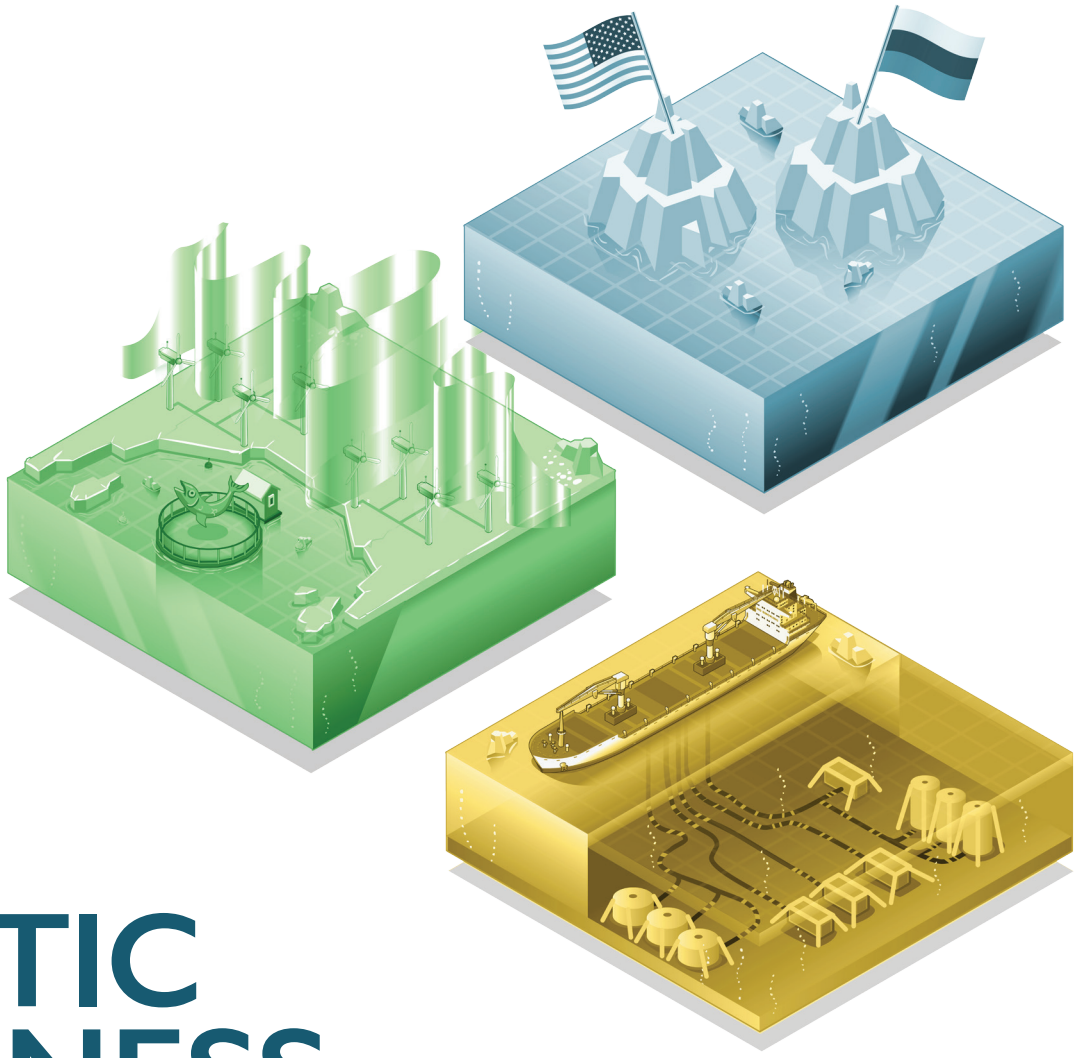

ARCTIC BUSINESS SCENARIOS 2020

OIL IN DEMAND
GREEN TRANSFORMATION
RE-FREEZE

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MENON Business Economics

Commissioned by:

Norges Rederiforbund
Norwegian Shipowners' Association

ARCTIC BUSINESS

CONTENTS

EXECUTIVE SUMMARY

This report was commissioned by the Norwegian Shipowners' Association in connection with the establishment of the ***Arctic Business Council*** and ***Arctic Business 2014*** conference (Bodø, Norway, October 8-10, 2014). It presents three scenarios for the development of Arctic business towards 2020, focusing on the petroleum, mining and seafood sectors, as well as regional and transit shipping.

By illustrating a spectrum of possible futures, scenarios help companies, governments and other actors prepare strategies that can be robust under different outcomes.

The authors conducted workshops and in-depth interviews with business leaders and Arctic experts in order to first determine which driving forces were most likely to shape future industrial development in the region.

This report addresses the following key questions:

- What are the main business opportunities in the Arctic within oil and gas, mining, seafood and world trade?
- How will relations between the Arctic states and with global powers such as China influence business opportunities in the region?
- How will global energy developments affect Arctic business?
- How will climate change awareness and environmental regulations affect Arctic business?

Based on the driving forces and different answers to the key questions identified, three internally consistent scenarios were developed.

Oil in demand is a story about the Arctic taking off as a global petroleum province. Large oil and gas discoveries have been made in the Barents and Kara Seas, followed by large-scale infrastructure development. A multitude of actors take part in the exploration, extraction and transport of natural resources to world markets. Despite political tensions, there is a high level of business cooperation between Russia and foreign partners. China is actively involved in the region, financing petroleum and mining projects and developing infrastructure. Fisheries coexist with extractive industries, though environmental problems with the latter impinge on the image of the former.

Green transformation is a story about a world rapidly adapting to alternative energy, leaving little room for Arctic oil and gas. Climate change has increased the need for alternative food sources; Arctic fisheries benefit from this, although the sector struggles to adapt to rapidly changing conditions. Rapid melting of the sea ice enables increased transit shipping. The global middle class seeks "authentic" experiences, making the Arctic an increasingly popular tourist destination.

Re-freeze is a story about the East-West division of the Arctic in a world that has moved rapidly away from Western-dominated "globalisation" to increased regionalism. Following Russia's intervention in eastern Ukraine, practically all Arctic partnerships with Western companies have been cancelled. Norway is developing the Barents Sea but does not have enough resources to compensate for the reduced Russian gas exports to the EU. China is now financing infrastructure for the exploitation of raw materials in the Russian Arctic, using the region as a raw materials base. Lack of access to Russian mineral resources has spurred Western mining activity in Canada and Scandinavia.

Some of the main findings across the scenarios include the following:

- Energy demand is projected to grow towards 2020 under all scenarios, increasing interest in new sources of supply; however, Arctic offshore petroleum will be competing with many lower-cost sources, including possible advancements in unconventional and renewable energies.

- Challenges related to lack of infrastructure, including oil spill preparedness and search-and-rescue resources, must be solved if costs are to be reduced and economies of scale exploited.

- There is a need to establish sets of common, enforced standards in all industries in order to enable designers to develop cost effective solutions, as well as to meet the scepticism of society about operating in a pristine environment.

- Climate change will have an important impact on operating conditions, while the perception of climate change will influence relevant environmental regulations.

- Cooperation and partnership between industries and across borders generally will be key factors for Arctic business to succeed. Under certain conditions, oil and gas exploration and production can act as a locomotive for other industries; however, coexistence can be a challenge, particularly between petroleum and fishing.

- Technological advancements can be relatively quick game-changers with long-term consequences, as can political developments in other parts of the world (e.g. the Ukraine crisis).

- Chinese economic growth and demand will be important for all sectors; Chinese financing will also be important, particularly for oil and gas and mineral developments if Western companies are not able to participate in Russia.

1. INTRODUCTION

This report presents three scenarios for Arctic Business towards 2020. It seeks to identify the main opportunities and challenges ahead and to inspire the business community to coordinate preparations for the future. Emphasis is on the petroleum, mining and seafood sectors, as well as on regional and transit shipping.

As a starting point for developing the scenarios presented in this report, we carried out workshops and in-depth interviews with business leaders and experts. We asked, what driving forces will shape the future of the Arctic as an arena for extractive, seafood related and maritime industrial activities – and what are the potential implications of these driving forces?

The driving forces identified and presented in this report are partly related to developments within the Arctic, but in some cases are shaped by what happens outside the region. For example, global energy developments are decisive for whether the Arctic emerges as a major petroleum region, while the Ukraine conflict that began in 2014 may continue to escalate tensions between Russia and the West. New markets and potential business alliances in the Arctic can be influenced by these developments.

Based on the driving forces identified and their implications, we have clustered elements for three alternative, internally consistent scenarios for Arctic business in 2020.

Each of the scenarios presented in this report provides different answers to the following key questions:

- What are the main business opportunities in the Arctic within oil and gas, mining, seafood and world trade?
- How will relations between the Arctic states and with global powers such as China influence business opportunities in the region?
- How will global energy developments affect Arctic business?
- How will climate change awareness and environmental regulations affect Arctic business?

Each scenario aims to challenge the reader to visualise and open up for alternative possible futures. Accordingly, neither aspires to predict the "true" future or describe one "best" or "worst" case. The goal is to illustrate how different combinations of developments in the various driving forces provide a spectrum of potential futures. Taking widely different possible outcomes into account helps business stakeholders prepare more robustly for multiple opportunities, as well as for the challenges and risks that accompany them.

2020 is only six years away. Does it really make sense to make scenarios in such a short-term perspective? There are several reasons why the answer is yes. Most importantly, shortening the time frame forces the scenarios to be relevant for decision making today. Secondly, the significant amount of change over the past six years alone illustrates the scope for future changes.

WHY 2020?

While the six-year period to 2020 may not be very long, keep in mind the significant events for Arctic business that have occurred over the past six years:

- The Arctic sea ice has melted far more quickly than expected, contributing to increased access to Arctic resources.
- The US shale gas revolution turned supply and demand patterns upside down, followed by an indefinite shelving of the Shtokman natural gas field, which was intended to serve the US market.
- The 2010 Barents Sea delimitation agreement between Norway and Russia cleared the way for new opportunities for petroleum exploration after 40 years of territorial dispute.
- The five Arctic coastal states convened in Ilulissat, Greenland, in 2008 to unite on the United Nations Law of the Sea as the framework for Arctic governance, reducing the conflict potential of the Arctic's main remaining territorial disputes.
- The Macondo oil spill in the Gulf of Mexico increased public awareness about the scale and consequences of a serious blowout. Stricter regulation followed worldwide, proving an obstacle for offshore petroleum development in both the Canadian and American Arctic.
- There has been a major shift in the geopolitical landscape, where the Ukraine crisis reflects an alteration in Russia's re-alignment towards Europe, while conflicts in the Middle East demonstrate a dwindling post-Cold War Western hegemony.
- China´s economic and military capabilities have grown, enhancing its capacity to claim the role of a dominant global power more quickly than previously expected. China has increased its interest and investments in the Arctic significantly and has become an observer to the Arctic Council.

2. THE ARCTIC IN BRIEF

The Arctic is made up of many different regions. Although these regions share some features, it is important to keep in mind their differences, both in terms of legal jurisdiction and environmental preconditions for human activities. Operating conditions and business opportunities vary.

A common definition of the Arctic is the area above the Arctic Circle at 66° 33′ 44′′ N. Other definitions include certain areas with specific climate and ice conditions, e.g. those areas in the Northern Hemisphere where the average temperature in the warmest month of the year is below 10° Celsius [1]. On land, Arctic regions are sometimes defined as lying north of the highest latitude at which trees grow naturally [2]. The focus in this report is defined more by industrial activity than geography, taking into account the Arctic Ocean and surrounding areas, while also looking at industrial activity on land in the northern parts of all the Arctic countries.

The Arctic population numbers approximately four million people, varying slightly with the different definitions of the region. Population density is greatest in southern Alaska and North-West Russia and the Nordic countries. Of the total Arctic population, approximately 10 per cent are considered indigenous [4], comprising a heterogeneous group that includes the Sami, the Inuit and the Nenets, among others, and in most cases form a minority in the areas where they live [5].

There is currently a wide spectrum of business activities in the Arctic, of which oil and gas, mining, seafood and shipping are the most significant. A brief status update of the four sectors in the region is provided at the end of this report in Chapter 6.

Figure 2.1: Geographical definitions of the Arctic
Source: Nordregio, cartographer Johanna Roto [3]

3. DRIVING FORCES FOR ARCTIC BUSINESS

3.1. ENERGY DEVELOPMENTS

Global energy demand will increase – but will Arctic petroleum be able to compete with other sources of supply?

Although the resource potential for Arctic offshore oil and gas is certainly there, whether or not there will be room for it in the world's future energy mix depends on demand, relative development costs and other supply-side dynamics, as well as the emergence of alternative energy sources.

Global energy demand is estimated to grow from 524 quadrillion BTU (British thermal unit) in 2010 to 630 quadrillion in 2020, an increase of around 20 per cent [6]. Most of this growth is expected to come from non-OECD countries, driven by rising populations and strong economic growth, especially in China and India [7]. Assuming such predictions prove true, the need to replace current resources with new sources of supply will be substantial. Easily available oil and gas from established petroleum areas is in decline, and many oil companies face an urgent need for new, large reserves to add to their balance sheets. For this reason the Arctic, and particularly the Arctic shelf, is of interest, due to its large expected resources. However, there is a lot of ground to cover between expecting resources to be in place and getting them into production.

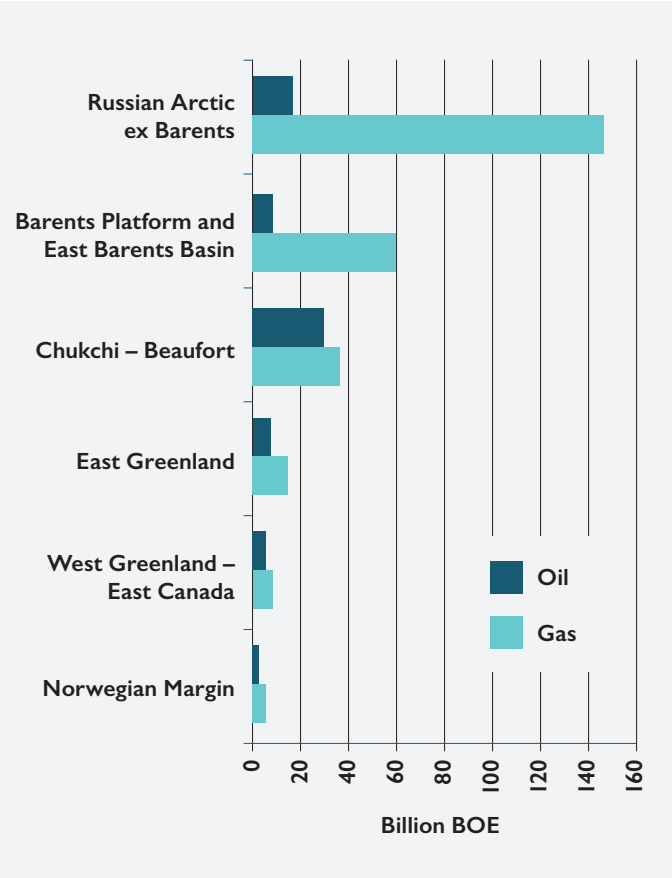


Figure 3.1: Arctic oil and gas resources
Source: USGS (2008) and ECON (2008)

The United States Geological Survey (USGS) was the first to provide an assessment of potential hydrocarbon reserves for the entire area north of the Arctic Circle. Its 2008 report concluded that the Arctic can be expected to hold 22 per cent of the world's remaining undiscovered, technically recoverable petroleum resources. It attributed some 13 per cent of undiscovered oil, 30 per cent of undiscovered natural gas, and 20 per cent of undiscovered natural gas liquids to the Arctic, branding it as a major potential energy province [8].

