PART II

THE FUTURE OF ARCTIC OIL AND GAS DEVELOPMENT

American perspective

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INTRODUCTION

Oil and gas development is often constrained by the so-called "above the ground problems." These obstacles can include political turmoil, government corruption and mismanagement, unpredictable political and legal risks, lack of contract sanctity (or even stability), uncertain tax regimes, poorly defined property rights, regulatory mismanagement, environmental activism, and extreme and harsh operating conditions. Nevertheless, large volumes of oil and gas have been produced even in environments where these risks are substantial. Many international oil companies (IOCs) have long experiences in managing a wide range of above the ground concerns, achieving profitable oil and gas production in such diverse political environments such as Libya, Iraq, Nigeria, and Russia.

Even when political and regulatory environments are stable, the harsh environment, limited infrastructure, extended development time and long distances required to bring production to markets common in the Arctic require a willingness to undertake substantial financial and technical risk. Arctic oil and gas projects are characterized by large capital commitments, complex and long-term project management, advanced engineering, and a requirement for high-volume reserves and production to justify capital

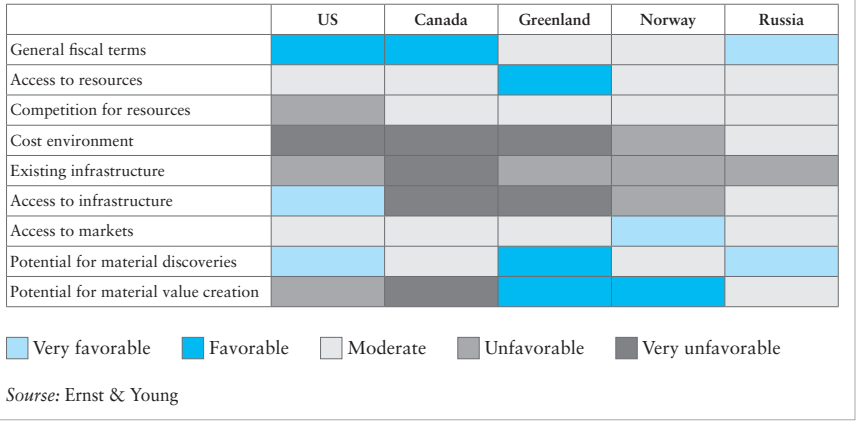


Figure II-1 Challenges to Arctic development by country

outlays. In general, Arctic projects are costly and lumpy, i.e., they tie up large amounts of capital for a long period of time before initial production. A recent report by Ernst & Young ranked the range of technical and financial conditions for oil and gas development among the countries with Arctic resources.[1] These are shown in Figure II-1.

The Ernst & Young assessment confirms conventional wisdom – it is expensive and risky to develop Arctic resources. If the price environment is favorable and advances in technology can reduce development costs, these risks can be managed. However, two forces are now in play that are likely to delay many higher-cost and risky Arctic projects. The first is an economic environment that is constraining sustained growth in the price of oil, especially at levels above USD $100/bbl. At prices above USD $100/bbl, there is growing evidence that advanced economies are adjusting to these price levels through lower economic growth. Economic adjustments to rising natural gas prices can also constrain price increases, but demand adjustments for natural gas are more likely to involve lower-cost fuel substitutes (e.g., coal) than lower economic growth.

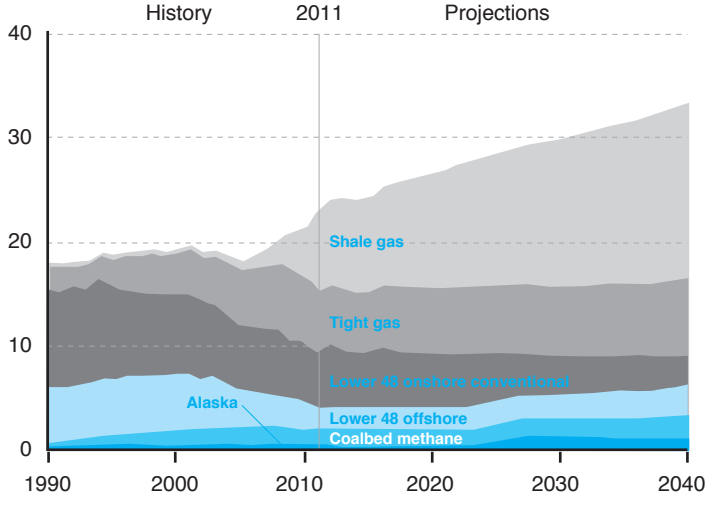
The second constraint to widespread development of Arctic resources is competition from lower-cost resources made available through advances in the production of oil and gas from so-called unconventional resources, now largely focused on the expansion of new supplies from the United States and Canada, but offer the potential for growth in other major world petroleum provinces. The U.S., in particular, has shown remarkable growth in oil and gas production from so-called tight formations, particularly shale deposits in Texas and North Dakota. Recent proposed reforms for the petroleum sector in Mexico may further expand the North American petroleum output.

Although it is too early to know whether the rapid expansion of oil and gas production in the U.S. can be replicated in other petroleum provinces, a recent assessment by the Energy Information Administration (EIA) and the private research group Advanced Research International (ARI) of world shale deposits lifts technically recoverable world reserves by 11% for liquids and 47% for natural gas compared with estimates made as recently as 2011.[2] An often overlooked feature of shale resource development is that financial and project risks are low. Although per barrel production costs for shale production can be relatively high by world standards, for the most part, shale development in the U.S. does not require massive capital outlays for long periods of time before initial production.

UNCONVENTIONALS: SHALE AND OIL SANDS

Since 2007, the U.S. has experienced large increases in both natural gas and crude oil production, raising domestic production to levels not seen since 1990. The U.S. resurgence as a major petroleum producer began with the rapid and sustained development of natural gas from shale formations in Texas and Pennsylvania. This expansion of domestic natural gas output has produced a paradigm shift in the outlook for U.S. natural gas supplies. In 2008, conventional wisdom operated under expectations that the U.S. was to become a major importer of LNG; a large number of costly LNG import terminals were constructed, and European and Middle East suppliers were looking to the U.S. as a major outlet for LNG shipments. The rapid expansion of U.S. production, combined with new discoveries of natural gas supplies worldwide, has limited the pricing power of major exporters such as Australia, Qatar, and Russia.

According to the U.S. Energy Information Administration, natural gas production is likely to see sustained production increases (Figure II-2) over the next 20 years even in a period where natural gas prices remain well below USD $6-7/mcf. The reason for such an optimistic production outlook



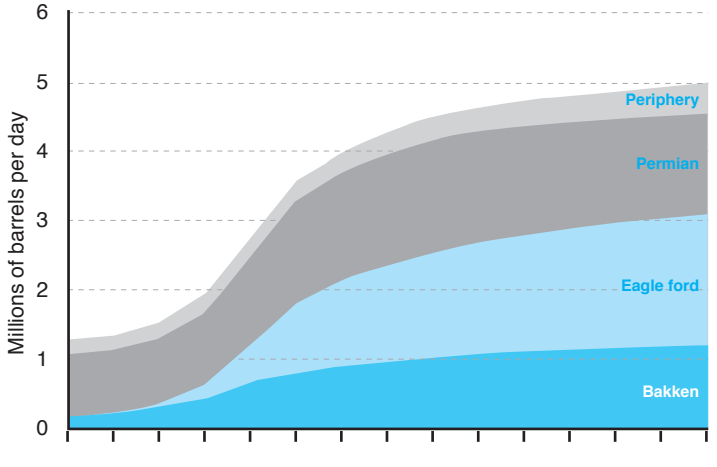
Sourse: EIA

Figure II-2 *U.S. natural gas output likely to continue growth (trillions of cubic feet/ year)*

is the continued domestic growth in natural gas output from growing volumes of associated gas from shale oil development. The high value of oil production is promoting low-cost natural gas production.

Technologies and production techniques (both art and science) contributing to rising natural gas production from tight formations are also available to oil-prone domestic shale plays. For shale oil development, North Dakota and Texas have been the largest success stories in the U.S. North Dakota's Bakken shale is responsible for a crude production increase of 600,000 barrels/day (b/d) in just five years, from an average production of 172,000 b/d in 2008 to 773,000 b/d in 2013. Texas alone is accountable for nearly a third of the U.S. production, standing at 2.4 million barrels/day (mbd) for 2013. The relatively recent development of the Eagle Ford play has added over 1 mbd to Texas' production since 2008. The application of innovative technologies and relatively favorable "above the ground" conditions has brought about a surge in oil and gas production in North America.

These growth trends are likely sustainable for some time to come. While initial achievements in lateral drilling and multistage fracking tapped the reservoirs, continual advances in technology have been and will continue to play an integral role in unlocking more barrels out of this tight source rock. To date, only a small fraction of the reserves are being



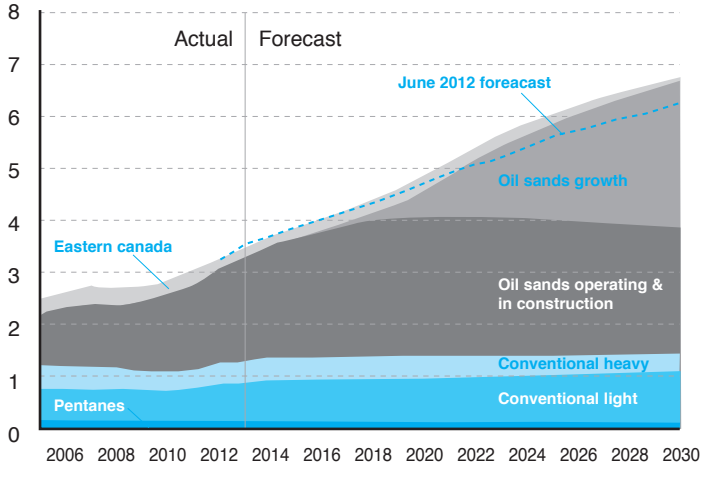
Sourse: EPRINC

Figure II-3 U.S. Unconventional oil production forecast

extracted from within these reservoirs. Through technological advances, producers are realizing that there is far less drainage of the reservoir than originally expected. As a result, companies have begun to downsize their acreage spacing between wells and place more horizontal wells both next to each other and on top of one another in stacked formations.

To help explain this production growth and its potential, EPRINC has developed a forecast model (Figure II-3) for the three major shale plays in the U.S.: the Bakken, the Permian Basin, and the Eagle Ford.[3] A "periphery" play category has also been added to designate other plays contributing to the U.S. production, such as the Niobrara in Colorado and the many stacked plays in Oklahoma. While there are justifiable reservations regarding this forecast should oil prices fall below USD $50-60/bbl, this is a relatively conservative calculation given current production rates, EPRINC's assessment of the technical difficulty of each play, pace of new drilling permits, and economics of production. Clearly, the experience to date with shale production has played to inherent strengths in the U.S. petroleum investment environment, among which are well-defined property rights for the mineral resources and a robust oil and gas service infrastructure. These conditions generally do not exist outside of the U.S.

The growth in the U.S.' lower 48 crude oil output has been paralleled by growing production in Canada. Oil sands production in the Western



Sourse: Canadian Association of Petroleum Producers, 2013 forecast

Figure II-4 Canadian production growth (millions of barrels/year)

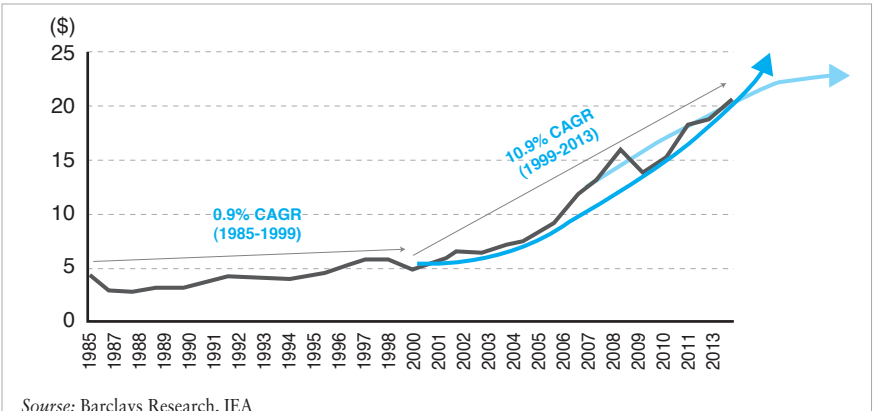
Canadian Sedimentary Basin has been gaining momentum for the last five years as substantial financial commitments are now underway to continue Canadian production growth, as shown in Figure II-4.

