OPPORTUNITIES and CHALLENGES

FOR ARCTIC OIL AND GAS DEVELOPMENT

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Wilson Center

LIST OF ACRONYMS

ANWR: Arctic National Wildlife Refuge

bbl: barrel

boe: barrels of oil equivalent

ENGO: environmental non-governmental organization

IEA: International Energy Agency

IOC: international oil company

LNG: liquefied natural gas

mtoe: million tons of oil equivalent

NGL: natural gas liquids

NGO: non-governmental organization

NOC: national oil company

NPR-A: National Petroleum Reserve in Alaska

NSR: Northern Sea Route

PADD: Petroleum Administration for Defense District

RAIPON: Russian Association of Indigenous Peoples of the North, Siberia and Far East

SDL: significant discovery license

SSRW: same-season relief well

TAPS: Trans-Alaska Pipeline System

TCF: trillion cubic feet

UNCLOS: United Nations Convention on the Law of the Sea

USGS: United States Geological Survey

VAT: value-added tax

I INTRODUCTION

OVERVIEW

As climate change renders the Arctic increasingly accessible, there has been a substantial uptick in industry interest in the region; it is believed an estimated $100 billion could be invested in the Arctic over the next decade.[1] The Arctic contains vast oil and natural gas reserves—the U.S. Geological Survey estimates the Arctic could contain 1,670 trillion cubic feet (tcf) of natural gas and 90 billion barrels of oil, or 30 percent of the world's undiscovered gas and 13 percent of oil. Energy companies are certain to be at the forefront of Arctic development and investment.

Climate change has played an important role in expanding access to the Arctic region, although there have been fewer opportunities to access lower cost oil and gas plays. As conventional production has declined, industry has had to focus more on difficult-to-access and unconventional oil and gas plays throughout the world, including those in the Arctic. Exploration and development in the Arctic requires expensive, tailored technologies as well as safeguards adapted to the extreme climatic conditions. In the wake of the 2010 Deepwater Horizon incident, there have been additional costs associated with emergency response and containment requirements.

Regulators, as well as social and environmental groups, have been outspoken about the dangers and risks linked to Arctic energy development. Bearing in mind the enormous challenges of cleaning up an oil spill in icy conditions, the greatest concern is what kind of impact such a disaster would have on the fragile Arctic ecosystem. In an effort to hedge against such an event, national regulators are assessing additional safety and environmental protection measures that have the potential to add considerable additional time and financial costs and reduce access to resource opportunities. Considering these heavy costs, technology requirements, and potential financial liabilities, the players best suited to exploring and developing these resources are international oil companies (IOCs). Those with strong balance sheets and significant offshore exploration experience will be favored; in fewer cases, well-funded and experienced national oil companies (NOCs) may also participate. In a number of cases, cooperation agreements have been struck between NOCs and IOCs.

The Arctic represents the final frontier of conventional hydrocarbon development. Accessing these resources and bringing them to market could require another 20 years or

more. Lining up these resources as the next major source of global energy supply — notably after the shale oil and shale gas boom — will require substantial investment and relatively immediate and extensive expansion of exploration activity.

In this paper, the Arctic will be defined broadly as not just the area north of the Arctic Circle, but any territory with Arctic-like conditions, such as permafrost, icebergs, and seasonal pack ice. This paper will focus largely on the Arctic offshore experience in North America. It will also consider the best practices that can be derived from the experience of countries such as Norway and Russia that have been successful in early hydrocarbon exploration and development efforts in their respective far northern and Arctic territories. It should be noted that while important lessons can be extracted from Norway's experience with offshore production and exploration, the conditions in Norway cannot be classified as truly "Arctic" because there is neither pack ice nor permafrost.

Although the pace of Arctic exploration activity in Alaska, Canada, and Greenland is picking up, viable commercial production is still decades away. In the meantime, producers can raise the profile of the industry and increase support for Arctic resource extraction by exercising caution, applying the highest safety standards to exploration activities, and continuing to consult with and incorporate the interests of the many different stakeholders in the region.

HISTORY OF ARCTIC EXPLORATION AND DEVELOPMENT

Recent high-profile forays by Shell into the Alaskan Beaufort and Chukchi Seas, by Cairn Energy with exploration drilling offshore in Greenland, and by Gazprom, Rosneft, and Statoil in far north and Arctic Russian and Norwegian waters, have raised global awareness of hydrocarbon development. These well-publicized exploration efforts in the Arctic have led to the popular misconception that the energy industry is entering these waters for the first time. In fact, numerous producing onshore and offshore Arctic fields have been successfully developed since the late 1960s with no significant adverse incidents.

In 1968, ARCO and Standard Oil drilled a well that tapped the largest oil field in North America, the Prudhoe Bay field on Alaska's North Slope. Production began in 1977 after the completion of the Trans-Alaska Pipeline System (TAPS) from Prudhoe Bay to Valdez, Alaska. Over time, companies including Shell in the 1980s, and BP in 2012 at its Liberty oil field in the Beaufort Sea, have successfully found oil; yet each has failed to extract the resource and abandoned the projects due to excessively high production costs. A debate recently has emerged between federal authorities and local Alaska legislators over allowing drilling in the National Petroleum Reserve in Alaska (NPR-A). Alaskans generally favor extensive resource development in the 23.5 million acre reserve, but the sentiment is not the same at the national level; the Obama administration approved only a limited drilling plan in the NPR-A. There is now concern that drilling in the NPR-A will become as politically charged as the debate over resource development in the 19.3 million acre Arctic National

Wildlife Refuge (ANWR), where a Congressional moratorium has banned drilling since 1982.

In the Canadian Arctic, oil seeps were discovered in the northern onshore in the 18th century. Imperial Oil began early exploratory drilling in the 1920s, which led to the discovery of the Norman Wells field in the Northwest Territories. Throughout the 1940s and 1950s, exploration activity increased in the southern portion of the Northwest Territories, and eventually moved north above the Arctic Circle to the Mackenzie Delta, the Arctic Islands, and the Sverdrup Basin in the 1960s, and offshore into the Canadian Beaufort in 1972. Although activity in the region started to subside in the late 1980s, higher energy prices renewed interest in exploration in the region by 2004. The exception during this slow period was the 20-year development of the Hibernia field off the coast of Newfoundland, which began production in 1997; it remains by far Canada's largest offshore oil project. Given the large waves and icebergs prevalent in the area, the field remains an important test case along the Arctic learning curve.

Greenland has had a more complicated history with hydrocarbon exploration and development, in part because the majority of its territory lies north of the Arctic Circle and is characterized by extreme ice conditions. The first substantial seismic surveys were conducted and exploratory wells drilled in offshore West Greenland in the 1970s, with little success. No discoveries of great commercial significance have yet been made, even after the most recent exploration efforts by Cairn Energy in the offshore off Western Greenland in 2011. Given the potential of Greenland's offshore reserves, the industry remains optimistic about the opportunities available there. Interest continues and in October 2012, Tullow Oil agreed to purchase a 40 percent stake in an exploration block in Baffin Bay.

These finds have shown that hydrocarbon development can successfully take place in the delicate Arctic ecosystem. New technologies can help ensure more extensive and safer resource development in one of the world's most extreme climates. Sakhalin and Hibernia in offshore Russian and Canadian Arctic waters respectively are two of the largest resource development projects in the Arctic region[2]; each took roughly 20 years to achieve commercial production. Given the lengthy timeline to move from exploration to production, large-scale Arctic resource development has to begin now to guarantee that these resources will be able to provide the global energy supply needed to meet demand by mid-century.

