2016
North Pacific Arctic Conference Proceedings

The Arctic in World Affairs

A North Pacific Dialogue on Arctic Futures: Emerging Issues and Policy Responses

Edited by

Robert W. Corell
Jong Deog Kim
Yoon Hyung Kim
Oran R. Young

KMI KOREA MARITIME INSTITUTE

EAST-WEST CENTER

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The KMI/EWC series *The Arctic in World Affairs* publishes work from the North Pacific Arctic Conference, which aims to provide a forum in which key individuals from relevant countries and major stakeholder groups are able to develop relations of trust that allow them to discuss complex and sometimes difficult issues pertaining to the maritime Arctic in a spirit of problem solving rather than advocacy.

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The second volume, *A North Pacific Dialogue on Arctic Marine Issues*, from the 2012 conference, was edited by Oran R. Young, Jong Deog Kim, and Yoon Hyung Kim.

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The forth, *A North Pacific Dialogue on International Cooperation in a Changing Arctic*, from the 2014 conference, was edited by Oran R. Young, Jong Deog Kim, and Yoon Hyung Kim.

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The volume, *A North Pacific Dialogue on Arctic Futures: Emerging Issues and Policy Responses*, from the 2016 conference, was edited by Robert W. Corell, Jong Deog Kim, Yoon Hyung Kim, and Oran R. Young.

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A JOINT PUBLICATION OF THE KOREA MARITIME INSTITUTE AND THE EAST-WEST CENTER

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EAST-WEST CENTER

Published by
Korea Maritime Institute
26, Haeyang-ro 301beon-gil, Yeongdo-gu,
Busan, 606-080 Republic of Korea
www.kmi.re.kr

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Published in December 2016
ISBN 978-89-7998-135-3 93300

Contents

List of Figures

List of Tables

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Lawson Brigham, Distinguished Professor of Geography and Arctic Policy, University of Alaska Fairbanks, USA

Robert W. Corell, Principal, Global Environment and Technology Foundation, USA, and Professor, University of the Arctic, Norway

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Preface

The North Pacific Arctic Conference (NPAC), now in its sixth year, provides a mechanism for encouraging off-the-record engagement among members of the scientific and practitioner communities regarding Arctic issues of mutual interest to leading North Pacific Arctic states (Canada, Russia, and the United States) and non-Arctic Asian states (China, Japan, and Korea). It aims to promote improved understanding of policy issues and options among these six states in the Arctic Council and in other settings. All six states are members of the G-20; together they account for more than 50% of the world's greenhouse gas emissions as well as a large share of global commerce.

The Arctic is a system of growing complexity in which numerous forces interact to produce changes that are often nonlinear, sometimes abrupt, and frequently surprising. We have known for some time that the impacts of climate change are more pronounced in the Arctic than elsewhere. But we were taken by surprise by the collapse of sea ice in the Arctic Basin during 2007 and the following years, and we did not anticipate the rates of melting of the Greenland ice sheet that scientific observations are now documenting. Some years ago, knowledgeable observers forecast the onset of a scramble for natural resources in an increasingly accessible Arctic. But this expectation did not take into account the dramatic decline during the last several years in world market prices for oil and other fossil fuels or the rise in tension between Russia and the western Arctic states. As a result, exploratory operations in the Chukchi Sea north of Alaska, the Kara Sea north of Russia, and off the west coast of Greenland have all petered out; even plans for the development of massive proven reserves like those of the Shtockman gas field in the Russian sector of the Barents Sea have been postponed indefinitely. Less than three years ago, the Arctic states declared formally that "The Arctic Council has become the preeminent high-level forum of the Arctic region and we have made this region into an area of unique international cooperation." Today, both the future of cooperation in the region and the role of the Arctic Council are in doubt.

There is no reason to draw alarmist conclusions from these observations. But they do make it clear that the Arctic is a complex system subject to major changes that are both rapid and surprising. There is no way to forecast with any precision the likely trajectory of developments in

the region, even over the short run out to 2020. More and better analysis will not alter this condition. But we can take steps to monitor major drivers of change in the Arctic more intensively and precisely, to engage in various types of simulation and visioning exercises aimed at broadening our awareness of the range of plausible developments in the region, and to enhance the agility of institutional arrangements like the Arctic Council dedicated to addressing Arctic issues in a cooperative fashion. Particularly helpful in this regard are high-level but informal mechanisms like the North Pacific Arctic Conference that allow knowledgeable people from many countries and many walks of life to engage in vigorous and open dialogues about emerging Arctic issues and the options for addressing these issues in a constructive manner.

To this end, the 2016 North Pacific Arctic Conference on "Arctic Futures: Emerging Issues and Policy Responses," organized by the East-West Center and the Korea Maritime Institute, was held in Honolulu, Hawai'i in August 2016. The conference provided an opportunity for expert presentations and informal dialogue among knowledgeable individuals on emerging Arctic issues and policy responses. We were particularly pleased to have significant engagement on the part of government policymakers as well as representatives of indigenous peoples and the communities in which they live. The conference explored transformative changes occurring in the Arctic that have major socioeconomic and geopolitical implications for the nations and peoples of the North Pacific Region and the needs for governance associated with these changes. Participants considered ways to ensure peace, cooperation, and growing prosperity in the Arctic in an uncertain world.

The chapters and commentaries included in the book are based on presentations made at the conference. We would like to thank Dr. Robert W. Corell, Principal, Global Environment and Technology Foundation and Professor, University of the Arctic; Dr. Jong Deog Kim, Senior Research Fellow at the Korea Maritime Institute; Dr. Yoon Hyung Kim, Professor Emeritus at the Hankuk University of Foreign Studies and Senior Fellow at the East-West Center; and Dr. Oran R. Young, Professor Emeritus at the Bren School of Environmental Science and Management, University of California, Santa Barbara for coordinating the conference and preparing this volume for publication. We also wish to thank the paper writers, commentators, and others involved in contributing to the success of this conference. We extend our appreciation to Daniel Glick, our copyeditor,

for his excellent contribution in preparing the text for publication. We are grateful to Dr. Nancy Lewis at the East-West Center for her support of the NPAC program. Our sincere gratitude goes to Jaymen Laupola of the East-West Center for his expert management of the conference logistics.

Chang-ho Yang
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INTRODUCTION AND OVERVIEW

1. Emerging Arctic Issues and Policy Responses[1]: Introduction and Overview

Robert W. Corell, Jong Deog Kim, Yoon Hyung Kim, and Oran R. Young

INTRODUCTION

The North Pacific Arctic Conference (NPAC), now in its sixth year, provides a mechanism for encouraging off-the-record engagement among members of the scientific and practitioner communities regarding Arctic issues of mutual interest to leading North Pacific Arctic states (Canada, Russia, and the United States) and non-Arctic Asian states (China, Japan, and Korea). It aims to promote improved understanding of policy issues and options among these six states both in the setting provided by the Arctic Council and in other settings. These six states, all members of the G-20, together account for more than 50% of the world's greenhouse gas emissions as well as a large share of global commerce.

The Arctic constitutes a system of growing complexity in which numerous forces interact to produce changes that are often nonlinear, sometimes abrupt, and frequently surprising. We have known for some time that the impacts of climate change are more pronounced in the Arctic than elsewhere. But world leaders were taken by surprise by the dramatic collapse of sea ice in the Arctic Basin during 2007 and the following years, and we did not anticipate the accelerated rate of melting of the Greenland ice sheet that scientific observations are now documenting. Some years ago, knowledgeable observers forecast the onset of major investments to assess and develop natural resources as the Arctic becomes increasingly accessible. But these forecasts failed to anticipate the dramatic decline during recent years in world market prices for oil and other fossil fuels or the rise in tension between Russia and the western Arctic states.

As a result, exploratory operations in the Chukchi Sea north of Alaska, the Kara Sea north of Russia, and off the west coast of Greenland have all been put on hold; even plans for the development of massive proven reserves like the Shtokman natural gas field in the Russian sector of the Barents Sea have been postponed indefinitely. Less than three years ago, the

Arctic states declared formally that "The Arctic Council has become the preeminent high-level forum of the Arctic region and we have made this region into an area of unique international cooperation." Today, both the future of cooperation in the region and the role of the Arctic Council are less clear.

There are good reasons to avoid an alarmist response to these developments. It is essential to understand that the Arctic is a complex system subject to major changes that are both rapid and surprising. We cannot forecast with any precision the likely trajectory of developments in the region, even over the short run out to 2020. More and better analysis will not alter this condition. But we can take steps to monitor major drivers of change in the Arctic more intensively and precisely, to engage in various types of simulation and visioning exercises aimed at broadening our awareness of the range of plausible developments in the region, and to enhance the agility of institutional arrangements dealing with Arctic issues. The Arctic Council provides a helpful venue for dialogue among the eight member states and twelve observer states especially with regard to issues that are regional in scope. But other mechanisms are needed to supplement the work of the council.

Particularly helpful in this setting are high-level but informal mechanisms such as the North Pacific Arctic Conference that allow knowledgeable people from many countries and many walks of life to engage in vigorous, off-the-record dialogues about emerging Arctic issues and the options for addressing these issues in a constructive and cooperative manner. The North Pacific Arctic Conference provides a venue designed to enhance evidence-based understanding of the changes and sustainable socioeconomic opportunities of the high north region, to foster planning strategies that address these changes and opportunities, and to facilitate strategies, mechanisms and tools that prepare nations and peoples for a variety of Arctic futures.

This volume comprises four substantive parts. Part I consists of a principal presentation followed by six perspectives providing insights into how the North Pacific countries and the Inuit Circumpolar Council look at the Arctic particularly through the lens of climate change. Part II contains five different perspectives from three Arctic Council associated entities, a non-Arctic state and an Arctic indigenous community on implications of the Paris Agreement on climate change for the Arctic. Part III presents seven interdisciplinary perspectives on the future of the Arctic

Ocean with particular reference to fisheries, shipping and tourism. The seven perspectives in Part IV address major factors influencing prospects for Arctic gas development. A brief Conclusion looks to the future and proposes the theme of *Building Capacities for a Sustainable Arctic through Improved Science-Policy Engagement* as an overall framework for NPAC activities during 2017-2019.

The common thread running through the contributions to NPAC 2016 is a concern for Arctic futures approached from a number of vantage points. Some of those who contributed are government officials who bring the perspective of the policy community to this theme. Others are associated with nongovernmental organizations, including indigenous peoples' organizations and other NGOs. Still others come from the world of academics and analysis. The result is not a set of predictions regarding the shape of things to come in the Arctic; the affairs of the region are too complex to allow for meaningful predictions. But the contributions to this volume do reflect a set of plausible projections on the part of knowledgeable people in a position to engage in disciplined thinking about what the future holds in store for the Arctic.

PART I: ARCTIC POLICIES IN A GLOBAL CONTEXT

Daniel Reifsnyder begins Part I with an overview of American climate policy in the Arctic context, focusing in particular on key features of the 2015 Paris Agreement emerging from the twenty-first meeting of the Conference of the Parties (COP21) of the UN Framework Convention on Climate Change. The 2015 agreement aims to strengthen the global response to climate change with the goals of holding the global average temperature increase to well below 2°C above pre-industrial levels and of striving to limit increases to 1.5°C. It seeks to increase our ability to adapt to the adverse impacts of climate change and foster climate resilience through low emissions development. The agreement also aims to make financial flows consistent with a pathway toward low greenhouse gas emissions and climate resilient development.

The Paris Agreement is to be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities in light of different national circumstances. The Parties aim to reach peak greenhouse gas emissions as soon as possible and to achieve

a balance between human emissions and removals by sinks in the second half of this century. Each Party must strive to formulate and communicate long-term low greenhouse gas emission development strategies. Parties are invited to communicate by 2020 mid-century long-term low greenhouse gas emissions development strategies for publication on the UNFCCC website.

Reifsnyder summarizes the nature and role of Nationally Determined Contributions (NDCs). Under the Paris Agreement, each party is required to prepare successive NDCs, reflecting progress in reducing emissions and stating its highest possible ambition. Developed countries should undertake economy-wide absolute emission reduction targets; developing countries should continue enhancing mitigation efforts and are encouraged to move over time to economy-wide emission reduction or limitation targets in light of different national circumstances.

Each Party undertakes to communicate an NDC every five years. The first session of the Conference of the Parties/Meeting of the Parties (COP/MOP) is to consider common timeframes for NDCs. The first NDC is due on ratification/accession. But if a Party has communicated an intended NDC, this requirement is satisfied. Parties with NDCs containing a timeframe up to 2025 are urged to communicate a new NDC by 2020 and thereafter every five years. Parties with NDCs containing a timeframe up to 2030 are requested to update these contributions by 2020 and to do so thereafter every five years.

The COP/MOP will periodically take stock of implementation efforts to assess collective progress toward achieving the purpose and long-term goals of the agreement. This Global Stock Take (GST) is to be carried out in a comprehensive, facilitative manner and will consider mitigation, adaptation and means of implementation and support in light of equity and the best available science. The first GST will take place in 2023 and occur every five years thereafter.

The outcome of the GST will inform Parties in updating and enhancing, in a nationally determined manner, their actions and support as well as in enhancing international cooperation for climate action. The COP will convene a facilitated dialogue among Parties in 2018 to take stock of Parties' collective efforts with regard to peaking and achieving balance between emissions and removals to inform preparation of updated NDCs.

Under the Agreement, developed countries are to provide financial resources to developing countries to assist them with both mitigation and adaptation. Provision of scaled-up financial resources will aim to achieve

a balance between adaptation and mitigation. Developed countries are obligated to communicate biennially indicative quantitative and qualitative information on finances, including projected levels of public finance to be provided to developing countries. Other Parties providing resources are encouraged to communicate such information biennially on a voluntary basis. Under the related Paris decision, developed countries state their intention to continue their existing collective mobilization goal through 2025 in the context of meaningful mitigation actions and transparency on implementation. Prior to 2025, the COP/MOP will set a new collective quantified goal from a floor of $100 billion per year.

The Paris Agreement entered into force on 4 November 2016, 30 days after 55 Parties to the UNFCCC accounting for at least 55% of total global greenhouse gas emissions deposited their instruments of ratification, acceptance, approval, or accession to the Depository. The first session of the COP/MOP of the agreement took place in Marrakech, Morocco on 15-18 November 2016.[2]

Reifsnyder concludes by noting that the actions of nations and citizens will determine whether the goals of the Paris Agreement can be achieved. One of the most important and significant actions countries took in the immediate aftermath of Paris was to adopt an amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer in Kigali, Uganda in October 2016 to phase down the use of hydrofluorocarbons (HFCs). This action alone could avoid as much as 0.5°C of warming by 2100.

The Climate and Clean Air Coalition (CCAC), initiated in February 2012, is also working on the so-called "short-lived climate forcers," including methane, black carbon, and HFCs. Two other important events took place during the fall of 2016:

- The third Our Ocean Conference hosted by Secretary of State John Kerry in Washington, D.C. from September 15-16.
- The first ever White House Arctic Science Ministerial in Washington in September just one year after President Obama's historic trip to Alaska in 2015.

Both of these events bear importantly on climate change in the Arctic by recognizing the tight links between atmospheric and marine systems and by stimulating the scientific research needed to supplement our existing understanding of the role of the Arctic in climate change.

Japan

In presenting a Japanese policy perspective on U.S. Climate Policy in an Arctic Context, Ambassador Kazuko Shiraishi notes that Japan is located close to the Arctic and is near the Bering Strait, the Pacific outlet of the Northern Sea Route. Climate change impacts have serious consequences for non-Arctic states like Japan. Japan's Arctic Policy, released in October 2015, aims to take cross-cutting perspectives to ensure that Japan is a significant player in Arctic affairs. In contains seven basic elements:

1. Science and technology from a global viewpoint.
2. Environments and ecosystems.
3. International cooperation and the rule of law.
4. Indigenous peoples and respect for their traditional ways.
5. National security.
6. Economic and social compatibility with respect for climate and environment.
7. Arctic sea route and development of resources to assist economies.

Based on these elements, Japan has launched three initiatives:

1. Research and development: what's going on and how it affects the global environment.
2. International cooperation: Japan has Arctic interests and wants to engage in rule-making in relation to the Arctic based on its scientific expertise.
3. Sustainable use of the Arctic: in order to prepare for utilization of the sea route, Japan would like a maritime authority to govern sea routes and to work on a framework for managing living marine resources.

Japan has more than 50 years of scientific monitoring and research in the Arctic. Japanese researchers have a base at Ny Ålesund in Svalbard. Japan has contributed data on sea ice and other issues including ocean acidification in relation to the Arctic. A project, entitled *Arctic Challenge for Sustainability*, has been initiated. This project has three aims: to understand climate change through integrated research; to determine future impacts; and to deliver information to decision-makers.

The way forward for Japan from a foreign policy perspective is to

engage international stakeholders like those at NPAC as well as domestic stakeholders at home. Japan is trying to identify cooperative initiatives with other states and to implement its Arctic Policy strategically. Shiraishi notes Japan's appreciation for the United States' efforts to engage non-Arctic states in the Arctic Council.

Republic of Korea

Ambassador Chan-Woo Kim provides a perspective on the Arctic policy of the Republic of Korea. He notes that there have been a number of important developments since NPAC 2015, including the Paris Agreement on climate change and the 20th anniversary of the Arctic Council. Conferences, such as NPAC 2016, involving participants from Arctic and non-Arctic states, help to work toward sustainability in relation to the Arctic. The IPCC has forecast major reductions in Arctic sea ice. This leads to the conclusion that despite current efforts, the so-called "Arctic paradox" will continue at the current rate. The Republic of Korea adopted an Arctic Master Plan in 2013, followed by action plans to implement it. The Plan is built on two pillars: (i) to address climate change by conducting scientific activity and (ii) to develop economic opportunities arising from changes in the Arctic.

Scientific knowledge needs to be emphasized and enhanced in the effort to diagnose and understand ongoing phenomena and to find solutions to them. The Republic of Korea will contribute to this scientific knowledge. Korea's Arctic research effort is led by the Korea Polar Research Institute (KOPRI) and carried out through assets such as the icebreaker Araon. Korea's efforts will be strengthened by building a second icebreaker.

Business potential is a second pillar of the Arctic Master Plan. The Guggenheim Partners have been conducting initiatives in relation to Arctic infrastructure development based on the assumption that a large portion of container shipping will use Arctic routes by 2030. There are also USGS estimates of large recoverable reserves of fossil fuels in the Arctic. Sea routes and resource development will be important to the Arctic's future. The Republic of Korea believes the Arctic will become a new zone of prosperity.

While the Arctic Council has handled Arctic issues since 1996, The Republic of Korea thinks it is time for the council to reconsider its governance arrangements for the next 20 years as Arctic issues become increasingly global in character. The Arctic Council should be reformed

to include non-Arctic partners and acknowledge the global importance of the Arctic. Scientific research is the most promising area for cooperative dialogue. The non-Arctic states have both the capacity and the will to contribute to the sustainability of the Arctic. The Arctic states need to respond to these non-Arctic interests.

Russian Federation

Yury Sychev presents a brief perspective on Russia's Arctic policy, noting that he is not a politician and cannot present Russia's official policy. Russia begins from the premise that there are no problems that require military solutions in the Arctic. Current challenges can be resolved through communication and cooperation, and Russia expects this to continue to be the case. Russia has supported and will continue to support and participate in the Arctic Council, the Barents Euro-Arctic Council, and other regional cooperative bodies and fora that bring states with different interests together.

Russia will continue with its Arctic: A Territory of Dialogue conferences after a hiatus of three years. The next conference will take place in Spring 2017. The State Commission on the Arctic has tried to achieve a balance between regional and national authorities working on the Arctic since 2015. The commission has developed a new policy on the Northern Sea Route to be discussed during a later session of this conference.

Canada

David VanderZwagg provides a Canadian perspective on Arctic policy. He notes that he is not speaking on behalf of the Government of Canada. He describes Canada's current approach as "policy pieces" and provides a number of examples.

Canadian policy is contained in several sources and encompasses several key pieces. The 2009 *Northern Strategy* put forward by the Conservative Harper government is the primary piece at the moment. Many of the initiatives launched under that strategy are ongoing activities and have not been renounced by the new Trudeau Liberal government. This strategy has four major pillars, (i) sovereignty (vessels are being built; NORDREG has been instituted; Hans Island is being addressed; the Beaufort Sea boundary is being considered, (ii) Social and Economic development (CANNOR has

been created; a small craft harbor has been built in Pangnirtung), (iii) Arctic environmental heritage (Canadian High Arctic Research Station is being built; a national marine conservation area is being developed in Lancaster sound), (iv) Northern Governance (NWT devolution has been completed; the Arctic Council is a priority).

A second piece is Canada's Foreign Policy Statement (2010) which puts some glosses on past policies. For example, it outlines Canada's approach to continental shelf extensions in the Arctic. More recent pieces of the Canadian policy picture have been enunciated in the 2015 Trudeau-Obama joint Arctic policy statement on climate, energy and cooperation.

Mandate letters to ministers in the Trudeau government are also relevant to the Arctic. Efforts are being made to increase the number of marine protected areas in the Arctic. Canada is again engaged on climate change issues. There have been policy commitments on Arctic fisheries (e.g. agreement with the Inuvialuit on a moratorium on commercial fisheries in the Beaufort Sea until more science is done).

Two other ideas that describe Canada's Arctic policy are "policy perplexities" and "policy promises." One perplexing policy issue is the Northwest Passage. There are ambiguities regarding Canada's position on issues relating to the Northwest Passage. The passage is open to transits, but there is not a clear vision on infrastructure developments and regulations covering use of the passage. Recent suggestions about a possible deepwater port in Iqaluit and a shipping corridor initiative are still unfolding.

With respect to promises, Canada's Arctic strategy on the Coast Guard has not yet been released. Regulations to give effect to the Polar Code are under development, and the government has promised new initiatives dealing with indigenous peoples issues and health. Canada is making an effort to implement the UN Declaration on the Rights of Indigenous Peoples (UNDRIP). Canada's NDC under the Paris Agreement pledges a 30% reduction in emissions from 2005 levels by 2030. Prime Minister Trudeau is meeting with provincial leaders and hopes to have a more fully-developed Canadian position on climate change soon.

China

Yang Jian provides a perspective on China's Arctic policy. He notes that his is not an official government position, but rather a "Shanghai Perspective." He is hopeful that China will follow the lead of the Republic of Korea

and Japan in developing an Arctic policy. To some extent China's current policy is passive and reactive. Awareness in China on Arctic issues is based on discussions with diplomats from the Arctic nations. Scholars on international law, global governance and international relations and world economy are the main contributors from the academic world to the formation of China's Arctic policy. China is a neighbor of the Arctic and an important stakeholder in Arctic affairs. China tends to approach Arctic policy through issues like claims to extended continental shelves, sustainable use of resources and sea routes, and so on. More recently, climate change has also been on China's radar. China's economy is large and economic policy involves cautious approaches requiring lots of coordination with various departments. Drafting an official Arctic policy will take time. But it is likely to happen fairly soon. China's overall development policy affects issues of global governance. Key words are: respect (for the Arctic Council, sovereign rights, indigenous rights, international law, and so on); win-win; and sustainability. These were reflected in a speech made by Chinese Foreign minister Wang Yi at the 2015 Arctic Circle conference. China wants to make scientific contributions to Arctic knowledge through multilateral and bilateral cooperation.

China is a potential user of the Northern Sea Route and a consumer of Arctic resources such as fish, oil and gas. China also wants to participate in global governance to deal with climate change and to see sustainable development that promotes balanced social systems. China takes peace and stability as the key bases for Arctic governance and sustainable development. It believes international security can be advanced by dialogue to preserve peace in the Arctic.

Inuit Circumpolar Council

Okalik Eegeesiak presents Inuit perspectives on Arctic policies. She notes that Arctic developments impact everyone around the world and, conversely, the world affects the Arctic. ICC is an international organization within the UN and one of six Permanent Participants in the Arctic Council. ICC represents Inuit in four countries (Russia, USA, Canada, and Kingdom of Denmark) and has been a strong voice for Inuit for almost 40 years. Eegeesiak is the international president of ICC representing Inuit in each of the four Arctic states where Inuit reside.

Arctic peoples have possibilities to work with peoples and governments

in non-Arctic areas. Already most stakeholders realize that Permanent Participants are practical partners in their work. A collective mandate can be developed. There is no time for an "us vs. them" approach. There is a need to protect the Arctic as a global commons and to maintain the viability of Arctic communities. There is also a need to take a long-term view of the Arctic.

Inuit look back to the past to help inform their views of the future. Inuit have survived many challenges in the past and are a resilient people. They have unity across Inuit Nunaat. Acquisition of knowledge among Inuit has been based on millennia of observation, but now there is a need for a broad-based plan for development and growth to address planetary challenges and issues. Across states and even within states, each Inuit community is unique. So the challenges facing Inuit vary. Responding to these challenges requires creativity. Devolution of governance systems gives Inuit more control over their future. But there are still major capacity and resource needs.

The context for Arctic state and non-Arctic state policy statements has changed over the years. The United States has made Arctic commitments through the 2015 GLACIER conference and held an important White House science conference in fall 2016. Russia has released its Arctic 2020 policy. Most Arctic states have released Arctic policies and strategies in the past five years. This is also the case for many non-Arctic states.

As for Inuit, they need more say in the future of the Arctic to address their own needs and those of their children and grandchildren. Inuit need to be partners in many of these Arctic strategies being generated by Arctic and non-Arctic states because these policies and strategies describe intentions to make use of Arctic resources including human resources. Knowledge of the Arctic is required to implement Arctic policies. Investment in human resources is needed to support trade and economic development. International Arctic policies can be framed to advance domestic policies. The Arctic Council must be strengthened as a governance process with ICC and other Permanent Participants strengthened within it.

Canada has an historical roll in Arctic policy. Canada is working to implement land claims, advance traditional knowledge and develop renewable energy systems for the Arctic. These and many other issues are too big to be handled successfully without partnerships.

Open Discussion

Significant points articulated during the open discussion include:

- The Guggenheim Partners work on an Arctic Infrastructure Protocol suggests that $1 trillion of investment in infrastructure will be required in the Arctic over the next 15 years.
- There is an immediate need to invest in human resources not just natural resources.
- Traditional Knowledge holders in indigenous communities do not always have the means to cooperate in scientific exchanges.
- Science is important for understanding the implications of change to inform business decision-making.
- Not all infrastructure investments will bring a return on investment (e.g. a new water system for a community), so clarity is required on questions of infrastructure development.
- Investors need to understand the differences and the conditions presented by the Arctic.
- Japan will host a consultation to see if there are Arctic specific ideas or projects that could be developed with China and the Republic of Korea.
- The Arctic Council has carved out the Arctic as a place for cooperation and this makes a contribution to global stability.
- Some Pacific states are dissatisfied with Observer status and want to do more in the Arctic.
- Having observers at the Arctic Council table is an advantage but there is a need to work out the details of how observers will participate in meetings.
- The real value-added of Arctic Council meetings comes informally, on the margins of formal meetings over dinner, etc.
- There are some fundamental questions we do not understand about feedback loops in the Arctic (e.g. release of methane; ocean circulation patterns; heat exchange off Greenland).
- To foster cooperation on these big questions, diplomats need to address themselves to getting agreements and commitments to tackle such issues.
- The business and investment communities will need to be involved to tackle infrastructure and other big issues facing the Arctic.
- Some Arctic issues, such as climate change impacts, need to be seen as

global issues, not regional issues.

- Interconnections between the Arctic and the outside world are increasing; while most issues over the past 20 years could be handled in the Arctic, this is not the case now.

PART II: IMPLICATIONS OF THE PARIS AGREEMENT FOR THE ARCTIC

Taking the discussion in Part I as a point of departure, Part II directs attention to the implications of recent developments in climate policy for the Arctic. Daniel Reifsnyder initiates the discussion by observing:

- The changes that may be ushered in because of the Paris Agreement will be crucial to the Arctic, both in terms of coping with the impacts already being experienced and in averting the release of methane, currently locked in the permafrost, as a climate change multiplier.
- The future is in our hands, and it will be up to participants here in this room as well as millions of others across the globe to determine what will unfold and what kind of world we will leave to the future.

Five panelists then consider the impacts of the Paris Agreement on the Arctic from a range of perspectives. Julia Gourley, the U.S. Senior Arctic Official, presents an Arctic Council perspective. Sung Jin Kim, Former Minister of Maritime Affairs and Fisheries of the Republic of Korea, provides a non-Arctic State perspective. Lars-Otto Reiersen, Executive Secretary of the Arctic Monitoring and Assessment Programme (AMAP), outlines the perspective of an Arctic Council Working Group. Okalik Eegeesiak, President of the Inuit Circumpolar Council (ICC), offers an Arctic community perspective. James Gamble, Executive Director of the Aleut International Association(AIA), provides an Arctic Council Permanent Participant perspective.

Major Observations

Several major observations arose from these presentations. The Paris Agreement represents a major step forward. For the first time, most of the world's countries have joined together to forge an agreement that contains serious commitments to address the problem of climate change. It also

includes mechanisms for assessing progress over time and strengthening or ratcheting up commitments in a timely manner. Nevertheless, it was pointed out that there is no basis for celebration from the perspective of the Arctic for several reasons:

1. The impacts of climate change on the Arctic exceed those globally and are accelerating. The impacts of climate change are already severe and will become more severe during the foreseeable future. The reduction in snow cover is as dramatic as the loss of sea ice. Ocean acidification is a growing threat. Greenland is the sleeping giant in the system. There is a need to harvest carbon from the atmosphere rather than simply reducing emissions.
2. The people of the Arctic are particularly affected. The people of the Arctic must live with the reality of climate change as well as a variety of other major problems involving issues of health, education, and welfare. The combined effects of these forces constitute a serious threat to Arctic communities, particularly communities in which a high proportion of residents are indigenous.
3. Arctic communities are particularly hard hit because they are located in advanced industrial societies and therefore are not eligible for sources of assistance available to developing countries.

The ensuing discussion emphasized that a broad range of Arctic actors are taking active steps to address climate change on a number of levels. The Arctic Council is an active player. The council is taking steps to support the Paris Agreement through measures emphasizing resilience as well as adaptation. An Arctic Resilience Action Framework is under consideration. There is discussion of developing an Arctic Council strategic plan driven by the issue of climate change. Arctic Council-associated entities are also active. The Arctic Coast Guard Forum and the Arctic Regulators Council, for example, are focusing on issues pertaining to climate change, especially those related to the Paris Agreements. Indigenous peoples organizations are particularly concerned and active. These organizations are working on these issues from the ground up.

Additional Themes

A number of additional themes emerged during the discussion. We need

a new understanding of the co-production of knowledge and especially recognition that indigenous knowledge is a distinct and valuable type of knowledge rather than simply an adjunct to western science. We need to improve the connections among regional bodies, such as the Arctic Council, and global mechanisms, such as the multilateral environmental agreements and international organizations like the IMO. Climate change is a crosscutting issue that requires integration across a range of sectors. Transcending the stovepipes of distinct agencies is hard under any circumstances, and all the more so when it involves a number of different countries. But it is critical to find ways to bring these different players together in order to solve a problem as complex as climate change. The Paris Agreement does not deal with some major issues (e.g. black carbon emissions from commercial ships and aircraft) that are important in the Arctic. Dealing with these issues should be a priority going forward.

The success of the Paris Agreement will depend on a number of factors that together provide the basis for a "UPA strategy":

- A robust *understanding* of and insight regarding the central challenges of change.
- A set of *planning* strategies, implementation plans and venues.
- A set of realistic and properly supported *actions*.

We have done well at understanding and are making real progress in the area of planning. But the critical challenge during the next stage will be to translate these advances into action, with a particular focus on more fully engaging the world's financial capacities to deal with climate change and to make a strong commitment to bring these resources to bear on the problem.

PART III: THE FUTURE OF THE ARCTIC OCEAN

Part III seeks to identify emerging human activities in the Arctic Ocean over the medium to long term (out to 2040 and beyond) and then to ask about issues pertaining to regulation, administration, and the welfare of coastal communities associated with these developments. Activities covered include: fisheries; shipping both along the NSR and using the Transpolar Route; and ship-based tourism. Issues relating to these developments

concern: (i) regulatory measures needed to address needs for governance, (ii) organizational/infrastructure arrangements needed to provide services, implement regulations and ensure compliance, and (iii) initiatives designed to ensure that coastal communities benefit from these developments rather than experiencing harmful effects.

Major Trends and Policy-Relevant Issues

Several participants characterize major trends in human activities pertaining to the Arctic Ocean. Alf Håkon Hoel explains that Arctic and subarctic fisheries are currently among the largest in the world. These fisheries are better managed today than they were in 1991. But we can expect significant changes by 2040, including fishing in new areas, more concern about food security, increases in aquaculture, more interest in marine genetic resources, new fishing technologies, and a focus on the shelves rather than the deep water of the Central Arctic Ocean.

Scott Stephenson emphasizes that the picture regarding future uses of the Transpolar Route for shipping remains unclear. There is much variation among models regarding the feasibility of central Arctic shipping. While the use of the Transpolar Route may be feasible technologically, at least in the summer, the economics of the route may be unfavorable. What is most likely is a gradual shifting of shipping routes to the north away from the coast of Russia.

As Yury Sychev notes, on the other hand, Russia expects a major increase in the use of the Northern Sea Route, especially to move cargo to and from Russian ports. Russia is undertaking large-scale developments in infrastructure, including ports, icebreakers, and railroads to serve economic development of the Russian North. There is less optimism, however, regarding through or transit traffic along the NSR.

In assessing the future of ship-based tourism, Peter Ortner explains that there is a fundamental difference between expeditionary cruise vessels and larger conventional cruise ships. Limits on growth in this realm include: lack of shoreside infrastructure, data gaps, SAR facilities, risk management, and regulatory support. There may be a 20-30% growth over the next five years and up to 50% growth over 20 years.

Developments in these areas are likely to raise a number of policy relevant concerns. David VanderZwaag discusses regulatory matters, including the question of whether any fisheries should be allowed in

the Central Arctic Ocean, the prospect of the development of a broader UNCLOS Implementing Agreement on Biodiversity Beyond National Jurisdiction, vessel routing schemes for ships, and issues relating to marine protected areas, such as possible PSSAs or EBSAs.

Kathleen Duignan, a captain in the U.S. Coast Guard takes up practical matters, including preparing for emergencies and developing dependable infrastructure. The U.S. Coast Guard is developing a strategy to deal with these issues, and the efforts of the Arctic Coast Guard Forum seem promising on a larger scale.

Denise Michels, a former mayor of Nome, Alaska, observes that local communities face opportunities as well as challenges in the face of these developments. Food security and the onset of climate change are major concerns. Practical problems include the need for better subsistence harvest mapping, the prevention of spills in the Bering Strait region, and the development of new techniques like "geo-fencing" to protect wildlife of interest to subsistence users.

Discussion among the panelists turned up several important observations:

1. Developments in the areas of fishing, shipping, and tourism may interact with one another. It will be important to look for synergies in this realm as well as to solve tensions among these activities. For example, there may be opportunities to develop infrastructure that is useful at one and the same time across all of these areas.
2. The use of strategically designed marine protected areas may help to avoid serious environmental impacts arising from resource development. But it is important to be clear on the purposes of MPAs and to recognize that there are many types of protected areas.
3. Infrastructure is a central concern. The contrast between the large-scale development of infrastructure in Russia and the more modest developments in the western Arctic is striking. Achieving the proper balance between the private sector and the public sector in the development of infrastructure is a challenge.
4. It is important to take note of global initiatives that could have a major impact on activities in the Arctic Ocean. One prominent example is the prospect of reaching agreement on the terms of an Implementing Agreement on Biodiversity beyond National Jurisdiction under UNCLOS.

General Discussion

A number of additional issues emerged in the course of the general discussion. We should be thinking not only about shipping but also more broadly about marine operations. The real issues lie in addressing the broader problems of marine operations beyond ships per se. Regarding infrastructure, there may be opportunities to involve local actors, to provide training for first responders, and to achieve a lot with a modest investment of resources. Exercises like the 2016 Arctic Chinook exercise dealing with SAR can be helpful. With regard to projections of the future of shipping, much depends on the choice of scenarios concerning matters like sea ice.

The impacts of large numbers of tourists descending on small Arctic communities constitute a serious concern but there are limits to the growth in numbers of tourists. There are opportunities for improving the integration of western knowledge and indigenous knowledge in addressing issues in this realm. One interesting option would be to run intensive exercises or workshops designed to focus on specific challenges in this realm. Finally, we must not ignore the danger of serious accidents in the Arctic Ocean and the human costs of such events. One participant recalled the problems arising from the sinking in 1989 of the *Bahia Paraiso* near Palmer Station in Antarctica. Something like this on a larger scale could occur in the Arctic.

PART IV: ARCTIC NATURAL GAS IN A GLOBAL CONTEXT

Part IV directs attention to energy development and specifically to the role of Arctic natural gas out to 2040. Arctic gas is expensive to extract. This raises serious questions regarding the profitability of Arctic gas, given the recent collapse of world market prices for energy and the prospect that low prices may continue into the future, resulting from the emergence of new supply sources at the same time as increasing efforts are made to reduce dependence on fossil fuels to combat climate change. However, Arctic deposits of natural gas are large; they are politically and economically important, especially for Russia whose economy is heavily dependent on the production and sale of hydrocarbons. They are also of potential significance to countries like China, Japan, and Korea interested in diversifying their

sources of imported fuels.

Seven experts present perspectives in Part IV relating to Arctic gas development through 2040, with particular reference to developments in international climate policies, the global energy supply-demand picture, technological innovations, and trilateral relations among China, Russia, and the United States. David Pumphrey speaks of the role of natural gas as a transition fuel to a low carbon future. Tomoko Hosoe addresses the impact of the Paris Agreement on the mix of fuels used by Japan in power generation. Yong Hun Jung discusses a similar set of questions pertaining to the fuel mix of the Republic of Korea. Keun Wook Paik adopts a broader perspective in asking about the possible role of the Arctic as one of the future global natural gas supply hubs.

Mark Myers turns to technological innovation and infrastructure development as determinants of the future course of hydrocarbon development in the Arctic. Tatiana Mitrova emphasizes the importance of long-term price projections as determinants of the prospects for the development of large gas reserves in the Arctic. Yang Jian then brings in considerations of political economy in analyzing the role of natural gas as a factor affecting the broader course of relations between China and Russia.

Taken together, these perspectives highlight seven factors influencing the prospects for Arctic gas development ranging from technological innovations to global markets and the choices of individual countries regarding their fuel mixes.

Technological Innovation

Arctic oil and gas development increases the risk of a serious oil spill into the Arctic marine environment due to the growth of ship traffic, more offshore wells, and additional coastline facilities such as fuel storage tanks. This requires that a complete oil spill toolbox be readily available for early response. Continued research is important in understanding and characterizing the long-term potential of methane hydrates in the Arctic. Arctic sandstone reservoirs hold the most promise for near-term recovery of natural gas from methane hydrates; portions of these reservoirs are located onshore within range of existing oil and natural gas production infrastructure.

China-Russia Relations

China and Russia are developing closer economic ties with energy as a central element. However, China will want to avoid alienating western countries. China does not want to form blocs or military alliances. Russia-China energy cooperation faces three big challenges: agreement on pricing; mutual understanding of policies; culture and business; and western sanctions. China has an interest in Russia's Arctic oil and gas as well as the Northern Sea Route because it offers diversification of energy supplies. This is the main reason why China has taken a strong interest in development of the Yamal LNG project.

Russia's Priorities and Constraints

Despite a lower price environment, Arctic gas development remains quite promising over the longer term, because gas use is growing in all global scenarios. There is, however, a huge difference in the economics of Arctic offshore development and onshore projects (e.g. Yamal). Onshore production in Northwest Siberia (Nadym-Pur-Taz and Yamal peninsula) is commercially viable, with low costs of production ($0.3-1/Mbtu) and the use of predominantly Russian technologies. The transportation infrastructure is already in place. There is no doubt that gas production in this area will continue in any projected price environment.

Low prices and a new geopolitical environment, however, will have major impacts on offshore developments in the Barents Sea, the Kara Sea, and Ob-Taz Bay. The new Arctic offshore projects in these areas are associated with high costs of production (above $3/Mbtu), uncertainties, and technological, economic and environmental risks. In the current geopolitical climate, the future involvement of international majors in the Russian Arctic is becoming increasingly uncertain. At present, transfer of all technologies for Arctic offshore drilling and production are under sanctions by the United States and the European Union. Attracting international financing for these projects is difficult, while the Russian domestic financial market as well as investment possibilities of Russian companies are limited. China's financial commitment to the Yamal LNG project is a turning point in Arctic gas development.

International Climate Policies

The policies countries adopt to confront climate change will have a major impact on the demand for natural gas. Less stringent polices, like those represented by current NDCs under the Paris Agreement, are not likely to accelerate demand for natural gas. Current commitments will not reach the 2°C target. As carbon policies become more stringent, however, natural gas is expected to play a larger role in the power sector. The Paris Agreement, which implies a continuous strengthening of commitments, will require massive changes in the energy sector, particularly the power sector. NDCs under the Paris Agreement will be politically and commercially difficult to fulfill. Maintaining acceptable prices for energy is a key to economic growth, seen by governments in many developing countries as more important than reduction of GHG emissions. Should climate policies become an important issue in trade negotiations, however, it could push governments and industries to take serious measures.

Fuel Choice for Power Generation

The electric power sector is viewed as the most critical part of the overall energy system in the context of actions to address greenhouse emissions. Consumption of various fuels used to produce electric power has been growing rapidly as economies are becoming increasingly electrified. Electric power generation represents about 40% of all energy consumed in the global economy. The electric power sector has the broadest range of options to produce power from both fossil energy and "clean" fuels such as nuclear, hydropower, and renewables, such as wind and solar.

Fuel choice for power generation is driven by relative costs for plant, fuel, efficiency, utilization rates, and location. In the United States, natural gas has moved quickly to overtake coal as the leading base-load fuel in power generation, thereby becoming a major factor in regulating GHG emissions. According to EIA's cost of energy estimates, natural gas shows a cost advantage over nuclear and coal in electric power generation, but wind power is at similar cost level. Lowered costs for renewables and increasing utilization rates have improved their competitiveness.

Rapid increases in U.S. production of shale gas led to a discussion of whether gas could be a bridge fuel on the way to decarbonization. Natural gas has about half the carbon intensity of coal and one-third of oil. Gas

combined cycle technology is more efficient than coal – even advanced coal technologies. However, if the world envisages radical decarbonization in the longer term, consumption of natural gas also will have to be curtailed at that point. This could mean that long term investments securing natural gas as a bridging fuel in the medium term will not be forthcoming. To solve this paradox some sort of support or 'insurance' scheme may have to be developed to prevent gas investments from drying up.

Global Gas Supplies

For Arctic natural gas development to become attractive, an increase in demand due to greater use of natural gas to meet climate commitments is not a sufficient factor. A price of natural gas high enough to make the Arctic attractive for long-term investment will likely exceed the price that will support a natural gas bridge. Only a limited number of Arctic LNG projects serving established natural gas production bases are likely to become a reality. But all the major Northeast Asian countries will be big consumers of gas. In particular, China's environmental policies will drive gas demand and contribute to global LNG production. China, Korea and Japan may share an interest in forming an alliance of "gas consumers to coordinate LNG purchases and facilitate lower cost investment in LNG projects. A gas-purchasing consortium could provide negotiating weight in contracts with suppliers and thus lower LNG prices. The three Northeast Asian countries could use government financing institutions and sovereign wealth funds to provide financing for LNG hubs in the Arctic to increase supply. In the meantime, supplies from other regions are likely to increase, including the U.S. (LNG via the Panama Canal), East Africa and Iran. In this context, LNG supplies from Arctic areas will help to make the prospect of LNG as a global commodity more realistic.

Energy Policies of Major LNG Importers

The Chinese government sees increased use of gas in power generation, alongside greater use of nuclear power and renewables, as one of the key ways to reduce carbon emissions and improve the country's environment. In April 2016, the National Development and Reform Commission and the National Energy Administration announced new measures that would halt the planned construction of about 200 new coal-fired power plants in

China.

China, by far the world's biggest emitter of greenhouse gasses, is aiming to reach a peak in carbon emissions by 2030 or before. China's gas-fired power capacity accounted for 4.4% of the country's total generating capacity in 2015. According to the National Energy Administration, it is likely to reach 5.1% by 2020 and 6.3% by 2030 (200 GW). All China's gas is supplied at present by the three big Chinese oil companies—PetroChina, Sinopec and CNOOC. For the future, power generators will be allowed to import LNG directly from abroad.

The highlight of Japan's current power generation mix target for 2030 is that nuclear energy remains a factor in base-load capacity, accounting for 20-22%. Coal is also regarded as a base-load fuel, thanks to the low cost of using it as well as lack of geopolitical supply concerns. Nevertheless, due to persistent environmental opposition to coal-fired power generation, METI supports use of LNG as a fuel for Japan's base-load power generation. There is also some uncertainty over the scope for nuclear in base-load power generation because of market deregulation.

In Korea, nuclear power generation has become politically unpopular. If the planned nuclear program is either revised downward or cancelled totally, demand for fossil energy will inevitably increase to meet the growth in electricity consumption. Korea is a small country and more than 70% of the land is rugged terrain. It lacks not only fossil fuel resources, but also renewable resources such as good quality wind and sunlight. If Korea acts to reduce GHGs to the level pledged in its NDC, switching to natural gas from oil and coal appears most suitable, as it is economically viable and publicly acceptable since Korea already owns relevant technologies and experience to expand natural gas consumption. So far, however, maintaining acceptable prices for energy is of key importance to the industrial sector and more important for the government than reduction of GHG's.

