous heritage.[39]

The changing patterns of migration and demographics, the consequences of climate change and socio-economic development also affect the future of **urban sustainability** in the Arctic. The factors that need to be considered are complex and inter-connected, but they include governance and economic development, demographic changes, environmental changes and land use, and changes in ecosystems and ecosystems services.[40]

The most visible effect of climate change in Arctic urban centres is the damage to infrastructure as a result of melting permafrost. In the Russian Arctic, the effect of melting permafrost on infrastructure is especially pronounced since the population is concentrated largely in urban centers located in regions with permafrost (such as Vorkuta, Salekhard, Nadym, Novyi Urengoi, Norilsk, Magadan, and Yakutsk).[41] The design life of the buildings in these cities averages 30-50 years. However, they are usually used for much longer. Climate-induced near-surface permafrost warming, was not anticipated at the time of construction. It can reduce the capacity of frozen ground to support structures and contribute to the corrosion of foundation materials. Already a large number of structural collapses have been reported in Russian Arctic communities. Deterioration of buildings negatively affects the socio-economic life of Arctic urban communities. In Russia alone, thawing permafrost affecting buildings, pipelines, and other infrastructure is estimated to result in an economic loss of $2.3 billion.[42] Thawing permafrost was the most likely reason for one of the largest ecological accidents in the Arctic: in May 2020, an oil tank collapsed near the city of Norilsk, releasing 21,000 tons[43] of oil which leaked into nearby Ambarnaya River, polluting an area of 180,000 sq m.[44]

Furthermore, climate change affects changes in freshwater ice and the hydrological regime. Cities and settlements located in the coastal zone (80% of settlements in the Russian Arctic) become extremely susceptible to floods. New research has identified a phenomenon of "urban heat islands", i.e. centers of warmth surrounded by rings of greening fuelled by human activity. These heat islands trigger significantly faster warming in cities than in rural areas and cause permafrost melting. As much as 80% of runways, roads, and other infrastructure in some parts of the Arctic has already been damaged.[45]

ECONOMIC VALUE OF THE ARCTIC REGION

Despite being a remote region, the Arctic is integrated into the world economy. According to the Arctic Human Development Report (AHDR) from 2004, the Arctic economy can be divided into three constituent parts:[46]

- Reservoir of natural resources serving the world market via extractive industries,
- Public sector that is supported by transfer payments from central to regional governments,
- Subsistence economy, i.e. customary use of living resources in activities such as family-based fishing, hunting and animal breeding, which is now inextricably linked with the market economy.

The Arctic Gross Regional Product (GRP)[47] of all Arctic states in 2010 was $ 442.8 billion, which equalled the total GDP of Malaysia. The Arctic's

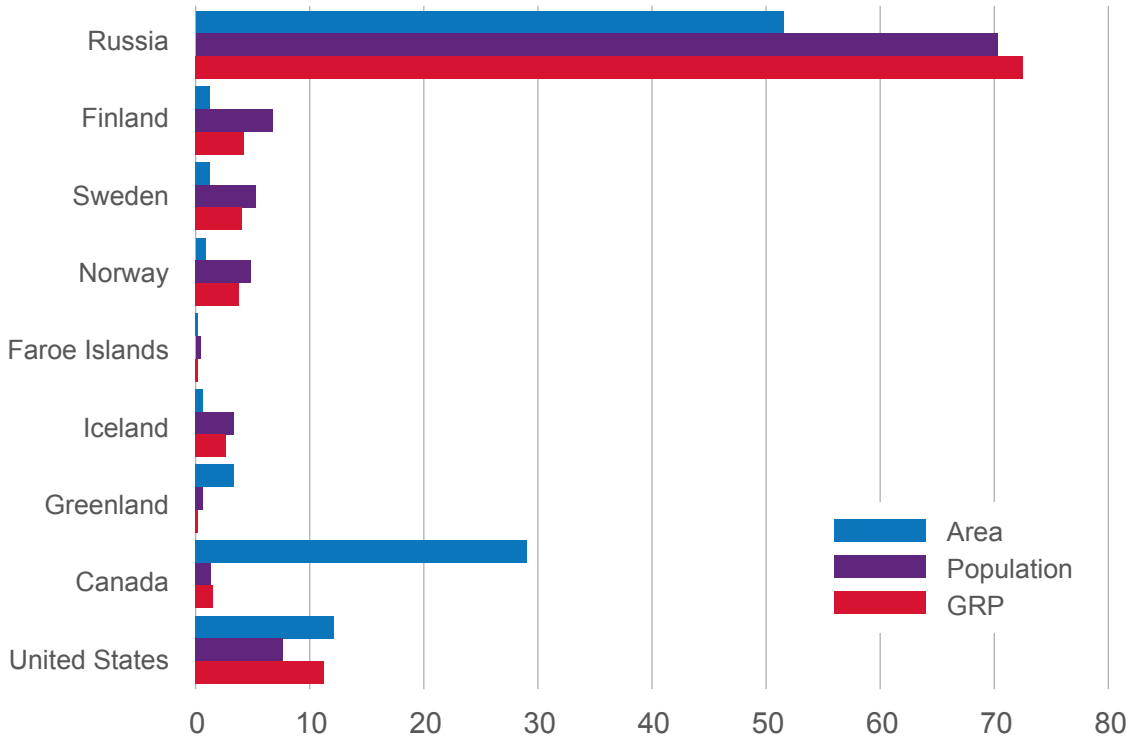
contribution to world output was four times its share of population; the Arctic produced 0.6% of world GDP and had 0.15% of world population (Figure 5). On a per capita basis, Arctic GRP in 2010 was $ 45,360 per person. This was comparable to the United States and greater than most European countries.[48] In real terms, Arctic GRP increased by 42.2% between 2000 and 2010, meaning annual average growth rate of 3.5%. The Arctic Economy grew twice as fast as those of the eight Arctic nations.

At circumpolar level the Arctic regions with 0.1% of the world population generated 0.5% of global Gross Domestic Product (GDP) in 2012. The Arctic covers as much as 8% of the global surface area, however, Arctic states hold different shares of the Arctic in terms of land area, population and GRP.
averages.

Russia's Arctic area covers slightly more than half of the total Arctic land area. The Russian GRP equalled over 70% of the total Arctic economy, with 70% of the Arctic population living in the Russian part of the Arctic. United States is the second-largest country by GRP contributing over 11%. Canada has the second largest share by land area (29 % of the Arctic surface area) but has disproportionally low population density and economic activity levels.

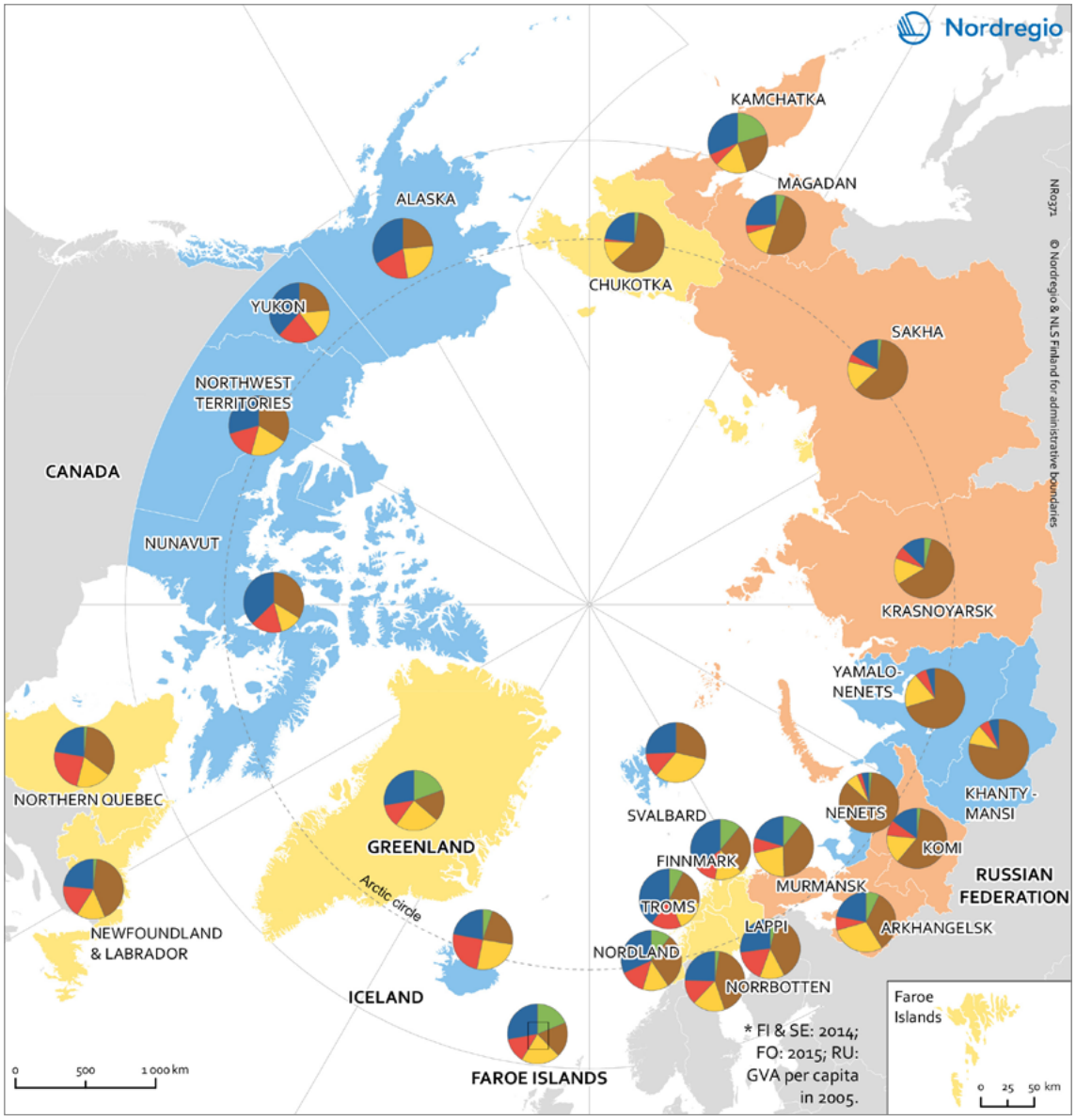
In terms of GVA[49] per capita in PPP, the variation is high in the Arctic regions, ranging from under €15,000 per person to over €45,000[50] (figure 6). Northwest territories, Nunavut, Iceland, Svalbard and Yamalo-Nenets Autonomous Okrug are the regions with the highest GVA per capita over €45,000. It is difficult to assess what share of GDP is available in the region for consumption and investment. While GVA per capita indicates economic efficiency, for evaluating human well-being the levels of disposable income per capita are more useful. Much of the income produced in the North leaves the region through rents, taxes, and wages paid to owners of resources in other regions.

FIGURE 5: SHARES OF THE ARCTIC STATES, BY LAND AREA, POPULATION AND GRP, 2012



Source: The Economy of the North (2015), p. 29.

FIGURE 6: GVA IN CURRENT PPP IN 2016



Gross Value Added per capita in Purchasing Power Parity in EUR & by branch of economic activity

- < 15,000
- 15,000 - 45,000 — Arctic average: 30,000
- > 45,000
- Agriculture, forestry and fishing (A)
- Industry, including construction (B-F)
- Distributive trade, transport, accommodation, food service and communication (G-J)
- Financial, real estate, scientific and technical activities, administrative and support service (K-N)
- Pablic services, arts and other services (O-U)

The Gross Value Added (GVA) is the measure of the value of goods and services produced in an area, industry, or sector of an economy. The GVA at basic prices is the economic output valued at basic prices minus intermediate consumption valued at purchaser's prices. The GVA is linked to the GDP, as both are measures of economic output. The GVA is sector specific, and the GDP is the sum of the GVA from all sectors of economy (including taxes and excluding subsidies).[51]

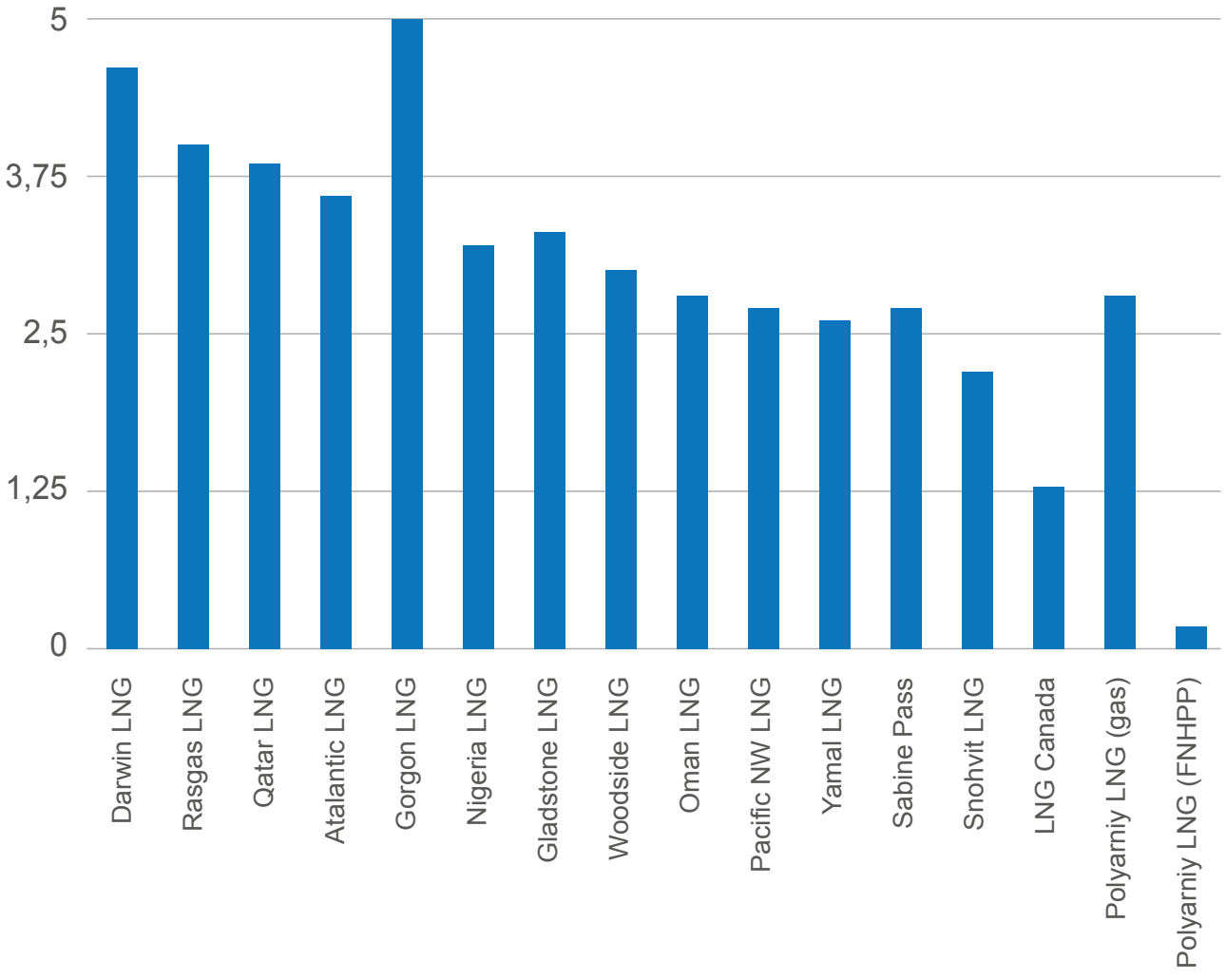
Source: Nordregio. Cartographer/GIS Analyst: Shinan Wang

The structure of the GVA demonstrates that the Arctic economy is dominated by **industrial activities** such as fishing, mining and quarrying, manufacturing, electricity, gas, steam and air conditioning supply, water supply, sewage, waste management and remedial activities and construction. The second-largest sector is divided between public sector activities (including public administration and defence, education, human health and social work, etc.) and services, including wholesale and retail trade, transport and storage, accommodation, food provision and communication. Financial, real estate, scientific and technical activities, administrative and supportive services as well as agriculture, forestry and fishing contribute to a lesser extent to the GVA of the Arctic regions.

Economic development in the Arctic is often linked to the future of **Arctic shipping**, e.g. via the Northern Sea Route. Development of the NSR will require substantial investment in icebreakers, search and rescue, communications and safety. The estimated budget for "Comprehensive Long-Haul Infrastructure Modernization and Expansion Plan" would be over $ 9.25 billion.[52] Uncertainty concerning the development of Arctic shipping is due to increased public focus on environmental concerns. The Arctic Shipping Corporate Pledge, initiated by the Ocean Conservancy in 2019, invites businesses and industry to commit themselves to not shipping through the Arctic Ocean. So far, the pledge has been supported by fashion companies (Nike, Bestseller, Columbia, Gap Inc., H&M Group, etc.); and big ocean carriers (CMA CGM, Evergreen, Hapag-Lloyd and Mediterranean Shipping Company).[53]

The economic development of the Arctic is impacted by several factors. First, there is no consensus on whether **hydrocarbon reserves** there should be further explored and exploited, or left untouched. Adherence to the Paris Agreement means a significant reduction of CO2 emissions via the reduced use of hydrocarbons and transitioning to renewable energy sources. Researchers argue that the development of oil and gas resources in the Arctic is incompatible with the efforts to limit average global warming to 2°C.

BOX 3: CARBON FOOTPRINT OF LNG PRODUCTION



The carbon footprint of LNG projects in the Arctic is significantly lower than for projects in the US and Australia. Energy transformation and stricter environmental regulations are affecting usage of all fossil fuels. Recently allegations of insufficient environmental safety have been voiced against natural gas. Despite technological advances along the entire production chain, which increase energy efficiency and reduce the carbon footprint, there are significant opportunities to improve the environmental efficiency of LNG production by using external cold, electric drives and low-carbon sources to generate electricity.

In Norway a project was carried out with an installed capacity of 4.3 million tons / year, using electric drives for LNG production. It was also a common technological solution for the Calcasieu LNG project (the US), which includes 18 LNG production lines and the Plaquemines LNG project (the US), which includes 20 lines.[54] Canada is promoting the use of hydroelectric power for LNG production as one of the competitive advantages for green LNG production. For the Shtokman LNG project in Russia experts planned to use nuclear energy for power supply. The project was not commissioned.[55] The ongoing and announced Arctic LNG projects up to 2030 will have a total installed capacity of about 80 million tons per year. On the one hand, climate conditions complicate the implementation of LNG projects, but on the other hand, they also allow to significantly reduce energy costs for LNG production through the use of external cold.

Source: SKOLKOVO Energy Center

On top of that, current oil prices do not create a sufficient incentive to invest in Arctic oil and gas extraction. Pressures from environmental NGOs and citizens are high. They favour putting a halt to oil and gas extraction in the Arctic. For instance, WWF is demanding that new offshore drilling is kept out of America's Arctic.[56] In Norway, a lawsuit initiated by Greenpeace, Friends of the Earth Norway, the Grandparents Climate Campaign and Young Friends of the Earth against the Norwegian government for issuing new licenses for the Arctic drilling received support from more than half a million Norwegians.[57]

Financing oil and gas projects in the Arctic can be challenging. For instance, the European Investment Bank has declared that it will stop financing fossil fuel energy projects from the end of 2021.[58] The large asset management company, Blackrock, announced in January 2020 that it would exit investments with high environmental risks. Furthermore, some of the biggest banks, such as Morgan Stanley, Goldman Sachs, JP Morgan Chase, Wells Fargo, and Citigroup, have announced that they will not support new financing for Arctic energy projects.[59]

Second, the prospects of the **Arctic Ocean** becoming a significant international trade artery remain dependent on technological, economic, social, and political factors. Public opinion regarding extractive industries and shipping in the Arctic has been fluctuating in recent years and it remains unclear whether the public debate around these industries will result in increasing or decreasing support.