Development of Canadian Arctic energy started in the 1920s, moving further north throughout the decades. Today, projects stretch from the Beaufort Sea to the Hibernia fields of Newfoundland.

II NORTH AMERICAN ARCTIC: HYDROCARBON SUPPLY AND MARKET DEMAND

Technological, climatic, and environmental considerations are critical to the development of Arctic hydrocarbons; at the same time, profitability is perhaps the one variable that has the strongest bearing on the speed and extent at which resource development takes place. According to the International Energy Agency (IEA), global oil and gas demand could grow by more than 35 percent[3] from 2010 to 2035. Meeting this demand will depend on the ability of energy companies to tap available energy resources that can be accessed in a safe and cost-effective way, including the vast energy resources in the Arctic. A combination of variables, from supply and demand levels to global energy prices, will be the determining factors in the development of Arctic energy. These resources are well positioned to become the next big source of supply following the unconventionals boom.

Map of Alaska's northern coast and the Beaufort Sea. Experts estimate that the Canadian and American Arctic alone hold 45 percent of all undiscovered Arctic energy resources.

SUPPLY SCENARIOS[4]

The Arctic's western hemisphere has significant medium- to long-term hydrocarbon resource potential, but the likely development timeframe will be from 2025 and beyond due to current limitations. Insufficient infrastructure is possibly the most critical limiting factor. Especially in North America, the remote Arctic regions are less attractive investment destinations for oil and gas companies, since the resources compete for market access with the abundant oil sands, shale oil, and gas reserves already being developed in Alberta, elsewhere in Canada, and the U.S. lower 48. And yet the North American Arctic contains huge undeveloped discovered resources[5] as well as immense undiscovered resources[6]. The U.S. and Canadian Arctic alone is estimated to hold 45 percent of all undiscovered Arctic energy resources.

Northern governments and major international oil companies are seeking to expedite the exploration process in order to develop cost-effective ways to bring these resources to market from relatively remote and not easily accessible fields in offshore Alaska, Canada, and Greenland.

Alaska

Alaska contains nearly 25 percent of the remaining U.S. proved oil reserves and 13 percent of remaining proved gas reserves. About 10 percent of all domestic oil currently produced in the United States comes from state-owned land in the North Slope and state waters offshore. Concern over the closure of the Trans-Alaska Pipeline System (TAPS) during the next 20 to 30 years because of declining production from North Slope fields has resulted in calls for an immediate expansion of Arctic exploration to achieve production sufficient to keep the pipeline open. As TAPS throughput falls, transportation costs are distributed over smaller volumes, so the price per barrel increases significantly. If the pipeline were to close, 1 billion bbls of oil reserves could be stranded onshore and offshore, which would pose significant problems for the United States to guarantee domestic supply security.

Alaska has considerable mean, risked, undiscovered resources in the Beaufort and Chukchi Seas, in state waters and on the onshore North Slope, and in South and Central Alaska.[7]

In June 2012, the Obama administration released a five-year drilling plan that pursued a cautious approach to medium-term Arctic leasing; the plan called for three potential lease sales in offshore Alaska by 2017. But the mixed experience of Royal Dutch Shell's 2012 exploration and drilling efforts in Alaska's offshore Beaufort and Chukchi Seas has prompted a renewed assessment of further Arctic exploration and production by federal regulators.

The best case scenario for the energy sector would be still more stringent review processes and greater oversight. However, such a review would threaten to halt or significantly scale back activity in the Alaska offshore. Not only would the review result in substantial and more costly disruptions to Shell's current drilling plans, but it could also push subsequent offshore lease sales beyond 2017. There would undoubtedly be spillover effects for ConocoPhillips, which is planning to drill exploratory wells in its Devil's Paw Prospect in the Chukchi Sea in 2014, and for Statoil, which had intended to start drilling in 2014 but

The Trans-Alaska Pipeline System (TAPS) moves oil from Prudhoe Bay to Valdez. With up to 1 billion bbls of potentially recoverable oil, more infrastructure will be necessary to unlock Arctic energy.

has now postponed its Chukchi Sea drilling program until at least 2015 following Shell's experience. According to federal officials, new rules for drilling in the Outer Continental Shelf off Alaska's Arctic coasts could be released as soon as year-end 2013. Once in place, the rules will help companies better plan their drilling programs, which should provide some clarification about the pace at which these pending projects may be able to proceed.

The industry was looking at Shell's 2012 drilling program as a bellwether for how exploration could be expected to progress in the offshore in the post-Macondo era of heightened regulatory oversight. However, Shell experienced several conspicuous mishaps during its first drilling season: the Noble Discoverer drillship slipped its anchor and nearly ran aground in July 2012, and the Kulluk drillship actually ran aground at the end of December 2012. These accidents, and other equipment problems and numerous delays that Shell encountered early on in this process¾such as obtaining air quality permits and approval for its oil spill containment barge, in addition to delays resulting from sea ice¾suggest the outlook for the offshore Arctic appears to be one of fairly slow progress. In the near term, development will likely be restricted to onshore North Slope resources; industry is now interested in the exploration of unconventional oil in the onshore region as well. In order to spur such development, the State of Alaska introduced a series of tax incentives and exploration credits intended to generate greater interest across its Arctic regions.

Canada

While development of Canada's Arctic hydrocarbon resources has been constrained by high costs and competition for investment, there has nonetheless been an uptick in activity. Since 2011, the Canadian government has awarded more than $600 million in oil and gas exploration rights in northern Canada; total offshore commitment bids now total around $1.9 billion. In a licensing round during the summer of 2012, Aboriginal Affairs and Northern Development Canada held an auction for more than 900,000 hectares in the Beaufort Sea and Mackenzie Delta that followed the release of a National Energy Board review of offshore Arctic drilling. The Conservative government has also called for bids to develop a five-year strategic plan to conduct oil spill research in the Canadian Arctic, in particular in the Beaufort Sea.

Canada has lagged in its Arctic resource development; it does not have the advanced planning and major development projects already underway in the United States, Norway,

Canadian icebreaker

and Russia. However, the Canadian Arctic is estimated to have considerable undiscovered reserves in the Mackenzie Delta onshore, in the Canadian Beaufort offshore, in the Baffin Bay offshore, in the Sverdrup Basin and Arctic Islands, and in the Newfoundland and Labrador offshore.[8]

Greenland

Most of Greenland lies north of the Arctic Circle; 80 percent of the island is covered by ice sheets. Greenland contains considerable oil, gas, and NGL resources, mostly in the East Greenland Rift Basin, the West Greenland Basin offshore, and the North Greenland Sheared Margin.[9]

No oil discoveries have yet been made in Greenland. Despite the disappointing 2010 drilling program by Cairn Energy in which all three of its wells came up dry, investors remain eager to acquire new exploration acreage in the island's offshore. A Greenland Sea pre-bid licensing round was held in January 2013 for offshore eastern Greenland that attracted 11 applications from three consortia for exploration acreage; license awards should be finalized by mid-2013. Furthermore, Cairn was granted a one-year extension until 31 December 2013 for its west Greenland license.

Cairn's experience in the west of Greenland does not necessarily imply a lack of potential in other parts of the huge island. The Greenland government remains anxious to develop these resources so it can begin replacing the billions of dollars in transfer payments it receives annually from Denmark and gain economic self-sufficiency. To this end, Greenland's national oil company Nunaoil is hoping to attract $20 billion in investments in the Baffin Bay and West Disko fields over the next 20 to 30 years, which may help to realize Greenland's goal of achieving independence.