COST COMPRESSION

Cost compression occurs when rising development project costs cannot be passed through – hence the compression. The rapid increase in oil prices over the last decade has brought about substantial investment and explosive growth in the worldwide petroleum service industry, including construction of deep water rigs, drill ships, specialty steels and products, as well as advanced engineering and technical services. The run-up in capital costs for exploration and development is shown in Figure II-5. The rate of increase accelerated in the beginning of 2005 and is no doubt a feature in recent announcements of not just major Arctic projects, but a long list of deep water prospects, and rising regulatory costs and delays as operators adjust to a post-Macondo world.

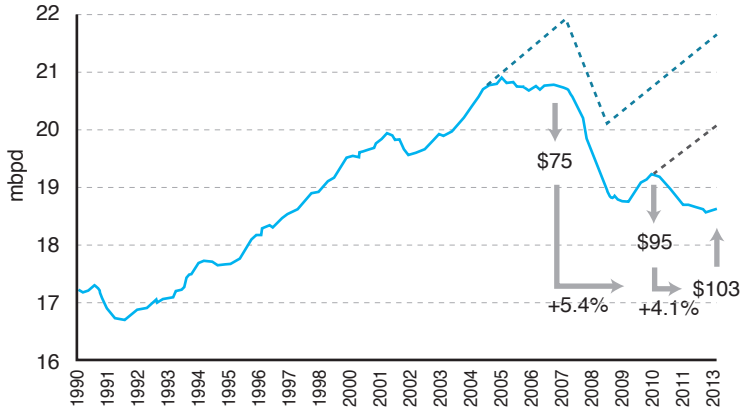
Against this background of rising costs for exploration and production, there is growing evidence that these costs are unlikely to find accommodation through rising prices. Figure II-6 provides an estimate of the capacity of the U.S. economy to adjust to rising oil prices.

In this model, economic growth is constrained as rising oil prices



Sourse: Barclays Research, IEA

Figure II-5 Cost outlook scenarios, growth in exploration and capital expenditures, per barrel



Sourse: EIA, Analysis from Douglas-Westwood
Note: The solid purple line shows actual U.S. consumption of liquid petroleum (crude and products). Carrying capacity is shown as declining from 5.4% of GNP in 2007 to 4.1% in 2011. Some analysts argue that the economy's growth is at risk even with petroleum consumption below 4% of GNP.

Figure II-6 *U.S. oil consumption with carrying capacity estimates*

act much like rising interest rates, choking off investment and consumer confidence and bringing about lower growth rates.[4] The lower growth rates cut oil demand and potential growth in oil prices.

What does all this mean for Arctic petroleum development? Clearly, managing both cost and price risks are central elements of any investment in petroleum development. However, Arctic projects offer much longer time exposure to both risks. We can expect more delays in the Arctic development and a cautious approach in taking on major projects where any combination of regulatory risks, long lead times to development, and limited infrastructure are prevalent. The decision by Statoil to pull out of the Russian Shtokman gas field project and the Johan Castberg oil field project, both in the Barents Sea, is driven by more than concerns over costs and price risks. But these concerns are now an important factor in any Arctic project. Royal Dutch Shell cancelled plans to drill off Alaska during 2013 after having spent USD $4.5 billion since 2005. The company may not return for another attempt in 2014. ConocoPhillips, which was working with Keppel to develop a landmark ice-class Arctic rig, has put the project on hold, and has shelved plans to drill in the Chukchi Sea in 2014. Total has publicly stated that the petroleum industry should refrain from

developing resources in the Arctic.

None of these development delays are set in stone, and circumstances can change. But policy makers should not fret over a massive (black) gold rush in the Arctic. Except for some unique opportunities, large-scale petroleum development in the Arctic will remain on hold.

Notes

1. "Ernst & Young Provides Arctic Assessment." Oil & Gas Journal. N.p., n.d. Web. Aug 11, 2013.
2. Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries outside the United States, Energy Information Agency. June 13, 2013. http://www.eia.gov/analysis/studies/worldshalegas/
3. Forecasts are from a forthcoming report to be published in September 2013 by the Energy Policy Research Foundation, Inc. (Washington, DC). The project author is Trisha Curtis, director of upstream and midstream research.
4. Lenzer, Robert. "The Price of Oil Is the New Economic Spoiler." Forbes Magazine. September 12, 2012. Lenzer provides an extensive review of the research on how higher oil prices curtail growth.

Russian and Norwegian perspectives

Arild Moe

KEY DEVELOPMENTS

In terms of offshore development, the most dynamic area in the Arctic is Norway's part of the Barents Sea. Exploration in this area started in 1980, though the first field came on stream only in 2007: the gas field Snøhvit ("Snow White"), located 40 km from shore at the northernmost point in Norway. The oil field Goliat, located closer to the mainland, is slated to start producing in 2014. In recent years, several promising discoveries have been made, and development is expected to start within this decade. Moreover, 20 new licenses for exploration and development in the Barents Sea were allocated in 2013.

In 2011, a delimitation treaty between Russia and Norway for the Barents Sea and Arctic Ocean entered into force. This meant that a virgin area of some 175,000 square kilometers equally divided between the two sides straddling the new boundary line could be opened for exploration. Norway immediately started seismic surveys that were concluded the following year. It is expected that a licensing round for blocs on the Norwegian side of the boundary, will be announced as soon as the collected data have been processed. The Norwegian decisions seem, to some extent, to be connected to developments on the Russian side of the boundary. The Norwegian government wants to have the best possible knowledge of the geology and the potential of discovered fields in the area in case discoveries are made on the Russian side that extend across the boundary.

Several international major companies and many smaller companies are already involved in the Norwegian Barents Sea, as operators or as members of license groups. This is the only Arctic offshore area that will see production this decade (with one exception in Russia). This means that the area will be important for companies developing their Arctic operations and technologies. But the Norwegian Barents Sea does not have ice problems. It is the least difficult Arctic Sea area; experience from this area has limited applicability to ice-infested areas.

On the Russian side of the Barents Sea, developments started at about the same time as in Norway. In the 1980s, several promising discoveries were made, including some super-giant gas fields and several medium-

sized and small oil fields, but little effort was made to develop these fields. Arctic offshore resources were regarded as a long-term option, and the oil and gas industry had their hands full with onshore projects. There were two exceptions to this story, however. Plans for development of the Prirazlomnoe oil field, located in shallow waters 57 km offshore in the southeastern part of the Barents Sea (also called the Pechora Sea), were already developed in the mid-1990s. Construction of a giant steel caisson to sit on the bottom of the field, protecting drilling, storage and loading facilities from the drifting ice in the area, started in a naval yard in the Arkhangelsk Province. The project, managed by a subsidiary of Gazprom, met with serious technological and financial problems. The platform was completed only in 2012, when it was towed into position. After further delays, it has been announced that production will commence at the end of 2013, eventually reaching a level of 6.5 million tons per year.

The experience of developing Prirazlomnoe has been mixed, to say the least, and nobody seems to know the full cost picture. However, once the platform is in place and operating, it will change the prospects for several small and medium-sized fields in its vicinity. The platform can also be used for storage and loading for these fields. Some exploration work, albeit limited, has been carried out on these fields in recent years and renewed interest is likely. In two of these projects, Rosneft has concluded an intentional agreement with the China National Petroleum Corporation (CNPC).

The other, and potentially far larger, project in the Russian Barents Sea is the Shtokman gas and condensate field, thought to contain around 3.9 trillion cubic meters of gas. Discovered in 1988, serious development efforts in this field started only in 2003, once technological developments made it feasible and the gas market in the United States seemed promising, with expectations of rising prices. After twists and turns, a special-purpose company, Shtokman AG, was set up in early 2008. Owned 51% by Gazprom, 25% by Total, and 24% by Statoil, the company was intended to develop and operate a third of the field. But it would not own the license or sell the gas. Disagreement on technical solutions as well as cost problems became apparent from the start. Yet it was the changed market outlook that finally broke the camel's back. In 2012, the partners concluded that they could not go ahead with the proposed project. Even though it has not been officially shelved, it seems that Gazprom has concluded that development would have to be postponed.

The lessons foreign companies draw from the Shtokman experience are manifold: Some are related to the framework conditions that were known before cooperation started, namely the restricted role foreign companies are allowed to play on the Russian continental shelf. Other problems became more acute in the course of the cooperation, including the complications that foreign partners experience in cooperating with a state-dominated monopolist that is pursuing several parallel agendas. Of course, the Russian side has also learned from this ill-fated project. A clear division of responsibilities between Russian and foreign partners is required, and the "Shtokman model" in its pure form, where the foreign partner is not allowed to sell the product, is probably no longer feasible. An obvious lesson is that Arctic offshore gas is marginal in today's market and that the effectiveness and cost of development is crucial. Russian companies are in no position to develop such fields on their own. The need for foreign project experience and technology is absolute.

After the delimitation of the Barents Sea and after Norway had started its seismic surveying, the Russian government awarded the state-dominated company, Rosneft, license to cover the whole Russian part of the previously disputed area. In April 2012, Rosneft announced cooperation agreements with ENI for the southern part of the area and with Statoil for the northern part. These deals include seismic surveying and exploration drilling to start before 2020. Activities will be conducted within the framework of joint ventures that are two-thirds sowned by Rosneft and one-third by the foreign partner. The areas are huge and largely unexplored. Expectations are high on the Russian side, but it will necessarily take time to carry out comprehensive exploratory drilling. In the event that several important discoveries are made, it is likely that the licenses will be split to allow more partners to come in. Developments in this area will be followed closely by the international oil industry.

The deals in the Barents Sea have the same structure as the agreement Rosneft concluded with ExxonMobil a year earlier for an area of some 126,000 km^2 in the Kara Sea. This area, as with the area where Statoil will cooperate with Rosneft, has ice and is located far from the infrastructure. Rosneft has announced that drilling will start in August 2014.

In early 2013, an area further east in the Kara Sea as well as large acreage in the Laptev and Chukchi seas were included in the Rosneft-ExxonMobil cooperation. Altogether, the joint exploration areas of the two companies in the Arctic amount to about 730,000 km^2. It appears that

the companies will concentrate on the areas in the Kara Sea first. Rosneft's president has announced that the first oil may be produced before 2020, but this is unlikely.

Gazprom signed an MOU with Shell in 2013 for joint exploration in the Russian part of the Chukchi Sea. Shell, however, sees this as a long-term option. In 2013, Gazprom also received several new licenses for very large gas and gas condensate fields in the Barents and Kara seas. Only limited seismic surveying is expected in the coming years, due to the uncertain demand for Arctic gas. Gazprom also has oil interests through its oil subsidiary Gazprom Neft, which is engaged in exploring the Dolginskoe oil field in the Pechora Sea. Rosneft has protested the right of this company to operate on the Russian continental shelf.

Meanwhile, the most advanced new gas project in the Russian Arctic is Yamal LNG. This project, in the Tambeyskoe group of fields on the eastern side of the Yamal Peninsula, is not an offshore project. However, the business plan is to build an LNG factory on the site and ship out the product via the Northern Sea Route (NSR). The project is 80% owned by the independent Russian gas company Novatek and Total owns the other 20%. In September 2013, it was announced that CNPC of China would buy a 20% stake in the project from Novatek, coupled with contracts for gas deliveries.