Finally, the long-discussed **diversification** of the Arctic economy has not yet materialized and the future pace and scale of the new economy in the Arctic remain open questions.

TECHNOLOGIES AND INNOVATION

Several elements of technological and innovation development can be identified that particularly relate to the Arctic: transport technologies and infrastructure, connectivity, space technologies, renewable energy, climate-resistant technologies, level of innovation and R&D in the Arctic, integration of innovations and indigenous knowledge.

The development of **transportation** is essential in the Arctic for extractive industries, tourism and the service industry. For instance, according to 2019 estimates, Northern Sea Route (NSR) development alone requires $11.7 billion in investment.[60] This is expected to come from the Russian federal budget, from companies and from banks, but the specific investors are not yet known. The International Maritime Organization (IMO) is working on adopting a ban on Heavy Fuel Oil (HFO) in the Arctic by 2021.[61] Hence, vessels operating in Arctic waters will have to be designed with safety in mind, as well as security and environmental risk.

The Arctic requires better solutions for **connectivity**. Firstly, by closing the digital connectivity gap, Arctic peoples would have affordable connectivity of sufficient quality to participate in today's digital economy, and to have access to digital education and telemedicine.[62] Uncertainty surrounds many connectivity questions, such as the availability of public-private financing models, multiple solutions for connectivity (e.g. fibre, mobile networks etc.), a lack of regulatory clarity, and the scarcity of data on connectivity in the Arctic. Connectivity solutions are needed for the data centres industry which sees the Nordic Arctic regions as attractive because of an efficient renewable electricity system, political stability, access to affordable land, a cool climate and innovative energy solutions.[63] However, the Nordic Arctic regions lack sufficient telecommunications infrastructure capacity and diversity, which is a requirement of data center players. The connectivity issue needs to be solved before the data center value proposition can be fulfilled in the Arctic.[64]

Space technologies can be one part of the technological solution for improving communication in the Arctic. As it stands, high bandwidth communication links are non-existent north of around 80˚ latitude. At the same time, the research community, tourism, fisheries, resource extraction and search-and-rescue (SAR) teams require reliable communication in the high latitudes.[65] The challenge results from incomplete land-based infrastructure and a lack of suitable satellite systems. While the lack of coverage in the Arctic area is widely recognized, there are only a few proposed systems which might mitigate this situation, and none are close to realization. For instance, the launch of the first satellite as part of a Russian unique satellite network dedicated to monitoring the Arctic has been postponed to 2021.[66] Grasping future opportunities in the Arctic space domain, in 2016 China established its first overseas land satellite receiving station in the Swedish town of Kiruna.[67] In 2019, it launched the BNU-1 micro satellite (Ice Pathfinder) to track ice drifts and iceberg thaw rates in the Arctic and Antarctic.[68] Norway plans to launch two satellites offering mobile broadband coverage to civilian and military users in the Arctic in late 2022.[69]

The transition to **renewable energy** sources worldwide is affecting the Arctic by highlighting challenges relevant to the region. The Arctic has two models of power distribution: centralized and distributed. Sweden, Norway, Finland, and some parts of the Russian Arctic are grid-connected to the larger European Union energy network or the Russian National Energy Grid and do not rely on microgrids. The second, distributed, model is present in Alaska, Greenland, the Canadian Arctic, and large portions of the Russian Arctic settlements, but they are not connected to a traditional power grid. Over 1,500 communities with a total population exceeding 1.5 million across the region rely on locally generated power.[70] A large proportion of the population in remote Arctic communities lives in "off-grid settlements" that rely on diesel for their energy needs. While renewable energy in the form of wind, solar, tidal and hydropower energy is abundant in the Arctic, communities there that are "off-grid" face big challenges installing renewable energy infrastructure. The Arctic has been portrayed as the "last frontier for hydrocarbon exploitation".[71]

But despite the abundance of hydrocarbons, minerals and bioresources, the Arctic is not a place where exploration and extraction can be conducted using standard methods. Harsh climatic conditions and climate change add to the complexity of technologies that are required in the Arctic.

Climate resistant technologies are vital for the Arctic as it faces the consequences of the climate change in an accelerated manner; there is a need for technologies to build infrastructure resistant to melting permafrost, floods and coastal erosion. Research has identified two measures: non-structural (relocation, land use regulation and soft-armouring approaches such as beach nourishment) and structural (the use of sea walls, dikes, groins, flood-proofing, and storm surge-resistant construction). However, due to the remoteness of Arctic communities, the costs associated with structural changes often make them non-viable.[72]

Arctic communities have low levels of **R&D activity**, which is one of the major drivers of economic growth in the knowledge-based economy. In northern parts of Norway, Sweden, Finland (apart from North Ostrobothnia) and Russia, the number of R&D staff in the business sector per 1000 people employed, and the number of patent applications to national and European offices, are both considerably lower than their countries' averages.[73] Without investment in R&D and innovative capacity, Arctic regions would fail either to commercialize new knowledge or to become attractive to highly-skilled people.

The integration of innovation and indigenous knowledge will play an important part in the future of Arctic development. The tacit knowledge of indigenous peoples related to traditional practices, institutions, and rituals of the local communities.[74] This has long helped indigenous peoples survive in extreme conditions and adapt to a changing environment. Some models of the effective integration of traditional and indigenous knowledge into governance structures have been demonstrated by hybrid or cooperative forms of administration (e.g. collective ownership of natural resources for the local community). These models include ecosystem management and co-administration. It is, however, uncertain whether these models can be generally accepted and implemented in the Arctic.

Overall, the technologies required for the future development of the Arctic are advanced and require substantial funding and political will for their realization. The lagging position of most Arctic regions and the slow integration of indigenous knowledge will tend to retard the development of a sustainable future for the Arctic.

BOX 4: FIELDS OF TECHNOLOGIES APPLIED FOR ARCTIC REGION

The Arctic region plays a key role for the global climate, reflecting solar radiation back out into space and acting as a carbon sink.[75] *If climate-altering technologies were, as is suggested by theoretical research and modelling, capable of slowing or reversing this vicious circle, It will make the region an area of special interest for technological advancement. The availability and application of new cutting-edge technologies are critical for reducing the pace of climate change. The future of the Arctic region depends on balanced economic, social and environmental development. Moreover, such technological development is essential for connectivity, resource development, shipping, search and rescue, environmental monitoring and disaster response.*[76]

N	FIELD OF INNOVATION	APPLIED AREA	TYPE OF TECHNOLOGY	DESCRIPTION
1	Geotechnical Engineering	Engineering aspects of permafrost and frozen ground Geohazards related to snow avalanches Investigation of landslides and rockslides Electromagnetic sounding technologies	Arctic Engineering	Living and building on frozen ground that may be subject to land subsidence and avalanches. Such technologies help to solve the challenges of mapping the permafrost and thermokarst, searching for aquifers and hydrocarbon-saturated reservoirs (including the shelf zone) and assessing their capacitive characteristics, as well as a number of engineering problems.[77]
2	Ice mechanics	In-situ tests on ice strength Monitoring of ice and icebergs drift characteristics using ice trackers Investigation of morphological characteristics of icebergs and ice ridges Monitoring of thermal changes in sea ice and ice ridges Unmanned aircraft systems for monitoring Investigation of thermo-mechanical processes in saline and fresh ice	Arctic Engineering	Field, laboratory and theoretical investigations of thermo-mechanical properties of ice and ice actions on offshore and coastal structures.
3	Applied Oceanography	ADV turbulent measurements Tide measurements Modelling of wave propagation in ice covered waters, wave actions on floating ice Modelling of tidal currents in navigational straits Modelling of hydro-thermodynamic processes inside ridge keels and around icebergs keels	Arctic Engineering	Field, laboratory and theoretical investigations of hydro-thermodynamic processes and turbulence in ice-adjacent sea-water layers and near fronts of outflow glaciers, propagation of surface and internal waves in ice covered waters.

4	Marine Technologies	Increased autonomy underwater vehicles IPAT – Icebreaker Performance Assessment Tool Arctic ice sensor buoy Marine technical equipment for oilfield development (Cable lines for oil&gas facilities, fiber-optic monitoring system, etc.) Seismic-acoustic systems Nuclear-powered icebreakers	Arctic Engineering	Application of (under)water vehicles in Arctic operations.
5	Mining and rock mechanics	Effects of loading rates, temperatures, and other loading conditions on rock fracture Dynamic rock fracture Efficient rock blasting - effects of blasting on resources recovery, mining profit, mining safety and vibration control Improvement on ore recovery Mining safety Reduction of mining vibrations New blasting techniques for improving rock fragmentation and ore recovery in mining engineering	Arctic Engineering	Research on mining, petroleum extraction, railway and highway construction, tunnelling, underground spaces, military industry
6	Surface transport and construction	Cryogen tanks for liquid gas Caterpillar trucks Off-highway trucks Snowmobiles Hus-Skies Amphibious hovercrafts Snow and swamp-going vehicles Bulldozers Pipeline boom cranes Harbor cranes Municipal and roadwork vehicles Supercondenser systems of ensure engine ignition Prefabricated, multi-storey cylindrical buildings Extruded polystyrene	Arctic Engineering	Off-road transport for industrial and scientific needs. Performing engineering surveys in the region, various sites inspections; development of equipment, software and hardware systems. Possible applied areas: - drainage of surface waters; - sound insulation; - reducing deformations and increasing the overhaul working lifespan; - the possibility of implementing an insulation system in a new construction unit or during reconstruction.[78]

7	Environmental Chemistry	Investigation of contaminant fate and distribution in the Arctic environment Identification of unknown chemical traces, transformation products and metabolites in the Arctic Elucidation of transport, up-take, accumulation, and transfer processes of organic pollutants in the Arctic ecosystem	Arctic Environmental Technology and Chemistry	Snow sampling for ultra-trace analysis of persistent organic pollutants.
8	Ecotoxicology	Persistent organic pollutants from long-range maritime shipping transport Pollution from oil&gas industry Pollution from rock mining industry	Arctic Environmental Technology and Chemistry	Effects of organic pollutants on Arctic marine organisms and top predators, from the cellular pathways causing toxicity, to the long-term ecological impacts on ecosystem structure and functioning.
9	Autonomous life systems	Autonomous power supply complexes Water-purification system Accommodation blocks for Arctic bases Innovative textile Agriculture Data-centres and IT solutions	Human supp ort	Technologies that let people survive and be at home with Arctic.

Source:** Arctic projects by Harvard;[79] Startups from this region;[80] IT in Arctica: Russian outlook;[81] Marine technologies for Arctic;[82] PMEL: Marine technologies for Arctic;[83] Rosatom: Russian marine technologies for Arctic;[84] Minpromtorg's catalogue of Russian goods for Arctic;[85] Unique Russian robotic vehicle for Arctic;[86] Russian systems of ensure engine ignition;[87] Russian technologies for environmental monitoring of Arctic sea;[88] Penoplex; [89] AWtech [90]

*This table includes fields for technologies rather than a variety of examples of specific Arctic innovations.

** The list of sources includes some specific cases applied for the Arctic context.

GEOPOLITICAL LANDSCAPE

The Arctic has become and will remain a geopolitical playground for a number of national and international actors. The increasing complexity of the geopolitical game defines the security and international relations context of the Arctic.

Shifting international policy contexts and globalization impose new realities on a region which for the decades has been characterized by a high level of geopolitical stability based on common interests in economic growth and decreasing military tensions after the Cold War (box 5). This stability was achieved due to the partial institutionalization of the Arctic, mainly within the Arctic Council (established in 1996) and other international organizations, broadening the pool of the actors, and extending the Arctic agenda beyond resource extraction and exceptional transboundary cooperation to climate change, environment protection, science and technology, culture, etc.

BOX 5: MAJOR STAGES OF ARCTIC GEOPOLITICS

COLD WAR'S GEOPOLITICS	TRANSITION PERIOD'S (80S-90S) GEOPOLITICS	POST-COLD WAR'S GEOPOLITICS
Militarization	Environmental degradation	Climate change and hype of exploitation
Nuclear system deployment	Transboundary cooperation	Hype of mass-scale exploitation and increase of economic activities (geoeconomics)
State hegemony and power game	Long-range pollution	State sovereignty and energy security
Classical geopolitics	Nuclear accidents	Transboundary cooperation (exceptional)
	Growing concerns over environment	Scientific and traditional knowledge
	International cooperation on environment protection and research	Critical geopolitics and globalism
	Self-consciousness and circumpolar cooperation by indigenous peoples	
	More critical geopolitical approach	

Source: Lassi Heininen (2018) Arctic Geopolitics from classical to critical approach - importance of immaterial factors. Geography, Environment, Sustainability, Vol.11, No1, p.171-186
DOI-10.24057/2071-9388-2018-11-1-171-186

Even though the Arctic is still one of the most stable regions on earth, its geopolitical environment has been significantly affected by the **revival of great power competition**.[91] However, the current geopolitical reality is very different from that during the Cold War. The pace of globalization, the trends for sustainable development, energy security and increasing

the role of international organizations, NGOs and other non-conventional actors in international relations has changed the geopolitical approach towards a more critical one. Recent developments show that in a globalized and more interdependent world the so-called "Arctic issue" is no longer a matter of concern only for the Arctic states. Rather: "What happens in the Arctic, doesn't stay there".

These trends have brought forward discussion of the limits of the Arctic Council in addressing the pace of change in the region. Some of the newer ideas include, e.g. creation of an Arctic League as a major regional peace-making institution of the 21st century working with Arctic states, the EU and several Asian states in order to provide an organising framework and the "rules of the game" for peaceful international commerce, transport, travel, science, culture, energy, and people-to-people and environmental relations.[92]

There are several reasons why the Arctic geopolitical context is shifting. First of all, the climate crisis and the melting ice are having a disruptive impact worldwide. This issue raises questions not only of environmental protection, but also of food and human security.[93] At the same time, projections of an ice-free Arctic hold out the prospect of significant revenue as the Arctic region is still viewed as a "Storehouse of resources" for the world. Mineral and biological resources will become more accessible, and the strategic position of the region connecting three continents – America, Asia and Europe – will offer new opportunities for extraction and shipping. While the melting ice increases the

BOX 6: MILITARIZATION IN THE ARCTIC

Enhanced military presence within the Arctic circle sparked a new discourse about the state domination approach and the region's militarization. The militarization of the Russian Arctic territories became a special matter of concern for US military forces. A recent military exercise on Franz Josef Land archipelago, the large-scale military exercises Vostok 2018, the re-opening of military bases and modernization of the icebreaker fleet were seen as a challenge for Arctic security and led to significant changes in US Arctic policy. In a 2019 speech Secretary of State Mike Pompeo pointed out that Russia's actions in the Arctic were illegitimate and could led to a new Cold War.[100] According to the Secretary of State, Canadian sovereignty claims over the Northwest passage in the Arctic was illegitimate as well, as these territories are considered to be international waters in accordance with international law.[101] In order to secure the US national interests in the Arctic and take control of the situation, the Trump Administration adopted a new Memorandum on Safeguarding US National Interests in the Arctic and the Antarctic regions,[102] under which at least three heavy and three medium icebreakers will be built by 2029. The Memorandum suggests "the US look into leasing arrangements while the new fleet is being built".[103] The plan also includes the construction of new support bases: two on the US territory and two more on foreign land.

At the same time, the majority of experts presume that the main geopolitical game will be between the United States, Russia, and China, as China's growing activities in the Arctic have become a matter of increasing concern.[104] China has already become one of the major stakeholders in Arctic LNG projects in Russia and it is eager to actively participate in the Northern Sea Route development. Moreover, China has always supported the concept of a Global Arctic as it guarantees access to the resources and potential routes. The US establishment is quite hostile toward Chinese engagement in the Arctic,[105] while the perception of China within the Arctic states differs. Scandinavian countries such as Sweden, Finland, and Iceland adopt more flexible policy towards the involvement of non-regional actors, "emphasising that Arctic governance should remain in the hands of the geographically Arctic states, although they are cautiously inclusive in their attitudes towards China and firmly supportive of the participation of the EU in Arctic affairs. Greenlandic officials perceive the economic involvement of China as an opportunity for greater self-sufficiency and as a stepping-stone towards Greenland's economic autonomy".[106]

Arctic's transport potential, "the opening up of what used to be ice-covered territories, shipping lanes and resources has sparked debates over questions of sovereignty and international law, activating the process of submitting territorial claims on the extent of the continental shelf, under the United Nations Commission on the Limits of the Continental Shelf (UNCLOS)".[94] This will make the region a new geopolitical arena over the coming decades, reflecting not only the classical approach of hegemony, sovereignty, exploration and force, but also globalism, technology, environmental and sophisticated power (knowledge, image, civil society).

The Arctic is also increasingly viewed as an area of geopolitical competition between Russia, the US, China, the EU and others. In addition, there is the growing interest of non-regional states in Arctic resources in terms of energy security, concerns over the global climate crisis and enlargement of the Arctic Council. Not only Arctic states have official Arctic strategies and policies. The EU, some European countries, China, Japan, South Korea, Singapore and other countries have published official policies based on their priorities in the Arctic region. Each of them is trying to redefine its geopolitical position in relation to the Arctic region, and have its own definition of the Arctic.[95] Several non-regional actors are self-identifying themselves as Arctic stakeholders in order to establish a legal claim over Arctic resource allocation.

The Arctic region is going through a massive change because of global warming, which further drives the debate on the ownership of this territory. The limits of the continental shelves are set at 200 nautical miles (approximately 370 km); therefore, a significant part of the Arctic Ocean remains independent of any state. According to the UNCLOS, states which ratified the treaty are given ten years in which to establish their claims to the outer limits of the continental shelves beyond the baseline of 200 nautical miles by means of submission to the UN Commission on Limits of the Continental Shelf.[107] This applies to the five states fronting the Arctic Ocean: Canada, Denmark, Norway, Russia and the United States. The territory beyond Arctic States' Exclusive Economic Zone is referred to as the high seas of the central Arctic Ocean, that is recognized as global commons, meaning areas and natural resources that are not subject to the national jurisdiction of a particular state but are shared by the international community as a whole. In 2018, Arctic states together with China, Iceland, Japan, South Korea and the EU signed an Agreement to prevent unregulated high seas fisheries in the Central Arctic Ocean. Under the Agreement, the Parties agreed not to engage in commercial fishing activities there for an initial period of 16 years after the Agreement enters into force.[108]

INSTITUTIONAL ECOSYSTEM AND ENABLING ENVIRONMENT

Apart from the international consensus and global governance, international organizations, national governments and markets have a major impact on introducing special regulatory frameworks, financial institutions, and instruments specifically tailored for Arctic development.

As governments, international bodies and other actors pursue different approaches to Arctic governance, a cohesive approach is needed to address the environmental, economic and social difficulties in transforming the region. The Arctic is undergoing substantial change which, on the one hand, damages its unique ecosystem and traditional livelihoods, but on the other hand, could open up new economic opportunities. Arctic stakeholders need to develop a cohesive enabling environment which will help to address the issues and build the necessary mechanisms for sustainable development in the Arctic.