ACCESS TO DEMAND MARKETS: INFRASTRUCTURE AND TRANSPORTATION

Energy demand is anticipated to grow over the coming decades, driven by growth in Asia and other developing markets. To meet this demand, the energy industry has had to turn to unconventional and other difficult-to-access resources to ensure sufficient future supply. As these new unconventional and remote fields come online, transportation and infrastructure remain important challenges to bring these products to market. Developers of these new projects are looking for affordable options, and year-round tanker transport has emerged as one of the best options.

Shell's exploratory drilling in the Alaskan Beaufort and Chukchi Seas in 2012 was an important step in weighing the viability of the year-round tanker option. But after serious complications in the summer of 2012, Shell was forced to delay drilling exploratory wells until 2014 at the earliest; equipment preparedness and regulatory response will be mitigating factors in how soon Shell can continue its initial drilling efforts. Considerable delays could jeopardize the availability of future crude supply to TAPS; shutting down the pipeline could have particularly negative consequences for crude supply to the U.S. West Coast and for the refining margins of PADD V refineries that run Alaskan barrels.

As TAPS continues to run at a very low rate, the transportation of oil by tanker is likely to become an increasingly attractive alternative to piping, especially for more remote offshore fields. Transport along the 800 mile-long TAPS pipeline has an average tariff of $4.50 per barrel, whereas a barrel tankered from Valdez

to the U.S. West Coast would incur tariffs of only about half this rate, despite the shipping distance being more than double the length of the TAPS pipeline. The Jones Act[10] has reduced U.S. competitiveness in the development and deployment of icebreakers, as well as in Arctic grade support vessels and tankers, since compliant vessels and their crews are more costly.

Reduced ice in the Arctic and the lower costs of transport by tanker may make ice-resistant tankers the preferred means for transporting Arctic oil instead of constructing new pipelines. Tankers are already used frequently in the Barents Sea in Norway and Russia, and Russia has begun testing shipment options along the Northern Sea Route to Southeast Asia using tankers assisted by icebreakers. In North America, this option is also employed to ship oil from fields in offshore Newfoundland.

With the exception of the TAPS pipeline and the few existing shipping routes, energy infrastructure in the Alaskan Arctic remains largely underdeveloped. Natural gas on the North Slope is currently not being produced because the region lacks pipeline and tanker capabilities to ship the gas to market. ConocoPhillips, ExxonMobil, BP, and TransCanada are considering a $65 billion project to send Alaska's North Slope gas to the south coast of Alaska, where it can then be shipped to Asian markets, notably to Japan. In addition to an 800-mile pipeline from the North Slope to Alaska's southern coast, the project would include a liquefaction plant as well as storage tanks. The entire project will be very costly and is unlikely to be completed before 2020, at which point Alaskan gas can expect to face very stiff competition in Asia.

Canada's most significant infrastructure and hydrocarbon development limitations are with the offshore. As is the case across the entire Arctic, tankering in Canada would be a practical solution for transporting resources to and from offshore production sites. However, the limited global supply of Arctic class drilling vessels, ice breakers, and support and oil spill response vessels restricts the speed and extent of hydrocarbon development activity currently possible in the Canada. Furthermore, the lack of deepwater ports around the Canadian Beaufort and Arctic islands increases the logistics costs of Canada's Arctic exploration and production program.

Of the North American Arctic littoral states, Greenland is the most deficient in terms of oil and gas export infrastructure. The lack of any significant offshore oil or gas finds means the country has yet to attract requisite investment to build a more robust oil and gas infrastructure network. This will be one of Greenland's biggest challenges, made more difficult because of the severe ice conditions and the presence of icebergs.

Development and production infrastructure—including pipelines—will be critical to Arctic resource development. Additionally, the ability to get these reserves to market, especially in a timely and economical manner, will rest heavily on the implementation of regulatory policies and incentives to encourage heavy investments from oil companies. The development of lease terms, approval processes, and environmental standards in particular are all variables that rest heavily on individual governments. Greenland has set an industry bar by offering 16-year lease terms, which may be a model that other governments will be inclined to adopt in order to make Arctic development economically viable. However, given the geological challenges to develop these resources, it is unlikely North American Arctic supplies will become readily and abundantly available in the 2025-2050 timeframe.

III NORTH AMERICAN ARCTIC: HURDLES TO EXPLORATION AND PRODUCT EXPANSION

REGULATORY CLIMATE

Boundary agreements and UNCLOS

Eighty-five percent of the vast untapped resource potential in the Arctic is contained offshore. Before permission to explore and develop Arctic waters can be granted, the Arctic littoral states have had to (or must still) resolve questions of rights to a number of disputed territories. Until recently, there was no pressing need to resolve boundary disputes and establish sovereignty over these waters and their subsea reserves, or even to codify maritime laws and customs. This changed in 1994 when the United Nations Convention on the Law of the Sea (UNCLOS) entered into force, establishing a framework to govern offshore activity.

A section of the UNCLOS is dedicated to the Continental Shelf and grants states sovereign jurisdiction over the resources on the continental shelf to a limit of 200 miles. Signatories to the treaty have the right to obtain an extension beyond this 200-mile limit by petitioning a dedicated UN commission. The United States is the only Arctic littoral state not to have become party to this agreement, which has been supported by Democratic and Republican administrations and the Joint Chiefs of Staff; it is also supported broadly in the business community, including by oil, gas, and fishing interests. Apprehension in the United States to becoming a signatory to the convention stems largely from the reluctance of several U.S. politicians to cede too much power to the United Nations. Moreover, most of the sizeable oil and gas resources in the U.S. Arctic reside within the 200-mile nautical boundary, so the United States does not stand to lose significant resource potential by remaining outside UNCLOS. U.S. regulators also feel that conventional means of border dispute settlement, in particular arbitration and bilateral negotiation, are more favorable to U.S. interests. UNCLOS signatories Russia and Norway took this alternative route to settle their disputed Barents Sea boundary in 2010 and opened up 68,000 square miles to oil and gas exploration. The United States and Canada have also opted for bilateral negotiations to resolve an ongoing dispute over the

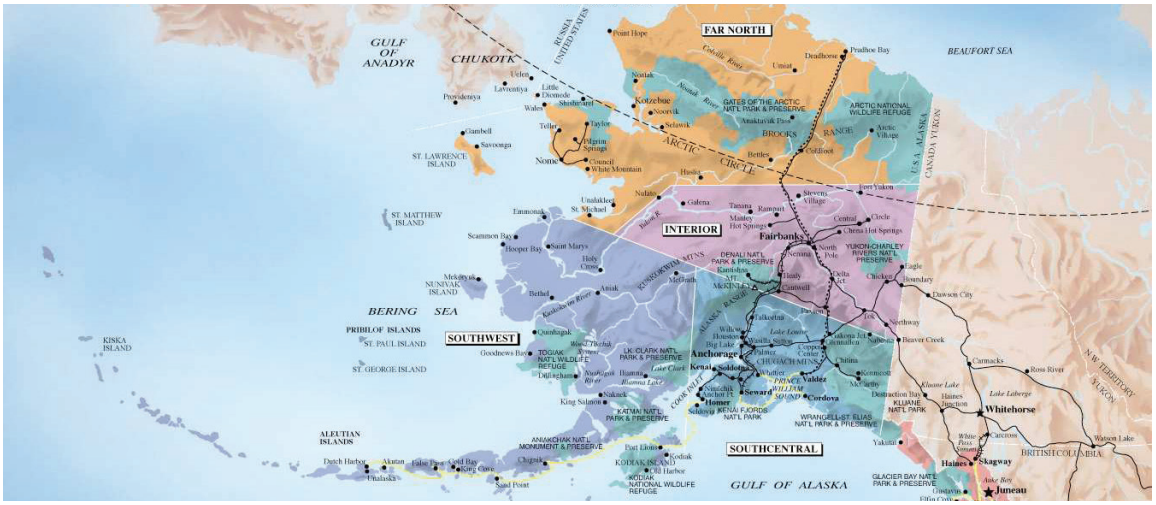
international maritime boundary between the Yukon and Alaska.