Since the USGS assessment methods rely heavily on assumptions about geological conditions in the Arctic, of which little is actually known, these estimates warrant prudence.

Given the technical and economic challenges of Arctic exploration and production, the highest prospective resource base will not necessarily coincide with the highest activity level. Russia is the clear winner if judged by expected volumes, but the most promising areas, such as the Kara Sea, where

exploration is currently being carried out, are challenged by great distances and severe climate. The Russian section of the Barents Sea can offer a far more hospitable climate while surpassing North American parts of the Beaufort and Chukchi seas in expected resources. Norway, Greenland and eastern Canada form the "junior" regions in terms of resources, but may still be significant from both national and international perspectives.

The oil and gas industry so far shows a tangible and steady interest in Arctic exploration, although a major wave of activity has yet to arrive. Russian licensing rounds have forged partnerships with ExxonMobil, ENI, Statoil and Shell, bearing witness to sincere competition for access to Russia's Arctic resources. Norwegian licensing has predominantly focused on Arctic waters in recent years and has succeeded in drawing record attention in terms of license applications. This has reinvigorated majors such as ExxonMobil while also bringing new players such as European utilities and Russian Lukoil and Rosneft. Exploration activity resumed in US Arctic waters after the 2008 record lease sale, although Shell's unsuccessful 2012 drilling season in the Chukchi Sea and later challenges have slowed industry enthusiasm in that area. West Greenland saw several wells drilled in 2010-2011, but activity since has been limited.

Arctic oil and gas developments are especially sensitive to changes in oil and gas prices, given the high costs and long lead times involved in fossil fuel exploration and extraction, particularly in such a remote region [9]. It is thus crucial to take factors such as long-term trends in oil and gas prices, and the availability of cheaper and more viable energy resources such as shale gas, into account when assessing the viability of Arctic oil and gas development projects. High oil prices may make Arctic petroleum development attractive – but at the same time increase the incentives to develop unconventional oil and gas or renewable energy in other part of the world.

Arctic projects may be cut rapidly if either environmental regulations or technological developments make renewables more competitive. Global environmental regulation may limit the demand for hydrocarbons as prices for carbon emissions rise, making renewable energy more competitive.

Renewable power generation, including hydropower, is the world's fastest growing source of electric power in the US Energy Information Administration's IEO2013 Reference case [10], rising by an average of 2.8 per cent per year. Cost cutting advances in conventional renewable energy technologies, such as wind and solar, as well the development of new renewable technologies, such as algae-based biomass production, could lead to a far stronger growth towards 2020. Although renewables' impact may not fundamentally transform the energy markets at first, small supply-side expansions may be enough to undermine Arctic petroleum projects, given their high costs. Currently, a "renewable revolution" leading to a rapid shift away from fossil fuel dependency in less than a decade may appear speculative, but looking back – game-changers such as the boom of unconventional oil and gas in the US completely altered the global energy reality within only a few years, taking the world by surprise. Shale gas developments in the US were not a case of high prices making possible the exploitation of economically marginal resources, but a technology-driven shock on the supply side. It is conceivable that similar advances could take place within alternative energy. Government policies and incentives throughout the world may speed up this development by supporting the rapid construction of renewable generation facilities.

Another challenge to the Arctic as a petroleum province is that it is expected to contain mainly natural gas, which can be more complicated to transport. Moreover, the shale gas revolution has caused gas prices to slump. Even though gas might increase in importance as a bridging fuel as the world moves to cut CO_2 emissions, it remains to be seen whether this will make room for Arctic gas. It may require cost-cutting technological progress to reduce the substantial infrastructure investments associated with gas projects today. The question is whether such advances will benefit Arctic gas at the expense of unconventional sources closer to market or benefit gas production more generally. If the latter, Arctic gas's competitive edge might be blunted further.

There is, in any case, a need for Arctic business development to overcome infrastructure constraints and technology challenges. The oil and gas sector holds the potential to be the industry that provides the vital push on both accounts. Better infrastructure and technology, along with increased industry presence and knowledge, will provide positive spillovers for other industries by reducing the entry barriers for all. However, the oil and gas industry poses coexistence challenges. Ports, airports and roads may become congested and emergency response capacities stretched if infrastructure investments to do not keep up with increased activity. Given the limited labour resources in the Arctic, oil and gas projects can quickly drain more traditional industries, such as fisheries, for manpower. A two-tier society may evolve with large differences in purchasing power between those with access to petroleum industry jobs and those without, causing social tensions and undermining the local benefit aspects of the industry's social "licence to operate". Increased offshore or maritime operations in traditional areas of fisheries may cause conflicts of interests unless proper management and decision making process are applied.

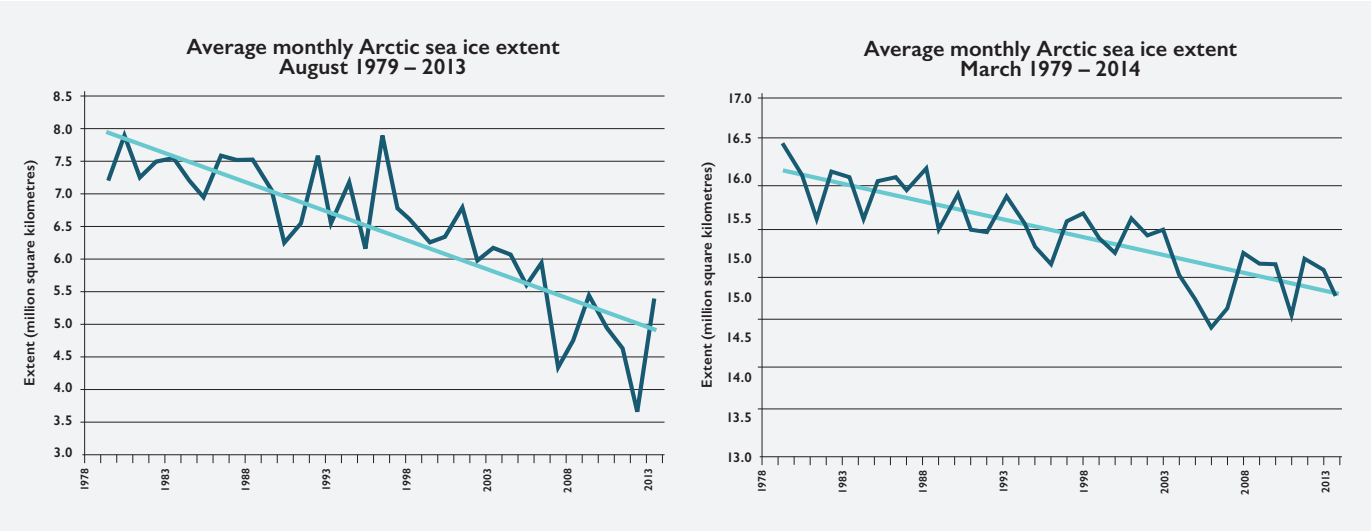


Figure 3.2: Average monthly Arctic sea ice extent in August and March since 1979

Source: NSIDC (2013) [11] Source: NSIDC (2014) [12]

3.2. CLIMATE CHANGE

Melting sea ice and warming of the sea are creating new operating conditions

Climate change is happening faster in the Arctic than in any other region of the world, and is already affecting daily life, particularly the traditional livelihood of indigenous people. For Arctic business, changes in climate and weather conditions both open up new opportunities and create challenges. Melting of the sea ice, warming of the sea and wilder, more unpredictable weather are all factors that will influence Arctic business over the long term, though also possibly towards 2020.

Melting of the sea ice is an example of a phenomenon that has evolved far more quickly than projected by climate models only 10 years ago. Since satellite measurements began in 1979, the end-of-summer ice extent has decreased by an average of 13.7 per cent per decade. The lowest extent to date was measured in September 2012 at 32 per cent below the 1981-2010 average. Ice extent decreases have been significantly slower during the winter months. Since the end of winter 1979, ice extent has decreased by 2.6 per cent per decade. It is important to note that the ice that returns during the winter months is increasingly thinner, as less and less multi-year ice survives.

While the melting of the sea is and will most likely continue to be dramatic, its practical effects on economic opportunities related to Arctic business, are expected to manifest themselves most strongly in the medium-to-long term, i.e. within the next 15-25 years [13]. At the same time, already today sea ice is no longer the critical challenge on the Northern Sea Route. Instead, stable operating conditions, such as Russian cargo fees, icebreaking assistance, poor sea charts, lack of search-and-rescue capacities and limited communication in tandem with variations in climatic conditions are equally important [14]. Increased knowledge about the Northern Sea Route among potential users is also an important factor for increased use.

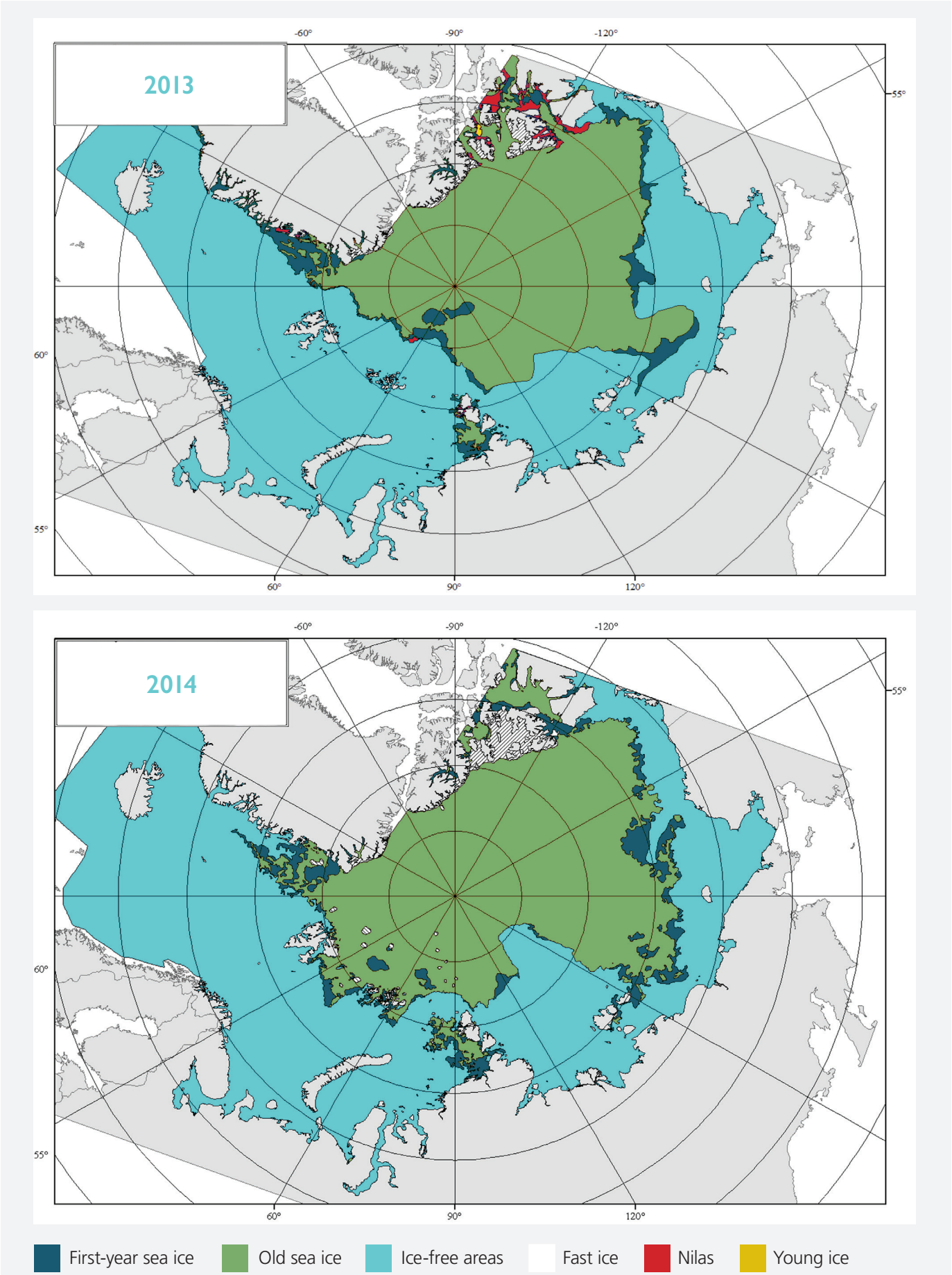
As there are annual natural fluctuations in the ice cover, it is also possible that there will be periods of increasing sea ice. This may limit the significance of climate change and ice melt as a driver for commercial activities, at least in the short term, while also undermining efforts to enact policies and regulations to address climate change.

While the rapid decrease in multi-year ice in the Arctic Ocean will enhance navigability during the summer season, significant obstacles to shipping will remain. These include icing from sea spray, wind chill, polar lows [15] and other challenges to the reliability of weather forecasts, as well as the general remoteness of the area and the implications of this for rescue and emergency operations. During the winter and spring months, ice conditions along Russia's Northern Sea Route will remain heavy, and the number of floating sea ice chunks and icebergs – a hazard to the safety of marine transport – may actually increase during the early melt season as ice floes break apart and drift across the Arctic Ocean [16]. Furthermore, the distribution of the remaining ice will not occur uniformly, while even limited outcroppings of sea ice can have a severe impact on shipping routes. The 2013 shipping season saw significant summer ice remain around the New Siberian Islands and Severnaya Zemlya.

This annual variation of where and when sea ice survives represents a significant obstacle for Arctic shipping in the short term.