There are several challenges that could impede the development of an enabling environment in the region:

- Protection of the environment and its people. Climate change has disruptive effects on indigenous and Arctic peoples,

destroying their livelihoods and traditional way of life. With increasing economic activity, questions of legal uncertainty arise.

- Lack of infrastructure (except for certain areas of Norway and Western Russia). The Arctic region remains sparsely populated and vastly underserved by transportation, ports, and other critical infrastructure.

- Unresolved territorial claims. The majority of territorial deputies have been settled in accordance with the international law, however melting ice has provoked new claims between eight Arctic states.[109]

- Outmigration and an ageing population (statistics is different for countries and regions).

At the international level, the Arctic Economic Council (AEC)[110] is the body responsible for the creation of a special regulatory framework for responsible business and the facilitation of cross-border cooperation. It is an independent organization that encourages Arctic business-to-business activities and sustainable economic development through sharing best practice, technological solutions, standards, and other information.

The analytical report ***Business Finance in the Arctic***[111] outlines at least 10 international programmes, sponsored by the EU, helping SMEs in the Arctic: the €80 billion Horizon 2020, the EU's largest R&D programme, the EU's €2.3 billion COSME programme, etc. Moreover, at the national level, each Arctic state adopts its own regulations and mechanisms of support embedded in official strategies or created independently. For example, Strategic Investments in Northern Economic Development (SINED) is an economic development programme that strengthens key economic sectors in Northern Canada, or the Alaska Industrial Development and Export Authority (AIDEA) and TESI (Teollisuussijoitus), a state-owned venture capital company that aims to improve the venture capital market in Finland.[112]

However, access to public programmes, credit and loans is challenging in the Arctic due to the absence of **financial institutions** and comparatively high interest rates. The most crucial problem across the Arctic is to attract investment or gain access to private venture capital. According to experts, a lack of venture capital impedes growth in all Arctic regions.

Another problem is that the Arctic economy remains fragmented. While Scandinavian countries show quite successful examples of building an enabling environment which promotes sustainable growth based on innovative solutions and a northern identity respectful of the environment, the overall Arctic economy remains dependent on extractive industries and does not have coordinated and sophisticated ecosystem-based management systems. Business cooperation in the form of clusters in the Arctic is underdeveloped; the only leader is Norway. The usual model of Public Private Partnership does not fit the region's context.[113] The Nordic countries, though, have more diverse and dynamic economies.

Bioeconomic ventures are already an important part in the economy of the Nordic Arctic, making up 10% of the overall Nordic economy and moving towards 20% in some countries.[114] They are developing creative industries and indigenous cultural businesses, contributing to a globally important platform. The Nordic countries successfully engage the business community in developing a solid enabling environment. For example, four countries spend a high percentage of GDP on R&D, and it is business which is responsible for this spending: around 54% in Norway, 65% in Iceland, 67% in Finland to 70% in Sweden.[115]

A well-elaborated and coordinated enabling environment is crucial for sustainable development of the Arctic region.

Stakeholders and diverse interests

The broadening Arctic agenda and increasing pull of Arctic stakeholders are closely linked with the geopolitical shifts in the region (box 7). Arctic globalization and the uncertainties of international governance and regional development emphasise global concerns about the climate crisis and could provide a basis for international cooperation and geopolitical stability. At the same time, these points are closely connected with a potential race for resources.

BOX 7: STAKEHOLDERS IN THE ARCTIC REGION

STAKEHOLDER GROUP	INTEREST	GROUNDS: WHY DOES THE ARCTIC MATTER?
Indigenous peoples	• Traditional way of life, including dwelling, and hunting, fishing, herding opportunities • Maintain culture, language • Access to healthcare, education, etc • Civic participation and social inclusion • Human-centred, sustainable development of the Arctic that is respectful of its unique environment • Indigenous people participate in policy-making and decision-making on Arctic issues • Production of new knowledge is based on the needs of the people living in the Arctic • Co-design and co-production of western and indigenous knowledge	Natural habitat, which historically grounded the patterns of living.
Business	• Make profit, short and long-term growth, etc • Market value and improve reputation • Decrease costs • Normalize (operational, regulatory, etc) risks/ Mitigate risks portfolio • Engage with stakeholders • Secure the return on investment • Generating knowledge • Differentiating / Increasing Willingness-to- pay	Abundance of natural resources, vast areas unveil transit potential and new economic prospective. The Arctic territories form new testbed for technological solutions applicable for the High North environment.
NGO / Associations	• Protect unique Arctic ecosystem • Ensure ecosystem-based management of the resources • Creating a special network to promote Arctic agenda • Access to the development of laws and regulation / Participation in policymaking process	Lack of clear regulatory framework initiate activities to protect and preserve the most vulnerable areas (climate, the waters, wild life, etc). NGOs and associations in the Arctic appear to be a relative integrator for regulatory policies and practices in the region.

International organizations	• Ensure international cooperation • Implement international regulation and governance • Foster peace • Provide platform and language of cooperation • Provide the platform for science and research/coordinate these activities	The source of the formal standards and regulation for national and some subnational actors such as the EU and NATO.
Cities	• Attract (prevent from leaving) human capital - Infrastructure development/modernization - Secure supply of different stuff - Access to healthcare and education - Improve living standards - Develop citizen cultural experience • Attract business (ease of doing business) • Diversify employment market • Become centers of education • Provide smart city solutions	Natural habitat. Due to the technological revolution and territory development the Arctic cities have become so-called "Prisoners of geography"
Governments (Arctic states and non-regional)	• Ensure strategic security • Promote national strategic interests • Secure territory and deposits • Control the pace of militarization • Develop economy • Ensure representation on the international arena/assure the image • Maintain an adequate level of international cooperation and engagement • Develop regulations and standards • Attract business (ease of doing business) • Attract/develop technologies • Attract human capital	*Arctic states:* Natural habitat, that makes the Arctic states "Prisoners of geography" advocating their interests. Abundance of natural resources, vast areas unveil transit potential and new economic prospective. *Non-Arctic states:* Abundance of natural resources, vast areas unveil transit potential and new economic prospective. The Arctic territories form new testbed for technological solutions applicable for the High North environment.
Media	• Promote the Arctic agenda • Describe the current developments in the region • Reflecting the interests of the key actors	Coverage of acute and sensitives issues
Academia	• Obtain the access for Independent research • Discover new data • Attract investment/ensure funding	Arctic data serving for climate change models, study of ecosystems change and humans in change, availability of funding for Arctic studies

Source: SKOLKOVO Institute for Emerging Market Studies

Arctic Council

The leading intergovernmental forum promoting cooperation in the Arctic.

It was formally established in 1996.

Not Shown: * Singapore ** EU

Source: Arctic Council, The Arctic Institute (2020)

8 ARCTIC STATES IMPLEMENT POLICY IN THE REGION:

- Canada
- The Kingdom of Denmark
- Finland
- Iceland
- Norway
- The Russian Federation
- Sweden
- The United States

The Ottawa Declaration defines these states as Members of the Arctic Council.

6 PERMANENT PARTICIPANTS REPRESENT THE INDIGENOUS PEOPLES OF THE ARCTIC:

- Aleut International Association
- Arctic Athabaskan Council
- Gwich'in Council International
- Inuit Circumpolar Council
- Russian Association of Indigenous Peoples of the North
- Saami Council

6 WORKING GROUPS CARRY OUT THE COUNCIL'S ACTIVITIES:

- Arctic contaminants Action Program
- Arctic Monitoring and Assessment
- Programme
- Conservation of Arctic Flora and Fauna
- Emergency Prevention, Preparedness and
- Response
- Protection of the Arctic Marine Environment
- Sustainable Development working Group

38 OBSERVERS:

- Non-arctic states
- Intergovernmental and interparliamentary organizations
- Non-governmental organizations

COUNCIL'S FIELDS OF WORK:

- International cooperation
- Generating data and knowledge
- Monitoring
- Assessment
- Recommendations

The Arctic Council is a forum which has no programming budget. All projects or initiatives are sponsored by one or more Arctic States. Some projects also receive support from other entities.

The Arctic Council does not and cannot implement or enforce its guidelines, assessments or recommendations. That responsibility belongs to individual Arctic States or international bodies.

The Arctic Council's mandate, as articulated in the Ottawa Declaration, explicitly excludes military security.

OTHER SUBSIDARY BODIES

The Council may also establish Task Forces or Expert Groups to carry out specific work.

WHAT ARE SOME ARCTIC COUNCIL ACCOMPLISHMENTS?

The Arctic Council regularly produces comprehensive, cutting-edge environmental, ecological and social assessments through its Working Groups.

The Council has also provided a forum for the negotiation of three important legally binding agreements among the eight Arctic States:

1. Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic (2011)

2. Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic (2013)

3. Agreement on Enhancing International Arctic Scientific Cooperation (2017)

CHAIRMANSHIP

The Chairmanship of the Arctic Council rotates every two years among the Arctic States. The first country to chair the Arctic Council was Canada (1996-1998), followed by the United States, Finland, Iceland, Russia, Norway, the Kingdom of Denmark, and Sweden. The second cycle of Chairmanships began in 2013.

Iceland chairs the Arctic Council from 2019 to 2021, and the Russian Federation chairs from 2021 to 2023.

Source: Arctic Council, The Arctic Institute (2020)

Arctic-2050

In this chapter we analyse the most important factors that will shape the Arctic's future. We will map those factors by their uncertainty and impact, and select the most critical ones that inform alternative scenarios for the Arctic region.

MAPPING THE FUTURE: CRITICAL UNCERTAINTIES.

THE PACE OF CLIMATE CHANGE

Global warming will make a significant impact on the Arctic. Increasing air and water temperatures. The melting of sea-ice and permafrost will all transform natural wildlife habitat, change the living environment of the indigenous peoples, and cause damage to urban and industrial infrastructure. These changes are happening right now, and they are proceeding much faster than expected. The Arctic region is probably one of the most fragile ecosystems. Although the change is evident, it is still hard to predict the extent, and the dynamics, of the possible damage. The pace of global warming affects decision-making processes and the business environment. This creates an incentive for innovation. How strong will this impact be?

Key factors to watch: rising sea levels, melting ice and permafrost, infrastructure degradation, transformation of the natural environment, physical accessibility of resources and routes.

ECONOMIC DEVELOPMENT IN THE REGION

The future of economic development in the Arctic will depend on the availability of sustainable solutions and technologies that encourage responsible business activities that are respectful of the environment while giving opportunities for indigenous and local populations. How will the Arctic economy change? Is it going to grow because of the overall interest in developing Arctic resources and shipping goods via the Northern Sea Route, or it is going to stagnate because of the environmental and social pressure on business and governments not to expand in the Arctic? Will the Arctic economy remain resource-based or it is going to be diversified and balanced?

Key factors to watch: level of knowledge generation, intensifying race for Arctic resources, pace of economic diversification, freight traffic activities.

THE TRAJECTORY OF SOCIAL DEVELOPMENT

The prospect of social development is not certain in the Arctic given the demographic and social challenges that Arctic people are facing. Both incoming and outgoing migration bring new dynamics to the region. Social development involves strategic planning for the Arctic communities that includes long-term demographic policies, increasing the attractiveness of the region by providing education and work opportunities, securing housing and access to health services. However, the lagging position of most Arctic regions and the slow integration of indigenous knowledge make for a high degree of uncertainty about the sustainable future of the Arctic. What will be the level of commitment by the Arctic states in terms of investment available for increasing the well-being of Arctic communities? How will the interests of local communities be protected?

Key factors to watch: population dynamic and outmigration, changing labour migration pattern, indigenous peoples urbanization, Increasing social disparities ("Arctic paradox").

QUALITY OF THE INSTITUTIONAL ENVIRONMENT

For sustainable growth, the Arctic needs a comprehensive and coordinated enabling environment – a set of laws, regulations, policies, international trade agreements, and other soft infrastructure, like public awareness and acceptance, that facilitate the economy and sustainable development in the Arctic region. However, it is unclear how adequate and balanced these institutions will be, looking ahead to a 2050 horizon. Will stakeholders reach a consensus? Will a joint Arctic investment platform be created? What if one of the most influential Arctic states stops economic activity in the Arctic completely due to environmental and social considerations? What if e.g. Russia halts exploitative activities in the Arctic in the next 30 years?

Key factors to watch: environmental policies and regulations, effectiveness of disaster response, demographic and social policies, financial and non-financial incentives, public acceptance of business in Arctic, international consensus and governance.

PACE OF TECHNOLOGY DEVELOPMENT AND INNOVATION

Harsh weather conditions require special technologies for each industry and sector. Social and environmental considerations add more requirements that new technologies should meet. Technologies required for the future development of the Arctic require substantial funding, political will, and entrepreneurial risk for their implementation. Will the Arctic innovations be the spearhead of economic development? Or will the innovations be slow and restrict the progress in the Arctic?

Key factors to watch: pace of digitization and connectivity of Arctic, energy transition in Arctic, commercialization of sustainable shipping technologies, advancement in extraction technologies, cost of doing business in Arctic.

DYNAMICS OF GEOPOLITICS AND INTERNATIONAL CONSENSUS

Shifting geopolitics defines Arctic stability and will stay as one of the critical uncertainties of the region's development. Geopolitical intensification fuelled by the national interests of the Arctic states and non-regional actors could transform current cooperation models. It is unclear whether the quality of consensus will increase or decrease, and how it will change the regional landscape in terms of political cooperation and further economic development. How will international cooperation develop in the Arctic? Will geopolitics facilitate or complicate economic development and trade in the Arctic? Will the tensions and resource race between stakeholders lead to (hybrid) armed conflict?

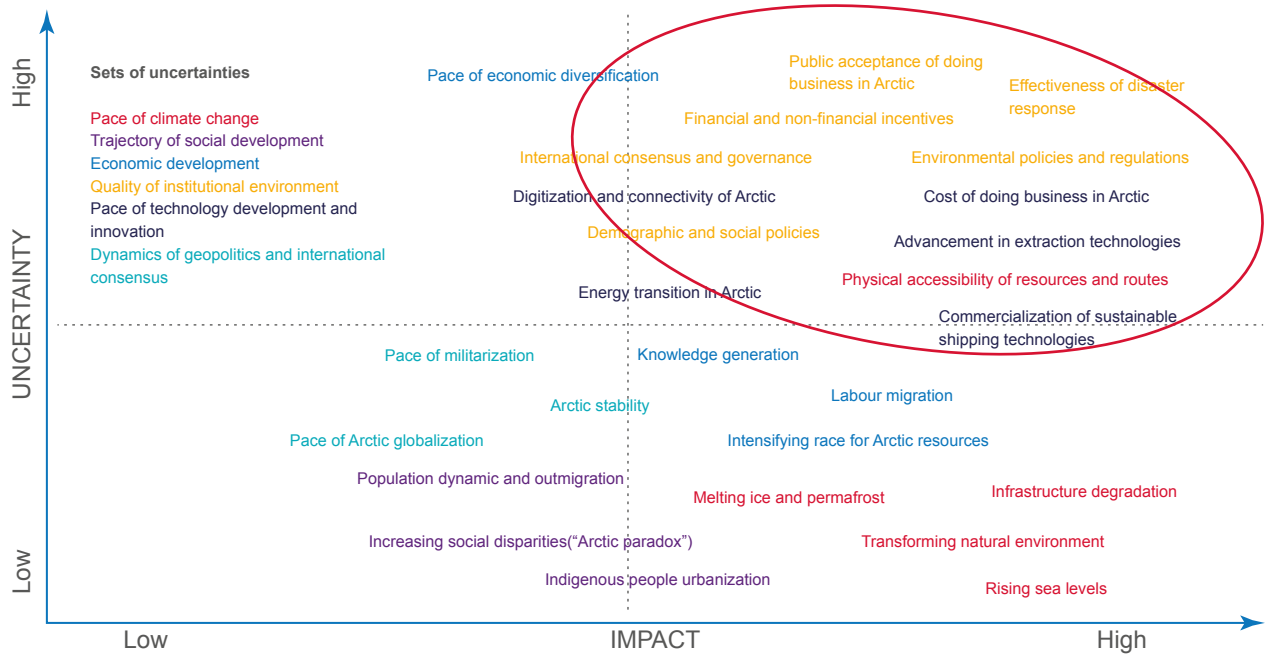
Key factors to watch: Arctic Stability, pace of militarization, pace of Arctic globalization.

Based on the impact vs uncertainty matrix (box 8), two sets of critical uncertainties clearly stand out as having the highest level and impact: a) quality of the institutional environment, and b) pace of technological development and innovation.

The quality of the institutional environment will be critical in defining economic and social development and defining the effectiveness of measures to mitigate impacts and adapt to accelerating climate change. **The pace of technological development and innovation** will be critical to economic intensification in an environmentally sustainable and socially just manner.

The extent of these uncertainties varies significantly, which creates numerous possible futures for the Arctic by 2050. While we can develop different scenarios to engage with wider and deeper assumptions underlying development of the region, "black swan" events are hard to predict (box 10).

BOX 8: MAP OF KEY FACTORS THAT HAVE THE POTENTIAL TO SHAPE THE ARCTIC REGIONAL DEVELOPMENT



Source: SKOLKOVO Institute for Emerging Market Studies

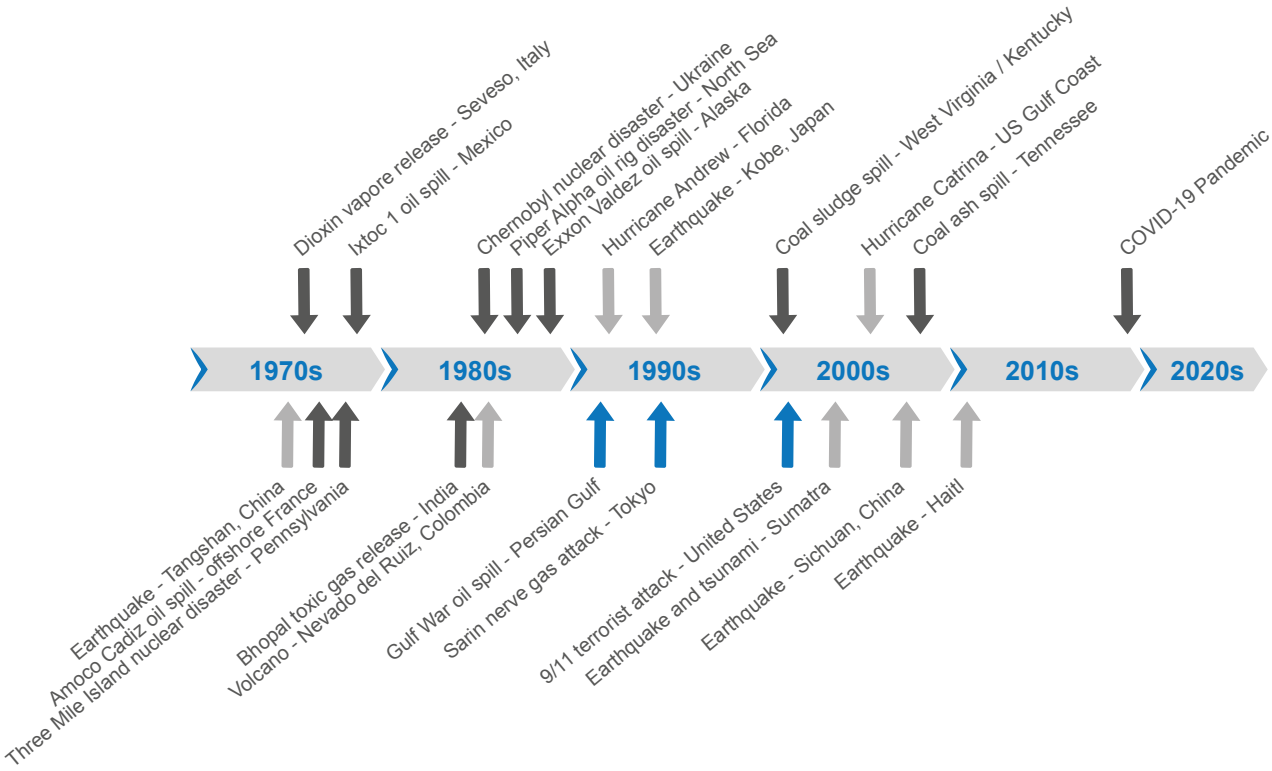
BOX 9: CRITICAL UNCERTAINTIES

UNCERTAINTY	DIMENSIONS
Quality of institutional environment	• Disaster response – effective vs non-effective • Environmental policies and regulations – effective vs non-effective • Demographic and social policies – effective vs non-effective • Financial and non-financial incentives – sufficient vs non-sufficient • International consensus and governance – strong vs weak • Public acceptance of doing business in Arctic – high vs low
Pace of technology development and innovations	• Digitization and connectivity of Arctic – strong vs weak • Energy transition in Arctic – fast vs slow • Advancement in extraction technologies – high vs low • Cost of doing business in Arctic – high vs low • Commercialization of sustainable shipping technologies – high vs low

Source: SKOLKOVO Institute for Emerging Market Studies

The outbreak of COVID-19 reflects a new reality of the world. Although the crisis is just a temporary phenomenon, it has caused fundamental shifts that entirely change our system of beliefs, behaviour, consumption needs, paving the way for new policies, regulations, etc. The virus outbreak and recent Arctic developments such as the catastrophe in Norilsk made us think about hard-to-predict events, which because they are unexpected could have a major effect on the Arctic future development.