Lease Terms

The length of lease terms in the Arctic has had the greatest influence on North American Arctic resource development. Given the extremely high costs of drilling in remote, icy Arctic conditions, and the severe limitations of the Arctic drilling season (drilling on average can be conducted only during a three- to four-month window in the summer), longer-term leases are one of the few incentives governments can offer to companies to justify the immense up-front exploration and drilling capital expenditure commitments.

The 10-year lease term in effect in the Alaskan Arctic is inadequate to support ongoing exploration and evaluation of oil and gas potential. Given the infrequency of lease sales and the lengthy permitting processes that involve multiple federal- and state-level government agencies, the 10-year timeline is hardly long enough to accommodate a preliminary drilling program; it also poses serious risks to cost-recovery prospects. The typical drilling period in the region is a maximum of 105 days a year in the offshore and 150 days onshore; thus, depending on well depth and complexity, it is challenging to drill a single-season well on the continental shelf, and even more difficult to drill a well in less than two to three seasons on the shelf edge. Furthermore, the United States requires a development plan and timeline as part of the approval process for granting a license; adherence to the schedule can force an operator to abandon a lease for any reason if commercial production is not achieved within the designated timeframe.

By contrast, Canada offers more favorable lease terms that encourage greater risk-taking by energy companies willing to commit capital and resources to the Arctic. The Significant Discovery License (SDL) offered in Canada differs from the U.S. system of leasing based on production unit determination; upon discovery, operators retain control over their field until it becomes economical to develop and produce the resource. Operators can acquire large tracts with work commitment bids covering nine years. If an exploration well hits trapped oil or gas during the nine-year term, the operator is granted an SDL and can keep the lease in perpetuity until it finds time to develop the resources.



Map of Alaska, the Yukon Territory, and British Columbia's energy infrastructure. The 10-year lease term for the Alaskan Arctic is inadequate to encourage responsible development of the region's infrastructure.

Greenland's terms are also more accommodating than those in the United States. Greenland permits operators to acquire much larger tracts of offshore blocks than the three square mile blocks offered by the United States. Furthermore, in the Northeast Greenland offshore, operators can extend the initial license term to 16 years. This area holds extremely promising resource development potential, but it also poses some of the most—if not the most—challenging ice conditions across the entire Arctic. The climate and challenging ice conditions in both Northeast and Northwest Greenland require advanced technologies and ice-strengthened equipment for seismic and drilling activities. A preferable leasing regime would extend the same 16-year lease period enjoyed by Northeast Greenland to Northwest Greenland.

Lease term agreements aside, it is also important to note that approximately 28 billion bbls of oil equivalent lie in areas of the North American Arctic that are either currently unavailable for leasing and licensing or are under development moratoria. The Alaskan Arctic contains the largest portion at around 14 billion bbls. In September 2012, a group of Democratic senators[11] called for the U.S. Department of the Interior to halt future Alaska offshore drilling leases until the president is able to make a case that drilling is safe in the region, that the U.S. government can implement a better monitoring plan, and that companies can provide adequate oil spill response. Until those conditions are achieved, they argued, even more areas should be off limits for bid rounds and leasing. The group also requested that offshore Arctic drilling be removed altogether in the U.S. 2012-2017 offshore leasing program; this would include a potential 2016 sale in the Chukchi Sea and a 2017 sale in the Beaufort Sea.

Despite these objections to further development, the Obama administration has committed to moving forward with offshore leasing in Alaska. However, if the United States were to implement a leasing system similar to what is offered by Canada or Greenland, operators would have a more solid guarantee that even small discoveries could be held until they can be economically developed in the future. Such a leasing regime would boost investor confidence and draw more interest to the Alaskan offshore.

Technological/infrastructure requirements and associated costs

It should be noted that safe and successful drilling campaigns were conducted in the 1970s and 1980s in the U.S. and Canadian Arctic. As discussed above, these successes should provide confidence that drilling in the world's Arctic basins, particularly given their relatively shallow depth, is technically achievable and operationally feasible. However, the intrinsically high costs associated with the remoteness of the region, the short drilling window, extreme conditions, and the more stringent well containment and emergency response requirements that followed the Deepwater Horizon incident will all continue to limit access to those few IOCs or NOCs with deep pockets. As exploration activity in the North American Arctic progresses, such measures will help to safeguard the Arctic ecosystem, but will also force operators to find creative investment solutions, most likely in the form of public-private partnerships.

There are an estimated 412 billion barrels of oil equivalent (boe) in undiscovered resources in the Arctic; 75 percent of the estimated 40 billion boes in the Arctic deepwater is believed to be found in four areas: Beaufort Sea-Canada Basin; West Greenland-East Canada;

East Greenland; and East Barents Basin. The economics of developing these fields is challenging, and producers are targeting prospects with at least 500 million to 1 billion bbls of potentially recoverable oil.

The strong currents, severe storms, multi-year ice, and floating ice found in the Arctic require specially tailored seismic and drilling technologies. Seismic exploration using 2D technology is difficult and expensive even in moderate pack ice; 3D seismic exploration is virtually impossible once pack ice gets too thick. Current gravity-based offshore drilling structures are limited to a maximum depth of 100 meters. The industry has not yet demonstrated an ability to employ deep pipeline trenching (necessary to avoid ice scour) in depths beyond 100 meters.[12] Such technology will be critically important in the Continental Slope regions of the Canadian Beaufort and Greenland. Iceberg management strategies will also be important for Greenland and for parts of the Canadian Atlantic offshore.

More investment in research and development will be necessary before drilling can be considered beyond the shelf edge into deeper waters. Regulatory requirements for relief wells, oil spill containment systems, and increased environmental protection measures will all require significant capital expenditures. Arctic resource development is reaching a critical juncture and it is imperative that operators not cut corners on technology and safety requirements. Just one accident would have serious implications not only for the culpable operator, but could jeopardize future prospects in the Arctic for the entire industry.

There is a variety of rigs available globally for offshore drilling. However, the demand for rigs in conditions far less severe than the Arctic is much greater, and access to rigs for Arctic operators is often a challenging prospect. There is limited justification for shipping this equipment to the Arctic given the extremely limited operating window and the need to outfit the equipment with additional Arctic-proof features. Additionally, drilling contractors are reluctant to send rigs to the Alaskan Arctic when they could be bidding on multiple well opportunities in the Gulf of Mexico.

Most equipment and rigs are typically leased for five years; an additional five-year option is often available. The very limited drilling season in the Arctic complicates the economics of leasing such equipment; there are only a few months of feasible drilling time, compared to non-Arctic resource-rich areas where drilling activity can be conducted year-round. The dilemma of equipment leases in the Arctic could be remedied at least in part by extending longer-term (15-20 year) leases, similar to the Canada and Greenland models. Public-private partnerships could also be used to establish equipment-sharing agreements.

There is a strong case to be made in support of public-private partnerships as an effective and smart approach to Arctic oil and gas development. Sweden and Finland have long pursued public-private partnerships with ice management vessels. The Swedish and Finnish governments employ the vessels in the winter; in the summer, the vessels head elsewhere in the Arctic to be used in hydrocarbon development projects. If the United States and Canada are serious about stepping up their game in Arctic resource development, public-private partnerships could help manage some of the high capital costs associated with equipment acquisition. Public-private partnerships could accordingly promote and incentivize additional investment in Arctic reserves.