The project is expected to reach a production level of 16.5 million tons of LNG per year. Primary markets are in Northeast Asia, but deliveries to the Atlantic market in the winter months also are foreseen. A complicating factor was that Gazprom by law holds an export monopoly, which Yamal LNG challenged. By autumn 2013, Yamal LNG was granted export rights. Front-end engineering design work on the project was completed in 2012 and Daewoo of South Korea won an option to build 16 ice-strengthened carriers in 2013. The technical details and marketing of the LNG continue, and a final investment decision for the project is expected by the end of 2013.

Currently, Alaska accounts for approximately 13.2% of U.S. oil production. Output is declining, but there is a potential for further development of Alaskan oil and gas resources. Although existing fields have reached maturity, new reserves are likely to be found both onshore and offshore. The U.S. Bureau of Ocean Energy Management estimates that there are 6.94 billion barrels of mean recoverable oil and a mean projection of 32 tcf of natural gas offshore in the Beaufort Sea. With huge geological

structures, the continental shelf under the Chukchi Sea offers great promise. The same agency estimates a mean of 15.4 billion barrels of oil and 77 tcf of gas there.

Many of the large U.S. oil companies are present in Alaska. The companies are making investments in order to prolong production from existing fields, as in the Prudhoe Bay area. There are several initiatives involving new exploration. Shell developed a plan for oil exploration in the Chukchi Sea off Alaska's northwest coast, which would be the first offshore exploration drilling in the U.S. Arctic in two decades. In September 2012, however, the company announced that it was cancelling its drilling program for 2013 after a containment dome designed for a potential oil spill in Arctic waters was damaged. ConocoPhillips and Statoil have also postponed plans for drilling in this area. Nevertheless, expectations for drilling will start in a few years and new leases in the area will be sold.

Recent development related to the Point Thompson field located on the coast 60 miles east of Prudhoe Bay has ignited new optimism regarding oil and gas development in the North Slope area. It is Alaska's largest undeveloped oil and gas field, holding an estimated 8 trillion cubic feet of natural gas and hundreds of millions of barrels of oil and gas liquids. Current plans call for an initial output of 10,000 barrels of natural gas condensate and 200 million cubic feet of natural gas a day.

Canada's offshore petroleum activities are dominated by fields off its east coast, near Newfoundland and Labrador. There are expectations of large discoveries in the Beaufort Sea and several major oil companies hold licenses for exploration in that area. A joint venture involving BP, ExxonMobil and Imperial Oil seems to have the most mature plans for an exploration drilling program. The regulatory framework is not yet in place and drilling is not likely to start before late in this decade.

In Greenland, Cairn Energy, the only company presently active there, has been drilling since 2010, searching for petroleum in Baffin Bay off the west coast, so far without success. Other companies also hold licenses. At present, the government seems to follow a cautious line, pursuing a slow exploration program.

TECHNOLOGICAL ISSUES

It seems that most major companies believe the technological challenges in

the Arctic can be tackled in principle with existing technologies, but that the risk level requires the highest quality and redundancy in all equipment. Particular technologies are highlighted by some companies. Shell maintains that during drilling, "We use a number of early detection measures such as sophisticated sensors that immediately alert specialists at our global real-time operations centers. And we use mechanical barriers such as 'blowout preventers' to seal off the wells. Mechanical barriers work rapidly and effectively. But in the unlikely event these measures fail, it is possible to drill a relief well alongside that can pump cement or heavy mud into the original well to cut off the flow. We also have a stringent process in place to ensure the safe and controlled temporary suspension of operations if needed.[1]" According to Statoil, "Subsea or down hole separation of water with associated direct injection back into the field will also be essential in handling production both above and below ice. Strong technological development in multiphase transport of mixtures of oil, gas and water is expected to further increase [possible] transportation distances.[2]" ExxonMobil stresses the need to handle icebergs: "In continuing to improve our ability to design structures to resist iceberg loading, ExxonMobil used new technology to perform complete 3D shape surveys of about 30 icebergs (both above and below the waterline) offshore Newfoundland and Labrador. This unique data set allows us to understand how icebergs interact with various structure geometries and to better predict the potential magnitude of ice impact loading.[3]" Development of new technologies and systems for the handling of oil spills is especially underlined by BP, but is a concern for all players in the region. In general the challenge is seen to be not so much technology itself, but operation systems and procedures that can enhance safety.

Transportation technologies are available already, but advances in ship design may increase the season for sailing without icebreaker assistance. The economies of projects can thus be improved.

NATIONAL POLICIES

Policies with regard to offshore Arctic development vary considerably among the coastal Arctic states.

Norway is currently pursuing an active licensing policy. This is partly explained by the expected reduction in output from fields in the North

Sea and Norwegian Sea and the need to sustain the activity level in the industry, which is of paramount importance to the Norwegian economy. As mentioned above, there may also be additional interest in developing the previously disputed area in the Barents Sea, in anticipation of cross-boundary fields. Norway also has, however, a strong green opposition that opposes forays in the Arctic. Depending on the balance of forces in the new parliament elected in the autumn of 2013, a more cautious attitude toward new licensing is a possibility.

Russia has given the development of Arctic resources as a high priority through official plans and statements over the last ten years. However, there have been other important developments in Russian energy policy. Assets were transferred to state-dominated companies and they received privileged access to resources, notably through changes in legislation in 2008 that granted Rosneft and Gazprom a monopoly on operating new offshore projects. The two companies were also given licenses for large areas. However, these two companies did not show the expected resolve offshore. This was understandable, given their limited offshore experience and extensive activities onshore. Other Russian companies with offshore experience, notably Lukoil, were barred from operating or seeking licenses.

There is a contradiction between Russia's declared goal of rapidly developing its Arctic offshore petroleum resources and the constraints imposed by national control and monopolization. The Ministry of Natural Resources has harbored the ideas of opening up the continental shelf for other Russian companies. However, the Rosneft deals preempted attempts at liberalizing access to the Russian continental shelf and extensive offshore licensing to Rosneft and Gazprom in 2012-2013 indicate that those who wanted a more liberal policy have been defeated. With so much promising offshore acreage already licensed, serious openings for private Russian companies are hard to imagine without unbundling the activities of Gazprom and Rosneft. There is not much opposition to Arctic offshore development as such, but the internal rivalries are likely to continue to put a brake on development.

In the U.S., the urgency of Arctic energy development is much lower than a few years ago, due to the revolution in unconventional gas and oil. Gas is less interesting for economic reasons, and the market for production in the Arctic would probably have to be LNG exports to Asia. Presently, exports are not allowed, but this could change. Oil companies are interested – particularly in oil – and in principle the government is prepared

to sell leases offshore Alaska. Nevertheless, it is evident that environmental considerations loom even larger than they did before the Mexican Gulf catastrophe.

The situation in Canada is much the same. The development of Alberta oil sands is at the center of attention, and Arctic offshore energy development does not seem to be a high priority. Environmental concerns and potential impacts on native communities are extremely important. The industry momentum is there, though, and will probably lead to exploration in some years.

Greenland connects its prospects with becoming fully independent from Denmark to future petroleum revenues. Despite this, recent developments have shown that environmental counter-arguments also carry weight.

Notes

1. http://s06.static-shell.com/content/dam/shell/static/future-energy/downloads/arctic/technology-in-thearctic.pdf
2. http://www.norden.org/no/nordisk-ministerraad/samarbeidsministrene-mr-sam/arktis/kalender/arctic-changing-realities/taler-og-presentasjoner/hege-marie-norheim-strategies-for-oil-and-gas-development-in-the-arctic
3. http://www.exxonmobil.com/Corporate/files/news_pub_poc_arctic.pdf

Conservation perspective

Alexander Shestakov

The Arctic, as defined by the Arctic Council's Conservation of Arctic Flora and Fauna working group, is much larger than the area defined by the Arctic Circle – it includes the tundra and boreal forest, and ocean environments ranging from almost ice free to permanently ice covered. The Arctic of today and tomorrow is one of the most rapidly changing parts of the world. It is warming twice as fast as any other region of the planet, causing multiple effects in the physical environment and in biota. The Arctic is cast as environmentally fragile because of its harsh environment and relatively low numbers of plant and animal species. At the same time, it is enormously powerful, providing numerous and varied ecosystem services for the benefit of Arctic indigenous peoples, northern communities, and the entire globe. The following factors may inform discussions about development in the Arctic:

ENVIRONMENT

- About 4 million people
- Some of the largest intact ecosystems in the world
- Unique, highly specialised species and human communities
- Warming twice as fast as the rest of the world
- Four of the 10 largest fisheries in the world
- An enormous carbon sink, including methane in permafrost
- 279 species of migratory birds (including 80% of the world geese population)
- Short food chain

DEVELOPMENT

- No easy resources
- No reliable technologies
- No infrastructure
- No strategic assessments
- No strong Arctic-specific sectoral standards
- No solid knowledge of ecosystems and impacts

- No comprehensive international governance regime
- No adequate system of insurance for major disasters

Any discussions about hydrocarbon development in the Arctic should include the entire operation cycle and also distinguish between different parts of the Arctic and different types of operations:

- Operations in the High Arctic (ice covered) and in Arctic/sub-Arctic with open water (where companies claim to have some so-called Arctic experience);
- Offshore, deep-water high Arctic operations versus onshore or near-shore (artificial island and shallow coastal water) operations.

WHAT ARE THE MOST PRESSING ENVIRONMENTAL CHALLENGES ASSOCIATED WITH ARCTIC PETROLEUM ACTIVITIES?

New hydrocarbon development in the Arctic will further foster climate change through additional burning of fossil fuels, aggravating the current worrying trends and speed of changes in the Arctic. This development is very much against countries' commitments to the goal of keeping the global average temperature from rising by more than two degrees. As some of the world's biggest producers of greenhouse gas pollution and exporters of oil and gas to the world markets, the Arctic states have an obligation to lead in this process.

Petroleum activities in the Arctic will bring numerous environmental challenges (impacts) associated with every stage of hydrocarbon development in both on- and offshore operations. The most pressing issues include, but are not limited to, the following (largely associated with offshore activities):

- Sound pollution and disturbances affecting marine life (in particular marine mammals) during the offshore seismic operations (these can be reduced and some mitigation measures may be taken; currently there is a lack of unified and coordinated regulations in the Arctic, and it depends on the company's approach and varies between operators);

- Pollution from oil spills, especially in and under ice and in ice-infested waters;
- Destruction of species and their habitats, including species essential for traditional use and traditional cultural practices;
- Pollution, including black carbon, causing degradation of biota and further melting of sea ice;
- Further emissions of greenhouse gases;
- Additional disturbances and destruction of sea ice and corresponding ice habitats;
- Threats to the provisioning of basic ecosystem services, including food security, to indigenous and local communities; and
- Others (the list is very long).

Table II-1 Percentage of time during the operating season when no response to in-situ burning, mechanical containment or recovery and areal dispersant application is possible (WWF, 2011)

		Percentage of time when no response is possible							
		Jan.-May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Beaufort Sea	Near Offshore	≤100	66	54	56	62	81	≤100	≤100
	Far Offshore	≤100	82	65	66	66	84	≤100	≤100
Davis Strait	Central	≤100	≤100	83	44	44	59	84	≤100
	West Central	≤100	≤100	≤100	45	48	59	84	≤100

Note: The dark shaded cells represent months outside the potential drilling season, when no countermeasure is possible.

In addition to direct environmental impacts, there are other risks that might directly affect the safety of operations associated with petroleum activities in the Arctic. Some of these are related to general environmental conditions in the region, including low temperatures, visibility and darkness, icing, sea ice and icebergs, melting permafrost, strong coastal erosion, etc.

In addition to extreme weather conditions, there are risks associated with inadequate technology, unavailability of proper, close and effective infrastructure, and the unavailability of qualified personnel to operate in those conditions. These difficulties and unreadiness to drill were graphically illustrated by Shell's series of mishaps as it attempted to drill off Alaska last year.