Such events have several distinguished features: nothing in the past suggests that they may happen and if they happen their impact is massive. Examples of possible black swans for the Arctic region include natural disasters and another pandemic.



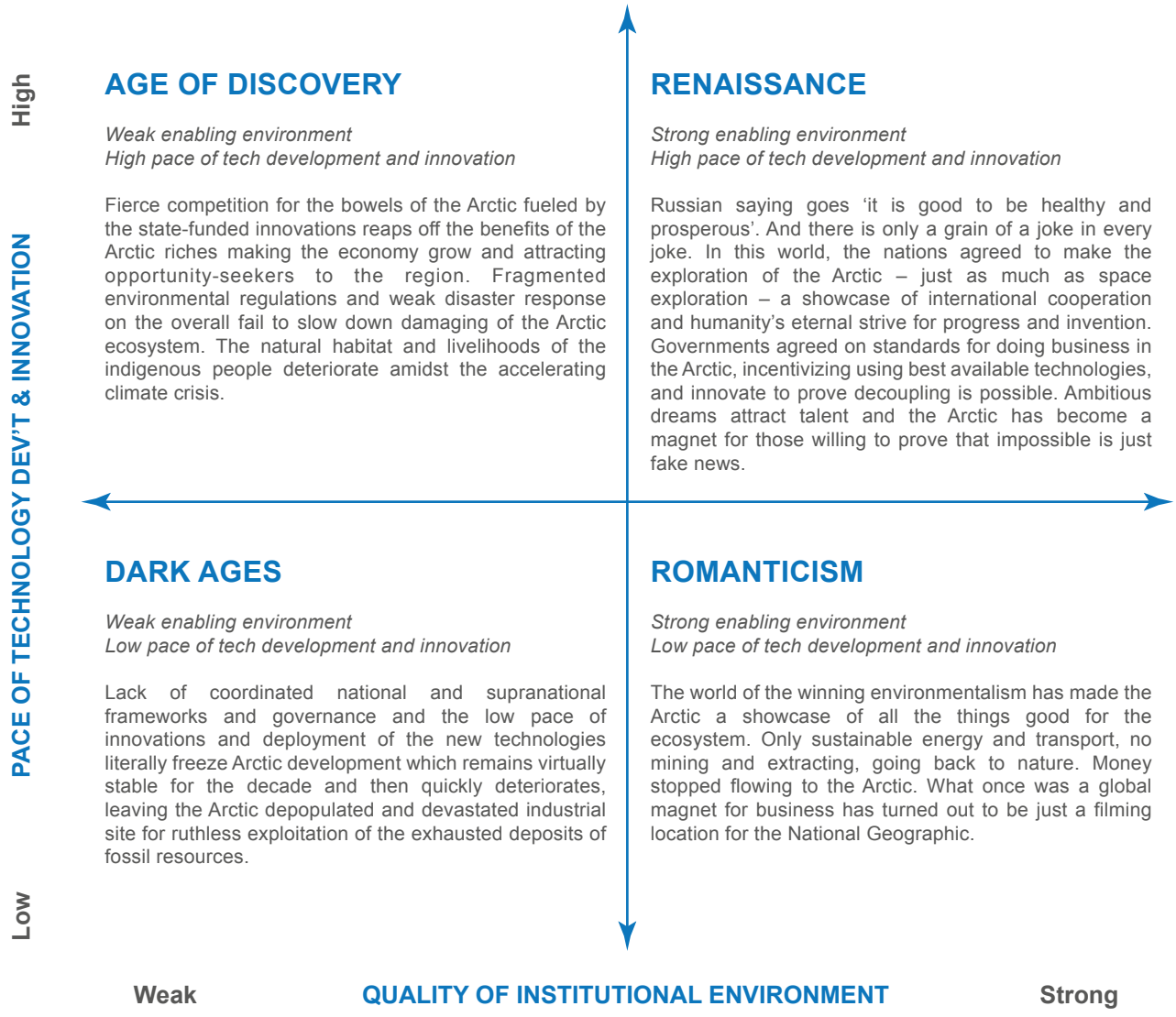
Source: EY (2011), SKOLKOVO Institute for Emerging Market Studies

Scenarios

All the factors described above will have a tremendous impact on how the Arctic region will evolve up to 2050. From multiple futures that can be created in an interplay of critical uncertainties, we selected four scenarios which seem to be the most challenging and thus the most interesting to explore. These plausible futures will help create a safe space for strategic leadership dialogue and drive the joint actions of diverse stakeholders.

The matrix below describes four scenarios in a nutshell followed by detailed stories of how the region might evolve to 2050.

BOX11: SCENARIOS MATRIX



Source: SKOLKOVO Institute for Emerging Market Studies

Scenario 1. Dark ages

Lack of coordinated national and supranational frameworks and governance and the low pace of innovations and deployment of new technologies literally freeze Arctic development, which remains static for a decade and then quickly deteriorates, leaving the Arctic a depopulated and devastated industrial site for ruthless exploitation of the scarce deposits of fossil resources.

Regional players – the Arctic Five – are very protective of what they believe is their exclusive right to Arctic riches. They collectively manage to constrain access to resources and routes for non-regional actors. Perhaps this is the only example of effective collaboration in the Arctic. Overall, governments fail to create an enabling environment that would normalize the risks of doing business in the Arctic. As a result, private business gets no significant incentives to invest in the region.

The Arctic economy remains dominated by the national states and large companies, either state-owned or private national champions. The extractive industries prevail, taking away the opportunity for diversification and new market development, cutting the **global Arctic GDP by half from its current volume to near $220 billion.**[116]

Very limited innovation and the vast deployment of obsolete and hazardous technologies and operational practices cause inevitable damage to the environment. Despite rising protests by the local population and the growing alarmism of social and environmental non-governmental organizations, unsustainable practices continue as they prove to be the only economically rational ones in the context of the short-term planning that dominates the boardrooms.

The natural environment is continuously damaged by economic activity and accelerating climate change. Melting permafrost triggers natural and technogenic disasters that gradually destroy Arctic biodiversity and indigenous peoples' traditional way of life. Indigenous people assimilate and out-migrate, leaving only artefacts behind. **The Arctic population will have declined by 60% by 2050**.[117] Most of it now is shift workers from the southern regions of the world who bring no families with them, but make Islam a growing power in the region.

Scenario 2. Age of Discovery

Fierce competition for the resources of the Arctic fuelled by state-funded innovation reaps Arctic riches making the economy grow and attracting opportunity-seekers to the region. Fragmented environmental regulation and weak disaster response fail to slow the damage to the Arctic ecosystem. The natural habitat and livelihoods of the indigenous people deteriorate amidst an accelerating climate crisis.

The Arctic Five fail to agree on protecting the region, which has become a global battlefield for superpowers. Global competition is always one step away from confrontation. The growing militarization of the region is a new reality. In the lack of efficient governance and supranational institutions, the situation gets more and more fragile. Some start calling the Arctic 'the new Middle East' – any spark could cause a disaster.

The race for Arctic domination triggers the direction of government funds into research and development. The rapid development of technology and the increasing availability of diverse innovative solutions make Arctic resources better accessible and thus open up new business opportunities. This boost to innovation makes economic activity in the

Arctic more and more profitable and attractive for private investors. Enormous government guarantees cover all risks. Although the Arctic economy remains predominately resource-based, now it is as hi-tech and digitally loaded as possible. This is largely responsible for rapid GDP growth in the first 15-17 years and a recession after 2035, when growth slows down by 15-17% and the GDP volume slumps by 30%.

Economic benefits have been prioritized over environmental considerations, so the extractive practices remain damaging for the Arctic ecosystem. Natural disasters happen more often but the ongoing global climate crisis forces regional actors to consider whether it is they who are causing damage or whether the Arctic is just one part of a much wider deterioration.

Arctic society splits: urban communities and professional opportunity-seekers flourish, while indigenous peoples suffer. Social and environmental organizations keep raising concerns on international platforms, but their voice is not heard. Greenwashing and purchasing the silence of the local population in exchange for short-term economic benefits are tacitly accepted by the major actors in the region. **By 2050 the Arctic population declines up to 2.7-6 million people from what it is now.**

The global level of public acceptance of Arctic exploitation is at a record low and multiple consumer and financial brands not only exclude companies involved in any business in the Arctic from their operations but also support growing global consumer/citizen activist movement MAFA: 'Make the Arctic Freeze Again'.

Scenario 3. Romanticism

The world of successful environmentalism has made the Arctic a showcase for all things good for the ecosystem – only sustainable energy and transport, no mining and extracting, going back to nature. Money stops flowing to the Arctic. What once was a global magnet for business has turned out to be just like a film set, as it were, for the National Geographic.

The Paris Agreement followed by the New Green Deal laid firm foundations for prioritization of long-term environmental returns over short-term economic gains. The global consensus on preserving the unique Arctic ecosystem has led to the development of what are probably the strictest environmental regulatory frameworks and enforcement mechanisms on the planet.

The social and environmental non-government organizations work together with academia to provide a better understanding of the Arctic ecosystem, coming up with guidelines for all types of human activities in the region. The pace of climate change is monitored to mitigate the possible risks for the natural environment. The Arctic Council has become one of the most powerful supranational bodies, with legislative and regulatory authority in the region.

Economic activity in the Arctic has been limited to sustainable fishing and herding, local crafts, and sustainable tourism. Indigenous peoples maintain their traditional way of life and receive social payments from the governments. **All extraction activity has been stopped and Arctic GDP has declined by 80%** from what it was in 2020 and accounts only about **$ 88 billion**[118]

Innovations have been mainly driven by the strengthening of sustainability standards and heavily subsidized by governments and international development agencies. The Northern Sea Route is being operated by green fuel-driven vessels only. Energy for local needs is 100% produced by CO2-free technologies.

Global public acceptance is high as people in other countries see the Arctic as the world's biggest national park. While it does a lot of good for the natural habitat and indigenous peoples, the Arctic cities are abandoned, and local

infrastructure deteriorates. No big companies work in the Arctic anymore and therefore all social and infrastructure burdens have been handed over to governments, which struggle to justify the growing budgetary expenses.

Lack of economic opportunity and a declining living standards have led to an accelerated out-migration of professionals and the urban population. No talent is attracted to the region, apart from scientists and environmentalists working in shifts. The natural decline of the indigenous peoples has slowed but not stopped, so **by 2050 the Arctic population is barely 20%[119] of what it was in 2020**.

Scenario 4. Renaissance

In this scenario, the nations agreed to make exploration of the Arctic – just as much as space exploration – a symbol of international cooperation and humanity's eternal striving for progress and invention. Governments agreed on standards for doing business in the Arctic, incentivizing using best available technologies and innovations to prove decoupling is possible. Ambitious dreams attract talent, and the Arctic has become a magnet for those willing to prove that "impossible" is just fake news.

The global consensus on the need for an economically prosperous and environmentally sustainable Arctic has led to the development of an effective enabling environment for business initiatives. Arctic resources have become more accessible not only physically but also institutionally. Governments incentivize businesses to invest in research and development with an overall vision of creating an Arctic technological platform, just as unique as the Arctic ecosystem.

Businesses have created cutting-edge technologies across the number of industries, including advanced extraction and construction, sustainable energy and shipping, digital technologies, etc. resulting not only in the economic growth in the Arctic but also in a significant reduction of the man-made environmental pressure. The Arctic has become a showcase for decoupling: economic growth does not increase environmental footprint anymore. **Arctic GDP has doubled by 2050** and accounts more than **US$ 880 billion[120].**

The Arctic ecosystem responds slowly but surely. Global warming cannot be stopped in a single area, even one as big as the Arctic, but local measures have helped to slow it down, leaving more time for the habitat to adapt to the new reality. The combination of the regulatory framework, behavioural changes, and the use of advanced technologies has enabled the environment to recover.

Public acceptance of economic activity in the Arctic has significantly increased. Talent moves to the Arctic, attracted by opportunities in innovative and creative industries. Arctic cities grow and prosper, integrating the best available technologies in sustainable construction, energy, transport, as well as social space and community areas. The cities and local communities go beyond technologies by enhancement of the social patterns and practices: now all across the Arctic, the indigenous peoples not only maintain their traditional ways of life, languages and cultures, but they are also participating in civic life and the decision-making processes. **The Arctic population has doubled to 9-18 million, from what it was in 2020.**

Triple-bottom line implications

The so-called **triple bottom line profile (Box 12)**[121] – is a holistic approach to the integrated impact assessment of each scenario. The overall meaning of the triple bottom line concept[122] is not only that any given course action should be considered in the context of the whole complexity of its outcomes, but the balance in the system is more important than the performance of each separate dimension. In other words, none of the effects can be prioritized over another as this will not be sustainable in the long term. With this in mind, here is how the scenarios look through the prism of the triple bottom line:

- **DARK AGES.** This scenario resembles a stalemate in chess, when the game ends because neither player has a safe move open to him. When there is no unity among the stakeholders, and no agreement on the way forward, the Arctic is not a safe place in which to invest, create a family, or migrate to. In chess, stalemate is a draw. But the Dark Ages scenario is not a draw for the Arctic as it leads to slow degradation of the region. While some stakeholders can just walk away, the Arctic cannot.

- **AGE OF DISCOVERY.** In this scenario, the economic dimension is prioritized over the other two – the social and the environmental. This leads to a short-term rise in the Arctic economy but soon brings social and environmental catastrophe, rendering economic activity in the Arctic barely possible. Irresponsible profiteering never works in the long term. In the case of the Arctic, short-termism not only fails its original intention to earn more but also makes a devastating impact on the region that will stay long after the profits have been spent, if not forever.

- **ROMANTICISM.** In this scenario, the view of the Arctic as a pleasant TV picture of white snow and "free-range" reindeer without any signs of industry prevails. The ideas of preserving nature and maintaining a traditional living environment for the indigenous peoples is prioritized over economic rationality, and over common sense too. This approach gives a short-term rise of hope for the environmentalists and certain groups of indigenous population but soon produces a disastrous development: without any reason to be there, business withdraws from the Arctic, and no state is capable of funding this biggest-ever nobody's national park. Depopulation, devastation, and deteriorating infrastructure is what the Arctic is left with.

- **RENAISSANCE.** The balance of all three dimensions of the triple bottom line is what makes this scenario special. When stakeholders agree that nothing can be sacrificed, and only in balance can there be prosperity, new enabling policies start working and responsible money flows into the region to make the Arctic thrive economically, socially, and environmentally. At last, business is no longer a threat to the environment, and the environmentalists are no longer a threat to business.

As said already, prioritizing one dimension over another does not work. In the military, the common sense view is that collective defence protects all, while the individual puts everyone at risk. The same is true of the triple bottom line: pursuing only one dimension without proper consideration for the others jeopardizes the whole ecosystem and therefore threatens each and every aspect of it. The ability to think long-term, and to maintain a balance between all three dimensions, is what is called a **'sustainable mindset'** and this is exactly what the Arctic needs from leaders now and in the future.

A new **leadership agenda** emerges in each and every sector, reflecting the paradigm shift:

- **policymakers** will have to work towards creating an **enabling environment,** incentivizing more responsible investment in the Arctic, instead of trying to find a balance between economic activity and environmental footprint;

- **business** needs to turn away from the cost reduction imperative and concentrate on creating **innovation** in technology and business models that together will make it possible to do business in the Arctic sustainably, which means both at the new level of productivity as well as in an environmentally and socially responsible manner;

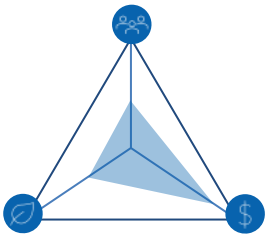
- **NGOs** must concentrate on facilitating **multi-stakeholder dialogs** aimed at finding a balance of interests, rather than lobbying for limiting policies and challenging business activity in the region.

What is more important, is that, just as with the triple bottom line, these paradigm shifts should be synchronized and synergetic. The sustainable future of the Arctic starts with the **sustainable thinking** of the leaders of today.

BOX12: REGIONAL TRIPLE BOTTOM LINE PERFORMANCE UNDER EACH SCENARIO

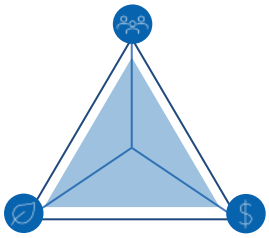
AGE OF DISCOVERY

Economic benefit prioritised over environment and society



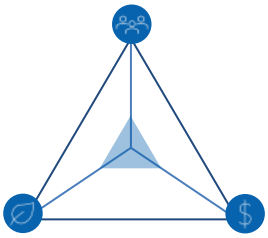
RENAISSANCE

Balanced approach to maximise societal, environmental and economic performance



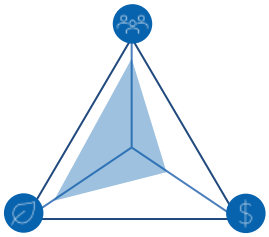
DARK AGES

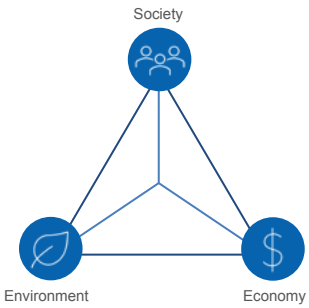
The region is not on track to progress with either – economy, social development and environment protection



ROMANTICISM

Strong regulation benefits society and environment, while economy is struggling to keep pace





- Society - (social return, demographic and living standards, inclusion)
- Environment - (environmental return, ecosystem-based management, limitations)
- Economy - (pace, diversification, equity return, environmental impact)

The size of internal triangle reflects social, environment and economic performance of the region under each scenario.