CONCLUSION: METHODS FOR ANALYZING ARCTIC FUTURES

In envisioning Arctic futures, NPAC 2016 included a facilitated discussion focused on the *Future of Arctic Marine Infrastructure*. The discussion explored a broad set of maritime issues: ports, charting and hydrography, aids to navigation, search and rescue (SAR) capacity, environmental

response capacity, icebreaking, salvage, pilotage, ice information systems, environmental monitoring and observing, marine domain awareness (ship traffic surveillance), shipyards and repair facilities, communication systems, routing schemes, and more. Marine infrastructure is seen as a key priority for future safe, environmentally sound, and efficient uses of the Arctic Ocean, which are closely linked to the sustainable development of the Arctic's natural wealth. Linkages between Arctic marine operations and shipping and similar activities in the North Pacific and North Atlantic regions are also expected to draw investments essential to an expanded Arctic marine infrastructure that will enable and stimulate the connections of trade within the Arctic to the broader set of outside global markets.

The facilitated discussion employed a scenario planning process with an emphasis on identifying drivers or significant factors that will influence the future of Arctic marine infrastructure. As the U.S. National Climate Assessment noted in its 2014 report:

> "Scenarios are important tools that help with analysis of climate drivers and the effects of management and policy decisions. They provide the scientific research and assessment communities with the capability to:
>
> 1. Evaluate the governing conditions (such as timing and rates of change in concentration of greenhouse gases and aerosols) in the atmosphere that might unfold under specific socioeconomic conditions and technological and environmental options;
> 2. Assess the natural response of the Earth system and the potential impacts and consequences of a range of future climates; and
> 3. Evaluate the implications of different approaches to mitigation and adaptation."

Stakeholders whose interests are affected and scientists with the expertise to identify the drivers provide the foundation for a scenario-building effort to enable assessments at regional to more local scales on timeframes of relevance to policy-making.

In the NPAC 2016 exercise, participants identified a diverse set of key drivers that would underpin the development of scenarios dealing with the *Future of Arctic Marine Infrastructure*. The session highlighted the complexity and range of drivers of change (social-indigenous, economic, political, environmental, and technological) that are likely to impact the

future of the Arctic and the needs for maritime infrastructure. The NPAC planning exercise focused on the initial phase of scenario development, a brainstorming session that generated ideas to serve as a basis for developing a set of plausible scenarios.

During the brainstorming session, participants identified 75 drivers of change that could affect the future of Arctic marine infrastructure, from which a consolidated set of nine key drivers emerged. The numbers in the following list are the number of participants in a voting session who thought that this driver was among the most import:

1. Financial Challenges (Combined votes 48)
2. Geopolitics and Sovereignty (33)
3. Rising Indigenous Voices and Needs (32)
4. Governance (32)
5. Market Forces (31)
6. Regulatory Environment (27)
7. Climate Change (25)
8. Redefining Regional Arctic International Community (25)
9. Environment (20)

The next step in a scenarios process is to use the key drivers as axes of variance in four-quadrant matrixes. For example, during the development of the Arctic Marine Shipping Assessment,[3] an exercise similar to the one used in this session identified a set of drivers that resulted in a *Four-Quad Scenario* (high demand and unstable governance, high demand and stable governance, low demand and unstable governance, low demand and stable governance) where two drivers were the critical elements of the scenarios:

Governance: Depicts the range of levels of relative stability of rules for marine use both within the Arctic and internationally. Less stability implies shortfalls in transparency and a rules-based structure, and an atmosphere where actors and stakeholders tend to work on a unilateral basis. More stability implies a stable, efficiently operating system of legal and regulatory structures, and an atmosphere of international collaboration.

Resources and Trade: Depicts the range of levels of demand for Arctic natural resources and trade. This axis exposes the scenarios to a broad range of potential market developments, such as the rise of Asia or regional political instabilities. More demand implies higher demand from more players and markets around the world for Arctic resources, including

increased access for trade in the Arctic Ocean. Less demand implies fewer players interested in fewer resources.

To obtain a set of plausible scenarios, a description and detailed analysis is developed for each of the four quadrants.

Scenario planning has become a major strategic tool for exploring many environmental issues, from the IPCC to national climate and environmental change issues. Scenarios are plausible sets of future conditions that are relevant in a particular analysis of the future. These scenario planning efforts are likely to be important to the future of NPAC activities, hence building on the 2016 NPAC facilitated discussion and other scenario planning strategies will be a foundation for NPAC in 2017 and beyond.

Over the next three years, NPAC should develop the overarching theme of "*Building Capacities for a Sustainable Arctic*" and focus on topics such as:

- Sustainable Arctic marine operations and supporting infrastructure.
- Engaging the next generation of leaders for the future of the Arctic.
- Sustainable communities in ice-free coastal regions.
- The Arctic region as a global partner in sustainable futures.

In this connection, NPAC should move from a "*Supply Strategy*" (i.e., providing insights, new knowledge and strategies arising from the work of the science and expert communities) to a "*Demand Strategy*" where future NPAC initiatives reach out and engage those affected by change who understand the challenges and opportunities and who are partners across a cascade that moves from:

1. Enhanced and deeper *Understanding* to;
2. Strategic and user-oriented *Planning;* and finally, to
3. *Actions* that adapt to and address causalities of change and provide pathways to a more sustainable future for the Arctic region and beyond.

The programs for 2017 and beyond will build on NPAC's past accomplishments and engage these framing concepts to: *Build Enhanced Capacities for a Sustainable Arctic through Improved Science-Policy Engagement.*

Notes

1. Many of the following points are based on Session Chairs' Reports from the 2015 North Pacific Arctic Conference prepared by Charles Morrison, Robert W. Corell, Oran Young, Yoon H. Kim, Bernard Funston, David VanderZwaag, and Arild Moe.
2. As of February 2017, 129 countries have signed on as Parties to the agreement, including seven of the eight Arctic Council members.
3. http://www.pame.is/index.php/projects/arctic-marine-shipping/amsa

PART I

ARCTIC POLICIES IN A GLOBAL CONTEXT

2. U.S. Climate Policy in an Arctic Context

Daniel A. Reifsnyder

Dr. Daniel A. Reifsnyder set the stage for the session, where he noted that the U.S. interests in the Arctic region are set forth in the *National Strategy for the Arctic Region*,[1] issued by the U.S. president in the policy of May 10, 2013, which states the United States Government's strategic priorities for the Arctic region, are: "*The United States is an Arctic Nation with broad and fundamental interests in the Arctic Region, where we seek to meet our national security needs, protect the environment, responsibly manage resources, account for indigenous communities, support scientific research, and strengthen international cooperation on a wide range of issues.*"

Based on this foundation of U.S. interests and his experience as co-chair of the UNFCCC ADP,[2] along with the other co-chair, Ambassador Ahmed Djoghlaf from Algeria, Reifsnyder led the development of what became known as the UNFCCC COP21 "Paris Agreement.[3]" He then focused much of his remarks on the foundations and negotiations that led to the Paris Agreement.[4] He noted that the changes that may be ushered in because of the Paris Agreement will be crucial to the Arctic, both in terms of coping with the impacts already being experienced and in averting the release of the climate change multiplier (such as methane), much of which is currently locked in the permafrost. He posited that the "*future is in our hands and it will be up to participants here at this NPAC 2016 conference, as well as millions of others across the globe, to determine what will unfold and what kind of world we will leave to the future.*"

He then outlined in some detail the elements and framework of the Paris Agreement and its central aim: "*to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C.*" To reach such ambitious goals, there will be a need for adequate financial flows, new technology implementations and an enhanced capacity to mitigate, as well as adapt to change. Additionally, the Agreement aims to strengthen the ability of countries to deal with the impacts of climate change, including supporting actions by developing countries, that also enables vulnerable

countries to address their needs. Finally, the Paris Agreement also provides for enhanced transparency of actions though a more robust global transparency framework.

His presentation outlined some of the key features of the *Paris Agreement:*

1. Nationally Determined Contributions (NDCs)[5]:

- All Parties are to prepare successive Nationally Determined Contributions (NDCs), representing a progression beyond the last and reflecting its highest possible ambition.
- Developed countries should undertake economy-wide absolute emission reduction targets; developing countries should continue enhancing mitigation efforts and are encouraged to move over time to economy-wide emission reduction or limitation targets in light of different national circumstances.

2. Periodicity of NDCs/Communications:

- Each Party shall communicate an NDC every five years.
- CMA first session to consider common time frames for NDCs.
- First NDC due on ratification/accession, but if a Party has communicated an intended NDC, this requirement is satisfied.
- Parties with INDCs containing a time frame up to 2025 are urged to communicate a new NDC by 2020 and thereafter every five years.
- Parties with INDCs containing a time frame up to 2030 are requested to communicate or update by 2020 these contributions and do so thereafter every five years.

3. Global Stock Take (GST):

- CMA[6] shall periodically take stock of Paris Agreement implementation to assess collective progress toward achieving its purpose and long-term goals.
- GST to be done in comprehensive, facilitative manner and consider mitigation, adaptation and means of implementation and support in light of equity and the best available science.
- First GST in 2023 and every five years thereafter.
- Outcome of GST shall inform Parties in updating and enhancing, in a nationally determined manner, their actions and support as well as in enhancing international cooperation for climate action.

4. Purpose:

- The Paris Agreement aims to strengthen global response to climate change by holding global average temperature increase to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels.
- Also, aims to increase ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development.
- Aims to make finance flows consistent with a pathway toward low greenhouse gas emissions and climate resilient development.
- Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities in light of different national circumstances.

5. Global Peaking and Long-Term Strategies:

- Parties aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a balance between human emissions by sources and removals by sinks in the second half of this century.
- Each Party shall strive to formulate and communicate long-term low greenhouse gas emission development strategies.
- Parties invited to communicate by 2020 mid-century, long-term low greenhouse gas emissions development strategies for publication on the UNFCCC website.
- COP to convene facilitative dialogue among Parties in 2018 to take stock of Parties collective efforts re: peaking and achieving balance between emissions and removals to inform preparation of NDCs.

6. Finance:

- Developed countries to provide financial resources to developing countries to assist them with mitigation and adaptation.
- Provision of scaled-up financial resources should aim to achieve a balance between adaptation and mitigation.
- Developed countries shall communicate biennially indicative quantitative and qualitative information on finance, including projected levels of public finance to be provided to developing countries. Other Parties providing resources are encouraged to communicate biennially such information on a voluntary basis.
- Developed countries intend to continue their existing collective

mobilization goal through 2025 in the context of meaningful mitigation actions and transparency on implementation; prior to 2025 the CMA shall set a new collective quantified goal from a floor of $100 billion per year.

His Presentation then Asked the Question: What's Next for the Paris Agreement?

1. **Initially What's Next:**
   - Entry into Force 30 days after 55 Parties to UNFCCC accounting for 55 percent of total global greenhouse gas emissions ratify.
   - As of July 25, 178 Parties had signed; 20 Parties representing 0.40 percent of total global greenhouse gas emissions have ratified.
   - UN Secretary General Ban Ki-moon invited world leaders to ratify at a special event on September 21, 2016.
   - He then suggested that entry into force likely this year.
   - Editor's note: On 5 October 2016, the threshold for entry into force of the Paris Agreement was achieved. Hence, the Paris Agreement entered into force on 4 November 2016.
   - He then suggested that entry into force likely this year.

   (Editor's note: On 5 October 2016, the threshold for entry into force of the Paris Agreement was achieved. Hence, the Paris Agreement entered into force on 4 November 2016.)

2. **What are Some of the Implications of "What's Next for the Paris Agreement?"**
   - Actions of nations and citizens will determine whether goals of the Paris Agreement will be achieved.
   - One of the most important and significant actions they can take in the near term is to adopt an amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer in Kigali, Uganda, in October 2016 to phase down HFCs (hydrofluorocarbons), he noted that it is believed that this action alone could avoid as much as 0.5°C of warming by 2100. (Editor's note: 140 countries that are Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer adopted, on October 15, 2016,[7] a landmark Agreement, called the Kigali Amendment,[8] that provided for a phase down in the consumption and production of

hydrofluorocarbons (HFCs), which are powerful climate-warming pollutants, but did so under the Montreal Protocol, which also addresses climate change issues.)

- The Climate and Clean Air Coalition (CCAC),[9] initiated in February 2012, is also working on the so-called "short-lived climate forcers," such as methane, black carbon & HFCs.

3. **He Noted that Two Events Are on the Horizon that Bear on the Arctic:**
   - The Third Our Ocean Conference[10] that Secretary Kerry will host in Washington, D.C. from September 15-16, 2016; and
   - The first ever White House Arctic Science Ministerial,[11] which is designed to be hosted at the White House in Washington just one year after President Obama's historic trip to Alaska.

   (Editor's Note)
   - Science Ministers from 25 governments and the European Union met at the White House to discuss Arctic research priorities and signed a Joint Statement[12] on increased international collaboration on Arctic science and inclusion of Indigenous peoples in understanding and responding to changes in the Arctic.
   - After the ministerial meeting, the U.S. issued a Fact Sheet[13] that summarized the accomplishments of the Arctic Science Ministerial to advance international research efforts in four thematic areas:
     - Theme I: Arctic Science Challenges and Their Regional and Global Consequences.
     - Theme II: Strengthening and Integrating Arctic Observations and Data-Sharing.
     - Theme III: Applying Expanded Scientific Understanding of the Arctic to Build Regional Resilience and to Shape Global Responses.
     - Theme IV: Empowering Citizens through Science Technology, Engineering, and Mathematics (STEM) Education Leveraging Arctic Science.

In Summary: The results of the Paris Agreement and other developments that were discussed, bear importantly on implications, challenges, and opportunities that climate and other socio-economic changes present for the Arctic.

Notes

1. https://www.whitehouse.gov/sites/default/files/docs/nat_arctic_strategy.pdf
2. The UNFCCC Ad Hoc Working Group on the Durban Platform for Enhanced Action that lead the negotiations that created the so-called "Paris Agreement" on climate change.
3. http://unfccc.int/paris_agreement/items/9485.php
4. On 5 October 2016, the threshold for entry into force of the Paris Agreement was achieved. The Paris Agreement entered into force on 4 November 2016.
5. http://unfccc.int/focus/indc_portal/items/8766.php
6. Meeting of the Parties
7. https://treaties.un.org/doc/Publication/CN/2016/CN.872.2016-Eng.pdf
8. https://www.nrdc.org/experts/david-doniger/countries-adopt-kigali-amendment-phase-down-hfcs
9. http://www.ccacoalition.org/en
10. The conference focused on the key ocean issues of our time, including marine protected areas, sustainable fisheries, marine pollution, and climate-related impacts on the ocean. http://www.state.gov/e/oes/ocns/opa/ourocean/2016/
11. On September 28, 2016, science ministers from across the globe gathered in Washington, D.C., for the first-ever White House Arctic Science Ministerial.
12. https://www.whitehouse.gov/the-press-office/2016/09/28/joint-statement-ministers
13. https://www.whitehouse.gov/the-press-office/2016/09/28/fact-sheet-united-states-hosts-first-ever-arctic-science-ministerial

Japan's Arctic Policy

Kazuko Shiraishi

Let me start by expressing my sincere appreciation to the East-West Center and the Korean Maritime Institute for hosting this North Pacific Arctic Conference. It is truly an honor for me to be able to participate at the East-West Center's important gathering and of course, truly a joy to be able to come to the Aloha State.

When I received an invitation to this conference, I was very much looking forward to spending relaxing time on beach in a stylish swimsuit. But on receiving the program I recognized it had been an exaggerated expectation.

The East-West Center, as President Charles Morrison said in his introduction, has made tremendous contributions towards promoting better relations and understanding among people of the United States, Asia, and the Pacific. Japan has a long history of cooperation with the Center through various projects, such as the Pacific Islands Development Program (PIDP) and the Northeast Asia Forum. I am excited that we can now add the Arctic to our long list of cooperative efforts.

ARCTIC AND JAPAN

Today, I would like to take this opportunity to give you the overview of Japan's policy towards the Arctic.

Let me begin by showing you a map. Its center, as you can see, is the North Pole. It may surprise you all, but Japan is located fairly close to the Arctic region geographically. A sailor navigating through the Arctic Sea Route from the west will come upon Japan soon after passing the Bering Strait. Although Japan is not an Arctic state, we see ourselves as a neighbor of the Arctic region. So the question emerges: Is Japan interested in the Arctic region solely because of its location? My answer is partly "yes" but partly "no." This answer begins with the fact that a changing Arctic brings both opportunities and challenges for Japan.

The changing Arctic also presents urgent challenges for the international community. Challenges related to climate change in the Arctic in particular are extremely serious, since they could affect not only the

Arctic region, but also the entire global environment.

JAPAN'S ARCTIC POLICY

Based upon this recognition, Prime Minister Shinzo Abe adopted our first comprehensive and strategic Arctic policy, "Japan's Arctic Policy," last October. This policy demonstrates our firm commitment to addressing Arctic issues.

Japan's Arctic Policy aims at taking strategic actions regarding the Arctic from multiple and interconnected perspectives. Through these actions, Japan seeks to contribute to the international community as a major player in addressing Arctic issues.

Taking these objectives into account, Japan defines seven basic policies as follows:

(1) Science and Technology—Make full use of Japan's strength in science and technology with a global perspective.
(2) Environment—Give full consideration to the Arctic environment and ecosystem, which is vulnerable and not very resilient to change.
(3) International cooperation—Ensure the rule of law and promote international cooperation in a peaceful and orderly manner.
(4) Indigenous People—Respect the right of Indigenous People to maintain continuity in their traditional economic and social foundations.
(5) National security—Pay full attention to the national security implications of Arctic activities.
(6) Economic and social compatibility—Aim for economic and social compatibility with climate and environmental changes.
(7) Arctic Sea Route and development of resources—Seek potential economic opportunities to use the Arctic Sea Route for resource development.

Based on these priorities, Japan has proposed three specific initiatives to achieve these goals.

The first initiative is research and development. While Arctic climate change has become a focal issue globally, many unknowns remain. The most important need is to understand ecological changes in the Arctic

and calculate their impact on the global environment. Japan will further strengthen its science and technology in this area.

The second initiative is international cooperation. Japan has various interests that dovetail in the Arctic. Japan engages in constructive discussions such as international decision-making and rulemaking on the Arctic, particularly by sharing its scientific expertise. Moreover, Japan further strengthens its contribution to the Arctic Council by dispatching more experts for further study.

Sustainable use of the Arctic is the third initiative. In order to prepare for utilization of the Arctic Sea Route, Japan calls for the establishment of a maritime navigation system to help ships to travel through the Arctic safely. Japan also is taking actions to enhance its economic activities in the Arctic, especially in the exploitation of natural resources, fisheries, and other marine resources, by working with other countries to create a framework for preservation and sustainable use.

MAKING BEST USE OF JAPAN'S STRENGTHS

Japan regards science and technology as our priority. Having spearheaded international efforts in this area, Japan has accumulated scientific expertise through more than 50 years of observation and research on the Arctic, both abroad and at home. We celebrated the 25th anniversary of the establishment of the Ny-Ålesund Observation base in Norway this past September. The fruits of this endeavor include Japan providing the international community with scientific analysis on ongoing environmental changes in the Arctic, such as declining thickness and density of sea-ice and increasing ocean acidification.

Last year, as a further step forward, Japan launched a new research project of an unprecedented scale: the "Arctic Challenge for Sustainability" project, or ArCS. This is a five-year project, for which Japan is allocating $6 million in FY 2015, and more than $6.8 million in FY 2016.

ArCS has three aims: to understand climate change in the Arctic holistically as well as its global impact in various fields through comprehensive and integrated research; to predict future changes and assess their potential socio-economic impacts; and to deliver robust scientific information to stakeholders and policymakers, including those in the Arctic Council, to use in decision-making and solving issues concerning the Arctic.

CONCLUSION

In conclusion, let me touch upon the way forward for Japan's Arctic policy from a foreign policy perspective.

My prime responsibility as ambassador in charge of Arctic affairs is to create a bridge between international stakeholders like those of you in this room and domestic stakeholders in Japan. Ever since I assumed the current post, I have been very keen on attending international conferences on the Arctic, following ongoing developments, and exchanging views with my counterparts and leading experts in order to identify potential cooperative initiatives with other states. I have then taken this new information back to Japan to infuse renewed momentum as well as fresh perspectives in our policy-making.

As I mentioned, Japan adopted its first Arctic policy this year. Now, our challenge will be to ensure that Japan strategically implements this policy. We are now tackling this challenge.

We continue to ask ourselves: How can Japan translate our scientific assets into international cooperative initiatives? How can Japan align our scientific assets with ongoing developments among the Arctic states as well as non-Arctic states?

Therefore, attending international forums and conferences, having the opportunity to present Japan's initiatives with my own words, and getting feedback from you all provide very valuable input for the strategic implementation of Japan's Arctic policy.

The Arctic Council is a premier forum to achieve this end. Other forums such as the Arctic Circle, the Arctic Frontier, and of course, international conferences like this one, also allow non-Arctic States like Japan the opportunity to present our initiatives. This is very meaningful. We also greatly appreciate the leadership of the United States, the chair of the Arctic Council, in its pursuit of the theme, "one Arctic," and for encouraging active participation of non-Arctic States and promoting international cooperation within the framework of the AC.

I would like to again express my appreciation to the East-West Center and the Korea Maritime Institute for this precious opportunity. I look forward to further discussions with all of you.

Korea's Arctic Policy

Chan-Woo Kim

I am pleased to present at the 2016 North Pacific Arctic Conference (NPAC). Since last year, several important changes have taken place: Ministers from more than 190 countries agreed on a new post-2020 climate change regime in Paris last December; and the Arctic Council is celebrating its 20th anniversary this year. Today, as international Arctic cooperation is growing more important than ever, I expect this conference, which brings together the leading North Pacific Arctic states with the non-Arctic states, will make a meaningful contribution to realizing a sustainable future for the Arctic.

The IPCC's Fifth Assessment Report (AR5) projects that the extent of Arctic sea ice will, depending on various scenarios, decrease by a minimum of 43% to a maximum of 94% compared to 1950 by 2100. This is approximately a 20% to 90% decrease in comparison to the present level. This outlook leads to the conclusion that despite efforts made by the international community (such as the Paris Agreement), the Arctic will continue to warm at a significant rate, with many implications not just for the Arctic but also for global climate systems.

On the basis of the current situation and future projections for the Arctic, the Korean government developed its Arctic policy by adopting the Arctic Policy Master Plan in December 2013, followed by detailed action plans. Korea's vision of the Arctic is for its sustainable future and Korea's contribution to that end. Korea has been conducting Arctic-related activities for decades, but the President Park Geun-hye administration was the first administration to establish a systematic policy on the Arctic.

Overall, Korea's Arctic policy is based on two pillars. The first pillar is to contribute to resolving Arctic climate change challenges by promoting scientific research activities. The second pillar is to seize business opportunities in the Arctic, especially those arising from the utilization of emerging new Arctic sea routes. In order to support these two pillars, Korea set up an inter-Ministerial coordination mechanism headed by the Ministry of Oceans and Fisheries and has been pursuing international cooperation activities.

Let me touch upon the first pillar, scientific research activities. The importance of Arctic scientific knowledge cannot be emphasized enough.

The most thoughtful and enduring solutions will be found through accurate scientific analysis of on-going phenomena related to climate change. Increased scientific knowledge about the Arctic can be considered as a global public good. However, one problem is that the amount of scientific research being conducted by the international community still falls far short of the tremendous challenges facing the Arctic. Korea will, despite its relatively short history of Arctic activities, contribute to fill this gap with its world-class research capacities.

In advancing Arctic scientific knowledge, the Korea Polar Research Institute (KOPRI) has played an important role at the Dasan Arctic Science Station in Svalbard, and with its first icebreaker research vessel, Araon. Korea's scientific findings include investigating the relationship between Arctic warming and the severe winter cold in the northern hemisphere, which has been noted by the international scientific community as the "Arctic paradox." Korea plans to further strengthen its current Arctic scientific activities by establishing a second science station and building a second icebreaker research vessel. If such plans proceed smoothly, Korea's polar research capacities will be greatly enhanced.

The second pillar is to tap the business potential of the Arctic. The Korean government is also interested in making use of business opportunities that a changing Arctic provides. Guggenheim Partners, a global consulting company, is projecting that 25% of container shipping between Asia and Europe will take place along the Northern Sea Route in 2030, and infrastructure demands in the Arctic will reach a staggering $1 trillion in the next 15 years. In addition, the United States Geological Survey (USGS) estimates that 13 percent of the world's untapped oil resources and 30 percent of untapped gas resources are buried in the Arctic region.

The Arctic is one of the last terrestrial frontiers left to humankind. Arctic sea routes will assume a pivotal role in utilizing the opportunities to be found there. However, Arctic sea routes are quite vulnerable to potential shipping accidents. The introduction of the IMO Polar Code requiring strengthened ship safety and environmental standards is very timely. When energy, mineral resources and goods move along the Arctic sea routes, the Arctic will be re-born as a new zone of prosperity.

The big question we should raise at this moment is this: How can we address the challenges and realize these opportunities in an environmentally sustainable manner?

Since its establishment in 1996, the Arctic Council has handled Arctic issues with its highest authority and expertise. As we marking its 20th anniversary in 2016, it is high time for the Arctic Council to consider its future governance for the next 20 years. Challenges such as climate change in the Arctic have global impacts, even as they open new global opportunities. The Arctic Council should be reformed in such a way to strengthen its relations with non-Arctic states and treat them as partners, which is in line with the perception of a "Global Arctic."

Last April, senior Arctic Officials of Korea, Japan, and China convened in Seoul. The three countries shared the view that they should continue their commitments to contribute to the Arctic Council and enhance the three non-Arctic countries' cooperation at various international forums. They also concurred with the view that scientific research is among the most promising areas for their joint activities. The trilateral Arctic dialogue among Korea, Japan and China is one example demonstrating the will of non-Arctic states to contribute to the sustainable future of the Arctic. Arctic governance should improve to actively engage these aspirations and expertise of non-Arctic countries.

The Arctic, once forbidding and distant, has come into a different focus in the current century. We are currently viewing it from a different angle and entering into "New Arctic Age," especially since the Arctic environment has changed so rapidly due to climate change. The Arctic has been reacting to greenhouse gas emissions from human activities since the Industrial Revolution. Ironically, however, climate change caused by these greenhouse gases is shedding new light on the Arctic and enlivening interest in its fate. Today, the Arctic is being seen a "7th Continent," providing us with new opportunities and challenges. We should prepare for this "New Arctic Age" with what distinguished economist Alfred Marshall stated should be a "cool head, but warm heart."

Lastly, I would like to deeply thank the Korea Maritime Institute (KMI) and the East-West Center for their tireless efforts in organizing today's conference.

Thank you.

Russia's Arctic Policy

Yuri Sychev

I am not a politician, so I cannot present the official position of the Russian Federation with regard to our relationships in the Arctic.

However, being a member of the Russian State Commission on Arctic Development, I can briefly describe my vision for the main directions and priorities of Russia's Arctic policy.

First, I'm confident in stating that the Russian leadership proceeds from the premise that a policy of cooperation in the Arctic is the only viable way forward. Every problem can be solved through good neighborliness and constructive dialogue. There are no problems that require military solutions. This is Russia's position, which Arthur Chilingarov, the special representative of the President of the Russian Federation for International Cooperation in the Arctic and Antarctica, has asked me to communicate to you.

Despite inevitable contradictions that arise from the respective policy positions of individual Arctic nations, we can say with cautious confidence that together we will be able to maintain the level of Arctic cooperation achieved in previous years.

Second, Russia supports and will actively participate in the work of the Arctic Council, Barents Euro-Arctic Region Council, Nordic Council and other international organizations and forums to effectively discuss and develop joint positions of Arctic states and states having interests in the Arctic at different levels. I believe this conference is also an important event that allows for us to place a cornerstone to help us build even more international cooperation in the Arctic together.

I would also like to take this opportunity to announce that Russia is planning to organize an international forum, "The Arctic: Territory of Dialogue," after a three-year break. The forum's organizer is the newly established State Commission on Arctic Development, and a tentative date is set for spring 2017.

Third, Russia has created an important instrument to implement the state policy in the Arctic, the aforementioned State Commission on Arctic Development. The Commission was established by a Russian Federation Presidential Order of February 3, 2015. The Commission's main objective

is to ensure interaction among federal and regional authorities, local authorities and interested organizations related to the development of the Arctic zone of the Russian Federation. Deputy Prime Minister Dmitry Rogozin was appointed the Chair of the Commission.

The Commission has shown its effectiveness in its one and a half years of work to date. In particular, the Commission has formulated and is implementing a new policy regarding the development of the Northern Sea Route, which I will mention in my report later.

Thank you for your attention.

Inuit's Arctic Policy

Okalik Eegeesiak

Thank you for welcoming me to address this plenary. My name is Okalik Eegeesiak. I was born and raised in Iqaluit, Nunavut on the shores of Frobisher Bay in Arctic Canada.

I would like to thank the East-West Center and the Korea Maritime Institute for their kind invitation to speak at this unique Conference once again, especially in such a beautiful and inspiring venue and with the assembled participants, who share an awareness of the value of the Arctic and its peoples.

I am also chair of the Inuit Circumpolar Council (ICC), an international organization with official status within the United Nations and one of six Permanent Participants in the Arctic Council. The ICC gives voice to the 160,000 Inuit living in Canada, Greenland, Alaska and Chukotka. Inuit people may be a small population in a global sense–but we have proven to be a strong, unified voice for more than 40 years.

I would like to share my perspective on Arctic Policy.

Look around and take in the beauty of this place. Honolulu, or "calm port," is home to many cultures, including the indigenous Native Hawai'ians. Let the ocean inspire us to move beyond the discussion of the challenges that the Arctic and its peoples face. Let us consider instead the possibilities that Arctic peoples can achieve by working together with you—scientists, policy makers, industry leaders, conservation groups and governments—all people who truly believe in meaningful partnerships with Arctic peoples.

I don't think I need to remind those of you in this room that Arctic peoples need to be actively involved in discussions about the Arctic. I believe you already see us as Arctic partners, whether we are Inuit or Saami, Aleutian or Russian, Gwich'in or Athabaskan, as a positive force in your work. I certainly believe you do not take this stance out of duty, but rather out of conviction. The number of Arctic representatives already here is proof enough.

I see this Arctic partnership as a source of new knowledge, a new and improved way of looking at the future of the Arctic, and a means to enhance a collective mandate—whether that is for commercial activities,

conservation, science, or policy. There is no longer the time for an "us-versus-them" Arctic. Instead, we must aspire to create an Arctic that helps foster the sustainability of Arctic communities and protects the Arctic for the global commons. This approach will inevitably lead to a prosperous, safer and more secure Arctic, which in turn benefits not only the Arctic but the global community as well.

To improve Arctic policy, we need to take a longer-term view. We need a 30-year vision for the Arctic, which we might call "Arctic 2050." Inuit believe in a vision for the Arctic that looks both backward and forward. It's a vision that is guided by our past in order to inform our future. I want to share with you a few thoughts that I hope will stimulate the discussion. I will speak about current Arctic Policy, and later in I will tell you about the challenges that rapid and unpredictable change is bringing to my *Nunaat*—my "source" and my home.

Inuit have occupied the circumpolar Arctic for millennia, carving a pragmatic culture from the snow and ice. We have lived through famines, the Little Ice Age, Vikings, whalers, missionaries and residential schools, and successive governments.

Inuit live in four countries with four very different political realities and relationships their respective states—yet we are one through our language and our culture.

As I travel to bring the Inuit voice to the world I constantly meet people who express great interest in the issues the Arctic faces, in our culture, and in our land. This conference is such an event. The Arctic truly has the global consciousness spellbound, not only for those who want to use it, ship through it, explore it, and mine it, but also for those who want to study it, learn from it, and protect it.

For Inuit, the Arctic defines who we are: a pragmatic hunting culture. Inuit base decisions on our indigenous knowledge of our past, of our present, and of our future. It's a knowledge system based on thousands of years of observing and testing, with an oral tradition that passes down this collected wisdom from generation to generation. Inuit continue to acquire knowledge today as we adapt to meet the challenges and embrace the opportunities of a rapidly changing world.

We must be proactive rather than reactive and identify key investigations and studies for economic opportunities. We must plan for development and growth, and analyze potential risks arising from climate change or other hazards. We must use the very best knowledge to make

evidence-based, informed decisions.

The Arctic is vast and each community is unique, both within nation states and among Inuit states. Any visioning exercise will be unique for each community, and the opportunities and challenges associated with Arctic change will vary significantly over time and place.

Different communities face different risks from a changing Arctic, and have different perspectives regarding the implications of those risks as well as the most appropriate response options. Being partners in planning, research, and the development of Arctic policy as well as the governance of our Arctic future will ultimately lead to more sustainable decisions in Arctic communities.

There remain uncertainties. For example, the evolution of governance systems and the economic stability of the Arctic depend on global demands for energy and the exploitation of Arctic resources. The economics of this sector are based more on commodity prices and global markets than on ice thickness. Over the last decade, the geopolitical context for which many Arctic policy statements have been written has changed. It is a dynamic Arctic, indeed.

The world is waking up to the Arctic. We have seen significant commitments by the U.S. through the Glacier meeting and the White House Arctic Science Ministerial held in September 2016. In 2009, the Russian Government released its Russian Arctic Strategy 2020. Canada's was drafted in 2010, Iceland delivered their Arctic Strategy in 2011, and we have seen an incredible interest in the Arctic Circle meetings that Iceland has promoted. The Kingdom of Denmark released their 2011-2020 Strategy, and the U.S. and Finland released theirs in 2013. Norway's strategy was released in 2014, and Sweden delivered its new environmental policy for the Arctic in 2016. I am sure we will see a revised strategy as Finland assumes the chairmanship of the Arctic Council in 2017.

Non-Arctic states are also taking note of their neighbors to the north. The EU presented its new Arctic strategy in 2016. The Republic of Korea, Japan and Singapore also have Arctic policies and host Arctic meetings.

The landscape has shifted. The Arctic is a truly global commons.

But what of the indigenous peoples who call the Arctic Nunaat—our home? We need to have more of a say about our future. About our children's future. About our grandchildren's future.

Engagement with Arctic residents, especially including Indigenous

Peoples, is not just an asset. It is a requirement. We must be partners in the development of any Arctic policy that wishes to share our land, our snow and ice, our water, our wildlife, and our resources.

Our Inuit or indigenous knowledge has value to add to the discussion and to the development of evidenced-based decision-making. Who would not want the best knowledge to move forward on any Arctic policy?

Implementing strong, thoughtful Arctic policies, regardless of the country from which they originate, is a way to strengthen Arctic communities, whether the subject is trade or sustainable economic development. International Arctic policies can be framed as a means to accomplish domestic Arctic policy throughout the eight Arctic nations, while still allowing for the differences each country has in relation to their respective Indigenous Peoples' governance structures.

The Arctic Council's 20th anniversary provides an opportunity to move forward by reflecting on the past. The value of the Arctic Council as a governance mechanism must be strengthened and the role of the ICC and other PP's strengthened. The utilization and value of our knowledge systems must be better recognized and better employed.

The Arctic Council has supported persistent and consistent themes to include and engage and reflect Arctic voices, including cooperation, collaboration, and bringing the human dimension into every discussion.

Canada, about which I am most familiar, has a longstanding historical role in Arctic politics. This includes establishing the Arctic Council, with its foundations drawn from Franklyn Griffith's 1989 report, *Towards an Arctic Basin Council*. It also finds continuity in Bill Graham's 1997 House of Commons Standing Committee on Foreign Affairs and International Trade report, *Canada and the Circumpolar World: Meeting the Challenges of Cooperation Into the Twenty-First Century*, and the work of Mary Simon, the former leader of the ICC and Canada's first circumpolar ambassador.

Simon was recently appointed to the role of Minister's Special Representative (MSR), responsible for leading engagements and providing advice to the Government of Canada on the development of a new shared Arctic leadership model. Canada announced a commitment to work in partnership to implement land claims and agreements to realize the social, cultural, economic potential of Indigenous People and northern communities. They pledged as well to develop a plan and timeline for alternative energies in the Arctic. Canada also committed to address the challenges of mental wellness, education, indigenous languages, and skill

development, particularly among indigenous youth. This model of Arctic leadership will be advanced through the Arctic Council and other venues where Arctic issues are discussed.

There are various visions for the future of the Arctic. We must recognize our commitment to the United Nation Declaration on the Rights of Indigenous Peoples, as we must recognize and reflect on the potential threats and risks emerging from geopolitical tensions in the Arctic. We must address the immediate and urgent social issues facing Arctic communities. We must act now on the environmental issues of climate change and contaminants that are forcing unprecedented change in the lives of Arctic peoples. These challenges are so big they can only be overcome in global partnerships.

Inuit opened the door to positive change and to productive and respective partnerships when the ICC was created to represent Inuit internationally. Our vision remains the same: A sustainable and enduring Arctic.

Canada's Arctic Policy

David L. VanderZwaag[1]

Canadian Arctic policy is contained in several sources with some key pieces. The 2009 *Northern Strategy* put forward by the Harper Conservative government is the primary piece at the moment. Many of the initiatives launched under that strategy are ongoing initiatives and have not been renounced by the new Trudeau Liberal government. This strategy has four major pillars:

1) Exercising Canadian Sovereignty—Arctic patrol vessels are being built; NORDREG, a mandatory vessel reporting system, has been instituted; the Hans Island territorial dispute is being addressed; the Beaufort Sea boundary dispute has been placed on the "back burner"; and Canada's legal position on the Northwest Passage is clear.
2) Social and Economic Development—The Canadian Northern Economic Agency (CANNOR) has been created; and a small craft harbour has been built in Pangnirtung.
3) Protecting Arctic Environmental Heritage—The Canadian High Arctic Research Station is being built; and a national marine conservation area is being proposed for Lancaster Sound.
4) Improving and Devolving Northern Governance—Devolution agreements with the Northwest Territories and Yukon have been concluded; and strengthening the Arctic Council is a priority.

A second piece is Canada's Foreign Policy Statement (2010), which puts some glosses on past policies. For example, it outlines Canada's approach to continental shelf extensions in the Arctic.

More recent pieces of the Canadian policy picture have been enunciated in the March 2016 Trudeau-Obama Joint Statement on Climate, Energy, and Arctic Leadership.

Ministerial mandate letters sent to members of the Trudeau government, which relate the Prime Minister's expectations, approach, and priorities, are also relevant to the Arctic. Efforts are being made to increase the number of marine protected areas in the Arctic. Canada is again engaged on climate

change issues.

There have also been policy commitments on Arctic fisheries. An agreement has been reached with the Inuvialuit to institute a moratorium on commercial fisheries in the Beaufort Sea until more science is done. A Fisheries and Oceans Canada policy on Managing the Impacts of Fisheries on Sensitive Benthic Habitat Areas (2009) would subject new commercial fishing proposals in the Arctic to strict scientific assessments and initial small-scale exploratory licensing.

Two other images that can describe Canada's Arctic policy are "policy perplexities" and "policy promises."

One perplexing policy issue is the Northwest Passage. It is unclear where Canada sits on developing the Northwest Passage. The Passage is open to transits, but there is not a clear vision for infrastructure developments and vessel routings in relation to the Passage. Recent suggestions about a possible deep-water port in Iqaluit and a shipping corridor initiative are still being considered.

With respect to "policy promises," Canada's Arctic Strategy for the Coast Guard has not yet been released. Regulations to give effect to the Polar Shipping Code are being developed but have not been released for public comment. New initiatives are promised to deal with Indigenous Peoples issues, including health and climate change impacts. Canada says it is trying to implement the United Nations Declaration on the Rights of Indigenous Peoples but it is not clear how this will be done. In respect to the *Paris Agreement*, Canada has announced an Intended Nationally Determined Contribution (INDC) of a 30% reduction from 2005 levels by 2030, and Canada ratified the Agreement in October 2016, just prior to the COP22 meeting in Marrakesh. Prime Minister Trudeau is meeting with provinces and hopes to forge a Canadian position on climate change soon.

Notes

1. David L. VanderZwaag provided a Canadian perspective on Arctic policy. He noted that he was not speaking on behalf of the Government of Canada. He described Canada's current approach as "policy pieces" and gave some examples of policy implementation.

China's Arctic Policy

Yang Jian

I would like to provide a perspective on China's Arctic policy, but note that it is not an official government position, but rather a "Shanghai Perspective." I am hopeful that China will follow the lead of the Republic of Korea and Japan, and develop an Arctic policy. To some extent, China's current policy is passive and reactive. China's awareness of Arctic issues is based on discussions with diplomats from the Arctic nations. China's Arctic policy has been formulated by consultations with international law scholars, global governance and international relations experts, and analyses of global economic trends. China is a neighbour of the Arctic and an important stakeholder in Arctic affairs. China tends to come at Arctic policy through issues such as claims to extended continental shelves, sustainable use of resources and sea routes, and other commercial and political considerations. More recently, climate change has also appeared on China's radar. China's economy is large, and anything that impacts its economy will involve cautious approaches that require substantial coordination with multiple governmental departments. Drafting an official Arctic policy will take time, but it is likely to happen fairly soon. China's overall development policy affects issues of global governance. This developing policy will be guided by several key concepts: respect (for the Arctic Council, sovereign rights, indigenous rights, and international law); "win-win"; and sustainability. These words were reflected in a speech made by Chinese Foreign Minister Wang Yi in the Arctic Circle forum. China also wants to make scientific contributions to Arctic knowledge through multilateral and bilateral cooperation.

China is a potential user of the Northern Sea Route and a customer for Arctic resources such as fish, oil and gas. China also wants to participate in global governance to deal with climate change and wants to see sustainable development that also promotes balance in social systems. China believes that peace and stability are key principles for Arctic governance and sustainable development. It believes that international security can be advanced by dialogue, in order to preserve peace in the Arctic.

PART II

IMPLICATIONS OF THE PARIS AGREEMENT FOR THE ARCTIC

View from an Arctic State

Julia L. Gourley

INTRODUCTION

I'm going to talk to you today about what the Arctic Council is doing to address the impacts of climate change in the Arctic. In fact, there is a lot going on, but it's not necessarily directly tied to the Paris Agreement.

BLACK CARBON

As you heard from Dan Reifsnyder last evening, the word "Arctic" is not found in the Paris Agreement. Another word (or phrase) you won't find in the Paris Agreement is "black carbon."

Black carbon, otherwise known as "soot," is not part of the UN Framework Convention on Climate Change (UNFCCC). But it is considered by the science community to have particular impact in the Arctic. What is known is that black particles absorb heat and accelerate melting of white surfaces and thawing of frozen ground. And there is a lot of both in the Arctic in the form of snow, ice, and permafrost.

What is less known is how much black carbon contributes to regional atmospheric warming. It does not have an assigned "global warming potential" or GWP number as the gasses within the UNFCCC do. And its occurrence in the environment is rarely in its pure form. Black carbon is often emitted with organic carbon which is typically lighter in color and would not be expected to have significant warming properties; in fact, it is thought to have cooling properties that off-set black carbon's warming properties.

Yet because there is evidence that black carbon does have warming effects on the Arctic cryosphere, there is significant scientific on-going research.

The United States initiated work in the Arctic Council on black carbon in 2009. After seven years of work, the Council is on the brink of agreeing to an "ambitious, collective, aspirational, quantitative black carbon mitigation goal."

Now that's a mouthful, but it's an important advancement in addressing climate impacts in the Arctic—that is, if the Arctic States actually reduce their black carbon emissions, and if the near-Arctic States do the same.

The Arctic States have been pressing, in particular, the Asian observer states to join with us in in our mitigation efforts since they are responsible for a significant amount of the overall black carbon load that reaches the Arctic.

As the chair of the Arctic Council's Black Carbon and Methane Expert Group, we are very pleased that most of the observer States submitted national reports on black carbon and methane sources and emissions inventories. These reports are a requirement for participation in the expert group.

RESILIENCE AND ADAPTATION

The Council is making an important contribution related to the Paris Agreement is in the areas of adaptation and resilience.

Most people do not know what "resilience" means. Some think of it as synonymous with adaptation, but it is not.

While both terms are used in climate contexts, "adaptation" refers to specific actions taken by a population, while "resilience" is an underlying capacity to enable adaptation. It is a broader concept and something that ideally is measureable and quantifiable.

The Arctic Council is embarking upon three separate, but related initiatives. The *Arctic Resilience Assessment* (ARA) will draw on case studies where major thresholds, or "tipping points," are already apparent in order to identify properties that make human and non-human systems more resilient to both anticipated and unanticipated changes.

The *Adaptation Actions for a Changing Arctic* (AACA), that you'll hear more about from Lars-Otto Reiersen, examines adaptation opportunities based on projections well into the future. It looks at three specific regions in the Arctic and then ties them together in a synthesis report.

Both of these initiatives focus on the key question: "What can be done to prepare for Arctic changes?" They move beyond assessing the state of the science, and evaluate the societal actions that can and are being taken to adapt to a changing Arctic and to build resilience to cope with both climate change and other processes affecting the Arctic.

The third initiative is an *Arctic Resilience Action Framework* (ARAF)

that will build on the key findings of the ARA and AACA by articulating a set of "guiding principles" for enhancing adaptation and resilience across the entire region. The ARA and AACA are time-limited projects, so their findings will need to be updated and further refined on an on-going basis. Thus, the ARAF is intended to be a long-term process within the Council.

SCIENTIFIC ASSESSMENTS

The Council has a rich history of climate change work and the thing that really put the Council on the map was its 2004 *Arctic Climate Impact Assessment* (or ACIA) that was chaired by our very own Bob Correll.

The ACIA accelerated the Council's focus on climate, and since 2004 there have been a number of cutting edge climate assessments. I mentioned the AACA a moment ago, but another very important one is called the *Snow, Water, Ice, and Permafrost Assessment* (SWIPA).

SWIPA was first released in 2011 with assessments of the Greenland ice sheet, the Arctic Ocean sea ice, and the terrestrial cryosphere components of snow, rivers, and glaciers.

The Council is going to release further SWIPA products including an Arctic Freshwater Synthesis at the next Arctic Council Ministerial in May 2017.

Another SWIPA product to be released in phases is a snapshot of how the Arctic will look in a fully implemented Paris Agreement world; which is to say the Arctic under a 1.5°C and a 2°C increase in global average temperature. Lars-Otto will discuss that further, but I suspect it will attract a lot of attention.

THE WAY AHEAD IN SUPPORTING PARIS AGREEMENT IMPLEMENTATION

So much of the Arctic Council's work is directly or indirectly related to climate change that the United States, sitting in the chair, believes that it's time for a strategic plan.