Figure 3.3: NSR Conditions in 2013 and 2014

Source: Arctic and Antarctic Research Institute [17]



As the sea ice decreases, particularly during the summer months, areas previously inaccessible for oil and gas companies look increasingly prospective. The Chukchi, Beaufort, Barents and Kara Seas all become more manageable due to less sea ice during the exploration season. However, thawing sea ice can cause problems for petroleum production that utilises the ice for operations, for example along Alaska's North Slope. Due to the long-term planning horizon in the petroleum industry, short-term fluctuations in ice conditions are not expected to significantly affect plans for Arctic petroleum activities.

Climate change and associated melting of the ice can also have a substantial impact on mining operations. A retreating ice sheet on Greenland means that more of its subsurface resources will become available for exploration and, eventually, extraction. Since the industry is strongly interconnected with world trade, its outlook will also be affected by climate change's impact on maritime transport. Cost economies achieved through new Arctic shipping routes effectuated by climate change could in turn increase the feasibility of Arctic mining projects.

Warming of the sea will be of particular importance for fisheries as new species establish themselves and existing ones migrate northwards or disappear. New species might mean new opportunities for fisheries and aquaculture, but their influence on the ecosystem will be difficult to predict. In the Barents Sea, the quotas and the yield of cod reached record levels in 2012 and 2013, after decades of joint management of the existing stocks with Russia [18]. This is related partly to a sustainable management regime, in addition to warmer waters and stocks moving north- and eastwards [19]. A concern in this regard is whether the industry will be able to adapt quickly enough to a changed situation.

A second consequence of sea warming is that new areas previously covered by ice will become available for unregulated fisheries, which may create disputes over quotas and stock movements in the region. Crucially, it is not only the Arctic countries that have histories of commercial fishing in Arctic waters, but also countries from lower latitudes with significant fishing industries. China, Japan, Korea and Poland, for example, already have been fishing extensively for Pollock in the Bering Sea, including in the high seas "Donut Hole". Similarly, European Union fishing vessels, particularly from Spain, Portugal and Greece, have been active in the Barents Sea and the Fisheries Protection Zone around Svalbard.

The five Arctic states bordering the Arctic Ocean (littoral states) have already responded to the possibility that Arctic commercial fishing might occur beyond exclusive economic zones. At a meeting in Nuuk in February 2014, delegates from the five states agreed on interim measures for regulating commercial fishing in the high Arctic Ocean [20]. A Ministerial Declaration for signature or adoption by the five states is planned for 2014, committing the coastal states to "authorise their vessels to conduct commercial fishing in this high seas area only pursuant to one or more regional or sub-regional fisheries management organisations [21]".

Since no such management organisation is currently in place – with the exception of the North-East Atlantic Fisheries Commission (NEAFC), which has competence in a portion of the Arctic high seas area – this can be interpreted as a de facto moratorium on commercial fishing in the high Arctic Ocean [22]. While this is a sensible initiative to take on behalf of the five states, the success of any regulation of high Arctic Ocean fishing in the long term will have to include non-Arctic actors with potential fishing interest in the region.

3.3. ENVIRONMENTAL REGULATION

Stricter regulations may limit business activities

Towards 2020, a new, binding international agreement on limiting greenhouse gas (GHG) emissions may be reached. Any Arctic development would be influenced by such an agreement, which would provide the framework within which CO_2-intensive activities in the region take place.

The objective is to adopt a new climate agreement at the 2015 United Nations Climate Change Conference (COP21/CMP11), to be held in Paris, France, in December 2015. The new agreement is expected to be implemented from 2020 onwards. The United Nations aims to have the first draft of the proposed treaty ready to be signed at the 2014 United Nations Climate Change Conference (COP20/CMP10), to be held in Lima, Peru, in December 2014.

Negotiators and civil society groups credit positive signals from the US and China, the two biggest emitters of greenhouse gases, for a new spirit of cooperation, ending a long period of stalemate [24]. New emissions reduction targets by individual nations are to be submitted by March 2015.

The mechanics of the new agreement are not clear yet, but it is assumed they will consist of a variation on existing carbon pricing mechanisms [25]. A price on carbon increases the cost of utilizing fossil fuels, which will have consequences for the energy mix. For example, it will make coal and oil less attractive, while increasing the competitiveness of gas – as well that of renewables and nuclear energy.

One potential outcome in this context could be that natural gas plays a role as a "bridging fuel" towards a green energy

WHICH REGULATIONS CAN WE EXPECT TOWARDS 2020?

There are several ongoing initiatives towards 2020 regarding business activities in the Arctic:

- A High Arctic Ocean Fishing Agreement is currently being considered by the five states bordering the Arctic Ocean (Norway, Russia, Alaska, Denmark (Greenland) and Canada). In April/May 2013, these five littoral states discussed issues concerning potential commercial fisheries in the high Arctic Ocean beyond their respective exclusive economic zones. The five states do not expect such activities to start in the very near future, but have agreed that interim measures should be developed to "advance the proposition that commercial fishing in the high seas area of the central Arctic Ocean should take place only pursuant to one or more regional or sub-regional fisheries management organisations or arrangements that are or maybe established to manage such fishing in accordance with modern international standards [26]. "It is understood by the A5 that, due to their geographical location as Border States, the right to establish any such initiative should remain with them.

- The US has unilaterally imposed a moratorium on fishing north of the Bering Strait in its exclusive economic zone stretching from the Russian to the Canadian maritime borders. This was put in place as a pre-emptive measure due to the melting of the sea ice and the fear that there would be unregulated fishing in Arctic waters as the climate changes [27]. In near Arctic waters around Iceland and the Faroe Islands [28], the yield of mackerel and herring has reached unprecedented highs, leading to an extended conflict between Norway, the European Union and Iceland and the Faroe Islands.New regulation – or disputes concerning a lack thereof – will therefore play an integral role in future Arctic development.

- International Maritime Organization (IMO) is currently developing a mandatory International Code of Safety for ships operating in polar waters (Polar Code), coordinated with the IMO's Sub-Committee on Ship Design and Construction (SDC). The Polar Code is intended to cover the full range of shipping-related matters relevant to navigation in waters surrounding the two poles – ship design, construction and equipment; operational and training concerns; search and rescue; and, equally important, the protection of the unique environment and eco-systems of the polar regions [29]. The Polar Code is planned to be adopted in 2015, which can result in a potential entry into force in 2107.

future. However, Arctic gas is not likely to be the most cost effective gas. Moreover, cost effective shale gas also may be increasingly available in Russia's current customer countries.

A possible counter-development could be that gas's reputation as a transition fuel is damaged if it turns out that methane emissions along the gas chain (including long pipelines) are higher than originally expected, causing us to view gas as hardly more climate-friendly than coal [30].

Another issue the oil and gas sector is facing is that negative events in the petroleum sector may increase demands for increased regulation. This already has been seen in the US, where several regulatory reforms followed the Macondo oil spill of 2010 [31]. In the aftermath of the its well blowout in 2010, both the US and Canada halted subsequent Arctic offshore drilling and underwent a review and a restructuring of their licensing and regulation processes. These new regimes still have not been fully tested, as subsequent offshore development has been delayed or halted. Additionally, after Shell´s halt in exploration in the Chukchi Sea, the call for further streamlining of the regulatory process in the US prompted the federal government to draft drilling requirements specifically tailored to the Arctic. These new operating standards are not expected to hinder future development, environmental organisations are actively lobbying for a stronger set of rules to limit potential projects.

Environmental regulations have already affected development in the mining sector. For example, in Finland a permit boom for new mining projects in 2011 was followed by prolonged legal disputes over emissions and water

pollution, and in 2012 several Finnish mining companies were faced with permit reviews [32]. Projects were not halted outright, but environmental permits were regulated more strictly. Claims granted in June 2014 for diamond exploration in Finnish Lapland (Tana River) by the Finnish Mining Authority led to protests in neighbouring Norway about potential effects on salmon stocks [33].

In Norway, the Nussir mining project in Kvalsund, Finnmark, gained political approval despite public protest and negative recommendations from several government authorities. The project plans to deposit sludge from ore separation processes in the Repparfjord, leading to concerns about the effect of local pollutants on bio resources in the area. Legislation aimed at protecting certain fjords for the sake of the wild salmon population previously stopped a condensate-reloading project in Varanger. Increased interest in Arctic mining likely will accentuate conflicting interests between this industry and the fisheries and aquaculture sector.

Norway opened a new coal mine in 2014 on the island of Svalbard, with the aim of safeguarding its territorial interest in the Arctic by maintaining economic activity in the archipelago and sustaining the community at Longyearbyen through the company Store Norske Spitsbergen Kulkompani AS [34]. Although the mine is not facing any specific regulatory difficulties, the project has sparked controversy because Norwegian lawmakers are currently pushing to ban the Norwegian Government Pension Fund Global from investing in coal stocks due to environmental concerns.

Environmental concerns pose challenges to Greenlandic mining projects, and local concerns regarding projects' impact on traditional ways of life add weight to environmental objections. On the other hand, clearer environmental regulations for the mining industry could actually help speed up project development by increasing clarity and reducing political risk.

3.4. CHINA´S GROWTH

China is taking a stronger position in the Arctic. How extensively will its resource and transport needs affect Arctic business developments?

Despite its lack of physical proximity to the Arctic, China has demonstrated a significant and sustained interest in the region. China's growth is likely to be a key driver for Arctic business. The country will probably also be a market for fisheries resources, as a potential investor in infrastructure and development, and as a political player in the game for Arctic influence and resources. China´s strategy has so far been based on pragmatism. How its role in the Arctic

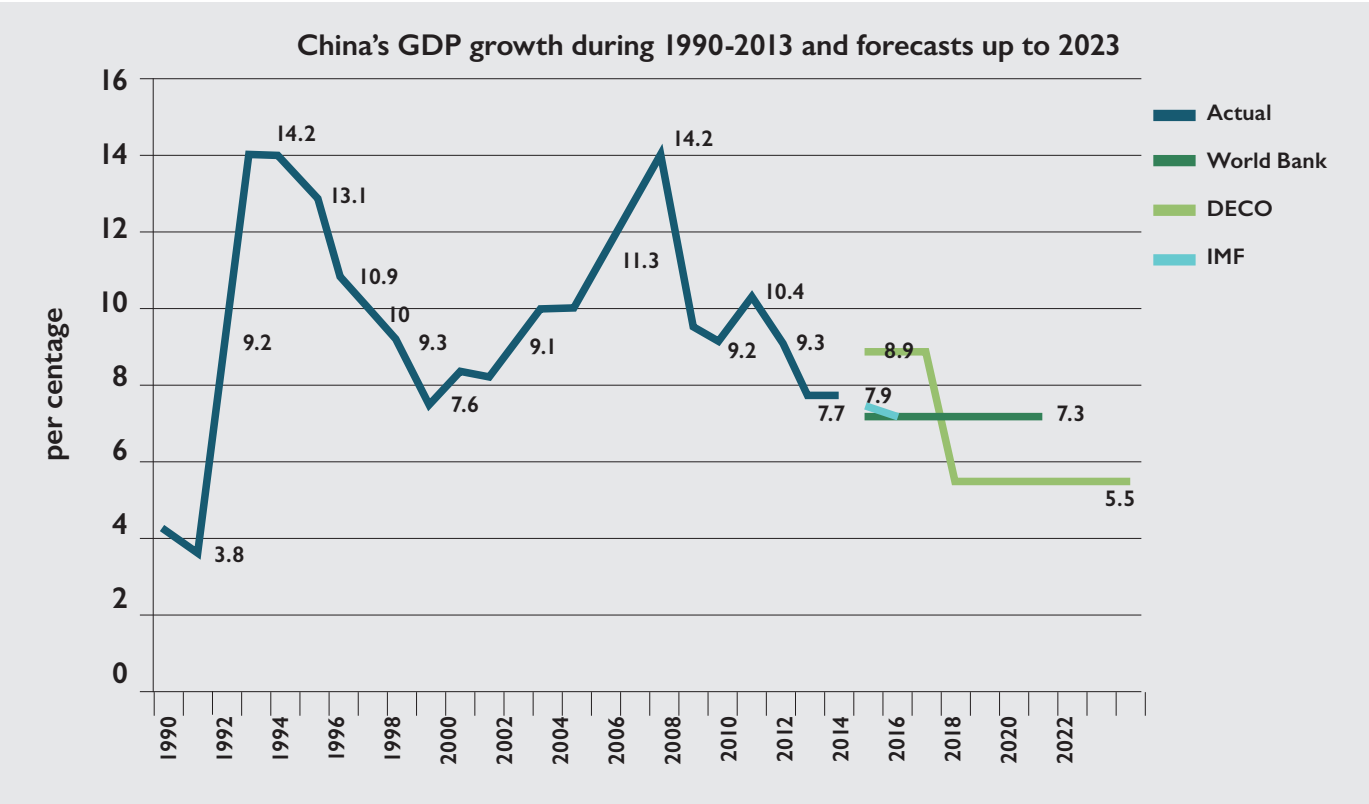


Figure 2.4: China's GDP growth
Source: World Bank and others

develops will in part depend on its own prioritisation of the region but also, to a large degree, on how much acceptance and openness it will receive from the Arctic states. For example, in May 2013, China was granted observer status in the Arctic Council.

Many economists predict that the People's Republic of China will surpass the US economically by 2020, possibly as early as 2016. It has also been argued that China may replace the US as the dominant world power as early as 2030 in terms of trade and supplies of capital [35].

However, there is also concern that the Chinese economy may not be able to continue to grow at its current pace, while some believe that, regardless of its economic strength, China´s future domination is exaggerated. For example, economic growth does not necessary imply that China will have the power to shape events and the actions of others [36]. China's stated defence budget for 2014 is some US$ 132 billion – an increase of more than 12 per cent over 2013 levels, following "double-digit increases almost every year for the past two decades [37]". However, military spending by China as a percentage of GDP remains far below that of the United States, which spent six times as much as China on defence in 2012 [38].

There are also claims that some regions in China have severely overstated local GDP growth rates, that GDP rates may be inaccurate as a result of faulty statistics, and that negative externalities associated with current levels of growth are not being adequately accounted for.

Unless China's growth stagnates, there will be a continued need to secure a diversified supply of energy as well as other resources to sustain growth. China surpassed the US as the world's largest energy consumer in 2010 and became the largest importer of crude oil in September 2013. China's oil imports are projected to increase from 54 per cent of its total consumption in 2010 to 66 per cent in 2015 and to 70 per cent in 2020. China has taken a broad approach to ensuring diversification of its resource supply. Over the past decade, China has begun to extend its strategic reach beyond Southeast Asia, and its business activities have become a prominent feature of many African countries [39]. The Arctic may be the newest region where China aims to exert a significant amount of commercial influence.