**inspired by Energy Trilemma Index by the World Energy Council*

Source: SKOLKOVO Institute for Emerging Market Studies

Conclusions

The strategic importance of the Arctic is continuing to increase. The complex combination of natural, political, social, economic, and technological factors makes Arctic dynamics unpredictable and uncertain. Why is now different from any other time? There are basically two reasons for this. The first is that accelerating climate change is transforming the Arctic not only as a natural ecosystem but also as a place for doing business. The second is that different players have started to explore the economic potential of the Arctic, and this has turned into a race for Arctic riches, not only without clear rules but even without clear track markings.

With this level of complexity and uncertainty, there is no single future for regional development. Many pathways are possible. Using two sets of critical uncertainties, the **quality of the institutional environment** and **pace of innovation development**, four scenarios have been developed. Those scenarios are The **Dark Ages, The Age of Discovery, Romanticism, and The Renaissance**. These are four different Arctics in aspects such as economic growth and prosperity, the livelihoods of the indigenous peoples and the broader Arctic population, urban development, environmental status, and many others. Putting the distinguishing characteristics of the scenarios into a **sustainability perspective**, the key observation is that all these possible futures have different **triple bottom line** strategies at their core. The sustainable strategy is the one where the **balance of all three dimensions** – economic, social, and environmental – is prioritized and supported with **long-term thinking**, which can only be achieved as a result of the collaboration of all the stakeholders. When stakeholders fail to agree and the balance is not sustained, what is left are different forms of decline of the Arctic. The scenario approach does not help to predict the future, but it definitely helps to map future development. In a way, **scenarios are the road markings for the future. They** are meant to help leaders of today and tomorrow navigate towards a better future for the Arctic.

One may say, that the difference between the scenarios reflects the difference in the leaders' mindsets. The sustainable mindset is the one that is centred around the balance of all three dimensions of the triple bottom line, and is long-term in its nature. In many ways, this new way of thinking reflects a paradigm shift: the traditional thinking varies considerably depending on where the leader is coming from – business, policymaking, or environmental/social NGO. Now, leaders in all three sectors will have to **share the same sustainable thinking if they are to** come to an agreement and ensure a sustainable future for the Arctic. All four scenarios highlight the **emerging leadership agenda, and urgent need for action**:

- The need for **collaborative innovation** between diverse stakeholders, including state and non-state actors, cities and local communities;
- The need to identify and leverage **integrated policy innovation opportunities** towards balancing economic prosperity, environmental sustainability, and social development in the Arctic region;
- The need to manage the r**isk of increasing fragmentation** in governance, geopolitics and approaches.

As noted above, the future cannot be predicted, but it can be influenced. The major **use of scenarios** is to define strategic choices more sharply and to inform better decision-making. The leaders of today and tomorrow can benefit from using these scenarios to shape policies and develop business strategies that will eventually make the Arctic a better place for people and business. The sustainable future of the Arctic will start with the **sustainable thinking** of the leaders of today. This report is aimed at **inspiring, guiding and supporting leaders** in search of a new agenda for the **Sustainable Future of the Arctic**.

Methodology

The scenario method was developed by the American scientist and military strategist Herman Kahn in the late 1960s as part of work commissioned by the US government to analyse the likely consequences of a nuclear war and find ways to increase chances of survival. Subsequently, the scenario method was widely used in corporate strategic planning in the 1970s in the world of the global crisis thanks to the practical work of Pierre Wack, who successfully adapted Herman Kahn's work for business strategies.

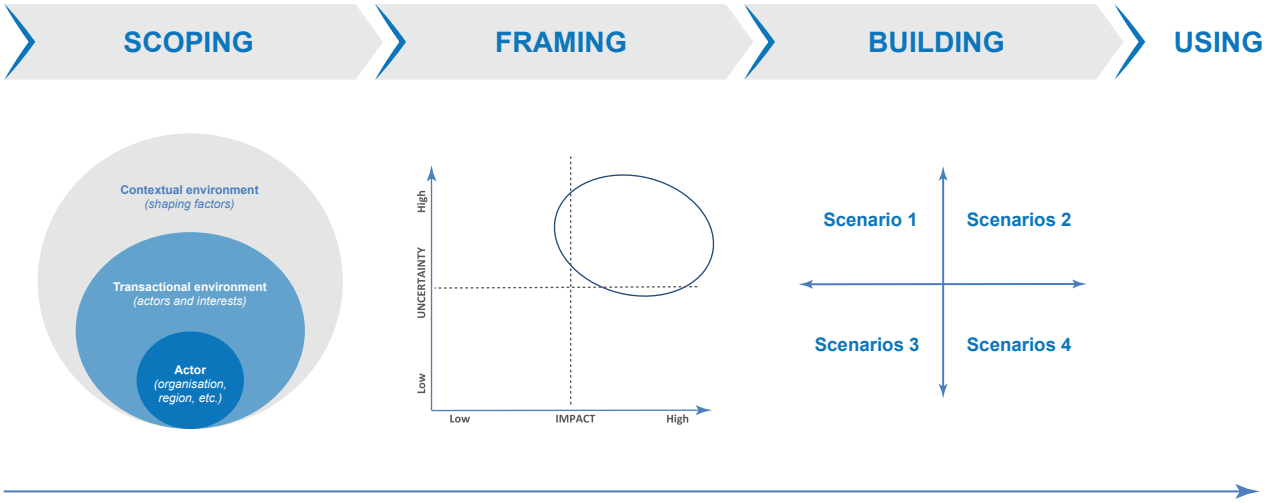
The scenario method is based on the identification of critical uncertainties, which are understood as current or future phenomena that can be transformed in a global or local context. As a rule, factors are analysed across the entire spectrum of changes, including geopolitical, economic, social, technological and environmental, while evaluating parameters such as the level of uncertainty and the level of significance or some other factor for the future.

A feature of the method is its cross-disciplinary contextual binding: scenarios are produced on the basis of several cycles of interviews and seminars with experts from various fields, and re-integrated to achieve the most weighted multivariate scenarios. Scenario framework helps to provide plausible long-terms visions, the possibility of choices in the ambiguity of an open future.[123]

The value of the scenario approach is that it engages with flexibility and variability in strategising. By incorporating many possible futures, the scenario method makes it possible to capitalize on the unexpected. This distinctive feature is particularly important in the contexts and environments characterized by instability, uncertainty, complexity, and ambiguity.

In recent years the scenario methodology has been significantly improved by scholars at the Saïd Business School at Oxford University. In 2016, Professor Rafael Ramirez and Dr Angela Wilkinson introduced the Oxford Scenario Planning Approach (OSPA) which is a "distinctive methodology for helping strategists realize their role in using scenario planning to enable their organizations to learn faster and better about changing conditions".[124] The approach developed by Oxford University scientists engages TUNA conditions (turbulence, uncertainty, novelty, and ambiguity) in order to build maps of possible futures, identify new challenges, and avoid missing unforeseen opportunities. "The OSPA enables strategists and policymakers to become more capable and flexible futures thinkers and, more importantly, to realize the value of this in rethinking what is going on and what can and should be done".[125]

BOX 13: SCENARIOS BUILDING PROCESS



Combined desktop research with series of in-depth interviews and seminars with key stakeholders, including businesses, government, local administrations, social and environmental non-governmental organizations.

Source: SKOLKOVO Institute for Emerging Market Studies

Cases

Rosatom (icebreakers)

The northern region is seen not only as a rich resource base and a potential transport artery but also as a promising research and tourism destination. Although climate change and melting ice have made some previously hard-to-reach areas more accessible, navigation along the Arctic shores still requires special technologies. The future of the Arctic economy, logistics and exploitation activities depends on the physical accessibility of the territories and mineral deposits. Icebreakers have always been 'keys to the Arctic', providing safe waterways for other vessels in drifting and land-fast ice.

Regular shipping along the Arctic is one of the outstanding technological achievements of the 20th century. It became possible due to development of the icebreaker fleet. Prototypes of icebreakers were created back in the 19th century[126] with the first ice-breaker, "Yermak", capable of cracking arctic ice, but the history of the modern icebreaker fleet is related to the Arctic territorial development of the Soviet Union. Soviet icebreakers used to ensure the navigation along the Northeast passage and secure the Arctic convoys during World War II. Although the Soviet Union was not the only country to build icebreakers for polar navigation, and by the 1950s several northern countries already had powerful icebreakers, the Soviet Union significantly shaped the further development of the Arctic by creating the first nuclear icebreaker, "Lenin", which was built in 1957. It went into service in 1959, securing navigation along the Northern Sea Route till 1989. It made the so-called "Northern Deliveries"[127] with the necessary cargo for enterprises and settlements in the Arctic as well as scientific expeditions to the polar regions and technical support for the development of polar deposits. In 1989 "Lenin" was officially decommissioned and converted into a museum, permanently based in Murmansk.

Since then, the global icebreaker fleet has grown significantly and become one of the most important drivers for the development of the North. Amid the latest trends in global politics, we observe increasing interest in the Arctic region in several dimensions, so the demand for ice-breakers and ice-class vessels is on the rise. Russia, Finland, Sweden, Denmark, Canada and the US are the countries with the biggest icebreaker fleets. In June 2020 US President Donald Trump issued a special memorandum[128] on "safeguarding the US national interests in the Arctic and Antarctic regions", according to which the US will build at least three new heavy icebreakers by 2029.[129] Non-Arctic states also are trying to catch up by building new vessels for the Arctic.[130] Recently China launched its 11th Arctic research expedition[131] which for the first time utilised a home-built icebreaker, Xue Long II (Snow Dragon 2). The vessel was commissioned in 2019. Not only Arctic states have operating icebreaking fleets. Experts say the model is simple. China's icebreaker is equipped with a diesel-electric propulsion system and is capable of breaking 1.5-meter ice. The duration of autonomous navigation is 60 days.[132] Moreover, China built a modern icebreaker in just three years, without any delays, traditional competencies or historical tradition. The next Chinese project Xue Long III is a nuclear icebreaker with a displacement of about 30,000 tons, capable of breaking through 3-meter ice. These developments could spark competition with Russia and trigger geopolitical tensions, significantly shaping the context of the Northern Sea Route. At the same time, Russia remains the leader in the field, having not only the largest icebreaker fleet – more than 40 vessels – but also operating the only nuclear icebreakers.

As for now, Russia operates four nuclear icebreakers: two 75 thousand horsepower twin-reactor (the Yamal and the 50 Let Pobedy), and

two 50 thousand horsepower single-reactor (the Taymyr, and the Vaygach). On top of that, Rosatomflot's fleet includes the ice-breaking nuclear container ship 'Sevmorput', as well as 9 non-nuclear service ships.[133]

The future of the Arctic economy, logistics and exploitation activities depends on the physical accessibility of the territories and deposits. The development of the Polar world has always been one of Russia's strategic priorities, implemented under a series federal programmes and initiatives. In 2019 the Russian government adopted a Plan for the infrastructure development of the Northern Sea Route up to 2035.[134] This is by far the most comprehensive strategic document defining one of the dimensions of Russia's policy in the Arctic. The Plan includes 11 key aspects, including ecological safety and modernization of the icebreaker fleet. To this end, Rosatom[135] plans to build eight new nuclear icebreakers - five of "Arktika" type (each equipped with two RITM-200 nuclear reactors), and three of "Leader" type (each equipped with two RITM-400 nuclear reactors)[136] - by 2035 in order to respond to growing transportation needs and to secure navigation along the Northern Sea Route.

Rosatom is preparing to transform the Arctic logistics system. The company is not only building up its nuclear icebreaker fleet but also integrating the existing Northern Sea Route with the global logistics system that connects it with the major international sea hubs both in Europe and in Asia. At the same time, climate change and increased global awareness of the Arctic's fragile environment and vulnerable indigenous peoples requires new rules for global markets. Low-carbon shipping and ecosystem-based management for exploitative and construction projects in the Arctic will require new technologies and governance solutions to ensure sustainable growth and public acceptance.

The safety and cost-efficiency of nuclear icebreakers are sometimes questioned. Building a new nuclear icebreaker costs about $2 billion and operations require special skills, technologies and regulation to prevent and/or tackle accidents and emergencies. Nevertheless, nuclear icebreakers remain one of the most sustainable transport solutions for the Arctic. Modern technology allows the safe and reliable deployment of the nuclear fleet and, what is more important, it has a zero-carbon footprint and there is no risk of fuel leakage, and so complies with the recent restrictions of the IMO.

Given the Arctic's special importance for the Russian and global economies, the development of the icebreaker fleet is an important tool for promoting the sustainable growth of the Arctic territories and integrating them into the global logistics ecosystem. Despite climate change and melting ice, the icebreaker fleet is still needed to provide navigation in the Polar region. Its development could have multiple effects on the Arctic future in terms of not only maritime logistics but also infrastructure and energy efficiency for Russia's Arctic territories.

Methanol Marine Fuel

The trend toward sustainable shipping and the new international maritime regulations aimed at reducing environmental impact and addressing the climate crisis could significantly shape the fuel market by opening more opportunities for low-carbon fuels, such as methanol.

Methanol represents a technologically, economically and environmentally efficient and industrially developed alternative to traditional types of marine fuel. The transparent liquid substance, also known as methyl alcohol, is a technologically, economically and environmentally efficient alternative to traditional types of marine fuel.

Methanol is soluble in water and easily biodegradable. Industrially, it is predominantly produced from natural gas by combining it with the water vapor and distilling the resulting mixture of synthesized gas. Methanol production capacities are usually located in the vicinity of natural gas fields, with their related infrastructure and, in particular, close to LNG terminals.

Apart from the traditional industries of chemical derivatives, Methanol is an attractive alternative for vehicles and ships, as it could be both directly used as a fuel and mixed with gasoline or biodiesel. At the same time, methanol production requires special technical and regulatory frameworks to ensure safety, especially at the stage of transportation and when refuelling. At the moment, methanol fuel is officially certified only in China and California, while in the European Union, Australia and India, methanol can be used in fuel mixtures.

The production of methanol and its derivatives is one of the fastest growing industries:

- Over the past 10 years, the growth of the methyl alcohol market has exceeded the growth of world GDP (more than 6.5% annually).

- The energy sector is the fastest growing methanol market. The main growth directions: production of formaldehydes (25% in 2017, 21% in 2025), olefins (MTO / MTP - 14% in 2017, 24% in 2025), and fuel (17% in 2017, 18% in 2025).

- By 2025 the demand for methanol will increase by more than 1.5 times, up to 122 million tons per year.

- The largest consumers of methanol are Northeast Asian states, especially China (more than 50% of global demand), the USA (10%) and Western Europe (8%).[137]

The global trend toward sustainable development and the new environmental standards of the International Maritime Organization (IMO) require vessels to reduce their environmental footprint and emissions of sulphur and nitrogen oxides. Being an environmentally friendly marine fuel, methanol can help moves towards a greener and more sustainable shipping industry. It is an optimal alternative due to its clean burning characteristics and economic efficiency.

Methanol is among the top 5 chemical products shipped worldwide, and unlike some alternative fuels, it is easily accessible through the existing global port infrastructure. Some shipowners have already begun to refit vessels to use methanol. In 2014, Stena Germanica was the first large ferry to be fully converted to methanol fuel. Waterfront Shipping (owned by the largest methanol producer Methanex) already owns about 10 ships with a dual fuel system (e.g. gasoil / methanol). These company tankers with a lifting capacity of 50,000 tons operate on two-stroke dual-fuel engines capable of running on methanol, fuel oil, marine diesel or gas oil all over the globe[138]

The challenges related to the use of methanol include lack of regulation and supply chain infrastructure, and limited economic feasibility.[139] Currently, methanol is more expensive than distillate marine fuels.[140] Moreover, spills of alternative fuels such as methanol present a problem for the Arctic. When methanol comes into contact with water, it rapidly mixes, but when it spills onto ice or snow, alcohol-water blends occur. They freeze, and the result can be transported over long distances in the Arctic ice and water stream, harming living organisms and animals, especially when it makes contact with skin or eyes.

Northern Sea Route

Global trade patterns show the logistics system faces several challenges. Geopolitical dynamics and economic volatility, climate change and increasing awareness are changing dramatically the existing logistics landscape. The COVID-19 outbreak and shifting consumer needs emphasize the necessity of diversifying global supply chains amid the growing demand for quick delivery services. The Northern Sea Route, which once was an inland Soviet transportation route, is now emerging as a new opportunity to meet the traffic needs for connections between Europe and Asia.

The NSR runs along the northern coast of Russia through Arctic waters (Kara, Laptev, East Siberian seas, Chukotka and Bering straits) connecting the European and far Eastern parts of Russia. The comparatively short transit distances, relatively cheap prices and conveyance capacity are seen as the main advantages of this route. Recently interest in Arctic shipping has increased, though development of the NSR as a competitive global transport artery will require a high level of international cooperation and a significant upgrade of the fleet and port infrastructure for operation in severe weather conditions.

The NSR is little more than half the distance of other sea routes from Europe to Asia. For example, from St. Petersburg to Vladivostok via the Suez Canal - over 12,840 nautical miles, and along the NSR – 5,770 nautical miles which is 40% shorter. The route from Rotterdam to Yokohama via the NSR is shorter by about 34% than via the Suez Canal. Although currently the navigation season is limited to 2-4 months, ongoing climate change, the extensive use of icebreakers and innovations in the shipping industry could one day make it feasible all the year round. Originally, the NSR was used for 'Northern Deliveries' – supplies of fuel, food and medicines to Russia's hard-to-reach territories. In Soviet times, the record NSR traffic was reached in 1987, at 6.6 million tons. Recent developments have led to significant increases in cargo volumes, from 9.9 million tons in 2017 to 31.5 million tons by the end of 2019. Although we observe significant growth, cargo volume is still much lower than the ambitious 80 million tons targeted in the 2018 Presidential Decree.

Maritime transportation remains incredibly important for the global logistics ecosystem as it handles more than 90% of cargo by volume. Now Russia is willing to make the Northern Sea Route a truly global transport artery integrated into the global logistics ecosystem.

In 2018 Russian President, Vladimir Putin, said the Northern Sea Route would become "the key to the development of the Russian Arctic and Far East regions", setting the ambitious goal of increasing the volume of cargo moved to 80 million tons by 2024. Significant growth will be driven mostly by the development of large energy projects such as Yamal LNG, Arctic LNG, etc. They will compel the problem of outdated transport infrastructure to be addressed, while cargo remains skewed toward natural resources. In order to be integrated into the global logistics ecosystem, the NSR fleet and infrastructure need significant modernization in compliance with new requirements in the shipping industry.

For this reason, Russia has committed to investing up to 7 billion dollars, 80% of which will go to building modern ice-class cargo ships and icebreakers, and the remainder to upgrading port infrastructure. The base-case scenario outlined in the NSR development strategy sets out 82 million tons of cargo by 2025. In the current geo-economic context of slumping oil demand, trade wars and the COVID-19 outbreak this objective does not seem to be feasible. However, the strategy also suggests a more conservative scenario of 65 million tons by 2025. With these numbers, the Northern Sea Route will operate at approximately 5% of the level of Suez Canal traffic, which places it in a specific market niche.

The Northern Sea Route is attracting new foreign investors. On the one hand, there is the promise of quicker, cheaper and safer delivery services, but on the other hand, the Northern Sea Route provides access to the development of the Arctic's natural resources.