The risks inherent in Arctic drilling are not only identified by environmental organizations, they are also recognized in reports by

governments, insurance agencies, and even in statements by oil companies. They include recent reports from the U.S. Geological Survey, Lloyds, the Canadian National Energy Board, the UK Parliament's Environmental Auditing Committee, and U.S. Senators. To condense the risks, they are ones not fully known and understood, identified but not fully assessed and known (e.g., major spills) but currently unmanageable or too expensive to effectively mitigate and reduce.

> "The environmental consequences of disasters in the Arctic arguably have the potential to be worse than in other regions. The resilience of the Arctic's ecosystems in terms of withstanding risk events is weak, and political sensitivity to a disaster is high." *Arctic Opening: Opportunity and Risk in the High North, Lloyds/Chatham House*

From an environmental point of view, the level of cumulative risks from petroleum development in the Arctic is unacceptable, a position that resonates with the general public.

A recent study conducted by the WWF provides evidence that the risk is not just from oil extraction; gas and gas condensate extraction also have significant environmental impacts that are still not fully understood and require further research.

ARE THERE ANY WAYS TO DEVELOP ARCTIC OIL AND GAS THAT WOULD SATISFY ENVIRONMENTAL CONCERNS ABOUT THE DANGER OF OIL SPILLS UNDER ARCTIC CONDITIONS? WHAT COULD BE DONE TO MINIMIZE THE DANGERS OF OIL SPILLS IN THE ARCTIC?

Currently there are no reliable technologies to fully deal with an oil or gas condensate spill under the sea ice, in the ice and to a great extent on the ice, or with oil in water mixed with ice.

> "5.10. Finding: ... While efforts are ongoing to develop countermeasures to address the potential of an oil spill in the Arctic and ice-covered waters, it remains unclear when and where any one of these countermeasures, or countermeasures in combination, will be available under current and future weather, sea state, ice, and light conditions of the Arctic – or whether they will work even if available." *An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in Chukchi and Beaufort seas, Alaska, USGS*

If oil and gas companies (and the governments that license them) decide to proceed despite the risks, a number of actions could be taken to reduce the danger and effects of spills. Those may include:

- Introducing sensitivity mapping approaches as an obligatory part of the EIA and contingency plans;
- Identifying the most important, productive, vulnerable and sensitive areas (both biologically and culturally), including protected areas, and build "no-go zones" (no oil and gas activities) around them using marine spatial planning tools;
- Carrying out full, comprehensive, open, participative and transparent strategic assessments and environmental impact assessments for all projects;
- Arctic states and companies cooperating with full transparency in contingency plans, operations and information about spills (including full implementation of the Arctic Council agreement on cooperation on marine oil pollution preparedness and response);
- An obligatory response gap assessment with identification of seasonal restrictions;
- Taking full financial responsibility with appropriate funds allocated (secured) before operations;
- Establishing and enforcing Arctic-specific technical requirements;

Technical requirements to reduce oil spill risks may include:
To maintain well control:
- BOPs and/or wellhead control systems;
- Proper well design, casing and cementing;
- Each well is drilled from start to finish using an uninterrupted BOP control system; and
- Government or independent inspectors verify BOP testing, casing and cementing plans
- Measures to stop a blowout:
- Same-season relief well capability;
- Alternate drill rig to be available within 72 hours technically capable of operating in specific location and includes qualified crew
- Measures to contain a blowout:
- Pre-constructed, field tested containment system (including ongoing storage and transport of recovered oil), deployable and on site within 24 hours
- Sufficient level of infrastructure:
- Communications, weather/ice forecasting and reporting, ice breaker availability, deep-water ports, airstrips, hangars etc.

- Strictly enforcing development of national, regional and site-specific contingency plans based on worst-case scenario,

Requirements for contingency and response plans:
- Based on a worst-case scenario (with realistic daily blowout rate and number of days needed to drill a relief well for a particular location)
- Meeting a defined oil spill response/removal standard (that ensures a specifically defined amount of oil, e.g., % of total discharge, to be removed)
- Referring to capabilities of equipment and response systems that :
  - are established through field tests (not the hypothetical efficiency of a component)
  - include encounter rates (assessment of ability to access the oil)
  - are established under a range of expected environmental conditions in the proposed drilling location (e.g., for all seasons)
  - are certified by an independent third party

- Including seasonal limitations (operations limited to only those periods when the oil spill removal performance standard can be met)
- Is open to the public

- Implementing a precautionary and stewardship approach based on principles of ecosystem-based management;
- Having same-season relief well capacity;
- Having infrastructure development and appropriately trained personnel; and
- Fully engaging society and in particular indigenous and local communities with full transparency of plans and operations.

Regardless of all the aspects mentioned above and in fact generally agreed on, including lack of knowledge, technologies, experience, regulations, and high risks to the environment and human safety, industry and governments continue their efforts in the Arctic development. However, if two or three years ago there really was a "gold rush" for Arctic hydrocarbons, a more sober assessment of such projects and related risks would have resulted in a number of postponed and cancelled projects in the Arctic offshore. In 2012, the Arctic's unpredictable features were demonstrated in full.

ARE INTERNATIONAL ENVIRONMENTAL AGREEMENTS LIKELY TO AFFECT THE DEVELOPMENT OF ARCTIC ENERGY PROJECTS?

A number of international agreements are currently applicable to hydrocarbon development in the Arctic, although they do not have region-specific regimes or cover all aspects of development. New initiatives also were taken at the regional level by the Arctic Council. The WWF believes the council can play a very significant role in putting in place Arctic-specific regulations. Processes such as the G20 are nearing issues related to the energy sector as a whole and specifically for offshore development. However, there is no coordinated or harmonized Arctic-specific system of regulations at the international level (that fully addresses Arctic

conditions) that could provide a full governance regime necessary for Arctic exploration. Arctic governments should work further to ensure a stronger coherence in their national approaches to regulate oil and gas activities in the Arctic based on joint approaches to avoid double standards or unfair usage of loopholes in legislation. This can be done through stronger international efforts at different levels (bilateral, regional and global). It is crucial to make national regulations at the highest possible level, as well as to meticulously work on the obligations agreed to in the Arctic Council Agreement.

HAVE INTERNATIONAL OIL COMPANIES MADE CHANGES IN RISK MANAGEMENT OR NORMS THAT AFFECT THEIR ARCTIC OPERATIONS AND STRATEGIES?

Companies are working internally and jointly (for example, through joint industry projects) to develop new technologies and reduce risks. However, it is difficult for the public to assess progress, as most of this work is not transparent. Many announced developments and tools have not been confirmed by real-life tests with full public access.

Last year and early in 2013, the industry made many new, more sound statements. Total warned about drilling for oil in the Arctic and Lukoil echoed this statement. Shell, BP, Conoco, and Gazprom postponed or cancelled projects in the Arctic offshore due to environmental risks and insufficient preparedness, and the Shtockman project was cancelled because it was not financially viable.

This seems to be a sign that a rational approach to risk assessment is being applied to operations in the Arctic. However, many things still depend on national regulations, which vary significantly from country to country. Thus, the U.S. Department of the Interior, in its 60-day review of Shell's operations, came up with serious recommendations on significant discrepancies in project planning and coordination (i.e., soft risk management tools), but no significant improvement in regulations have been observed in other parts of the Arctic. For example, in Russia, huge licensing blocks were granted without any competition. In fact, this means that even if the industry intends to stay on the safe side, differences in national regulations create inevitable intentions to go further to the Arctic,

while major infrastructure and technologies for preparedness, prevention and response are only about to be developed and constructed sometime in the future.

In the Arctic, the risks of exploiting hydrocarbons are clear, both on a local and global basis. Therefore, the WWF believes that without proper regulation of operations, available proven techniques for prevention and response to oil spills and adequate knowledge about Arctic systems, there should be no new development of hydrocarbons in the Arctic offshore.

Community perspective

Edward S. Itta

I was asked to join this distinguished panel because I am an indigenous resident of the Arctic. My people are the Inupiat Eskimo, who have lived along the Arctic coast of Alaska for thousands of years. We are Inuit and are related to the Inuit of Canada, Greenland and the Russian Far East.

I was born in Barrow, which is the hub community of Alaska's Arctic. I grew up learning the subsistence of whaling and hunting traditions that enabled our survival and knit us together as a community. We lived off the land and the ocean in a harsh environment. That environment shaped us; it continues to define us as Inupiat. We still depend on whaling and hunting for our nutritional needs, and these practices continue to function as the central activities of our traditional cultural life.

I was the mayor of the North Slope Borough from 2005 to 2011. It is the regional government that represents the eight communities along Alaska's northern coast. These communities are predominantly Inupiat, so the borough has always provided a strong voice for Inupiat concerns.

The terms of reference for this gathering call for discussion of ways in which oil and gas development affect the Arctic coastal communities; issues that arise in coastal communities as a result of this development, and strategies for minimizing negative community impacts and maximizing benefits from development. This commentary provides a general description of what I consider the most important elements for our discussion.

Oil and gas development is nothing new in our region. In 1968, the largest oil field in North America was discovered onshore at Prudhoe Bay, 150 miles east of Barrow. The Trans-Alaska Pipeline was built across 800 miles of the state in order to get all that oil to an ice-free port. In nearly 35 years of production since then, tremendous wealth has been created from the flow of oil headed south.

Our experience with onshore oil and gas development at Prudhoe Bay is instructive as oil companies begin to explore what they believe to be the next big Alaskan oil and gas provinces offshore in the Chukchi and Beaufort Seas. Prudhoe Bay spawned infrastructure that spreads across the tundra far beyond what was envisioned in the early stages of development. Along with the economic benefits of that expansion, there have been increased environmental impacts as well as an expansion of the area that

is off-limits to traditional subsistence hunting on the part of villagers living nearby.

The most important concept to understand is that the effects from the expanding infrastructure on our subsistence way of life are cumulative. At the request of Congress, the U.S. National Research Council conducted a study to examine the impacts of oil and gas development on the North Slope ("Cumulative Environmental Effects of Oil and Gas on Alaska's North Slope," National Research Council, 2003). A statement at the end of the study is worth repeating:

> *"Continued expansion will continue to exacerbate existing effects and create new ones. Whether the benefits derived from oil and gas activities justifies acceptance of the foreseeable and undesirable cumulative effects is an issue for society as a whole to debate and judge."*

As one can see, this is an acknowledgement that there are impacts and at the same time there are only a few definitive answers.

Offshore development may well follow a similar pattern, with the success of one or two drilling sites leading to wider and wider exploration. That is the best of all possible results for companies that have invested heavily in the outcome.

For local residents, on the other hand, more and more development and placement of associated infrastructure is not necessarily the best result. As the offshore oil province expands, so will the extent of impacts on the underwater ecosystem. There will be more stress on migrating whales as the level of underwater noise and habitat disruption interferes with all the marine populations. When the bowhead whale is under stress, the Inupiat are under stress.

It is clear that the Inupiat and the oil companies have different priorities. The companies want to extract oil to create wealth in the cash economy while protecting the ecosystem. The Inupiat want to continue hunting bowhead whales to sustain their subsistence economy while participating in the cash economy. The question is this: Can the companies and the federal government honor and protect Native subsistence values at the same time that they allow and promote offshore development?

I believe this is possible. First of all, it requires that federal policymakers recognize the economic value of subsistence activities. People migrated to Alaska's North Slope thousands of years ago because the subsistence

resources – whales, seals, walrus, caribou, fish, etc. – held tremendous value for them. These resources were (and are) the currency of survival. So they have economic value.

Once the economic value of subsistence is recognized, we need to identify areas so biologically productive for subsistence purposes are with drawn from consideration for petroleum development. This has been done (at least temporarily) onshore around a lake in the Federal government's National Petroleum Reserve about 70 miles southeast of Barrow. Similarly, rich subsistence areas offshore could be identified and exempted from industrial activity.

Next, standards uniquely responsive to Arctic conditions should be created and applied appropriately offshore. You cannot just take the Gulf of Mexico standards and tweak them for the far north. Arctic standards should include the ice classification of vessels used in operations. These standards must take into account also the vast distances involved in Arctic operations, including distances from significant response capabilities. The Federal government is currently scoping a set of Arctic standards that will apply to offshore oil and gas activity in the region.