The Council is an intergovernmental forum that has evolved over time to look more like a formal international organization. While some Arctic states do not wish to see the Council transform officially into an international organization, some do believe that the time has come for

the Council to have a more defined path with specific goals and means of achieving them.

The term "strategic plan" mostly makes people groan, but if they are well-done they can really help drive action and render operations to be more efficient. This would get at precisely what Mark Meyers said this morning about the need for answers to the big questions in order to reach the goals of the Paris Agreement, such as how to manage the enormous amount of carbon stored in the Arctic. We need a more strategic direction to the Council's work to get to outcomes we need for the planet's health.

A real life example of the thawing permafrost that is not carbon-related is the current outbreak of anthrax in the Yamal Peninsula in Russia. There are thousands of animal graves in the tundra and as the permafrost thaws, these bodies and their anthrax spores are now uncovered and reindeer are eating them and dying. There has also been a human death—a boy who came in contact with anthrax-contaminated land or possibly one of the reindeer carcasses.

This is a clear consequence of climate impacts in the Arctic. The Russian government has warned of many other diseases including smallpox and influenza that may become bioavailable due to thawing permafrost. Thus, there are huge public health ramifications in addition to global warming impacts. Fortunately, the Council also focuses on Arctic health issues.

CONCLUSION

Although climate change is not the only game in town in the Arctic, it is the 800-pound gorilla and deserves a bit more thought and direction from the Arctic States as to how to manage the region in the best possible way, including what the Arctic States can do to support the mitigation and adaptation aspects of the Paris Agreement.

One more thing: the East-West Center wrote a piece on the Arctic for the State Department's "Our Arctic Nation" blog on *Medium.com*. We came up with the idea to do one blog post per week from each of the fifty states and Washington, D.C. describing why the Arctic matters to that state. We were so pleased that the East-West Center agreed to write the very first blog post to kick off our project. I think it was very eye-catching that Hawai'i was the first entry in "Our Arctic Nation" because who thinks of Hawai'i as having any Arctic ties?

View from a Non-Arctic State

Sung Jin Kim

The Arctic is a region where the climate is warming twice as fast as the global average. Every year, the extent of sea ice during the summer is hitting record lows, and the onset of melting is starting sooner. While many issues related to the Arctic tend to be confined to Arctic States, addressing climate change is one issue that requires the engagement of non-Arctic States as well. No borders constrain climate change, and any effective measures intended to address climate change in the Arctic will need the cooperation and efforts of both Arctic and non-Arctic states. In this regard, the recent adoption of the Paris Agreement is significant in that it now involves 196 nations and includes both developed and developing countries in a common effort to combat global warming.

The Republic of Korea is one of the 175 countries that signed the Paris Agreement at the 22 April 2016 high-level signature ceremony, and ratified it on 3 November 2016. As the world's 11th largest economy, Korea's efforts to curb greenhouse gas emissions will no doubt be a significant contribution to the global climate effort, and consequently to mitigating and adapting to climate effects in the Arctic. In this paper, I will first provide a summary of two climate regimes (the Kyoto Protocol and the Paris Agreement), as well as perspectives on future implementation challenges. I will then discuss Korea's climate change policy, with a particular focus on adaptation policy. Finally, I provide my thoughts on what role the North Pacific Arctic Conference, and in particular NPAC member states, could take in addressing climate change issues.

THE KYOTO PROTOCOL AND ITS LIMITATIONS

The Kyoto Protocol is the predecessor of the Paris Agreement that was adopted at COP21 in Paris[1] and achieved its threshold for ratification on 4 November 2016. In order to understand how and why the 2015 Paris Agreement came about, it is first necessary to understand the Kyoto Protocol agreements of 1997 and to examine its successes as well as its failures.

The United Nations Framework Convention on Climate Change (UNFCC) was one of the agreements resulting from the groundbreaking Rio de Janeiro "Earth Summit" in 1992. The major objective of the UNFCCC was "to achieve...stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[2] However, the agreement did not codify binding limits on greenhouse gas emissions and had no enforcement mechanisms. In order to move forward, the Kyoto Protocol was negotiated and adopted in 1997 at the "Conference of Parties" (COP) 3 as a tool to put these UNFCCC principles into practice. The Kyoto Protocol sets binding emission reduction targets for 36 industrialized nations and the European Union (Annex I countries). Also, it has complementary market mechanisms to help countries achieve reduction targets including by investing in green projects in developing countries. Then-U.S. President Bill Clinton called the agreement "environmentally strong and economically sound."[3]

One major element of the Kyoto Protocol was its binding emission reduction commitments for Annex I parties. Based on the principle of "common but differentiated responsibility and respective capabilities" the Paris Agreement recognized that industrialized countries are largely responsible for the high accumulation of greenhouse gases in the atmosphere, and the reduction targets only bound developed countries. This left out a number of emerging countries such as China, India and Brazil, which were also releasing significant greenhouse gas emissions. About 80% of the countries in the world were exempt from the Protocol, and the U.S. did not ratify the treaty. Before the second commitment period, Canada formally withdrew from the treaty, and Japan and Russia declared that they would not join the second commitment period. Ultimately, since the Kyoto Protocol included fewer than 50 countries for emissions controls and did not include many top emitters, it was an ineffective climate treaty.

The treaty's record of countries complying with their emissions targets is also disappointing. The Kyoto Protocol established flexible market mechanisms to accommodate Annex I countries in meeting their reduction targets. The market mechanisms commoditized greenhouse gases, especially carbon, and it was thought to be a win-win for both developed and developing countries. Developed countries could take credit for GHG reductions, while developing countries received help to "green" their economy through joint projects and technology transfer. However, according to an UNFCCC report on Kyoto Protocol compliance, by 2012

the remaining 36 countries subject to the binding greenhouse gas targets in Kyoto had a poor record for compliance, with 17 failing to meet their targets.[4] Thus, going into negotiations on the Paris Agreement, some of the major contentious issues involved fairness. Developed countries claimed that to have an effective climate treaty, it was important that developing countries also commit to goals for emissions reductions. Developing countries argued that in order for them to come on board, developed countries would need to commit more financing and assistance to the developing world.

POST-KYOTO: THE PARIS AGREEMENT

"Historic, durable and ambitious."[5] These are the words used to describe the Paris Agreement, adopted on 12 December 2015 at the Paris Climate Change Conference (COP21). The agreement entered into force on 4 November 2016, prior to the beginning of COP22 in Marrakech, Morocco.[6]

The goal of the Paris Agreement (Agreement) was to respond to climate change by reducing greenhouse gas emissions, and to create adaption strategies that respond to climate changes already being documented around the globe. The Agreement includes details on how to support developing countries by means of financial and technological support, as well as capacity building. In addition, transparency was emphasized for every aspect of the process, including a number of areas that relate to both content and procedure. The six areas covered by the Agreement—mitigation, adaptation, finance, technology, capacity building, and transparency—are considered to be the six pillars of the new climate regime.

Compared to the Kyoto Protocol, the Paris Agreement is a remarkably different international accord. Some of the key aspects of the new Agreement are as follows:

- ***The first universal climate agreement:*** Unlike the Kyoto Protocol, where only developed countries were mandated to reduce their emissions, the Paris Agreement includes both developed and developing countries; 196 in total. As of February 2017, 129 Parties have ratified of 197 Parties to the Convention and Paris Agreement went into force on 4 November 2016, the required thirty days after

the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55% of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession with the Depositary. At the time this is being written, the 129 signatories account for nearly 80% of global emissions.

- ***Long-term temperature goal:*** countries are committed to a long-term temperature goal of keeping the rise in average global temperatures well below 2°C compared to pre-industrial times, while aspiring to limit the increase to below 1.5°C.
- ***Bottom-up approach:*** Whereas the Kyoto Protocol was mainly a top-down regime, the Paris Agreement takes a bottom-up approach. It will be up to each country to determine its own reduction goals based on each state's current emissions and capabilities. Every five years, each country is obligated to prepare, maintain and communicate a nationally determined contribution (NDC) and to pursue domestic measures to achieve them. Furthermore, countries are expected to respect the principle of progression, whereby the goals of successive NDCs should be higher than the previous ones.

Table II.1 Comparison of Paris Agreement to Kyoto Protocol

Kyoto Protocol	Category	Paris Agreement
GHG emissions reduction (Phase 1: 5.2%, Phase 2: 18%)	Target	2°C reduction goal, with an effort to achieve 1.5°C
Mainly focused on GHG reductions	Scope	Comprehensive, including not only GHG reduction, but also adaptation, finance, technology transfer, capacity building, and transparency.
Mostly Advanced Nations	Obligated States	All Parties
Top-down	Goal-setting approach	Bottom-up
Penalty (1.3 times the unmet amount added to the next phase)	Penalty for non-compliance	No penalty
No particular mention	Target Setting Standards	Principle of progression
Questionable due to an end date during the commitment period	Sustainability	Sustainable action possible because of no specified end date
State centered	Actor	Participation by non-Party stakeholders encouraged

- ***Global stock taking:*** From the year 2023 and every five years thereafter, an assessment of the collective progress toward meeting the goals of the Paris Agreement will be made.
- ***Transparency:*** The Paris Agreement is based on voluntary participation, much like the Kyoto Protocol. However, the Agreement goes a step further than preceding schemes by focusing on increasing transparency and promoting compliance through incentives. Countries are required to report on mitigation, adaptation and support, and to undergo international review on submitted information.
- ***Climate finance:*** Developed countries will mobilize $10 billion per year from 2020 to 2025 to support low-carbon growth and climate resilience in developing countries.
- ***Adaptation:*** Adaptation is included for the first time in the climate treaty with its own article (Article 7), and a balance between adaptation and mitigation is emphasized throughout.

CHALLENGES IN EFFECTIVE IMPLEMENTATION

The historical achievement of the Paris Agreement was met with praise and celebrations. Now the question remains: How can the agreement be effectively implemented? As Miguel Cañeta, the European Union Commissioner for Climate Action and Energy, said fittingly, "Today we celebrate, tomorrow we have to act." Each of the parties has the obligation to submit *Intended* Nationally Determined Contributions (INDC), but there is no binding mechanism to enforce implementation. Continued emissions of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Adaptation and mitigation are complementary strategies for reducing and managing the risks of climate change. Substantial emissions reductions over the next few decades can reduce climate risks in the 21st century and beyond. Effective implementation depends on policies and cooperation at all scales. An effective policy must necessarily be global in scope. Countries have strong incentives to take "free rides" on the efforts of others because emissions reductions are local and costly while the benefits are diffuse and distant over space and time. An effective global arrangement will need an effective mechanism to encourage participation and discourage free riders.

Every signatory has committed to provide long-term national vision and strategies and find additional ways to reduce greenhouse gas emissions, including a system that measures, verifies, and evaluates progress on implementation to achieve targets. In the end, we can only plead to the good will of participating countries and the principle of good faith. In particular, regarding the long term temperature goal which has been agreed to (below 2°C), many are dubious that it will be achievable since there is no power of enforcement, nor are there specific plans and a timeline built into the agreement. According to Climate Action Tracker's analysis, based on all the submitted INDCs for 2025 and 2030, even if they were fully implemented it would bring warming down to only 2.7°C, which is substantially above 2°C.[7] The success of the new climate regime is dependent upon new negotiations for ensuring methods for implementation of the Agreement. It is crucial to engage the participation of emerging countries that are experiencing fast economic growth, as well as developing countries. The general meeting of the parties has ended, but a marathon of new negotiations for opening a new era has just begun. In the words of Prime Minister Narendra Modi of India, the "outcome of the Paris Agreement has no winner or losers. Climate justice has won." Now, we all need to gather our strongest will and efforts to realize climate justice for all.

ESSENTIAL IMPLEMENTATION TOOLS

Finance, technology and capacity-building are three interrelated tools that are essential for reducing greenhouse gas emissions and adapting to climate change. To effectively reduce greenhouse gases, first, the development of relevant technologies is needed. The ultimate goal of the UNFCCC is the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. There are three major ways to respond to climate change. First, instead of trying to prevent climate change, accept that it is happening and devise adaptive measures against climate risks. Second, find ways to reduce greenhouse gases. Third, utilize geo-engineering methods to help cool the earth's temperature.

Technology is important in all approaches, as evidenced by discussions at the most recent Davos Forum. Participants focused on finding ways to solve climate change and related social issues through technological

innovation, and explored how that innovation can dovetail with achieving sustainable growth. The climate conference in Paris last December was ultimately also about developing climate change response technology and international aid strategies.

Technology development requires a lot of investment and human resources. This means technological innovation by one country alone will be difficult. Instead, it is advisable to conduct joint research as a way to create complementary and mutually beneficial technologies among participating countries. This way, both the efficiency of R&D and the quality of results will improve. Furthermore, developed countries should take on more leadership in technology development and transfer, in order to encourage the participation of developing countries. In addition, in order to promote the development and sharing of implementation tools, a global mechanism should be created that enables active communication among countries.

NEW OPPORTUNITIES

Climate change is both a threat and an opportunity. We need to ensure that greenhouse gas mitigation efforts present new opportunities for growth. Manufacturing methods and industrial structures will need to be completely revamped. Mitigation targets could be met by using technology and the market, such as by adopting new manufacturing methods and products and expanding investment in research and development for greenhouse gas mitigation technologies. President Park Geun-hye of the Republic of Korea pointed out at the Paris Climate Conference that, "the new climate regime is a big opportunity rather than a new challenge." Similarly, then-U. S. President Barack Obama said that climate responses can provide new opportunities for the United States by way of technology development that can be used at home and exported around the world.

The development of new economic growth engines can be achieved by promoting the development of new energy industries and transforming industry into a more environmentally friendly sector while reducing carbon emissions. This can be done through the adoption of smart manufacturing methods that increase energy efficiency, by expanding the production of electric and hybrid cars, by developing carbon capture and storage (CCS) technologies and installing them in power plants, and by promoting renewable energy development.

Many companies are already profiting in the new market environment through the development of new technologies and products. Several hundred global enterprises around the world have formed a climate change response network that emphasizes the role of industry.

The Korean government, for its part, will support the development and procurement of core technologies in order to help ensure that global climate change efforts and the new climate regime provide an opportunity for economic growth. It will support the development of renewable energy and efficiency technologies such as solar cells and secondary batteries, carbon resource recovery, and the export of small- and medium-sized nuclear facilities as ways to create future growth engines.

I hope that technology that helps lead us into this new post-Paris Agreement era is developed through the convergence of IT, which is an area where the Republic of Korea excels. This new era will also include the expansion of smart production methods and improvements in incorporating software technologies into the manufacturing industry. Furthermore, it is hoped that the Republic of Korea, together with NPAC, will lead this new era by having not only the government, but also industries and individuals, actively join in these efforts.

Table II.2 Milestones in International Climate Response Effort

Year	Milestone
1988	Establishment of IPCC (Intergovernmental panel established with support from UNEP and WMO. The Assessment Report (AR) published, which evaluates impacts caused by climate change and reviews response measures)
1990	Establishment of the Intergovernmental Negotiation Committee(IND)
1992	Adoption of the UNFCCC (entered force in 1994)
1997 (COP 3)	Adoption of the Kyoto Protocol (entered into force in 2005) (As of May 2016, 191 nations and the European Union are parties to the conference) (The Republic of Korea ratified in 2002)
2007 (COP 13)	Adoption of the Bali Action Plan
2009 (COP15)	Negotiation on Post-2012 agreement breaks down at the Climate conference in Copenhagen
2011 (COP17)	In Durban, the Kyoto Protocol is extended, negotiation on the new climate regime begins
2015 (COP21)	Paris Agreement which lays the foundation for the post-2020 climate regime is adopted

KOREA'S CLIMATE CHANGE POLICY

Climate change became one of the main national agenda items in the Republic of Korea in 2008, when newly elected President Lee Myung-bak adopted green growth as a national development strategy. The government adopted the Framework Act on Low Carbon, Green Growth, and established the Presidential Committee on Green Growth as the leading entity for coordinating national green growth policy efforts. In 2009, the National Strategy for Green Growth and the Five-Year Plan (2009-2013)[8] was announced and set forth a national goal of becoming the world's seventh greenest nation by 2020, and the world's fifth greenest by 2050.

Despite the fact that as a non-Annex I country, the Republic of Korea was not obligated to state a reduction goal and follow it, in 2009 the president declared an ambitious greenhouse gas reduction goal of 30% below Business As Usual (BAU) by 2020. This was one of the highest reduction goals stated amongst countries that made non-obligatory reduction commitments, which reflected the administration's strong will to pursue green growth policies domestically and actively join international climate change efforts. To help achieve this ambitious mitigation goal, the Republic of Korea launched the Greenhouse Gas (GHG) and Energy Target Management System (TMS) for the industrial sector. To promote cost-effective measures for mitigation, it adopted the Korea Emissions Trading Scheme (KETS), which came into force in January 2015. This is the second largest market in terms of emissions, after the EU ETS, covering 525 entities and about 66% of the nation's greenhouse gas emissions.[9] Korea's successful bid to house the new international organization, the Global Climate Fund (GCF) is reflective of the nation's rise in international stature as a leading nation on climate change responses.

With the change of government in 2013, the Park Geun-hye administration vowed to continue Korea's efforts to reduce emissions by "designating climate change response as a key sector of the creative economy."[10] The president also promised to "expand investment in the development of technologies that address climate change, including energy management systems, new and renewable energy, and carbon capture and storage (CCS)."[11]

REPUBLIC OF KOREA AND COP21

Ahead of the Paris Climate Change Conference in December 2015, countries were expected to submit their INDC by June 30. The government of the Republic of Korea announced four options for its INDC on June 11. These were to achieve reductions of 14.7%, 19.2%, 25.7%, and 31.3%, compared to the BAU level by 2030. But after more in-depth review and discussions by stakeholders through public hearings and forums, the Korean government decided on a higher mitigation target of 37% below BAU emissions by 2030. This is equivalent to limiting GHG emissions in 2030 at 536 $MtCO_2e$ (81% above 1990 emission levels) excluding land-use, land use change and forestry (LULUCF), Out of this 37%, 11.3% is expected to come from utilizing carbon credits from international market mechanisms, and 25.7% domestically.

Overall, Korea's 2030 Mitigation Target has not been received well. The Korean business community has complained that it is too ambitious, yet some international observers have rated it as "inadequate."[12] In particular, the mitigation target of 37% has been criticized as violating the principle of progression. The pledge made in 2009 to reduce greenhouse gas emissions by 30% from standard levels by 2020 was based on a projection of 776.1 million tons of CO_2 equivalent. That would require emissions of no more than 543 million tons that year, or 233.1 million tons less than the projected level. In comparison, the 2030 Mitigation Target promises to limit greenhouse gas emissions in 2030 at 536 $MtCO_2e$, and a significant portion of 11.3% is to come from using international market mechanisms, which according to Climate Action Tracker (CAT) analysis would allow domestic emissions (excluding LULUCF) to double by 2030 compared to 1990.[13] Exclusion of LULUCF (forest) activities in the INDC was also criticized.

Korea has an energy-intensive economy heavily reliant on heavy industries such as the manufacturing and chemical industries. Thus, steering the national economy towards a greener path will require substantial effort, time and investment, as well as coordination with other sectors across the economy. In that respect, the Second National Energy Master Plan covering up to 2035 is expected to contribute in reducing Korea's fossil fuel consumption, increasing energy efficiency, and increasing reliance on renewable energy. In particular, the Plan expects to reduce final energy consumption by 13% below BAU by 2035, and to increase the share of renewable energy out of total energy consumption to 11% by 2035.

Also, the government will support the development and deployment of new and renewable energy and nuclear energy, as well as manage energy demand-side. Some of the stated goals include increasing Korea's market share in the global solar manufacturing market from 5% in 2008 to 20% by 2030, and consequently promoting the Republic of Korea as a major renewable energy products manufacturer. More recently, the Ministry of Science, ICT, and Future Planning has established and adopted the Climate Change Response Technology Development Program Implementation Plan for 2016, which is a program for supporting technological development in six focus areas in order to realize greenhouse gas emissions reductions through technology and to create new industries and markets: solar cells, fuel cells, bioenergy, secondary batteries, electricity IT, and Carbon Capture and Storage (CCS). According to the Plan, the Ministry will spend 56.8 billion won ($48 million) for 26 projects to develop carbon-mitigating next-generation technologies, which is a 10% increase over the previous year. Other efforts to mitigate Korea's GHG emissions include creating the showcase carbon-free Jeju Island, creating new markets worth 100 trillion won ($85 billion) and 500,000 additional jobs by 2030, and opening a 'prosumer' (combination of producer and consumer) market for electricity that would allow people to sell power saved through renewable equipment or energy storage systems as under the "Strategy for Nurturing New Energy Industries 2030."[14] While there will be challenges and resistance during the transition to a green economy, this global trend via the Paris Agreement to move towards a greener and sustainable world will help continue to promote and support every nation to live up to global standards on greenhouse gas emissions. It will help to keep the climate change issue high on every country's national agenda, which will help climate change policies to be continuous and integrated through changing government administrations.

ADAPTING TO A CHANGING ENVIRONMENT

Even if every country stopped emitting greenhouse gases today, the cumulative effects of previous decades of emissions will continue to take its toll on the environment for some time. In the case of the Republic of Korea, over the past 30 years (1981-2010), temperature has increased on average 1.2°C on the Korean Peninsula. Even if greenhouse gas emissions

are significantly reduced (RCP4.5), the average temperature is expected to increase to 3°C by the end of this century.[15] That is why discussions on climate change adaptation strategies are as important as the ones regarding mitigation. But too often, adaptation gets sidelined in comparison to mitigation, in part because adaptation is difficult to measure, and tends to involve more national and local scales that makes it more complex than addressing mitigation. The first four IPCC assessment reports had much more emphasis on mitigation. However, the Fifth IPCC report includes much more on adaptation, which also reflects a growing literature on adaptation responses. The number of scientific publications on these subjects more than doubled between 2005 and 2010, with especially rapid increases in publications related to adaptation.[16] The importance and attention to adaptation aspects of climate change has also been increasing at high-level meetings since UNFCCC COP 13. The Paris Agreement also requires each nation to formulate a national climate change adaptation plan and submit reports on its implementation. The Green Climate Fund (GCF), established through the UNFCCC as a way to help finance climate change responses in developing countries, will be spending half the fund on adaptation projects. In the final section of this paper, I will discuss Korea's efforts to address climate change adaptation, which is less known compared to the country's mitigation efforts.

The government of the Republic of Korea takes an integrated, systematic approach to climate change adaptation. The government formulated the 1st Korean Adaptation Strategy (2011-2015) in 2010 through joint efforts by 13 relevant government ministries under the lead of the Ministry of Environment, and subsequently the 2nd Korea's Adaptation Strategy (2016-2020) prior to the Paris Climate Change Conference in December 2015. Under the 2nd Adaptation Strategy, the government is developing guidance and tools to support the assessment of vulnerability and risks, and is implementing projects on research and development for comprehensive and quantitative analysis of climate change impacts. In order to establish a "happy and safe society resulting from successful climate change adaptations," the government aims to strengthen its capacity for climate change adaptation by implementing the following strategic actions:[17]

- Establish a science-based climate change risk management system.
- Build a society safe from climate change impacts by establishing a pre-emptive response system that prioritizes vulnerable social groups

and regions to minimize adverse climate change impacts.

- Enhance industry competitiveness and secure the nation's new growth engine by strengthening various sectors' capacity to adapt to climate change.
- Manage natural resources sustainably, especially by formulating resiliency and conservation measures for protecting vulnerable and endangered species against climate change effects.
- Ensure enforceability and practicality of adaptation policies by establishing related laws, securing budgets, and establishing networks for cooperation.

Furthermore, regional and local governments, which play an important role in adaptation, are mandated to develop their own action plans for climate change adaptation by 2015 and tailored to local contexts. The Ministry of Environment reviews performance every year, and together with the Korea Adaptation Center for Climate Change (KACCC), assists local governments in enhancing their respective adaptive capacities.

Among various adaptation projects and policies, one particular project I would like to highlight is the MOTIVE development project. MOTIVE, which stands for Model on InTegrated Impact and Vulnerability Evaluation, seeks to develop a model for an integrated inter-sectoral assessment of climate risks, and to create a risk-based assessment method for Korea that will be used to formulate important policies. The research group for developing MOTIVE was established in 2014. For the next seven years, until 2021, MOTIVE will devise an integrated assessment model that will be used for establishing national and local climate change adaptation policies. Research has shown that climate change causes unusually high temperatures, which among other impacts causes increased ozone pollution that is linked to increased pubic health concerns. This indicates that rather than individual assessments, an inter-sectoral assessment is needed. Thus, unlike most risk assessment models that are based on individual sectors, the research group will focus on developing MOTIVE as an integrated and interlinked model.

CLIMATE CHANGE AND ITS IMPACT ON THE ARCTIC

It is widely known that climate change affects every corner of the globe. In

particular, global warming in the Arctic region is expected to happen two to three times faster than other regions. Climate change impacts on the Arctic will be more serious than any other region, and global warming is changing the general perception about the Arctic. If the Earth warms by on average 2°C, the Arctic is projected to see an increase in temperature of about 5°C. This Arctic phenomenon referred to as "Arctic Amplification." This happens because the Arctic is normally covered by ice and snow, which reflects solar radiation. When the sea ice and snow covering the ice in the Arctic melts and turns into darker sea water, only 10% of the solar radiation will be reflected and the rest absorbed. The more melting, the less solar reflectivity. As a result, the temperature in this region increases more rapidly than in temperate zones. In other words, a "positive feedback loop" occurs, which then causes global climate changes to happen much faster. Currently, heat waves in the Northern Hemisphere during the summer and cold spells in East Asia and North America during the winter are both attributable to rapid Arctic warming. If the Arctic sees an increase in temperature by more than 5°C, extreme weather events will become more frequent and intense, and consequently will produce social and economic impacts not only in the Arctic, but also in lower-latitude areas. In addition, the rapid melting of the Greenland ice sheet is contributing to global sea level rise, and changes in the ecosystem in the Arctic and in the permafrost change in the subarctic are becoming increasingly serious and widespread.

According to research done by the Korea Polar Research Institute, the frequency and intensity of cold spells in the winter has increased since the 1990s. This phenomenon can also be linked to the rapid melting of the sea ice in the Arctic. Extreme weather events such as cold waves disrupt daily lives as well as national economies, and more scientific monitoring and efforts are needed to understand climate change impacts as they ripple around the world. Moreover, the frequency of weather-related disasters have increased on the Korean Peninsula, including snowstorms, heat waves, torrential downpours, and drought. These events have already had significant effects on agriculture and fishery production. Thus, there is a need to detect and project changes in the Arctic and also project the impacts that a rapid warming in the Arctic will have on lower-latitude regions and devise adaption policies accordingly. Also, carbon mitigation policies should go hand in hand with adaptation policies in order to minimize damages from climate change.

Establishing the link between sea ice reduction in the Arctic and climate

change in nearby regions will require time, methodological observation, and robust research. The recent increase in the frequency of cold waves in East Asia that are related to this rapid Artic warming affects countries such as China and Japan. I expect that a joint research effort among China, Korea and Japan scientists will improve attribution studies that detail the links among global warming, Arctic melting, and these cold waves. For this cooperation, the North Pacific Arctic Research Community (NPARC), which is a network that includes scientists from China, Korea, and Japan (organized by the Korea Maritime Institute), could play a role in strengthening mutual cooperation. Furthermore, if NPAC leads in taking the initiative for further joint research and cooperation, I believe meaningful results could be obtained. Additionally, an experts group that involves both Arctic states and Arctic Council Observer states could be organized and implemented, with NPAC leading the process.

Climate change in the Arctic is deeply concerning. At the same time, melting sea ice in the Arctic also presents new development opportunities. For example, less ice in the Arctic will allow easier passage of Arctic sea routes, and also the development of hydrocarbon resources under the seabed. According to an oft-cited estimate, the Arctic is thought to hold an estimated 13% of the world's undiscovered oil and 30% of the undiscovered natural gas, as well as 20% of the undiscovered natural gas liquids in the world.[18] While warming in the Arctic is attracting development opportunities for Arctic- and non-Arctic nations and businesses, the likely adverse impacts of increased hydrocarbon development in the Arctic on sea ice in the region is troubling. Thus, the development of technologies that minimize carbon emissions should be promoted, such as by investing in R&D related to fuel energy use to reduce emissions from ships that will travel Arctic sea routes. Also, international regulations on emission standards for ships during sea travel, environmental standards for offshore plants, and the promotion of an expansion of LNG-powered ships should be considered. Preliminary studies and discussions could be instigated at NPAC.

CONCLUSION: IMPLICATIONS FOR THE ARCTIC

Climate change will affect every corner of the globe, but its impact on the Artic region will be the most pronounced. However, climate change

responses by Arctic states alone will not make much of a difference to the Arctic's future climate. Thus, the recent adoption of the Paris Agreement is meaningful in that it involves 197 nations, and the future of the Arctic region hinges upon the success of the post-2020 climate regime. The active participation by every nation in the world is important, in order to reduce global greenhouse gas emissions. The Republic of Korea a non-Arctic state that is part of the new climate regime, has declared a commitment to reduce greenhouse gas emissions by 37% below BAU by 2030. The country is planning to achieve this mitigation goal through various means such as through the Emissions Trading Scheme, transitioning its current carbon-intensive energy paradigm to a more environmental friendly one, and by supporting the development of green technologies. At the same time, adaptation polices are increasingly becoming as important as mitigation efforts, since the Korean Peninsula is expected to experience higher increases in temperature and sea level than the global average.

In comparison to a sectoral approach taken by the first National Adaptation Policy, the Second Adaptation Policy puts its focus on pursuing an integrated and holistic approach. Trends in Korea's climate change policy show that formulating an integrated adaptation policy in the Arctic will be necessary and as important as concerns about climate change mitigation.

Mitigating various negative consequences from climate change and global warming is the most urgent task facing humanity. The Paris Climate Conference was a venue where the conflicting interests and concerns of various countries were aired, and there were many challenges to be overcome. Fortunately, a higher level of agreement was reached as a result of concessions and compromises made in the name of humanity's future. The Paris Agreement is considered to be great historical achievement, in that it includes all 197 developed and developing nations.

Core contents of the Agreement include strategies on mitigation, adaptation, long-term goals, market principles, review processes, technology and finance, and capacity building. Signatories agreed to major principles and future directions of the Climate Agreement. Unfortunately, the Paris Agreement is not legally binding, and there are weak provisions for enforcement. Thus, the successful implementation of the Agreement must depend on the good will and efforts of responsible countries. What remains now is to fully understand the basis and principles of the Paris Agreement, and to take specific actions for implementation of various aspects of the

Agreement. All countries, as part of the greater international society, should adopt a mid- to long-term perspective and take resolute actions for the future of each country as well as that of humanity. Furthermore, an institutional mechanism to ensure a transparent and fair review within the new climate regime should be established.

I believe that the new climate regime is a meaningful step in the right direction. I hope that it achieves far more than the Kyoto Protocol, which is considered to be only half a success. Also, to overcome the "tragedy of the commons," active participation by every nation in this endeavor is absolutely required. Moreover, it is important to make sure that words as written in the Paris Agreement actually translate into action. Considering the fact that nation-states lean towards making choices that serve national self-interests rather than global ones, it will be important for the international community to make an effort to adopt measures such as carbon taxes and give themselves enforcement powers to implement then. The Republic of Korea thanks to its geographical location and economic and global status, can act as a bridge between developed and developing countries, and it is prepared to take on that role with various lessons learned from its fast-growth experience. I am certain that the Republic of Korea and NPAC will be capable and active in leading the new climate regime towards success.

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Arctic Council Working Group

Lars-Otto Reiersen

THE STATE OF CLIMATE CHANGE IN THE ARCTIC: PAST, PRESENT AND FUTURE

The eight Arctic countries (Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden and the United States) established the Arctic Monitoring and Assessment Programme (AMAP) in 1991 as part of the Arctic Environmental Protection Strategy (AEPS). This entity was subsequently transferred to the Arctic Council in 1996. Over the last 25 years, AMAP has monitored and assessed the status, trends and effects of climate change and pollution on Arctic ecosystems and peoples. The area covered by AMAP studies is shown in Figure II.1. The Intergovernmental Panel on Climate Change (IPCC) and AMAP were initiated more or less at the same time, therefore a decision was made in 1991 that the main focus for the

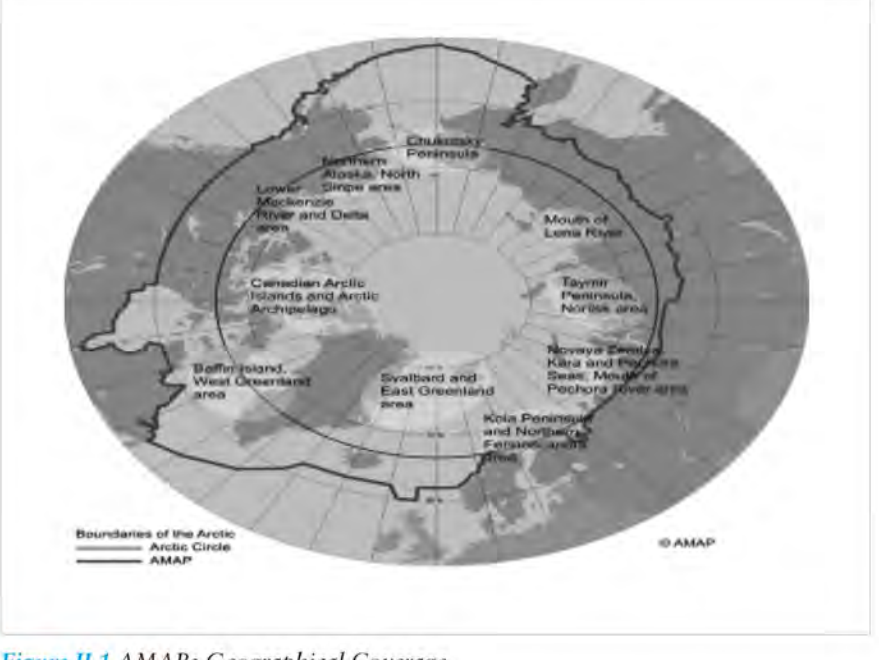


Figure II.1 AMAPs Geographical Coverage

first period of AMAP would be on monitoring and assessing the major pollutants believed to be affecting the Arctic. However, in the AMAP 1998 assessment, one of its major conclusions was a recognition that the IPCC did not substantively address data or models that included areas north of 60N. This realization led to an increase in AMAPs work related to climate change and ozone/UV in the Arctic. Since then, several scientific assessments have been created, including ACIA 2005, which was produced with IASC, AMAP 2011 (the SWIPA report), produced with IASC and CliC/WCRP, and AMAP 2013 (the Arctic Ocean Acidification report). There are currently new reports in the pipeline that will be launched in April/May 2017, including the Snow Water Ice and Permafrost in the Arctic—2 (SWIPA-2) and Arctic Ocean Acidification-2 (AOA-2). This paper presents some of the latest scientific results pertaining to relevant ongoing Arctic council activities implemented by AMAP.

The latest data shows that the temperature over northern and Arctic areas has increased more than twice the global average. The observed atmospheric temperature over the northern hemisphere and the area North of 60N is presented in Figure II.2. Over the last decade, the media has focused on the reduction of the minimum extent of Arctic summer sea ice and the resultant reduction in sea ice volume. As the sea ice melts, the color of the sea surface changes from white (due to ice and snow) to

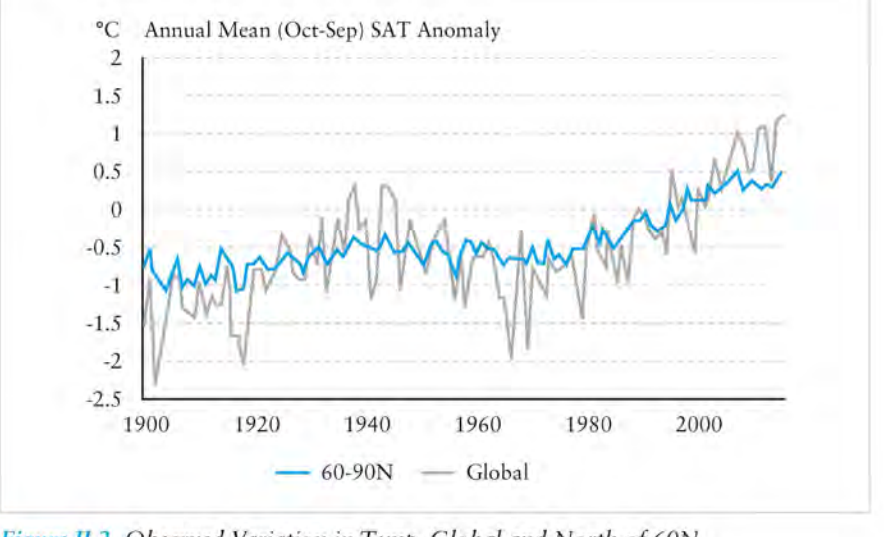


Figure II.2 Observed Variation in Temp, Global and North of 60N

blue, thereby reducing the albedo effect. This in turn results in reduced reflectivity of solar radiation and increased adsorption of energy from the sun into the sea. Equally important yet relatively uncovered in the media is the significant reduction in snow cover over land—both in terms of days of snow cover and total volume (Figure II.3). This reduction in snow cover generates a positive feedback loop; the change in color (darkening) of the land surface also further reduces albedo and leads to greater increases in the heat absorption. The change in albedo is the single-most direct cause of increasing temperatures in the Arctic. A further and related effect of the melting of sea ice and snow on land is the change in the timing of seasonal processes; spring-related transitions start earlier and the autumn lasts longer. Both of these extensions result in a shorter winter period in the Arctic (ACIA, 2005, AMAP, 2011).

Since 2008, AMAP has analyzed the effects of Short Lived Climate Forcers (SLCF)—including black carbon (BC), methane (CH_4), ozone (O_3) and organic carbon (OC). The AMAP 2015 report documents that the main driver of climate change in the Arctic is global greenhouse gas emissions – by far the most significant of which is CO_2. The total global mitigation of the non-CO_2, SLCF's alone could only reduce the warming of the Arctic by a maximum 0.5°C by 2050 (AMAP, 2015abc).

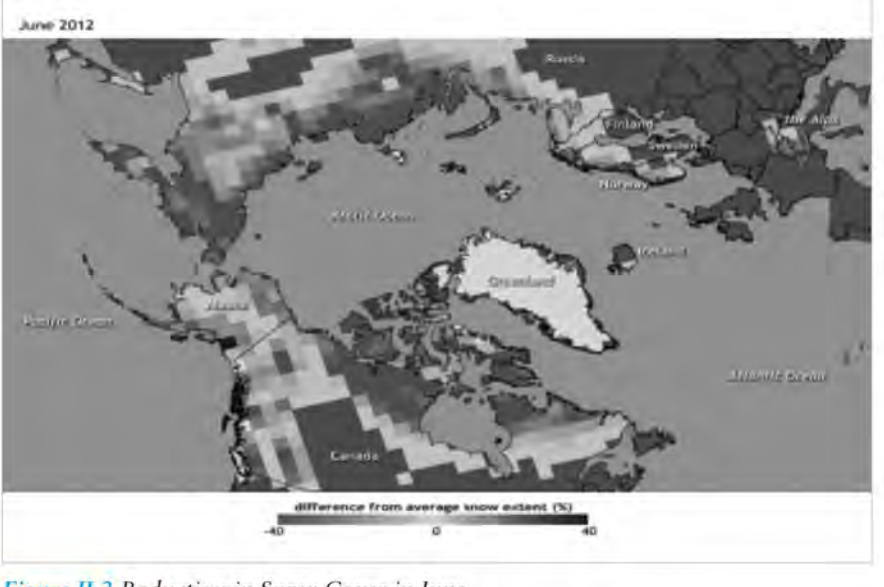


Figure II.3 Reduction in Snow Cover in June

The report, entitled "The Arctic Freshwater System in a Changing Climate" (CliC/AMAP/IASC, 2016), documents significant changes in the Arctic freshwater system linked to climate change. These and other changes will increase in the future as the climate continues to change in response to human activities such as the burning of fossil fuels. There are observed changes in precipitation and evaporation, in permafrost thawing, and ice conditions on rivers. The report also documents a significant increase of stored "freshwater" in the upper Arctic Ocean that may affect ocean circulation in the Arctic Ocean and adjacent seas. The current global-scale General Circulation Models (GCMs), coupled with new Arctic specific climate models, predict a future with an increased level of precipitation and freshwater runoff from the rivers as global warming continues. Evaporation is also projected to increase, especially in the winter, but the effects of changing cloud formation are currently unclear. Current and past changes in the distribution of continuous and discontinuous permafrost and river ice have already had significant impacts on infrastructure such as buildings, airport runways, and roads/ice-roads critical to transportation in the Arctic, and this is projected to continue.

The increase of CO_2 due to manmade emissions from burning fossil fuels not only increases the global temperature (the greenhouse effect), but also increases the amount of CO_2 in the oceans due to the passive transport of CO_2 from the atmosphere to the ocean over the surface film. This is a natural process: When there are more molecules (higher concentrations) of a substance such as CO_2 on one side of a membrane than the other side, then nature will always try to reduce the difference by passive transport over the membrane. The increased amount of CO_2 in the ocean will then affect the calcium cycle and lead to increased ocean acidification. In 2013, AMAP presented the Arctic Ocean Acidification (AOA) report, documenting that parts of Arctic oceans are becoming more acidic faster than lower-latitude global oceans. This is due to a combination of several factors. One is that cold water can store more gas than warm water. In addition, some of the largest rivers in the world are emptying fresh water into Arctic shelf areas, and consequently are reducing the alkalinity (the buffering capacity of the sea to acidification) of these waters. Many organic compounds released from upriver that affect both primary production and the carbon cycle when the sea ice is melting reduce the alkalinity of the surface water and reduce the concentration of calcium ions. Since the retreating ice creates more open-ocean areas, these new open-water expanses can absorb

more CO_2 from the atmosphere.

This increase in acidification will have both direct and indirect effects on Arctic marine life. Some marine organisms may respond positively to the new conditions associated with ocean acidification (e.g. some sea grasses), while others will be disadvantaged, possibly to the point of local extinction. Examples of direct effects include changes in growth rate (e.g. shell formation) or behavior and shell building (mollusks)—especially during early life stages. Indirect effects include changes in food supply to other animals (e.g. fish, birds and sea mammals) when seasonal migrations become out of sync with invertebrate reproduction, insect hatches and other food sources. Studies show that in some parts of Arctic oceans, the level of acidification may go critical within a decade or two (AMAP, 2013), corroding shellfish during key development phases. This may lead to cascading effects on other parts of marine ecosystems, and in turn may affect human harvests of marine species. AMAP plans to release a new assessment on Arctic Ocean acidification, focusing on the possible socio-economic consequences of the increase of acidification in parts of the Arctic Ocean.

Climate change and ocean acidification are not the only ongoing processes that affect Arctic marine ecosystems. Some of the world's largest fisheries (including shellfisheries) occur in the Arctic, and adjacent seas

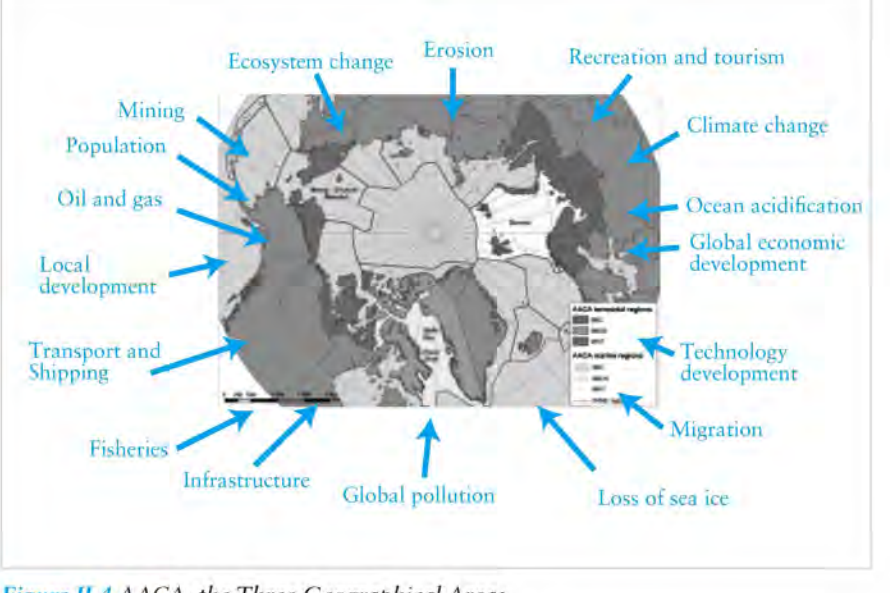


Figure II.4 *AACA, the Three Geographical Areas*

are affecting the marine ecosystems. An increase in aquaculture, shipping, and tourist activities may also affect these ecosystems. In addition, there is the ongoing, long-range transport of different types of pollutants (e.g. persistent organic pollutants and mercury) to the Arctic from industrial and agricultural activities further south. Some of these bio-accumulate to levels that create biological effects on Arctic species and humans (AMAP, 1998, 2002, 2015d). Finally, industrial and military activities in the north may have effects on the marine ecosystems, due to their traffic and discharges. All of these "drivers" and stressors occur at the same time, but to a different degree, depending on the exact location and combination of impacts. Therefore, the cumulative impacts of all of these mixed stressors are to some extent unknown. To clarify how best to prepare (adapt) for the future where all of these drivers and stressors act together, the Arctic Council, through AMAP, has initiated an assessment called "Adaptation Actions to a Changing Arctic" (AACA). This assessment focuses on three regions of the Arctic (see Figure II.4), and the results will be presented at the Ministerial meeting in May 2017.