Chinese economic growth has been an important driver behind the price growth in global commodity markets over the last two decades. Should the Chinese economy slump, this will result in lower prices for many minerals. While the Sørvaranger iron ore project in Kirkenes, Norway, was deemed profitable at its outset, slumps in ore prices since commissioning have negatively affected the project's profitability. Considering the high development costs of mining projects in general, and in the Arctic in particular, marginal profitability could put such projects to test if Chinese growth fails expectations.

In tandem with China's economic growth, its demand for a safe and secure supply of nutrition is increasing [40]. The World Bank predicts that China will consume 38 per cent of all fish [41] by 2030, and that more than 60 per cent of all new demand will be met by farm-raised fish. Already today Arctic waters off the coast of Alaska and Northern Norway are used for fish farming, constituting a significant Arctic industry -- while also using the Arctic "brand" to emphasise quality and purity. The potential for Chinese demand to spur increased production of "exclusive" Arctic products should not be underestimated [42]. Since the Chinese fishing fleet currently dominates much of the world's oceans, one can expect an influx of Chinese vessels as the Arctic opens up for commercial fisheries. This is particularly relevant for the Bering Strait and the maritime area stretching from the Bering Ocean up towards the North Pole.

Today, China operates the world's largest non-nuclear icebreaker, the Xuelong (Snow Dragon), and has plans to put a second icebreaker into operation within the next few years. The country has undertaken multiple expeditions to the Polar regions and maintains a scientific station (the Yellow River Station) on Svalbard. China's interest in the region is partly based on geopolitical considerations, including regional strategic partnerships with Iceland and Greenland [43].

Chinese firms have been investing heavily in energy, commodities and transport. One example of long-term strategic thinking on the part of Chinese firms are ongoing and significant investments along the Suez Canal route. Thus far, interest in the Arctic by China's shipping sector has been limited. In the summer of 2013, COSCO sent the vessel Yong Sheng on the country's first ever commercial transit of the Northeast Passage above Russia, known as the Northern Sea Route. After this initial voyage along the Northern Sea Route, the company put out a press release explaining that the vessel would be returning via the Suez Canal and that, although the route might be profitable, it would be impossible to scale up.

Towards 2020, the biggest question is, however, how developments in the energy sector will play out. China needs energy resources, and these resources may or may not come from the Arctic, depending on how commercially viable and competitive Arctic oil and gas production turn out to be. Increased focus on climate change and stricter environmental regulations limiting pollution from coal-based power plants

may increase the attractiveness of natural gas in the next years. Some of this gas might come from the Arctic, but China also has other procurement options.

If production costs in the Arctic are significantly higher than elsewhere, there is little incentive for China to invest in infrastructure, besides supply diversification. The same goes for shipping and the Northern Sea Route: it will only be interesting if it can be scaled up and provides a distinct cost advantage compared to the Suez route. Yet, demands in a growing Chinese economy have the potential to spur Arctic development, as China seeks to leverage against overdependence on specific geographic areas for particular commodities. Political and financial investment in projects on Iceland, Greenland or in Svalbard/Norway must be understood in this context, as China is not only growing as an economic actor, but also as a political actor on the world stage. Investments that do not hold an immediate financial benefit often serve multiple other purposes in China's long-term planning, and this could hold true in the Arctic as much as it already has in other regions.

On the other hand, if internal pressures and a declining growth rate force China to slow its spending, the country could reduce the amount of attention it pays to the Arctic. While shipping routes and resources represent potential strategic interests, a constrained budgetary environment may lead China to focus more on securing current resource bases and maritime lines of communication than on investing in a relatively far-off and speculative region. Likewise, while China certainly has legitimate scientific interests in the Polar regions, its primary concerns in this regard relate to rising sea levels and climate change; given the inherent collaborative nature of work on these issues, China could likely decrease its spending on in-region work while still benefiting from data collected and analysis performed by researchers from other nations.

3.5. RUSSIAN DOMESTIC POLICIES

Russia is set to lead Arctic petroleum developments, but will decision-makers provide a favourable business climate?

To Russia, the value of Arctic resources lies not only in their monetary value as tax income, but also as a means to finance Russia's presence in an area that covers more than a fifth of the country's territory. To access these resources and facilitate their development, substantial investments have to be made in communications and onshore transport infrastructure, as well as search-and-rescue capacities.

Russia has substantial experience working in the Arctic, and this experience can embolden decision makers to venture into ambitious projects. However, Russia's expansion into the Arctic is very much the result of political focus, and the current openness towards foreigners is a conscious development strategy. Changes in the domestic sociopolitical landscape and increasing conflicts with Western countries may yet divert policymakers' attention away from its current Arctic push.

International cooperation is currently seen as a prerequisite for stepping up Arctic navigation along the Northern Sea Route and for harnessing offshore oil and gas projects. Offshore equipment technologies are important, but equally important is the capacity to engineer, plan and execute complex projects in a financially sustainable way. The partnerships of Rosneft with ExxonMobil, ENI and Statoil reflect the fact that international partnerships are seen by Russia as instrumental to realising its Arctic agenda. These partnerships inaugurated a new era of Russian openness to foreign players after a long period of resource nationalism and restrictions. As the Arctic continues to be viewed by Russia as an area of strategic standoff with foreign adversaries, rather than a change in fundamental sympathies, foreign partnerships reflect a pragmatic cooperation model, allowing Russia to balance its dependence on foreign input against its reluctance to give concessions to foreign companies.

Russia is in the fortunate position of having inherited infrastructure along much of its Arctic coast. Due to limited activity in the region since the breakup of the Soviet Union, however, military and security interests have continued to dominate the region and define the rules. Security concerns currently deny commercial players and foreign citizens access, effectively limiting the use of much infrastructure for business development. The question is whether Russia will have the political will and capacity to challenge security interests' monopoly on setting the rules of the game, so that towns such as Amderma and Dikson, for example, can be re-tooled to serve as mustering points for crew changes and equipment.

A policy of increased international cooperation has opened up new opportunities for foreign offshore companies in Russia. But foreigners have been restricted from gaining resource rights. So far, Russia's President Vladimir Putin and Rosneft head Igor Sechin have been the guarantors and architects behind the currently relatively open model for foreign participation. However, policy towards foreigners has changed more than once before and may change again. Changes to the domestic power configuration could draw Russian policy makers' attention away from Arctic petroleum, causing development to slow down. This would in turn impede trade-related transport along the Northern Sea Route, as increased oil-and-gas-related cargo presumably

would be needed to raise transport volumes to a critical mass necessary to make this route a truly commercial option.

Russian seafood policy, on the other hand, has been directed at increasing self-provision, which includes domestic processing. This policy is likely to continue, leading to fewer raw materials for the limited fish processing industry that is left in Norway. Russia is an important market for Norwegian fish exports, but Norwegian producers have been meeting increasing market barriers. As of January 1, 2014, all but a limited number of exporters were given access to the Russian market, and as of August 7 2014, Norway has been faced with a complete fish and agriculture embargo. In the short-to-medium term, Russia's domestic production will not be able to compensate for imports, but its self-sufficiency goals, combined with deteriorating bilateral relations between Russia and Norway, could put the existing Barents Sea fisheries management cooperation at risk.

3.6. INTERNATIONAL RELATIONS

Are we headed towards a new global block division?

Following the break-up of the Soviet Union, American political scientist Francis Fukuyama declared the "End of history [44]", claiming that the global spread of Western liberal democracy and the market economy marked the end of humanity's socio-cultural development. "We may be witnessing [...] the end of history as such: that is, the end point of mankind's ideological evolution and the universalisation of the Western liberal democracy as the final form of human government. [45]"

Starting from a multi-polar international system, in which Western powers competed with and fought against each other for centuries, a bi-polar world order emerged after World War II, with the US and the Soviet Union competing and deterring each other militarily in what became known as the Cold War [46]. The breakdown of the USSR subsequently led to a period of unipolar dominance by the US. Over the past decades, however, non-Western societies, particularly in East Asia, have developed at an almost unprecedented rate, creating the foundation for a global power shift from West to East, politically, economically and socio-culturally.

China is frequently pointed to as the world´s rising superpower – but other emerging economies may also play an important part in the new international system. Russia is still a major power with the world´s largest territory and substantial resource wealth, though at the same time vulnerable due to its resource dependency, population decline, weak institutions and corruption. As long as energy prices remain high, economic reforms are implemented and political stability is maintained, the country has significant potential. The question, however, is how probable it is for all these criteria be met at the same time, e.g. high oil prices tend to undermine the need for reform.

There have long been worries about geopolitical tensions over sovereignty intensifying as new opportunities open up in the Arctic. Russian flag planting on the bottom of the Arctic Ocean in 2007 was seen by some as a sign of aggression, leading to global media claims of a "race for the Arctic". Most Arctic resources are, however, located in undisputed areas, and several previous major sovereignty disputes have already been resolved.

Nonetheless, Arctic business may be affected by international tension in ways previously unexpected. The outbreak of unrest in Ukraine in 2013, followed by the Russian annexation of the Crimean peninsula and ensuing Ukrainian civil war, has led to a serious worsening of the relationship between Russia and the US and Europe. The West has imposed sanctions that limit foreign partnerships with Russia, including in the petroleum sector. Offshore projects will likely see slower progress because of less managerial know-how and because access to key technologies and equipment have been cut off. As a result, the Russian oil industry may concentrate further on onshore projects. A further escalation of the conflict may threaten the use of the Northern Sea Route or the joint fisheries management regimes.

The long-term consequences of the Ukraine conflict are still unknown. Many believe that mutual economic dependency and corporate interests will trump politics, making the current unrest temporary. Given the complex dynamics of the conflict, however, the outcome could conceivably go in the other direction.

If the relationship between Russia and the West worsens, Russia may turn increasingly eastwards. In May 2014, Gazprom and the Chinese state-owned China National Petroleum Corporation signed a deal believed to be worth some US$ 400 billion to provide China with up to 38 bcm of natural gas per year over a 30-year period [47]. It has been claimed that China was finally able to obtain favourable terms due to pressure being felt by Gazprom to increase its interests in Asian markets in light of the dispute with Western Europe over Ukraine. The deal, which was preceded by over ten years of negotiation, is strategically important for China in several respects. Critically, the arrangement will help to insulate China – the world's third-biggest importer of liquefied natural gas – from fluctuations in the Asian LNG spot market, such as the record high prices that developed in early 2014 [48]. Likewise, the Chinese government is actively

looking to move away from coal-burning plants as part of ongoing efforts to curb the country's increasing pollution problems. To this end, the government has set a target of using 420 bcm per year of natural gas by 2040 [49].

An increased focus on developing Sino-Russian cooperation also may lead to increased interest in mining projects, including in the Arctic. While such projects would increase the level of industrial activity in the region, ancillary business opportunities for Western companies would be limited. Mining is well within the know-how of Russian and Chinese companies, while the Chinese generally prefer to award contracts to Chinese companies when possible. In that case, the main potential cargo flows from activity in the Russian Arctic may be related to projects without western partners. Although cargo flows may increase, the business opportunities for Western companies will be more limited.

For decades, Norway and Russia have jointly managed the fish stocks in the Barents Sea, with particular regards to cod. This has led to a record high yield in 2012 and 2013 [50]. As fishing vessels move further north, such cooperation is essential for an industry that depends on sound international resource management. Such cooperation may be threatened if international tensions rise further. However, cooperation in Norwegian-Russian fisheries management has enabled these industries to weather many past downturns in East-West relations.

Potential strengthening of Russian-Chinese ties may be countered by a revival of the NATO alliance and the approval and implementation of an EU/US free trade agreement (TTIP). As a result, after many decades of increased globalisation, we may be heading towards increased regionalism, where new competing blocks are formed, some of which could seek to become self-sufficient in resources and industrial production.

3.7. ARCTIC COOL

Perceptions matter for business development

The global perception of the Arctic is an additional factor that will influence future business development in the region, be it oil and gas, mining, fisheries or trans-shipment.

The image of the Arctic as a pristine, snow-and-ice-covered region has strong public appeal, which may spark new opposition to industrial development. Greenpeace has focused on the risks of petroleum development in the region, e.g. receiving broad media attention for its activities to counter the start-up of oil production from Russia's Prirazlomnoye field, during which several of its activists were arrested. The environmental movement may increase momentum towards 2020 as people experience the effects of climate change, or as fear about such changes mounts. A new "green wave" may make the oil and gas industry increasingly taboo, at least in the Arctic, negatively affecting opportunities for large-scale petroleum development in the region. However, another narrative may also gain a foothold, under which the Arctic is not construed as a unique region, but one where industrial activity simply has unique requirements. The difference is subtle, but in the latter narrative, which the Norwegian government appears to be pursuing, industrial activity has its place in the Arctic.

While oil, gas and Arctic transit shipping would benefit from the latter narrative, the seafood sector might be disadvantaged if the public ceases to perceive Arctic products as exceptionally clean and wild. Focus on a "green" lifestyle may increase the demand for products that are seen as healthy and clean, implying big business opportunities for products that are able to benefit from the Arctic's pristine image. One can, for example, imagine that in 2020 restaurant guests will be able to order fish while using their smart phones to locate where it was caught and even view a video of the catch. As green concerns catch on in China, an increase of only 0.1 per cent of China's population choosing Arctic fish could mean significant market opportunities.

The Arctic may also emerge as a popular tourism destination, featuring wilderness, animals, midnight sun and northern lights, as well as the customs of its indigenous peoples. This represents another set of business opportunities, though one that may conflict with more industrial ones. Increasing attention to the claims of indigenous populations that industrial development harms traditional livelihoods such as reindeer herding may also harm the case for industrial activities. Increased demand for indigenous products – such as reindeer meat or handicrafts – could represent an alternative business opportunity, while improved infrastructure and money coming in to the regions may create opportunities to develop small-scale businesses and transport goods to outside markets.

3.8. COMMUNICATION

Advances in information technology may improve the surveillance and control needed for Arctic operations

Improved communications and monitoring capacity is a prerequisite to harnessing Arctic resources and transport. Towards 2020 we may see improvements in both satellite and earth-based systems, which will be decisive for shipping, the exploration and development of oil and gas and for fisheries.

Today, insufficient satellite coverage in the Arctic creates

challenges for search and rescue, reliable communications and data transfer, as well as possibilities for remote operations. It was only in 2010 that the first satellite built specifically to measure sea ice thickness, CryoSat2, was launched. Iridium, the only commercially available satellite network with continuous coverage of the Arctic, lacks surveillance capability, and because it relies on frequent handovers from one satellite to another, it suffers from bandwidth and reliability challenges. While the system suffices for phone calls and simple emails, large data transfers are not possible.