The high cost associated with drilling devel-

opment wells has been described as one of the greatest hurdles limiting more extensive technology development in Arctic oil and gas production. Beyond simple drilling and shipping costs, additional financial outlays are required for safety and environmental protection, such as containment wells and emergency response equipment. Following the Deepwater Horizon incident, 10 major oil companies committed more than $1 billion to fund the initial costs of developing a marine well containment system to prevent future underwater well blowouts. Additional operating and maintenance costs as well as contracts with operating vessels will significantly increase overall expenses associated with drilling in the Arctic.

The Canadian government first enacted a same-season relief well (SSRW) policy in 1976 that required operators to demonstrate the ability to drill and complete a relief well within the same operating season. Technology developments over the last several decades have put the industry into a position to question whether relief wells are the most appropriate solution for safety, environmental protection, and resource conservation. Well capping (instead of drilling relief wells) is now being explored as a primary response tool because it is a faster solution for spill cleanup; it also relies less on dispersants and other chemical spill cleanup solutions.

The well-relief costs outlined above come on top of an average well cost of about $600-900 million; leasing and permitting expenses add even more to the total. Capital expenditure requirements remain too great even for some of the large oil majors to engage in Arctic projects[13]; only a very few of the largest IOCs and some NOCs are pursuing Arctic exploration. It should be noted that advances in drilling technology are beginning to reduce development costs, and partnership agreements have permitted some operators to mitigate additional Arctic-specific cost burdens.

SOCIAL AND ENVIRONMENTAL OPPOSITION IN NORTH AMERICA

Local and indigenous communities and environmental NGOs (ENGOs) have expressed concerns with and even actively opposed the expansion of Arctic hydrocarbon development. They have been particularly concerned about the effectiveness of clean-up technologies in the event of a spill, especially one that occurred at the tail end of drilling season where ice re-formed before a spill could be contained. A leaking well could cause immense damages if it were left leaking until the drilling season recommenced the following year.

The level of opposition from ENGOs and indigenous communities continues to mount as new leases are offered for previously unexplored Arctic territory. Not only are these groups concerned about protecting the fragile Arctic ecosystem, but also about protecting wildlife and the livelihoods of local communities. They want to ensure that local populations are sufficiently compensated for the exploitation of their resources.

According to ENGOs, new government requirements, and regulatory oversight and additional safety measures employed by energy companies, are insufficient to protect Arctic wildlife and marine ecosystems. Greenpeace has been the most vocal ENGO with very public campaigns against pan-Arctic exploration and production for oil and gas. Among those protest efforts, which include scaling rigs in the Arctic, Greenpeace has launched

an online petition and collected 1.6 million signatures urging world leaders to declare the Arctic a global sanctuary and place it off limits to any oil and gas exploration.

The extensive presence of indigenous groups, particularly those living close to areas where key Arctic oil and gas exploration and production projects are underway, suggests that Arctic states will have to make an ongoing and concerted effort to acknowledge the interests and respect the concerns of these peoples. Many coastal indigenous groups in the North American Arctic are concerned about how an oil spill might compromise fishing and whaling, which are mainstays of their subsistence economies. In order to alleviate some of these fears, Shell, for example, has agreed to suspend drilling activity in the Beaufort Sea until the local indigenous Inupiat have concluded their traditional fall whaling season.

Industry and indigenous communities have worked together to build mutually beneficial arrangements in spite of concerns raised by ENGOs. In Alaska, the $350 million annual budget of the North Slope Borough government is funded with tax revenues paid by oil companies operating in the state waters of the North Slope onshore and offshore. In addition, Alaska residents pay no state income tax; in fact, they receive checks from the Alaska Permanent Fund, a corporation financed largely by oil revenues. The oil and gas industry provides about 100,000 jobs or a third of Alaska's employment.

Currently the tax revenue advantages for local communities apply only to state lands; they do not apply to the federally controlled offshore territory that is likely to see significant new production. Federal government revenue-sharing with the State of Alaska could provide incentives to the local coastal communities that must assume much of the perceived risks associated with offshore resource development.

Finally, increased hydrocarbon exploration in the North American Arctic has forged closer bonds among indigenous communities themselves, which have begun to advocate for their common interests before national governments. Indigenous communities have also started to participate in international fora regarding Arctic energy and commercial development. Six indigenous organizations are now permanent participants on the Arctic Council; they have full consultation rights in connection with the Council's negotiations and decisions (see Section VI for more detail on the Council).

Greenpeace ship "Arctic Sunrise" is seen anchored outside the Arctic port city of Murmansk September 24, 2013.(Reuters / Stringer)

IV EASTERN HEMISPHERE: HOW DOES IT COMPARE?

Russia's and Norway's experience with far north and Arctic resource development provides useful context and a basis of comparison to better understand North American scenarios. However, it is important to note that overall climatic and ice conditions vary significantly between the Western and Eastern Hemispheres.

As in North America, exploration activity began in the 1970s in Norway and the 1980s in Russia; neither country is a stranger to offshore development in extreme northern climates. Seismic surveying of the Norwegian Barents Sea began in the 1970s, and exploratory drilling in the 1980s. In 1984, Statoil discovered the Snøhvit development, the world's northernmost offshore gas field. Norway has since drilled 94 exploration wells in its section of the Barents Sea and constructed the world's northernmost liquefied natural gas (LNG) facility near Hammerfest; it has a good reputation for compliance with strict environmental standards.

In Russia, the first offshore Arctic gas field was discovered in the Barents Sea in 1983, and in 1986 the first offshore oil was discovered at the Severo-Gulyaevskoe field. Since then, Russia has continued to pursue exploration activities in its western Arctic waters in the Kara, Barents, and Pechora Seas. The 2010 agreement between Norway and Russia on an Arctic border in the Barents Sea has unlocked significant opportunities for resource development by both countries.

RESOURCE POTENTIAL AND LEASE TERMS

Russia

Russia is experiencing production decline at its currently producing—but ageing—oil fields. It is depending on tight oil production, as well as production in more remote East Siberian and Arctic offshore fields, to meet its fiscal targets and balance its budget. Furthermore, the government has been experimenting with various adjustments to the tax regime to encourage production at fields that are remote or more difficult to access. Russia needs these new fields to offset declines in production at its conventional, legacy fields and to maintain

production at a level of at least 10 million bpd beyond 2020.[14]

For Russia, and particularly the state-run oil giant Rosneft, Arctic shelf development is a longer-term strategic priority that could be a significant source of production growth beyond 2020. The government is looking to introduce tax incentives to make shelf exploration and production more economically viable. The finance ministry announced plans to finalize a tax package for the Arctic offshore by 1 January 2014 that will apply to new shelf projects that begin production from 1 January 2016. Rosneft and the state-run gas company Gazprom enjoy exclusive rights to the Arctic shelf and already hold a combined 80 percent of the shelf currently open to exploration and production. Proponents of shelf liberalization argue that the two companies are unable to conduct timely exploration and production activities on their own in such challenging waters and that their monopoly will further delay progress in the Arctic. The tax package currently under consideration would include a number of incentives to make shelf projects more economically appealing, including cancelled export duties and a reduced mineral extraction tax. The energy and finance ministries have been engaged in ongoing debates over a range of topics including property tax, royalty, VAT, and import duty calculations; customs procedures; and additional royalty discounts should oil prices fall below $60 per barrel. With ExxonMobil's plans to begin Arctic drilling in 2014, Russian tax reform legislation should be passed by the 2014 deadline to avoid further delays.