A third consideration involves the creation of a system to replace the subsistence value lost as a result of offshore development with some sort of economic equivalent, which could include an ownership stake. Such a system would recognize that the Inupiat are rights-holders in the ocean environment by virtue of their occupation and users of the region for many centuries. Our people have a clear and legitimate interest in any issue affecting subsistence, onshore or offshore. The way I like to put it is that the Inupiat are not separate from the Arctic environment – we are a part of it.

A system to replace lost subsistence value also recognizes that the contemporary Inupiat economy is a mixed economy. It relies on both subsistence resources and cash income to make ends meet. This has been the case since Alaska Native land claims were settled in 1972 through the transfer of land and the creation of for-profit corporations whose shareholders are the state's indigenous peoples. The resolution of Alaska Native land claims largely succeeded in creating a fair deal for Alaska Natives because it did two things: the settlement recognized the importance of a land base to the continuation of Native culture, and it created the potential for the Native peoples to have an ownership stake in resource development.

These two underlying principles – the accommodation of our traditional cultural values and the opportunity to have a stake in the cash economy

– need to be at the core of the terms by which offshore oil development takes place. The land claims act took care of the issue for onshore development. The same thing needs to be done for development beyond the water's edge.

Chinese perspective

Kang Wu*

This brief note summarizes the Chinese perspective concerning oil and gas development in the Arctic. The following questions will be addressed: How important is the Arctic for China's long-term energy supplies? Under what conditions are Arctic oil and gas attractive to China? What role is likely for China in the development of Arctic energy, as an industrial participant, an investor, or a buyer of energy? Does China prefer to proceed bilaterally in dealing with Russia on such issues?

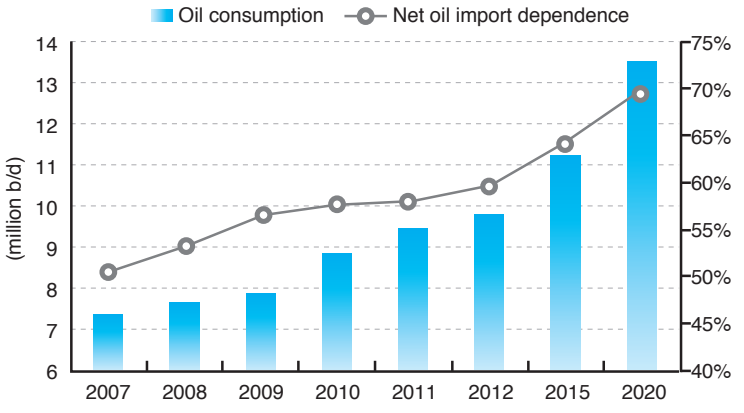
CHINA'S LONG-TERM ENERGY SUPPLIES: THE ROLE OF THE ARCTIC

Since becoming a net importer of all three types of fossil energy – oil, gas, and coal – in the late 2000s, China's appetite for energy continues to grow, despite its strong efforts to reduce energy intensity. As a result, the issue of energy security has been looming larger for Chinese policy makers in recent years.

Of the three types of fossil energy, China has the highest import dependence on oil. In 2012, China imported a total of 6.4 million barrels per day (b/d) of oil (crude oil and refined products combined) and exported some 540,000 b/d. The net imports of 5.9 million b/d were the highest in history, accounting for some 60% of China's total petroleum product consumption, up from 50% in 2007 (Figure II-7).

In comparison, the net oil import dependence of the United States – the world's largest oil-consuming country ahead of China – declined from 67% in 2007 to 51% in 2012 (BP 2013). Looking forward, China's oil demand is expected to rise continuously, but domestic production has stagnated. As a result, every incremental barrel of oil will be translated into more oil imports, leading to a higher import dependence ratio. According to Facts Global Energy (2013a), the net oil imports as a share of total oil consumption in China is forecast to go up to 67% in 2020.

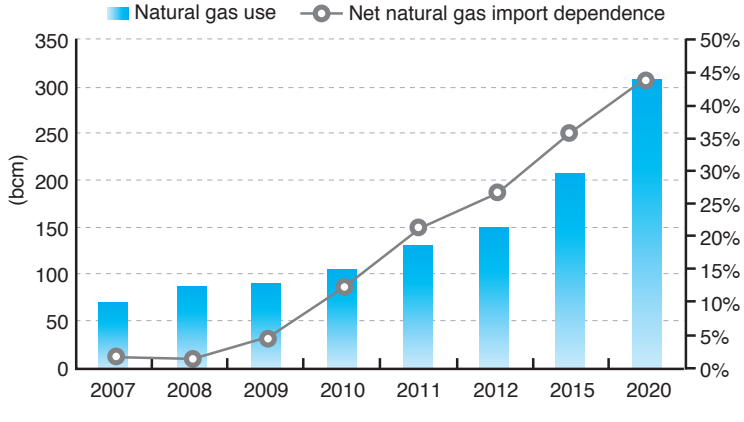
* The author hereby acknowledges the research input provided by Robert Young, a Yale University undergraduate and research intern with FGE.



Note: 2015-2020 data are projections.

Figure II-7 China's oil consumption and net import dependence, 2007-2020

China has a small but fast-growing natural gas market. Until 2006, China did not import a single cubic meter of gas. The amount of imported gas has since grown rapidly and has become an important part of gas use in China. In 2012, the share of natural gas in China's total primary commercial energy consumption (PCEC) was under 5%, way below the global average share of 24% and 30% for the U.S., and less than one third of the average share of 19% for the rest of the Asia-Pacific region (BP 2013). Despite the small share in total PCEC, China is the largest natural gas consuming country in Asia. In



Note: 2015-2020 data are projections.

Figure II-8 China's nature gas use and net import dependence, 2007-2020

2012, China imported 14.7 million tonnes (mmt) of LNG (23 billion cubic meters or bcm) and 23 bcm of pipeline gas. After taking out the volumes of Chinese gas exports to Hong Kong, the net gas imports accounted for 27% of China's total gas consumption in 2012, up from merely 2% in 2007 and 1% in 2008 (Figure II-8).

Unlike oil, China's domestic natural gas production still has huge room to grow. The emergence of shale gas, along with other unconventional types of gas, such as coal-bed methane (CBM) and coal-to-gas (CTG), will add more to the domestic supply. However, with the rapid growth of gas demand, China will still need to import more LNG and pipeline gas. By 2020, the share of net natural gas imports in China's total natural gas use is likely to go up to 44% (FGE 2013a). If domestic unconventional gas is included, the share of imports is lower both at present and in the future.

When it comes to coal, which is not the focus of this note, the situation is quite different. China was a net coal exporter for decades. But in 2009, it switched to a net importer. In 2012, China imported 288 mmt of coal, the highest in the world, ahead of Japan. However, the share of China's net coal imports was only 7% of the country's total coal consumption.

Given the above circumstances, energy security has become vital for China. Since the early 2000s, the Chinese government adopted a series of measures to address the issue of energy security. As far as oil and gas are concerned, some of the key measures are to: (1) establish strategic upstream oil and gas reserves, (2) enhance domestic oil and gas exploration and production activities, (3) diversify sources of oil and gas imports, (4) strengthen overseas investments, (5) increase investments in the oil and gas infrastructure, and (6) speed up unconventional gas development.

Of these key measures, diversification of oil and gas supply sources and increasing overseas oil and gas investments stand out not only as important but also relevant to Arctic oil and gas development. To diversify sources of energy supplies, China imports oil from all over the world. In 2012, the Middle East accounted for half of China's crude oil imports, followed by Africa with 24%, Russia, Central Asia, and Latin America with 23%, and the rest of the world with 3%. For natural gas, while China imported all of its pipeline gas from Turkmenistan in 2012, imports of LNG were more diversified. Altogether, China imported 54% of its gas (LNG and pipeline gas combined) from Central Asia (Turkmenistan), 26% from the Asia-Pacific region (including Russia), 19% from the Middle East, and 1% from the rest of the world. For both oil and gas, China is eager to diversify its

sources of imports further. As such, seeking supplies from the Arctic, if they are available and economically viable, fits naturally into this strategy.

China's push in the area of overseas investments has been strong and steady since the late 1990s. The cumulative actual and intended investments by Chinese national oil companies (NOCs) and other players have exceeded USD $120 billion. In 2012, China's equity oil production from overseas operations reached an all-time high of 1.7 million b/d. That was 41% of China's domestic oil production and one-sixth of China's total oil demand.

In the above picture, the Arctic has become increasingly important. To alleviate the pressure of transporting the majority of its oil imports through the Strait of Malacca, China has been searching for new routes for quite some years. These efforts include the opening of two oil pipelines (one from Kazakhstan and one from Russia) and two natural gas pipelines (one from Turkmenistan via Uzbekistan and Kazakhstan and another one from Myanmar), the pending operation of a third oil pipeline (Myanmar-China), and expansions of the existing gas and oil pipelines from Central Asia and Russia. Any potential new supply from the Arctic for China will thus satisfy the Chinese government's desire for continuous import diversification.

Regarding overseas investments, the Chinese NOCs are increasingly running out of opportunities to strike big in reaching traditional deals to explore conventional oil and gas. They have to turn to areas such as shale gas, deep water drilling, Canadian oil sands, and most recently the Arctic for new potentials.

As far as diversification of oil and gas supply sources and increasing overseas oil and gas investments are concerned, the importance of the Arctic can be viewed from a number of angles. First, commercially available oil and gas from the Arctic in the future represents a new source of supply that can help China better manage its external energy flows. Second, the Arctic is one of the new frontiers for Chinese NOCs to expand their overseas investments. Third, through energy trade and investment, China can expand its activities in other areas of Arctic business. Finally, although China does not border the Arctic, it is geographically "close" to the region. As China integrates with the rest of the world as a regional and global power, it is only natural for it to get more involved in all aspects of Arctic affairs, including energy.

Arctic oil and gas is generally attractive to China mainly because of the huge resource potential and future prospects there. However, the Chinese NOCs are currently moving in small steps. To make Arctic oil and gas more

attractive to the Chinese government and NOCs, several conditions need to be met. First is the need for direct links of Arctic oil and gas supplies to the Chinese market. With direct links, the Chinese government will be more supportive in viewing the Arctic as a new source of energy supply. Second is the embrace of foreign investment from China by the Arctic countries. Third is the matter of transparent regimes and open acreage for foreign investment in the Arctic. Fourth is the existence of opportunities to form joint ventures with local or international companies engaged in Arctic oil and gas development and purchase of local energy assets. Last, the Chinese NOCs need international partners to ensure the availability of all technologies needed to conduct oil and gas exploration, development, and production.

CHINA'S ROLE IN THE DEVELOPMENT OF ARCTIC ENERGY

China is not a claimant state regarding the Arctic, but that does not prevent it from desiring to play a role as a global power in the region. After years of applying, China was granted observer status in the Arctic Council in May 2013, along with India, Italy, Japan, Singapore and South Korea (Myers 2013). Since the mid-2000s, China has gained recognition as a player in the Arctic business mainly due to its rising economic might, growing interest in investments, and willingness to be a responsible economic partner (Struzik 2013). For the Arctic's energy and natural resources, China seeks to participate in exploration, development, and eventually production as a major investor (Wu 2012). As mentioned previously, China will be a major market for oil and gas produced from the Arctic.

More specifically, China's role in the development of Arctic energy can be assessed from both trade and investment perspectives. For trade, China is the biggest market for any future oil and gas exported from the Arctic region. Even with Arctic oil and gas flowing to other parts of the world, a large portion of the displaced volumes from sources supplying those markets will also come to China. In that regard, China plays an important role in Arctic oil and gas developments even without direct investment there.