BOX 14: MAIN GLOBAL TRENDS AND THEIR IMPACT ON NSR DEVELOPMENT

TREND	SCOPE	EFFECTS ON THE NSR
Energy transformation	Curtailment on demand of fossil fuels	Positive for gas field Negative for oil and coal fields
Climate change agenda	Gzreenhouse gas reduction	Positive
Tightening environmentzal requirements	Contaminating material emission reduction	Positive
Geopolitical ambitions	Geopolitical competition upsurge	Negative
Research and technology advancement	Advancement of shipping industry	Neutral

Source: SKOLKOVO Energy Center

Global trends are promoting the development of the Northern Sea Route, but geopolitical competition limits it. At the same time, global competition in logistics increases. Greenhouse gas emissions would be cut on the NSR by 23% when trading with China, Japan, Korea and the EU, when using LNG, by 38%. Using a carbon-free ammonia, hydrogen or nuclear fleet, that reduction would be by 100%.[141]

Massive natural resources and the transport potential were what attracted the first foreign investors, as France, China, Japan, India and South Korea. LNG remains the key commodity of interest. In total, the CNPC and the Silk Road Fund have already directly invested in Russian Arctic projects operated by Russia's private company Novatek to develop a gas field and construct an LNG terminal in the Yamal region.

As China is becoming one of the most important players in the global logistics system, China's government has expressed interest in developing new routes via Russia's Arctic. In 2019 the leaders of Russia and China agreed to integrate the Northern Sea Route into the Belt and Road Initiative[142] to boost bilateral ties and develop the Arctic territories. The BRI is by far the biggest infrastructure undertaking worldwide. It connects China with the rest of the world by both hard and soft infrastructure, thereby deepening economic, political and cultural ties. The alignment of the Northern Sea Route with China's Belt and Road Initiative extends the vast Chinese initiative into the Polar regions and is expected to favour economic development, science and research on the Arctic shores. China's state-owned COSCO shipping corporation, in partnership with the Japanese-owned MOL, has already despatched some LNG-related shipping via the Northern Sea Route.[143]

The increasing share of non-energy cargo will require global logistics operators to explore the NSR in order to gain confidence in it.[144] In 2018 COSCO sent a multi-purpose cargo vessel via the NSR to deliver equipment for subway and fertilizer plant construction. The Danish shipping giant, Maersk, for the first time used the new route in 2018, shipping Russian fish and other refrigerated cargo, plus South Korean electronics, on the ice-class 3,600 TEU vessel, Venta MAERSK.[145] It was the first commercial containership to pass through the Northern Trade Route.[146] Such examples are still rare, as the NSR's development is related mostly to large energy projects.

The shipping industry in the Arctic requires special international cooperation and a regulatory framework to provide sustainable services while conserving the unique Arctic environment. As for now, the major part of the fleet operating in polar waters uses heavy oil fuels. The regulation framework set by the International Maritime Organization bans maritime oil fuel in the Arctic. Although the ban was postponed[147] and countries with access to the Arctic coast (Russia, Denmark, Canada, Norway, USA) would be able to issue additional permits for ships under their flags for the use of marine fuel oil until July 1, 2029, this situation affects the vessels that provide the 'Northern Deliveries', and which export hydrocarbons. This highlights the acute need to move toward lower carbon, greener fuels.

Although the Northern Sea Route will not capture more than 1% of the world's sea traffic even in the most ambitious scenario, it is still one of the most important emerging solutions for global logistics. Compared with the Suez Canal, the Malacca Strait and other traditional routes, the NSR is shorter and cheaper, but still safe. The cargo's carbon footprint along the NSR will be lower, which may help to attract environmentally responsible shipowners. However, to fill its own market niche in the global logistics ecosystem the NSR requires a serious technological and governance upgrade if it is to comply with sustainable shipping standards and regulations while providing safe navigation in the Arctic. This is what makes the Northern Sea Route one of the biggest business challenges.

LNG: local fuel for global needs

Extraction and manufacture of Liquefied Natural Gas (LNG) in the Arctic provides by far the cleanest form of energy available from fossil fuels. The LNG market is diverse and dynamic worldwide, so it would be quite reasonable to assume that LNG will be widely used in the region.

Since 2000, LNG market volume has more than doubled, primarily due to growing demand in Asia. Today, LNG accounts for 40% of the world's gas trade, and by 2040 its share will increase to 60%. China was the biggest LNG importer in 2018, and global demand was projected to grow by 20% by the end of 2020.[148] In 2019 the LNG market reached its peak, hitting the 354.73 million mt, which was an increase of 13% from 2018 and the 6th year of consecutive growth.[149] The experts predict a sharp market decline due to the supply and demand cuts amid post-COVID-19 crisis.[150]

The Arctic is a rapidly developing region with world-class exploitable resources, which are especially important to Russia. So the transition to the LNG is crucial for the Arctic's future development. The volume of traffic in materials, equipment and finished products is growing. This leads to rising fuel consumption and a negative impact on the unique Arctic environment, increasing the risks of fuel spills, and escalating economic and political tensions.

The development of technologies of LNG transportation, storage and regasification both for onshore and offshore projects, will help reduce costs for energy transition, and replace traditional fuels with more sustainable LNG. LNG is a local resource for the Arctic. An important advantage of this type of fuel is its price competitiveness. As it is produced in the Arctic, transport costs for fuel delivery are low. According to expert estimates, several LNG plants have clear advantages for onshore consumers in the Arctic zone. Potentially, the volume of LNG consumption for energy supply only for Russian Arctic projects may exceed 581 thousand tons of LNG.[151]

The important advantages of LNG are its long-term availability and its compliance with the IMO environmental requirements and possible future restrictions. The main environmental advantage of LNG is the complete elimination of risk of accidental oil spills. The main environmental advantage of LNG is the complete elimination

of the risk of accidental oil spills. A significant benefit is the low cost of oil spill response infrastructure.[152]

The development of LNG production is closely related to the development of LNG infrastructure and shipping: plant, infrastructure facilities that provide LNG export, LNG-tankers and icebreakers, port infrastructure, etc.

In recent years, international shipping requirements have become stricter, especially for Arctic waters. Usually, LNG projects use LNG carriers that consume natural gas as fuel. LNG tankers are the least affected by international environmental standards, and it is highly likely they will meet all the new possible restriction on the 2050 horizon. By using LNG, greenhouse gas emissions are reduced by up to 20%, sulphur oxide emissions by 100%, nitrogen oxides emissions by more than 90%, soot and particulate matter up to 98% compared to petroleum fuels.[153]

NOVATEK

PAO Novatek is the largest independent (public) energy company in Russia. The company is engaged in exploration, production, processing and marketing of natural gas and liquid hydrocarbons and has more than twenty years of experience in the Russian oil and gas industry. Novatek supplies 20% of Russian gas demand. The company Novafininvest (name until 2003) was established in 1994 in the Yamalo-Nenets Autonomous Okrug focusing on oil and gas fields development – East-Tarkosalinskoye, Khancheyskoye and Yurkharovskoye fields – and made significant investments in field development and surface facilities construction. Trial operation of the East-Tarkosalinskoye oil field commenced in 1996 and commercial production of natural gas started in 1998. Gas marketing started in 2002 with first sales to end-customers. Novatek completed the consolidation of the company's main assets in 2004 and disposed of its non-core businesses in 2005.[154] Novatek continues to grow. Its shares are traded on the London and Moscow stock exchanges. The major shareholders of Novatek are:

- Group of companies owned by Leonid Mikhelson (24.8% of capital)
- Group of companies owned by Gennady Timchenko (23.5% of capital)
- Total (19.4% of capital)
- Gazprom (10% of capital)[155]

The Company's production volumes and asset portfolio grew rapidly in recent years. Novatek acquired stakes in SeverEnergia, Nortgas and Yamal LNG, as well as new licenses in prospecting areas in the Gydan Peninsula and the Gulf of Ob. Yamal LNG has started producing LNG at the first LNG train in 2017. The second LNG train was launched in August 2018. This means that Novatek has entered the global gas market and is becoming a global company.[156]

PROJECTS IN THE RUSSIAN ARCTIC

YAMAL LNG

Yamal LNG is an integrated project for LNG production, liquefaction, supply and export of natural gas. The project comprises the construction of an LNG plant on the resource base of the Yuzhno-Tambeyskoye field (Yamal Peninsula), and transport infrastructure – a seaport and airport Sabetta.

The LNG plant was built directly at the field on the shore of Ob River Bay. The plant was expected to be commissioned in 3 phases in 2017, 2018 and 2019, respectively, with the

capacity of each stage of 5.5 mn tons. The total capacity is 16.5 mn tons of LNG and 1 mn tons of gas condensate per year.[157] A fourth production line with a capacity of 0.9 mn tons LNG per year will be built with special liquefaction technology called the "Arctic Cascade" which was patented by Novatek in 2018.[158] This ensures maximum energy efficiency by using the Arctic climate. Construction is expected to complete and commissioning to start in 2020. Experts say the target cost of construction is $450-500 per ton, which is half the cost of the first three lines.[159]

The multifunctional port of Sabetta was built as part of the Yamal LNG Project on the principles of public-private partnership. To receive materials and technological modules for the plant's construction, cargo terminals were developed first. The port is now operating year-round. The terminals in Sabetta can now load LNG only to large gas carriers, but after four LNG-powered icebreakers have been commissioned, bunkering infrastructure for ships will be created. The terminal in Murmansk also would be able to ship LNG from large Arctic-class LNG carriers to conventional LNG carriers, but for now it is a distribution hub for the needs of the Murmansk region and bunkering LNG ships.

For the Yamal LNG project, 15 special ice-class Arc7 tankers were built. This allows year-round navigation without icebreaker assistance in the western direction and, during the summer, in the eastern direction via the Northern Sea Route. As for now, 8 tankers of the Arc7-type are already in operation. The others are expected to be commissioned within a year.

New small-scale LNG plants could emerge in the Russian Arctic: in Arkhangelsk, Chukotka, etc. They might help to increase the reliability of LNG supply to consumers and thereby contribute to the development of infrastructure in the region.

An international airport was built near the LNG plant and the Sabetta village, to ensure reliable air connections. Sabetta village, located on the eastern coast of the Yamal Peninsula is the base for the Yamal LNG Project. All necessary infrastructure has been built at Sabetta for the comfortable residence of construction workers. The auxiliary facilities of the living complex are being built: a fuel and lubricant storage depot, boiler facilities, a power supply complex, dining halls, medical centers, laundry facilities, saunas, gymnasium, administrative buildings, hotel, fire station, sewage and water treatment facilities, heated garage, and storage facilities for food supplies.[160]

The Project Operator is Yamal LNG, a joint venture of Novatek (50.1%), TOTAL (20%), China National Petroleum Corporation (20%) and the Silk Road Fund (9.9%).[161]

The huge ecological footprint, including stream bed degradation, in the Ob River Bay during the port's construction provoked harsh criticism and concerns among NGOs and the local population, as they damaged the livelihood of the indigenous people and the population of rare river species of Yamalo-Nenets Autonomous region. The company assured them that a scientifically-grounded decision was made and, according to the experts, the impact has been minimized. Studies show that the plankton population will be restored within a year, and fish stocks in 7-10 years. It will require regular environmental monitoring. During construction of the port 35 million rubles was spent on ecological monitoring of the area. The company has allocated 526 million rubles for compensation.[162]

ARCTIC LNG 2

Arctic LNG 2 is Novatek's second large-scale LNG plant in the Russian Arctic. The resource base for the project is the Utrennoye field located on the Gydan Peninsula. The plant's capacity is 19.8 million tons of LNG per year. The capacity of the LNG storage is 213 thousand cubic meters per each. One of the main advantages of the project is its lower cost of LNG per ton due the low cost of gas extraction, the possibility of using built infrastructure, and a high share of localization.[163]

Arctic LNG 2 shareholders:[164]

- Novatek - 60%
- Total - 10% (+ 5% option)
- Mitsui and Jogmec - 10%
- CNODC (CNPC's subsidiary) – 10%
- CNOOC - 10%

There are not enough ships to meet transport needs in the Arctic. To ensure the export of products manufactured in the region, a significant number of new vessels is required. However, for year-round navigation in the Arctic, vessels must be at least of Arc4 ice class.[165]

Probably Novatek's aspirations for LNG production and the experience gained from operating Yamalmax LNG carriers will require new solutions and business practices in the future.

Another exploitation giant, Norilsk Nickel, has been providing a significant part of the cargo traffic in the Arctic for more than half a century. The company has extensive experience in shuttle tanker operations and has its own fleet, comprised of Arc7 class containerships. But the company uses oil as a marine fuel, which puts Norilsk Nickel's fleet into a risk zone with tightening IMO requirements.[166]

Recently, the number of gas carriers for the Arctic LNG-2 project was increased from 15 to 17.[167] But this July, the Russian companies Sovcomflot, Zvezda and Novatek expressed the intention to sign contracts for another 10 LNG carriers for the Arctic LNG 2 project.[168]

FSUE Hydrographic Enterprise, a Rosatom subsidiary, and the industrial contractor Mezhregiontruboprovodstroy, signed a contract for the construction of a federal terminal at the Utrenny field for Novatek's Arctic LNG 2 project. The cost of the project is 95.7 billion rubles.[169]

PUROVSKY PLANT

The company's plant produces wet gas - a mixture of natural gas and gas condensate. After separation and de-ethanization, the unstable gas condensate is supplied to the Purovsky plant which is located near the East-Tarkosalinsky field. The Purovsky plant was launched in 2005. The main products are stable gas condensate (SGC) and a range of light hydrocarbons (NGL). During the 2005-2017 period, the Plant processed 65 million tons of gas condensate. The main volume of the product is supplied from the Purovsky Plant by rail to Ust-Luga for further processing or export.[170]

ARCTIC LNG-3

Arctic LNG 3 holds a license for the Severo-Obskiy field. According to Novatek's strategy, it could be the next liquefaction project after Arctic LNG 2.

In January 2019, the Obsky LNG LLC was registered in the village of Yar-Sale (Yamalo-Nenets Autonomous Okrug) with initial capital of 1 million rubles. The company was created for future investment projects based on the existing resource base in the region. The main activities are the production of gas and condensate, oil and associated petroleum gas, trade in solid, liquid and gaseous fuels and similar products, pipeline transport, and geological exploration. The investment decision will be made in 2020. It will be a small plant with a capacity of 4.8 mn tons per year of LNG based on Russian equipment and technologies, located in Sabetta. The cost of the project will be about 5 US$ bn. The launch of the first line is planned for 2024-2025. Novatek is unlikely to involve foreign investors in this project.

In 2018 Novatek, the Ministry for the Development of the Far East and the Government of Kamchatka signed a letter of intent[171] about a project for an offshore LNG trans-shipment complex on the Kamchatka Peninsula in the Mokhovaya Bay in Avacha Gulf. It is supposed to be a Russian hub for LNG delivery to the Asia-Pacific region. The complex will optimize transport logistics and use the existing Arctic tanker fleet, making LNG supplies from Yamal and Gydan more efficient helping the development of the Northern Sea Route. The marine LNG trans-shipment complex will serve to create conditions for the gasification of the Kamchatka Territories. Novatek will play a major part not only in the transformation of the NSR, but in the also development of the Russian Far East and engagement with the Asian market. The trans-shipment terminal will create a new independent center for LNG pricing in the Asia-Pacific region.[172]

Successful international projects, new deals, subsidies and tax remissions, though, have provoked sharp comment and criticism. There are allegations that Novatek was given unreasonable benefits and subsidies, receiving money from the state budget for infrastructure.[173] At the same time, these steps are at the heart of the renewed Russian Arctic strategy[174] which

includes new tax regulation for the Arctic zone. Tensions are running high as the market gets more complicated. The state giant Gazprom is experiencing difficulties in the European market. The future of Nord Stream 2 is still unclear, though Novatek increased its exports of gas to the EU gas in 2019. Novatek sent 80% of the gas produced in the Arctic to European hubs.[175]

POST COVID-19 UPDATE

The company has been hit by lower LNG prices. The company's revenue from the sale of hydrocarbons fell by 120 billion rubles during the first 6 months of 2020, compared to the same period in 2019. The net profit is one thirtieth of that before the pandemic, falling from 460 billion rubles to 15 billion.[176]

But this has not changed Novatek's plans for key projects in the Arctic.

The company has confirmed the planned dates for commissioning its projects in the Arctic: the Arctic LNG 2 plant on the Gydan Peninsula and LNG trans-shipment terminals in Kamchatka and Murmansk. The only possible changes are in the operation of the Obsky LNG project.[177]

Arctic cities

BODØ - A EUROPEAN CAPITAL FOR CULTURE 2024

Bodø is the second-largest city in northern Norway, located at 67 ° 17'N. Bodø municipality has 51,681 inhabitants. It was founded in 1816 as a market town with just 55 inhabitants and continued to grow as a result of the herring boom. In 1940, during the Second World War, bombing destroyed over 60% of all buildings in Bodø and the city had to be rebuilt. Now it is a modern trade, service, administration, education and communication center.[178]

In 2014 the city adopted a new municipal plan. The objective was to develop a compact city and a strong city centre, making sure that growth occurs in the urban areas, facilitating high-quality housing projects, and green structures in the city centre and nearby districts.[179] The compact city model is motivated by a commitment to addressing environmental issues, reducing the number of cars and transportation needs, and to avoiding construction on undeveloped land. Furthermore, a compact structure increases walkability, and the use of public spaces for social interaction, urban gardening, etc.

Several buildings in the city were demolished to make space for more compact structures, including high-rise buildings. Anticipating population growth over the next 50 years, a new area near the airport is going to be built as a compact and mixed neighbourhood hosting up to 15,000 dwellings.

The city focuses on promoting the cultural aspect of city living. Constructed in 2014, the cultural centre Stormen houses a concert hall and a public library and brings vitality to the city center. Bodø was named a European Capital of Culture 2024, the first city in the Arctic to win the title. As part of the project, Bodø will increase the use of the Sami languages both locally and around Norway north of the Arctic Circle.[180] The project will help create jobs in new and existing industries.

TERIBERKA

The small village is situated in the Murmansk region (Kola Peninsula) on the Barents Sea coasts. Teriberka was first mentioned in 16th century and originally it was a Pomor[181] settlement. Nomadic nature and proximity to the sea define the way Teriberka exists. Through the years this marine-orientated settlement utilised the resources of the sea and developed international connections with other Northern countries.

In the Soviet times, Teriberka became one of the important Polar administrative centres. The fishing industry and shipyards located in the town drove economic growth and infrastructure

development. The prosperity phase was related to the early post-WWII period. In those days apart from the strong shipbuilding and fishing industries Teriberka developed agriculture: two fish farms, two dairy farms, a poultry farm, mink breeding farm, etc. In the 1950s the population grew to 5,000. It had all the necessary social infrastructure such as schools, hospitals, an ambulance station, community center, etc.[182] Although there was a lack of hard infrastructure connecting the town with the rest of the country – reaching Teriberka was possible only by sea or air – it was a flourishing remote settlement with strong nomadic roots and traditions. The 1960s marked the start of a period of decline for Teriberka due to the development of fishing and port facilities in Murmansk and Sevemorsk. The village was transferred to the jurisdiction of the Severomorsk and was made a "closed city".[183] Teriberka lost its economic backbone, the population began to shrink, and the village fell into disrepair.