Meanwhile, Rosneft has announced plans to spend nearly $40 billion in shelf exploration over the next 10 years and has established joint ventures with IOCs such as ExxonMobil, Statoil, and Italy's Eni in order to tap their offshore technological expertise. Despite the current restrictions on private Russian companies for shelf access, private foreign companies will inevitably benefit from the tax breaks extended to Rosneft.

Norway

Norway is faced with a similar predicament as Russia in terms of production decline at its ageing fields in the North Sea and Norwegian Sea. Over the past few years, Norway has attracted more than $9 billion in investments in far northern fields, largely due to the more predictable and stable regulatory environment for its offshore hydrocarbon developments. It is important to note that although a good deal of Norway's future hydrocarbon potential lies in areas north of the Arctic Circle, the conditions do not meet true Arctic criteria, particularly in terms of the ice regime.

There is potential for far greater activity in the region if additional portions of offshore areas are opened up to the oil and gas industry. Currently 40 percent of Norway's continental shelf remains off limits to exploration. One such restricted area includes the waters off the Lofoten, Vesteralen, and Senja islands, which Norwegian authorities estimate could hold 1.3 billion boe; this region is situated closer to existing infrastructure than other acreage in the Barents Sea. Due to ecological sensitivities associated with this area, the government has postponed a decision on exploration until after Norway's September 2013 parliamentary elections. Some members of parliament want to introduce a ban on development until at least 2017. A parliamentary vote on opening up new areas for exploration in the Barents could happen before the 2013 elections.

Interest in the Barents has picked up signifi-

cantly in recent years, due in part to the 2010 Russia-Norway border agreement, which has allowed Norway to open up the southern part of the formerly disputed area. Statoil's Havis and Skrugard discoveries (estimated to hold 400-600 million bbls of recoverable oil) are also responsible for the uptick in interest. By summer 2013, Norway's Ministry of Petroleum and Energy will award 72 new licenses in the Barents Sea, including licenses to drill Norway's northernmost wells.[15]

In terms of taxes, Norway applies a 28 percent corporate tax and an additional 50 percent tax on profits derived from oil and gas production, for a total tax rate of 78 percent. These taxes are assessed only on earnings in Norway, rather than as a proportional share of producers' worldwide earnings as is the case in Alaska. Also, there are no federal property taxes, which are left entirely to the municipality. Much like its Arctic counterparts, Norway has felt pressure to offer incentives for its more remote, far northern fields. For example, in an effort to encourage development of the Snohvit natural gas field, Norway decided not to apply the combined 78 percent profits tax on LNG shipped overseas, but instead to tax profits at just the 28 percent rate.

TECHNOLOGY, INFRASTRUCTURE, AND TRANSPORTATION

As in the Western Hemisphere, little infrastructure is in place due to the extreme conditions and the remoteness of the Russian Arctic and Norway's far north regions. Developing resources in these regions will require both specialized technologies and large capital commitments. In addition to its joint development agreement for the Barents Sea signed with Norway, Russia has also pursued a joint venture model with IOCs to gain access to additional capital and technical expertise as it expands exploration activity on its continental shelf.

In May 2012, Rosneft and Statoil signed an agreement to jointly develop the shelf of the Barents and Okhotsk Seas. The agreement establishes a joint venture to develop the Perseyevsky license area in the Barents Sea and three fields in the Sea of Okhotsk; Statoil will finance geological prospecting work. Rosneft will then have the opportunity to buy a stake in Statoil's North Sea and Barents Sea projects. The agreement permits Russia to leverage Statoil's vast offshore experience and its good safety record. The agreement also creates an opportunity to stimulate Russia's shipbuilding industry since the two parties plan to order ice-class vessels and drilling platforms that will be constructed in Russian shipyards.

Rosneft has pursued similar agreements with other IOCs that have extensive offshore experience and are willing and able to fund exploration work in Russia in exchange for a 33.3 percent stake in the joint venture. This preferential tax treatment would make production at the offshore fields more profitable. In addition to its joint venture with Statoil, Rosneft has an agreement with ExxonMobil and the two companies will start a seismic program in the Kara Sea in 2013; they plan to drill their first exploration well in the Kara Sea in 2014-2015. Rosneft and Eni also signed an agreement to develop blocks in the Barents Sea. The two companies will drill an exploration and appraisal well by 2020 in the Fedynsky block, located in the ice-free southern portion of the Barents, and will also drill an exploration well in the Central Barents by 2021. The Rosneft-Eni agreement includes technology and staff exchanges that will enhance Rosneft's competence on the shelf.

As Arctic interest mounts, Russia is well po-

sitioned to become a leader in cutting-edge icebreaker and ice class vessel construction. Hydrocarbon development will likely create a surge in Arctic shipping over the next decade; access to the Northern Sea Route (NSR)—a stretch from Novaya Zemlya, Russia, to the Bering Strait—will be crucial to this effort. With the help of modern icebreakers, it is estimated that ice class superlarge vessels will be able to navigate the NSR three to four months out of the year along a route that cuts the travel distance from Europe to the Asian Pacific by 40 percent.

The potential commercial viability of the NSR lends support to Russia's Arctic LNG projects, including Shtokman and Yamal. Russian gas producer Novatek, which operates Yamal in a joint venture, has signed a 15-year icebreaker transport agreement with the Russian state nuclear company Rosatom. Russia's Baltiysky Zavod shipyard recently won a tender to build for Rosatomflot the largest nuclear-powered icebreaker of its kind for delivery by the end of 2017. And in December 2012, the Ob River tanker, operated by Dynagas and Gazprom Global, completed the first successful LNG shipment from Hammerfest, Norway, through the NSR to Japan's Tobata terminal; the LNG tanker was accompanied by a nuclear-powered icebreaker from state-owned Rosatomflot.

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS IN RUSSIA AND NORWAY

Russia has not been immune to social and environmental opposition to its Arctic resource development ambitions. As in the North American Arctic, the most vocal groups have been local indigenous groups and global ENGOs such as Greenpeace. In August 2012, Greenpeace environmental activists scaled the side of Gazprom's Prirazlomnaya oil platform in the Pechora Sea, claiming that Gazprom had failed to produce a comprehensive spill response plan for its Arctic operations. The Association of Indigenous Peoples of the North, Siberia, and the Far East (RAIPON) has expressed its grievances with energy exploitation in Russia's resource rich northern territories, particularly the Yamal Peninsula, arguing that such activities could have a negative impact on members' semi-nomadic lifestyle and disrupt the sensitive ecosystem. Russia ordered the association to suspend activity in November 2012 and temporarily banned it from participating in Arctic Council meetings. RAIPON was reinstated in March 2013.

Russia has attempted to alleviate environmental concerns through a series of environmental protection agreements with its Arctic joint venture partners. The agreements outline measures to protect the Arctic ecosystem during oil and gas exploration, and to minimize the impact of oil and gas activities on indigenous communities. Furthermore, Rosneft is considering opportunities to cooperate with Russia's federal space agency, transport ministry, and emergency situations ministry. The Rosneft-Statoil declaration could set a precedent for bilateral agreements on responsible Arctic resource development among North American Arctic countries, or between Russia and Canada.

Most of the debate in Norway on resource development in the Far North is centered on environmental issues and ecological concerns. Although Statoil has a solid record of rig safety, the company lost control of a North Sea well just a month after the Deepwater Horizon accident in 2010. Statoil managed to

shut 50 wells and avert a serious disaster, but the accident raised concerns about the risks of offshore drilling, particularly in more fragile, remote areas such as the Barents Sea.