FEEDBACK FROM THE ARCTIC ON THE GLOBE

"What happens in the Arctic does not stay in the Arctic" is a phrase that several politicians have used in recent years. One reason for this statement is a series of observed feedbacks. In AMAP 2011, there is a discussion about both positive and negative feedbacks, both of which can have substantial impacts on the region and globe. Examples of positive feedbacks (such as those that stimulate more warming) include the change in albedo, which progressively makes the Arctic darker and decreases solar reflectivity. An example of a negative feedback is the increase in clouds due to increased evaporation, which will reduce the amount of incoming energy from the sun that hits the ground/sea surface, thereby reducing warming. There has also been reported clear correlation between the Arctic summer sea ice extent and the weather in Southeast Asia, including changing monsoon seasons (Guo et al. 2013). Various extreme weather events, such as the increased frequency and severity of snowstorms in the southern and eastern United States, increased floods and droughts in parts of Europe and the Middle East, and forest fires in North America and Russia all appear to be linked to changes in jet streams and ongoing changes in the Arctic.

THE FUTURE

The modeling results made for SWIPA-2 (to be released in 2017) project a significant warming trend until 2100. The degree of warming is clearly correlated to what future global actions are taken and when they are implemented.

Figure II.5 shows two scenarios for projected increases in winter temperature (November – March) for the globe and the areas north of 60N. The two scenarios used, RCP 4.5 (with significant reductions of global greenhouse gas emissions) and RCP 8.5 (business as usual), have more or less the same development until 2040/2050, but thereafter they separate. This is due to the fact that there is already so much heat stored in the world's oceans, and so many greenhouse gas emissions already in the atmosphere from fossil fuel burning. These existing emissions will continue to have an impact, although significant global mitigation actions will slow the rate of global temperature rise in the future. As can be seen from the figure, the average temperature in the Arctic will be approx. 4°C higher in 2040/2050 than it is today. In 2100, if actions are taken according to RCP 4.5, projections are that we will have an average temperature increase in the northern areas of 6°C and a global increase of 3°C. If no actions are taken, it is projected that there will be an average increase of 12°C in the north and 6°C globally for the November-March period. Local and

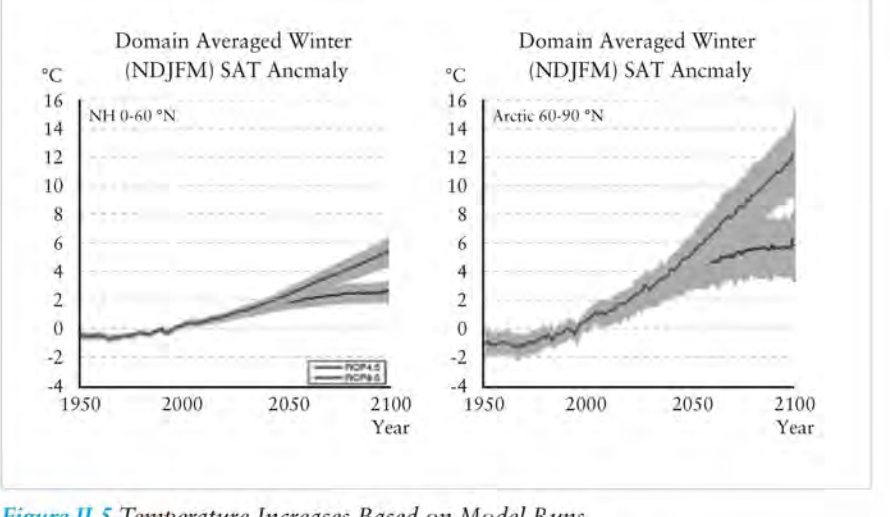
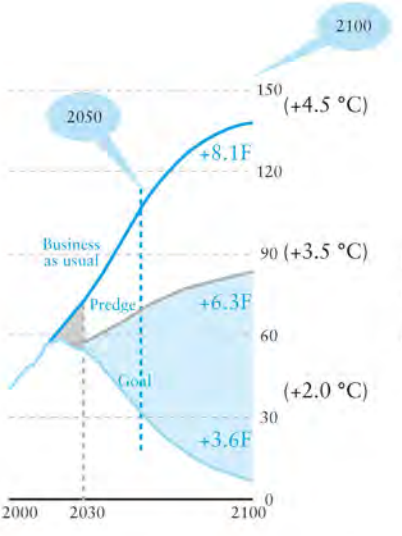


Figure II.5 Temperature Increases Based on Model Runs



Delegates in Paris will discuss a plan for **ratcheting up national commitments** over time.

Figure II.6 Paris Agreement—Three Scenarios

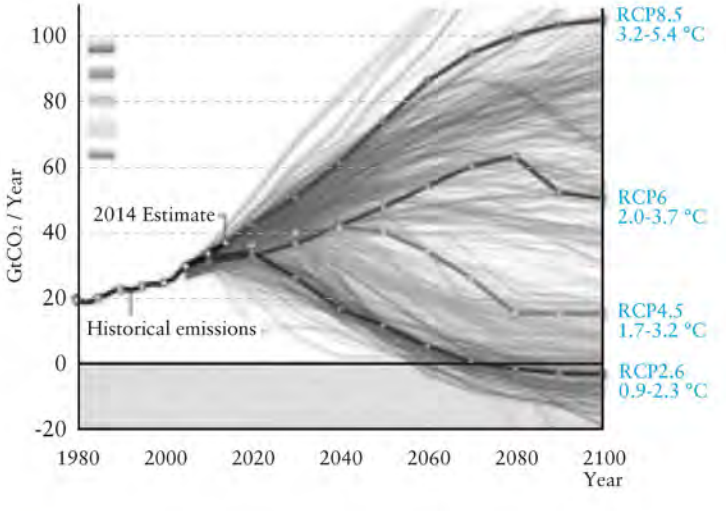


Figure II.7 Negative Emissions Needed to Achieve Goals from the Paris Agreement

seasonal variations might show higher and lower temperature increases. The COP-21 Agreement targets the cessation of temperature increases at 1.5°C - 2.0°C above the reference baseline. A key question related to these targets is whether or not mitigation (reduction of GHG emissions) alone can effectively get us to these targets. Recent studies by Smith et al. (2015) and others consistently show that due to the existing thermal inertia in the global climate system, even the complete reduction of all GHG emissions today would still lead to a global warming of 2.0°C or higher by the end of this century (Figure II.6). If so, then it appears that some form of climate intervention involving some form of manipulation of the atmosphere itself (Negative Emissions Technology, or NET) will be necessary in order to achieve even the 2.0°C target (Figure II.7).

WHAT DOES COP-21 MEAN FOR THE ARCTIC?

What is clear from the assessments and modeling work by AMAP and others is that by 2040 and 2100, the Arctic will experience significant changes (as will the rest of the world) compared to what we have been familiar with over the last centuries. These changing climate and environment conditions will affect humans, animals, and plants – and thereby economies, human health, and global societies. The degree of change that will occur in the Arctic will depend on actions taken by the global society, and how fast these actions are initiated. However, as mentioned above, we will not observe any significant desired changes as a result of current actions until after the 2040/2050 timeframe.

The longer we wait to take significant action, the longer it will be before the desired changes occur. Maybe even more significant is the fact that the longer we wait to take action, the more significant and aggressive our reduction policies will need to be. This includes incorporating more aggressive climate intervention strategies, and the use of NET in order to achieve the desired long-term atmospheric temperature outcomes.

The melting of snow and ice on land and sea will continue, especially in the spring-summer-autumn period. This situation has already triggered interest among private companies and countries to plan for the possibility of increased shipping, mining, oil and gas exploration and exploitation, and other commercial activities in Arctic areas. Whether this will happen depends on several other factors besides simply the rates of snow and

ice melt. Some key factors include the demand for Arctic shipping routes and Arctic resources, the cost of extraction and transportation, the global markets for these products, and the stability and security of both the physical and geopolitical environment.

Some of the world's largest fisheries occur in the adjacent seas of the central Arctic Ocean, including the Bering and Barents seas. With the sea ice melting, the sea ice edge will move north. As new ocean areas open up, it is unclear whether these areas will be able to support commercial fisheries, It is difficult to give a clear answer today because there are several important factors involved that will influence what may happen, such as food availability and optimal water temperature for various fish species. The central Arctic Ocean is a cold, deep- water area – with depths of as much as 2,000-4,000 meters. The main ongoing fisheries of benthic fish in the Barents Sea (100-400 meters deep) focus on the North East Atlantic cod population, and it is highly unlikely that this cod species will become a pelagic or bottom fish, capable of surviving at 2,000-4000 meters under the central Arctic Ocean. However, cod may be able to thrive along the continental edge that goes from the shelf down to the deep bottom. For pelagic fishes it might be a little different situation. Mackerel, for example, had rarely been seen north of 67N along the Norwegian coast until a decade ago. In 2007, however, mackerel schools were observed further north, and a few years later as far north as Svalbard, indicating that the changing conditions have provided sufficient food and an acceptable water temperature. Observations of chlorophyll in the ocean areas that are opening as the sea ice melt shows a clear primary production in these "new" waters, however, it is not clear if it will be enough to feed a large or commercially viable fish population. This will depend on several factors, such as availability of nutrients and stratification of water masses.

The thawing of the permafrost in the Arctic will continue, and with that more water will run to the sea and contribute to sea level rise (SLR). This thawing, along with an increase in precipitation, has been expected to lead to a greener Arctic. However, observations over the last decade show that some existing permafrost areas might be drying up, because water is drained away as a result of the thawing. Therefore, one cannot speak about only "one" new situation for the Arctic. There will be a variety of new situations. Some might be temporary during a transition process from the rather stable seasonal cycles for temperature and precipitation experienced over most of human existence, evolving to new and unknown future

conditions.

Observed changes in Arctic climate and hydrological systems have had significant impacts on several human and ecological activities and rhythms. This includes species appearing in previously undocumented habitat, changes in animal migrations and aggregation, human hunting possibilities, transport on ice-roads, building construction, and new parasites and diseases affecting both animals and humans, among other changes.

Water runoff from Arctic mountain glaciers and the Greenland Ice Sheet is larger today than the snowfall and freezing in these areas, thereby creating a net runoff that has a significant effect on SLR. In 2011, AMAP reported a net runoff from Greenland of approximately 200 Gigatons of water/year—an amount equal to approximately one meter of water spread all over Australia. This amount has increased since then, and is projected to increase as temperatures increase. Natural variations between years will occur, but the trend will be toward increasing amounts of water flowing into the sea, and thereby increased rates of SLR. The SLR will be further increased as a result of thermal expansion, since water expands as it warms, as well as in response to increased runoff from the Antarctic. SLR will inundate coastal areas and cities far away from the Arctic, but for Greenland the opposite effect will happen: As the ice melts, the weight of its pressure on the land will decrease, and Greenland is projected to rise in a phenomenon known as "isostatic rebound."

REQUIREMENTS FOR SUCCESS (REDUCTIONS AND INTERVENTIONS) TO ACHIEVE THE 1.5 -2.0°C GOAL

Several institutions have made calculations that document how much carbon is being emitted into the atmosphere every year. Figure II.7 shows the emissions that are projected to happen in the years ahead, according to the RCP 4.5 and RCP 8.5 scenarios, both of which are significant amounts, as well as what would happen if these emissions were reduced to zero by 2100. As seen from the figure, reductions in emissions are not likely to be sufficient to reach the Paris Agreement goal. We will have to harvest carbon out of the system to achieve the goals set in the Agreement. That pledge is also shown in the figure, and illustrates how far there is to go in order to achieve the stated goals.

THE NEED FOR A THREE-FOLD POLICY STRATEGY: MITIGATION, INTERVENTION AND ADAPTATION

Reduction of emissions of CO_2 and other GHGs is important, and this will require the introduction of non-carbon energy resources at a much more rapid pace than has been done to date. This includes finding new ways of building houses, fueling transport, and rethinking many aspects of modern life that will inevitably change the lifestyles of many societies. In considering the choices for such potentially disruptive intervention, it is important that the solutions chosen are based on sound science in order to avoid actions that create new, unintended consequences in the future. Some experts have already proposed that we begin geoengineering, for example by adding sulfur and other chemical components to the upper atmosphere that may reduce the amount of the sun's energy reaching the earth surface. Lessons learned from human history, however, where people have tried to solve a human-induced problem by introducing a new pollutant or "agent," do not bode well for this kind of "fast track" solution. We need to somehow "catch" vast amounts of carbon dioxide and remove it from the active climate system as soon as possible. This should be one of the top research priorities for research councils and private companies all over the world. There is, therefore, an imperative for close cooperation among science communities, businesses and governments to secure ample financial support and involvement of the major stakeholders.

In addition to reducing emissions (mitigation) and initiating interventions to harvest carbon dioxide, societies and companies need to develop adaptation strategies that are relevant for the situation—now and into the future. Adaptation strategies will be different for different stakeholders and geographical areas, but must be based on global, regional and local knowledge. In this work as well, a close cooperation among stakeholders and scientific community is important to find the most effective actions.

THE ARCTIC—A KEY ACTOR FOR GLOBAL PROBLEMS AND SOLUTIONS

For Arctic areas, the Arctic Council plays a key role in initiating and implementing large important science-based assessments (e.g. ACIA and

SWIPA) and research programs (IPY). Under the Arctic Council, AMAP has been asked to perform the first in-depth set of analyses on Adaptation Action for a Changing Arctic (AACA). Three regional reports involving two to four Arctic countries in each region are under preparation, and the results will be presented to the Arctic Council Ministerial meeting in May 2017. These reports will be essential for development of locally based adaptation actions and tools that will need to be developed and implemented in the forthcoming years by local, regional and national stakeholders.

In addition to the AACA reports, there are several new science reports related to climate change and its effects on Arctic ecosystems and humans under preparation by AMAP and other Working Groups under the Arctic Council. These science assessments will be significant platforms for further discussion on adaptation efforts in the Arctic—and how best to implement them.

In any forthcoming process to achieve the goals of the Paris Agreement, a close cooperation among Arctic Council countries, the IPCC, and international and private finance institutions is highly recommended. It is interesting to note that the eight Arctic countries and the twelve observing countries to the Arctic Council are currently responsible for more than two thirds of global CO_2 emissions. To solve the global problem, these 20 countries should therefore take the lead on actions for mitigation and intervention.

IMPLICATIONS OF THE PARIS AGREEMENT FOR THE ARCTIC

This paper has presented some of the ongoing changes and effects in the Arctic due to climate change and other human activities. Some of the most salient points include:

- Increasing volume of meltwater is coming out of the Arctic today, and this will continue to increase in the decades ahead. Sea-level rise related to this Arctic melting and other factors will also continue to increase.
- Based on current trends and analyses, even if countries achieved the reduction of global CO_2 emissions to set by the COP-21 agreements, it

is not likely that the Paris Agreement goal to limit global temperature increases at 2.0°C will be met. In fact, even a zero emissions target will very likely not achieve the limit. Thus, carbon has to be removed from the atmosphere in order to achieve the overall COP21 target.

- Even if the agreement is achieved, the reductions will unfortunately not be enough to stop much of the snow and ice melt and permafrost thaw in the Arctic.
- A global increase of average temperature of up to 1.5-2.0°C will most probably mean an increase of at least 3.0-4.0°C in the Arctic. Seasonal increases will likely be even higher, and may be the prime driver of multiple related climate change impacts in the Arctic.
- Arctic Council countries have a unique opportunity to be leaders in taking actions that can either exacerbate or prevent increasingly deleterious climate change related impacts and effects in the Arctic and elsewhere.
- Ultimately, it is the voice of the Arctic local and indigenous people that must be heard. The residents of the Arctic should have the first opportunity to take actions that will protect their long-term social, cultural, spiritual and financial welfare.

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Arctic Indigenous Communities

J. Okalik Eegeesiak

INUIT CIRCUMPOLAR COUNCIL AND THE ARCTIC CONTEXT

Inuit are an international people, and the Inuit Circumpolar Council (ICC) gives voice to more than 160,000 Inuit in Chukotka, Alaska, Canada and Greenland. As such, the ICC engages in a variety of national forums within the individual states where Inuit reside, as well as multilateral forums that include the Arctic Council and the United Nations. ICC works towards building a shared understanding of Inuit issues and our role in the management of Arctic resources and our communities' health. The cultural diversity and knowledge Inuit have to offer the global community, and how the global community can support the unique and vibrant Inuit culture, our way of life and our vision for the future remains a priority.

Inuit people formally organized in 1977, creating the Inuit Circumpolar Conference, which is now the Inuit Circumpolar Council. Brought together almost 40 years ago by Eben Hopson and other Alaskan Inupiaq, the ICC helps address global environmental and economic challenges affecting our communities. Since then, ICC has engaged with many different governments with different priorities and changing policies. However, our issues have remained the same: concern for the environment, wildlife, education, and Inuit health, with the ultimate objective of supporting socially and economically thriving communities.

This paper will discuss the Arctic context and overarching conditions that affect efforts to enhance Inuit capacity, and highlight recent accomplishments of the ICC within the context of international climate change activities. This will be followed by an overview of COP21 and the Paris Agreement (Agreement), specifically the ICC's involvement in COP 21 and a discussion of relevant articles of the Agreement for Inuit and the Arctic. Follow-up events from the Paris conference and movement towards COP22 will then be addressed along with information about Canadian and U.S. commitments on climate change concerning the Arctic and Inuit. Finally, Inuit engagement in the UNFCCC moving forward and current adaptation actions will be highlighted.

Inuit have occupied the circumpolar Arctic for millennia. We have lived through famines, the Little Ice Age, Vikings, whalers, missionaries, residential schools, international regulations that have affected important cultural practices, (such as the seal hunting ban), and successive governments of different countries. We intend to live with and through climate change. That said, it is crucial to remember that the issue of climate change is not an isolated challenge. The people of the Arctic are experiencing considerable socioeconomic change as well as climatic change. The variety and number of forces bearing down on the Arctic and Inuit create cumulative challenges and opportunities.

This July, NASA's analyses of ground-based observations and satellite data reported that two key climate change indicators—global surface temperatures and Arctic sea ice extent—had broken numerous records through the first half of 2016. Each of the first six months of 2016 set a record as the warmest respective month globally in the modern temperature record, which dates to 1880, according to scientists at NASA's Goddard Institute for Space Studies (GISS) in New York. The six-month period from January to June was also the planet's warmest half-year on record, with an average temperature 1.3°C warmer than the late 19th century.

However, climate change is only one of many compounding pressures affecting Inuit today. Suicide rates are high in the Canadian Arctic, and mental health is a serious and massively underfunded and underserviced concern. Life expectancy statistics for Inuit are well below the levels of any non-Arctic people, food insecurity is increasing, housing is inadequate in both quantity and quality, success rates in schools remain despairingly low, and international regulations and actions restrict our rights, such as the right to hunt species we use as food and trade for currency.

Recently, the Inuit Tapiriit Kanatami released their National Inuit Suicide Prevention Strategy, which speaks to the cumulative impacts of multiple challenges faced by Inuit communities, and the need to address all the issues simultaneously to achieve social equity and effect meaningful change. The same is true of climate change. We cannot look at one impact, or one source of emissions, or one adaptive strategy. Rather, we must look at the entire Arctic and all its parts, living and non-living. We must consider the past, the present and the future that we as Inuit and the global society envision for the Arctic. We must take into account the history of relocation, residential schooling, sled dog slaughters and other colonialist acts that are the root for much of the intergenerational trauma Inuit communities

are living with today. We must address climate change as a fundamental challenge that exists within the broader context of cumulative societal challenges. This is daunting, but it is also possible. We are in an era of reconciliation and, with that, optimism for our future. We have come a long way, and while we cannot forget our history, we must forge partnerships built on understanding and of shared values as we imagine together the opportunities of the Arctic.

In addressing the consequences of climate change and efforts to enhance the capacity of communities within the Arctic to respond, new socioeconomic futures must be envisioned, since we cannot predict the consequences of the rate of change occurring in the Arctic. Nor can we predict the potential and real impacts of various adaptive strategies conceived often in the south. We must be proactive rather than reactive, and identify key investigations/studies to explore economic opportunities. We must plan for development and growth, and analyze potential risks arising from climate change and other hazards. We must develop strategies to move beyond the challenges of climate impacts in our communities. These strategies must reflect Inuit realities, they must be supported by national legislation, international instruments, and the best available knowledge systems, including indigenous knowledge.

Inuit will meet the challenges of a changing Arctic and rise to the opportunities of the Arctic when:

- *We maintain kinship ties to our families in Greenland, Canada, Alaska, and Chukotka and learn from each other.*
- *We achieve the same level of health care, education and opportunity afforded to other people in our countries so our communities are healthier.*
- *We are able to live on and maintain our relationship to our land and sea and harvest our wildlife, with the uncertainty of climate change.*
- *Our indigenous knowledge system is valued and used alongside other knowledge systems for evidence-based decision making in designing strategies to adapt to climate and societal change.*
- *The national and international community respects and recognizes our cultural practices, while valuing our shared understanding of the Arctic and its global importance.*
- *We have our rights respected and recognized, including, as Sheila Watt-Cloutier said, "Our Right to be Cold."*

- *We have free, prior and informed consent in relation to any action that affects our lives, lands and resources as climate change policies are implemented.*

Indeed, these conditions will enhance the capacity of Inuit to respond to environmental, social, economic, and cultural changes that face our communities.

We need not start from scratch. Much has been accomplished in moving forward to ensure our communities have the tools to address the challenges we face and create opportunities for our youth. More recently, these accomplishments include many national and international efforts:

1. We have seen the Arctic Council chairmanship move from Canada to the United States. The U.S. chairmanship is focused on improving the lives of Arctic residents by addressing issues that are important in our communities, including our health, our climate and our economies.
2. The ICC has participated in various gatherings and visioning exercises, such as the Wilton Park Conference and the International Arctic Assembly, at which we have highlighted matters of importance to Inuit. Inuit believe in a vision. It is a vision that is reflective while looking forward, and is guided by our past to inform our future. This visioning must be grounded in an understanding of the challenges that rapid and unpredictable change is bringing to our communities. This grounding will result in evidence- based decision-making in the Arctic with equitable input from all knowledge systems. While scientific research must always be valued, equal importance must be placed on indigenous knowledge, which is all too often ignored to the detriment of all.
3. The European Union launched a new Arctic policy that is more reflective of Arctic realities. This policy is important, as it exemplifies the interest in the Arctic from all corners of the globe. The new EU Arctic policy states that, "The Arctic is an area of growing strategic importance. The European Union has an important role to play in supporting successful Arctic cooperation and helping to meet the challenges now facing the region."
4. We are forging new partnerships with other Indigenous Peoples, governments, industry, foundations and NGOs that respect Inuit values and visions, as we recognize that we are stronger when we

work together.

5. We contributed to productive conversations at the Arctic Circle Forum, where I urged the delegates to leave the forum with new partners and to shift their views of the Arctic, moving beyond the challenges of the changing Arctic to the imminent opportunities. I asked that we be bound by a foundation that ensures a safer and sustainable Arctic in the decades ahead, as we look towards a developing comprehensive Arctic policy, Inuit economic aspirations and a shared future.
6. Circumpolar Indigenous Peoples from Canada, Greenland, Alaska and Russia participated in the United Nations Permanent Forum, an important venue for the promotion of dialogue among governments, Indigenous Peoples and the UN system. It also provides an opportunity for Inuit in Alaska, Canada, Greenland and Chukotka to cooperate and collaborate with the larger global indigenous community on the many issues and opportunities before us. Inuit added our voices to those of Indigenous Peoples from all regions of the globe and called for appropriate resources to participate in achieving the 2030 sustainable development goals. ICC applauded the advances made by various Arctic States to recognize the rights of Indigenous Peoples and urged countries to actively commit to the implementation of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in their countries.
7. In December 2016 in Paris at the UN Climate talks, I led a delegation of Inuit leaders and youth to bring our voices to the international table. We worked hard to negotiate for real action—to stabilize warming to 1.5°C rather than 2.0°C—and for the recognition of the rights of Indigenous Peoples in the core of the Agreement, which is legally binding. In the end some of the language was included in both the preamble to the Decision Document and the Agreement and acknowledges the unique and differentiated rights of Indigenous Peoples. The ICC also advocated for financing of climate adaptation and mitigation projects and the recognition of Indigenous Peoples' knowledge. Although the outcome was better than expected, the final agreement is only a global life raft that gives the world a little more time to address the issue of CO_2 emissions. As the climate talks concluded, every major news article on the Paris Agreement featured a photo of the Arctic. At the same time, Singapore convened an Arctic

shipping conference where they, China, India, Korea and others noted they have an eye on opening routes across the Arctic Ocean as a result of climate change. It was difficult to simultaneously watch this and see how hard it was for Inuit to make the world understand the Arctic sea ice is our *Nunaat*, which means our source—of both spiritual and corporal sustenance.

8. In September 2016, Inuit attended a meeting at the White House to speak with Arctic Science Ministers, the first meeting of its kind. This was another opportunity to share our knowledge and our vision for the future, including the research we believe is critical to lead, be part of, and support.

COP21 AND THE PARIS AGREEMENT

The Paris Agreement aims to strengthen the global response to the threat of climate change by limiting the increase in global average temperature to below 2°C above pre-industrial levels and to pursue efforts to limit temperature increases to 1.5°C above pre-industrial levels. The Agreement identifies the level of global ambition for tackling climate change, and highlights the fact that the parties have common but differentiated responsibilities and capabilities when it comes to climate action. Furthermore, the Agreement identifies ways in which developing countries and countries that are particularly vulnerable to a changing climate can be supported, including climate financing, capacity-building, and technology development and transfer.

The adoption of the Paris Agreement on December 12, 2015 was an important milestone in the work of the UNFCCC. It is a complex, carefully balanced document. In order to ensure its adoption, "constructive ambiguity" was woven throughout the text, allowing for different interpretations over time. This has shaped the discussions of the subsidiary and constituted bodies under the Convention as parties began to unpack and flesh out the Paris Agreement. In addition to the constructive ambiguity of the text, the negotiations in Paris produced considerable compromise, both with regards to the degree of ambitious action the parties will take to address climate change, and with regards to ensuring international recognition of the fact that climate change has implications for human rights and for the rights of Indigenous Peoples. Is it enough to "save" the

Arctic? The test will really come in the commitments that countries make in implementing the Agreement.

INUIT CIRCUMPOLAR COUNCIL AND COP21

ICC attended UNFCCC COP21 as an ICC delegation, in addition to our participation as part of the Arctic Delegation to the International Indigenous Peoples Forum on Climate Change (IIFPCC), and on individual country delegations such as the Canadian delegation. While in Paris, Inuit delegates from Greenland, the United States, and Canada lobbied to advance the interests of Inuit and other Indigenous Peoples around the world as the Paris Agreement text was being finalized.

Inuit collaborated with Indigenous delegates and others to advocate for recognition of the effects of climate change on the rights of Indigenous peoples, as well as the recognition of the important long-standing role of indigenous knowledge in climate adaptation and mitigation. Additionally, Inuit Circumpolar Council and Inuit delegates collaborated with Saami Council and the Saami delegates to raise the profile of the Arctic during the negotiations.

ARTICLES OF THE PARIS AGREEMENT IMPORTANT TO THE ARCTIC AND TO INUIT

Within the Paris Agreement, paragraphs in the Preamble, Article 2 and Article 7 are particularly relevant to Inuit and the Arctic. In Paragraph 11 of the Preamble, the rights of Indigenous Peoples are highlighted and parties are directed to "respect, promote and consider their respective obligations" concerning these rights, among others, when taking action on climate change. This is an important consideration for Inuit because recognition that climate change affects the rights of Indigenous Peoples ensures that the world understands what is at stake. Specifically, cultural diversity must be seen to be equally as important as biodiversity.

In Article 2, Paragraph 1(a) discusses sustainable development and efforts to eradicate poverty as part of the context in which global efforts to address climate change and its corresponding threats occur. Part of this global response included specific targets and agreed-upon aims: limiting

global average temperature to "well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels"; supporting and enhancing adaptive capacity along with "climate resilience and low greenhouse gas emissions development"; and promoting finance flows towards this type of development. The ICC pushed for a target of 1.5°C, which would significantly reduce the risks and impacts of climate change and more specifically limit the extent of impacts on Arctic ecosystems. The less ambitious 2.0°C target was agreed to, and this unfortunately will ensure significant climate related impacts to Inuit communities.

Article 7 is especially significant for Inuit and the Arctic, with several paragraphs particularly important due to inclusion or omission of certain information. For example, in Paragraph 5, parties agree to acknowledge the need for adaptation action to be participatory, consider vulnerable groups, communities and ecosystems and, "be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems." However, reference to local, traditional, indigenous knowledge systems is omitted later in Article 7 where, in Paragraph 7, the text discusses strengthening cooperation to enhance adaptation action by, as one point states, "Strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making." Likewise, Paragraph 9 also lacks inclusion of any focus on Indigenous Peoples when it mandates parties to "engage in adaptation planning processes and the implementation of actions" which include the following: (1) vulnerability assessments to inform and contribute to prioritizing responses "taking into account vulnerable peoples, places and ecosystems"; (2) monitoring and evaluation to draw lessons for adaptation; and (3) "Building the resilience of socioeconomic and ecological systems, including through economic diversification and sustainable management of natural resources." The inclusion of Indigenous Peoples and indigenous knowledge in this text is appropriate, constructive and necessary, for example the inclusion of sustainable management of natural resources.

With its focus on a state-driven approach to addressing climate change, as well as on supporting developing countries and parties that are vulnerable to climate change, the Paris Agreement makes only one reference to Indigenous Peoples and to Indigenous Peoples' knowledge respectively.

Additionally, in spite of the efforts of Inuit and Saami delegates to raise the profile of the Arctic, the Agreement makes no reference to the Arctic, its role in maintaining global environmental systems, or the dramatic changes already being seen in the region and the impacts on Inuit people and culture from this rapid rate of change.

However, the Agreement recognizes the value of engagement by all levels of governments and a variety of actors in addressing climate change (see Paris Agreement, preamble, paragraph 15). This, in addition to the work of the ICC at the Arctic Council, offers Inuit several entry points for active engagement with various states on climate mitigation and adaptation. Furthermore, throughout COP 21, Inuit delegates participated in side meetings and produced statements that not only raised the profile of Inuit and the Arctic, but also contributed to Inuit relationship-building with Arctic Council states and permanent participants, as well as circumpolar Inuit political leadership. A selection of these events:

- Okalik Eegeesiak and Reggie Joule met with U.S. Secretary of the Interior Sally Jewell to discuss the U.S. chairmanship of the Arctic Council.
- ICC issued a joint press release with the Saami Council, Inuit Tapiriit Kanatami, the National Inuit Youth Council, the Pacific Indigenous Network, and the Ambassador on Climate Change from the Republic of Seychelles, calling for a 1.5°C limit to global warming.
- ICC and the governments of Nunavut and Greenland released a joint statement on climate change.

BONN, MAY 2016: UNPACKING THE PARIS AGREEMENT AND MOVING TOWARDS COP22

The finalization of the Paris Agreement is important because it signals the intention of the global community to act in the face of the changing environment.

However, the pace of transition from political negotiations to technical work mode will prove to be an important indicator of international will to address climate change.

From May 16-26, 2016, several months following the Conference of Parties in Paris, Parties met in Bonn for the first climate change conference

since the adoption of the Paris Agreement. This was the first meeting of the Ad Hoc Working Group on the Paris Agreement (APA). The Subsidiary Bodies for Implementation and for Scientific and Technological Advice (SBI and SBSTA, respectively) also met over the course of the ten days and were to address a number of topics that had been set aside in the lead-up to COP21. The priorities of the Ad Hoc Working Group on the Durban Platform negotiations included national adaptation plans, arrangements for intergovernmental meetings, and appeals against decisions of the Clean Development Mechanism and the Executive Board.

The International Institute for Sustainable Development (IISD) Environmental Negotiations Bulletin (ENB) IISD/ENB reports from these meetings (http://www.iisd.ca/climate/sb44/) indicate that momentum was still high. There was pressure to keep the "spirit of Paris" alive with 175 signatories to the Paris Agreement at the high level ceremony in April, 17 ratifications already submitted,[1] the promise of ratification in 2016 by the world's two highest emitters (China and the United States), and discussions about early entry into force before the 2020 planned date. (Prior to the COP22 meeting in Marrakech in November 2016, the Paris Agreement was ratified, including both the U.S. and China.)

The objective of the Bonn Climate Change Conference was to unpack the Paris Agreement, identifying the gaps, synergies and overlaps in the tasks and mandates it outlines for the subsidiary and constituted bodies under the convention, thus setting the stage for a successful meeting of COP22 in Marrakesh that took place in November 2016. The Bonn meeting marked a transition into the technical mode of work mandated by the Paris Agreement.

In spite of the progress made in Bonn, some participants pointed out that many of the technical discussions contained political undertones. This is due to the careful balance and constructive ambiguity struck in the Agreement, particularly about common but differentiated responsibilities for climate mitigation. Our question is, "What does this mean for Inuit and the Arctic?"

The APA 1 discussions highlighted differing views on guidance for national determined contributions (NDCs), with some parties recommending guidance offered by type (e.g. economy-wide targets or intensity targets), with others recommending guidance by status as developed or developing nation. Similarly, SBI was unable to come to an agreement on modalities and procedures for a single public registry or

two separate registries for NDCs and adaptation communications, due to a longstanding call from developing countries to give adaptation and mitigation equal status. Inuit agree with this point, as one must work on both to achieve results. In the Arctic however, there are few opportunities to contribute meaningful reductions of CO_2 emissions, aside from heating and transportation. Inuit communities are experimenting with both of these sectors through demand-side reduction and renewable energy supply alternatives, but our overall consumption rates are comparably very low.

According to IISD/ENB, the SBI and SBSTA meetings produced significant results, closing with calls for submissions, requests for technical papers from the Secretariat, as well as technical workshops. APA 1 in contrast, concluded solely with calls for the submission of views on all but one of the APA's agenda items. This led to concerns that parties would be under-equipped leading to COP22, due to the substantial amount of work that is expected, particularly given that there have been calls for early entry into force of the Agreement. However, reports indicate that APA 1 was a relative success, noting that the constructive spirit that infused the week of agenda consultations reflected trust and confidence among the parties and the APA co-chairs.

Overall, the Bonn Climate Change Conference is reported to have made important progress unpacking the Paris Agreement. The meetings kick-started the technical work required for the implementation of the Agreement and sent a signal that the UNFCCC has kept its momentum following COP21 and is on track to deliver its mandates. Meeting participants noted that COP22 was expected to be an "implementation and action COP."

Under "implementation," negotiations are expected to focus on loss and damage, as well as a facilitative dialogue on finance. With respect to "action," the Bonn meetings reiterated calls to engage with non-state actors in climate action. Many meeting participants view this as a sign that it is now a given that the Paris Agreement will not be fully achieved without the active participation of non-state actors in the UNFCCC process.

Once again, not being able to attend these meetings put Inuit at a disadvantage in being an active player in decisions that affect our future. The ICC will review these events and formulate our participation and positions for COP22.

CLIMATE COMMITMENTS FROM CANADA AND THE UNITED STATES

Canada signed the Paris Agreement at a high-level ceremony on April 22, 2016, then ratified the agreement in October 2016. The Canadian government has identified climate change as a top priority and has announced its intention to work with provinces, territories, cities and Indigenous Peoples. The government plans to take action based on scientific evidence and is particularly focused on investing in clean energy growth and policies that support low-carbon economies, including carbon pricing mechanisms adapted to provincial and territorial realities, as well as existing conditions in Arctic and sub-Arctic regions. This process has begun, yet Inuit and other Indigenous Peoples are not at the working group tables and are, once again, outside looking in, unable to share Inuit priorities and direction.

The United States was also a signatory of the Paris Agreement and ratified the agreement in September 2016. As part of its efforts to address climate change, the U.S. has committed to investing in clean energy and addressing the security implications of climate change.

In March 2016, Canada and the U.S. released a Joint Statement on Climate, Energy and Arctic Leadership. It indicates a commitment to address these three issues through the lens of "integrating indigenous science and traditional knowledge into decision making" and acknowledged that our shared Arctic rests on the lands and territories of indigenous peoples who possess a wealth of knowledge and cultural diversity. Leaders not only identified the value of indigenous knowledge, but also stated that,

> *"Canada and the U.S. are committed to collaborating with Indigenous and Arctic governments, leaders, and communities to more broadly and respectfully include Indigenous science and traditional knowledge into decision making, including in environmental assessments, resource management, and advancing our understanding of climate change and how best to manage its effects."*

Emission reductions, enhanced transparency, capacity building, and adoption of the Montreal Protocol for reduction of hydrofluorocarbons were among the specific commitments in this statement. Perhaps most importantly for Inuit and the Arctic, both countries committed to continue to respect and promote the rights of Indigenous Peoples in all climate

change decision-making and pursue a shared model of Arctic leadership. This model of Arctic leadership has four objectives:

1. **Conserving biodiversity through science-based decision making.** This will call for collaboration and partnership between states and indigenous partners, and using indigenous knowledge to develop pan-Arctic marine protection areas.
2. **Incorporating indigenous science and traditional knowledge into decision-making.** To do this more broadly and respectfully will involve working with indigenous and Arctic governments, leaders, and communities.
3. **Building a sustainable Arctic economy** by working to build a shared and science-based standard for considering the life-cycle impacts of commercial activities in the Arctic.
4. **Supporting strong communities** by developing new approaches and exchanging best practices for strengthening resilience of Arctic communities and continuing to support the well being of Arctic residents while respecting rights and territory of Indigenous People.

Furthermore, the U.S. and Canadian governments have announced a commitment to work in partnership to implement land claims agreements to realize the social, cultural, and economic potential of indigenous and northern communities. They have also committed to develop a plan and timeline for the substantial integration of renewable energy in the Arctic. Further, both have committed to addressing the challenges of mental wellness, education, indigenous languages, and skill development, particularly among indigenous youth. This model of Arctic leadership will be advanced through the Arctic Council.

INUIT ENGAGEMENT IN THE UNFCCC PROCESS: THE WAY FORWARD

Although discussions are ongoing, ICC remains optimistic that funding will be confirmed so that the Arctic Region (i.e. ICC or Saami Council) will attend COP22. An ICC delegation should be attending COP22 and participate in the inter-governmental dialogues in order to be aware of and continue support what the IIPFCC is working on and move Inuit interests

forward. That being said, the IIPFCC's global steering committee (GSC) is moving ahead with plans for an inter-governmental dialogue between states and global Indigenous peoples, modeled on the one held in Paris, that would be held a few days before COP22 opens.

While the degree of ICC's formal participation in COP22 is yet to be determined, there are several possible paths for Inuit engagement in activities and events related to the conference, such as through side events. Within these venues, the key aspects that ICC will strive to highlight include the Inuit-state working relationship, circumpolar collaboration with Indigenous peoples, and Inuit activities in raising awareness of human rights and climate change. ICC has submitted an application for a side event titled "Leadership during transition—effectively using Inuit Knowledge and science to inform adaptation." Building on Article 7 of the Paris Agreement, this side event will discuss examples of leadership, cooperation and innovation shown by Inuit at local, national and international levels in their efforts to adapt to a rapidly changing Arctic and have their voice shape Canadian and international policy. If approved, this side event would not only highlight the Inuit-State working relationship, but also showcase best practices of combining Inuit Qaujimajatuqangit and science for adaptation policy development. It may also showcase the contributions Inuit Tapiriit Kanatami, Canada's national Inuit organization, is planning on making to the Federal-Provincial-Territorial working groups to develop Canadian Inuit priorities and recommendations for action on climate change in October 2016.

The side event would also complement the work that Inuit Tapiriit Kanatami is doing to revitalize the National Inuit Climate Change Committee, as well as Article 7 of the Paris Agreement, and the Canadian Prime Minister's statements at COP21 about the importance of Indigenous knowledge in addressing climate change. It would also connect with Canada's commitment to UNDRIP and the government's intentions to ratify the Paris Agreement in fall 2016. Lastly, this side event would also serve to raise the profile of Inuit and the Arctic and provide a venue to voice Inuit-specific concerns and priorities related to climate change.

Another side event opportunity could showcase the best practices of the Arctic Council as a model for collaboration and cooperation between states and Indigenous peoples and highlight the work ICC does as a permanent participant. This would relate to Article 7 of the Paris Agreement and serve as an example of the role of non-state actors in addressing climate change.

It would tie into the Arctic Council SAO decision made in Fairbanks, which states that the Arctic Council should engage more with the work of UNFCCC as well as other Arctic Council work.

Finally, the Human Rights and Climate Change Working Group is considering a Human Rights day in Marrakesh during the COP22 proceedings. ICC could be involved in some of the programming on that day to build directly on ICC's work last year with the IIPFCC, which focused lobbying attentions on recognition of Indigenous peoples' rights. It would also build on the partnership between ICC and the HRCCWG that has been more dormant in recent years. Again, participating in this event would raise the profile of Inuit and the Arctic and highlight the long history Inuit have of raising awareness about Human Rights and Climate Change, and serve to renew ICC's relationship with the HRCCWG.

ADAPTATION STRATEGIES: MOVING FROM AWARENESS TO ACTION

Great interest has been expressed by people around the world in the issues facing the Arctic, both for our culture and for our land. The Arctic truly has the global consciousness spellbound, including those who want to use it, ship through it, explore it, mine it, and protect it. For Inuit, the Arctic defines who we are: a pragmatic culture. Inuit base decisions on our indigenous knowledge of our past, our present and our future, which is a knowledge system based on observing, testing and orally passing down knowledge. Acquisition of Inuit knowledge continues today as we adapt to the changing Arctic. The challenge for Inuit mirrors the challenges presented by climate change, since the pace of change may outstrip our ability to adapt. Similarly, the pace of environmental change may outstrip the ability of some plants, animals, and ecosystems to adapt fast enough to avoid extinction and widespread ecological disruption.

Some believe there is a governance vacuum in the Arctic. This is not the case. Inuit must constantly remind the world that we are here with governance systems that work for us, when run by us and directed by us. We sometimes find it daunting that so many people and so many interests from outside the Arctic have such detailed and energetic plans for our future and for our homeland, often implemented without our input, knowledge or consent.

No adaptation action will be fully effective or successful unless Indigenous Peoples are equal partners in discussions and decision-making. We know that one unquestionable way to empower Inuit views is to meaningfully implement the right to free, prior and informed consent as affirmed in the UN Declaration on the Rights of Indigenous Peoples. The UN Declaration and other international human rights instruments elaborate upon the need to ensure that Indigenous Peoples have heard, discussed and prioritized whether or not they will give or withhold their consent and determine for themselves the nature of safe and sustainable use of their resources.

Inuit are already actively leading and participating in adaptation actions at local, regional, national, and international levels. We have been working with the Arctic Council Arctic Monitoring and Assessment Program's Adaptation Actions for Changing Arctic (AACA) in the production of three regional assessments: 1) Bering, Chukchi, Beaufort; 2) Baffin Bay Davis Straight; and 3) Barents Region. The next step will be to develop a synthesis document that will allow policymakers to assess the integrated knowledge from these three assessments.

These assessments discuss various adaptation actions, with the aim of assisting in policy- and decision-making. For example, the assessments not that economic opportunities within the fisheries, shipping, cruise tourism, and resource exploration sectors are of interest to northern residents, and will be increasingly possible considering climate projections for the Arctic region (such as declines in sea ice opening up shipping routes). However, infrastructure requirements are substantial and currently not available in the Canadian Arctic (such as deep water ports). This presents an ideal opportunity to mainstream adaptation efforts. At the same time, we must enhance education and training opportunities for Inuit to create better access to programs and education that can provide the background and skills needed for employment and business opportunities in expanding sectors. Lastly, the assessments highlight the need for flexible governance, knowledge sharing, communication, and outreach as a basis for any adaptation-related action in the Arctic.

In addition, the ICC joins Indigenous Peoples from around the world in calling for substantial resources to collaborate with the UN and its agencies. Funds and programs are essential to ensure our direct and effective participation in achieving the 2030 sustainable development goals. More specifically, we encourage and support the establishment of a global

fund for financing the participation of Indigenous Peoples to international meetings dealing with indigenous issues, and that any such fund is established and managed by Indigenous Peoples themselves.

Inuit have a will for sustainable and equitable development, but it must be in accordance with our aims, our values, our ethics and on the basis of fair conditions and real partnership. This is not a lot to ask for. After all, the Arctic is our homeland. We live here and we intend to ensure that our future generations live here as well. As the world looks northward for resources, shipping, fisheries and tourism, Inuit voices must be heard. We must be part of any decision making in and for our Nunaat, our "source." The utilization and value of our knowledge systems must be employed. Inuit aspire for positive change, to seek productive and respective partnerships, and to work together for a sustainable and more secure Arctic. Indeed, being part of the planning, researching, and governance of evidence-based decision-making will ultimately lead to a more sustainable Arctic and thriving Arctic communities.

CONCLUSION

Inuit live in four countries with four very different political realities and relationships with their respective national governments, yet we are one through our language and our culture. It is said that boundaries between disciplines are largely artificial, and addressing the world's problems requires combining knowledge in new ways. This sentiment resonates with me because Inuit believe that global problems need global solutions. I would suggest that boundaries between countries and among people are also largely artificial. By communicating and listening and learning from each other, and by combining our collective knowledge, we can find solutions to complex challenges such as climate change. We have much to share about global relationships and Arctic issues, and we look forward to contributing to positive progress in implementing agreements that commit to working with Indigenous Peoples.

Our simple message is: Talk with us, not to us. Hear what we have in our minds and in our hearts. Learn what our concerns are. Learn from what we have learned. Include us in decision-making at every level, and at every stage.

Notes

1. As of February 8, 2017, of the 197 Parties to the Convention, 129 have ratified the Agreement, accounting for nearly 80% of global GHG emissions

Arctic Council Permanent Participants and Climate Change

James Gamble

HISTORY OF THE PERMANENT PARTICIPANTS

The six Indigenous Peoples' organizations that are Permanent Participants (PPs) of the Arctic Council (AC) are as varied as the people, geographic regions, and cultures they represent. What they do have in common, however, is the challenge of representing their constituencies to and contributing to the work of an ever- expanding AC, which in many cases has grown faster than the PPs have been able to adapt.