In the early stage of Arctic development, China can play a bigger role in the area of investment. As mentioned in the previous section, overseas

investment has for years been one of the key energy security measures adopted by the government. The Arctic is a new frontier area for Chinese investors, led by the NOCs, which mainly consist of China National Petroleum Corporation (CNPC) and its publicly listed subsidiary PetroChina, China Petrochemical Corporation (Sinopec) and its publicly listed subsidiary Sinopec Corp., China National Offshore Oil Corporation (CNOOC) and its publically listed subsidiary CNOOC Ltd., and Sinochem Corporation. Among these four, CNPC/PetroChina and Sinopec have various energy investment projects in Russia with Rosneft, Novatek, and others. Concerning the Arctic, CNPC/PetroChina signed a deal with its partner Rosneft in March 2013 for oil and gas drilling in three areas of the Pechora and Barents seas (Bloomberg 2013). Separately, following China's acceptance as an observer with the Arctic Council, CNOOC has entered into a partnership with Eykon Energy of Iceland in seeking a license for oil and gas exploration in Iceland's Arctic waters (Williams 2013). If the application goes through, it will be the first direct exploration project by a Chinese NOC in the Arctic outside of Russia. In June 2013, CNPC signed a Framework Agreement to acquire a 20% equity share in the Novatek-led Yamal LNG project. A deal was finalized in early September 2013, under which CNPC committed to the purchase of at least 3 mmtpa of LNG from the project. CNPC agreed to help procure external financing for the Yamal LNG project from Chinese financial institutions. As a result, the China Development Bank Corporation, Industrial and Commercial Bank of China, Bank of China, and China Construction Bank will consider taking roles in the project financing of Yamal LNG (FGE 2013b).

In short, the likely role for China in the development of Arctic energy will be both an investor and a buyer of energy. China can participate in investment during the oil and gas exploration stage and then import energy at a later stage when resources are developed and produced. China is also likely to be an active player in non-energy trading, investing, shipping, infrastructure buildup, local developments, and some industrial activities in the Arctic.

RUSSIA-CHINA ENERGY COOPERATION IN THE ARCTIC CONTEXT

Russia-China energy cooperation is wide-ranging, and has been nurtured

by both sides at the government and company levels. Russia is the only country that sends all three types of fossil energy to China: it is currently the largest pipeline oil exporter to China, and it sends coal and LNG to China as well, albeit in smaller volumes. The biggest disappointment for energy cooperation between Russia and China is the failure to reach a natural gas pipeline deal after tortuous negotiations of nearly a decade.

In the Arctic context, Russia-China energy cooperation is also important. Of all Arctic Council members, Russia is rather unique from China's perspective. Russia is the third-largest oil exporting country to China (accounting for 9% of China's total in 2012) and minor gas (LNG) exporter (around 1% of China's total gas imports in 2012). Canada is the only other Arctic Council member country that exports any oil to China. Russia is not only the largest Arctic country, but also the only one that shares a border with China. Russia is also rich in oil and gas resources, which can only grow with the development of the Arctic.

As mentioned earlier, Russia's Rosneft has already begun engaging CNPC/PetroChina in oil and gas investment activities in the Arctic areas. It is expected that other Chinese NOCs will follow suit in the not-so-distant future.

China and Chinese NOCs generally prefer to deal with Russia and Russian companies on a bilateral basis. For the Chinese government, it is a tradition to deal with important partners, particularly big ones, bilaterally. Chinese NOCs follow that tradition. More importantly, the NOCs compete among themselves in the domestic energy business, and they also often compete in international arenas. To have Chinese NOCs cooperating with each other is difficult and a challenge in itself, let alone having wider cooperation with partners from other countries. However, individual NOCs in China have experience and prefer to work mostly with international oil companies in jointly bidding for projects around the world. China and Chinese NOCs need to learn to work with other companies, particularly those from Japan and Korea.

CONCLUDING REMARKS

Various studies show the potential of oil and gas resources in the Arctic and surrounding regions. The U.S. Geological Survey (USGS) released two studies in 2012. A study of the Amerasia Basin petroleum province

(Houseknecht et al., 2012a) shows 3 billion barrels of oil equivalent discovered but not produced, and 9 billion barrels of oil and 57 trillion cubic feet of natural gas undiscovered but technically recoverable resources. A study of the Arctic Alaska petroleum province (Houseknecht et al., 2012b) indicated that the undiscovered, technically recoverable resources are estimated at 30 billion barrels of oil and 219 trillion cubic feet of natural gas. At the 2012 North Pacific Arctic Conference, Moe (2012) stated that oil and gas resource potential in the Arctic is huge. For proven reserves, the Arctic accounts for 4% of the world's total for oil and 19% for gas. If the unproven portion is added, the share of the Arctic is 7% for oil and 24% for gas. The move from unproven or technically recoverable resources to proven reserves is a big step. However, with continuous growth in energy use with a large base, the implications of the resource potential in the Arctic are still huge for China in the long run.

Overall, the Arctic is important for China's long term-energy supplies due to the continuous growth of its energy needs and the sheer volume required in the long run. While Arctic oil and gas is attractive to China, several conditions, such as direct links of Arctic oil and gas supplies to the Chinese market, acceptance of foreign investment from China by Arctic countries, transparent regimes and open acreage, opportunities to form joint ventures with local or international companies, and technology availability need to be met before Chinese NOCs massively invest in the region. China can play an important role as both an energy buyer and investor in the development of Arctic energy. Lastly, China does prefer to deal with Russia, and for that matter other Arctic countries, on a bilateral basis. However, it is time for China to step outside this traditional thinking and consider enhancing cooperation with other potential buyers and investors, particularly Korea and Japan, and companies from these countries. Together, Asian buyers and investors can have a bigger say in Arctic affairs and impact on oil and gas developments in the region.

Notes

1. The author hereby acknowledges the research input provided by Robert Young, a Yale University undergraduate and research intern with FGE.

References

Bloomberg. 2013. "Russia Lets China into Arctic Rush as Energy Giants Embrace." March 25. Accessed July 29, 2013. http://www.bloomberg.com/news/2013-03-25/russia-cuts-china-intoarctic-oil-rush-as-energy-giants-embrace.html

BP (British Petroleum). June 2013. BP Statistical Review of World Energy 2013.

FGE (FACTS Global Energy). 2013a. *FGE Data Books*. Spring.

FGE. 2013b. *Global LNG Monthly Series: Markets*. September 23.

Houseknecht, D. W., Bird, K. J., and Garrity, C. P. 2012a. *Assessment of Undiscovered Petroleum Resources of the Amerasia Basin Petroleum Province, Scientific Investigations Report 2012–5146*. Reston, Virginia: U.S. Geological Survey.

Houseknecht, D. W., Bird, K. J., and Garrity, C. P. 2012b. *Assessment of Undiscovered Petroleum Resources of the Arctic Alaska Petroleum Province, Scientific Investigations Report 2012–5147*. Reston, Virginia: U.S. Geological Survey.

Moe, A. 2012. "Arctic Oil and Gas Development: What Are Realistic Expectations?" Paper presented at the 2012 North Pacific Arctic Conference, August 10-12, East-West Center, Honolulu, Hawaii, USA.

Myers, S. L. 2013. "Arctic Council Adds 6 Nations as Observer States, Including China." *The New York Times*, May 15. Accessed July 27, 2013. http://www.nytimes.com/2013/05/16/world/europe/ arctic-council-adds-six-members-including-china.html?_r=1&

Struzik, E. 2013. "China Signals Hunger for Arctic's Mineral Riches." *Guardian Environment Network*, June 4. Accessed July 27, 2013. http://www.theguardian.com/environment/2013/jun/04/ china-arctics-mineral-riches

William, S. 2013. "China's CNOOC Eyes First Foray Into Offshore Arctic Oil Drilling." *The World Street Journal*, June 5. Accessed July 29, 2013. http://online.wsj.com/article/BT-CO-20130605-707202.html

Wu, K. 2012. "Potential Arctic Oil and Gas Developments: Chinese Perspective." Paper presented at the 2012 North Pacific Arctic Conference, August 10-12, East-West Center, Honolulu, Hawaii, USA.

Japanese perspective

Fereidun Fesharaki and Tomoko Hosoe

This commentary summarizes the implications of Arctic petroleum development for Japan. We consider the potential importance of Arctic energy supplies for Japan. We also highlight the changes needed at the federal government level to formulate a coherent Arctic energy policy and thereby encourage investment. Finally, we contemplate the potential for cooperation with Russia to spur Japanese investment – and possibly energy procurement – from the Arctic region.

JAPAN'S LONG-TERM ENERGY SUPPLIES: THE IMPORTANCE OF SUPPLY SECURITY

Japan is almost 100% dependent on imports to guarantee its energy supplies. Given its lack of indigenous fossil fuel reserves, the importance Tokyo assigns to "security of supply" has always been significant. However, the issue assumed even greater prominence in the 1970s, when Japan was impacted by the two global oil crises that unfolded during that decade. Japan's response was swift and multifaceted:

- Cognizant of its huge reliance on imported Middle Eastern oil, Japan encouraged the growth of gas in the nation's energy supply mix, with a preference for sources outside the Middle East. This accounts for Japan's patronage of LNG projects in the Asia-Pacific region, which continues to this day.
- Japan also emphasized the role of nuclear power in its power generation mix in a bid to reduce its dependence on energy imports.
- Tokyo also implemented a series of energy efficiency and conservation measures.

Japan's commitment to energy supply security remains steadfast. But the two energy supply responses devised by Tokyo in the 1970s to address concerns about dependence on supplies from the Middle East are losing ground. The reasons for this are simple. Some of the Asia Pacific LNG projects launched in the 1970s and 1980s that were essentially dedicated to

Japan are maturing. Japanese buyers are consequently seeking LNG supply sources elsewhere, such as from North America and Russia, to compensate for declining "legacy" LNG supply contracts and to meet new gas demand.

Also, the 2011 Tohoku earthquake and tsunami resulted in the closure of vast quantities of Japanese nuclear power generation capacity. As of August 2013, all but two of the country's 50 nuclear power generation units (2.4 gigawatts out of over 46 GW) remained closed (Hosoe 2013). Fossil fuels are compensating for some of the shortfall. But given the nuclear power's role as Japan's "home-grown" solution to fighting the issue of energy import dependency, nuclear power's uncertain future in Japan is a bitter pill to swallow. It also makes the urgency of fossil fuel supply procurement from new sources more urgent.

We believe that more nuclear plants could be back online toward the end of 2013, although the long-term outlook for nuclear power in Japan is poor. Four companies have submitted papers seeking to resume operations at four nuclear power plants around the country, representing 11.3 GW of capacity (see Hosoe 2013). The country's Nuclear Regulation Authority (NRA) is set to release the safety examination results for these plants by the first quarter of 2014. If all goes well, Japan might have five nuclear plants back in service – toward the end of the year. Two new facilities currently under construction will also be placed into service upon completion.

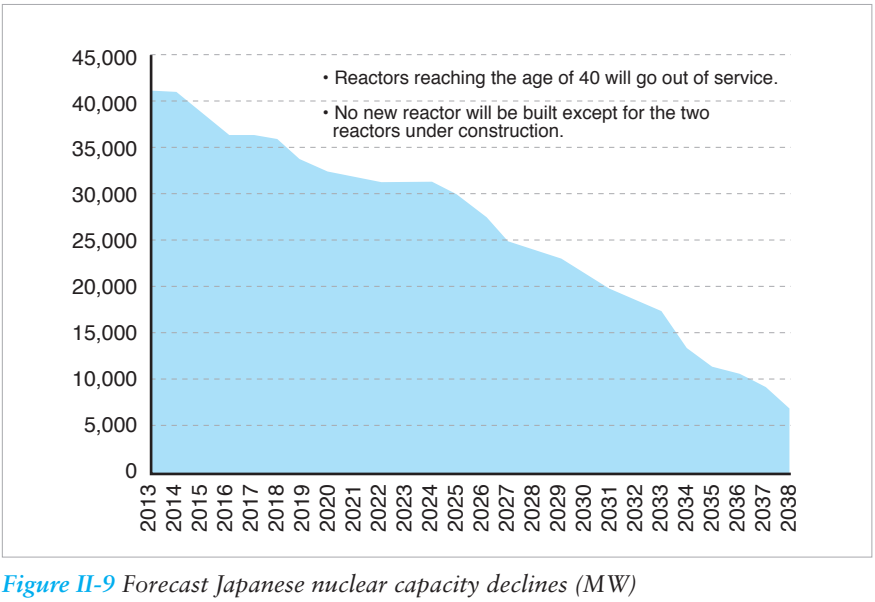


Figure II-9 Forecast Japanese nuclear capacity declines (MW)

However, no more new construction is expected. Older, existing plants will be decommissioned once they reach the age of 40. As a result, Japan's nuclear power generation capacity could dip below 30 GW by the middle of the next decade (see Hosoe 2013).