Future Arctic operations will require high-speed internet connections and remote sensing in order to provide emergency response based on sufficient information to adequately address emergency situations. The Iridium network is set for an upgrade starting in 2015 that promises to increase bandwidth from 128 kb/s to 1.5 mb/s and mitigate data link handover issues between satellites [51]. The first satellite by a private company for monitoring sea ice conditions for commercial navigation purposes was launched in late 2013 by Weathernews Inc [52]. Likewise, the Sentinel satellites, part of the Copernicus environmental monitoring system of the European Space Agency (ESA), are to provide numerous services starting in 2014, including "monitoring of Arctic sea-ice extent, routine sea-ice mapping and surveillance of the marine environment, including oil-spill monitoring and ship detection for maritime security [53]".

The Molniya (Russian for Lightning) orbit utilises a highly elliptical path that passes close to the Earth at the South Pole and far from the Earth at the North Pole, providing long periods of Arctic coverage per overflight. Each satellite maintains visibility of the Arctic for eight hours, implying that three satellites will be sufficient for continuous coverage of the region. The Molniya orbit was launched by the Soviet Union in 1965 and has since been used for television broadcasting and military reconnaissance purposes. The defence contractors Raytheon and Northrop Grumman have developed the Enhanced Polar System (EPS) [54], which is set for launch in 2016 and uses the Molniya orbit, to expand communication coverage for the US military in the Arctic. Software services, like the Raytheon Arctic Monitoring and Prediction (RAMP) [55] tool, are using these new sources of data to help those operating in the Arctic do so more cheaply and safely. The Canadian military is considering building two satellites for Arctic communications, with work expected to start on these in late 2016 [56].

Safety and environmental concerns may also induce Arctic stakeholders to launch additional satellite capacities as a cooperative effort, realising that without adequate communication and surveillance systems, Arctic risks will lead to prohibitive costs and lost opportunities for all. Increased civilian infrastructure along the Molniya orbit would also solve global navigation satellite system (GNSS) augmentation

Figure 3.5: EADS (Airbus) Arctic Airship Concept
Source: WN.com [60]

Figure 3.6: DP 27 "Anyuta"
Source: RT.com [61]

issues, increasing the navigational precision of GPS and GLONASS, as well as the future GALILEO system, all of which currently suffer from inaccuracies at Arctic latitudes [57]. Russia is already pioneering an Arctic satellite-based monitoring system – Arktika [58]. However, international cooperation is needed to accelerate these endeavours and to ensure that they meet the requirements of commercial players as they gain experience from Arctic business and expectations grow.

Earth-based systems are also enhancing communication, and monitoring capability is increasing. In the air, unmanned (and unarmed) aerial vehicles such as the American high-altitude 'Global Hawk', modified for use in Arctic conditions, are being considered for monitoring sea ice and for disaster management. The Buoyant Airborne Turbine (BAT), a cylindrical helium-filled balloon tethered to a ground station, currently being developed by Altaeros, can serve as a platform for transmission equipment, cameras or other sensors; for example to help aid in iceberg detection and monitoring, since it gives a line of sight over 100 km (60 miles) in any direction. EADS Innovation Works, part of the Airbus Group, has designed a concept for an unmanned airship that is intended to cruise Arctic areas at low (60 km per hour) and high (150 km per hour) speed for surveillance and communication purposes. If financing partners are found, a prototype will be tested in 2016.

In the shorter term, the Russian armed forces plan to utilise an unmanned blimp-like airship for Arctic monitoring starting already in 2016. Low fuel consumption means that such systems can operate autonomously for long periods of time and travel significant distances while providing surveillance capability and acting as relay base stations for digital VHF communications, supplementing satellite monitoring and communications capacity. The DP 27 "Anyuta's" advantage over other airships lies in its ability to statically position itself without being anchored to the ground.

Several subsea cables are under development to bring high-speed communications to remote Arctic locations. The Arctic Fibre [59] and Arctic Link broadband projects will span more than 15,000 km from Japan to Europe, running through the Northwest Passage. The first connection could be ready by November 2014, with local spurs serving Nunavut in north-eastern Canada and others serving northern and western Alaska. The Russian Optical Trans-Arctic Submarine Cable System (ROTACS) is expected to run 14,700 km along Russia's northern coast.

Increased monitoring and communication capability is being driven by (and is driving) increased activity levels in the Arctic. Furthermore, it is increasing scientific awareness of the importance of the region for studying environmental conditions at lower latitudes. The rapidly falling cost of IT systems is also behind the growth of monitoring and communication capability. For example, the Weathernews satellite is estimated to have cost about US$2.5 million (about 15 million Norwegian kroner), a fraction of what a similar system might have cost just a decade ago. Nevertheless, the costs of Arctic operations can still be staggering. Coverage of the Canadian Arctic by Global Hawk drones is estimated to cost about US$1 billion, while the Arctic Fibre subsea cable project is estimated to cost up to US $1.5 billion.

For all Arctic maritime activities, including those related to petroleum, fisheries and world trade, increased communication and surveillance capability mean greater safety. More and more accurate observations on ice extent and movements mean vessels can venture further and for a greater part of the year without icebreaker assistance. Unmanned aerial patrolling will increase the ability to find and save sailors and vessels in distress. For the oil industry in particular, increased communications capacity is vital for remote operations that reduce the need for manpower and reduce costs.

3.9. TECHNOLOGY

Advances in technological design and integration will create new opportunities

Today, large parts of the Arctic are unavailable for commercial activity due to a lack of technological solutions – or due to currently available solutions having costs that are not commercially viable. Cargo and passenger transport, seismic and drilling operations, and all maritime operations are constrained by the severe winter climate. Transit shipments though the Northern Sea Route, NWC and, potentially, the Transpolar Sea Route, generally require ice-class tonnage and icebreaker support, placing physical constraints on volume and raising costs. Present-day seismic research and

drilling vessels can only operate in the summer season. This, combined with remoteness and substantial transit distances between areas of operation, implies substantial limitations to exploration vessels' productive time and raises costs. A typical seismic season in the Russian Arctic is limited to 100 days, sufficient for a vessel to conduct a 3D survey of only one licence area. For example, Rosneft and ExxonMobil's 2014 drilling campaign in the Kara Sea was only able to complete one well before the West Alpha vessel had to leave the area.

Numerous innovative new ship and oil rig designs have recently been developed for cold climates. Ulstein's unique X-BOW® design offers less hydrodynamic drag, higher transit speeds in calm water, and no water slamming in the foreship, according to the company. This latter could be beneficial in cold conditions, as diminished sea spray mitigates the threat of vessel icing. The innovative Baltika icebreaker can move obliquely, to carve out a path wider than the vessel itself. The first ship of this type will enter service in mid-2014. Double-acting cargo ships, which were pioneered by AkerArctic for Norilsk Nickel, have since become the backbone of the Yamal LNG project's logistics operation. Yamal LNG anticipates that its LNG tankers will be able to break 2.5-metre ice autonomously. Increasing penetration of these technologies will reduce dependence on icebreakers at the beginning and end of the ice-free season.

Norwegian Kvaerner and American ExxonMobil have submitted patent applications for ice-resistant drilling rigs that can be left in place over the winter season. Cost estimates promise that constructing special-purpose drilling vessels will reduce the cost of exploration drilling compared to leasing existing rig types commercially. Ice resistant rigs may remain in place through the winter, so reduced transfer time and drilling capacity while locked in ice may potentially expand drilling capacity to three wells per season. In a concept study conducted with DNV GL, AkerArctic envisions the possible

Figure 3.7: Yamal LNG Tanker Design
Source: AkerArctic [66]

use of metallic foam composite materials [62] on ice-class vessels that could act as deformable impact-absorbing layers in the event of an ice collision and as flooding barriers in the case of a hull breach.

Additive manufacturing (or "3D printing") is seen as a way to provide prototypes during the design phase, as well as functional parts. The Arctic is likely a prime environment for 3D printing technology, as people and companies there are eager for ways of reducing logistics delays and costs. Uptake of this technology could be highest among scientific, oil and gas, and military endeavours, due to the high need for custom-built, specialised parts. In the shipping, mining and infrastructure sectors, where strength and reliability issues are more important, the uptake of 3D printing may be lower, at least in the near term.

New robotic IT equipment, such as nimble robotic hands, immersive vision systems, and humanoid walking robots, are also pushing the ability of "tele-presence" solutions to reduce the need for people on site. New materials are also likely to be a key factor in the viability of many Arctic projects. Researchers worldwide are developing better insulators,

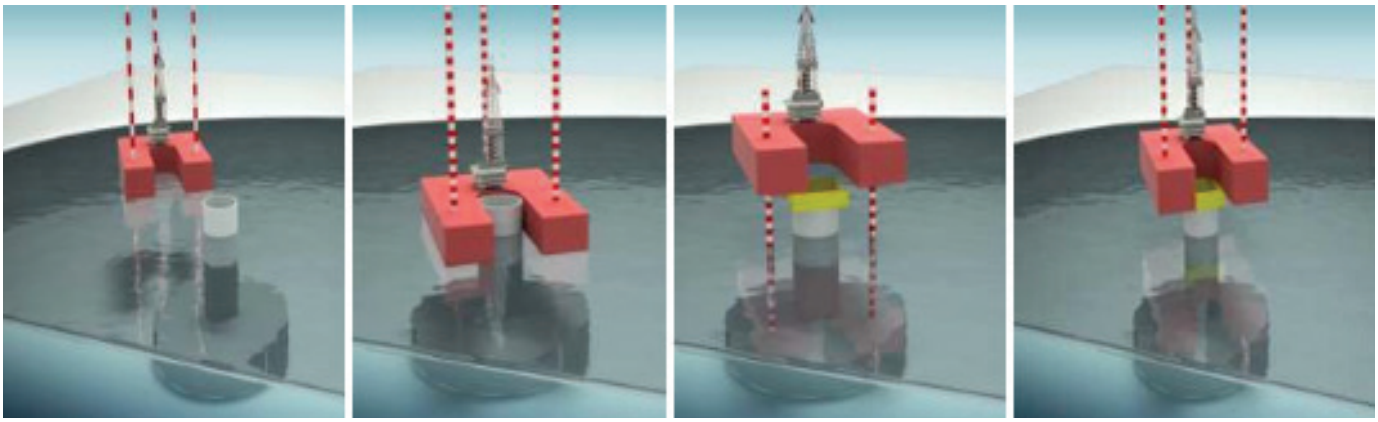


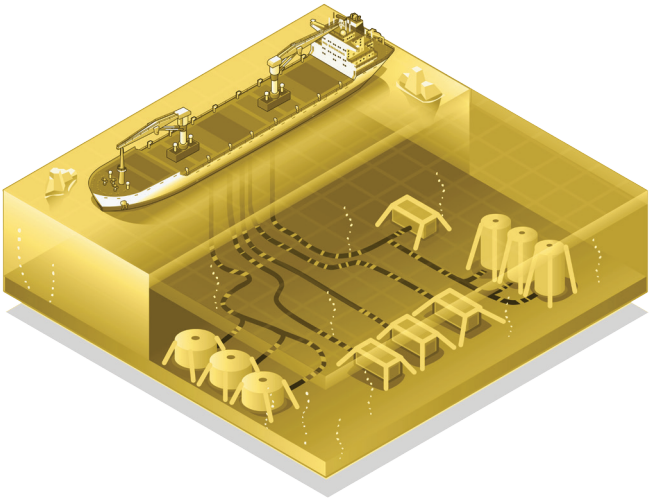
Figure 3.8: Kvaerner drilling rig concept
Source: Kvaerner [67]

materials with icephobic ('ice-fearing"), hydrophobic ("water-fearing") and nano-patterned surfaces, and those that can combat contaminants in the environment or can prevent them from getting there in the first place. In 2012, a team from Harvard University reported coating metal surfaces with a strongly icephobic material called SLIPS (Slippery Liquid Infused Porous Surfaces) that they claim greatly reduces the formation of ice and makes ice removal significantly easier than it is on uncoated metal surfaces. Scientists have also recently developed bacteria-resistant paints that could help prevent biofilms from forming on ship hulls, helping to reduce the introduction of invasive species in Arctic waters. New surface coatings could also prevent the build-up of methane hydrates that can block deep-sea oil and gas wells. The oil and gas industry currently spends at least US$200 million a year just on chemicals for this purpose [63].

Methods for absorbing oil and other contaminants from the environment constitute a second potential breakthrough area. Boron added to carbon nanotubes gives them an astounding ability to absorb oil spilled in water, though the technology is currently only lab-scale. A polymer sponge called Petrogel [64] can absorb 40 times its own weight in oil. The material, which is based on polyolefins, one of the least-expensive polymeric materials, can simply be refined or discarded along with the crude oil it absorbs. And a powder called Thiol-samms has been engineered to have a high affinity for mercury in water, irreversibly binding the mercury inside the powder's porous particles [65]. As the material is silica-based, it is otherwise chemically inert and stable up to high temperatures, making disposal straightforward.

Technological advances provide the key to safe and economically sound exploitation of Arctic resources. Specialised vessels will have a large impact on the capabilities of the petroleum industry and on maritime transport generally, including transhipment. For all vessel types, including fishing vessels, anti-icing nanotechnology can prove a cost-effective way of winterising existing capital. This will increase access to the Arctic for a wider range of stakeholder countries and will increase the capacity for Arctic business – though it may also increase potential for conflict as more nations find it feasible and expedient to fish in unregulated northern waters.

4. THREE SCENARIOS FOR ARCTIC BUSINESS TOWARDS 2020



4.1. SCENARIO I: OIL IN DEMAND – ARCTIC TAKE-OFF

Oil in demand is a story about the Arctic taking off as a global petroleum province. Large oil and gas discoveries have been made in the Barents and Kara Seas, followed by large-scale infrastructure development. A multitude of actors take part in the exploration, extraction and transport of natural resources to world markets. Despite political tensions, there is a high level of business cooperation between Russia and foreign partners. China is actively involved in the region, financing petroleum and mining projects and developing infrastructure. Fisheries coexist with extractive industries, though environmental problems with the latter impinge on the image of the former.

4.2. WE ARE NOW IN 2020

What do we see?

Do you like being at the centre of the action? If so, the Artic is the place to be.