In an effort to address concerns from environmental groups, commercial interests, and opposition parties within the Norwegian Parliament, the government of Prime Minister Jens Stoltenberg offered a compromise to leave large areas in the northern Barents Sea and northeastern Norwegian Sea off limits to exploration activities for the time being. The fishing industry and environmental groups have expressed fears about the disastrous impacts pollution or an oil spill would have on a region that is critical to commercial fish species, seabirds, marine mammals, and what is believed to be the world's largest cold-water coral reef.

Norway's indigenous Sami population has spoken out against energy development in the past, expressing concern about adequate protection of wild salmon runs and reindeer feeding grounds. As the oil and gas industry expands its footprint in Norway's far northern reaches, debate on environmental issues will continue, particularly on the potential impact of pollution or spills on wildlife.

Unidentified people take part at the meeting in support of 30 Greenpeace activists charged with piracy at an oil platform in the Arctic, October 5, 2013 in Moscow, Russia.

Photo by: vlad0209 / Shutterstock.com

V EAST-WEST: LESSONS AND COOPERATION

As resource exploration in the Arctic's eastern hemisphere catches up with the western hemisphere, technological progress continues to be made across the entire Arctic. Cooperation has helped identify best practices and opportunities for technology and policy transfer. Russia and Norway continue to aggressively target new resources in their respective Arctic and far north regions. Greenland is eager to become the next big player. Canada and the United States continue to direct greater attention to developing unconventional plays. Regional cooperation through organizations such as the Arctic Council will result in greater research and technology sharing, more cooperation on environmental preservation, and better coordination on policy planning.

Production of conventional energy resources faces sharp decline in the less remote, more temperate areas of Russia, and in Norway's North Sea and Norwegian Sea. At the same time, new energy projects in the far north and Arctic regions of Norway and Russia will become an important source of future supply. This situation stands in sharp contrast to what is found in the United States and Canada, where significant tight oil reserves in the Bakken and Eagle Ford formations, and in Alberta (tight oil and oil sands) are contained in far more agreeable climates. The United States and Canada also have easier access to existing infrastructure networks—or at least easier access to locations where additional infrastructure can be built to link these fields to existing pipelines, railways, and ports. However, without longer and more accommodating lease terms and public-private partnerships to facilitate equipment leases (a practice that is already effective in Scandinavian countries), it will be difficult to incentivize large-scale production in the North American Arctic in the near term. With respect to transportation and shipping experience, tankering has become a widespread practice in the Barents Sea, and the Russians have begun to experiment with limited tanker traffic to Southeast Asia through the NSR. Russian companies are also using icebreaking tankers to export oil to North America and Europe from an ice-resistant floating storage unit in the far north. The United States and Canada continue to weigh the tradeoffs of pipeline versus tanker exports.

As Arctic littoral states gain experience in Arctic energy development, they have begun to work through different treaties and international organizations to establish uniform safety

standards, search and rescue protocols, and new environmental precautions. Having resolved a long-standing border dispute, Russia and Norway have also worked to harmonize health, safety, and environmental standards for industrial activities in the Barents Sea through the Barents 2020 project. Norway also signed a historic energy agreement with the United Kingdom in October 2011 committing to use the best available technologies to manage energy sector-related emissions and to enhance environmental protection. Similar cooperation agreements among littoral states in the North American Arctic could be an effective strategy for ensuring best practices in oil and gas exploration and production in those regions.

Finally, the Arctic Council has been established as the main, consensus-based, high-level intergovernmental forum through which the eight Arctic nations, six international indigenous peoples organizations, and non-Arctic observer countries can coordinate policies for the region. The council focuses on a range of issues relating to sustainable development and environmental protection. In 2011, the Arctic Council member states signed their first agreement on cooperation in air and maritime search and rescue. Since then, an Arctic Council working group has completed the draft Arctic Marine Oil Pollution Preparedness and Response Agreement, which will be signed in Kiruna, Sweden, at the Arctic Council meeting in May 2013. The rapid expansion of oil and gas exploration activities has exposed the need for pan-Arctic compliance with an established set of environmental regulations for hydrocarbon development.

Organizations such as the Arctic Council can help maintain open channels of communication between key stakeholders and encourage best practices in Arctic resource exploration and development. Such cooperation and discussion can ensure that the interests of social, environment, government, and industry groups are adequately addressed as the development of Arctic energy resources continues.

Oil rig in Canadian Atlantic. As the current Chair of the Arctic Council, Canada will have a leadership role in determining how to responsibly develop the region's energy resources while keeping geopolitical tensions manageable.

VI CONCLUSIONS: BEST PRACTICES

Despite the large variation in climatic conditions and offshore ice regimes between the western and eastern Arctic regions, hydrocarbon development across the Arctic and far north comes with inherent risks. It is in the best interest of all Arctic littoral states to find forums to share experience and technology, as well as to cooperate on environmental protection. While there is no one-size-fits-all approach, certain lessons can be derived from the experience of oil and gas companies currently operating in the Arctic and the far north that can help create more cost-effective, efficient, and safe approaches to resource development in the region. Shared best practices can also help mitigate disasters and improve overall accountability in the Arctic.

LONGER LEASE TERMS

Longer lease terms are particularly important in the North American Arctic, where severe ice conditions limit the window for exploration and production activity to just three to four months of the year. Short lease terms, combined with the more stringent consultation processes and regulatory oversight, make it extremely difficult for operators to conduct preliminary drilling programs in anything less than two years; it is even longer before production can reach a state where cost-recovery can be achieved.

Short lease terms are particularly problematic in Alaska, where the 10-year terms render the U.S. Arctic relatively unappealing to potential operators, because of concerns this is an insufficient time to recover extremely large up-front capital expenditure costs. Greenland and Canada offer slightly more favorable terms. Greenland offers an extension of up to 16 years in northeast Greenland. In Canada, although work commitment bids cover just nine years, operators can keep fields in perpetuity with a Significant Discovery License (SDL) if resources are found during this initial stage. The lease regimes in Greenland and Canada come closer to offering more attractive and favorable timelines, but the longest possible lease terms would offer the most favorable conditions for operators. A combination of Greenland's lengthier lease terms for northeast Greenland and Canada's SDL would create more favorable conditions for operators across the North American Arctic. Longer lease terms would give operators time to implement more comprehensive safeguards

and better observe best industry practices and safety precautions.

PUBLIC-PRIVATE PARTNERSHIPS

Cooperation between state and private companies can potentially incorporate a wider range of interests in Arctic resource development. Public-private partnerships can leverage the most cost-effective, efficient, and advanced technologies and methods available; this is particularly true for shipyards and shipbuilding efforts.

Construction of ice class vessels is extremely costly. Many oil and gas companies that require such vessels for drilling, exploration, and production support find it prohibitively expensive to construct their own, particularly when the use of the ships is limited to one-third of the year.[16] A financing model based on a 20-to-30 year contract between the state and a private entity creates an opportunity to spread the costs over a much longer time frame.

In most cases, the construction of icebreakers is financed by the state. Public-private partnerships that share construction financing and establish annual vessel sharing agreements will improve vessel access for all parties involved. Furthermore, as resource extraction activity increases in the Arctic, so will shipping. Governments will need more substantial fleets of ice class vessels for security, research, and surveillance. Public-private partnerships, particularly in ship construction, can also reduce the financial burden to taxpayers.

The same strategy can be used to support infrastructure projects such as port construction. For example, Russia's Sabetta Port on the northeast coast of the Yamal Peninsula is expected to become a critical gateway for LNG exports. Government financing of the port's construction will come to $1.6 billion, while shareholders of Yamal LNG will invest $830 million into port infrastructure.