Indigenous organizations have been involved in international work through entities like the United Nations since long before the AC existed. There is a longstanding and growing realization among industry, policymakers, and scientists that indigenous knowledge could not only be useful, but in many cases was essential to understanding the Arctic. Not only this, but in many cases Indigenous Peoples were and are landowners and rights holders in the Arctic. As a result, consultation, negotiation, and agreement with the people who live on the land is in many cases settled national and international law.

In the earliest seeds of the AC (the Rovaniemi Process), the notion that the Indigenous Peoples of the Arctic should have a seat at the table was already stated. When the Rovaniemi Process was formalized into an agreement among the eight Arctic states to form the Arctic Environmental Protection Strategy (AEPS), three organizations were established as observers when the following was stated, "*In order to facilitate the participation of Arctic indigenous peoples the following organizations will be invited as observers: the Inuit Circumpolar Conference, the Nordic Saami Council and the U.S.S.R. Association of Small Peoples of the North.*" Two years later, when membership in the AEPS grew and was given additional responsibilities, it became the Arctic Council. At that time the role of Indigenous People's organizations was also expanded with the creation of the category of Permanent Participant (PP). The PPs were endowed will full consultative powers and a seat in all AC matters. With the exception of possessing voting powers, PPs were given equal footing

with the Arctic states. However, this notion that the PPs have a seat but not a vote is too simplistic. In an organization like the AC that operates on the principle of consensus, only a "no" vote that prevents consensus matters. So that means that while the PPs can't prevent consensus and keep an initiative from moving forward, in my experience there has never been an occasion when one or more of the PPs had serious reservations that weren't addressed by an effort to reach consensus that took into account the PPs' concerns.

It should be noted that the six PP organizations are all very different in size, structure, and how they are funded. The three original PPs—ICC, RAIPON and the Saami Council—existed long before the AC and have a history of involvement with other international organizations such as the United Nations. Because they have been around longer, they tend to be larger, better established, and better-funded entities. The three subsequent PPs—Aleut International Association (recognized as a PP in 1998 in the first Iqaluit Declaration), Arctic Athabaskan Council, and Gwich'in Council International (both recognized in 2000 in the Barrow Declaration)—were created specifically to be Permanent Participants in the Arctic Council. As a result, their activities tend to be more focused on the AC (although all are working to expand to other forums, such as AIA' involvement in the International Maritime Organization). All three are smaller organizations with somewhat less robust funding. In addition, the PPs have differing relationships with the Arctic states in which their memberships reside. For instance, the relationship that Aleut International Association has with the United States government is different than what the Saami Council experiences with the Norwegian government. This doesn't change the fact that all of the PPs have many similar goals and challenges in contributing to the work of the AC. They all strive to serve their constituencies through that venue, and so working together to address these common elements can be beneficial to all of the PP's and to the Arctic States.

INDIGENOUS PEOPLES AND CLIMATE CHANGE

Climate change is a phenomenon that affects us all, although some people and landscapes will be affected sooner and more drastically than others. SIDS (Small Island Developing States) and the Arctic are the most vulnerable to climate change because of their proximity to the ocean. Many

islands are threatened by rising sea levels, increasing numbers of extreme weather events, ocean acidification, and other issues.

According to the UN's Permanent Forum on Indigenous Issues, "Indigenous peoples are among the first to face the direct consequences of climate change, owing to the dependence and close relationship with the environment and its resources. Climate change exacerbates the difficulties already faced by vulnerable indigenous communities, including political and economic marginalization, loss of land and resources, human rights violations, discrimination and unemployment."

"SIDS are among the Parties least responsible for climate change but the most affected." (UNFCCC). With an already volatile system, changes to small islands' climate could make lands uninhabitable, causing Indigenous People to be forced to leave their homes at some point.

While almost all SIDS depend heavily on fossil fuels, there is significant potential to increase the use of existing renewable energy sources. According to the UNFCCC, "Renewable sources of energy, such as fuelwood, sugarcane bagasse, hydropower and solar water heating are also being exploited. SIDS have a long history of renewable energy use in the agricultural sector, where in some countries wind turbines were traditionally used to pump water and drive machinery. In addition, the presence of geothermal springs, vents and other geo- and hydrothermal resources on land as well as in the ocean increases the potential sources of energy production."

With the trends in climate change continuing, the SIDS and the Arctic will be facing further stressors in addition to current issues. "Higher temperatures are expected to adversely affect the health of some island inhabitants who already suffer through heat waves and associated increased outbreaks of vector-borne diseases" (UNFCCC). With the continued rise of sea levels, saline and brackish water will further penetrate into agricultural lands and lead to reduced food supplies. Currently, most fresh water is gathered through rain collection, increased droughts and other rainfall changes will further stress this limited supply. "Human activities such as sand mining, coastal and beach erosion is already a problem on many islands. Papua New Guinea reports that 25% of its existing shoreline has already been inundated. If sea level rises by one meter, the Maldives will disappear entirely, and in Grenada, up to 60% of the beaches would disappear in some areas following a 50-centimetre sea-level rise" (UNFCCC). "Indigenous peoples in the Arctic region depend on hunting, herding reindeer, fishing and gathering, not only

for food to support the local economy, but also as the basis for their cultural and social identity. Some of the concerns facing indigenous peoples there include the change in species and availability of traditional food sources, perceived reduction in weather predictions and the safety of traveling in changing ice and weather conditions, posing serious challenges to human health and food security (United Nations).

"SIDS have ongoing projects which will implement adaptation measures to help increase resilience to the impacts of climate change. These projects involve strengthening of institutions, policy and regulations, but also ground-level tasks such as water storage and introduction of drought resistant crops" (UNFCCC). We also need to be aware of an increase in monoculture crops and plantations and an associated decline in biodiversity and food security. "In North America, some indigenous groups are striving to cope with climate change by focusing on the economic opportunities that it may create. For example, the increased demand for renewable energy using wind and solar power could make tribal lands an important resource for such energy, replacing fossil fuel-derived energy and limiting greenhouse gas emissions. The Great Plains could provide a tremendous wind resource and its development could help to reduce greenhouse gas emissions as well as alleviate the management problem of the Missouri River hydropower, helping to maintain water levels for power generation, navigation, and recreation. In addition, there may be opportunities for carbon sequestration" (United Nations).

"It is important to note that enhancing and supporting the adaptive capacity of indigenous peoples will only be successful if this is integrated with other strategies such as disaster preparation, land-use planning, environmental conservation and national plans for sustainable development. In many instances, adaptation to new conditions requires additional financial resources and the transfer of technological capacity that most indigenous communities do not possess. While short-term adaptation activities are underway, resource and capacity constraints are limiting the implementation of long-term strategies" (United Nations).

THE ARCTIC COUNCIL PERMANENT PARTICIPANTS AND CLIMATE CHANGE

Since the release of the Arctic Climate Impact Assessment (ACIA) by the

Arctic Monitoring and Assessment Programme of the Arctic Council in 2004, the focus of the Arctic Council has turned increasingly towards climate change. The ACIA was groundbreaking, and its many merits have been documented thoroughly. However, it's important to highlight that the ACIA was tremendously important to the Permanent Participants because the ACIA did not simply focus on climate change science, but also delved into the meaning of climate change for people living in the Arctic. For this reason the development of the report received an unprecedented level of support and input from the Permanent Participants. This is not to say that the PPs always agreed on every aspect of the report as it was being assembled. One could say, however, that the PPs felt they had the ability to object when they thought something wasn't being done right. If the work of the Arctic Council began to shift towards climate change related activities with the release of the ACIA, there was another event that also shifted the public face of the Arctic Council towards climate change. This event took place on 29 April, 2009 in Tromso, Norway when the ministers of foreign affairs of the Arctic States came together for the 6th ministerial meeting of the Arctic Council that signaled the end of the Norwegian chairmanship. This meeting was significant in many ways, including the level of engagement of Arctic Council Observers, the sheer size of the meeting, and the amount of attention it attracted from both the public and the press. There were two notable presentations at this event: one, by Bob Corell, updated climate change data since the release of the ACIA; and another by Nobel Peace Prize winner and former U.S. Vice President Al Gore, which was a version of his "Inconvenient Truth" presentation. While the Arctic Council had been working seriously on climate change related issues since before the release of the ACIA, the Tromso ministerial meeting signaled this in a strong and very public way.

The 6th ministerial meeting wasn't just a public signal of the Arctic Council's increased attention to climate change. It was also a turning point for the Permanent Participants and the way they approached the topic. One important element of this was the recognition of the increasing public focus on climate change as an issue, and the growing interest and power of the media (in all its forms) in documenting activities and bringing attention on regional issues related to climate change. Since then the PPs have worked on this topic in a number of key ways.

Local or Regional Initiatives, through the Arctic Council and Independently

A good example of this type of project was the report on food security recently released by ICC-Alaska, which took a focused approach to food security and its connection to subsistence and culture for Alaskan Inuit.

Another example is a project of the Aleut International Association that looks at how the community of St. George in the Pribilof Islands can protect access to subsistence activities and strengthen their culture by establishing marine protected area measures around their island home. Both of these projects are focused in one country and funded through collaborations, although the PP organization took the lead. The projects are generally not considered a product of the Arctic Council, although the projects may contribute to other work directly related to the Council. Both projects also seek to answer the question of how communities can take responsibility for some of the available strategies to adapt and respond to climate change effects. There have been a few examples recently of PPs leading efforts to bring projects forward through the AC. This can be useful for a PP organization that wants to bring an issue of regional importance to a wider circumpolar audience. In addition, the inclusion of a project on a working group work plan or the AC's endorsement can both be useful tools to help secure project funding.

Sometimes the PPs can make powerful statements collectively when they come together to express strong principles related to areas of interest or concern. Every four years the Inuit Circumpolar Council holds a General Assembly that brings together members from all four Arctic States. One of the outcomes of these assemblies is a Declaration that expresses the position of the organization on a number of issues. As a statement from the most recent 2014 Inuvik, Canada declaration reads:

> *"Mandate the ICC leadership to continue addressing climate change, highlighting the human impact on Inuit, and to urgently press the international community to cooperate both on mitigation of climate change and in the development of adaptation strategies and mechanisms;"*

Joint Efforts with Other Permanent Participants

As might be expected, the PPs often work together on initiatives, generally

through the context of the Arctic Council. This can happen in a number of ways, including collaborating on the development of working groups, or creating strategic plans with the intention of steering efforts towards issues of concern for indigenous communities. The PPs also work together on AC projects, which are usually led by one or more of the Arctic States. In the past, it's been unusual for PP organizations to have sufficient resources to lead a project, so it has been more common to co-lead with an Arctic State. This can still result in a significant amount of influence on project direction and outcomes/deliverables. There have been a number of recent AC projects of this type with a focus on climate change adaptation, including the Arctic Adaptation Exchange Portal, which is led by Canada and the United States and co-led by AIA and GCI. The focus of this project was to develop an interactive online database of adaptation information, best practices, and case studies. From the beginning of project development, a prime focus for the PPs involved was to insure that the final online database was a useful tool for communities. In addition, there has been discussion regarding adding an "innovation space" to the portal that would allow communities to come together around topics of mutual interest and to search for common solutions to community challenges. Projects such as this on that include multiple collaborators are common in the Arctic Council. They are well suited to the PPs, which are often struggling to maximize what they can accomplish with limited resources.

The PP's also collaborate extensively on AC reports and assessments, a practice that has been common since the beginning of the Arctic Council. PP's have provided significant contributions to reports such as the Arctic Climate Impact Assessment (ACIA), the Arctic Marine Shipping Assessment (AMSA), and the Arctic Biodiversity Assessment (ABA). PP's are also co-authoring chapters on upcoming reports including the Arctic Resilience Assessment (ARA) and all of the Adaptation Actions for a Changing Arctic (AACA Part 3) regional reports. The opportunity to contribute to major AC deliverables provides another way to bring a community perspective to these documents, and also to make them useful to community decision makers. Reports such as these are often accompanied by summaries for policy makers intended for ministers or other high level officials in the Arctic States, so PP's can help focus recommendations or calls for future action at the community level.

As has been discussed above, the six PP organizations are very different in terms of size, structure, funding, and approach to their work in the

international arena. For this and other reasons, such as timing or available resources, it is hard to have all six be in a position to agree on a joint course of action or to move forward together on an initiative. When this does happen it often manifests itself as an effort to work together on a matter related to administration within the Arctic Council. An example of this was the work that all six PPs contributed to the development of the principles for the use of indigenous knowledge in the work of the AC. Another example has been recent work to develop a funding mechanism to support the core functions of all the PP organizations. However, sometimes an initiative begun by one of the PPs will gain a strong external expression of support from all. This was the case when, during the Canadian chairmanship in 2014, the Saami Council sought to have all six PPs take a common position on the commitment of the Arctic States towards the reduction of carbon dioxide emissions. This commitment had been expressed in the Kiruna Declaration, but the mechanisms through which these reductions would be carried out had not been articulated. This effort by the Saami Council led to a letter, which was sent to then SAO Chair Vincent Rigby, which was signed by representatives of all the PP organizations. Among other things the letter stated:

> *"The Permanent Participants welcome the Arctic Council's continued efforts in reduction of short-lived climate forcers, an initiative that, Aleut International Association, Arctic Athabaskan Council, Inuit Circumpolar Council and Saami Council now also participate in. On the other hand we see no concrete initiatives by the Arctic Council member states to address the necessary and ambitious cuts in emissions of carbon dioxide, as called for in the Kiruna Declaration. With this letter we as Permanent Participants would like raise our sincere concerns to the Arctic Council in this regard."*

An effort like this that focuses the efforts of all six PP organizations on a particular topic can be particularly effective because it is so difficult to accomplish, unusual, and showcases the importance of the topic to all six.

Through Other International Forums

As was mentioned above, three of the PPs (ICC, Saami Council, and RAIPON) existed as organizations before the creation of the Arctic Council, and as a result their involvement in international activities has

manifested itself in a number of ways. However, an important area for work for all three organizations has been through the United Nations Permanent Forum on Indigenous Issues. This forum, which is an advisory body to the U.N. Economic and Social Council, submits recommendations related to Indigenous Peoples and contains seven socio-cultural regional groupings, one of which is the Arctic. One of the most prominent accomplishments of the forum has been the UN Declaration on the Rights of Indigenous Peoples (UNDRIP). Although it is not legally binding under international law, the declaration does represent a strong step toward the creation of international legal norms for the rights of Indigenous Peoples. The forum also brought about the Indigenous Peoples Climate Change Assessment Initiative, which was designed to help Indigenous Peoples use their own organizations, mechanisms, and indigenous knowledge to help build adaptation strategies and mitigate the impacts of climate change. Activities within the Permanent Forum directly led to the formation of the International Indigenous Peoples Forum on Climate Change, which made specific recommendations to the UNFCCC in advance of COP21.

There has also been work completed through associations with other international forums. One example is the recent efforts of the Aleut International Association to be more closely involved with the work of the International Maritime Organization (IMO). However, the nature of organizations such as the IMO, with no clearly identified path for the involvement of Indigenous Peoples except through the delegations of member states, has made it difficult to know how to be effective and if the expenditure of resources on these efforts are justified.

CONCLUSIONS: THE ARCTIC COUNCIL PERMANENT PARTICIPANTS AND COP21

Throughout the history of the PP organizations, the interconnectedness of climate change effects means that much of the work of the Permanent Participants has been related to either mitigation of or adaptation to climate change. While many issues of importance to Indigenous Peoples were not well represented in the Paris Agreement, certain key elements are present and will likely be areas of focus for the Permanent Participants:

- Green energy projects, though necessary to meet emission goals, must

not override the rights of Indigenous Peoples in the name of fighting climate change. Indigenous Peoples must be involved at the earliest stages of projects that are either on or affect their lands.

- Indigenous peoples must have access to climate funding and should not have to depend on their countries of residence for such access. Some Indigenous Peoples reside in countries where difficult relationships with national governments could interfere with their access to climate funding; there should be a path to this funding that they can access directly.
- Respect and recognize the indigenous knowledge of Arctic Peoples, their innovations, culture, and practices. Without this indigenous knowledge, it is impossible to understand the potential effects of actions on Indigenous Peoples, and in fact, indigenous knowledge may itself lead to better solutions.
- A ground-up approach through community based projects is part of the solution to both mitigating and adapting to climate change
- It is important to establish a platform for sharing best practices on mitigation and adaptation; this is how successes in one place can lead to successes in other places facing similar challenges.

It has been well established that the close cooperation of the Arctic States and Permanent Participants in the work of the Arctic Council has led to more robust solutions, improved work products and deliverables, and provided better overall outcomes. The successes of this type of collaboration can also help to insure the best solutions to mitigate the effects of climate change, both in the Arctic and globally.

PART III

THE FUTURE OF THE ARCTIC OCEAN

The 5+5 Process in Arctic Fisheries

Alf Håkon Hoel

ARCTIC FISHERIES: STATUS AND PROSPECTS

In winter, the Arctic Ocean has a 15-million km^2 ice cover. In late summer, the ice cover is reduced to four million km^2 or less. In a few decades from now, summer ice is likely to be all but gone (Wadhams 2012; Overland and Wang 2013). This rapid change will have multiple impacts on fish populations, which are strongly affected by their physical environment. Changes in water temperatures, salinity, and other environmental factors affect the size and distribution of populations of living marine resources. Global warming already affects fish populations in numerous ways (ACIA 2005; IPCC 2013), and will continue to do so. Globally, it is anticipated that fish populations will expand their geographic distribution away from the equator toward the poles (Cheung et al. 2010), a development which can be observed already and which has implications for food security (Barange et al. 2014). At regional geographical scales the same dynamics are observed, with varying rates of movement among different fish species and stocks (Pinsky et al. 2013).

The Arctic, the area to the north of the Arctic Circle at 66′33″ (which amounts to 4% of the Earth's surface), and the sub-Arctic seas contain major fisheries. These include globally significant fishing grounds in the Bering Sea, the Barents Sea, and the seas around Iceland, Greenland, and east of Canada (Vilhjamsson and Hoel 2005). A substantial part of the global fish catch is harvested from these areas. There are no commercial fisheries in the central Arctic Ocean due to ice cover, ocean temperatures, and other factors. There are, however, some subsistence fisheries, mostly for anadromous fish in coastal areas (Zeller et al. 2011). As a result of reductions in sea ice and warming of the oceans, fish populations that sustain the sub-Arctic fisheries could expand their geographic distribution northward into the central Arctic Ocean.

The central Arctic Ocean consists of areas under the jurisdiction of the five coastal Arctic states (United States, Canada, Denmark/Greenland, Norway and the Russian Federation), as well as a high seas area beyond national jurisdiction (map). Most of the central Arctic Ocean high seas

area (approximately 2.8 million km^2) is still ice covered most of the year or year round. In response to growing evidence that fish stocks are moving north, and as a consequence in some cases also a northward movement of fisheries, the five coastal states met in Oslo in 2010 to discuss options for addressing the issue. This was the start of a process that eventually resulted in a *Declaration Concerning the Prevention of Unregulated High Seas Fishing in the Central Arctic Ocean of 16 July 2015*.[2] Following that declaration, an expanded process was initiated later in 2015, also involving the Peoples Republic of China, the Republic of Korea, Japan, Iceland, and the European Union, seeking to expand the Oslo efforts to prevent unregulated fishing.

The purpose of this perspective is to provide an understanding of the context and background of the issue of fish in the central Arctic Ocean and potential fisheries there, as well as to discuss other elements that are important for future governance of potential resources.

FRAMEWORK OF CURRENT INTERNATIONAL GOVERNANCE

The 1982 Law of the Sea Convention[3] (which went into force in 1994) provides the basic global framework for the management of living marine resources. The Convention gives coastal states sovereign rights over the natural resources within their Exclusive Economic Zones (EEZs), which can extend to 200 nautical miles from a country's baselines.[4] The Convention outlines an obligation of each country to manage and utilize their resources sustainably and to cooperate with other countries in the case of transboundary resources (Hoel and VanderZwaag 2015).

In order to make these provisions more effective, particularly for fisheries on the high seas beyond national jurisdiction, an implementing agreement—the 1995 United Nations Fish Stocks Agreement (UNFSA, which entered into force in 2001)[5]—was negotiated. The UNFSA requires a precautionary approach to be applied in the management of living marine resources, international cooperation in the management of high seas fisheries in accordance with Regional Fisheries Management Organizations or Arrangements (RFMO/As), and enforcement of regulations to be strengthened as necessary.

Following up on this at the global level, the FAO has developed a

number of International Plans of Action and guidelines for implementing the precautionary approach, as well as an ecosystem approach to fisheries. In addition, a Port State Measures Agreement to deter Illegal, Unreported, and Unregulated (IUU) fishing was concluded in 2009[6] (and put into force in 2016). Guidelines for flag state performance were adopted in 2014. At the global level, the UN General Assembly provides annual oversight over the implementation of the Law of the Sea Convention and the UNFSA. Adopting comprehensive resolutions on oceans and the law of the seas and fisheries, respectively, the General Assembly provides guidance for states and international organizations in the management of living marine resources.[7]

At the regional level of governance, existing RFMO/As have been substantially revised over the last two decades, bringing their provisions up to the standards provided by UNFSA. A number of new RFMO/As have been negotiated. Globally, about 20 of these arrangements now exist.[8]

Particular to the North Atlantic, the International Council for the Exploration of the Sea (ICES), established in 1902, draws on the collective scientific capacity of its member countries in providing scientific advice for the management of living marine resources to individual countries as well as to international cooperative bodies.[9] All Arctic states are members of ICES. The North Pacific Marine Science Organization (PICES) plays a similar role in the North Pacific.[10]

In the Arctic, this global framework has been applied extensively (Arctic Ocean Review 2010). All Arctic countries have established 200-mile zones, and all have comprehensive domestic fisheries management regimes.

With regard to international cooperation, a significant number of bilateral arrangements for fisheries cooperation, such as the management of trans-boundary stocks (shared fish stocks, occurring in the waters under the jurisdiction of two states) are in force. These include the Joint Norwegian-Russian Fisheries Commission,[11] which manages fisheries in the Barents Sea, as well as the United States-Russian Federation cooperation through an intergovernmental consultative committee.[12] In the high seas areas of the Arctic and sub-Arctic, a number of regional fisheries bodies exist to address straddling fish stocks (stocks that occur both within EEZs and on the high seas). In the North Atlantic, the Northeast Atlantic Fisheries Commission (NEAFC)[13] is mandated to manage fisheries, including in the Atlantic sector of the high seas area in the central Arctic Ocean. In the Northwest Atlantic, the Northwest Atlantic Fisheries Organization (NAFO)[14] has a similar

mandate. The 1994 Convention on Conservation and Management of the Pollock Resources of the Central Bering Sea[15] establishes the foundations of an RFMO there. The North Atlantic Marine Mammals Commission (NAMMCO)[16] is a forum for cooperation on marine mammals management, and the North Atlantic Salmon Conservation Organization (NASCO) coordinates the management of salmonids.[17]

CURRENT FISHERIES

The central Arctic Ocean coastal states are all major fishing nations, with substantial parts of their harvests coming from sub-Arctic waters. In the central Arctic Ocean, ice cover, lack of nutrients, stratified water masses and other factors explain the absence of fish in commercial quantities, and therefore a dearth of commercial fisheries (Haug et al. 2017). The sub-Arctic Bering Sea and the Barents Sea are globally important fishing grounds, with pollock fisheries in the Bering Sea and cod fisheries in the Barents Sea among the highest yielding whitefish fisheries in the world. The 2015 Total Allowable Catch (TAC) of cod in the Barents Sea was 890,000 tons, while the corresponding figure for pollock in the Bering Sea was 1,310 million tons. There are also major fisheries around Iceland, Greenland, and off eastern Canada. In addition to cod and pollock, important fisheries include haddock, Greenland halibut, redfish, and capelin, as well as shrimp, crabs and shellfish. Several seal species and whales are also harvested.

Key factors in providing for high, sustainable yields over time include extensive scientific efforts to assess the status and extent of fish stocks, the adoption and implementation of long-term management plans with harvest control rules committing managers to precautionary approaches to regulations (Kvamsdal et al. 2016), and robust enforcement of regulations.

Fish populations are affected by their environment (Hjort 1914). Water temperatures and other oceanographic factors influence the growth and distribution of fish populations. Since marine ecosystems are subject to major natural variability, fish populations vary in size as well as in geographic distribution from year to year. For a number of species, populations have been observed expanding northward (Fossheim et al. 2015). This is consistent with global modeling predictions (Cheung et al. 2009) as well as with regional assessments (ACIA 2005), and can be attributed to natural variability as well as to the effects of global warming on the oceans.

DEVELOPING A FISHERIES REGIME FOR THE HIGH SEAS IN THE CENTRAL ARCTIC OCEAN

In 2008, the five coastal states in the Arctic Ocean adopted the Ilulissat Declaration,[18] stating their intent to cooperate on the basis of the United Nations Convention on the Law of the Sea (UNCLOS) in the governance of Arctic marine areas. Following up on this, and in response to concerns regarding fish stocks in the central Arctic Ocean, the five coastal states met in Oslo in 2010. At this first meeting, the coastal states requested their marine research institutes to assess the status of fish populations in the Arctic Ocean and to review relevant research. A scientific meeting to follow up on this took place in Anchorage in 2011, concluding that commercial fisheries were unlikely to emerge in the High Seas area in the central Arctic Ocean in the short term, and underlining the need for research and monitoring in this area.

Representatives of the five governments met again in Washington, D.C. in 2013, asking for additional scientific information on the likelihood of commercial fisheries developing in areas beyond national jurisdiction in the central Arctic Ocean. These representatives also initiated a discussion on interim measures to prevent potential unregulated fisheries. A second meeting of scientists was held later in 2013 in Tromsø, addressing existing efforts to survey marine ecosystems in the Arctic Ocean. The meeting, which included participation from the International Council for the Exploration of the Sea (ICES), the International Arctic Science Committee (IASC),[19] and other international scientific bodies, developed recommendations to enhance scientific monitoring.

Meeting in Nuuk, Greenland in 2014, officials from the five coastal states agreed that interim measures to prevent increases in unregulated fishing in the area beyond national jurisdictions in the central Arctic Ocean should be established. It was also agreed that more scientific research to improve understanding of the fish resources of the Arctic Ocean was needed, and that a scientific program should be established for this purpose. A third outcome, inspired by the realization that other countries/entities were potential flag states for vessels attempting to fish in these areas, was that a broader process involving more countries should be initiated.[20] A third scientific meeting was held in Seattle in April 2014, which included participants from Japan, China, the Republic of Korea, and Iceland, further refining recommendations for future scientific work.

An important step in this process was the adoption by the five coastal states of the *Declaration Concerning the Prevention of Unregulated High Seas Fishing in the Central Arctic Ocean* on 16 July 2015 in Oslo. This Declaration is built on the outcomes of the Nuuk meeting. Essential provisions include an agreement that the coastal states will not permit their vessels to fish in the high seas of the central Arctic Ocean in the absence of an RFMO/A. It also identified a need to establish a Joint Program of Scientific Research, and signaled an intent to work with other states. The parties stated that, "... an extensive international legal framework applies to the Arctic Ocean. These interim measures will neither undermine nor conflict with the role and mandate of any existing international mechanism relating to fisheries, including the North East Atlantic Fisheries Commission."

In December 2015, a new stage in the process was initiated with the inclusion of Japan, the Republic of Korea, China, Iceland and the EU. Meeting in Washington, D.C., initial discussions revolved around considering the format of a possible extended agreement, as well as potential substantive issues to be included. Also, the terms of reference for a fourth scientific meeting were discussed, focusing on the development of a science plan to address the question of whether commercial quantities of fish may emerge in the high seas in the central Arctic Ocean. Meetings of the extended circle have continued in 2016, taking place in Washington, D.C., in Iqaluit, Canada, and in Torshavn in the Faroes. The delegations are committed to preventing unregulated fishing in the High Seas and to promoting conservation and sustainable use of living marine resources. Substantive issues under discussion include the manner in which an agreement addresses exploratory fishing, the conditions under which negotiations on one or more additional regional fisheries management organizations or arrangements should be instituted for the central Arctic Ocean, and decision-making procedures. The discussions also addressed how to proceed with continued scientific cooperation, which now includes participation from all 10 parties. A fourth scientific meeting was held in September 2016, discussing a draft Joint Scientific Research and Monitoring Plan as well as a framework for an Implementation Plan for the assessment of fish stocks in the central Arctic Ocean.

WILL THERE BE FISH?

Numerous studies have projected that various fish species will migrate into the high Arctic (ACIA 2005; Hollowed and Sundby 2014; Hollowed et al. 2013). Fish are parts of complex marine ecosystems, however, and the "borealization" of some regions of the Arctic Ocean and its impacts on fish is not yet well understood (Fossheim et al. 2015). Hollowed et al. (2013) discuss the lifecycle characteristics of 17 fish and shellfish stocks that should be considered when assessing their potential for migrating in response to a changing Arctic climate. Acknowledging that "range expansions and successful colonization of new regions will depend on a complex suite of factors," the authors review the adaptive capacity of these species, suggesting that suitable water temperatures, availability of prey (food), distances to spawning grounds, and ocean floor topography are among the limiting factors. Based on this, it is suggested that species such as beaked redfish, Greenland shark, polar cod (borreogadus saida),[21] and Arctic skate have a high potential to move into the high Arctic. Commercially important species such as Atlantic cod and Alaska pollock have a low potential for such movement.

The findings of the largely theoretical review of Hollowed et al. are supported by data-based observations. In the case of Atlantic cod, for example, the northernmost sighting was made in 2012 at 82 degrees N (Ingvaldsen et al. 2015). Cod are not likely to move further north due to topographic conditions, nor are pollock, due to prey availability and other factors (Hollowed et al. 2013). It is important to note that a documented sighting of a single specimen does not necessarily mean that the species is present in commercial quantities, or even that reports of small catches will translate into commercial fishery opportunities. Capelin, for example, can be readily observed at the ice edge, but the actual fishery for capelin occurs close to the coast.

An additional factor determining the geographic expansion of a fish stock could be stock size. Large fish stocks require more food and space than smaller stocks. It has been suggested that this is an important factor in the changed distribution of capelin, for instance (Ingvaldsen and Gjøsæter 2013), and it is obviously an important explanation for the expansion of mackerel in the northeast Atlantic in recent years (Nøttestad et al. 2016).

While both theory and observations confirm the movement of fish into the high Arctic and the central Arctic Ocean, another question is whether

fish will ultimately occur in commercial concentrations in those high seas. This area is 200 nautical miles (370 kilometers) north of the nearest landmasses and beyond, and is covered with ice all or most of the year.

Scientific meetings that have taken place thus far have concluded that such an expansion into very high latitudes—the high seas in the central Arctic Ocean—is not likely in the near future, and that due to the topographic conditions of these areas (most of them several thousand meters deep) only pelagic species will be able to move into these areas for sustained periods. Another limiting condition is the stratification of water masses in the central Arctic Ocean, with layers of fresh water at the surface and limited vertical mixing. This limits the supply of nutrients and therefore the potential for biological production and the presence of prey (Wassmann et al. 2011).

PROSPECTS

A continued reduction of ice cover in the central Arctic Ocean will likely mean that populations of some fish species, including beaked redfish, Greenland shark and Arctic skate, may have potential to expand their geographic range northwards. It is uncertain whether, and to what extent, these fish species will occur in commercial quantities in these regions. A number of limiting factors are at play, including stratification of water masses and low biological productivity (Arrigo 2013). In the near future, fisheries are likely to remain within the EEZs of the coastal states. To appear in the high seas area, fish would first have to move through waters under national jurisdiction into the central Arctic Ocean, a considerable distance.

The five coastal states are all major fishing nations and have extensive management regimes for their fisheries. When present in the waters under the jurisdiction of the coastal states, domestic fisheries regimes apply to the fish stocks and the fisheries there. Where fish stocks are shared between two countries, bilateral arrangements for cooperation on their management exist, such as the bilateral Joint Norway-Russia fisheries commission. In some cases such bilateral arrangements have not been established and may need to be considered should fisheries emerge in these areas in the future. One example might be for potential trans-boundary stocks in the Beaufort Sea between Canada and the United States.

Given the considerable uncertainties regarding oceanographic, ecological, and biological conditions (Wassmann et al. 2011), scientific research is likely to remain a critical issue in discussions about fish stocks in the central Arctic Ocean. The question of geographical expansion and/or migration of fish species in response to climate change is currently subject to a substantial research effort, which is increasingly reflected in the scientific literature. Real, comprehensive answers to questions about the prevalence of fish in commercial quantities in the high seas area of the central Arctic Ocean can only be provided by carrying out extensive ship-based research surveys. Given the high costs of such operations and the limited prospects of returns on such an investment, it remains to be seen whether such surveys will be funded in the near future. The current political debate in the U.S. on the need for new icebreakers could be taken as an indicator of the obstacles facing the funding of such operations.

Regarding scientific cooperation, the International Council for the Exploration of the Sea is a well-established mechanism for scientific cooperation and consultation regarding the management of fish stocks in the high north. As pointed out above, all Arctic coastal states are party to the ICES convention.[22] The ICES working group for Arctic fisheries has existed for more than 50 years. A new working group for integrated assessments of the marine environment in the central Arctic Ocean is now operative involving also Arctic Council working groups and ICES' North Pacific counterpart, PICES.[23]

From the perspective of marine food production, aquaculture is increasingly important in the Arctic. In northern Norway in particular, but also in northwest Russia, Iceland, the Faroes, and eastern Canada, aquaculture based on Atlantic salmon is growing rapidly in importance, already amounting to several hundred thousand tons per year. With the prospects of warming waters in the high north, it is reasonable to assume that aquaculture will continue to grow there.

In a broader perspective, perhaps the most important thing about the current process of establishing mechanisms for fisheries governance in the high seas of the central Arctic Ocean is that the five coastal states have taken a path based on scientific research and precautionary measures to reinforce and further develop the existing legal-political order in the high Arctic. Current efforts to expand this cooperation and include other parties are likely to build on this standard. However, predictions about how this actually will play out in the future are premature.

Notes

1. Wikipedia: https://en.wikipedia.org/wiki/Arctic_Circle. See also NOAA website: http://ngdc.noaa.gov/mgg/global/etopo1_ocean_volumes.html[Accessed 7 August 2016]
2. Declaration Concerning the Prevention of Unregulated High Seas Fishing in the Central Arctic Ocean. https://www.regjeringen.no/globalassets/departementene/ud/vedlegg/folkerett/declaration-on-arctic-fisheries-16-july-2015.pdf
3. http://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm
4. On the continental shelf, these rights extend to the outer limit of the continental shelf, also where this is beyond 200 nautical miles. Cfr. Art. 76 of the Law of the Sea Convention.
5. Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. https://documents-dds-ny.un.org/doc/UNDOC/GEN/N95/274/67/PDF/N9527467.pdf?OpenElement
6. http://www.fao.org/fishery/psm/agreement/en
7. http://www.un.org/depts/los/general_assembly/general_assembly_resolutions.htm
8. https://www.igfa.org/Conserve/RFBs.aspx and www.neafc.org/system/files/types-of-RFMOs-04.pdf
9. http://ices.dk/Pages/default.aspx
10. https://www.pices.int
11. http://www.jointfish.com/eng
12. http://www.nmfs.noaa.gov/ia/agreements/bilateral_arrangements/russia/us_russia.html
13. http://neafc.org
14. http://www.nafo.int
15. http://www.afsc.noaa.gov/refm/cbs/
16. http://nammco.no
17. http://www.nasco.int
18. http://www.oceanlaw.org/downloads/arctic/Ilulissat_Declaration.pdf
19. http://iasc.info
20. To date, Norway is the only country to deny vessels flying its flag to fish in unregulated waters areas beyond national jurisdiction, including those of the

central Arctic Ocean.

21. As opposed to the commercial species Atlantic cod, gadus morhua.

22. http://www.ices.dk/explore-us/who-we-are/Documents/ICES_Convention_1964.pdf

23. http://www.ices.dk/community/groups/Pages/WGICA.aspx

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Trans-Polar Shipping

Scott R. Stephenson

INTRODUCTION

In recent years, there has been considerable speculation about the implications of climate change for Arctic shipping. Arctic sea ice has undergone a striking transformation, marked by widespread reductions in extent, volume, thickness and age (Maslanik et al. 2007; Kwok et al. 2009; Comiso, 2012; Stroeve et al. 2012b). As a result, cargo shipping across the Arctic Ocean has become possible for longer periods in summer each year. Travel distances between European and East Asian ports are approximately 40% shorter via Russia's coastal Northern Sea Route (NSR) than by traditional routes through the Suez Canal (Farré et al. 2014). The Northwest Passage (NWP), subject of a centuries-old quest to link East and West, circumvents the Panama Canal to offer new potential linkages between the North Atlantic and North Pacific regions. Compared to these routes, relatively little attention has been given to the possibility of shipping from the North Atlantic to the Bering Strait through the central Arctic Ocean, passing over or near the North Pole. This route, hereafter termed the "trans-polar route" (TPR, or alternatively the trans-polar sea route or North Pole route), represents the most direct passage through the Arctic and therefore the greatest potential distance savings (Humpert and Raspotnik 2012). However, no commercial voyages to date have used the route due to its year-round ice cover and high incidence of hazardous multi-year ice. Even after the Arctic continues its transition to a summer ice-free state, it is unclear whether the economic benefits of the TPR will outweigh the risks.

This perspective will explore the potential of the TPR as a commercial shipping corridor over the next 50 years. First, the paper will examine the future technical accessibility of the route as a precondition for commercial shipping. Sea ice projections from several climate models will be presented to obtain a comprehensive picture of present and future accessibility along the TPR. The paper will then discuss critical non-climatic enabling and constraining factors such as greenhouse gas (GHG) emissions, climate feedbacks, and global trade dynamics to articulate the potential of the TPR within a broader environmental and economic context.

MARITIME ACCESSIBILITY IN A WARMING ARCTIC

In order to assess the future viability of the TPR, it is necessary first to estimate the degree to which the route will become technically accessible in the coming decades. One way to do this is to translate sea ice outputs of global climate models (GCMs) into measures of ship accessibility. Several studies have employed geospatial modeling techniques to project future maritime accessibility in the Arctic (Khon et al. 2010; Stephenson et al. 2011; Smith and Stephenson, 2013; Stephenson et al. 2013; Stephenson et al. 2014; Aksenov et al. 2016). This section examines the results of Stephenson and Smith (2015), as their multi-model approach enables exploration of a wide range of conditions regarding sea ice variability.

Stephenson and Smith (2015) investigated the technical accessibility of the TPR as projected by ten high-performing GCMs from the fifth phase of the Coupled Model Intercomparison Project (Taylor et al. 2012). While climate models generally agree that the overall extent of sea ice will decline in the long term, they differ markedly regarding the timing and spatial distribution of the decline. The GCMs were shown to represent well the historical trend and seasonal climatology of sea ice in multiple independent analyses (Jahn et al. 2012; Massonnet et al. 2012; Liu et al. 2013). To assess the degree of future accessibility of the TPR, vessel transits from the Bering Strait to North America (Halifax) and Europe (Rotterdam) were computed

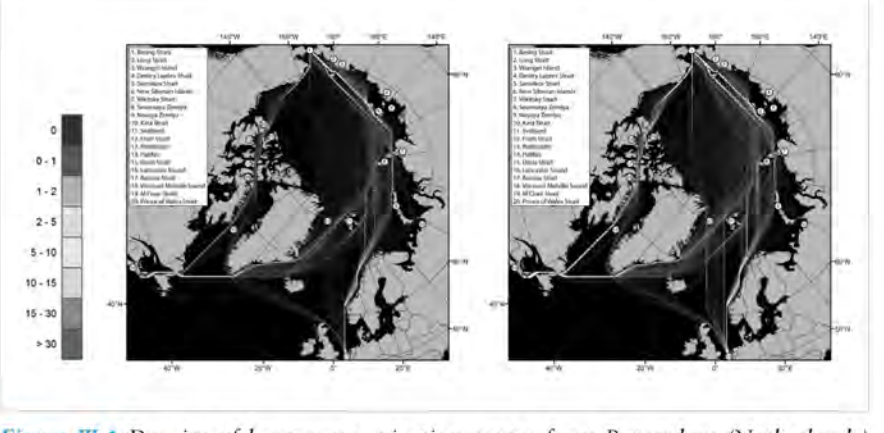

Figure III.1 Density of least-cost navigation routes from Rotterdam (Netherlands) and Halifax (Canada) to the Bering Strait by open-water vessels at early-century (2011-2035; left) and mid-century (2036-2060; right). Values indicate the average of 10 global climate models as computed by Stephenson and Smith (2015).

according to the projected concentration and thickness of ice during two time periods: "early-century" (2011-2035) and "mid-century" (2036-2060). Vessels were assumed to take the fastest route possible given the constraints of their ice class. Ships with medium icebreaking capability ("Polar Class 6") were assumed to be capable of "summer/autumn operation in medium first-year ice which may include old ice inclusions" (Transport Canada, 1998; IMO, 2002), while non-ice strengthened "open-water" vessels were assumed to be capable of operating in "gray ice" (10 cm). Routes were computed monthly from 2011-2060 and aggregated for each climate model to illustrate the spatial "density" of routes projected during early-century and mid-century. The 10-model average of these density maps is depicted in Figure III.1.

The results illustrate a range of possible futures of Arctic shipping accessibility, owing to differences in vessel polar class, greenhouse gas emission scenarios, and model variability. Several spatial patterns can be observed in Figure 1. Most routes originating from the North Atlantic follow the NSR along Russia's Arctic coast, while a minority of transits from Halifax follow the NWP through the Canadian Archipelago (Viscount Melville Sound—M'Clure Strait). The central Arctic Ocean and TPR see very sporadic use before 2035, owing to continued persistence of thick ice even as the proportion of first-year ice grows. Vessel transits are highly concentrated during summer and autumn, with no model projecting year-round access for non-ice strengthened vessels. These observations broadly reflect the current pattern of maritime use of the Arctic. Today, few unescorted voyages by open-water vessels occur in winter, outside of limited regions with ice-free access such as the southwest Barents Sea.

Despite present-day limitations, there are several signs that the TPR will see increasing use as an alternative to the NSR in the coming decades. The majority of routes originating from Rotterdam enter the Kara Sea passing north of Novaya Zemlya rather than via the Kara Strait, indicating that sailing several hundred miles north of the Russian coast is often faster than along near-coastal routes, even before 2035. Many of these routes migrate northward over time with continued retreat of the ice edge, and ultimately coincide with the TPR. Routes originating from Halifax broadly replicate this pattern early in this century, though a majority of these transits switch to the Northwest Passage by 2060. Comparing outputs of individual climate models appears to confirm the robustness of these results. A majority of models project routes across a wide swath of ocean

from the Russian coast to the North Pole, rather than restricting passage to the NSR. Furthermore, only two models project no access in the central Arctic. As a result, it is likely that the TPR will become technically viable by mid-century in all but the most conservative of climate scenarios. With global greenhouse gas emissions currently tracking close to a "business-as-usual" scenario (i.e. IPCC Representative Concentration Pathway [RCP] 8.5) (Peters et al. 2013), the likelihood that the central Arctic will remain accessible year-round by mid-century is looking increasingly high.

It is important to note that the projected shift of the fastest Arctic route from the NSR to the central Arctic will most likely happen gradually. Contrary to evidence of a possible "tipping point" for accelerated ice loss in the near future (Holland et al. 2006), most models show that the central Arctic will remain largely inaccessible before 2040 and will not experience robust rapid northward route migration in any single year. These results align with a future characterized by gradual, sustained change to Arctic physical and human systems that may be anticipated and planned for by maritime regulatory agencies (AMSA 2009). It is also possible that ice decline may be inhibited in the coming decades due to reduced oceanic poleward heat transport stemming from a weakening of the Pacific or Atlantic conveyor (Zhang 2015), slowing ice retreat and dramatically reducing viability of the TPR. In addition, these projections do not account for ice features such as icebergs, growlers, and pressure ridges that pose significant hazards to shipping. Pressure ridges are particularly formidable barriers to navigation and are expected to occur with greater frequency as ice floes become thinner and more mobile (Stern and Lindsay 2009; Kwok et al. 2013; Bourbonnais and Lasserre 2015). With these caveats in mind, however, the likely increase in trans-polar accessibility should not be overlooked: by 2060, the number of routes transiting the central Arctic "high seas" is projected to increase more than 150% relative to Stephenson and Smith's (2015) early-century baseline scenario. Furthermore, it is possible that climate models fail to capture critical feedbacks in the climate system, such as methane release from thawing permafrost (Schuur et al. 2015) and local surface winds (Ogi and Wallace 2012). Such non-linear climate change could increase trans-polar access dramatically in a relatively short period of time.

Perhaps unsurprisingly, the single most important determinant of trans-polar accessibility for the foreseeable future is vessel class. Whereas the central Arctic Ocean will see few transits by open-water vessels before

2040, route possibilities more than double overall when polar-class vessels are assumed. The accessibility afforded by ice-strengthened vessels far exceeds the impact of rapid climate change. While a scenario of severe ice melt (as projected by RCP 8.5) has a significant impact on increasing trans-polar accessibility, this increase is more than ten times larger when using an ice-strengthened vessel. This implies that much of the central Arctic will be off-limits to the vast majority of the global fleet (which is largely not ice-strengthened) for most of the year well into mid-century, even if climate change continues unabated. The need for polar-class vessels will be even greater during winter, when ice is colder and stronger than in summer (Prowse et al. 2009) and prolonged darkness and fewer navigable cracks in the ice (leads) substantially raise the risk of ice encounters. Even during summer, relatively dispersed ice in the marginal ice zone (MIZ) can be dangerous. During the 1990s, ice drift and compression accounted for about half of the recorded shipwrecks along the NSR (Marchenko 2012), and will continue to pose a hazard as ice drift accelerates in the MIZ due to climate change.