4.2.1. The Barents and Kara Seas become major petroleum provinces

People already had started talking about the Arctic as the world´s new hotspot for oil and gas more than a decade ago. Books were published with titles like "Race for the Arctic" and "Black gold rush". But when a giant field in the Russian Kara Sea was discovered in 2015, things really took off. The discovery of one unique field with reserves of upwards of 3 billion barrels of oil was a turning point, not only for the Arctic, but for the global petroleum industry as a whole.

It had long been thought that the era of cheap and easily available oil was past, and the petroleum industry was marked by pessimism. Climate regulations and alternative energy sources were increasingly in focus, and many thought the oil age was close to ending. But they were wrong. And Russia´s President Vladimir Putin was right when he stated that "Offshore fields – especially in the Arctic – are without any exaggeration our strategic reserve for the 21st century". The oil price, which just passed US$ 200 has allowed Russia to maintain domestic political stability, and strengthen her position in the global arena.

Only one year after the discovery of the field in Kara Sea, a new large oil field was discovered – this time in the Norwegian side of the Barents Sea, in the area formerly disputed with Russia. This increased interest in the Barents Sea, where several more discoveries followed. Doubts about commerciality and lack of cost control were replaced by a strong will to invest in infrastructure development by companies, and to implement a beneficial investment framework by the authorities. Developing infrastructure for a new petroleum region is expensive. But once one big field is under development, it becomes easier to find synergies for new projects. In Norway, the Johan Castberg field is currently being developed in the Barents Sea, with production expected to start by the end of this year (2020). Development of the Kara Sea is expected to commence in full within the next few years, and the first investments in onshore infrastructure are already visible.

It is still unclear how the development of the discoveries in the formerly disputed area between Norway and Russia will be carried out, but there is no doubt that common infrastructure will contribute to increased profitability. However, opinions in both countries are divided: Some in Russia are sceptical about giving away control of resources, while sceptics in Norway argue that cooperation will be very difficult. Russia additionally continues to pursue onshore gas projects in the Arctic, and is working on new partnerships for the offshore Shtokman field – aimed at the Asian LNG market. Shale gas developments in other parts of the world mean other Arctic gas projects remain an option only for the future.

The State of Alaska, in tandem with Shell, ConocoPhillips and Statoil, is pushing for offshore petroleum development in the Chukchi Sea, as production is dwindling onshore and the throughput of the Trans-Alaskan Pipeline System (TAPS) is reaching critically low levels. The State wishes to compensate for falling oil production but is meeting resistance from the environmental movement, and ice-conditions are a major challenge. Other challenges include an abundance of shale and tight oil in the "lower 48", as well as a strong tar-sands lobby in Canada. In Greenland there is currently no petroleum exploration – although this looks set to change in the coming years.

4.2.2. The Northern Sea Route sees growth in transit during summer months

A multitude of actors are now taking part in the exploration, extraction and transport of resources to world markets. Arctic mining has benefitted greatly from new infrastructure, boosting the regional economies of northern Sweden and Finland. Greenland has approved several mining projects, leading to a massive influx of capital and labour to the island. Increased passenger and equipment transport capacity is needed, and in the initial phase limited infrastructure means that goods must be unloaded directly to shore and in some cases offloaded onto the ice.

Russia has invested large amounts of money in developing and promoting the Northern Sea Route as a transit corridor, in addition to its increased use for transport within the Arctic region by the petroleum industry. Russian companies find themselves at a competitive advantage thanks to long experience with the climatic conditions, but Western companies also increasingly see the opportunities for the route. Two-way transport has made the use of the Northern Sea Route far cheaper than before, carrying everything from timber, minerals and European luxury goods to Asia and bringing back cars, computers and other manufactured products on the return trip.

4.2.3. Financing mega-projects makes China an "Arctic" nation

Technological progress has reduced risks and solved many HSE and communication challenges. Implementation of new solutions is largely made possible due to massive financing from China. Ice-resistant drilling rigs financed with Chinese loans have significantly reduced the costs of Arctic drilling in the Kara Sea. China has also financed a highly elliptic satellite network, providing Arctic communications coverage and capacity comparable to levels elsewhere in the world. It is possible to obtain environmental surveillance data from the same network, but for perceived security reasons these have not been made available. The network has significantly enhanced different industries' ability to manage and coordinate Arctic activities, but also forced the Arctic nations to accept China as a member of the Arctic Council and thereby depart from the doctrine agreed in 2012 that only Arctic coastal states should have a legitimate say in Arctic affairs.

4.2.4. Fisheries and aquaculture live in the shade of the oil industry

Fish stocks and fishing activities remain in traditional areas, due to the limited migration effects of climate change so far. As a result, industry adaptation has been limited. The ice extent has actually increased slightly over the past few years, despite long-term climate projections going the other way. Although this is probably a temporary phenomenon, it has led to reduced focus on climate change in the public debate. Regular warnings still appear that the seafood industry needs to prepare for changes in fish stocks and commercial species. Except for Iceland, however, the industry has so far not taken heed. Similar to the situation in the tourist-industry, people working within fisheries and

seafood are feeling left out of the industrial boom, listened to less by the government and prioritised lower in terms of infrastructure investments.

The environmental organisation Greenpeace has long been campaigning against petroleum in the Arctic – using pictures of oil-covered seals and polar bear cubs to convince the public that what´s good for the oil industry is not good for nature. For its part, the oil industry has struck back, emphasising safely programmes and how these help minimise the chance of major oil spills.

Then, suddenly, in October of 2018, a Norwegian oil tanker headed towards the Northern Sea Route to China suffered engine failure after passing into Russian waters. Because of Northern Fleet military exercises at the time, the vessel had diverted south from the regular shipping lane and a sudden storm caused it to drift toward shore. Norwegian traffic control mustered response forces among local fishermen, but due to a miscommunication, they were denied access by Russian border guards. As a result, the tanker became grounded on the Rybachy Peninsula just east of the Norwegian border, resulting in an oil spill. Russia blamed Norway for the accident, even while it delayed providing access to clean-up personnel. Norway and the rest of the Arctic countries blamed Russia, but eventually ended up cooperating in a surprisingly successful clean-up operation, as everyone seemed to recognise it was in their interest to maintain the status quo. At the end of the day, the oil spill had few consequences for the petroleum sector. However, the reputation of the region's fisheries suffered. Even if the oil spill only covered a limited area, consumers in China, Japan and other markets no longer perceive Arctic fish to be as "clean" as they once had done.

4.2.5. International cooperation increasing

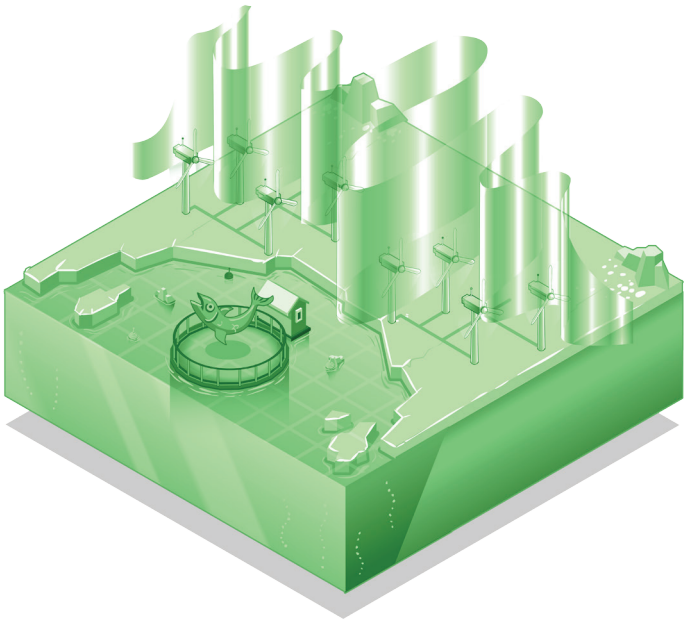
Since the discovery of the field in Kara Sea in 2015, international cooperation in the Arctic has been strengthened. Some claim that the oil discovery not only represented a turning point for Arctic business, but also may have prevented a new Cold War – as tensions following the Ukraine crisis were escalating. Much of the credit for finding a new path toward cooperation between Russia, the EU and the US is given to the head of NATO, Jens Stoltenberg, who managed to reach out to all sides. Focus shifted towards finding a pragmatic solution that would let all parts "save face". In a deal brokered in 2015, Ukraine was federalised and the Russian language given increased prominence in Ukraine's eastern provinces. This gave Russia an opportunity to scale down the conflict without appearing to let down Russian nationalists.

Today (2020), there are still tensions between Russia and NATO, but there is less focus on NATO expansion than there was five years ago, and the EU has opted to cooperate with Russia on deeper mutual economic integration rather than expanding the EU eastward. Together these factors have proven conducive to easing Russian apprehension towards foreigners. Russian visa procedures for the Arctic have been simplified, so that specialised workers, researchers and business persons can visit the region with relative ease. Western oil companies are now allowed to hold resource rights offshore, although still as minority partners with Russian companies. The Russian Arctic offshore is still not capable of fully satisfying Western capital markets' required returns, but solutions are found through Chinese preferential loans in return for strategic offset agreements with Russian partners in the projects. Western oil companies that adapt to Russian and Chinese partners' modes of assessing profitability gain a clear competitive advantage.

4.2.6. International crowd transforms previously peaceful communities

Large parts of the Arctic are still characterised by hardships, particularly where fishing, hunting and traditional livelihoods are concerned. But big changes over the past five years have taken place, particularly in Norway and Russia, where the increase in economic growth of their northern regions has dramatically exceeded the pace of overall growth in those countries. Regional capitals, such as Tromsø, Bodø, Murmansk and Arkhangelsk, are developing into modern, competent cities which are increasingly attracting the best and the brightest from all over the world. Expensive cars, decadent partying and a truly international crowd are now found in the provisional barracks and over-filled hotels in the Arctic towns where petroleum developments are taking place. The majority of the local population is content. There are ripple effects in the form of job opportunities, upgrading of worn-out villages, building new roads and airports, high salaries for families working in the extractive industries and even cultural activities. Last week, for example, the rock group Metallica visited Murmansk – sponsored by the petroleum industry – to cheer up the workers and give the local population "something back".

Indigenous people living from reindeer herding fear for their traditional livelihoods, however, and are coming out strongly against large-scale industrial development. Small communities where everyone used to know each other have now been split between people on the "inside" and those on the "outside". Nevertheless, the business community from all over the world is providing new life to a region that was once in crisis – and there are signs that this is just the beginning.



4.3. SCENARIO 2: GREEN TRANSFORMATION – ARCTIC TRANQUILITY

Green transformation is a story about a world rapidly adapting to alternative energy, leaving little room for Arctic oil and gas. Leading powers race for economic ascendancy. Climate change has increased the need for alternative food sources, and Arctic fisheries benefit from this, although the sector struggles to adapt to rapidly changing conditions. Rapid melting of the sea ice enables increased transit shipping. The global middle class seeks "authentic" experiences, making the Arctic an increasingly popular tourist destination.

4.4. WE ARE NOW IN 2020

What do we see?

It took some time. But when climate change really came onto the agenda, the transformation happened faster than anyone previously had imagined.

4.4.1. US and Chinese push for climate agreement leads to green transformation

The effects of climate change had been known for many years, without much happening. But at the 2015 United Nations Climate Change Conference in Paris, China and the US took the world by surprise by jointly announcing a bilateral pre-agreement. This led to a spiral of events, which has since been labelled the "green transformation".

By 2018, a binding international climate agreement was finalised. The US implemented substantial cuts in CO_2 emissions from national power plants, while China set an absolute ceiling on its emissions. For the US, increased gas supply facilitated fuel shifting, making cuts less painful. For China, pollution from coal threatened to suffocate the population and was leading to civil unrest. Both countries saw advantages to becoming leaders in the development of renewable energies, while traditional petroleum producers began losing their influence.

The international community has now agreed on a binding roadmap to curb emissions by 2035, including international emissions levies on maritime transport. Critics, however, remark that such measures will have limited effect on climate change and are motivated primarily by protectionist tendencies in the

EU and US, which are eager to shift production-related employment back from Asia after one-and-a-half decades of severe unemployment.

4.4.2. Financial market flight from fossil fuels means the end of Arctic oil and gas

By 2015, leading global investors started perceiving the risk of increasing investments in fossil fuels as too high – leading to a widespread evacuation from "stranded" fossil-fuel assets. After the so-called "burst of the carbon bubble", all global players – politicians as well as big business – started the race to become winners in the new "green future".

The idea of developing the Arctic into a major oil and gas province was soon written off as completely unrealistic. The large oil discovery in Russia's Kara Sea in 2015 failed to spur the additional activities the industry had hoped for. Even before the climate agreement, high costs and challenging operating conditions had led to doubts about the commerciality of petroleum developments in the region. Oil companies are now being accused of having kept politicians and researchers silent in order to prolong an unavoidable shift away from hydrocarbons.

When it became clear that Arctic petroleum would never take off, this was considered more of a victory than a defeat in the US. Environmental interests had a strong position, which certain Alaskan interests could not prevail against in their wish to develop offshore resources in the Chuckchi Sea. Since Canada and Greenland had not gone very far in developing plans for industrial development of the Arctic, they did not have much to lose. In contrast, Norway and Russia were hit relatively hard by the shelving of plans for the Arctic shelf. The Goliath field in the Norwegian Barents Sea was closed down, only a year after production started, an event celebrated by environmental organisations.

Norway´s oil and gas production is now in decline, unemployment has risen, and the country is struggling to re-tool the oilfield services industry, much as shipbuilding switched to building oil platforms. Just as in other Western countries, however, people agree there is no turning back.

In Russia, on the other hand, it is a common opinion that climate change is unrelated to CO_2 emissions – and that pursuit of so-called "green transformation" is being pushed by economic interests in the US. Although the sanctions following the Ukraine conflict have been removed, and relations between Russia and the West have improved, Russia is in the midst of its worst economic crisis since the 1990s. An oil price collapse served as a serious blow to Putin's old economic model, but, at the same time, gave an opportunity to carry out necessary economic reforms, which in the long term may lift the Russian economy again.

4.4.3. China leads race towards renewables

Renewable energy is increasingly substituting for hydrocarbons, largely thanks to a "race" between the US and China to become self-sufficient in energy through the development of cost effective renewable energy sources.

A first, major breakthrough was made in Sweden in 2015, when scientists found a way to nearly double the efficiency of solar cells at relatively low cost. The implementation of the new technology was expected to take nearly 10 years, but due to large investments from the US, the new cells were in use in many parts of the world within only a few years. This increased the competitiveness of solar power dramatically, enabling renewable energy to grow beyond all projections.