Given the circumstances outlined above, energy security has become even more of a hot-button issue for Japan. To guarantee its petroleum supplies, Japan has long followed a multi-pronged strategy. This includes: (1) the creation of a state-controlled strategic oil reserve as well as private oil reserve, (2) a focus on domestic petroleum exploration and research, especially in the field of unconventional petroleum sources such as gas hydrates, (3) diversification of petroleum import sources, and (4) participation in the petroleum projects that supply Japanese imports, especially the upstream components of these projects.

Of these key measures, Japan's quest to diversify its petroleum import sources and its record of participating in many overseas oil and gas projects that supply Japanese demand are the most pertinent to this analysis. The Arctic represents a brand new potential source of supply for Japan. It is a frontier location for conventional hydrocarbons, albeit a long-term one. The Arctic holds an estimated 13% (90 billion barrels) of the world's undiscovered conventional oil resources and 30% of its undiscovered conventional natural gas resources, according to a 2012 U.S. Geological Survey (USGS) assessment (USEIA 2013). Given the region's remoteness and the technical challenges inherent in exploiting Arctic reserves, the Arctic is unlikely to see development for at least another couple of generations – assuming, of course, that oil prices are high enough to support it. But fossil fuel exploitation is a very long-term play, and hence, it is not premature to consider the implications of Arctic resource development for Japan at this juncture.

At this time, the Arctic holds a considerable promise for Japan, not only as a potential new supply region, but also in terms of potential Japanese business opportunities. There are numerous precedents for Japanese companies investing in the development of their fossil fuel supply sources. For example, upstream companies such as INPEX and gas/power utilities like Tokyo Gas and Tokyo Electric Power are already project participants and offtakers from LNG supply projects in Australia (e.g., Darwin LNG and Ichthys LNG). Additionally, Japanese trading houses' financial support has paved the way for utilities to patronize LNG projects in the Asia-Pacific region (e.g., Australia's North West Shelf project, Russia's Sakhalin

II project) and the Middle East (e.g., Abu Dhabi's ADGAS project). Finally, in addition to the customary roles for upstream companies, trading houses, and utilities, the Arctic offers new prospects for Japanese financial institutions, engineering companies, and shipping companies.

JAPAN'S ROLE IN THE DEVELOPMENT OF ARCTIC ENERGY

Owing to its geographical location, Japan does not have a legal title to access natural resources in the Arctic region. But the nation was granted observer status by the Arctic Council in May 2013, along with India, Italy, China, Singapore, and South Korea. These additions reflect the heightened interest by some of the world's most powerful economies in the Arctic region's resources, which include petroleum as well as minerals, seafood, and new transportation possibilities (Associated Press 2013).

Until fairly recently, framing a policy on Arctic issues was not a priority for Tokyo, as the industry was "hopelessly bewildered" on the subject of formulating an Arctic business strategy (Ocean Policy Research Foundation 2012). But this is apparently changing. Melting ice in the polar region increases the feasibility of ships traversing the Northern Sea Route (NSR) across the top of Russia and the Northwest Passage through Canada's Arctic Archipelago. This offers the potential benefit of reduced shipping costs for Japan. Already, there have been forays in Arctic resource shipments to Asia. In June 2011, the independent Russian petroleum company Novatek sent 60,000 tons of condensate from Murmansk to the Chinese port of Ningbo. In late 2012, Russian state-controlled gas giant Gazprom sent an LNG cargo from Norway's Snøhvit liquefaction terminal in Hammerfest to the Japanese port of Tobata. The route was cleared by Russian icebreakers (Hiscock 2013).

It remains to be seen how Japan will use its newfound Arctic Council observer status. Japan readily admits its historic lack of a unified Arctic policy/strategy, especially on the topic of fuel resources. Although it is rapidly recognizing the importance of remedying this deficiency, it might take some time. To accomplish this, the particular characteristics of the Japanese government administration, where horizontal ministerial cooperation is rare, must be overcome (Tonami and Watters 2012). Today, various ministries deal with specific issues relating to the Arctic

(environmental issues, scientific research, foreign policy, energy security issues, ocean policy and the shipping industry). The idea of an organized government body that speaks with one voice on the topic of Japan's approach to potential future Arctic resource development, or even the idea of high-level cooperation between the various departments, is therefore novel. But in our view, a cross-ministerial, centralized Arctic policy to support business/industry is essential for Japan if it hopes to benefit from the development of Arctic resources. It is hoped that Japan's new observer status, together with a clearer delineation of the Arctic region's resource potential, will provide the incentives needed for Tokyo to devise a coherent Arctic strategy. It is further hoped that Japan's new Arctic Council status will set the wheels in motion for government/industry coordination conducive to an agreeable investment climate for Japanese companies.

RUSSIA-JAPAN ENERGY COOPERATION IN THE ARCTIC CONTEXT

Japan is not an Arctic coastal state. To carve out a role in the region's resource development, it must focus its attention on bilateral relations with states that do have an Arctic presence,[1] most likely Russia. Of all the Arctic countries, Russia has the longest Arctic coastline, and is certain to assume a prominent role in the region's resource development. Moreover, Russia and Japan have already established a relationship as a petroleum supplier/off taker, which could form the basis of new initiatives. For example, Russia's Sakhalin II LNG export project, which exported its first LNG cargo in 2009, was predicated on LNG sales to Japan. Russia's Gazprom and a consortium of Japanese companies are also working together, with the express backing of Moscow and Tokyo, to develop the green field Vladivostok LNG project.

Given this preexisting relationship, and the fact that Russia can claim vast tracts of land and sea for Arctic resource exploration by virtue of its sheer size, any Japanese quest to seek Arctic resources will probably use the existing Russo-Japanese relationship as a starting point. However, there are unresolved issues between the two nations, especially the long-running dispute over the Kuril Islands. Although the dispute has not blocked the Russo-Japanese development of Sakhalin II and cooperation on Vladivostok LNG, it could rear its head in the future. Efforts by both

countries to establish a bilateral framework for Arctic issues might be necessary, which could include high-level talks between ministries and a private-public collaborative "Japan-Russia Arctic Forum" of sorts (see OPRF 2012) to maintain goodwill. Before making any overtures to Russia, however, the onus is on Japan to reach a consensus at home on a coherent Arctic policy and formulate what Japanese policymakers believe to be an agreeable fiscal and legal framework conducive to investment.

CONCLUDING REMARKS

Based on current information, the Arctic has vast resource potential. But tapping these resources will not be easy. Consideration of these resources as (eventually) commercially viable is relatively recent, owing in no small part to the sustained high oil price environment in recent years as well as declining conventional reserves worldwide and the emphasis on developing unconventional resources. Ultimately, much work needs to be done before the Arctic's unproven or technically recoverable resources can be transformed into a proven reserves base. But Japan's growing recognition of the Arctic as a potential resource supply frontier and the government's cognizance of the need for a coherent Arctic policy are encouraging developments. If history is any indication, Japan is capable of playing a dual role in resource development as co-investor and customer. This is highly favorable for Arctic nations seeking the partners and market outlets needed to support Arctic resource development on their lands and in their territorial waters. Russia will undoubtedly be Japan's first port of call when evincing interest in Arctic resource development and potential energy supplies.

However, the possibility of Japan soliciting cooperation with other potential buyers and investors such as China and Korea cannot be ruled out. A unified "buyer's forum" would give Asian energy buyers and investors a stronger voice in Arctic affairs, and consequently, ensure they have a bigger impact on Arctic oil and gas developments.

Note

1. The area north of the Arctic Circle is apportioned among eight countries: Canada, Denmark (Greenland), Finland, Iceland, Norway, Russia, Sweden, and the United States. Under current international practice, countries have exclusive rights to seabed resources up to 200 miles beyond their coast, an area called an Exclusive Economic Zone (EEZ). Beyond the EEZ, assessments of "natural prolongation" of the continental shelf may influence countries' seabed boundaries. See EIA 2012.

References

Associated Press. 2013. "Arctic Council Grants China, Japan Observer Status." May 15. Accessed October 9, 2013. http://www.cbc.ca/news/canada/north/arctic-council-grants-china-japan-observer-status-1.1375121

FGE (FACTS Global Energy). 2013. *Gas Databook 2013*.

Grashenkov, A. 2011. "Russia-Japan: The Kuril Islands Conflict and Russia's Defense Arsenal in the Far East." *Global Research*, February 13, 2011. Accessed October 15, 2013. http://crisisboom.com/2011/02/13/russia-japan-kuril-islands/

Hiscock, G. 2013. "China Eyes Russian Options in Energy, Transport." *CNN*, May 16, 2013. Accessed October 8, 2013. http://edition.cnn.com/2013/05/16/business/china-arctic/index.html

Hosoe, T. 2013. "Japan Focus." Session 8, FGE Pacific Petroleum Insiders (PPI) Briefing September 5-6, 2013. Singapore.

Ocean Policy Research Foundation (OPRF). 2012. "Developing a Japan Policy Toward the Arctic Ocean." Paper presented at the Arctic Conference Japan, March 2012. Accessed October 8, 2013. http://www.nccj.or.jp/wordpress/wp-content/uploads/2013/02/Developing-a-Japan-Policy-towards-the-Arctic-Ocean-OPRF.pdf

Tonami, A. and Watters, S. 2012. "Japan's Arctic Policy: The Sum of Many Parts." *Arctic Yearbook* 2012: 93-102.

U.S. Energy Information Administration (USEIA). 2012. "Arctic Oil and Natural Gas Resources." January 20. Accessed October 11, 2013. http://www.eia.gov/todayinenergy/detail.cfm?id=4650

U.S. Energy Information Administration (USEIA). 2012. "Arctic Oil and Natural Gas Resources." January 2012.

Korean perspective

Seong-Min Lee

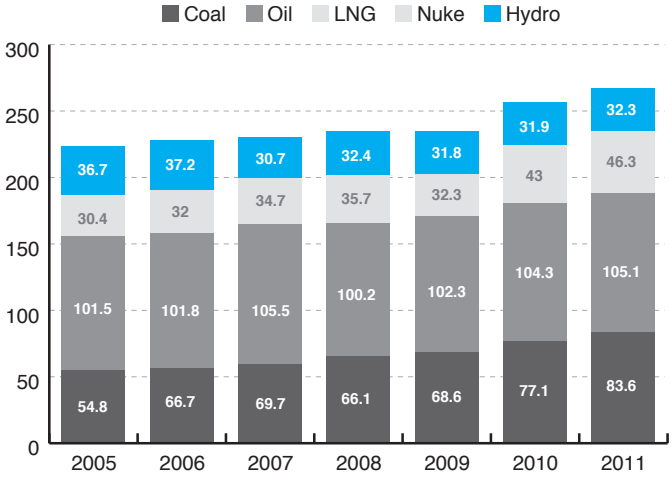
In order to comprehend the Korean perspective on Arctic energy development, one needs to understand the position of Korea on oil and gas supplies. There is no regional trunk line to transfer these commodities among the Far East nations: Korea, Japan and China. Both Korea and Japan are poor countries in energy resource. Thus, they each have to operate their own stringent demand/supply policy by trading outside the region. Moreover, both countries are especially remote from available energy sources and thus have been dependent on the Middle Eastern and Southeast Asian markets. Both countries are subject to the so-called "East Asian premium" in energy prices. Therefore, the main principle for Korea to procure hydrocarbon energy is to secure a supply in a timely and cost-effective manner.