Looking beyond mid-century, however, it is likely that polar-class vessels will become progressively less essential for seasonal summer transits. Sometime in the next 10-30 years, Arctic ice extent will drop below one million km^2 for five consecutive summers, signaling the arrival of the first "ice free" Arctic on record (Overland and Wang 2013). Under such conditions, open-water vessels may be able to make unescorted voyages through the central Arctic, depending on the spatial distribution of the remaining ice. While "ice free" summers will be brief initially, lasting for less than one month in September, climate models indicate that they will increase in frequency and may occur nearly every year near the end of the century (Massonnet et al. 2012; Stroeve et al. 2012a). More aggressive climate warming will be a significant contributor to the frequency of ice-free summers, particularly in the latter half of the 21st century, as indicated by the divergence of RCP 8.5 from less aggressive climate scenarios post-2060 (van Vuuren et al. 2011). "Arctic amplification" caused by increased solar absorption by open water will further accelerate ice melt as ice-free summers become commonplace (Barnes and Polvani 2015). These developments suggest that while the TPR is barely accessible at present, climate change will create a very different picture by the end of this century.

EMISSIONS, ECONOMICS, AND CLIMATE CHANGE

Regardless of the rate of future ice melt, the viability of commercial Shipping via the TPR will be determined ultimately by numerous environmental and economic considerations. These determinants arise from both the unique geophysical landscape of the Arctic region and extra-regional processes operating at global scale.

First, the attractiveness of the TPR could be shaped by global efforts to limit GHG emissions within the shipping industry. In December 2015 at the meeting of the UNFCCC Conference of the Parties (COP 21) in Paris, 196 countries reached an agreement to limit global warming to 2°C above pre-industrial levels, with an additional stated goal to "pursue efforts to" limit the increase to 1.5°C. These benchmarks, generally associated with limiting atmospheric CO_2 concentrations to 450 ppm or below, are believed to be necessary to avoid catastrophic climate impacts such as the deglaciation of the West Antarctic ice shelf and the collapse of the Atlantic Meridional Overturning Circulation (IPCC, 2014). Achieving this goal will require widespread and drastic emissions reductions across many industrial sectors, including transportation, which is heavily reliant on fossil fuels. The International Maritime Organization (IMO) estimates that increases in global maritime trade may cause CO_2 emissions from international shipping to grow to 12-18% of the total allowable emissions under a 450 ppm scenario (Heitmann and Khalilian 2011). Achieving stabilization at 450 ppm would require the shipping industry to reduce its emissions by 2.6% per year from 2020 to 2050 (Anderson and Bows 2012; Bows-Larkin et al. 2015). The industry will thus be under pressure to employ a variety of emissions-reductions strategies such as low-emission fuels, novel hull designs, speed reductions ("slow steaming"), and alternative shipping routes. In this context, a distance savings of 40% from using Arctic routes carries significant potential for fuel and emissions reductions of bulk cargo shipments. When combined with fuel efficiency practices such as slow steaming, use of Arctic routes may reduce CO_2 emissions by as much as 78% (Schøyen and Bråthen 2011). As the TPR is the shortest possible passage through the Arctic, it represents the greatest potential emissions savings of any Arctic route. It is therefore conceivable, though ironic, that the TPR will be promoted as means of mitigating the impacts of climate change even as its existence was enabled by those same impacts.

However, environmental concerns could also serve as a deterrent

against future use of the TPR. While Arctic routes may reduce aggregate GHG emissions relative to traditional routes, non-GHG emissions such as sulfate aerosols (e.g. SO_2) and particulates (e.g. black carbon) can produce regional climate effects with powerful radiative feedbacks. Sulfate aerosols reflect sunlight back into space, resulting in a net cooling effect. However, black carbon deposition on high-albedo surfaces such as snow and ice is projected to increase radiative absorption in the Arctic, leading to net warming from shipping in ice-covered areas during this century (Fuglestvedt et al. 2014). Black carbon emissions along the TPR have a high likelihood of falling on ice compared to the NSR or NWP, owing to the fact that a large percentage of the TPR passes through seasonally or year-round ice-covered waters. The "climate penalty" from black carbon emissions is therefore likely to increase as Arctic voyages migrate northward with the retreat of the ice edge. Regardless of climate considerations, shipping along the TPR will carry increased environmental risks from oil spills due to the extreme remoteness from ports, search-and-rescue (SAR) stations, and other spill cleanup infrastructure. Banning heavy fuel oil in the Arctic will mitigate this risk somewhat, though efforts to pursue a ban through the IMO Polar Code have failed thus far due in part to Russian resistance (Weber 2016).

In addition to environmental concerns, numerous economic factors limit development of the TPR and negate the fuel cost savings of shorter sailing distances in the near term. The most important of these are the limited market opportunities available via the TPR and the uncertainty of whether and how long the route will be accessible each year. The TPR's primary advantage over other Arctic routes is as a transit corridor for trade rather than as an alternative pathway for destinational shipping activities such as fishing, resource extraction, tourism, and community resupply (AMSA 2009). While the central Arctic basin is believed to contain significant quantities of oil and gas (Gautier et al. 2009), the costs of extraction in the region are prohibitive, and no state currently has a fully recognized claim to seabed resources beyond its Exclusive Economic Zone (EEZ) (IBRU 2015). The current pattern of maritime use of the Arctic, dominated by transport of onshore or near-coastal offshore oil, gas and mineral resources out of the region, is therefore unlikely to change in response to greater accessibility of the central Arctic Ocean. Fishing in the central Arctic is similarly off-limits following a July 2015 agreement by the five Arctic coastal states (Canada, Denmark/Greenland, Norway, Russia, and the U.S.) to impose

a moratorium until better scientific knowledge of the marine resources in the region is obtained (Rosen 2015). Furthermore, like the NSR and NWP, the TPR makes sense only for bulk cargo shipments that do not operate within a "just-in-time" mode of delivery and therefore are not subject to strict shipping schedules (Lasserre and Pelletier 2011; Lasserre 2014). The economic viability of these shipments is further constrained by the lack of intermediate ports of any kind from the Bering Strait to the North Atlantic and the fact that distance savings may only be realized for voyages between a handful of ports in northern Europe and East Asia. In general, distance savings via Arctic routes are modest or negative for voyages to/from any European port on the Mediterranean Sea and East Asian ports south of Hong Kong (Farré et al. 2014). Barring a geopolitical security crisis at key "choke points" such as the Malacca Strait and Bab-el-Mandeb, it is highly unlikely that the TPR will attract traffic from these ports away from the Suez Canal Route.

At present, all trans-Arctic routes including the TPR traverse areas covered at least partially by first-year ice, except along the western NSR during brief periods in summer (Stephenson et al. 2014). The IMO Polar Code therefore mandates that vessels plying these routes must be polar class, escorted by an icebreaker, or both (IMO 2015). While capital cost premiums for polar-class vessels vary widely (20-40% by most estimates, and as much as 120%), they are often cited as a critical constraint on the economics of Arctic shipping (Lasserre 2014; Lasserre 2015). In addition to capital costs, ice- strengthening results in significantly higher fuel consumption due to the additional hull load (Bourbonnais and Lasserre 2015), rendering polar-class vessels uneconomic in open water. However, one cost factor that may be avoided by using the TPR is the mandatory icebreaker fees levied by Russia's Northern Sea Route Administration. The TPR is the only Arctic shipping route outside of coastal state jurisdiction, and therefore not subject to regulation for the "prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone" under UNCLOS Article 234 (UNCLOS 1982). While icebreaker fees vary with vessel class, season, ice conditions and gross tonnage, current estimates for a full escort of the NSR during summer exceed $800,000 for an open-water vessel greater than 100,000 GT (FTS of Russia 2014). As the maritime shipping industry has remained viable in part through intense cost concentration and razor-thin profit margins (Notteboom and Rodrigue 2009), removing this critical cost

factor could alter the economic calculus in favor of Arctic routes for bulk cargoes in summer. The period of viability for these diverted shipments will be very brief as the central Arctic Ocean will generally be the first area of the Arctic to freeze over in autumn. Outside of summer, the TPR will require icebreaker escort for the foreseeable future, leaving the NSR as the only viable Arctic route from a technical accessibility perspective.

CONCLUSION

In the same way that trans-polar air routes radically transformed air travel in the 20th century (Humpert and Raspotnik 2012), the TPR has the potential to revolutionize international cargo shipping in the 21st century as the single shortest marine link between Europe and Asia. However, the revolution will come slowly, with significant limitations. For the next several decades, multi-year ice and thick first-year ice will remain persistent obstacles for all but the heaviest icebreakers outside of brief periods in summer. Polar-class vessels will be required for the foreseeable future, mitigating the fuel cost and time savings of the TPR relative to the NSR and traditional routes via the Suez Canal. Environmental risks along the TPR are likewise significant, owing to climate feedbacks from black carbon emissions and the ever-present danger of oil spills in remote, fragile areas. Nevertheless, despite the risks and limitations, signs are that the TPR is poised to become the most expeditious Arctic transit route in the long term. As shown here, it is very likely that the TPR will become progressively viable over the next 50 years under all but the highest-mitigation climate scenarios. As the ice edge migrates gradually northward toward a summer ice-free state, we may begin to see the TPR displace the NSR at the center of the debate over the future viability of trans-Arctic shipping.

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Northern Sea Route

Yury Sychev

THE CURRENT STATE OF NORTHERN SEA ROUTE SHIPPING

According to Russian law, the Northern Sea Route (NSR) is an historical national transport route of the Russian Federation (RF) in the Arctic. It is located east of the archipelago of Novaya Zemlya and continues up to the Bering Strait. From the Kara Gates Strait to Providence Bay, the NSR spans 5,600 kilometers, or 3,000 nautical miles.

For the purposes of this perspective, when speaking of NSR development prospects, I assume its boundaries to be the limit of the RF EEZ adjacent to the Arctic zone of the Russian Federation, identified by President Vladimir Putin on May 2, 2014.

Shipping along the NSR has increased substantially recently after a sharp decline in the 1990s. In 2015, 5.4 million tons of cargo was shipped along the NSR (including transit). The volume of traffic has increased by 3.7 times, compared to a low in 1998 of 1.46 million tons. At the same time, transit traffic, which had sustainably increased since 2010 (Table III.1), decreased by 1.2 million tons in 2015—almost by a factor of four.

In sum, the amount of shipping to and from RF Arctic ports more than doubled in 2015. This is associated with changes in the cargo base and, in a more comprehensive sense, with changes in state policy in developing the RF Arctic zone.

Table III.1 Data on Transit Traffic in 2010-2015 (according to published data)

	2010	2011	2012	2013	2014	2015
Total cargo volume, t	111,000	820,789	1,261,545	1,355,897	1,659,207	419,101
Total number of voyages	4	34	46	71	129	44

RUSSIAN FEDERATION DEVELOPMENT PROGRAMS FOR THE ARCTIC ZONE 2014-2030

In conformance with the Strategy of Development of the Arctic Zone of

the Russian Federation (AZRF) to 2020, the RF State Program, "Socio-Economic Development of the AZRF until 2020" was approved in 2014. The program essentially formalized and integrated activities from other industrial programs already being implemented in the AZRF.

In March 2015, the State Commission for Arctic Development was established by presidential order. The main objective for establishing the Commission was to solve strategic problems defined by the report, "Fundamentals of State Policy of the Russian Federation in the Arctic until 2020 and Beyond," and to dramatically improve the efficiency of AZRF public management.

One of the first issues considered at the meeting of the State Commission was to prepare a new version of the State Program. The goal was for the existing, formal documents to be shaped into a practical framework to guide AZRF development.

The new version of the RF State Program, "Socio-Economic Development of the AZRF until 2020," which was prepared by the Ministry of Economic Development and Trade in 2015, provides for the creation and development of a system of "support zones" in the Russian Arctic.

It is expected that the development of "support zones" and their transport component will become the main driver of the AZRF development. The following eight "support zones" are planned as a result of an analysis of the existing transport and coastal infrastructure in the Arctic:

1. Kola support zone
2. Arkhangelsk support zone
3. Nenets support zone
4. Vorkuta support zone
5. Yamal-Nenets support zone
6. Norilsk support zone
7. Northern Yakutia support zone
8. Chukotka support zone

"Anchor" investors and other enterprises interacting in the form of scientific research and/or technological cooperation are identified in each of the zones. The plan includes the provision of state support in the form of subsidies, tax benefits, investment loans, and the creation of a customs-free zone. The establishment of support zones is planned for completion by 2025.

This approach coordinates with the system of priority projects implemented in the AZRF under the State Program.

The Ministry of Economic Development and Trade has identified a list of 145 projects that have been implemented or are planned in the AZRF, some of which may potentially become "anchor" projects for the development of AZRF entities, and which could eventually provide a multiplier effect for the development of less critical projects and adjacent non-Arctic areas. They include:

1. Creation of the Northern Latitudinal Railway
2. Integrated development of the Murmansk Transport Hub
3. Construction of the seaport facilities in the vicinity of Sabetta
4. Implementation of "Yamal-LNG" project
5. Construction of the "Belkomur" railway
6. Construction of a deep-water seaport of Arkhangelsk
7. Construction of a deep-water seaport of Indiga
8. Construction of the Sosnogorsk-Indiga railway
9. Ensuring of the "Prirazlomnaya" OIFP functioning

According to this scenario, the implementation of activities provided by the State Program will result in an increase of cargo traffic along the NSR by a factor of more than ten. The largest projects are given in Table III.2.

As a result of implementing these projects, export cargo traffic will increase to 30 million tons by 2030, including 13.5 million tons heading eastward and 16.5 million tons heading westward. At the same time,

Table III.2 Largest Cargo Projects in AZRF

Project	Design capacity /year	Period
Yamal-LNG (Novatek)	16.5 million tons, LNG	2014-2040
Novoportovskoe field (Gazprom Neft)	8.5 million tons, oil	2014-2035
Norilsk Nickel	1.3 million tons, non-ferrous metals	1975-2040
Payakha field (Independent Oil Company)	7.3 million tons, oil	2019-2030
Arctic LNG-2 (Novatek)	16.5 million tons, LNG	2022-2045
Licensed Site "River Malaya Lemberova" (Arctic Mining Company)	7 million tons, coal	2016-2035
Pechora-LNG (Rosneft)	2.5 million tons, LNG	2022-2035
Prirazlomnaya OIFP (Gazprom Neft)	5 million tons.	2014-2035

imports using container cargo along the NSR are projected to increase to 16.2 million tons (including rail traffic). Coastal traffic is estimated at 4.9 million tons, including the supply of goods to northern Russia in support of Arctic regions at 3.2 million tons. Thus, the total Russian cargo traffic is forecast to be 51.1 million tons by 2030.

DEVELOPMENT OF ICEBREAKER AND CARGO FLEET, INFRASTRUCTURE, AND NSR PORTS

The following Arctic fleet and NSR infrastructure projects are expected to be completed under the integrated project of the NSR development approved by RF Prime Minister Dmitry Medvedev in 2015.

Nuclear icebreaker fleet. Currently, Rosatomflot has two "Arktika" type icebreakers with the capacity of 54 MW and draft of 11 meters (nuclear icebreakers *Yamal* and 50 *Let Pobedy*), and two "Taimyr" type icebreakers with the capacity of 35 MW and draft of 8.5 meters (nuclear icebreakers *Taimyr* and *Vaigach*). The two latter vessels will be decommissioned by 2020. They will be replaced by three dual-draft project LK60 (22220) icebreakers with the capacity of 60 MW and draft of 10.5/8.5 meters. The prototype icebreaker of this type was built by the Baltic Shipyard in July 2016.

Rosatomflot is also going to build a lead icebreaker with the capacity of 100-110 MW capable of piloting vessels in up to four-meter thick ice.

Diesel-electric icebreakers. Four diesel-electric icebreakers (*Admiral Makarov, Krasin, Kapitan Khlebnikov*, and *Kapitan Dranitsyn*) are now operating in NSR waters.

Two liner diesel-electric icebreakers, *Vladivostok* and *Murmansk*, with s capacity of 16 MW, were built for FSUE Rosmorport in 2015 under the Federal Target Program "Development of Transport System of Russia (2010-2020)" covering icebreaker assistance in NSR waters. Construction is under way on diesel-electric icebreakers *Novorossiysk* and *Viktor Chernomyrdin* with a capacity of 16 and 25 MW, respectively.

Development of cargo and auxiliary fleet. Currently, large Arctic projects such as the Varandey terminal (Lukoil), Prirazlomnoe field, and Novoportovskoe field (Gazprom Neft) have been launched. In 2017, the

Yamal-LNG plant will start production in a place where a number of high ice class vessels are already operating. In addition:

- The Prirazlomnoe field transport system includes three multitask icebreakers and two shuttle tankers.
- Safe operation of the Varandey terminal and tanker loading in ice conditions is supported by the ice class auxiliary tug *Toboy* and the icebreaker *Varandey*, built for Lukoil. Oil is exported using three Sovcomflot tankers with the deadweight of 70,000 tons, all built specially to work in this terminal.
- Three Arctic class tankers and two Arctic Class 8 icebreakers are being built.
- The Yamal-LNG project logistics provide for the construction of 16 LNG carriers of Arc7 class, two tankers to transport gas condensate, and several port icebreakers.

The stated demand of Russian oil/gas and shipping companies for vessels and offshore platforms to explore and develop offshore fields, shipment and transport of raw materials and products between now and 2022 includes more than 500 units, with an estimated cost of 2-2.5 trillion rubles. It is obvious that the deadline for implementing some offshore projects will be postponed due to a lower forecast of world hydrocarbon prices. This shortfall requires a search for innovative technological solutions to provide new levels of economic efficiency both in oil/gas and shipbuilding technologies.

Development of port infrastructure. The implementation of an ambitious program of the development of Arctic ports is scheduled for the period between now and 2020-2025:

- Construction of a deep-water seaport at Arkhangelsk. The project provides for the construction of four special transshipment terminals with a total capacity of 28 million tons.
- Integrated development of the Murmansk Transport Hub.
- Construction of seaport facilities in the vicinity of Sabetta (Yamal Peninsula), including the creation of a ship channel in the Gulf of Ob.
- Construction of the Arctic oil transfer terminal of the Novoportovskoe field with a capacity of 8.5 million tons a year in the

vicinity of Cape Kamenny, Yamalo-Nenets Autonomous Okrug.
- Reconstruction of federal property facilities in the seaport of Pevek.
- Construction of transshipment terminals in Nenets Autonomous District (seaport of Indiga) with the prospective cargo turnover of 30 million tons a year.
- Construction of LNG storage and shipping facility at the Salmanovskoe field.
- Construction of the oil terminal Tanalau to transport oil from the Payakha field with the capacity of 7.5 million tons a year.
- Construction of the coal terminal Chayka in the vicinity of the seaport of Dikson.
- Construction of a coal terminal in the vicinity of the seaport of Beringovsky with the capacity of 10 million tons a year.
- Reconstruction of the Petropavlovsk-Kamchatsky seaport infrastructure facilities.

The integrated NSR development project also includes practical measures to develop navigational, hydrographic, hydrometeorological and rescue support for the functioning of the NSR and development of communications and navigation systems and facilities.

TRANSIT TRAFFIC PROBLEMS ALONG THE NSR

Recently, problems involving use of the NSR for transit traffic circumventing the Suez Canal have emerged. Considerable adjustments are necessary to revise previous optimistic forecasts for Arctic transit development.

Low oil prices, a global economic downturn, and the relative excess of commercial fleets led to declining rates for freight transport and reduced profitability for maritime transport. As a consequence, the opportunity to invest additional funds in new high-Arctic class vessels has become problematic, since potential reductions in transport route distances that the NSR provides cannot justify the expense of constructing an Arctic fleet. At present, there is a limited number of existing Arc 5 and Arc 7 vessels in the world.

Thus, existing specialized Arctic-class vessels will be mainly used for bulk cargo transit in the foreseeable future. No large-scale construction of

new bulk carriers is expected.

As for transit container traffic, a part of container cargo traffic from northeast Asia to northern Europe can be transferred to the NSR. The NSR, however, cannot yet be considered an alternative to the Suez Canal Route.

That is why a container line between Murmansk and Petropavlovsk-Kamchatsky will be created, to transport mainly Russian cargo from the central part of Russia to Magadan and to the ports of Sakhalin and Chukotka as well as to import cargo from Asia bound for central Russia.

After the Murmansk-Petropavlovsk-Kamchatsky line is launched and functioning well, international transit services may become feasible on the NSR, with cargo transshipment from container carriers to Arctic carriers, and vice versa, at container line terminal ports.

Creating this container line project for transit along the NSR requires constructing Arctic-class container ships with the capacity of 1500-5000 TEU.

A cautiously optimistic forecast for the transit of general and container cargo by 2030 estimates suggests a range of between 15-19 million tons.

NSR MANAGEMENT ISSUES

One of the important problems cargo companies operating on the NSR will face in the near future is a lack of capacity for the nuclear icebreaker fleet to provide support for all anticipated cargo traffic.

The main customers will be:

- Federal and regional customers, including the supply of goods to northern Russia.
- Resource companies.
- Coastal commercial traffic, including container traffic.
- Transit traffic.
- Operators of drilling and auxiliary fleets in implementing offshore projects.

These sectors are already competing for common resources and attempting to address sector-specific concerns. This competition will only increase in the future.

There is an obvious need to optimize NSR operations, including the

activities of icebreaker fleets, which will require changing the management structure in the following ways:

1. Expansion of the NSR's Administration functions for the organization of maritime traffic, ensuring navigational safety and information support for the NSR, including:

   - Developing vessel navigation routes on the NSR as well as procedures for identifying the necessary icebreaker assistance and navigation.
   - Monitoring and controlling icebreaker and vessel traffic on the NSR.
   - Organizing navigational, cartographic and hydrometeorological support of maritime traffic.

2. Creation of a single logistics operator in the AZRF to organize cargo traffic on the NSR, based on public-private partnerships. The integrated logistics operator should:

   - Coordinate the execution of transport logistics and service operations to provide services for interested customers.
   - Perform centralized interaction with NSR infrastructure operators, including coordination of icebreaker assistance and navigation.
   - Perform centralized current and strategic planning for the revenue load of NSR infrastructure.
   - Perform coordination of the use of the NSR transport-logistic infrastructure to support fishery, technology, scientific, and research operations and also to support search and rescue operations in the AZRF.
   - Participate in creating tariff policies, including icebreaker dues and expenditures for delivery, as well as loading and unloading fees, including the use of undeveloped beaches for the entire Arctic zone.
   - Ensure a strong and fair competitive environment among transport operators.

The strengthening of the NSR Administration's supervisory responsibilities, together with the creation of a single coordinator acting in the name of all traffic participants, will help regulate shipping at a time

when there is an inadequate icebreaker fleet, and also help reduce expenses related to "dead freight." The creation of a single logistics operator will also allow better planning for shipping companies' activities by providing a more reliable prediction of infrastructure condition and availability, volumes of work, and deadlines for payment.

CONCLUSION

Joint efforts of the Russian Federation and business interests in developing the AZRF have launched qualitative changes in the operations of the NSR, which is considered an historical national transport route of the Russian Federation in the Arctic. The river and land components of cargo transport infrastructure that connect with loading and unloading points have not been considered here. Since the marine component is the central element of the NSR, I have emphasized its role.

Declining hydrocarbon prices have reduced the relevance of developing offshore oil and gas fields in the short term. However, transportation of raw materials produced at low cost on land and in the AZRF estuarine areas will provide multiple opportunities to increase traffic along the NSR in the near term. Efforts unprecedented during the modern history of Russia are underway to restore and improve the NSR infrastructure to increase support for shipping in anticipation of additional requirements expected with increased traffic.

Making qualitative changes in the State Program "Socio-Economic Development of the AZRF until 2020" and applying the concept of support zones has made it possible to implement large-scale measures of state support to develop the Russian Arctic, primarily within the framework of public-private partnerships.

Efforts to upgrade the icebreaker fleet will increase the capacity for providing year-round icebreaker assistance.

The strengthening of the NSR Administration's regulatory functions and the creation of a single non-governmental transport-logistic operator should become important elements of future transport policies and infrastructure organization.

We hope these measures will enable full-scale participation of our foreign partners in their future use of the NSR.

Trends in Arctic Ship-Based Tourism

Peter B. Ortner

The potential growth of the ship-based tourism sector in the Arctic differs from that of the commercial shipping and fishing sectors. While all sectors can reasonably be expected to grow as maritime access to the Arctic increases due to decreased sea ice coverage as well as reduced and thinning multi-year ice, there are current and long-term constraints on the growth of ship-based Arctic tourism. This perspective develops this thesis. First, I will distinguish between two models for ship-based tourism: conventional and expeditionary. Second, I will characterize the present status and highlight some recent trends in the industry. Third, I will discuss some of the inherent operational challenges to tourist ship operations and the near-term limitations to industry growth. Finally, I will make some highly speculative longer-term inferences and briefly discuss some collaborative opportunities and approaches already being taken that address gaps in the environmental information required for responsible risk management with respect to ship-based Arctic tourism.

First, a caveat: I am not a participant in the ship-based tourism industry, a policy expert, or an Arctic expert (although I have worked in Alaskan waters). My work has focused primarily in lower-latitude systems as a seagoing research oceanographer. That said, both my research group and our closest collaborators have for many years been using cruise ships, ferries and container ships as ship-of-opportunity research platforms in the context of what has become the OceanScope program.

My long-term industry partner in our OceanScope efforts (Royal Caribbean Cruise Lines) generously contacted both CLIA (Cruise Lines International Association) and AECO (Association of Arctic Expeditionary Cruise Operators) on my behalf. Representatives of both industry groups graciously provided relevant information[1, 2] and discussed the short-term prospects for growth that affect various sectors of the ship-based tourism industry (including vessel construction plans). They were also willing to share their issues of concern and personal assessments of the factors that currently limit growth in their respective sectors of the ship-based tourism industry. That said, my conclusions about longer-term industry prospects are entirely my own and reflect both my expertise in climate change science

and my personal experience with the industry.

In discussing ship-based Arctic tourism, it is important to distinguish between conventional and expeditionary vessels at the outset. Conventional cruise ships are larger than expeditionary ships (often very much larger), carrying from 500 to more than 5,000 passengers. Most expeditionary vessels carry only a few hundred (or fewer) passengers. The capital investment required is approximately proportional to the vessel size; a large conventional cruise ship can cost well above $1 billion. The business model of the largest carriers is to recoup their initial investment in as little as five years of operation. Moreover, conventional cruise ships are rarely if ever ice-strengthened, while many expeditionary vessels were specially built (or modified) to work in high latitudes and around sea ice. This means that the "season" open to larger cruise ships is considerably shorter than the one open to smaller special purpose expeditionary vessels, and the areas in which they can safely operate (and navigate) are more restricted as well. Nearly all expeditionary vessels carry sufficient landing craft to take all (or most) of their passengers near or onto undeveloped shorelines, or to make ice excursions assuming favorable weather conditions. Cruise ships have a much-reduced capacity in this regard. Cruise ships are highly dependent on local infrastructure. The port facilities required to simply load and discharge passengers are proportional to ship size, in addition to the requirements for shore-side support regarding supplies, wastes and fuel. By contrast, expeditionary vessels are considerably less demanding of port infrastructure. These are generalizations, and recent examples (and some historical ones as well) blur the distinctions I have made. Nonetheless this difference is to a large extent informing business perspectives on the financial opportunity represented by ship-based Arctic tourism and therefore ship traffic patterns with respect to Northwest Passage, Trans-Polar Route, and Northern Sea Route options and opportunities.[3]

AECO provided summary data (valid through last year) on passenger distribution and recent growth for overall ship-based tourism as well as AECO member (purely expeditionary) cruises. While the overall number of tourist passengers accommodated was somewhat higher in the most recent years of the past decade, this growth was predominantly around Svalbard and to some degree represented a shift from Greenland. Other regions experienced relatively low client numbers (excepting perhaps Alaska but not within the high Arctic). If one considers only the AECO expeditionary vessels (about 20% of the total tourist traffic), little overall growth has

occurred in recent years. Whatever overall growth has occurred of late represents an increase in average vessel size rather than an increase in vessel traffic.

That said, at least three forays into the Northwest Passage are planned or recently completed, which will markedly increase the 2016 Canadian totals. This includes two larger (CLIA) conventional cruise ships.[4] The largest is the Crystal lines *Serenity* (a smaller "luxury" cruise ship that still accommodates more than 1,000 passengers). She sailed in August 2016 from Anchorage, Alaska to New York City, making an historic commercial cruise line navigation of the southern route through the Northwest Passage. While a much smaller cruise ship made this passage more than two decades ago, the passage of this larger vessel is significant. Since 1903, there have been only four tankers, one recent bulk carrier and no large cargo ships that have made the full passage (USCG, personal communication). To limit risk, *Serenity* was accompanied by an icebreaker (ICE level 05), the *RRS Ernest Shackleton* chartered from the British Antarctic Survey equipped with two helicopters (not standard equipment) and supplementary zodiac landing craft. Moreover, to prepare for the voyage, relevant officials from the United States, Canada, and Crystal Lines conducted a tabletop disaster response exercise in April 2016. Last, Crystal stated that prior to the voyage, *Serenity* herself would be equipped with state-of-the-art forward-looking sonar, ice detection radar, ice searchlights and thermal imaging, as well as an ice navigation system displaying near real-time satellite and model data. In part because of these risk-related additional costs, individual passenger costs for the 32-day cruise were more than $120,000 per passenger for the most desirable cabins. Crystal provided additional opportunities for small boat natural history discovery excursions as well. While this cruise was promoted as being of "expeditionary" character, in truth it was something of a hybrid venture that included multiple port stops in Alaska, Canada, Greenland, and New England, as well as visits to Canadian Inuit communities (whose total populations are less than the sum of passengers and crew arriving aboard *Serenity*). A repeat *Serenity* cruise is already being promoted for 2017, as is one by the smaller Regent Lines *Seven Seas Navigator* (more than 500 passengers and 150 crew) from Seward, Alaska to Montreal, Canada. Last, the "expeditionary cruise ship" Hapag-Lloyd's *MS Bremen* made a partial transit of the Northwest Passage in August 2016. Her scheduled cruise began and ended in Kangerlussuaq, Greenland and penetrated the Passage as far as Cambridge Bay. In 2006

Bremen successfully navigated the entire Passage with the then novel real-time assistance of satellite-derived sea ice data. She has made seven cruises to date in the Arctic, and in 2017 she is planning a full transit cruise from Nome, Alaska, to Kangerlussuaq, Greenland.

While decreasing ice and improving technology make cruises increasingly possible, knowledgeable observers remain concerned that much of the Northwest Passage still lacks adequate nautical charts, ports, and search-and-rescue (SAR) capability. For example, with respect to Canada, SAR aircraft are based thousands of kilometers away in British Columbia, Nova Scotia and Ontario. In U.S. waters off Alaska, sea ice conditions are typically more favorable. Nonetheless, according to the most recent U.S. assessment, "As sea ice retreats, the lack of U.S. Arctic infrastructure to support increased maritime activity grows more apparent. Limited nautical charts, aids to navigation, communication, emergency response, and rescue capabilities make operations difficult and potentially dangerous. Other elements contributing to accident risks in the Arctic include inadequate maritime infrastructure and environmental and economic uncertainties."[5]

The major conventional cruise ship operators in CLIA have yet to be convinced that the Northwest Passage has "staying power" as a cruise destination, and few members see it as a major business opportunity in the near future. The cost-benefit analysis is not sufficiently favorable. They question whether a Northwest Passage cruise offers enough to attract a great many passengers (and importantly, few if any repeat passengers critical to the conventional cruise industry business model) to justify their enormous capital investment. Moreover, risk management costs remain very high, and it is not certain that routes/schedules are sufficiently predictable.

With respect to SAR responsibility, it is coordinated to the extent that it is partitioned and assigned in accordance with the Nuuk Agreement of 2011. The issue has received explicit attention in recent reports and assessments by the relevant national and international agencies, however, and these reviews do not suggest that SAR capacity is truly adequate (see the recent Arctic Council progress report[6] on AMSA 2009 implementation). Substantial problems are anticipated should a larger passenger vessel ground, become icebound, or for some other reason become disabled or uninhabitable and require full evacuation. Operational concerns include: how quickly can assistance reach a vessel given the sparse distribution of relevant assets (such as icebreakers or aircraft); how and where can the numerous passengers be offloaded, since suitable ports are few in number;

and, what transportation is available to passengers once safely ashore? In addition, cruise passengers (and crew) invariably include citizens of numerous nationalities. This raises a host of procedural hurdles in this era of heightened security concerns.

Significantly, the regions of greatest promise for ship-based tourism do not always coincide with those with the most long-term potential for cost savings in commercial transport.[7] For example, a trans-polar passage is not thought to represent a real business opportunity for ship-based tourism. There is too little to see. Also, the shorter and more direct routes through the Northwest Passage or offshore along the Northern Sea Route are for the same reason not as attractive from a tourist perspective as the more tortuous southern routes. Tourists want to see charismatic high-latitude marine life and, where possible, have the opportunity to interact with indigenous Arctic peoples. That said, and perhaps not surprisingly, there is a more substantial overlap with some regions already being heavily fished.[8] It is somewhat of an anomaly that from 1977-2004, of the 52 successful voyages to the North Pole, 39 were tourist excursions. In 2016, the Russian icebreaker, *50 Let Pobedy*, took 130 passengers to the North Pole, where they participated in collecting sea ice and other observational environmental data. The opportunity to contribute through a "citizen science" experience was cited by passengers as one of the most attractive aspects of the cruise.[9]

Based on trade journal announcements, a number of Arctic tourism "new builds" are scheduled to come on line in the next few years: Crystal is planning a 200-passenger vessel for August 2018; Companie-Ponant is planning a 184-passenger vessel for 2018/2019; Hurtigruten is planning two 500-passenger vessels for 2018 and 2019 respectively; Lindblad is planning a 100-passenger vessel for 2019, and Scenic Cruises Lines a 228-passenger vessel for 2018. Given typical industry planning horizons and build times, these plans were all made some time ago. In fact, AECO projects that over at least the next five years, whatever growth occurs will continue to be focused on Iceland, East Greenland and Svalbard. While the west of Greenland is ice-free for much of the year the only significant wildlife attraction there is said to be whale watching, keeping the focus where it has been—on the eastern shores. In addition, there is a growing concern that recently enacted legislation in both Iceland and Greenland affecting vessels accommodating 200 or more passengers will make it more difficult to operate out of the traditional ports. This could affect both new

ship construction and ship conversion plans since the "local" ports with the most capability remain Longyearbyen in Svalbard and Reykjavik.

Over the long term, the greatest potential for ship-based tourism growth is in Russian and Canadian coastal waters, primarily because both offer charismatic wildlife viewing as well as access to indigenous peoples living in communities along their Arctic coasts. That said, at present there are major impediments to growth in both regions and it remains arguable how from a tourist perspective more "expensive" cruises will differ significantly from present more accessible (and logistically favorable) destinations.

Although Russia's efforts appear to have slowed due to decreased available funding with the fall in oil prices, the Russian Federation has been investing in maritime support infrastructure, including icebreakers, port facilities, navigation aids and navigational chart improvement. Similar Canadian investment has lagged (at least according to newspaper reports), and in both regions there remain significant regulatory and approval obstacles to expanding passenger vessel operations. With respect to Russia, few non-Russian companies have as yet been able to establish the long relationships required to sustain ongoing operations from Russian ports or within Russian waters. Canada's system of government distributes relevant regulatory authority broadly among different provinces and the central federal government as well as the moral and constitutional responsibility to protect the rights of Canada's indigenous peoples. This combination has resulted in an unusually complex regulatory situation. One AECO operator has stated that getting approval for one of their recent expeditions required them to obtain 57 different "permits" from 35 different "offices." It is thought that Canada's attention has been so focused upon oil and gas development and the enormous policy and regulatory challenges it will present, that the challenges faced by the tourism industry have yet to be addressed. At present, AECO members feel their expeditionary vessels are being discouraged rather than encouraged to enter the Canadian market. Moreover, the Coasting Trade Act, the Canadian equivalent of the U.S. Jones Act, has constrained the ability of non-Canadian operators to embark and disembark passengers at Canadian ports, which rules out some favorable routes and destinations.

The above perspectives are in the short-to medium-term (at most seven years out). Looking further into the future is even more speculative. First, let us consider the issue of navigability. The consensus view is that

the Northern Sea Route (NSR) will become accessible for a longer season more rapidly than the Northwest Passage (see for example the U.S. Navy Roadmap[10]). All else being equal, one might expect tourism along the Russian Arctic coast to develop more rapidly than in Canada (and as noted earlier, Russian investment in relevant Arctic maritime support infrastructure has been more substantial). Regulatory procedures will have to be streamlined, and regardless of vessel construction, maritime support infrastructure development will help determine the extent to which Arctic tourism shifts from the "expeditionary" to the "conventional" model (and how rapidly both expand).

Other long-term issues that cannot be ignored include the effects of tourism upon previously isolated and self-sufficient coastal communities and the rapid changes being experienced by the Arctic marine ecosystem. While in the short term, cruise ship visits result in significant local financial benefit; experience indicates that over time the unique character of the affected communities is often eroded. This is particularly true in less "developed" ports of call. Unfortunately this social transformation will be occurring at precisely the same time as the Arctic marine ecosystem, itself highly dependent upon a previously predicable seasonal ice environment, is rapidly evolving and thereby further disrupting traditional ways of life. Some of these changes are inevitable. But in my view, they raise issues of long-term industry sustainability. At what rate will the Arctic lose it special character, which makes it unique, and become less attractive as a tourist destination? Will environmental and societal transformations limit tourist industry growth? Or given a "shifting baseline," can interest be sustained through the all-too-human process of diminished expectations?

The environmental information needs required to justify and support major investments (and minimize risk) also remain a limitation to the growth of ship-based tourism. These needs are likely to remain for decades, given the state of the global economy and the consequent reduction in Arctic research funding. The slow pace of substantive progress on AMSA recommendations in regard to transport infrastructure has already been noted. Equally significant is that research priorities expressed by various relevant reports have changed only incrementally over the past decade, even though it is well recognized that change in the Arctic environment has accelerated.[11] While bathymetric data are lacking throughout the global ocean (the full surface topography of Mars is mapped more accurately than the bathymetry of a large fraction of the global ocean) (L. Mayer, personal

communication), these data are particularly lacking in the Arctic. Moreover, navigational quality bathymetry is not the only data gap affecting both safe ship normal and SAR operations. Arctic oceanic and coastal currents are as yet neither well documented nor robustly modeled, especially in areas of changing ice coverage. In addition, significant changes in circulation are inevitable as a result of global warming and ice melt. Meteorological forecasts are generally less accurate in the Arctic, due in part to the highly dynamic environment and also to a paucity of the timely data on initial conditions upon which accurate weather modeling depends. The impact of decreased sea ice upon Arctic meteorological patterns is a concern; it could lead to more frequent (and intense) Arctic cyclones. Ocean circulation and meteorological modeling deficiencies (as well as inherent issues of parameterization) in turn limit sea ice modeling on operational (versus climate) scales. What is infrequently stated, and worth emphasizing here, is that the ship tourism industry can itself contribute substantially to addressing some of these data gaps (such as incorporating more "citizen science" efforts), thereby benefiting both itself and the entire maritime sector.

AECO's partnership with international regulatory and response agencies with respect to satellite ship tracking and SAR is well recognized (consider the recent and planned SAR tabletop exercise meetings in Reykjavik). There also have been remarkable partnerships with the scientific community, including collaborative projects with the University of Tromsø, Nordlandsforskning, University of Ottawa, British Antarctic Survey, Danish Meteorology Institute, and the Norwegian Meteorology Institute. Here, I want to focus on AECO's collaboration with the Norwegian Hydrographic Services with respect to "crowdsourcing depth soundings." AECO and its Antarctic counter-part the International Association of Antarctic Tour Operators (IAATO) have not only been able to implement a virtual real-time sharing of the depth-sounding data being taken continually aboard their vessels; they have also shared the treasure trove of historical depth-sounding data from prior cruises (to the extent the raw data are preserved). These data have improved the bathymetric information available, at least for the present destinations. While the data are not individually of the same accuracy as that obtainable with the sophisticated multi-beam systems used to update official navigational charts, by averaging multiple less accurate measurements reasonable precision is achieved. This is especially significant in that the financial resources required to obtain comprehensive

high resolution bathymetric data throughout the Arctic are unlikely to be available for many decades.

A final and personal observation: OceanScope is a nascent international program articulated by a SCOR-IAPSO working group uniquely comprised not only of academic and government research scientists but also of marine industry representatives (ship builders, designers, and operators as well as marine research instrument suppliers).[12] What remains unique about OceanScope is that participating vessels (cruise ships, container vessels, and ferries) autonomously collect measurements of ocean circulation and local atmospheric conditions. Their work includes simultaneously making present- and next-generation biological and chemical measurements, transmitting the information to shore site laboratories, and freely distributing these data and analyses to the international research and operational communities such as weather services, coast guards, and ship operators. The possibility of obtaining data from repeat transects in an under-sampled environment like the high Arctic and the proven willingness of Arctic cruise and expeditionary ship operators to collect data imply that an Arctic OceanScope could substantially (and cost-efficiently) augment ongoing international efforts to fill significant maritime environmental information gaps.

Notes

1. Association of Arctic Expeditionary Cruise Operators (personal communications, websites and press releases with particular thanks to Ilja Leo Lang).
2. Cruise Lines International Association (personal communications and websites with particular thanks to Kierstin M. Del Valle and Richard Pruitt).
3. William E. Eucker, "A Geospatial Analysis of Arctic Marine Traffic" (Ph.D. Dissertation, Scott Polar Research Inst., Cambridge University, 2012).
4. http://www.businesswire.com/news/home/20160916005705/en/Mission-Accomplished-Crystal-Serenity-Completes-32-Day-Northwest.
5. U.S. Committee on the Marine Transportation System, A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic, A Report to the President(Washington, D.C., 2016).
6. Arctic Council. Status on Implementation of the AMSA 2009 Report Recommendations, April 2015.

7. Arctic Marine Shipping Assessment 2009 Report.

8. Ibid, Eucker 2012.

9. EOS Project Update, June 2016. Citizen Scientists Train a Thousand Eyes on the North Pole.

10. U.S. Navy Task Force on Climate Change, Arctic Roadmap 2014-2030, 2014.

11. U.S. National Arctic Research Policy, 2013-2017.

12. http://scor-int.org/Publications/OceanScope_Final_report.pdf.

Cooperative Currents and Challenges of Arctic Ocean Governance

David L. VanderZwaag

INTRODUCTION

Two nautical images help capture the status of international efforts to regulate three growing concerns in the Arctic Ocean: fisheries, shipping, and marine tourism. The first is "cooperative currents." Fisheries management cooperation to date has taken the form of efforts led by the five Arctic Ocean coastal States to prevent unregulated commercial fishing in the central Arctic Ocean (CAO) (Pan and Huntington 2016; Molenaar 2016; Wegge 2015) along with initiatives on the part of regional and bilateral arrangements. The North East Atlantic Fisheries Commission (NEAFC) has imposed some regional fisheries management measures for a sector of the CAO (Davis et al. 2013). At the bilateral level, the 2010 Norway-Russian Federation Treaty on Maritime Delimitation and Cooperation in the Barents Sea and Arctic Ocean has not only resolved a long-standing ocean boundary dispute, but also continues cooperation in trans-boundary fisheries management and the work of the Joint Norwegian-Russian Fisheries Commission (Scott and VanderZwaag 2015; Glubokov et al. 2014).

International cooperation in addressing increased shipping activities in the Arctic has progressed substantially at both global and regional levels. A new Polar Code has been concluded under the auspices of the International Maritime Organization (IMO) and will enter into force on 1 January 2017 (Leary 2015). At the regional level, the Arctic Council has played a role in developing two regional agreements with relevance to shipping: the 2011 Agreement on Arctic Search and Rescue,[1] and the 2013 Agreement on Marine Pollution Preparedness and Response in the Arctic.[2] The Council's Protection of the Arctic Marine Environment (PAME) Working Group has been discussing various Arctic shipping issues, including whether further protective measures should be taken for future shipping in the CAO beyond national jurisdiction. The Arctic Council has developed best practice guidelines for Arctic marine tourism (PAME 2015a).

A "sea of challenges" is the second descriptor. Governance

arrangements for the CAO have yet to be fully worked out. Shipping law and policy challenges include a number of issues: putting the Polar Code into practice; extending the coverage of the Polar Code; considering the need for a ban or bans on the use of heavy fuel oil (HFO) in Arctic waters; further addressing the emissions of greenhouse gases and black carbon within the International Maritime Organization (IMO); considering the establishment of Emission Control Areas in the Arctic; getting a firm grip on ballast water management in polar waters; and protecting areas of heightened ecological and cultural significance. Another issue is whether the Arctic Council should undertake additional efforts to address marine tourism.

Since the focus of this session is on the Arctic Ocean proper, various "sub-Arctic" fisheries challenges, of which there are many (Hassan 2009), will not be discussed. They include the following: the management of pollock in the Bering Sea "doughnut hole" (Kaye 2001); the struggles of the North Atlantic Salmon Conservation Organization (NASCO) to manage harvesting off West Greenland of wild salmon originating from North American and European rivers (VanderZwaag and Pudden 2010); the emerging take by Greenlanders of Atlantic bluefin tuna off East Greenland without the blessing of the International Commission for the Conservation of Atlantic Tunas (MacKenzie et al. 2014); and the management of the shared North Atlantic mackerel stock, which has migrated into the Icelandic EEZ (Hannesson 2016).

COOPERATIVE CURRENTS

Because the paper by Alf Håkon Hoel provides an overview of the 5+5 cooperative process to address potential CAO fisheries, and Norwegian-Russian fisheries cooperation has been extensively discussed elsewhere (Henriksen and Ulfstein 2011; Hønneland 2012), this paper emphasizes the main global and regional efforts to respond to the prospects of increased shipping and marine tourism. The limited role of the North East Atlantic Fisheries Commission in addressing CAO fisheries is also noted.