Less than a year after the Swedish breakthrough, global energy markets were taken by surprise as China announced a large-scale shift to clean energy under the slogan of a "Green People's Revolution". The Chinese population, which had been suffering from increasingly intolerable levels of pollution in major cities, saw similar challenges begin to affect rural areas as well. At the 2016 session of the National People's Congress, President Xi Jinping momentously announced the results of a seminal work acknowledging that China's future as a nation was challenged both by climate change and local pollution, and that the latter was a major contributor to the former.

4.4.4. Arctic fisheries and fish farming see boom as arable farmland diminishes

Climate change continues to accelerate with important effects on global food production, as farming on land begins to be hampered by heat waves and droughts in an increasing number of countries. Arctic fisheries and aquaculture emerges as a potential area of great business opportunity, along with seaweed farming and algae-based biomass production, drawing steadily more investment.

Continuous branding efforts have secured Arctic fisheries a reputation as healthy, safe and sustainable, making their product a preferred alternative in global high-end markets. Increasing prices make fish farming an attractive venture even in the colder waters around Greenland, although Norway remains the prime producer. Russia invested heavily in aquaculture but volumes are still small and Russian producers suffer from inefficient logistics, making their produce uncompetitive on global markets.

4.4.5. Arctic transport stays on growth course

The sea ice has continued to melt, opening up for new opportunities for the transport of fish and minerals through the Northern Sea Route, though its use for transit shipping has not yet taken off. Russia's inland waterways have been revitalised as export channels for Russian grain, allowing increased traffic of grain carriers from Arkhangelsk transiting the Norwegian coast westward. The North-West Passage remains unused because of lack of support from underlying trade flows.

Emissions levies on international shipping, combined with more severe and unpredictable weather, have forced the seafood industry to turn away from processing and packaging in Asia. However, the loss of physical and human capital in preceding years excludes the revival of onshore processing. Offshore packaging and processing between production and markets has become the way to go, also for fish farmers.

The severe weather has also forced the industry to find new technologies. In particular, existing fish-farming cages have proven too feeble, leading to large losses. Another challenge facing the industry is that the receding ice cap and increased water temperatures are causing fish to migrate north. Catches are now made increasingly further north, and within a few years may be predominantly in unregulated waters. Combined with tighter food supplies globally, this increases opportunistic behaviour by non-Arctic fishing nations and poses substantial risk to the sustainable management of fisheries resources.

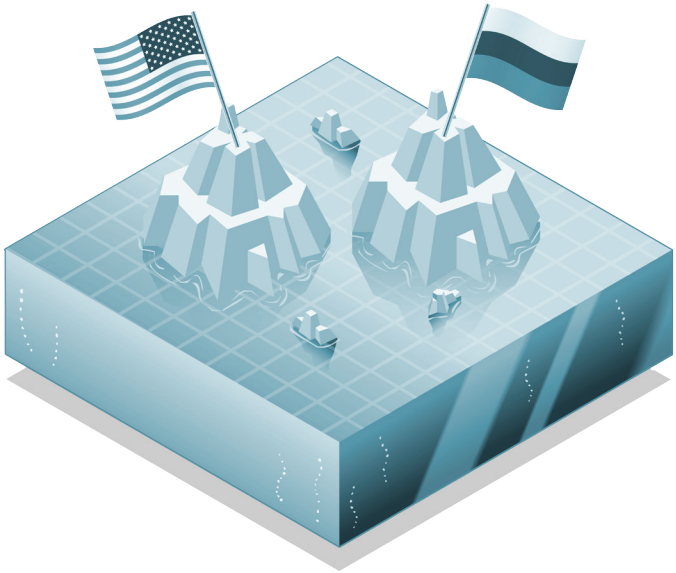
4.4.6. Tourists rush to see polar ice before it is gone

The global middle class is increasingly willing to choose a "green" lifestyle and seek "authentic" experiences. This may include an eco-cruise in the Arctic. A common argument for tourists traveling to the Arctic (even if they have to enlarge their carbon footprint by taking a plane to reach the ship) is that they want to see the polar ice, along with polar bears, seals and other exotic animals before they disappear due to climate change. Asian tourists dominate in cruises focused more on the midnight sun and northern lights.

The tourist boom creates new opportunities on Svalbard. In addition to cruise tourism, Svalbard's role in scientific research increases, not least related to fish migration. With no more coal mining, research activity at Svalbard has become an entry ticket to the Arctic for non-Arctic nations. New Ålesund grows as a research station, while Longyearbyen contends with the closing down of mining activities and Store Norske. A new centre for coordination of search and rescue in the Arctic is opened on Svalbard, which is now considered an environmental zone with limited economic activity.

Russia has captured only a small portion of the tourist market, due to rigid entry procedures for ships and passengers, as well as limited investments in coastal towns' visual attractiveness. Russia's otherwise most promising tourist destination, the Solovki Archipelago, has been completely taken over by the Russian Orthodox Church, and religious functions have crowded out the variety of potential tourist offerings. Canada is a leading provider of Arctic cruises, either traversing through the Northwest Passage with the assistance of Canadian icebreakers, or in waters between Canada and Greenland.

Diamond mining continues to grow in importance in the Canadian north, spurring investment in the mining of rare earth minerals as well. Kiruna, Sweden, struggles to balance the needs of its popular tourist attractions with the development of the local iron mine, which is requiring residents to literally pack up the town centre and move a few kilometres down the road over the course of 20 years. A similar combination of mining activity and cruise ship tourism enable Greenland to start a process towards independence from Denmark. Iceland's hydroelectric and geothermal power allows it to produce more aluminium, perhaps exported across the Northern Sea Route to Asian markets, without endangering the landscape and unique environment that attracts so many tourists to the island nation each year.



4.5. SCENARIO 3: RE-FREEZE – ARCTIC EAST-WEST DIVISION

Re-freeze is a story about the East-West division of the Arctic in a world that has moved rapidly away from Western-dominated "globalisation" to increased regionalism. Following Russia´s intervention in eastern Ukraine, practically all Arctic partnerships with western companies have been cancelled. Norway is developing the Barents Sea but does not have enough resources to compensate for reduced Russian gas exports to the EU. China is now financing infrastructure for the exploitation of raw materials in the Russian Arctic, using the region as a raw materials base. Lack of access to Russian mineral resources has spurred Western mining activity in Canada and Scandinavia.

4.5.1. WE ARE NOW IN 2020

What do we see?

A new Cold War has transformed the Russian Arctic into a resource base for China.

4.5.2. The world is divided into two main political blocks

Nobody believed it would have gone so far. But following the Russian military intervention in eastern Ukraine, there was a perceived need to strike back hard – and Western governments banned practically all business cooperation with Russia. Cold War rhetoric has continued to escalate, and today (2020) the world is divided between two main blocks: a reinvigorated NATO on the one hand, led by the US and backed up by a weaker EU, and a China-led block on the other hand, backed up by Russia.

The Russian intervention in Ukraine, presented as a "peace-keeping" mission, allowed separatist fighters to launch an assault on Kiev, ultimately leading to the ousting of President Petro Poroshenko and the creation of two new states – East and West Ukraine. The West on the one hand, and Russia on the other, recognised West and East Ukraine respectively as the successors to the previous Ukraine Republic. Economic sanctions against Russia remain in place.

A slim chance of thawed relations failed in 2017 when, wearied by sanctions, Russia's President Vladimir Putin made an attempt to reconcile East and West Ukraine. The Russian

initiative was, however, rejected as a media propaganda stunt by a US administration, which claimed Russia was not doing enough. The Russian population also reacted negatively, considering Putin's peace initiative to be a sign of weakness towards the US. Finally, in the 2018 elections, Putin supported a 43-year-old special forces veteran who promised a harder line towards the West, along with patriotism and religious values. He was elected with 57 per cent of the votes.

It has become practically impossible to obtain visas between Russia and the West, and both sides view interaction with the other as "unpatriotic". As a result, the Barents Cooperation and Arctic "people-to-people" programmes have become increasingly difficult to carry out, and the Arctic Council has lost importance for practical and constructive dialogue between Arctic states.

4.5.3. Emerging economies take the West´s place in Russian economy

The new re-freeze between Russia and the West has had negative consequences for the economies of all the Arctic countries, particularly Finland, which had the closest business ties to Russia. Economic growth is low in Russia, but the situation has not became as difficult as Western commentators expected.

Attempts to isolate Russia internationally have been only half successful, as countries like China, India and Brazil have taken over Europe's formerly prominent role in its economy. China has come out of the conflict relatively strengthened and continues to rise towards superpower status. In 2016, China surpassed the US as the world´s biggest economy and is actively building up its resource base in all parts of the world – including the Arctic.

The US and the EU have compensated for the reverse of globalisation by increasing cooperation between them – signing the Transatlantic Trade and Investment Partnership (TTPI) in 2019. Focus has shifted away from global economic integration towards Atlantic regional self-sufficiency.

4.5.4. Arctic petroleum is largely a Russian-Chinese affair

Petroleum development in the Arctic continues but is largely a Russian affair supported by strategic off-take agreements with Chinese interests. Thousands of Chinese workers have entered the Russian Arctic in the development of raw materials and transport infrastructure. Russia is not happy to be China´s raw material provider – but has little choice. Russia´s negotiating position vis-à-vis China and its ability to reject demands for lower prices is weak.

Europe has limited its gas imports from Russia and has reduced overall energy consumption, in part due to lower economic growth and in part due to adaptation to the new energy realities.

Norway has still not found enough natural gas in the Barents Sea to justify development of transport infrastructure – pipeline or LNG solutions – and is thus only to a limited degree able to replace Russian exports to the EU. The start-up of the Johan Castberg oil field is expected soon. Development of the formerly disputed area between Norway and Russia is, however, put on hold as it would have required more cooperation than is possible now.

The US and the EU have prohibited Western companies from participating in Russian energy projects, ending Rosneft's partnerships with ExxonMobil, ENI and Statoil. BP hasbeen forced to divest to avoid becoming a target of sanctions itself. US attempts to isolate Russia mostly seem to have isolated American and European companies from Arctic business opportunities.

Russia's dependence on Western oil companies, however, turned out to be overestimated, and Russian companies continue to pursue Arctic projects in addition to enhanced oil recovery and unconventional oil projects onshore. China has stepped up as Russia's strategic partner, not only in the Arctic but also in the wider petroleum sector, providing financing as well as backdoor access to technology when needed. A few Western equipment producers continue to benefit from Russian Arctic projects, but using China as a conduit for this export has allowed Chinese manufacturers to begin closing some technological gaps.

4.5.5. Arctic mineral extraction provides new opportunities for Western business interests

Mining companies blocked off from the vast Russian resource base increased their interest in Greenland, Arctic Canada and Scandinavia. Canadian projects continue to be developed as stand-alone, fly-in-fly-out communities, while in Scandinavia, Swedish and Finnish mining projects lay the foundation for new and expanded rail corridors that are bringing positive repercussions to other industries.

While Greenland sees increased interest from American and European mining firms, it continues to rely on Chinese investments, and Asia is the dominant market for Greenlandic minerals. A Chinese Arctic trade route has been established along the Northern Sea Route, which is otherwise little used

by others. Bulk carriers load first in Greenland and then top up their loads in Narvik and Kirkenes in Norway, before passing through the Northern Sea Route.

4.5.6. High conflict level puts fisheries management and Svalbard treaty at risk

Arctic fisheries are on the rise thanks to the prudent resource management policies of preceding decades, though increased conflict levels are putting their future at risk. The US and Russia continuously fail to reach agreements on Bering and Chukchi Sea fisheries. And while the Russian Norwegian Fisheries Commission continuous to function, disagreements on quota levels are increasingly frequent, with accusations of overfishing regularly issued by both sides.

This animosity has impacted Svalbard's position as well. Although no formal encroachment has been made on the fisheries protection zone, Russian vessels continue to fish there in claimed "compensation" for what Russia sees as Norway's rigging of quota calculation methods in its own favour. After the Russian Navy fired a warning shot at KV *Svalbard*, while the latter vessel was attempting to detain a Russian fishing boat, Norway was widely considered to effectively have lost control over the waters around the archipelago.

5. USING THE SCENARIOS

The three scenarios have been created to serve as a useful backdrop for thinking about opportunities and challenges for the maritime industry in the Arctic in the medium-to-long term. Taken together, they are meant to illustrate a spectrum of possible outcomes for which stakeholders may wish to prepare.

In scenario-based long-term planning and strategy making, the future operating environment is captured in a set of different stories, instead of one prognosis or prediction. The idea is to look for flexible, strategic actions and choices that are robust against multiple backdrops. For individual commercial actors who have limited possibilities for shaping this future – but must prepare for and adapt to it – the types of questions to ask are:

- Are there any possible strategic actions and choices we can make that seem wise in all scenarios?
- Are there any tempting opportunities that exist only in one or two of the scenarios – and can we implement easily reversible strategies to position ourselves for these?
- Can we create for ourselves an early warning system to help us see as early as possible when the time has come to implement or reverse risky strategies?

For national political actors, which have opportunities to at least shape political and regulatory frameworks for the future, additional questions concern how to take measures unilaterally or multilaterally to move the overall development of the region in a direction they consider favourable.

Disclaimer: please note that the scenarios are based on information obtained as of 1 Sept 2014. The actual data may change and differ from these projections due to a multitude of factors.

6. STATUS UPDATE FOR ARCTIC BUSINESS

This section provides a brief status update for each of the four sectors in focus – oil and gas, mining, seafood and world trade – in each of the Arctic countries.

6.1. OIL AND GAS

Russia

No country has a bigger economic stake in the Arctic than Russia, as oil and gas revenues provide for about 80 per cent of the entire state budget [68]. Russian petroleum interests are dominated by a series of mega-projects located primarily from the Kola to the Yamal Peninsulas and also in the Far East. Russia's first-ever offshore oil production started from the Prirazlomnoye platform in the Pechora Sea in early 2014. On the Yamal peninsula, Bovanenkovo field, one of the three largest-known gas fields in the world, started production in 2012 [69] and is scheduled to reach its full production rate in 2017. As part of the project, a 500-kilometer railway line, the world's most northerly, was opened in early 2011. In 2014, ExxonMobil and Rosneft teamed up in the Kara Sea to drill one of the most expensive exploration wells in history. The first Yamal LNG shipments are expected in 2016 using a fleet of ice-breaking tanker ships. These shipments alone will increase the cargo volume on the Northern Sea Route substantially. One big project, the Shtokman field in the Barents Sea, was put on hold in late 2012, though Vladimir Putin claimed the field will eventually be developed [70].