The development of energy resources outside Korea by domestic companies has been encouraged by the government since 2008. National companies such as Korea National Oil Corp. (KNOC) and Korea Gas Corp. (KOGAS), as well as a couple of private companies, have concentrated on the exploration and development business.

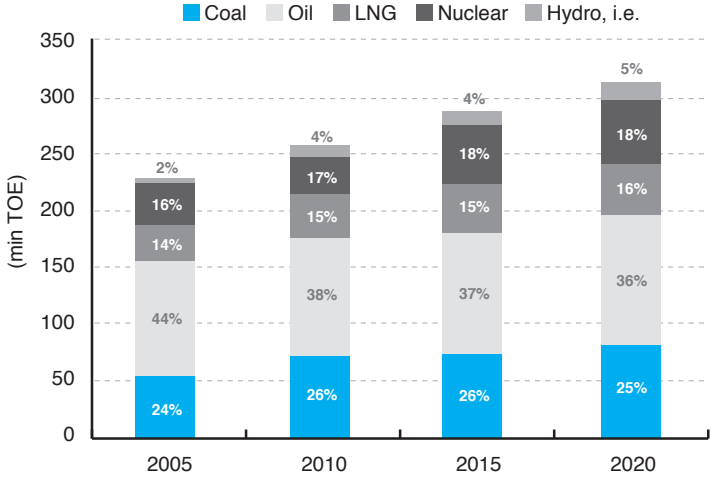
Korea has been increasing its level of reliance on gas while decreasing reliance on oil with the objective of consumption diversification for primary energy as shown in Figure II-10 (a). This trend coincides with expectations in the National Energy Basic Plan (NEBP) released in 2008, which is the primary plan for Korea's energy policy. In this report, the energy mix was forecast as illustrated in Figure II-10 (b).

The NEBP is revised and published every five years; it is expected to be released again in 2013. However, it has not been announced yet because of the drastic changes in energy resources, the international energy market likely caused by emerging unconventional energy resources and the catastrophic incident at the Fukushima nuclear plant in Japan. In such circumstances, the Korean government announced an interim plan for long-term natural gas demand/supply in April 2013. According to this plan, the share of natural gas will remain unchanged or be slightly reduced, as shown in Figure II-11. This is assumed to be attributable to a reduction in power generation using LNG, whereas nuclear and coal power generation are to be expanded.

The next key issue the NEBP has to consider is the share of nuclear power generation and renewable energy. Currently, renewable energy is expected to grow from the level of 11% in the previous plan, while the share of nuclear generation may be reduced due to the Fukushima incident. In the previous NEBP, nuclear generation was emphasized, but it is likely to



Source: Yearbook of energy statistics 2012, Korea energy economics institute



Source: National energy basic plan, 2008.

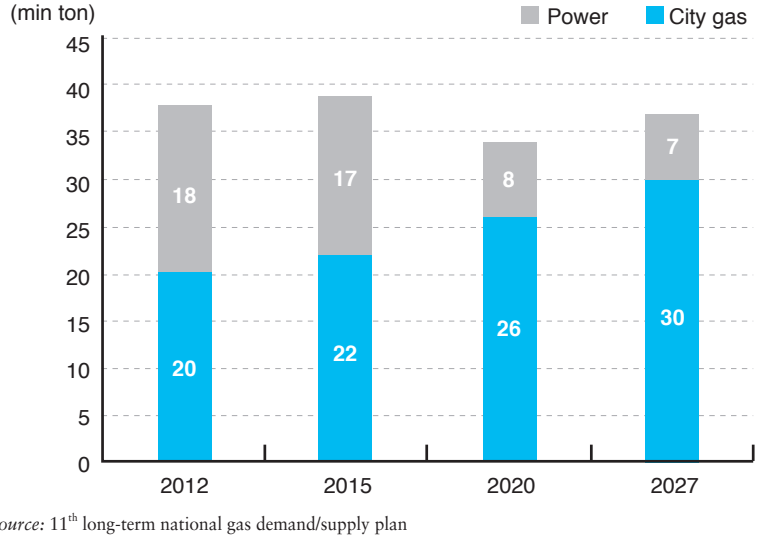
Figure II-10 (a) Korean primary energy market[1] and (b) Expected primary energy share[2]

be lower in the new plan.

Even though there is still controversy regarding the reduced role of natural gas in the interim plan, the forecast is that there will be a shortage from 2025 if the plan is implemented. The long-term volume deficiency can be addressed by Arctic resources with a long-term commitment to development or by competing unconventional sources such as shale gas and coal bed methane. Optimistically, if there is a finalized government policy that stresses a higher share of natural gas in the primary energy mix, the deficiency will increase and Arctic energy may become more attractive to Korea.

It is well known[3] that KOGAS acquired a 20% share in the Umiak gas field in the Mackenzie River Delta from the Canadian company MGM Energy in 2011. This is the first Korean investment in a polar resource; it is now in the appraisal stage with production planned for 2020. KOGAS is also studying Arctic projects elsewhere, including all the on- and offshore areas of Alaska, Yamal, and Greenland. At the moment, however, the Arctic projects, including the Umiak field, are generally recognized as less attractive in terms of costs and uncertainty than onshore projects in non-extreme regions. The uncertainty comes from the possibility of a project falling behind schedule and doubts about year-round deliveries.

The uncertainty is mainly caused by the harsh environment,



Source: 11th long-term national gas demand/supply plan

Figure II-11 Expected natural gas supply[4]

which could bring about many technical difficulties. The environment encompasses extreme weather, near-total darkness, potential ice hazards, and marshy tundra that could take a huge toll on equipment and personnel. Aside from this, the uncertainty can be triggered by many other reasons: unpreparedness of contingent spill contaminant/spill recovery plans, limited existing infrastructure prepared for cold weather and emergency response, competition with other resources such as shale gas, long project lead time, sovereignty claims, and country-specific environmental laws/regulations.

Nevertheless, one can agree that global cooperation has to be encouraged in various areas, as Professor Lawson Brigham pointed out in Part I. This may result in some kind of synergy. For example, fostering an Arctic-class ship industry may lead to pilot commercial shipping, followed by active trading between buyers and sellers throughout the Arctic Ocean, and the early establishment of relevant standards/codes, which in turn require global maritime cooperation.

ROLE OF KOREA IN ARCTIC ENERGY DEVELOPMENT

Korea can play a major role in the development of Arctic energy both as an industry partner and as an investor in and buyer of energy. Regarding the Northern Sea Route (NSR), Korea will endeavor to encourage its use by contributing to making icebreakers so as to enable commercial passage through the NSR. Korean shipyards can play a role in this area. I was recently reported[5] that the Korean shipbuilder Daewoo Shipbuilding & Marine Engineering (DSME) won a bid for up to 16 ARC 7 ice-class tankers for the shipment of LNG from Russia's Yamal project.

Also, the Korean government and the commercial shipping company Hyundai Glovis are planning commercial navigation through the NSR this year. The company intends to launch a pilot commercial service on the NSR in the middle of October, with other Korean shippers set to follow suit.[6] The first passage through the NSR by Hyundai Glovis will be made from Ust-Luga near the Baltic Sea of Russia to Sapo in Gwangyang, South Korea by the ice-class Norwegian carrier "Stena Polaris." It expects a 35-day navigation over a distance of 15,500 km, carrying 37,000 tons of naptha.

KOGAS and other Korean oil and gas companies also can contribute to the development of Arctic resources as investors and buyers of energy. Aside from its own business, KOGAS is considering developing relationships

through its corporate social responsibility programs by encouraging learning and training for indigenous people and by promoting bilateral exchanges in various areas to understand cultural differences.

Korea won observer status on the Arctic Council at a meeting in Kiruna, Sweden last May. To boost its presence in the Arctic as a council observer, the Korean government is establishing a master plan for its Arctic strategy. This is being developed on the premise of sustainable development while considering climate change and safe utilization. It will release details of the plan at the end of 2013. It might make sense for the Arctic to be treated together with the Antarctic in a macroscopic sphere of polar science and engineering. This framework can support not only systematic approaches to overcome the technical difficulties mentioned earlier, but also new multidisciplinary solutions for traditional objectives such as biodiversity conservation and Arctic Ocean and Arctic marine ecosystem protection.

The Ministry of Oceans and Fisheries of Korea[7] will do its best to promote the public welfare of mankind by emphasizing three goals of its Arctic policy: building partnerships with other countries, stepping up research in the Arctic, and creating new business opportunities.

COOPERATION WITH RUSSIA ON ARCTIC ENERGY DEVELOPMENT

Korea has a bilateral dialogue with Russia on Arctic energy development that addresses the merits of spatial location and long-lasting business relationships for pipeline gas (PNG) negotiations.

Over the last decades, a feasibility study was conducted and many commercial discussions on the introduction of PNG from eastern Russia have taken place. KOGAS strategically considered that the PNG project would be advantageous to LNG in terms of cost and stable supply. However, this effort has not yet succeeded due to the risks from North Korea and its economic issues. It does not seem likely to proceed for the time being due to the shale gas revolution. Other Arctic sources of oil and gas may provide an alternative.

The principal constraint on this option is likely to be the emergence of unconventional resources such as shale gas. In 2012, KOGAS contracted[8]

for 3.5 mtpa of shale gas with Sabine Pass LNG (Cheniere Energy) starting from 2017. The price of the gas on the Henry Hub spot market in mid-April, 2012 was below USD $2US/MMBtu,[9] while some prominent consulting companies such as Deloitte[10] and Mackenzie[11] forecasted that the mid- to long-term price would be from USD $4 to $8/MMBtu. It seems to be quite a reasonable price compared to current LNG prices in the Middle East.

By virtue of the shale gas revolution and changes in the worldwide natural gas market, LNG trading is gaining a momentum compared to PNG. Russia also seems to be shifting to LNG projects from their traditional PNG. This is a big turning point in the Russian posture toward the natural gas business. In Eastern Siberia, for example, the Russians have already decided to export natural gas as LNG to East Asia and have constructed a liquefaction plant in Vladivostok. The required volume for KOGAS, over the long term, will probably be LNG, no matter where it originates.

This trend is not detrimental to Korea from a technical point of view. Since both Korea and Japan are traditionally LNG-utilizing countries, their gas industry infrastructure is also LNG-oriented. Thus, LNG projects are technically favorable in terms of gas interchangeability for gas burners and appliances and gas quality for emissions and infrastructure health. Nevertheless, Korea is still considering Russian PNG for long-term stability, even with the positive outlook for LNG projects.

In summary, bilateral communication with Russia is on-going for Arctic energy development. Arctic resources can be regarded as a long-term source of energy for Korea. However, the commercial availability of these resources is strongly dependent on the price of competing energy such as shale gas, oil, and so on. Thus, while longer seasons of Arctic navigation are becoming more likely, we need to enhance navigation technology to pass safely through the Arctic and to encourage innovation in resource development technology for harsh Arctic environments.

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Notes

1. Korea Economics Institute, Energy Statistics Yearbook 2012, 2012.
2. Korean Ministry of Knowledge and Economics, National Energy Basic Plan, 2008.
3. Market Wire (Marketwire.com), December 15, 2010.
4. Korean Ministry of Trade, Industry and Energy, 11th Long-Term National Natural Gas Demand/Supply Plan, 2013.
5. Shipbuilding Tribune (Shipbuildingtribune.com), July 4, 2013.
6. Asia News Network (asianewsnet.net), July 30, 2013.
7. National Arctic Roadmap, Korean government, in preparation (to be released in October 2013)
8. The Korea Herald (koreaherald.com), December 26, 2012.
9. Henry Hub Natural Gas Spot Price Chart, 2013.http://ycharts.com/indicators/natural_gas_spot_price
10. Deloitte press release (deloitte.com), July 26, 2011.
11. Wood Mackenzie press release (woodmacresearch.com), July 8, 2010.