In 2009[184] the "closed city" status was lifted and Teriberka became accessible for visitors and tourists. The population has significantly declined since the Soviet collapse, and now there are only 596 people living there.[185] Teriberka remains a remote settlement which lacks infrastructure and basic ground transportation facilities. The development of the territory after the removal of the special status was related to the Shtockman gas-field exploration by Russia's Gazprom in cooperation with Total and Statoil. The project also involved improvement of the infrastructure and could have shaped Teriberka's urban and social development if the project had not been halted due to lack of feasibility.[186] Before the plans were changed, Gazprom helped build a new road in the village.[187] The population works mainly in the public sector in schools, libraries and the community centre.[188]

New opportunities for the economic development of Teriberka are usually associated with the creative industries and tourism. The iconic 2014 Russian drama "Leviathan", directed by Andrey Zvyagintsev, received a number of top global movie awards, such as the Cannes Prix du scénario, Golden Globe, and Munich International Film Festival.[189] It opened this small village to the world. Since then the tourist flow to the Kola Peninsula, especially to Teriberka, has grown constantly. In 2015-2017 the number of Russian tourists visiting the Murmansk region increased to 300 thousand people, while the share of foreign tourists – mostly Chinese citizens – rose almost 1.5 times.[190] The 2020 winter was a record for Teriberka's tourism as more than 2,000 people arrived here for the New Year holidays.[191] In the summer season Teriberka hosts a special music festival.[192] Since 2014 the festival has become a platform for promoting the unique culture, cuisine and music of the region attracting investors and expanding international ties.

The development of tourism in Teriberka, though, remains very controversial. First, the settlement, as well as the whole Murmansk region, needs significant both hard and soft infrastructure improvements to handle the increasing flow of tourists and to provide relevant services. Moreover, such big events as the Teriberka Festival require sustainable organization skills and facilities in order to save the unique environment from the resulting waste and pollution. Second, sociological research shows that the local population is sceptical of the developing tourism industry,[193] as they are excluded from the profit chain. The hotels, restaurants and other facilities are created mostly by non-residents, and the local community does not receive any profit or jobs. Unemployment is a serious problem for Teriberka, and locals are often involved in semi-legal or illegal operations like picking berries and mushrooms, fishing and crab poaching.[194] Igor Zadorin, the head of the ZIRCON research group, stated: "The grey economy is highly developed in Teriberka, and it seems to create significant barriers to human capital development and the establishment of public trust. Many businessmen told us that it is almost impossible to reach an agreement with local partners." According to the ZIRCON experts, it is essential to eliminate unofficial activities and achieve mutual trust, as it will enable an increase in the level of involvement of the local population in the transformation and development of the territory.

The local authorities in Murmansk are planning to boost tourism in Teriberka, hoping to reach 100,000 visitors by 2025. The aim is to create a national park, Teriberka, with designated routes in order to promote sustainable tourism. The Barents branch of WWF is involved in preparing the plan.[195]

Arctic Connectivity

The lack of digital infrastructure in the Arctic negatively impacts business development, local communities, digital governance and health and education provision. For instance, in the Canadian Arctic, the Nunavut population is entirely dependent on satellite services for navigation and communication. Resource developments such as mines, oil and gas projects, as well as service industries need access to modern telecommunications. The Arctic region requires improved connectivity by subsea fiber cables and satellites. Capital-intensive projects demand careful consortium-building and secured financing from the initial stage outset.

There have been several initiatives to enhance connectivity in the Arctic.

In U.S. Arctic. Quintillion is a leading infrastructure provider of broadband connectivity, satellite ground station operations, big data and cloud services. In 2017 it was the first and only telecommunications operator to build a submarine and terrestrial fiber optic cable network in the U.S. Arctic. It provides broadband access at a substantially lower cost than existing satellite and microwave capabilities.

In 2019, Quintillion Networks and ATLAS Space Operations announced plans for North America's highest latitude ground station, to be located 250 miles inside the Arctic Circle in Utqiagvik, Alaska. This partnership will bring availability, capacity, bandwidth and low latency to LEO satellites on multiple existing and planned fiber routes to major global internet exchanges. Upon its completion in the first quarter of 2020, the new Quintillion-ATLAS 3.7meter ground station will be put to use immediately by the US Government and commercial customers.

In the Canadian Arctic. Canada has announced an $85 million initiative to improve connectivity in the northern province of Nunavut. Canada is expected to lay a new submarine cable connecting Nunavut to Greenland and a network of onward connectivity, bringing high-speed internet services to 3,215 homes and businesses in Nunavut. The 1,700km long cable will provide residents with broadband speeds of up to 1 gigabit per second. The expected date of completion is 2023.[196]

In the Nordic and Russian Arctic. The Russian company Megafon, in cooperation with Finnish Cinia, established a joint-venture, Arctic Connect, to lay a submarine telecommunications cable across the Arctic Sea. The international project would create a completely new route to connect continents and also to fulfil the connectivity requirements of the Arctic region. According to preliminary estimates, the project could cost in the region of $778 million to $1.11 billion depending on the final design, the number of possible branches and/or extensions to the main system from Europe to Asia.[197] Preparations for marine surveys started in August 2020 and ended in November. Actual work could begin as early as 2022. The reinforced cable will be laid from the Norwegian city of Kirkenes to Kyotango, Japan. The trunk cable to Murmansk, Teriberka, Sabetta, Dikson, Dudinka, Tiksi, Khatanga, Yamburg, Pevek, Anadyr, Petropavlovsk-Kamchatsky, Yuzhno-Sakhalinsk, Vladivostok and Nakhodka will branch out to reach other Arctic territories.

In 2020 Russia started its own state-led $0.86 billion worth, 12,000 km long subsea cable project from Murmansk to Vladivostok with landing lines to the largest ports and settlements along the Russian Arctic zone. The project is being implemented by the Ministry of Transport of Russia, the Federal Agency for Sea and River Transport "Rosmorrechflot" and Federal State Unitary Enterprise "Rosmorport". The Federal State Unitary Enterprise "Morsvyazsputnik" has been identified as the operator of the cable.[198] The first section of the cable from Teriberka to Amderma is planned to be launched in 2021. The project is estimated to be completed by 2026. The subsea cable will help boost industrial activity such as production and transportation of hydrocarbons in the Arctic, solving geological exploration problems, and providing an alternative to

satellite communications for northern latitudes. The availability of reliable connectivity solutions is crucial in the development of the Northern Sea Route infrastructure and providing Arctic residents with fast Internet.

Improved digital infrastructure will benefit Arctic communities and will attract new industries, e.g., data centre operators and knowledge/intensive industries that require reliable connectivity.

Arctic Indigenous Peoples

The Arctic Indigenous peoples consist of over 40 different ethnic groups representing 10% of the total population living in the Arctic. All Arctic countries except Iceland have indigenous peoples living within their Arctic territory. Arctic indigenous peoples include for example Saami in circumpolar areas of Finland, Sweden, Norway and Northwest Russia, Nenets, Khanty, Evenk and Chukchi in Russia, Aleut, Yupik and Inuit (Iñupiat) in Alaska, Inuit (Inuvialuit) in Canada and Inuit (Kalaallit) in Greenland (see Map).

These are the six Arctic Indigenous organizations that hold Permanent Participant status in the Arctic Council:

- Aleut International Association
- Arctic Athabaskan Council
- Gwich'in International Council
- Inuit Circumpolar Council
- Russian Association of Indigenous Peoples of the North
- the Saami Council

BORDERS AND SÁMI

The Sámi are the indigenous peoples of the northern part of Sweden, Norway, Finland and Russia (the Kola Peninsula). The Sámi population is estimated at between 50,000 and 100,000 people.

The Sámi have their history, language, culture, traditional livelihoods, and identity. From time immemorial they have lived in the Sámi homeland (called Sápmi) extending across four countries from Central Norway and Sweden through the northernmost part of Finland and into Russian parts of the Kola Peninsula (see Map 2). The original Sami area of settlement was even larger, but it has gradually contracted. The treaty Lapp Codicil of 1751 (often called the Sami Magna Carta) allowed the Sámi to cross the border with their reindeer in spring and autumn as before and to use the land and the shore for themselves and their reindeer, regardless of national boundaries. When the borders of the Arctic nation-states were created, the Sámi had to abide by national and international treaty rules governing the movement of their reindeer across the Norwegian, Swedish and Finnish borders in the region. Several Reindeer Grazing conventions in 1919, 1972, 2009 were negotiated between Sweden and Norway, but due to legal disputes, the status of reindeer herders in the cross-border area of Norway and Sweden is unclear.

I am a Sami among Swedes, but I do not feel the same sense of a common identity with them as I do together with other Sami among Norwegians or among Finns. National boundaries criss-cross our Sápmi, but what do we care, they're not on our "maps". Johannes Marainen, headteacher and chairman of the Gothenburg Sami Association

Reindeer husbandry is the main Sámi occupation, but nowadays more and more Sámi are involved in tourism, food production and other sectors. Sámi are actively using modern technology for reindeer herding. Among these technologies are drones, snowmobiles, GPS and the Internet of Things (IoT). These allow reindeer owners to receive alerts on their smartphones warning them that their animals may be in danger.

The Sámi people are represented by three Sámi parliaments, one in Sweden, one in Norway and one in Finland, while on the Russian side they are organized into NGOs. In 2000, the three Sámi parliaments established a joint council of representatives called the Sámi Parliamentary Council. In 2019, The Sámi Arctic Strategy: Securing enduring influence for the Sámi people in the Arctic through partnerships, education and advocacy was released. The

strategy argues for human-centred, sustainable Arctic development which is respectful of environment.

ARCTIC FOOD

Arctic indigenous peoples have a rich food culture and strong traditions associated with food. All food resources are fully utilized without producing any waste, a tradition deeply ingrained.

The EALLU project initiated by the Arctic Council in 2015 investigates reindeer herders' food culture through the lens of traditional knowledge, adaptation to climate change and youth combining academic work, education, seminars, food culture across Eurasia. The results of the project demonstrate that reindeer herders have indigenous knowledge in food systems. This knowledge is developed over generations by observing and monitoring food, from the choice of resource through processing, preservation and food preparation in a sustainable way. The ability to engage in reindeer herding and yet to continue eating traditional dishes and products helps preserve the unique diversity of indigenous languages. For instance, the Yup'ik and coastal Chukchi have a very rich knowledge of the value of the plants in their food culture which maintain health and well-being.

The EALLU Cookbook[199] documenting food practices and the recipes of Arctic indigenous peoples won Best Food Book of the World, across all categories, at the Gourmand Awards,[200] the major Food Culture event in the world.

In Greenland, traditional Inuit foods include arctic char, seal, polar bear and caribou — often consumed raw, frozen, or dried. These foods, native to the region, are rich in the vitamins and nutrients people need to stay nourished in the harsh winter conditions. The parts of the animal that aren't edible, like the fur and skins, are used to create clothes and other products that hunters can then sell for cash.

"What's already working in the North is Inuit culture — harvesting, sewing, making art. So it's not reinventing the wheel but working with the wheel that's already there." Leesee Papatsie

"The best way to show people's connection to the land is through the hunting practices because the land is the food source that sustains people." Acacia Johnson, an Alaskan photographer

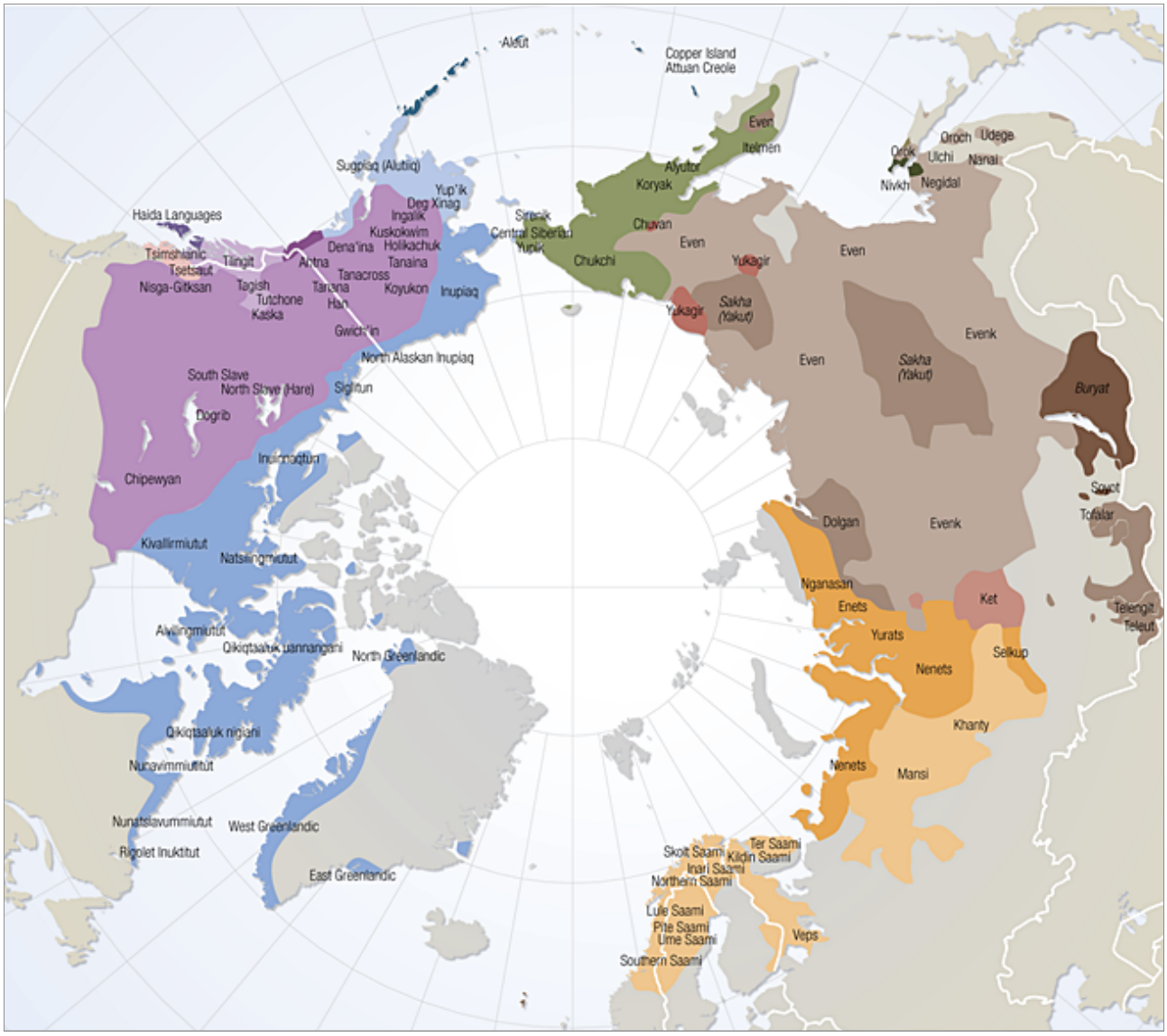
The people in Greenland have survived on a diet of little fruit and vegetables but lots of meat. Therefore, replacing Greenlanders' traditional game and fish-based diet with imported agricultural products is neither sustainable nor healthier, argues microbiologist Aviaja Lyberth Hauptmann.

A generation of new companies is starting to produce Arctic foods, using unique knowledge and traditions. They are considered gifts from Nature which are received graciously as they respect the local community which shares an identity with the same resources.

Arctic Warriors is a superfood producing firm which uses unique herbs, berries, and plants from Lapland that are sourced from a network of local pickers. According to Tuija Kauppinen, sales and marketing manager, Arctic Warriors are proud to be based in Lapland and to support local communities. The company's project manager Katja comes from a family in which herbs have been a natural part of everyday life for centuries, and the knowledge has been passed down from one generation to another.

Furthermore, as part of the EALLU project, a training workshop will be organized for Arctic indigenous youth focusing on ´Food innovation leadership´. These are some practical steps supporting Arctic indigenous youth who wish to be food entrepreneurs and food innovators.

MAP 1: ARCTIC INDIGENOUS PEOPLES BY LANGUAGE GROUP



Na`Dene Family:

- Athabaskan branch
- Eyak branch
- Tlingit branch
- Haida branch

Indo-European Family:

- Germanic branch

Eskimo-Aleut Family:

- Inuit group of Eskimo branch
- Yupik group of Eskimo branch
- Aleut group

Uralic-Yukagiran family:

- Finno-Ugric branch
- Samodic branch
- Yukagiran branch

Altaic Family:

- Turkic branch
- Mongolic branch
- Tunguso-Manchiurian branch

- Chukotko-Kamchatkan family
- Ket (isolated language)
- Nivkh (isolated language)
- Tsimshianic (isolated language)

Source: Arctic Center

Mining in the Arctic

ALASKA

Alaska has a growing mining industry which includes exploration, mine development, and production. The industry produces zinc, lead, copper, gold, silver, coal, as well as construction materials such as sand, gravel, and rock. There are six large operating mines (Fort Knox, Greens Creek, Red Dog, Usibelli, Pogo, and Kensington) providing 2,675 full-time jobs out of the nearly 4,600 mining industry jobs in total in Alaska in 2019. Mining there involves a rigorous permit process. The state contains 75 future mineral recovery prospects.

ECONOMIC IMPACT

Mineral products accounted for 36% of the state's total exports in 2018, with a value of $1.7 billion, consisting primarily of zinc and lead from the Red Dog Mine.

The mining industry provides mostly year-round jobs for residents of 70 communities throughout Alaska, more than half of which are found in rural Alaska where few other jobs are available.

NANA Regional Corporation's Red Dog Mine is the largest lead and zinc concentrate producer in the U.S. Red Dog Operations was developed in 1989 through an innovative agreement between the operator Teck and the land-owner NANA. NANA is a Regional Alaska Native corporation owned by the Iñupiat people of northwest Alaska. NANA is owned by the more than 14,500 Iñupiat shareholders who live, or have roots, in northwest Alaska. The mine and concentrator properties are leased from, and were developed under an agreement with, NANA.

In 2019, Red Dog employed 650 people, of which over half are NANA shareholders. In partnering with NANA, Red Dog operations paid $241 million to NANA in 2019, with $140.5 million of that being redistributed to other Alaska Native regional and village corporations. The mine's life is expected to continue to 2032.

SWEDEN

In Sweden, mining is one of the major economic activities, with the mining industry contributing to the country's economic growth as a main source of tax and employment.[201] Among the mining companies are Atlas Copco, Sandvik, LKAB, Boliden, and Lundin Mining. The Swedish government has formulated Sweden's mineral extraction strategy with the aim of ensuring long-term sustainable growth while taking ecological, social, and cultural factors into consideration. It is expected that by 2025, Sweden will triple its mining production, which should provide more than 50,000 new jobs.[202]

ECONOMIC AND SOCIAL IMPACT IN THE NORTH

Swedish LKAB is Europe's leading producer of iron ore. LKAB's mine in the northern Sweden town of Kiruna (20,000 inhabitants) is the world's largest underground iron ore mine. The Kiruna underground mine is about 80 metres wide and four kilometres long. The mine employs over 2,000 people. Kiruna has three main industries; mining, tourism and space. But the industrial profile of Kiruna is defined by the iron ore company LKAB, which is the dominant employer.[203] LKAB is owned by the Swedish state and has always played a key role in Kiruna's development.