Norway

Norwegian interest in the Arctic focuses largely on the southwestern part of the Barents Sea, where the discovery of the Johan Castberg field was one of the biggest oil finds of 2011. The Goliat oil project, though plagued by delays and cost overruns, is now anticipated to come online in early 2015. It is declining production at lower latitudes that is slowly pushing oil producers further north; of the 61 exploration blocks intended to be offered in Norway's 23rd licensing round, 54 are in the Barents. Additionally, the Norwegian government has begun a process to open areas south of Jan Mayen, a small Norwegian island east of Greenland, for petroleum exploration. South of there, Iceland expects commercially exploitable discoveries in three offshore regions including Dreki where research in 2011 found "incontestable proof" of oil [71]. Rights to these regions were won by UK-based Faroe Petroleum in late 2012 [72] and exploration licenses awarded in December 2013 [73]. In anticipation of significant future revenues, Iceland announced plans in late December 2012 to establish a sovereign wealth fund similar to Norway's, the world's largest sovereign wealth fund per capita.

Canada

Canadian cold-conditions petroleum exploration and production is currently centered in the far north-west of the country and south-east of Newfoundland, where ExxonMobil has announced that their Hebron field project will begin production in 2017. But exploration licences are planned for 2015 and beyond in the Gulf of St. Lawrence, one of North America's busiest waterways.

Greenland

Elsewhere, exploration activity has witnessed a noticeable slowdown in the past few years. In Greenland, Cairn Energy sold its stake to Norway's Statoil after having little success finding oil off that country's western shore. ENI is not expecting north-east Greenland to be a production centre until the 2030s.

Alaska

Activity in the Chukchi and Beaufort Seas ground to halt after Shell's Kulluk rig ran aground in late 2012 but onshore projects, such as a possible natural gas pipeline from Point Thomson, are vital to a state that derives more than 90 per cent of government revenue from the energy industry.

6.2. MINING

The past decade has seen some of the highest-ever prices for iron, copper, gold, coal, rare earths, uranium and other metals and minerals which are available in great quantities above the Arctic Circle. Already the Arctic is home to the world's largest lead and zinc mine (Red Dog in Alaska) and the world's largest nickel mine (Norilsk in Russia). In just the past two decades, Canada has become one of the world's largest exporters of certified "conflict-free" gem-quality diamonds, with most production in Arctic locations. In the

Yukon, the Faro Mine Complex, once the world's largest open-pit lead-zinc mine is now an enormous, and expensive, remediation site.

Greenland

Now, miners are looking to Greenland for iron, gold, uranium, rare earth minerals and rubies, among others. Lars Emil Johansen, former Prime Minister, estimates the Kvanefjeld deposit in Greenland's far south could one day produce 20 per cent of the world's supply of rare earth minerals, with production estimated to start in 2016 and to last more than twenty years. The site is also one of the world's largest deposits of uranium. Once in full production, the royalties from this project alone could boost Greenland's GDP by 20 per cent, according to Greenland Minerals and Energy, the company developing the site. In contrast to the view of the Arctic as a high-cost operating environment, Kvanefjeld "could be among the bottom half of uranium producers in terms of cost and one of the lowest-cost rare earth element producers in the world", according to World Nuclear News. In late 2013, the Greenlandic government lifted a national moratorium on uranium mining and also issued an exploitation licence to London Mining for the Isua iron deposit. In the construction phase, up to 3,000 imported workers, mostly from China, would assist the building of that mine. Other projects, such as the gold mine at Nalunaq, have recently started production. Other mines, such as Qeqertarsuaq and Maniitsoq, are in advanced stages of development. Both mining and oil development provide the possibility of Greenland's economic independence from Denmark, currently the source of 40 per cent of Greenland's income.

Canada

On Canada's Baffin Island, directly to the west of Greenland, a scaled-down version of the Mary River Project, one of the world's most concentrated deposits of iron ore, is progressing, with the first extraction expected in 2014 and the first shipment in the summer season of 2015 [74]. Falling metal prices have pushed plans down to 3.5 million tonnes of ore per year, mostly likely destined for smelters in continental Europe. A variety of other mining projects in the Canadian Arctic are seeking coal, copper, silver and diamonds, including the Chidliak diamond site on southern Baffin Island and a copper-zinc-silver project located on the north-west coast of Somerset Island, immediately to the west of Baffin. Other large projects include iron mines at Lac Otelnuk, Ungava Bay and Roche Bay.

Alaska

On Alaska's southern coast, the planned Pebble Mine would be North America's largest gold and copper source [75] and also one of the largest mines of any kind in the world. The complex is planned to cover more than 50 square kilometers (about 20 square miles) and use as much electricity as half of Alaska's current total level of consumption, with power likely coming from locally produced or imported natural gas. The project is especially controversial due to the potential impact it may have on the fisheries of nearby Bristol Bay, one of the world's most-productive fishing grounds, and on Alaska's legendary salmon rivers such as the Kvichak. These risks stem primarily from the need for long-term storage of hazardous tailings, which would require construction of the world's largest earthen dam, more than 200 metres tall and several kilometres in length.

Russia

Russia is the world's premier Arctic mining nation, producing nickel, copper, tin, uranium and a wide variety of other minerals. Major mining centres are located around Murmansk on the Kola Peninsula and Norilsk, to the east. The Norilsk site is the world's largest nickel mine and also produces nealry half of the world's supply of palladium, used in catalytic cracking of petroleum and in some electronic components.

Finland

A boom in interest in Arctic mining in northern Europe is focused on Finland, where about one-eighth of the country has been designated for mining activity. An expected railway linking Finnish Lapland with northern Norway and the Barents Sea might help dozens of proposed giant mines, including Norway's Yara International planned phosphorus mine at Sokli, near the Russian border, to open.

This dramatic increase in mining interests is causing concerns for environmentalists. "The number of mining permits in Lapland is now so big that we are approaching a tipping point, a point of no return," said Tero Mustonen, lead author in the Finnish government's Arctic Biodiversity Assessment. A 2012 leak at the Sotkamo nickel mine in Finland caused heavy metal levels in local water supplies to rise "to a level poisonous to fish and other organisms [76]".

Sweden

The government's recently published Mineral Strategy sees the number of active mines in Sweden more than doubling in number from 15 to 31 by 2020, along with a similar rise in production volume, and increasing further to 47 sites by 2030, many of them in the country's northernmost provinces [77]. The activity of a local iron mine requires residents of Kiruna, Sweden, to literally pack up the town centre and move a few kilometers down the road over the course of 20 years.

Norway

Northern Norway currently has over 40 working mines, a number expected to increase to nearly 70 within a few years. Handling mining waste is especially controversial in Norway, one of the few countries that allows tailings to be

dumped under water, typically in deep fjords.

Norway opened a new coal mine in 2014 on the island of Spitsbergen, driven more by a political interest in maintaining Norwegian economic activity in the Svalbard archipelago than the economics of the project. The project has sparked controversy because Norwegian lawmakers currently are pushing to ban the Norwegian Government Pension Fund Global from investing in coal stocks due to environmental concerns.

Iceland

Plentiful, clean energy from hydropower and geothermal sources have made Iceland one of the world's top aluminium producers. The economic difficulties the island has experienced in the past few years, along with strong, but unsuccessful, environmental opposition to Alcoa's project at Fjardaál in the early 2000s have made other large-scale projects – such as the canceled Bakki project near Húsavík – less likely in the near future. However, growing global demand for aluminium continues to make projects like these attractive in the long run.

6.3. SEAFOOD

The Arctic is home to some of the planet's most productive fishing grounds, totaling more than US$20 billion annually [78]. In general, Arctic marine mammals and fish populations are on the rise, according to the Arctic Council's biodiversity working group [79]. It is estimated that fish catches at high latitudes, including the Arctic, could increase by 30 to 70 per cent by 2055 [80]. However, a meeting in February 2014 in Nuuk, Greenland of senior officials of the five Arctic littoral states concluded that commercial fishing is likely to remain in coastal areas and unlikely to occur in the international waters of the central Arctic Ocean in the near future, due in part to logistics but also because, as a March 2013 report by the US government report noted, there is not yet a concentration of fish species of commercial interest there [81]. Even newly ice-free waters at the ice cap edge are too deep for some commercially important species, such as cod [82].

In the long term, production from Arctic fisheries depends strongly on demand and on sustainable management of fish populations and changing environmental conditions. Warming temperatures might increase the stratification of ocean water, preventing nutrients from migrating to the surface and increasing acidification might detrimentally affect shellmaking creatures, reducing the food supply for fishes.

Greenland

Fishing is the single most important economic activity on Greenland, accounting for about half of the country's economy and about 90 per cent of exports. Shrimp, prawns and halibut are major products, though salmon is as well, with dams having been removed in the north-eastern US to help Greenlandic salmon that spawn there.

There is no aquaculture ("farming") of fish in Greenlandic waters.

Alaska

Bristol Bay, in the south-western part of the state, is the world's largest commercial wild salmon fishery, employing about 14,000 people in Alaska. The state is also a major producer of crab, salmon, trout and many other species. The United States closed nearly the entire US Arctic Ocean to any commercial fishing in December 2009, mostly a symbolic decision given that much Alaskan fishing occurs farther the south, but also due to a lack of data about fish populations also to avert any potential conflicts with energy industry activity. At the February meeting, the US also proposed a ban on all commercial fishing in international Arctic waters.

Aquaculture in Alaska focuses on shellfish and kelp, as the farming of fish is prohibited by law.

Canada

For Canada alone, the fisheries along almost three-quarters of its coastline are largely unexploited. Nunavut recently opened its first commercial fishing harbour. Pangnirtung, on Baffin Island, was once supported by sealing, but changing market dynamics have brought trawlers to the area. Turbot catches in Davis Strait and Baffin Bay have almost tripled in the past 15 years, with much of the catch going to China. Elsewhere in the Arctic, the commercial fishing industry can expect to find itself both at odds with the energy, mining and transport industries, as competitors for labor and pristine grounds, but also mutual beneficiaries of easier logistics and emergency services.

Russia

Russia's annual fish production totals about 3 million tonnes, making the country the world's ninth-largest fishing nation. Only about 100,000 tonnes are farmed species, almost all of this in inland waters, not marine environments. Overall, fishing accounts about 0.3 per cent of the Russian economy, a figure that is declining as fish production has remained steady while the total economy has grown.

Norway

The Fridtjof Nansen Institute (FNI) has called the Barents Sea, north of Norway and Russia, one of the best-managed fisheries in the world. The cod population of this region is the largest cod stock in the world, resulting in an historically high quota being set for 2013. Further south, in Norway's ecologically sensitive Lofoten archipelago in particular, fishers

are finding themselves at odds with the energy industry. A 2013 survey found the majority of residents opposed to offshore oil drilling, though they expect it to happen [83] anyway. A recent survey conducted by DNV GL found the majority of Norwegian adults concerned about oil and gas activity in the Arctic, with most people citing harm to the environment, in the form of pollution and oil spills, as a primary reason.

The largest sector in Norwegian aquaculture is farmed salmon, accounting for about 80 per cent of the total production, with rainbow trout accounting for much of the remainder. Also, Norwegian firms acting outside Norwegian waters, in places like Chile, are major players in the global aquaculture industry. In 2014, Norway became one of the agricultural exporters most affected by food sanctions imposed by Russia, which has previously imported over US$1 billion in Norwegian fish products per year.

Iceland

Iceland has long been dependent on fisheries for export income, with about one-quarter of Icelandic GDP being derived from the export of fish, fishing equipment and from other related industries. Due to the abundance of fish in their waters, nearly all of this production is wild-caught, with very little being due to aquaculture. In near Arctic waters around Iceland and the Faroe Islands, the yield of mackerel and herring has been at unprecedented highs, leading to an extended conflict between Norway, the European Union and Iceland and the Faroe Islands. However, cod remains the most important species economically.

6.4. WORLD TRADE

The eight Arctic nations have a combined population of roughly 500 million, who generate 30 per cent of global economic activity. In contrast to the image of the Arctic as being remote, it is in fact the convergence point of the shortest air and sea paths joining Western Europe, North America and East Asia. Thus, interest in shipping via Arctic waters is increasing as climate conditions moderate. Much attention is being paid to the Northern Sea Route (NSR), north of Russia and stretching from Asia to Europe, which has been used annually by international traffic only since 2009. In 2013, the Yong Sheng became the first container vessel to sail the route, going from Dalian, China to Rotterdam, in the Netherlands. In November 2012, the Ob River, one of few LNG tankers with an ice-classed hull, sailed the NSR for the first time from Norway's Melkøya plant to the port of Tobata, Japan. A small fleet of tankers is now under construction to transport LNG from the Yamal Peninsula, with shipments expected to start in 2018, heading toward Asia in warmer months and toward Europe year-round. This development alone would increase traffic along the NSR tenfold from its current level of about 1.25 million tonnes per year. The Economist magazine estimates a level of 64 million tonnes annually by then. In anticipation, the renovation of the port at Murmansk, the largest city in the Arctic, is scheduled to be finished by 2016. In September 2011, Vladimir Putin emphasised "the importance of the Northern Sea Route as an international transport artery that will rival traditional trade lanes in service fees, security and quality." To this end, Russia plans to construct the largest and most powerful nuclear icebreaker ever built, the LK60, which will make commercial traffic possible through the Northern Sea Route year-round [84]. It is also establishing a series of ten search and rescue centres along the route. "Global shipping operations depend on three key factors: predictability, punctuality, and economy of scale," all of which are problematic issues along Arctic routes, according to an article in IEEE Spectrum [85].

Other Arctic shipping routes are seeing increasing traffic as well. In the hundred years from 1906 to 2006, there were 69 transits of the North West Passages, from the Atlantic to the Bering Strait via the Canadian archipelago. In 2011 there were 22 and 28 in 2012. US Coast Guard figures show that the number of vessels making the voyage through the Bering Strait, the end point of Russia's Northern Sea Route but also used by vessels on the American side of the border, nearly doubled from 2009 to 2012, when it was 250 vessels. And oil companies are looking to the Arctic Bridge route, already used to carry Canadian wheat through the Hudson Bay, south of Greenland and to Murmansk, as a means to export products from the tar sands and shale revolution. North-east Iceland is being considered as a location for a transshipment port for goods traveling the Northern Sea Route and Arctic Bridge and also as a base for serving oil exploration activity.

This increased activity will require an increasing number of specialty vessels, such as the new Nunavik, an icebreaking ore carrier that will be used to transport copper and nickel concentrate from Deception Bay, Canada, to Europe and the Polarsyssel, a new vessel utilising Ulstein's unique X-BOW® design, to be used half of the year for offshore supply and the other half for activities around Svalbard, including search-and-rescue operations.

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