Global

The central regulatory progression for Arctic shipping at the global level is

development of the International Code for Ships Operating in Polar Waters (the Polar Code). The IMO's Maritime Safety Committee (MSC) adopted the safety provisions of the Code in November 2014, including global standards for design, construction, equipment and operational requirements for ships navigating in Arctic waters.[3] The IMO's Marine Environment Protection Committee (MEPC) adopted the environmental provisions of the Code in May 2015.[4]

The Code's coverage is limited both geographically and by type of ship. The Polar Code covers waters north of 600 North, with the exception of some warmer waters off Iceland, Norway and northwest Russia (Brigham n.d.). The safety provisions of the Polar Code will only apply to passenger vessels and cargo ships of 500 gross tonnage or more, while most of the pollution discharge provisions will apply to all ships.[5]

The mandatory safety provisions are set out in 12 chapters of Part 1-A of the Polar Code. One of the key requirements is for ships to have a Polar Ship Certificate that classifies the capabilities of ships to navigate through sea ice. Category A ships are designed for operation in at least medium first-year ice which may include old ice incursions.[6] Category B ships are designed to operate in at least waters with thin first-year ice which may include old ice incursions.[7] Category C ships are designed to operate in open water or ice conditions less severe than for categories A and B.[8] A Polar Water Operational Manual (PWOM) must be carried on board that includes information on ice capabilities and limitations and various procedures to be followed, for example, in voyage planning, emergency response situations, and when using icebreaker assistance. Machinery and fire safety equipment must be designed to operate in low temperatures and to avoid ice accretion and snow accumulation. Requirements for navigational and communication equipment are also stipulated. Various life-saving requirements are set out in chapter 8 of the Polar Code. These include a requirement that lifeboats be partially or totally enclosed.

The training requirements for masters, chief mates and officers in charge of navigational watch are set out in chapter 12 of the Polar Code. Details of the training requirements are actually found in the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention) and the STCW Code, as amended.[9] The latest amendments, setting out basic and advanced training requirements from the Polar Code for ships operating in Arctic waters, are expected to be adopted at the MSC's 97th session in November 2016 with entry into force

on 1 July 2018 (MSC 2015a).

Part I-B of the Polar Code provides additional non-mandatory guidance on safety aspects of the Code. For example, a model table of contents is provided for the Polar Water Operational Manual, and contingency plans are encouraged to address the emergency transfer of liquids if needed.

Part II-A of the Polar Code will establish strict global pollution discharge standards for Arctic shipping. Discharges into the sea of oil or oily mixtures from any ship will be prohibited, as will be discharges of noxious liquid substances. Garbage discharges will be substantially restricted. Discharges will be limited largely to food wastes. Food wastes discharges are only permitted when the ship is enroute and not less than 12 nautical miles (NM) from the nearest land, ice shelf, or land-fast ice, and garbage discharges must be as far as practicable from areas of ice concentration exceeding 1/10. Food wastes must be comminuted or ground. Wastes must not be discharged onto the ice. In addition, discharges of some cargo residues are allowed if not harmful to the marine environment.

Sewage discharge standards might be described as variable. They are strong for new Category A and B ships and new passenger ships constructed on or after January 1, 2017. Those ships will be required to have operational approved sewage treatment plants. Existing Category A and B ships that operate in areas of ice concentrations exceeding 1/10 for extended periods of time will also require approved sewage treatment plants. Existing passenger ships will still be allowed to discharge untreated sewage at a distance of more than 12 NM from the nearest land, ice-shelf, or fast ice. Such discharges shall be as far as practicable from areas of ice concentration exceeding 1/10.

Part II-B of the Code provides additional guidance on pollution prevention in polar waters. For example, ships are encouraged to apply the prohibition on heavy fuel oil use in the Antarctic when operating in Arctic waters and to use anti-fouling coatings resistant to abrasion by ice.

A second major global cooperative effort to support safe shipping in Arctic coastal waters and the CAO is the World-Wide Navigational Warning Service. As a collaborative effort of IMO and the International Hydrographic Organization, the globe has been divided into 21 regions called "NAVAREAs," whereby countries are charged with collecting information on sea states and issuing navigational warnings through the Global Distress and Safety System (GMDSS). Five NAVAREAs have been designated in the Arctic (USA 2015).

Regional

As part of its mandate, The North East Atlantic Fisheries Commission includes a segment of the Arctic Ocean beyond national jurisdiction. While NEAFC has closed various vulnerable marine ecosystems (VMEs) to bottom fishing, that closure has not extended to the CAO. Pursuant to Recommendation 19:2014, future exploratory bottom fisheries would be subject to a notification and scientific assessment process (NEAFC 2014). NEAFC has also prohibited directed fishing for deep-sea sharks, effective 1 January 2013 to 31 December 2016 (NEAFC 2013).

Five regional cooperative "eddies" in relation to shipping stand out following the publication of the Arctic Council's Arctic Marine Shipping Assessment (AMSA) in 2009 (Arctic Council 2009). In May 2011, the Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic was adopted at the Nuuk Ministerial meeting of the Arctic Council. The Agreement delineates areas of national search-and-rescue (SAR) responsibilities in the Arctic, calls for further cooperation in joint exercises and training, and provides for expedited cooperative responses to SAR incidents (Wood-Donnelly 2013).

In May 2013, the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic was concluded after negotiation by an Arctic Council task force. The Agreement commits the parties to maintain effective national pollution preparedness response systems, calls for cooperation in response operations and promotes joint exercises and training. The Agreement also applies to high seas areas. Each party pledges to undertake appropriate monitoring activities to identify pollution incidents not only in areas under its national jurisdiction but also, to the extent feasible, in areas beyond national jurisdiction. When a party receives information on an oil pollution incident in the high seas, there is a duty to notify other countries. Requests for assistance in response operations may also apply to areas beyond national jurisdiction.

Efforts to identify areas of heightened ecological and cultural significance in the Arctic as called for in the AMSA report as a precursor to implementing protective measures[10] have also progressed. Three of the Council's working groups, the Arctic Monitoring and Assessment Programme (AMAP), the Working Group on Conservation of Arctic Flora and Fauna (CAFF) and the Sustainable Development Working Group (SDWG), published a report in 2013 (AMAP/CAFF/SDWG 2013)

that identified more than 90 areas of heightened ecological significance in the Arctic, including many polynya areas and more than half of the total ice-covered area of the marine Arctic. Essentially, the entire central Arctic Ocean Large Marine Ecosystem (LME) was identified as an area of heightened ecological significance. The report noted the limited information on areas of heightened cultural importance and simply provided some examples from Norway, Canada, Greenland and the United States. In March 2014, a workshop was held in Helsinki, Finland to facilitate the description of ecologically or biologically significant marine areas (EBSAs) in the Arctic. A collaborative effort of the Convention on Biological Diversity (CBD) Secretariat and the CAFF Working Group, the workshop identified [1] areas meeting the EBSA criteria under the CBD including two EBSAs in the CAO: the multi-year ice of the CAO, and the dynamic marginal ice zone having open water periods in summer (CBD 2014).

A fourth key initiative was a study undertaken by the PAME Working Group on possible future options to protect areas of the Arctic high seas from impacts from international shipping. The report, published in 2014 (Det Norsk Veritas 2014), identified three main options that could be pursued at the IMO:

- Pursue a particularly sensitive sea area (PSSA) designation for the entire high seas area with a vessel traffic system (VTS), a ship reporting system (SRS) and a dynamic area to be avoided (ATBA).
- Pursue a PSSA designation for the entire high seas with just a VTS and SRS.
- Pursue a PSSA designation for one or more core ice areas within the CAO with ATBA.

The PAME Working Group also has focused specifically on Arctic marine tourism. Following two workshops on the topic, PAME published Arctic Marine Tourism Best Practice Guidelines in April 2015 (PAME 2015a). The title is somewhat of a misnomer, since the document does not set out specific guidelines. Instead, it urges further efforts by the Arctic Council and Arctic States. For example, the Council is encouraged to complete and regularly update a publicly available repository of circumarctic marine tourism information, and governments are encouraged to streamline their marine tourism permitting and oversight processes.

SEA OF CHALLENGES

A broad array of governance challenges loom on the horizon for controlling fishing, shipping and marine tourism activities in the Arctic Ocean. Ten leading challenges are highlighted in this perspective. Regulatory issues relating to the bio-fouling of vessels (Kraska and Rittschoff 2015), noise levels, and grey water from cruise ships are not addressed, even though they continue to be important considerations (VanderZwaag 2015).

Sorting Out Future Governance Arrangements for the CAO

Four main gyres of uncertainty hover over the future of governance arrangements for the CAO (VanderZwaag 2016). First is the outcome of the 5+5 CAO fisheries process regarding many questions yet to be settled:

- Will a legally binding agreement be forged?
- If so, what will be its membership and elements?
- How will a scientific cooperation program be operationalized?
- How will cooperation in maritime monitoring, control and surveillance be advanced?
- Should a commercialization future be promoted?
- What will be the participation rights by Arctic residents and indigenous peoples?
- What principles should govern the granting of future access to fisheries resources assuming commercial fishing is authorized?
- What level of scientific certainty would justify opening up new fisheries?
- What level of "exploratory fishing" should be allowed and how should it be regulated?

A second "swirl" of uncertainty is the role of the Arctic Council's Task Force on Arctic Marine Cooperation (TFAMC) in setting future governance coordinates relevant to the CAO. The Arctic Council Ministers established the Task Force at their Iqaluit Ministerial meeting in April 2015 and charged it with assessing "future needs for a regional seas program or other mechanism, as appropriate, for increased cooperation in Arctic marine areas."[11] Detailed terms of reference for the Task Force set by the Senior Arctic officials (Arctic Council 2015) give the Task Force broad latitude

to consider the following matters: what functions might a cooperative mechanism serve; whether a cooperative mechanism should have a defined geographic scope, such as the high seas area of the Arctic Ocean and/or other (seabed) areas beyond national jurisdiction; what the mechanism's relationship is with the Council; and what legal form any agreement should take (binding or non-binding)? The AMCTC, meeting in September 2015 and February 2016, is expected to issue a report to the 2017 Ministerial meeting. It is not yet clear what recommendations will follow and how CAO governance will be addressed.

A third area of uncertainty is what future steps within the IMO might be taken to address Arctic high seas shipping. Consideration of the question within PAME might be described as "slow and stalled." At PAME's September 2014 meeting in Whitehorse, representatives agreed on the need for four interim steps to be taken prior to further actions by the IMO:

- Develop a paper exploring whether it would be possible for the IMO to establish dynamic areas to be avoided.
- Develop a paper exploring whether it would be possible for the IMO to designate a PSSA located exclusively on the high seas.
- Develop a paper exploring other ideas for making mariners aware of the ecological significance and hazards to navigation by drifting multi-year pack ice, such as NAVAREA warnings and IMO Circulars.
- Continue to seek current ship traffic data from the high seas area of the CAO (PAME 2014a).

Only two of the tasks have been carried out. At PAME's February 2015 meeting in Akureyri, Norway submitted a paper documenting 50 unique vessels operating within the high seas area in 2014 (Norway 2015). The United States submitted a paper exploring future use of NAVAREAs and IMO Circulars to give warning pertaining to drifting ice packs (USA 2015).

At PAME's February 2015 meeting, a further brake was placed on the process. PAME invited AMAP and CAFF to denote areas within the CAO high seas particularly vulnerable to international shipping activities. However, that designation has yet to occur (PAME 2015b).

A further dimension of uncertainty pertains to the implications of a potential UN Agreement on the Conservation and Sustainable Use of Marine Biodiversity in Areas beyond National Jurisdiction. Through Resolution 69/292, the UN General Assembly has set in motion a

preparatory committee process (2016-2017) to make recommendations to the General Assembly on elements of a draft text for a new agreement on marine biodiversity in areas beyond national jurisdiction. Discussions are ongoing to address a number of issues relevant to the CAO. They include gaining access to and sharing of benefits of marine genetic resources, environmental impact assessment obligations, and area-based management tools including marine protected areas (Long 2016).

Putting the Polar Code into Practice

Five especially challenging aspects of Polar Code implementation stand out:

- ***Revising national laws to give effect to the Polar Code***

Passing legislative or regulatory amendments may be time-consuming and it remains to be seen whether countries will be able to harmonize their shipping laws by the time of the code's implementation. Canada and the Russian Federation need to decide whether some national regulatory measures, previously adopted under Article 234 of the Law of the Sea Convention granting special pollution prevention powers in ice-covered waters, should be retained even though they are not consistent with the code (McDorman 2015).

- ***Deciding on whether ice conditions exceed the ship's design limits***

This is especially critical for Category C ships where an assessment needs to be made regarding whether additional equipment or structural modification is needed before navigating in ice.[12] The methodology for such assessments is not spelled out in the Polar Code and the IMO has merely issued "interim guidance" for assessing operational capabilities and limitations of ships in ice (MSC 2016).

- ***Developing detailed Polar Water Operational Manuals for each ship***

The Polar Code calls for each ship to carry a PWOM on board with considerable flexibility allowed as to details, for example, of procedures to be followed in encounters with ice exceeding the ship's specific capabilities and procedures for contacting emergency response providers. Ensuring there is a manual tailored to each ship in time for the code's entry into force has been identified as a substantial challenge (Brigham n.d.).

- *Ensuring adequate crewing and training*

With the Polar Code calling for new special training of masters, chief mates and officers in charge of navigational watches in polar waters, Flag States may be challenged to modify and ensure appropriate training courses. Training of crew members may be even more challenging, since the code leaves wide latitude as to what exactly this training should include: "Every crew member shall be made familiar with the procedures and equipment contained or referenced in the PWOM relevant to their assigned duties."[13]

- *Providing adequate reception facilities for ship wastes*

With new restrictive discharge standards for oil, noxious liquid substances and garbage in the Arctic pursuant to the Polar Code, the challenge of providing adequate waste reception facilities, either within or outside the Arctic, arises. PAME has established a Correspondence Group to develop a Regional Reception Facilities Plan (RRFP) and the group has been asked to complete a final draft deliverable document by the end of 2016 (PAME 2015c).

Extending the Coverage of the Polar Code

It remains to be seen if/when the Polar Code might be extended to cover other ships operating in the Arctic, such as fishing vessels and private yachts. The Arctic Ocean Review report did recommend that Arctic States consider approaches, including at the IMO, to address safety and environmental concerns with respect to other types of vessels that may not, due to their size, routes and nature of activity, be subject to the Polar Code (Arctic Council 2013: 96).

Considering Further Heavy Fuel Oil (HFO) Bans

The question of whether HFO use should be further banned in Arctic waters (beyond bans already in place for some nature preserves and national parks off Svalbard) (AECO 2015) has been controversial and remains unsettled. A ban on the use and transport of HFO in Antarctic waters has been in place since August 1, 2011. Reasons supporting broader banning include the long persistence of HFO if spilled into the environment, and the higher risk of engine failure with HFO than other fuels. Although

the IMO's Marine Environment Protection Committee decided against an Arctic HFO ban at its meeting in May 2013, some delegations were of the opinion that such a regulation might be desirable in the future (MEPC 2013). The PAME Working Group has continued to study the uses and risks of HFO in the Arctic. Studies in 2013 found that of 1,347 vessels operating in the Arctic throughout 2012, 371 (28%) were most likely using HFO as fuel (Det Norsk Veritas 2013a) while 84% of vessels operating in the Bering Sea were identified as HFO users (Det Norsk Veritas 2013b). Two additional HFO studies, one on HFO releases from shipping in the Arctic and the other on possible hazards for engines and fuel systems, are due to be submitted to the 2nd PAME meeting in 2016. PAME invited member States and others to submit proposals for mitigating the risks of HFO use and carriage in the Arctic by June 1, 2016 (PAME 2016).

Controlling Greenhouse Gas Emissions from Ships

The control of GHG emissions through the IMO has been limited (Hackmann 2012). In July 2011, a new chapter 4 was added to Annex VI of the MARPOL Convention (IMO 2011), setting out energy efficiency regulations for ships of 400 gross tonnage and above. New ships are required to meet Energy Efficiency Design Index (EEDI) requirements while each ship, including existing ships, are required to keep on board a Ship Energy Efficiency Management Plan (SEEMP).

Consideration of further measures, such as setting a global target for GHG emission stabilization or reduction or imposing a levy on fossil fuel use, has lagged. One of the points of controversy is whether a common but differentiated principle should apply in the shipping context. In the wake of the 2015 Paris Agreement on climate and growing pressure for the shipping industry to commit to its mitigation "fair share," the Marine Environment Protection Committee (MEPC) took on the issue. At its 69th session in April 2016, the MEPC agreed to establish a working group at its 70th session to further discuss the reduction of GHG emissions from ships (MEPC 2016a).

Reducing Black Carbon Emissions

Moving forward with black carbon emission measures from ships has also been a difficult issue within the IMO. The IMO began addressing black carbon in 2011, but it wasn't until the 68th session of the MEPC in May

2015 that a definition of black carbon was approved. The IMO's Sub-Committee on Pollution Prevention and Response (PPR) is still struggling with the issue of appropriate methods for measuring black carbon emissions and has yet to consider possible control measures to reduce the impact of black carbon emissions for international shipping (PPR 2015).

Considering the establishment of Emission Control Areas (ECA) in the Arctic

MARPOL Annex VI provides for the establishment of Emission Control Areas where more stringent than normal air emission controls for SOx, NOx and particulate matter might be imposed.[14] While a number of ECAs have been established under MARPOL, including for sea areas off the Atlantic and Pacific coasts of Canada and the United States (IMO 2010), none have been established for Arctic waters. The United States has gone on record through PAME regarding its openness to further analysis regarding the establishment of one or more ECAs in the Arctic including in the high seas of the CAO (USA 2014).

Getting a Grip on Ballast Water Management in the Arctic

A further challenge is ensuring effective ballast water management in polar waters in order to prevent the spread of invasive species (Jing et al. 2012). One major hurdle has been the difficulty of bringing into force the International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004) and getting all Arctic States to become parties to the agreement. The Convention's entry into force requires the ratification/acceptance by 30 States with combined merchant fleets constituting not less than 35% of the world's gross tonnage. On 8 September 2016, Finland deposited its instrument of acceptance, and the 35% gross tonnage requirement was met. The Convention will enter into force on 8 September 2017.[15] Of the eight Arctic States, Iceland and the United States are still not parties.[16]

Practical challenges also abound. Flag states have been slow to require their vessels to install ballast water management systems (BWMS), partly due to the costs and limited shipyard capacities (VanderZwaag 2012). Even where BWMS have been installed, a recent study indicates they may seldom get used (MEPC 2015). The performance of BWMS in cold waters

still remains uncertain with no shipboard trials on efficiency conducted below 5°C (MEPC 2016b). PAME's 2013 Arctic Ocean Review report recommended that Arctic States support research into ballast water management systems that are effective in colder polar regions (PAME 2013), but that recommendation does not appear as yet to have been heeded.

Protecting Areas of Heightened Ecological and Cultural Significance

While substantial progress has been made in identifying areas of heightened ecological and cultural significance in the Arctic, moving to actual protective measures to avoid adverse impacts of shipping has been slow. No PSSAs have been established in Arctic waters. Vessel routing measures remain sparse (United States, Denmark and Norway 2013) with the leading examples being the imposition of traffic separation schemes and recommended routes off Northern Norway (IMO 2006) and five recommended areas to be avoided off the Aleutian Islands, Alaska (MSC 2015b).

Considering Further Marine Tourism Measures

Very little follow-up to the recommendations in PAME's 2015 Best Practice Guidelines appears to have occurred yet. PAME has invited Canada, the United States, and Norway to submit a paper identifying specific Arctic Marine Tourism Project follow-up activities for consideration at PAME's second meeting of 2016 in September (PAME 2016). The development of yacht-specific guidelines for Arctic operations is likely to be discussed.

CONCLUSION

One final nautical image helps to capture the international regulatory realities for fishing, shipping and marine tourism in the Arctic: "unfinished voyaging." Arctic States and the broader community still have a long way to go in implementing existing law and policy commitments and in establishing further regulatory standards and measures.

Some "rough waters" will likely be encountered ahead. In particular, the disputed Beaufort Sea boundary between Canada and the United States

remains to be resolved. Sorting out access rights to subsistence and possible future commercial fisheries in the boundary area may prove to be especially challenging (Warner, VanderZwaag and Engler 2014: 401).

Notes

1. Available at <https://oaarchive.arctic-council.org/handle/11374/531>.
2. Available at <https://oaarchive.arctic-council.org/handle/11374/529>.
3. Res. MSC. 385 (94). Corresponding amendments to the Safety of Life at Sea (SOLAS) Convention were adopted through Res. MSC. 386 (94).
4. Res. MEPC. 264 (68). Corresponding amendments to the MARPOL Convention were adopted through Res. MEPC. 265 (68) [hereinafter Polar Code].
5. Annex IV, setting sewage discharge limits, applies to ships of 400 gross tonnage or more or to ships certified to carry more than 15 persons. (MARPOL 2011 Annex IV, Reg. 2).
6. Medium first-year is defined as first-year ice of 70 cm to 120 cm in thickness. Ibid., Introduction para. 2.8.
7. Thin first-year ice is defined as first-year ice 30 cm to 70 cm thick. Ibid., para. 2.15.
8. Ibid., para. 2.3.
9. Ibid., para. 12.3.1.
10. Recommendation II(C) of AMSA (Arctic Council 2009).
11. Iqaluit Declaration 2015, para. 43.
12. Polar Code, supra note 4, Part I-A, para. 1.3.3.
13. Ibid., para. 12.3.4.
14. MARPOL Annex VI, Reg. 2(8).
15. IMO, BWM. 1/Circ. 38 (2016).
16. Ibid.

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U.S. Coast Guard Arctic Strategy —Dramatic Vision to Implementation

Kathleen A. Duignan

The United States Coast Guard has statutory responsibilities for maritime safety, security, and stewardship in the country's sovereign waters, including waterways in the Arctic. The Coast Guard monitors all forms of human activity at sea, promulgates regulations to prevent mishaps or mischief, and prepares to respond to maritime incidents. These are especially challenging tasks in the Arctic's extreme environmental conditions. Any increase in navigable waters associated with receding ice will place greater operational demands on the Coast Guard.

ENDURING PRESENCE

The Coast Guard has been an Arctic leader since the days when the only federal presence within the Arctic borders of the United States was in the territory of Alaska. Prior to the formation of the current Coast Guard, Captain "Hell Roaring" Mike Healy patrolled the area and operated throughout the high latitudes during Alaska's nascent affiliation with the United States. Captain Healy was effectively "the law" in Alaska during the 1880s and 1890s, enforcing federal law along Alaska's 20,000-mile coastline as captain of the Revenue Cutter Bear. During his time as captain, he acted as judge, doctor, and policeman to Alaskan natives, merchant seamen, and whaling crews. His legacy is replete with stories about arresting lawbreakers, quelling mutinies on merchant ships, interdicting alcohol and drug smugglers, rescuing sailors at sea, providing medical aid to isolated villages, preventing the slaughter of wildlife, and exploring Alaska's coastline.[1] For his service, one of the two active icebreakers in the Coast Guard fleet today bears his name—the medium endurance cutter USCGC HEALY (WAGB-20).

More recently, the Coast Guard has taken a mobile and seasonal approach to meeting our statutory responsibilities in the Arctic, vastly increasing surface and air assets in the Arctic during the summer months when ice coverage recedes and marine activity is at its peak. Operating in

the Arctic is not a new prospect for the Coast Guard, but changing factors in the region and increased focus on the Arctic today affect our operational framework.

So-called "Arctic Shield" operations are an annual series of large cutter deployments providing mobile command and control functions, accompanied by patrols of ocean-going, ice-strengthened buoy tenders, maritime patrol aircraft, and land-based helicopters. These forces are used to generate a comprehensive understanding of Arctic maritime conditions covering more than 950,000 square miles of ocean off the Alaskan coast. Arctic ports, waterways, and rivers provide tremendous economic value, and national prosperity is inextricably linked to maritime activities and infrastructure in the high latitudes. The Coast Guard works closely with industry and other stakeholders to ensure this economic engine operates safely and efficiently. As both a military service and a law enforcement agency, the Coast Guard is armed with broad authority and plays a pivotal role in preserving U.S. national security interests.

Operation Arctic Shield employed more than 1,000 Coast Guard members from June through October 2015, including cutter crews, aviation personnel, and land-based personnel. Operational activities included the following:

- Maritime domain awareness patrols and ice rescue training.
- Enforcement of safety zones.
- Training for local populations.
- Public comment meetings.
- Volunteer search and rescue training.
- The rehearsal of mass-rescue operations with villages.
- A spill response drill.

The 17th Coast Guard District continued these same operations in 2016. In addition, Arctic Shield assets supported a joint mass-casualty rescue field exercise named Arctic Chinook. This exercise involved the full spectrum of response scenarios, including launching air and surface forces, transferring survivors to remote staging areas, conducting triage activities, ensuring personnel accountability, making appropriate notifications, and optimizing available resources ashore. Arctic Chinook was intentionally scheduled for the period prior to the voyage of the *Crystal Serenity*, a cruise ship headed into the Arctic by way of the Bering Strait.

Guided by the lines of effort outlined in the U.S. National Strategy for the Arctic Region, the Coast Guard focuses in the Arctic on the three strategic objectives of the Coast Guard Arctic Strategy:

- Improving awareness.
- Modernizing governance.
- Broadening partnerships.

This strategy, first published in May 2013, is part of a 10-year vision that describes where the Coast Guard is now and where the organization is headed during the next decade. Since the time of the strategy's release, the Coast Guard has worked actively to ensure that the strategic vision this document sets for the service is being fully implemented.

To develop this strategy, the service developed a Coast Guard Implementation Plan promulgated in December 2015. The Coast Guard has been a leader in the federal government in ensuring the safe, secure, and environmentally responsible conduct of maritime activities in the Arctic. In order to transform this strategy into reality, the Coast Guard outlined 13 initiatives in its Implementation Plan:

- Enhance Arctic operations and exercises.
- Improve maritime domain awareness.
- Enhance Arctic surface and air capabilities with associated support infrastructure.
- Improve Arctic communications capabilities.
- Implement the IMO Polar Code.
- Promote Arctic waterways management.
- Support the Arctic Council and the U.S. chairmanship.
- Advance the Arctic Coast Guard Forum.
- Support a Center for Arctic Study and Policy.
- Establish an Arctic policy board.
- Create an Arctic fusion center.
- Create an Arctic maritime assistance coordination center.
- Strengthen marine environmental response in the Arctic.

The Coast Guard has made significant progress regarding several of these initiatives since the Implementation Plan was published. Many of the challenges in the Arctic have been addressed, and the Coast Guard has

taken multiple steps to broaden international, federal, state, local and tribal partnerships that will increase interoperability, identify critical resources, enhance preparedness and facilitate discussions. Two noteworthy successes include the international Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic and the international Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic developed under the auspices of the Arctic Council in 2011 and 2013, respectively.

EMERGING FRONTIER

The Arctic is a vast and dynamic operating environment. Ice, persistent sub-zero temperatures, low visibility, extended darkness, equipment gaps, remote areas, and limited experience all make operating in the Arctic a challenge for maritime operations generally, and specifically for emergency and environmental response. Ships operating in the Arctic are exposed to a number of unique risks. In addition to poor weather conditions, a relative lack of hydrographic data, unreliable communications, and insufficient navigation aids collectively pose exponential dangers for Arctic mariners. Cold temperatures, for example, can reduce the effectiveness and functionality of numerous components of the ship, ranging from deck machinery to emergency equipment. When ice is present, it imposes additional loads on the hull, propulsion and steering systems, and other appendages. Moreover, the remoteness of the polar regions makes search and rescue, environmental response, and other operations difficult and costly.

Receding sea ice is generating new demands on operational resources. In September 2012, the world observed the lowest sea ice extent in the Arctic since satellite tracking began in 1978. Near-record low levels of ice coverage and thickness were also observed in parts of 2015 and 2016 along with higher-than-average temperatures. Warmer temperatures lead to reduced ice coverage and in turn increase the number of navigable waterways. Seasonal trade routes across the Arctic are now physically possible, including the Northwest Passage and the Northern Sea Route. Using these trade routes, merchant ships can cut 1800-4000 nautical miles from a journey between Europe and Asia. One result of this increased navigability is that vessel traffic is rising. Bering Strait transits have

increased steadily from around 220 in 2008 to approximately 350 in 2014. There were more than 400 transits in both 2015 and 2016. Although these numbers are relatively small in absolute terms, they signal real growth in marine activity in a region that already requires additional Coast Guard presence. Potential new shipping routes between the Atlantic and Pacific Oceans and within the Arctic Basin are major drivers for future marine activity in the Arctic.

Oil and gas exploration and recovery, as well as mineral exploitation, are also significant factors affecting future planning efforts. The expansion of open waters along the North Slope of Alaska will likely incentivize increased oil exploration, resource development programs, and the potential for increased adventure tourism. These increases in human activity are taking place in a region that has yet to be surveyed and charted to 21st-century standards, since much of the Arctic had been covered perennially with ice. The receding ice now exposes the seabed to potential exploration and extraction of vast natural resources. The Arctic seabed is rich with oil and strategic minerals. An estimated 13% of the world's undiscovered oil and 30% of the undiscovered natural gas are in the Arctic; the bulk of these resources are located offshore. An estimated $1 trillion worth of minerals, including nickel and zinc, may be available. Offshore drilling and mining projects will undoubtedly increase in direct proportion to the rate of increase in navigable waters, allowing more access to the region.

Warmer temperatures and melting ice also are causing some fish stocks to shift northward, prompting analysts to predict significant changes in Bering Sea fisheries. About 50% of U.S. fish stocks are harvested in the Alaskan Exclusive Economic Zone (EEZ), and fishing vessels are naturally expected to follow fish stocks further north, a development that will draw them further from existing response capabilities and support infrastructure. Where they go, the Coast Guard must follow.

Likewise, the prospects for profitable tourism will find less resistance as waterways open up, as evidenced by the historic *Crystal Serenity* cruise ship expedition scheduled for mid-September. This 30-day voyage from Seward, Alaska to New York City, via the Northwest Passage, is a precedent setting and major milestone in Arctic tourism. The *Crystal Serenity* (Flag: Bahamas), sailing with a scheduled 1,725 total persons on board (1,080 passengers and 635 crew), was to be the largest cruise ship ever to attempt such a voyage. Ensuring safety for this event was a team effort.

In preparation for the *Crystal Serenity* cruise, the Coast Guard hosted

four formal planning sessions, including a voyage-specific emergency response table-top exercise to test emergency plans. Coast Guard personnel were actively engaged in planning with Crystal Cruises for more than a year, planning the route, coordinating logistics, inspecting equipment, evaluating crew training, and exercising joint response drills appropriate to the anticipated challenges and potential emergency situations en route. In the end, Crystal Cruises exceeded every requirement for transits in these regions, including having two ice pilots, hiring the HMS *Shackleton* as an escort vessel, installing ice lights, radar, and countless other passenger safeguards.[2]

When considering worst-case disaster scenarios, adventure tourism is certainly of the greatest concern to the Coast Guard because of the vulnerable population and lack of onboard response capabilities. For example, a cruise ship evacuation for *Crystal Serenity* would have quickly exhausted the resources of all villages in the region as well as any federal or state assets around the region.

As a consequence of these transportation safety challenges, human and economic activity in the northern Arctic region will likely also increase the risk of maritime accidents and general incidents throughout the region, affecting visitors and residents alike. The Coast Guard and other agencies must monitor activity and assess the risks to determine proper responses and resource allocations, including the challenges of harsh climate and vast distances. The Coast Guard's plans for continued involvement in the Arctic are based on assumptions that maritime activity will remain at current levels or increase (but will not likely decrease). At-sea presence, which is essential to protecting American interests, must continue. Planners also assume that climate change and its associated affects will continue to affect the Arctic disproportionately compared to lower latitudes, with losses of sea ice occurring at rates equal to or greater than current rates. Less ice equates to more open waterways, making the Arctic more attractive to industries, fishing enterprises, adventurers, and tourists. As a consequence, Coast Guard operations will have to be responsive to changing mission demands, while respecting the limits of available resources.

A 21st-CENTURY COAST GUARD

The Arctic will be developed further as climate changes increase

accessibility to this once remote and forbidding environment. The Coast Guard monitors Arctic shipping, fishing, and tourism, and has observed rising trajectories in all three areas. Resource development is another form of human activity likely to increase over the next decade. Such development has proven to be successful despite challenging conditions off the coast of Norway, and will undoubtedly emerge in the fertile seabed off the north coast of Alaska. The Coast Guard must be ready to protect U.S. security, economic and environmental interests wherever called upon to do so. It must recapitalize its vessels, aircraft, boats and infrastructure in preparation for these anticipated changes. With many ships in its fleet already exceeding 40 years of service, recapitalizing our heavy icebreakers is particularly crucial to national and homeland security. Only heavy polar icebreakers can ensure year-round access to both polar regions in order to guarantee our sovereign rights, ensure national security, and protect commerce and lives.

Our projected needs include three heavy and three medium icebreakers. At present, we have one medium icebreaker and one heavy icebreaker, which is approaching the end of its service life. All projections for changing environmental conditions and increased human activity in the Arctic suggest that current and planned fleet improvements must be accelerated to respond to the expected increases in demand for Coast Guard services.

Tremendous steps have been made to modernize the Coast Guard, but new assets also require properly trained and equipped people to operate and maintain them. To address the challenges ahead, the Coast Guard must maintain an appropriately sized and trained workforce to address emergent challenges and remain prepared for major contingencies. An increasingly competitive labor market and new personnel policies are also increasing the competition for America's talent. To remain attractive and competitive in this market, the Coast Guard's personnel system must be agile enough to recruit, develop, and retain a diverse and talented future workforce.

The Coast Guard must also continue to demonstrate leadership among the eight Arctic nations and beyond. As the principal architect of the Arctic Coast Guard Forum, the service has forged substantive cooperation among Arctic nations, increased awareness of foreign activity in the Arctic, and helped keep the region peaceful. The Arctic Coast Guard Forum is comprised of the agencies fulfilling the functions of coast guard missions from all the Arctic countries: Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States. The Coast Guard also has helped

to shape the IMO Polar Code for vessels operating in the Arctic, and is considered a lead agency for joint operations and exercises that directly support safety of life at sea and the prevention of oil spills. Demands for the Coast Guard's services will only increase.

Notes

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2. The *Crystal Serenity* completed its voyage successfully in September 2016. Crystal Cruises and other companies are considering similar voyages in the future.

Impacts on Local Communities

Denise L. Michels

Attention to Alaska and the Arctic has increased with the U.S. Chairmanship of the Arctic Council, the historic visit of President Obama to Alaska in 2015 at the time of the GLACIER summit, and an extremely early breakup this year as the "Arctic sea ice extent continued tracking close to levels in 2012."[1] The Bering Strait region in Alaska continued to see an increase in ocean vessel traffic. In 2015 the Northern Sea Route Administration permitted 18 vessels to use the Northern Sea Route, which was a smaller number than the 31 vessels permitted in 2014.[2] The Marine Exchange of Alaska tracked 452 vessels traversing the Bering Strait in 2015, which was an increase from 255 in 2014.[3] Vessel calls at the Port of Nome increased from 498 in 2014 to 635 in 2015.

In 2012, *The World*, a privately owned residential yacht, sailed from Nome to Greenland following Roald Amundsen's journey.[4] In August-September 2016, Crystal Cruise's *Serenity* traversed the Northwest Passage, stopping in Nome before transiting the Bering Strait. This happened before the IMO's Polar Code went into effect. Coincidentally, the Northern Command held its "Arctic Chinook SAR FTX" exercise at Tin City—while the *Serenity* headed to Nome—with United States Coast Guard (USCG) and Joint Base Elmendorf Richardson assets. There was international coordination from every Arctic nation.[5]

There is an ongoing increase in expedition cruise ships in the Alaskan Arctic. The *Hanseatic* and the *Bremen* were traditionally the only cruise ships docking at the Port of Nome after completing the Northwest Passage. Now the Silver *Discoverer, Silver Explorer, Le Boreal, L'Austral, Le Soléal, and the Caledonian Sky* offer expedition cruises through the Northwest Passage and down the Aleutian chain to Asia. Ponant's *L'Austral* cost per person starts at $19,600 for a 22-night cruise from Kangerlussuaq, Greenland to Nome, Alaska via the Northwest Passage.

On the horizon, there are plans to construct more ice hulled or polar-class ships, including expedition-type ships such as the upscale 25,000-gt Crystal *Endeavor*, being built by Germany's Lloyd Werft for operation by Los Angeles-based Crystal Cruises.[6] "Norway's Kleven Vertf yard has been chosen to build two, and possibly four, 600-passenger ice-strengthened

ships for Hurtigruten's expedition voyages in the Arctic and Antarctic regions."[7]

A question emerges: With this increased activity, do we need to build up the infrastructure in the Alaskan Arctic? The Port of Nome is the only medium-draft port north of St. Paul Island, Alaska. The USCG press release of June 24, 2016 reported a Norwegian-flagged chemical tanker, the *Champion Ebony*, ran aground on Nunivak Island, Alaska, though the crew was able to refloat it. The U.S. Army Corps of Engineers (USACE) cancelled its plan to build a deep draft port in Nome, Alaska after Shell pulled out of their Arctic drilling program in 2015.

As a former elected official, I have identified a gap in U.S. Arctic Policy that needs to be addressed by the Arctic Executive Committee in the Executive Office of the President. The Arctic policies of both the United States and the state of Alaska call for infrastructure development,[8] specifically for constructing a U.S. Arctic Deep Draft Port. The U.S. Navigation and Navigable Waters Law (33 USC § 2241) defines a deep-draft harbor as "a harbor which is authorized to be constructed to a depth of more than 45 feet (other than a project which is authorized by section 2020 of this title)."

In March 2013, the USACE and the Alaska Department of Transportation and Public Facilities published the "Alaska Deep Arctic Port System Study." Under Definitions and Acronyms, it states, "The term 'deep-draft' is a term to describe ports that can accommodate large vessels such as big cargo ships. In this report, the Study Team defines "deep draft" as a depth greater than 35 feet water depth (or -35)." (page e)

Under the USACE's Tentative Selected Plan, the cost-benefit ratio (CBR) analysis only identified benefits going to -28' Mean Lower Low Water (MLLW), which does not meet U.S. Arctic Policy requirement of deeper than -45' MLLW.

Russia is expanding its ports. Other nations are utilizing their services and are dependent on Russia. The U.S. needs an Arctic deep draft port for our own presence. It is diplomatically difficult for the U.S. to place sanctions on Russia, since our allies rely on Russia's Arctic port infrastructure through the Northern Sea Route (NSR).

Nome is a Port of Call for Customs. There are no Customs Ports of Call north of Nome. The U.S. is at risk from an increase in international smuggling activities, since there are no national security assets in place in Alaskan waters. Vessels with passengers are disembarking on land and in

communities north of Nome, including kite boarders, jet skiers, hikers, motor vehicles, international swimmers and yachts.

Since there are no national security assets in the Arctic, passengers can disembark at various places north of Nome, then fly from the village where they disembark to Nome. From Nome, they can fly to Anchorage and on to the lower 48—opening a route whereby smuggling activities could infiltrate the U.S. through the Arctic.

The need for Arctic marine infrastructure is abundantly clear, and the time is now to design, fund and build a deep draft port facility to ensure the protection of life, safety, the environment, and natural resources of the United States. An Arctic deep draft port at Nome would effectively meet each of the nation's Arctic strategy priorities and provide a location of strategic importance for national defense assets to protect the sovereignty of the United States.

The President, Secretary of Defense, or Congress could instruct the USACE to construct an Arctic Deep Draft Port in Nome deeper than -36 MLLW per federal regulation's definition and U.S. Arctic policy.

The closest USCG base is in Kodiak, Alaska, more than 800 miles away from the Bering Strait region. It takes more than a day of ocean travel by a cutter, two hours of flight time in a C-130, and five hours by a HM-65 helicopter to access the Bering Strait region. Along the lower 48's western coastline, there are numerous bases and stations between Washington State and California. Alaskan officials view this area as comparable to Western Alaska's coastline from Kodiak to the Canadian border. If we don't include Nome, Alaska, there is a huge gap in adequate response time for the Northern Bering Sea and the waters of Norton and Kotzebue Sounds. Nome is a prime location to allow the USCG to respond more quickly to enforcement issues and emergencies and to monitor environmental concerns.

The USCG's Bering Straits Port Access Route Study is supported by Alaska's indigenous communities, as it would provide a "highway" for all these vessels to use and limit conflict over uses of the waterways between subsistence hunters and the commercial ocean vessel industry. The USCG's District 17 issued a Marine Safety Information Bulletin 01-16 on June 14, 2016 entitled "Voyage Planning Notice for Vessels Transiting the Bering Strait," establishing voluntary measures to follow the established route.

The Arctic Council's Task Force on Arctic Marine Cooperation is discussing ideas for enhancing cooperation in the Arctic.[9] There are two

doughnut holes (high seas areas) in the Arctic. There are international marine governing bodies, including OSPAR, which have agreements for the management of high seas areas.

There are a number of existing legal frameworks for high seas issues:

- The UN Convention on the Law of the Sea.
- The International Maritime Organization's Polar Code.
- The International Convention for the Safety of Life at Sea (SOLAS).
- The International Convention for the Prevention of Pollution from Ships (MARPOL).

Recently the U.S. created a marine protected area at the Hanna Shoal, an exceptionally productive biological hot spot, with little consultation with indigenous residents of Alaska.

Several options to be considered in protecting marine areas are ecosystem-based management arrangements, regional seas agreements, and marine protected areas (MPA).

MPA's should meet three requirements:

1) There needs to be a real reason for the protection.
2) The U.S. government (Executive Order 13175) and the Arctic Council must consult with indigenous residents of the Arctic who have Permanent Participant status. Within the Arctic Council, there is very little opportunity to engage with the delegates unless you are a Permanent Participant representative or an actual delegate.
3) Indigenous residents must have access in the areas for subsistence harvests and related activities.

The Arctic Waterways Safety Committee recommends that the U.S. delegation and the Arctic Council consider geo-fencing in the high seas of the Arctic. Marine mammals are migratory and their migratory patterns are changing in response to climate change. Any governance arrangement should be dynamic and evolve as conditions continue to change

Marine discharges that can affect traditional harvests are a critical concern for our subsistence hunters. The Arctic Waterways Safety Committee is drafting a "Safety Plan"[10] with subsistence hunting coalitions, industry, and state and federal agencies to partly address this issue. "Alaskan Inuit food security is the natural right of all Inuit to be part of

the ecosystem, to access food and to take care of, protect and respect all life, land, water and air. This right allows for all Inuit to obtain, process, store and consume sufficient amounts of healthy and nutritious preferred foods—foods physically and spiritually craved and needed from the land, air and water—which provide for families and future generations through the practice of Inuit customs and spirituality, languages, knowledge, policies, management practices and self-governance. It includes the responsibility and ability to pass on knowledge to younger generations, the taste of traditional foods rooted in place and season, knowledge of how to safely obtain and prepare traditional foods for medicinal use, clothing, housing, nutrients and, overall, how to be within one's environment. Food is a lifeline and a connection between the past and today's self and cultural identity. Inuit food security is characterized by environmental health and is made up of six interconnecting dimensions: 1) Availability, 2) Inuit Culture, 3) Decision-Making Power and Management, 4) Health, and Wellness, 5) Stability and Accessibility. This definition clarifies that without food sovereignty, food security will not exist."[11]

For the last two years, Bering Strait regional leaders have held workshops entitled "Bering Straits Voices on Arctic Shipping." Oil spills are a huge concern, since we have already witnessed the damage that spills cause to the natural resources we need to survive. Discharges from vessels are also a concern, and we need to ensure that foreign-flagged vessels comply with MARPOL Annex IV for sewage discharge. A gap that needs to be addressed is contained in the Polar Code, Chapter 11-Voyage Planning 11.3.7 "current information on relevant ships' routing system, speed recommendations and vessel traffic services relating to known areas with densities of marine mammals, including seasonal migration areas," including designated protected areas (such as Hanna Shoal).

The Polar Code, Chapter 4: Prevention of Pollution by sewage from ships 4.2, states the following "Operational requirements:"

1. Comminuted or disinfected sewage in accordance with regulation 11.1.1 of MARPOL Annex IV at a distance of more than three nautical miles from any ice-shelf or fast ice and shall be as far as practicable from areas of ice concentrating exceeding 1/10;
2. Sewage not comminuted or disinfected at a distance of more than 12 nautical miles from any ice-shelf or fast ice and shall be as far as practicable from areas of ice concentration exceeding 1/10.

United States-flagged vessels comply with 33 Code of Federal Regulations (CFR) 151, which governs the management of ballast water, as well as the Clean Water Act, which prohibits discharges within three miles of shore and is enforced by the state of Alaska.

The "gap" that needs to be addressed is that the Polar Code does not mention any raw sewage discharge regulations when marine mammals are present, such as when a herd of walruses or a pod of whales are migrating. We recommend that the Polar Code be amended to address the dumping of raw sewage when marine mammals are present, and that such dumping not be allowed until ships are 12 nautical miles from a pod or haul-out location. Absent such restrictions, it would be the same as a farmer herding cattle through raw sewage before harvesting the cattle for human consumption.

It is vitally important that we protect the environment that Indigenous People rely upon for food security. Kawerak, a regional non-profit organization that supplies services to residents of the Bering Strait Region, recommends reductions in CO_2 emissions. The tribal community and State of Alaska need to continue to take a more active role in addressing climate change.

Due to changing sea ice conditions as a consequence of climate change, limited access for hunting walrus in the northern Bering Sea from May 2013-2015 resulted in poor walrus harvests. The disaster was not due to flooding, earthquakes or typhoons. The food shortage created by climate change impacts on the natural environment contributed to a dire situation, which contributed to food insecurity among many residents. We believe that climate change will worsen as predicted by the scientific community, and our villages will continue to have issues related to access to marine mammals for food security and sustenance. Many rural communities in Alaska do not have piped water or sewer systems; they live in third-world conditions. Many of the United Nation's education, scientific and cultural organizations such as UNESCO and climate change programs such as the Global Environment Facility, along with grants from global banks such as the World Bank, are directed at developing countries. Alaskan communities are not eligible for UN-sponsored climate change adaptation and mitigation programs. One request is that our congressional delegation advocates that the UN accept indigenous communities in developed nations that live in third-world conditions as eligible for UN programs.