EXPANSION OF ARCTIC COUNCIL'S LEGAL RIGHTS

The Arctic Council's first two legally binding agreements will help enforce a uniform set of environmental and operating standards across the Arctic. These agreements will eliminate sources of ambiguity or confusion by clearly delineating roles and responsibilities of each Arctic littoral state in search and rescue and oil spill response efforts. Future agreements could expand the role and prominence of the Arctic Council in Arctic affairs by enforcing environmental stewardship, representing the interests of indigenous peoples, and promoting social responsibility and economic development in far northern and Arctic territories.

Indigenous peoples will likely play a much larger role in the development of hydrocarbons and other resources as new Arctic territories are opened to exploration and new leases are offered. With the ability to establish legally mandated consultations among producers and indigenous groups, the Arctic Council can ensure that the interests of indigenous groups are respected, their livelihoods protected, and that resource and economic development benefit the communities.

The Arctic Council could also play a role in coordinating best practices in the use of equipment and technology. As a pan-Arctic forum, it can look at Arctic resource development more holistically. It could promote the application of new technology to oil and gas

development by establishing equipment standards, best drilling techniques, and well safety measures that are legally binding across the whole Arctic. Adding safeguards to Arctic hydrocarbon development is a positive step that will ensure the best interests of industry, indigenous groups, and environmental organizations.

BILATERAL AGREEMENTS

Cooperation among Arctic littoral states can ensure greater responsibility and adherence to best practices at the local level. Collaboration among Arctic countries on best practices, environmental standards, and technology transfer can introduce an additional layer of accountability to ensure safe and responsible Arctic development.

Norway and Russia have recently been very active, reflecting the benefits of formal cooperation. The July 2011 maritime border agreement in the Barents Sea has enabled Russia and Norway to explore the resource potential in the region. Statoil and Rosneft have agreed to jointly explore offshore deposits in the region. Norway and Russia are also exploring the possibility of joint naval exercises in the Barents and Norwegian Seas. As climate change makes larger portions of the Arctic accessible, cooperation on bilateral energy exploration and maritime capabilities could benefit other nations as well (for example, among Arctic neighbors Canada, Russia, and the United States in the Chukchi and Beaufort Seas).

When possible, bilateral dispute settlements and cooperation between countries in contiguous Arctic regions can ensure that best practices are employed as operators expand oil and gas exploration and production activities.

Bilateral agreements can be more comprehensive and quicker to achieve than multilateral efforts. Canada and Russia have had a long-standing debate over rights to the Lomonosov Ridge and Mendeleev Rise; Russia submitted a claim to the UN Commission on the Limits of the Continental Shelf in 2001 providing its recommendations on how the shared border should be delineated. However, with 51 sea claims currently before the UN Commission and only three examined each year, a timely resolution is unlikely. Bilateral agreements can resolve border disputes more quickly and avoid inefficiencies and delays.

USCG and Canadian icebreakers working in tandem to support American and Canadian Extended Continental Shelf claims. Elsewhere, Russia and Norway also concluded a maritime border agreement which will allow for greater resource exploration.

ENDNOTES

1 According to an April 2012 report from Lloyd's in conjunction with Chatham House, available at http://www.lloyds.com/~/media/Files/News%20and%20Insight/360%20Risk%20Insight/Arctic_Risk_Report_20120412.pdf; for the purposes of this paper all monetary values will be presented in U.S. dollars.

2 Sakhalin has approximately 1.5 trillion barrels (bbls) in recoverable reserves; Hibernia has about 1.2 trillion bbls in recoverable reserves

3 From 6,900 million tons of oil equivalent (mtoe) in 2010 to 9,400 mtoe by 2035

4 All resource estimates based on U.S. Geological Survey methodology, which uses a calculation based on the mean, risked, undiscovered, technically recoverable oil, natural gas liquids, and gas volumes. For more information see: http://pubs.usgs.gov/fs/2008/3049

5 6.4 billion bbl of oil, 0.9 billion bbl of natural gas liquids, 83 tcf of gas

6 An estimated 80.1 billion bbl of oil, 11.1 billion bbl of natural gas liquids, and 595 tcf of gas

7 Estimates for the Chukchi Sea are 14.5 billion bbls oil and 76.8 tcf of gas, and 9.2 billion bbls of oil and 33.5 trillion cubic feet of gas for the Beaufort. Additionally, state waters and the onshore North Slope are expected to contain an additional 15.2 billion bbls oil, 61.3 tcf of gas, and 0.1 billion bbls of natural gas liquids. South and Central Alaska also contain smaller volumes of oil and gas, an estimated 3.8 billion bbls of oil, 61.3 tcf of gas, and 0.1 billion bbls of natural gas liquids.

8 Undiscovered recoverable volumes are estimated to be 20.2 billion bbls of oil, 186.8 tcf of gas, and 0.9 billion bbls of natural gas liquids (NGL). The region around the Mackenzie Delta onshore and Canadian Beaufort offshore contains the largest portion of these reserves: 8.1 billion bbls of oil, 67.1 tcf gas, and 0.2 billion bbls NGLs, followed by the Baffin Bay offshore, and the Sverdrup Basin and Arctic Islands. Additionally, the Labrador-Newfoundland offshore, while estimated to contain smaller volumes of oil at only 2.7 billion bbls, has fairly significant natural gas reserves with an estimated 57 tcf of gas.

9 Greenland contains an estimated total of 16.1 billion bbls of oil, 137.6 tcf gas, and 9.93 billion bbls of NGLs. The East Greenland Rift Basin is believed to hold the largest share of such reserves with 8.9 billion bbls of oil, 86.2 tcf of gas, and 8.1 billion barrels of NGLs. The West Greenland Basin offshore contains the next most significant reserve base followed by the North Greenland Sheared Margin.

10 The U.S. Merchant Marine Act of 1920 (better known as the Jones Act) requires that vessels transporting goods between U.S. ports be U.S.-flagged; these vessels must furthermore be constructed in the United States and owned and operated by U.S. companies.

11 These Democratic senators include: Richard Durbin, IL; Barbara Boxer, CA; Frank Lautenberg, NJ; Patrick Leahy, VT; Jeff Merkley, OR; and Sheldon Whitehouse, RI.

12 This does not apply to the U.S. Outer Continental Shelf.

13 In July 2012, BP announced it would abandon its offshore Alaska Liberty field, originally anticipated to cost $1.5 billion. It cited increased safety standards and additional technical needs that would add additional costs and render the project uneconomical.

14 The United States Geological Survey (USGS) estimates that the Barents Sea could contain as much as 11 billion bbls of oil and 380 tcf of natural gas, and the Kara Sea another 2.5 billion bbls of oil and 622 tcf of gas. Ninety-five percent of Russia's gas reserves and 60 percent of its oil reserves are believed to lie in the Arctic. With just 252 wells drilled on the entire Russian continental shelf, and most

concentrated in the Barents and Kara Seas in the west, Russia's shelf remains largely unexplored. Additionally, there has been practically no surveying or drilling carried out in the Laptev, East Siberian, and Chukchi Seas. Several promising finds have encouraged the Russian government and investors alike to pursue opportunities on the shelf, including the supergiant Shtokman gas field and the Ledovoye and Ludlov fields in the Barents Sea, and the Rusanov and Leningrad gas fields in the Kara Sea.

15 The exploration lease period for shallow water blocks will be seven years (down from eight years previously) and eight years for deepwater blocks (down from nine years previously).

16 An average icebreaker can cost as much as $200 million. The price is even higher for Russia's nuclear-powered vessels, which cost more than $1.5 billion each. High-tech vessels with military enhancements can cost more than $850 million each.