As mining operations expanded, parts of the town came to be situated on top of the mine and be at risk of collapsing due to sinkholes. Kiruna Municipality decided to relocate the affected parts of the town about 3 km east. The process began in the early 2000s and will not be completed for many years.[204] LKAB's future is dependent on parts of Kiruna and Malmberget (a town of 5,000 inhabitants) being successively moved. These urban transformations are the

result of the location of the ore bodies and the expansion of mining operations. In all, around 5,000 homes and 700,000 m^2 of housing and business premises will be relocated or replaced. The process of urban transformation is expected to continue at least until 2035. According to the Swedish Minerals Act, LKAB is responsible for paying the costs incurred when a company's mining operations make urban transformations necessary.[205] The municipality is responsible for urban planning. In 2020, a conflict between LKAB and Kiruna municipality erupted, based on the municipality's demand that the mining company should compensate for the population decline caused by the city relocation.[206]

RESPONSIBLE MINING IN THE ARCTIC

Mining has on the one hand has the potential to contribute to economic development, but on the other, it harms the environment and irrevocably shapes the social dynamics of Arctic communities and indigenous ways of life. The Arctic Economic Council's Responsible Resource Developing Working Group produced recommendations for responsible mining in the Arctic.[207] According to the recommendations, in developing mining activities, project proposers and northern governments must engage in early and ongoing open dialogue, consultation and cooperation with indigenous communities. Mutually beneficial partnerships, ensuring long-term sustainable benefits, depend on this.

Airships for Arctic

In the era of sophisticated technologies, modern manned and unmanned airships could become one of the great logistical opportunities for the Arctic region once again. Modern airships can perform a wide range of air transport and aviation technical missions to hard-to-reach areas with undeveloped infrastructure. The main advantages of airships are:[208]

- high carrying capacity of up to 200 tons (there are airships with the capacity of up to 500 tons in development, which is twice the carrying capacity of most other transport aircraft),
- ability to transport bulky cargo due to the suspension type of transportation system. This allows the delivery of equipment and building structures assembled direct to the installation site,
- ability to cover very long distances, there are no requirements for port infrastructure (except for the home port): airships do not need to land for loading/unloading,
- high fuel efficiency and sustainability: fuel consumption is comparable to that of a helicopter. It is possible to use sustainable fuels for modern airships, decreasing the environmental impact and carbon footprint, experts say.[209]

These advantages make modern airships the most economically and environmentally efficient means of transport in hard-to-reach areas. On the other hand, the relative disadvantages of airships are their low cruising speed (no more than 200 km/h) and relatively low manoeuvrability. In addition, there is a need for special infrastructure in the base ports, especially large airship sheds (hangars).[210]

From a technical point of view, airships belong to the class of controlled balloons. The airship body has a volume of up to 200 thousand m3, equipped with stabilizers, vertical and horizontal rudders as part of an attitude control system, which provides the ability to move in any direction regardless of the direction of air flows. Airships are equipped with aircraft-grade propellor engines. Most use helium as the lifting gas.

The American aircraft manufacturer Lockheed Martin[210] is the world leader in modern airship design and construction. In addition, there

are outstanding manufacturers in Germany, Great Britain and France. The only Russian designer and manufacturer of airships is the Dolgoprudnenskoye Automation Design Bureau (DKBA),[212] which is part of the Ruselectronics concern, managed by the Rostec State Corporation.

FIRST AIRSHIPS IN THE ARCTIC: BRIEF HISTORICAL BACKGROUND

The unique and extremely remote Arctic territories were always a difficult problem for scientists and manufacturers, as it was never easy to build stable and reliable logistics systems for the region's industrial and civic needs. This problem has not been completely solved, even today, and the climate crisis and transformation of the natural and urban environment of the modern Arctic presents complicated challenges.

The exploration of the North Polar territories using airships began in the US in the early 20th century. In 1907 the American airship pioneer, Walter Wellman, flew a dirigible inside the Arctic Circle for the very first time. He made two flights, in 1909 and 1910.[213]

In 1926, the Norge was the first airship to fly over the North Pole. It was designed by Umberto Nobile in Italy. Classified as a semi-rigid airship because of the flexible tubular metal keel, the aircraft had a pressurized envelope reinforced by metal frames at the nose and tail, three engine gondolas and the separate control cabin attached to the bottom of the keel. In 1928 Nobile tried again only with a slightly larger ship, the Italia. The Italia, unfortunately, crushed at 81°N because of a concatenation of different circumstances, which are still discussed between the scientists.[214]

In summer of 1931 the Graf Zeppelin made its flight above the Arctic Circle. To date, the LZ127 Graf Zeppelin is the largest airship in history ever to have flown above the Arctic Circle.

In 1958, the US Navy flew a ZPG-2 airship north of the Arctic Circle. The route was directed via Churchill, Manitoba, and the most northern settlement reached was Resolute Bay, NWT. "It took approximately 24 hours for this leg of the flight. Short flights out of Resolute Bay were abandoned because the landing strip was too soft and was melting".[215]

The latest example of an airship that operated in the high north is the legendry ABC blimp that provided coverage at the 1994 Winter Olympics at Lillehammer, Norway.

Experts point out that, Russian Rosaerosystems AU-30 airship, acquired in 2008 by a French group to undertake a Polar expedition, suffered damage in France during preparation for the mission. As a result, it was unable to fly to the Arctic.

NOW: NO ROADS, NO AIRPORTS – NO PROBLEM

Now the Arctic is undergoing significant environmental changes. Melting sea ice and permafrost, as well as coastal degradation, pose a serious threat to the existing urban and industrial infrastructure as much as to the natural environment. Hence, the region more than ever needs strong and sustainable logistics systems. Modern airships could be part of that.

In 2002 the first Airships to the Arctic conference was held. There was a wave of scepticism about both cargo for airships and climate change. But now, decreasing the carbon footprint is an issue worldwide. In the Arctic, ice roads are becoming unpractical due to rising temperatures, and food supply for remote communities is becoming a matter of national concern for the Arctic states. "The problems that airships can address have become more acute and public interest in the technology is suddenly growing".[216]

Airships could be part of a solution for big mining and energy projects which need to deliver equipment without harming the environment unnecessarily.

The team of Lockheed Martin (US) and Hybrid Air Vehicles (UK) was founded to bring hybrid airships into operation. According to its official website, the company, "Straightline", will be the driving force behind the introduction of innovative and eco-efficient hybrid airships creating a transport revolution that will change the face of aviation.[217] The Airlander 10 can take off and land in a short distance from or on unprepared sites in desert,

ice, water or open field environments. The airship is designed to stay airborne for up to five days at a time to fulfil a wide range of communication and survey roles, as well as cargo-carrying and tourist or passenger flights.[218] "The Hybrid Airship[219] uses non-flammable helium and carries about 10,000 pounds, whereas the Hindenburg carried seven million cubic feet of hydrogen gas".[220] The Swedish company OceanSky is now offering the unique experience of sustainable tourism in the Arctic. A 30-hour travel package to the Arctic in a modern airship, the Airlander 10,[221] starts in Svalbard, Norway, and promises the adventure of an expedition led by Robert Swan, the first person to reach the North and South Poles by foot.[222] The first commercial flight is planned for 2023-2024.

At the same time, the further development of airships for Arctic exploration and tourism will require elaboration of the regulatory framework, as well as a significant investment to monitor the market and set up special environmental and security policies.

Creative industries

Conventionally, the Arctic is viewed as a "resource storehouse" of the world and northern economies are thought to be primarily based on exploitative activities. Nonetheless, the socio-economic context is changing, and the Arctic landscape is multifaceted. The Arctic countries are trying to diversify their economies, building human capital, boosting local innovation and entrepreneurship, and taking advantage of global developments related to digitalization and the circular economy. These ideas are also expected to contribute to sustainable development[223] and to creative clusters in the urban environment. The emergence of creative spaces and the dynamics of creative industries are an indicator of the development of the creative economy and creative capital in the region. This significantly affects territorial development and the desire of the inhabitants to realize their own potential. In 2017, during the global crisis, when almost all industries were adversely affected, creative clusters grew by 14% globally.[224]

The Nordic Arctic region has become quite successful in this respect. A report entitled Arctic Business Analysis: Creative and Cultural Industries[225] points out that the creative and cultural industries of film, tourism, and indigenous cultural commerce are becoming increasingly important platforms through which the Nordic Arctic countries create value. Moreover, they are a tool for economic, social, and cultural growth and international cooperation. The development of the Arctic's creative economy requires not only policy support and a favourable enabling environment but also knowledge sharing and collaboration. For example, in developing film production skills, official training is needed right across the Arctic. "Nordic Arctic tourism has grown steadily in the last decade. Public support, public-private collaborations, and transnational collaborations have been key in developing Arctic tourism. Transnational collaboration shows great potential, as Arctic regions, especially those in Finland, Norway, and Sweden, are generally perceived as one destination by the tourism market".[226] The expansion of Sami and Inuit indigenous businesses represents a vast opportunity for economic growth and the integration of indigenous Arctic communities into the global economy.

An example of a sports event organized in Norway that received global recognition is the Arctic Race of Norway. This is a multi-stage cycle race which has been held since 2013. It is an official UCI-sponsored event, and is now part of the European Tour. In 2019, it was covered by 39 broadcasters, using two TV helicopters. It was televised in 190 countries and had about 3 million online media views. It involved 1,300 riders and a live audience of 150,000 people.[227]

The development of creative and cultural industries in the Russian Arctic is an evolving process. Despite its huge potential, the sector is experiencing stagnation due to the remoteness of the territories, a lack of infrastructure, massive out-migration of the younger element in the population and other such factors. But

recently, the Russian North has started to attract more attention. The Arkhangelsk and Murmansk regions are becoming popular tourist destinations, especially after the award-winning Russian film Leviathan was shot in Teriberka. The government and different NGOs support initiatives to develop the tourism industry and construct the required infrastructure, both hard and soft, based on the principles of sustainable development and oriented towards "winter cities".

Three art residences were established in the Russian Arctic as part of the Russia-EU cross-border cooperation programme "Karelia".[228] New residencies in the Russian Arctic cities - Kostomuksha, Sortavala, and Petrozavodsk - are equipped with everything necessary for living and working of the artists. The project is not only a new space for artists but also a creative platform for all kinds of positive changes: social, environmental, and economic.

SAYBM: A HIGH-QUALITY INNOVATIVE PLATFORM TO UPGRADE THE JEWELLERY AND LAPIDARY INDUSTRY OF THE REPUBLIC OF SAKHA

Yakutia's permafrost, in Russia's coldest and largest region, hides large deposits of one of the most precious natural resources – diamonds. Diamonds were first found in the taiga in the 1950s by two female geologists who were accompanied by local reindeer herders.[229] Although diamond mining is usually associated with Africa, Russia is by far the largest producer.[230]

New Year 2020 was an important date for Yakutia's (the Republic of Sakha) diamond cluster as a new project was initiated by JSCB Almazergienbank, and the subsidiary structure **"Saymb"** was founded. The overall project investment is expected to be 537 million rubles. In the Kangalassy district of Yakutsk city the company has built a two-storey building with workshops, with a total area of 1450 sq. meters. The cluster provides jobs and equipment for small and medium-sized businesses, as well as jewellers who are individual entrepreneurs.[231]

Saybm is a high-quality innovative platform to upgrade the jewellery and lapidary Industry of the Republic of Sakha. "The world is changing. Innovation is replacing traditional approaches. Bold, new and innovative solutions become part of our reality. Moving forward reflects qualitative change and development. Using unconventional solutions and progressive ideas contributes to the company's future. We work to ensure people live better, consume higher-quality products and enjoy their lifestyle".[232]

In a short space of time, ten talented jewellers processed 511 carats of rough diamonds and produced unique pieces of jewellery worth over 1 US$ million. Exclusive premium-class jewellery was presented during the "The Middle East International Jewellery & Watch Exhibition" in Bahrain.[233]

Saybm operates from the Yakutia area of advanced socio-economic development in the Russian Federation. Together with the British Higher School of Design the Company, it is implementing a remarkable project to help young professionals and shape industry in the region. As for now Saybm and the British Higher School of Design have undertaken two projects: Summer School of Jewellery Design in 2019 and the soon-to-be-launched special professional accelerator in Yakutsk. This is a two-month intensive course for specialists and entrepreneurs in the jewellery industry. The programme includes design training, special courses on entrepreneurship, management, exporting, digital marketing and personal development to prepare participants for entering the global market.[234]

"The best participants will be invited to become residents of the cluster, and the most unusual projects will have the opportunity to export their products under the cluster's international umbrella brand or under their own private jewellery brand." [235]

The first Summer School of Jewellery Design was held in cooperation with the Arctic State Institute of Culture and Arts in 2019. In November 2019, Zhanna Doari, a graduate of the program, together with the creative director of Saybm, took part in 7th International Jewellery Tokyo AUTUMN 2019 to present their works to buyers from Japanese jewellery chains and large jewellery companies.[236]

"POLARNYE ZORI - CITY OF LIGHT": WORLD'S FIRST LIGHTS FESTIVAL BEYOND THE ARCTIC CIRCLE

Polyarnye Zori is a small town in the Russian Arctic zone, where the Kola Nuclear Power Plant is located. The northern city lives under harsh conditions of polar night for part of the year, but this natural phenomenon could present an opportunity for further development. Despite the natural conditions, in the next five years the town is to become bright, cosy and attractive due to the ambitious project "Polyarnye Zori - City of Light". This five-year project includes an accelerator of urban projects, work with mentors and experts, as well as a crowd-sourcing platform for finding solutions and receiving proposals.[237]

The project Polyarnye Zori has participated in the programme of the Agency for Strategic Initiatives (ASI) "100 City Leaders" since 2019. This programme is aimed at changing the quality and lifestyle of Russian cities through the implementation of specific leadership projects. "The City of Light" represents a new model of urban lighting in the Arctic, as well as forming a unique brand for the town of Polyarnye Zori as a center of lighting design, which will develop its tourism potential. Within the project, all street lighting is to be modernized, which will be a platform for training sessions and festivals in the field of lighting design. This is expected to trigger a tourist flow which, according to expert estimates, could exceed 50,000 people annually.[238]

The first stage of the project was a training and strategic session on lighting design in August, 2019. Students and practicing lighting designers from Moscow, St. Petersburg, Yekaterinburg, Krasnodar and the Murmansk region took part in workshops, master classes and expert sessions. They shared their approaches, talked about basic lighting techniques, stages in project development, as well as about the characteristics of lighting equipment and its applicability in the Arctic context. As a result, two concepts for an integrated city lighting system were presented. Designers captured the local charm of the Aurora Borealis and took its colors as the basis for a solution to architectural lighting. Warm colors, dynamic projections and art objects were used for courtyards and narrow streets, and the walls of houses. In addition, the "smart city" system was integrated with the concept to change the intensity and scenarios depending on the time of day.[239]

The next step was a light festival, held in December 2019. As part of it, an International Congress in the field of lighting technologies and design was held in Polyarnye Zori, where Russian and foreign experts discussed the global experience of lighting systems and urban development in northern cities, the impact of urban lighting on social inequality, as well as issues related to urban lighting design.[240]

On December 22, in Polyarnye Zori, there are only 17 minutes of daylight, from 12:41 to 12:58. During the Festival, the city was transformed by numerous light installations, projections and the facade lighting of buildings, etc. The Festival was an example of energy efficiency, as the total use was only 20 kW due to the application of energy-saving technologies. More than 2 thousand visitors and dozens of experts came to see this first festival of light in Polyarnye Zori, on the shortest day of the year. It was the first light festival anywhere in the Arctic. The project's main goal is to change life in the north under conditions of polar night by utilising modern lighting design solutions while taking account of urban sustainability.[241]

The case of Polyarnye Zori will be used as a benchmark for energy-efficient solutions in 20 cities in Russia's Arctic. Beyond that, it will be a model for Norway, Sweden, Finland and other northern countries.[242]

Another important component of the festival was the region's first platform for training sessions and festivals in the field of lighting design, as an international congress on lighting technologies and design was also held in Polyarnye Zori. But the main benefit of the Festival has been the first creative space beyond the Arctic Circle in Russia - "Boiling Point". That brings together the work of city activists. Several areas will be developed, including the training of activists, consultations and methodological support for project activities, meetings and sessions on small and medium-sized businesses and non-profit organizations.[243]

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- Internationalization of mid-market firms
- Strategies for winning a global niche
- Emerging markets to emerging markets: internationalization strategies

RESEARCH AREAS

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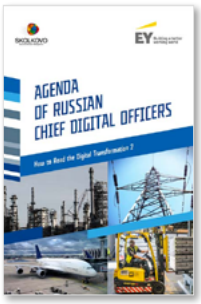
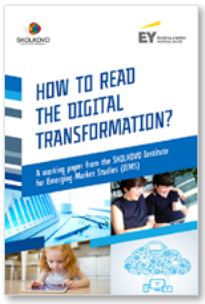
SUSTAINABLE DEVELOPMENT

- Business strategies addressing the United Nations' Sustainable Development Goals
- Responsible consumption
- Sustainable sourcing and supply chains

DIGITAL TRANSFORMATION

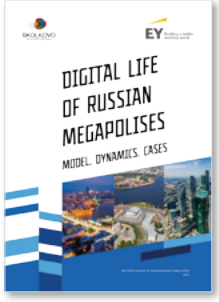
- Digital transformation of the living environment, of business models and of consumer behavior
- Innovations for, in, and from the emerging economies
- Management, governance, and policy in the digital age





IN COOPERATION WITH

Unilever



SKOLKOVO
Moscow School
of Management

Moscow School of Management SKOLKOVO

Moscow School of Management SKOLKOVO is the largest private business school in Russia established in 2006 by a group of forward-looking philanthropists and international business leaders seeking to foster Russia's integration into the global economy. SKOLKOVO aims to develop ethical and responsible leaders who can succeed in the rapidly changing multicultural and technology-enabled environment.

SKOLKOVO offers a broad range of educational programs for individuals and organizations, including international MBA and Executive MBA, customized executive education programs for business and public sector, specialized programs for startups and small and medium businesses, as well as open enrolment programs supporting life-long learning trajectories.

As an open and independent thought-leadership platform, SKOLKOVO brings together business, academia, government, and non-profit organizations to enable continuous dialog around most pressing issues concerning sustainable development for the future.

Awards

FT FINANCIAL TIMES **Executive Education** Ranking 2020

1st in Eastern Europe and the youngest school in the Financial Times' Top 50 for Corporate and Open Programmes.

EFMD Excellence in Practice GOLD 2020

EFMD Excellence in Practice 2020 Gold and Bronze Prize winner

Accreditations and partnerships

EFMD EQUIS ACCREDITED

GLOBAL NETWORK FOR ADVANCED MANAGEMENT

gbsn

EFMD GLOBAL NETWORK

unicon CONSORTIUM FOR UNIVERSITY-BASED EXECUTIVE EDUCATION

AAPBS

CEEMAN

РАБО РОССИЙСКАЯ АССОЦИАЦИЯ БИЗНЕС-ОБРАЗОВАНИЯ

SKOLKOVO Institute for Emerging Market Studies (SKOLKOVO IEMS) was established in 2008 by philanthropist and impact investor Ruben Vardanyan, a visionary and a strong believer in the future role of the emerging markets in the global economy. The same year, EY became a strategic partner of IEMS. Under the strategic guidance of Karl Johansson, IEMS has developed into an international network uniting research teams in Hong Kong University of Science and Technology and Indian School of Business in Hyderabad.

The research mission of IEMS is to provide business executives and policymakers with insights that help make better strategic decisions in the emerging markets. IEMS conducts applied research and offers advisory services focused on the strategic issues of the global economy, international strategies, sustainable development, and digital transformation and innovation.

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