USAID, through its Office of U.S. Foreign Disaster Assistance, responds

to international disasters, including slow-onset emergencies such as prolonged droughts that create food insecurity. Communities in the Bering Strait region have a slow-onset disaster related to prolonged climate change issues. These include the impacts of reduced sea ice since 2013, which is causing food insecurity by changing migration patterns and creating accessibility issues for traditional hunters. When foreign countries qualify for USAID disaster assistance money, the program supplies immediate provisions of up to $50,000 so affected communities can coordinate with non-governmental organizations for grants. Alaska and the U.S. should each review statutes and codes to include slow-onset emergencies that lead to food insecurity. USAID programs should consider including indigenous communities for eligibility, when they live in developed nations yet experience persistent third-world conditions. The Center for Climate and Health wrote, "Climate Change in the Bering Strait Region"[12] that speaks further about resiliency and mitigation for our communities.

The North Pacific Fishery Management Council's (NPFMC) Arctic Management plan has closed the area north of the Bering Strait to commercial fishing until further baseline data are collected and studies conducted. We need sound data to ensure sustainability of fishery resources in the U.S. federal waters of Alaska's Arctic, as conditions are changing rapidly and unpredictably. Last year Edward Itta, a former Mayor of the North Slope Borough, posted a picture of a king crab that washed up after a storm. It was the first time in his life he saw a king crab in the Barrow area. The NPFMC's rule is a sound start toward sustainability for future fisheries.

Traditional knowledge is essential to human survival in the Arctic. Kawerak, like the North Slope Borough and Northwest Arctic Borough, has created ocean current maps and maps of marine mammal habitat areas. Each organization's website has posted these documents, which are available to be downloaded.

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PART IV

ARCTIC NATURAL GAS IN A GLOBAL CONTEXT

The Role of Natural Gas as a Transition Fuel toward a Lower Carbon Future

David L. Pumphrey

New global efforts to reduce emissions of greenhouse gases (GHG) raise the question of the appropriate mix of energy fuels for the future. Because natural gas is the lowest GHG-emitting fossil fuel during combustion, it has been identified as a possible transition or "bridge fuel" leading to a lower carbon energy world. The expected level of natural gas demand has important implications for future hydrocarbon activity in the Arctic. Evaluations of the region's oil and gas resources have indicated that the Arctic may have large natural gas potential. Arctic conditions, however, will make these resources expensive and challenging to develop. The key question is whether global natural gas demand will grow to the point that significant commercial exploration, development and transport activity will emerge and be sustained.

GLOBAL EFFORTS TO CONFRONT CLIMATE CHANGE

The meeting of the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP) held in Paris in December 2015 resulted in an agreement signed by 174 countries and the European Union to undertake a new strategy for international cooperation to address climate change. The Paris Agreement reiterated the previously agreed objective of limiting the increase in global temperature to 2°C and urged efforts to limit the increase to 1.5°C. The Kyoto agreement's top-down approach with differentiated country responsibilities was replaced with a set of "Nationally Determined Contributions" (NDCs) by all countries. All countries committed to report on progress in the implementation of their NDCs and to report new NDCs every five years. These new NDCs are expected to reflect more robust goals for actions to address climate change. The Paris Agreement also addressed other critical areas, including financial assistance for climate actions in developing countries.

By the time of the Paris COP meeting, 147 countries accounting for

about 80% of total global emissions had submitted Intended Nationally Determined Contributions (INDCs), which represent a starting point for future and stronger NDCs. Because emissions from the energy sector value chain contribute about two-thirds of global greenhouse gas emissions, actions to control and eventually reduce energy sector-related emissions are central to any plan to reach the targets that have been agreed to by the international community. Analyses prepared by the International Energy Agency (IEA) and the UNFCC concluded that the INDCs submitted for the Paris meeting were not sufficiently ambitious to put the world on a pathway to achieve the two-degree target and that much more ambitious actions would need to be taken in future NDCs.[1,2]

Reducing greenhouse gas emissions in the energy sector requires actions in two broad areas. The first area is lowering the amount of energy required to support continued economic growth. This is done by improving the intensity of energy use through the introduction of more energy-efficient technologies and practices, economic restructuring, and lifestyle changes. The second group of actions focuses on shifting from heavy reliance on fossil fuels to energy sources with low- or no-carbon emissions. The electric power sector is viewed as the most critical part of the overall energy system for actions to address greenhouse emissions. The amount of fuel used to produce electric power has been growing rapidly as economies becoming increasingly electrified. Electricity generation represents about 40% of all energy consumed in the global economy. The electric power sector has the broadest range of options to utilize both fossil fuel energy as well as "clean," low carbon fuels such as nuclear, hydropower and renewables. The power sector also has extensive opportunities to introduce more efficient technologies in the production, transmission, distribution and use of electricity.

NATURAL GAS AS A BRIDGE FUEL

Interest in the role of natural gas in a lower carbon future has been stimulated by two factors: lower CO_2 emissions associated with burning natural gas for electricity generation compared to coal; and the shale gas revolution in North America.

Coal has been the dominant fuel of choice for power generation. Coal can be mined and delivered at relatively low economic cost. Coal is widely

available in many countries, reducing energy security risks and high import costs associated with other fossil fuels. Globally, coal accounts for nearly half of all power generation. However, in China and India, countries that are increasing energy use rapidly, coal accounts for around 80% of power generation. Globally, coal represented nearly half of CO_2 emissions. Given these factors, the search for lower carbon substitutes that can generate electricity competitively with fossil fuels has become the central theme of climate policy.

At a power-generating plant, burning natural gas to generate electricity produces about one half the GHG emissions as burning coal and about one-third the emissions of oil. Natural gas has lower carbon content per unit of energy than both oil and coal. In addition, combined cycle gas technologies (CCGT) used to generate electricity from natural gas are significantly more efficient than coal technologies. CCGT units operate at about 60% efficiency, while advanced coal plants are generally in the range of 40-45% efficiency. One issue that has been raised about increased use of natural gas is the impact of fugitive methane emissions released during production, transport and distribution of natural gas. Methane is a more powerful greenhouse gas than CO_2, but analyses of the actual rate of release of methane during the value chain has resulted in a wide range of estimates that vary substantially by region. Recent estimates indicate that methane leakage may put the estimate of amount of GHG reduction in using natural gas instead of coal close to 45%.[3] In some countries, increased of use of natural gas will also result from a need to address health problems linked to coal burning. China has set expansion of natural gas use as a major element in its environmental programs.

The transformation of energy markets that resulted from the successful application of hydraulic fracturing and long-reach horizontal drilling was described in detail in a paper at NPAC 2015.[4] The resulting increase of commercially producible natural gas caused the U.S. price to drop from above $10/million btu (MMBtu) in 2008 to prices that currently fluctuate around $2.50 to $3. The supply that has been developed in recent years has made it possible for the United States to become an exporter of not only pipeline gas but also liquefied natural gas. Further analysis indicated that geologic conditions that could be conducive to these technologies exist in a number of countries–with China's potential exceeding that of the United States. The prospect of a future with large volumes of competitively priced natural gas coming from conventional and unconventional sources was

termed the "Golden Age of Gas" in a 2011 IEA publication.[5]

As a result of low prices, natural gas has taken a significant share of the electricity generation market in the United States. In 2010, the amount of electricity produced by coal was about double the amount produced by natural gas. By 2015, coal and natural gas were nearly equal in the amount of electricity generated. With the increased use of natural gas, the level of CO2 emitted in the power sector was about 15% lower in 2015 than 2010 even though the amount of electricity generated was virtually the same.[6]

The recognition that natural gas supplies at relatively low cost could be used by the electric power industry to lower emissions with little or no increase in the cost of electricity gave rise to the concept of the "natural gas bridge." Essentially the argument was that natural gas could be used to lower emissions as a bridge to a point in time when renewable energy and other zero carbon fuels could be introduced on a broad scale to become the predominant fuel for generating electric power.

OUTLOOK FOR NATURAL GAS DEMAND

A number of recent energy market outlooks can provide a basis for examining the possible role of natural gas in the transition to a lower carbon future. Tremendous uncertainty is currently plaguing the energy sector. The question of climate polices to be implemented over the next few decades will affect both the energy fuel mix and the pattern of energy demand. Decisions by major oil producers such as Saudi Arabia, as part of their role in managing oil markets, will have major implications on the price path for oil as well as natural gas. To get a broader view of the thinking about future energy paths, several outlooks were reviewed to obtain a view of possible gas demand in a world that adopts policies on climate change that would be close to those put forth in NDCs submitted to the Paris COP meeting. A more limited number of outlooks also provide scenarios of the energy world in which climate policies would be made more consistent with achieving a two-degree target. Outlooks providing a view that incorporate to some degree the policies announced in Paris have been released by the International Energy Agency (WEO 2015), the U.S. Department of Energy's Energy Information Administration (EIA) (IEO 2016), British Petroleum, and Statoil. The EIA forecasts are the most conservative and only included countries INDCs in the forecasts. Statoil

assumes that countries will continue to strengthen their policies in future NDCs. The IEA and Statoil have also released outlooks that provide a scenario for a two-degree world.

In a world where actions on climate change are roughly consistent with the commitments that have been made in the Paris agreement (low ambition case), total energy demand is expected to grow in range of 1.0-1.4%/year through 2040. This growth rate reflects continuing improvement in energy intensity throughout the world and supports GDP growth rates at about double energy demand growth rates. The increase in total energy demand by 2040 ranges from 31-48%.

Natural gas exhibits the strongest growth of the fossil fuels in these outlooks, with growth rates ranging from 1.1-1.8% per year, higher than the overall energy growth rate. Natural gas demand in 2040 is projected to be 30-70% higher than in the base year. The strongest growth for natural gas use is in the industrial sector and the electric power sector. In the IEA forecast, natural gas consumption is forecast to grow over this period by about 70% in the industrial sector and 43% in the power sector. The increasing role of natural gas is linked to both its environmental attributes as a cleaner-burning fuel and to its relatively lower cost as a more extensive resource base of unconventional gas is developed. Statoil concluded that "lack of demand rather than lack of resources will shape the global gas market in the decades ahead."[7]

In the low ambition case, coal's role in total energy continues to shrink in all outlooks with growth rates of -0.6 to 0.6%/year. The fastest-growing energy sources are wind, solar, and other new renewables, with growth rates of 6-8% per year.

In the cases where the world adopts more stringent climate policies designed to attain the target of limiting global temperature increase to two degrees (high ambition case), total energy demand is substantially lower with growth rates of 0.2-0.5% per year. Total energy demand is about 15-18% lower in this case than in the low ambition case.

Natural gas demand grows at about 0-0.5%/year in the high ambition case, as demand grows more slowly than total energy demand. Total gas demand is 20-25% lower than in the low ambition case. While gas demand in all sectors is lower due to the lower growth rate of total energy, the greatest change is in the electric power sector where gas use is projected to be about 6% lower in 2040 than 2013. Comparing the two IEA projections for 2040 gas demand, the stricter carbon policies show gas demand as

about 35% lower in the high ambition case than under the low ambition case. Stricter environmental policies drive extremely rapid increases in investment in renewables, especially solar and wind and to some degree in new nuclear projects. The solar and wind sector grows by 9% to 15% per year while power produced by coal, oil and natural gas all decline through this period.

The role of natural gas as a bridge fuel to a low carbon future will be heavily influenced by the stringency of the policies that countries adopt to confront climate change. Less ambitious policies, such as those represented by INDCs submitted for the Paris COP meeting, will likely provide support to natural gas demand. Natural gas can substitute easily for coal-fired generating capacity and can be built in locations that more easily utilize existing transmission systems. As carbon policies become more ambitious, however, natural gas will not be expected to play as large a role in the power sector. Although natural gas power generation emits lower levels of carbon than coal, it still emits levels that will likely exceed tighter carbon standards, requiring greater investment in renewable energy sources. In addition, the expansion of natural gas demand becomes limited by the overall reduction in total energy use required to meet stringent carbon standards.

In a recent study, the Joint Institute for Strategic Energy Analysis examined the role of natural gas in reducing carbon emissions. The study concluded that for the United States, a strict carbon target could increase the amount of natural gas used in the power sector for a period of time but that demand for natural gas will reduce in the later years, indicating a bridging role for natural gas in the movement to a lower carbon future. The study also demonstrated that the role of natural gas will be critically dependent on its relative price. Scenarios based on low natural gas prices showed large increases in natural gas used for power generation while high prices resulted in little penetration by natural gas in the power sector irrespective of the carbon target level.[8]

The future pathway for natural gas prices may become a critical factor in decisions about new electric power generating capacity. While sharply lower prices have driven increased use of natural gas for power generation, the cost of renewable energy has also been declining rapidly. Expansion of renewable energy has exceeded expectations for several years. Over the past five years total wind power generation has more than doubled and solar power consumption has increased by four times.[9] Although

renewables are still a small share of total generating capacity, they have been the fastest growing sector. This growth has been driven by supportive policies and declining cost of the technologies. As the wind industry has expanded, the cost of wind power has continually dropped and larger units have facilitated greater efficiency in generation with utilization rates nearly doubling since 2000. Solar systems have demonstrated even more dramatic cost improvement, which is expected to continue in the future.[10]

The Energy Information Administration publishes estimates of the Levelized Cost of Energy (LCOE) for electric power generation with each annual forecast. The 2016 LCOE estimates reflect the increasing competitiveness of renewables. The LCOE estimates shown in the following table are taken from the 2016 EIA Annual Energy Outlook. While natural gas CCGTs are the cheapest form of fossil fuel generation with an estimated LCOE of about $57 per Megawatt hour (MWhr), onshore wind power is estimated to cost about $62/MWhr. As shown in Table IV.1, a significant part of the LCOE for CCGT projects is the price of natural gas. Since this is an estimate for the U.S. market in 2020, the gas price is relatively lower than most other countries. Wind project costs, on the other hand, will be sensitive to the quality of the wind resource at specific locations and the cost to hook up to the grid. For solar photovoltaic (PV), the LCOE fell by about one third from EIA's estimate in 2015 to about $81/MWhr in 2016. If the cost of wind and solar generation continues to fall and capacity utilization factors rise, the competitiveness of renewables will continue to increase, especially if natural gas prices rise either because of market factors or the imposition of carbon costs.

Table IV.1 EIA Assumptions for Levelized Cost of Energy for Generating Plants Entering Operation in 2022 (2015 $/MWh)[11]

Generating Technology	Capacity Factor (%)	Capital Cost	Fixed O&M	Variable Cost (Fuel)	Total LCOE
Gas CCGT	87	13.9	1.4	41.5	56.8
Advanced Coal w/CCS	85	97.2	9.2	31.9	138.3
Nuclear	90	78.0	12.4	11.3	101.7
Onshore Wind	36	48.5	13.2	0	61.7
Solar PV	25	70.7	09.9	0	80.6

Natural gas has the potential to provide a lower-carbon fuel that can contribute to the goal of reducing GHG emissions as the world

decarbonizes the energy system. The long-term role of natural gas in the power sector will be set by the level of ambition of the policies the world will adopt as well as the cost of natural gas relative to other fuels. The emergence of a "natural gas bridge" will be determined by a number of factors. The availability of natural gas resources and the cost of delivering cost to end-users will be a critically important factor. For regions with large, low-cost gas resources such as North America and Russia, natural gas may play an important role in achieving lower GHG emissions in the near term. Countries such as China and countries in Latin America and the Middle East have the potential to discover major gas supplies. Others, including Japan, Korea and India, will likely have to rely on imported natural gas, principally liquefied natural gas, which will make gas much more costly and may limit penetration into the market. For all countries, the rapidly falling cost of renewables may limit the amount of natural gas that will be used in power sector. Natural gas may play an important load-balancing role for intermittent renewables although development and commercialization of other storage options for electricity will also play this role. In a world where the increase in average global temperatures is held to two degrees or less, natural gas consumption may show little if any growth over the next century.

IMPLICATIONS FOR ARCTIC NATURAL GAS

For Arctic natural gas development, the increase in demand due to greater use of natural gas to meet climate goals is not likely to be a major factor. The existence of a natural gas bridge is tied closely to the cost of natural gas relative to lower- carbon alternatives. A price of natural gas high enough to make the Arctic attractive for long-term investment will likely exceed the price that will support a natural gas bridge. Arctic gas development will be extremely expensive. Offshore ice-prone Arctic areas will be the most expensive and difficult places to establish production. Bringing Arctic gas to major markets will require lengthy pipelines and long distance LNG shipping, which also add significantly to the expense of the delivered gas. A limited number of LNG projects serving established natural gas production bases may become a reality, but major expansion of this industry is unlikely within the foreseeable future or as a result of sustained climate policies.

Notes

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The Impact of the Paris Agreement on Japan's Fuel Mix in Power Generation

Tomoko Hosoe

JAPAN'S OFFICIAL POWER GENERATION MIX TARGET FOR 2030

Overview

The Ministry of Economy, Trade and Industry's (METI) official power generation mix target is revised every three years. However, METI did not announce its target in 2013, as it was too soon after the Fukushima disaster of March 11, 2011 to revisit Japan's energy policy, especially its policy regarding nuclear power production. Therefore, the existing power generation mix target was not announced by METI until 2015. The next official target will be announced in 2018.

The current power generation mix target for 2030, which was announced in 2015, confirms Japan's two pillars—nuclear and coal—and retains their base load status. The current energy mix target is compared with the previous target that METI had set in 2010 and is summarized in Table IV.2.

Table IV.2 METI's Power Generation Mix Targets for 2030

		Current Target Announced in 2015	Previous Target Announced in 2015
	Nuclear	20-22 %	53 %
Base Load	Coal	26 %	11 %
	Renewables	22-24 %	21 %
Middle Load	LNG	27 %	13 %
Peak Load	Oil	3 %	2 %

Source: METI

Nuclear Remains Critical for Base-Load Capacity

The highlight of this post-Fukushima generation mix target is that nuclear energy remained as Japan's base-load capacity, accounting for 20-22% in the total mix. The Abe Administration has declared nuclear energy to

be a cornerstone of its quest to revitalize the Japanese economy. Nuclear power offers an attractive source of base-load power generation in terms of reducing carbon emissions and fuel imports. Furthermore, both employment and local infrastructure related to the nuclear power industry play an important role in Japan's regional economy.

Electricity rates for the residential as well as the industrial sectors increased significantly in major cities, in some areas by as much as 30%, after a temporary moratorium on nuclear-powered electricity production was announced after Fukushima. As a result, the Abe Administration is particularly concerned about any further implications of high utility costs on the economy. In order to achieve the nuclear power target, the government will need to save existing reactors that pass the Nuclear Regulation Authority's (NRA) technical inspections and allow some reactors to extend their lifespan from the current standard of 40-60 years. The nuclear power production targets clearly reflect the Abe Administration's consistent policy decision to reintroduce nuclear power with appropriate safety assurances for the long term.

Coal Remains Important for Base-Load Capacity

Coal is also a base-load fuel due to the lower power-generating cost of using coal relative to other fossil fuels, as well as the comparative lack of geopolitical concerns over supply sources. However, the government said that environmental issues stemming from its use merit close monitoring. There are as many as 40 proposed projects to construct coal-fired power plants, including small-scale (100 MW) plants. The Ministry of Environment has already stepped in and objected to any expansion of coal-fired electricity capacity, as Japan plans to reduce greenhouse gas emissions by 26% from the 2013 level by 2030. Even if many of the proposed plants do not materialize, we expect there to be sufficient coal-fired capacity to supply 26% of Japan's electricity in 2030.

Levels of Renewables Set High for Political/Environmental Reasons

It is the Abe Administration's political decision to bring renewables' share higher (22% to 24%) than nuclear in order to appease voters, despite its higher cost. As hydro accounts for 9-10% of the total renewables, it is quite a challenge for the remaining portion to be supplied by solar, wind,

and geothermal. METI estimates ¥4 trillion ($36 billion, at 110/USD) will be needed to produce electricity from renewable sources in order to achieve the 22-24% target in 2030. This estimate includes subsidies in feed-in tariffs and infrastructure needed to stabilize electricity specifications.

Indeed, renewables are an important energy source and investment must be ramped up in order to achieve the government's environmental and energy security targets.

LNG to Augment Potential Shortfall of Other Fuels

The role of Liquid Natural Gas (LNG) (27%) is limited to a middle-load fuel in the power generation mix. METI advises utility companies against excessive dependence on LNG, with a stated goal to reduce fuel procurement costs. METI did not define LNG for base-load capacity under the current target, considering that Japan imports all its gas demand in the form of LNG imports as the country has no international gas pipeline. This in turn leads to energy security concerns. Domestic gas production has been declining steadily as well. Furthermore, this target was formulated when oil price was higher, that made the LNG price to Japan also higher since most of the existing long-term LNG prices are based on the oil prices. METI had thought then LNG would be too expensive to play as a base-load fuel. However, we believe that LNG is the key fuel to make up for potential shortfalls in other fuels (i.e. nuclear and renewables), and its actual share is likely be higher than the government target in 2030.

Oil Remains Important for Peak-Load Capacity

The role of oil remains important, especially since it can substitute for other fuels for power generation in case of emergency. Its primary role in the power generation mix remains as a peak-load fuel. Indeed, burning of low-sulfur fuel oil (LSFO) and direct-burn crude—both peak-load fuels—has increased significantly post-Fukushima. However, by 2020, crude and fuel oil consumption will reach the minimum level required, responding to both environmental and supply reasons. Japan's oil refining capacity will be reduced by as much as 40% by 2030 and custom-made LSFO for power generation will no longer be readily available. Low-sulfur waxy crude, such as Indonesian Minas crude, will be even more difficult to procure as crude export availabilities are limited. Furthermore, a great deal of oil-fired power

generation capacity will be decommissioned or modified to utilize gas-fired generation.

OUTLOOK FOR REVISING THE FUEL-GENERATION MIX IN 2018

METI has already started preparing the new generation target for 2030, which is expected to be announced in 2018. Based on our observations, METI will increase the share of natural gas in the new generation mix. For the first time, METI is supportive of the use of LNG as a fuel for Japan's base-load power generation. The current trend of low LNG market prices appears to have played a role. Until recently, METI has not supported the use of LNG as Japan's base-load fuel in power generation, due to security of supply concerns (as Japan does not own international gas pipelines and must depend on LNG imports) and "high LNG prices." However, METI's attitude toward LNG has changed, as their concerns have become irrelevant in today's LNG long market.

On the other hand, the share of coal will inevitably be reduced in response to persistent opposition to coal-fired power generation due to environmental concerns. METI's stance on nuclear energy as Japan's base-load power generation source will remain unchanged as long as the Liberal Democratic Party (LDP) remains in power. The LDP-led government focuses on revitalizing Japan's economy. Nuclear energy is the key to reducing Japan's electricity rates, which have risen in recent years due to high fuel costs. Meanwhile, METI will keep its ambitious target for renewables for environmental and political reasons. However, given Japan's climate and landscape, we believe achieving the targeted share for renewables remains unrealistic.

The fate of the nuclear industry in Japan, however, is unclear under deregulation. The regional monopoly that Japan's ten power companies enjoyed is no longer available following power sector deregulation, which was instituted in April 2016. This action forced power companies to become more efficient and profit-oriented. From April 2020 onwards, further deregulation will take place where power generation, power transmission, and power retail businesses will be separated into independent entities. At present, the fate of Japan's nuclear sector post-2020 remains unclear.

Although it is assumed that the current power companies that own the nuclear power plants will continue ownership/operatorship, it is also possible that they will form alliances with other utilities and integrate their nuclear business due to stricter safety regulations that carry higher cost burdens that one private company cannot bear. From the government perspective, in order for Japan to maintain enough nuclear power for base-load generation, nationalizing the nuclear business is a realistic option. Also, more reactors must be approved to extend their lifespan from 40 years to 60 years.

GAS DEMAND OUTLOOK FOR 2030

Japan's gas demand declined by 3% to 10,611 mmscf/d in 2015 over the previous year, with the decrease being led by the decline in consumption from the power sector. The power sector continued to dominate Japan's gas demand in 2015, at 67% of total demand, compared to 69% in 2014. Municipal gas demand was composed of industrial (18%) and residential and commercial (15%). In 2015, industrial demand declined by 0.8% over the previous year and the remaining sectors by -0.5% over the previous year. The demand slump was attributed to a warmer-than-usual winter.

The power sector will continue to dominate Japan's gas demand through 2030. As many nuclear reactors are scheduled to be retired after 2030, the share of natural gas is forecast to increase further.

We assume overall power demand will grow marginally to 2020 in preparation for the Tokyo Olympics, before demand starts declining. Power demand will respond to structural and social changes, such as declining population, an aging society, a deeply rooted power-saving mindset in consumers, and improvements in fuel efficiency.

Our 2030 base-load generation mix projection is: nuclear (17%); gas (36%); coal (24%); oil (6%); with others (hydro, geothermal and renewables) accounting for 17%. Our assumption for gas is higher than METI's current official target of 27% for 2030. Industrial demand for municipal gas is forecast to remain flat or fall slightly, considering Japan is shifting to a more service-oriented industry from one that has been traditionally been more manufacturing focused. Residential and commercial demand will continue declining in response to Japan's structural changes, including an aging and shrinking population and increasing efficiency.

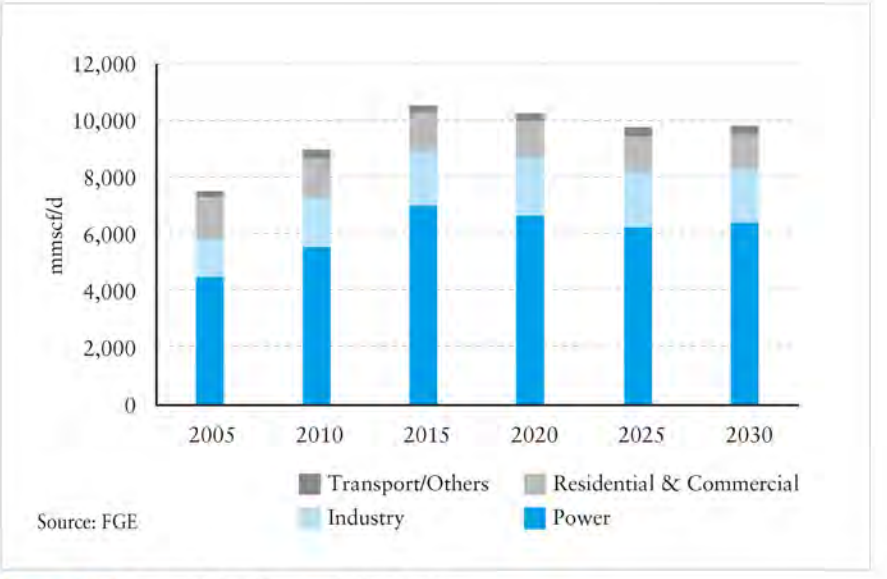

Figure VI.1 Japan's Gas Demand Outlook

Under our base-case projections, Japan's LNG demand is forecast to be 75.6 mmt in 2030, 77.8 mmt in 2035, and 77.7 mmt in 2040. Future demand is lower than the 2015 actual consumption of 85.1 mmt—when Japan only had two nuclear power plants operating. The share of gas used to generate electricity is expected to continue to increase, however, even as overall power demand is expected to decline. Currently, Japan imports 98% of its natural gas, all of which is in the form of LNG, since Japan has no international pipeline connections. As domestic production continues to decline, more than 99% of gas demand will be met by imports by 2030 as it is unlikely that Japan will have any pipeline connections by then.

CONCLUSIONS: FATE OF NUCLEAR POWER TO DETERMINE JAPAN'S GENERATION MIX

Under any policy scenario, the fate of Japan's nuclear power sector will affect Japan's future generation mix significantly. The government is considering nationalizing the nuclear power business as a viable option, but the biggest problem is how to finance this transition. The government's intention is to generate more competition in the deregulated power market.

If it were to control the nuclear sector, the government has indicated it would try to meet its long-term nuclear energy target. For the Abe Administration or the LDP-led government, there is no long-term energy scenario without nuclear.

We believe that nationalizing the nuclear power business is a realistic option. However, we do not expect nationalization to take place by 2020, for both fiscal and technical reasons. Indeed, the biggest issue is how the government can finance the purchase of nuclear plants from the utilities. While Prime Minister Abe supports nuclear energy in order to revitalize Japan's economy, other energy issues are not on his priority agenda. The government has other pressing issues such as social security expenditures, as the country's population ages and decreases. If the government does indeed nationalize the nuclear sector, the total LNG demand post-2020 could be lower if it becomes politically easier for the government to operate and/or re-start the nuclear reactors.

We view LNG as the only viable and realistic option for Japan to securely and flexibly supply power demand in the near term, depending on the status of nuclear power. The target set out by METI for the share of renewables is too ambitious. At the same time, the likelihood for many of the proposed new coal-fired plants to be built is slim due to increased pressure by the Ministry of Environment, since Japan plans to reduce greenhouse gas emissions by 26% by 2030 from the 2013 level. An increase in coal-fired electricity production would make those targets more difficult to achieve.

As Japan's projected power generation mix remains the biggest uncertainty affecting its future LNG demand, Japanese utilities will continue to exercise restraint in committing to future LNG imports until a clearer picture emerges. Japanese buyers will strive to maximize flexibilities in their LNG contracts to mitigate the risk of over- or under-contracting for LNG supply. Japan, however, needs to tread carefully, considering the national security implications of energy supply and demand. As a resource-poor country, Japan relies on LNG imports for almost 100% of its gas supply, and increasing flexibility should not come at the expense of supply security.

Furthermore, Japan's energy policy has always focused on diversifying supply sources in order to achieve greater national security. As a result, its relationship with Russia (including these kinds of Arctic projects) remains important for Japan's energy policy and diplomacy. The government

believes deeper bilateral ties between Russia and Japan are mutually beneficial; Russia gains more investment and funding, while Japan will have greater access to Russian energy resources to diversify Japan's energy portfolio. As part of Japan's efforts to cultivate energy cooperation with Russia, the Japan Bank for International Cooperation (JBIC) reportedly plans to provide $400 million in financing for the Yamal LNG project in the Artic. The Yamal project is led by Novatek OJSC, Russia's largest independent natural gas producer. There has also been some consideration of METI supporting investment in Russia's state-owned oil company Rosneft through government-backed Jogmec.

Prime Minister Shinzo Abe and Russian President Vladimir Putin met at a summit in Nagato, Yamaguchi Prefecture—Abe's home political district—in December 2016. The meeting included discussions about some Japanese economic and energy proposals and continued talks on bilateral territorial issues. The ramifications of the outcome of this meeting will be significant in the context of reducing Japan's dependency on the Middle East for oil and the Asia Pacific for LNG.

The Impact of the Paris Agreement on Korea's Energy Mix

Yonghun Jung

EXECUTIVE SUMMARY

This paper addresses the possible impact of implementing policies and measures to honor the Korea's Intended Nationally Determined Contribution (INDC) to the Paris Agreement, which was adopted in December 2015. A long series of negotiations among more than 190 United Nations members produced a non-binding international platform on which climate change mitigation actions of the participating countries are to be established, coordinated, monitored, reviewed, and further enhanced.

Invariably, the Paris Agreement will have significant impact on the future course of energy policies and energy mix in Korea, despite its non-binding legal nature. In order to understand the potential impact of the agreement on Korea's energy mix, this paper looks specifically at the following:

1. Korea's INDC and the Paris Agreement
2. Current energy consumption in Korea and main drivers for future growth
3. Government plans for a national energy mix, including the Energy Master Plan, Power Demand/supply plan, and natural gas demand/supply plan
4. Scenarios on the trajectory of Korea's energy demand: challenges and opportunities for the addressing climate change mitigation in the context of making practicable energy choices while weighing other national concerns.
5. Implications

Lacking indigenous energy resources, Korea has been struggling hard to meet ever-growing energy demand in tandem with rapid industrialization over the last 40 years. Increasingly tenuous prospects for energy supply have led the government to place higher priority on supply security than on the environmental impacts of energy production. One result is that

government and industry have neglected climate change issues.

Since the adoption of the UNFCCC in 1992, the government has instituted consistent, albeit ineffective, efforts to move from a growth-focused economic development path towards one that includes a better balance with environmental concerns. It aims to avoid potential trade conflicts brought about by international environmental treaties, such as those concerning climate change, ozone depletion and/or biodiversity. As the nation's economy depends entirely on trade, the government has feared punitive economic measures by trading partners in response to potential non-compliance with these international agreements.

The nation faces a challenging task to balance the energy "trilemma" of energy security, economic growth and environment protection–the so-called "3Es." The Korean government and industry are both likely to confront multiple technical, institutional, and market challenges, including the following:

- Korea is still an export-oriented economy depending heavily on energy- intensive industries such as steel, petrochemical production, automobile manufacturing, and shipbuilding. GHG emission-reduction measures will inevitably increase the cost of production for major export goods.
- Given the energy conservation and efficiency improvement policies that have been instituted over the past few decades, and in particular since the first oil crisis in 1973, there remain quite limited opportunities to find "low-hanging fruit" to accelerate new energy efficiency improvement.
- The opportunity for NREs (new and renewables) to displace fossil fuels in Korea is quite limited, as wind and solar resources are neither readily available nor economically viable at a commercial scale due to the lack of quality wind resources and limited available land space.

As the Paris Agreement is not legally binding, it is still doubtful whether the government will translate its announced pledge into concrete action. The first section of this paper provides background on Korea's INDC with regard to the Paris Agreement, and attempts to characterize the main features of Korea's pledge to combat climate change. The second section reviews the recent energy- consumption trend in order to identify its major drivers. The third section looks at the government's various energy plans

that are directly linked to Korea's INDC. To provide a long-term view on Korea's energy demand in connection with the INDC, the fourth section examines challenges and opportunities in addressing climate change in the context of this energy trilemma: energy security, economic growth, and environment.

KOREA'S INDC REVISITED

The Republic of Korea submitted its INDC in 2015 to UNFCCC, a few months before COP21 in Paris, following the mandate of the Durban Platform. This set the nationally determined, long-term GHG emission reduction target at 37% below the business-as-usual (BAU) scenario in 2030, an ambitious goal.

Unlike the Kyoto Protocol, the Paris Agreement is technically non-binding. Korea's target is a mere pledge, yet it placed climate change back on the national policy priority list. The initial enthusiasm after the Paris meeting has subsided, both due to the loose interpretations of what was meant by commitments in the form of "contributions," coupled with the continued global economic downturn. In practice, the Paris Agreement has fallen short of providing a clarion call to the world for responding to climate change.

The government announced that it set a greenhouse reduction target of 37% from 850.6 million tons of carbon dioxide to 535 million tons, along with the 2030 emissions-reduction strategies and targets. While environment groups in Korea viewed the plan as inadequate, Korean industries strongly resisted the plan and argued that, "the plan is a bottleneck standing in the way of the nation's economy."

Korea's voluntary pledge targets 37% below the BAU emission in 2030, but the target itself remains unclear until the BAU is fixed. The BAU has been updated every five years in accordance with the Energy Master Plan. The target volume of GHG emissions also has to be revised. The basic plan of long-term electricity supply and demand, as well as the biennial long-term natural gas supply and demand plan will also need revision. At best, the interpretation of the term "BAU" is unclear.

A list of issues is still pending regarding how to reduce GHG emissions to redeem the pledge. This includes types of policies and measures, annual work programs, public acceptance, and most importantly, the formulation

Table IV.3 Korea's INDC

Baseline

($MtCO_2eq$)

Year	2020	2025	2030
BAU	782.5	809.7	850.6

The scenario is based on the BAU projection of KEEI-EGMS (the Korea Energy Economics Institute Energy and GHG Modeling System), taking into account projections for key economic variables, including population, GDP, industrial structure and oil price.

Reduction Level	Emission reduction by 37% from current levels by 2030
Coverage Sectors	Economy-wide Energy, industrial processes and product use, agriculture and waste (A decision on whether to include land use, land-use change and forestry (LULUCF) will be made at a later stage)
Gases	• Carbon Dioxide (CO_2) • Methane (CH_4) • Nitrous Oxide (N_2O) • Hydrofluorocarbons (HFCs) • Perfluorocarbon (PFCs) • Sulpher hexafluoride (SF_6)
Metric	Global Warming Potential (GWP) values from the IPCC Second Assessment Report (1995) used to calculate CO_2 equivalents.
Inventory Methodology	• Consistent with methodologies used in Korea's Biennial Update Report (BUR) submitted in December 2014 • 1996 IPCC Guidelines used in general to calculate greenhouse gas emissions and sinks • 2016 IPCC Guidelines used to calculate greenhouse gas emissions from rice cultivation in agriculture (4C) and other waste (6D)
International Market Mechanism	Korea will partly use carbon credits from international market mechanisms to achieve its 2030 mitigation target, in accordance with relevant rules and standards.
Land Sector	In assessment of mitigation performance, a decision will be made at a later stage on whether to include greenhouse gas emissions and sinks of the land sector as well as methods for doing so.

of detailed domestic targets by sector and source.

An international organization (climatechangetracker.org), which tracks the path of INDCs, has rated Korea's INDC as "inadequate," a setback from the previous pledge to reduce its emissions by 30% below BAU emissions in 2020, which was rated "medium." Korea's INDC is a mere outline without details, and much work is needed to be done in the next few years to finalize the action agenda toward its intended contribution to reduce climate change.

CURRENT ENERGY CONSUMPTION IN KOREA AND MAIN DRIVERS FOR FUTURE GROWTH

Energy consumption in Korea has been tied to electricity consumption and by industry sector demand. As seen in Figure IV.4., household, commercial and public sectors have shown no sign of growth for the last ten years. China has been the key driver for global aggregate demand increase since it joined the WTO in 2001, prompting the rapid growth of Korea's industrial production of intermediate as well as final goods. However, the Chinese economy began sputtering in 2012, and the deeply dependent Korean economy also started losing its momentum for industrial production growth. As a direct result, energy consumption in Korea fell sharply over the past two years. This indicates that energy consumption may not increase for the foreseeable future, and could even fall further depending on global economic conditions, and in particular, on China's economic outlook.

In light of the current energy trend, Korea's energy consumption seems as if it is now entering a mature stage in terms of Total Primary Energy Supply (TPES). The previous trend of rapidly growing energy consumption seems to show a sign of flattening, at least in recent years as seen in Figure IV.2. Of course the current slow-down could be a temporary one due mainly to the economic recession in China and falling global aggregate demand.

The million-dollar question is whether Korea's industrial sector will resume its growth when the global economy recovers from its present recession. Judging from historical evidence of economic development[1] in Japan and Korea for the last few decades, it might not be possible for China to return to its double-digit growth path. Even it does, Korea might not have the same level of economic stimulus from China as it did in the past, since the Chinese domestic market is incorporating an increasing number of domestic and foreign competitors.

Although Korea is regarded as one of the newly developed countries, its industry structure has not escaped from a reliance on heavy, energy-intensive industries common to many traditional developing countries. The lion's share of GDP is still being generated from the steel, petrochemical, automobile, and shipbuilding industries. It is not an overstatement to say that the future growth of the nation's energy consumption depends critically on the future of these key industries.

Combined with an anticipated significant reduction in industrial

activity, stagnant residential and commercial sector energy consumption, energy efficiency improvement and rapid dissemination of NREs, Korea's total energy consumption may not ultimately increase in the future.

In terms of energy mix, petroleum remains the major energy source accounting for about 37% in TPES, followed by coal (30%), natural gas

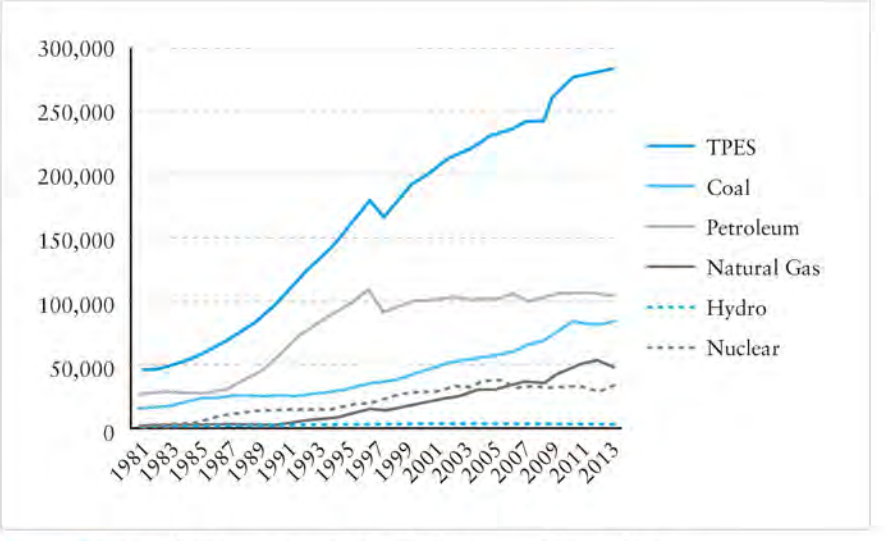

Figure IV.2 Total Primary Energy Supply by Source (thou. TOE)

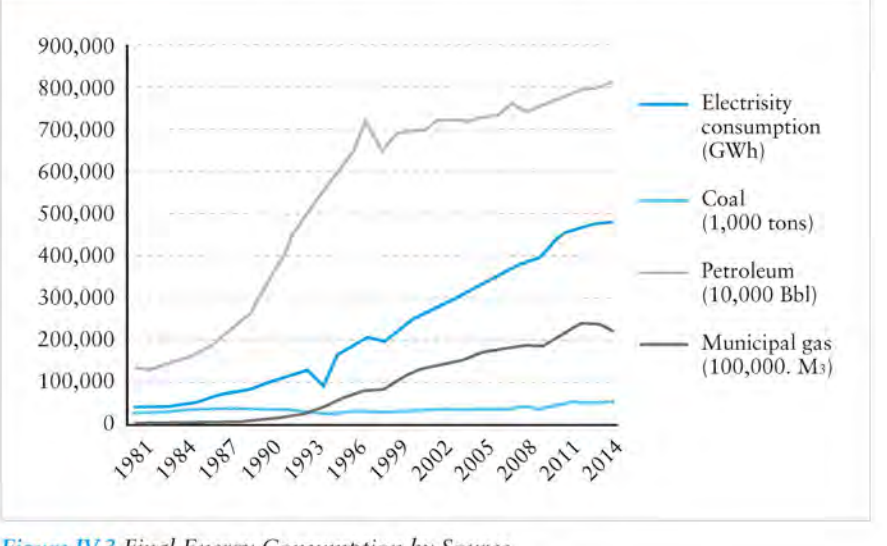

Figure IV.3 Final Energy Consumption by Source

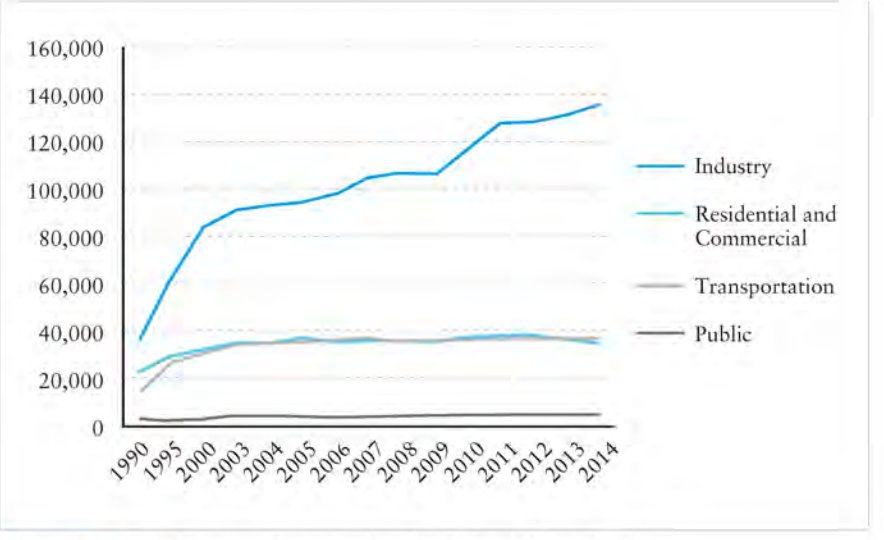

Figure IV.4 Final Energy Consumption by Sector (thou. TOE)

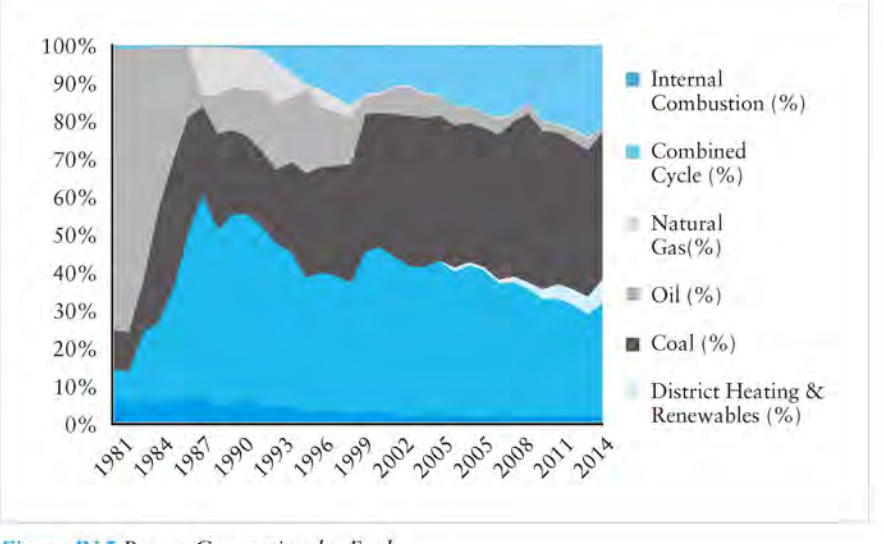

Figure IV.5 Power Generation by Fuel

(17%), and nuclear (12%) as of 2014. The trend shows that the energy mix appears to be stable since 2010. While the share of coal remains flat, natural gas consumption has increased slightly at the expense of petroleum.

Over the last few years, per-capita energy consumption has shown negligible level of increase from 5.56 Tons of Oil Equivalent (TOE) in

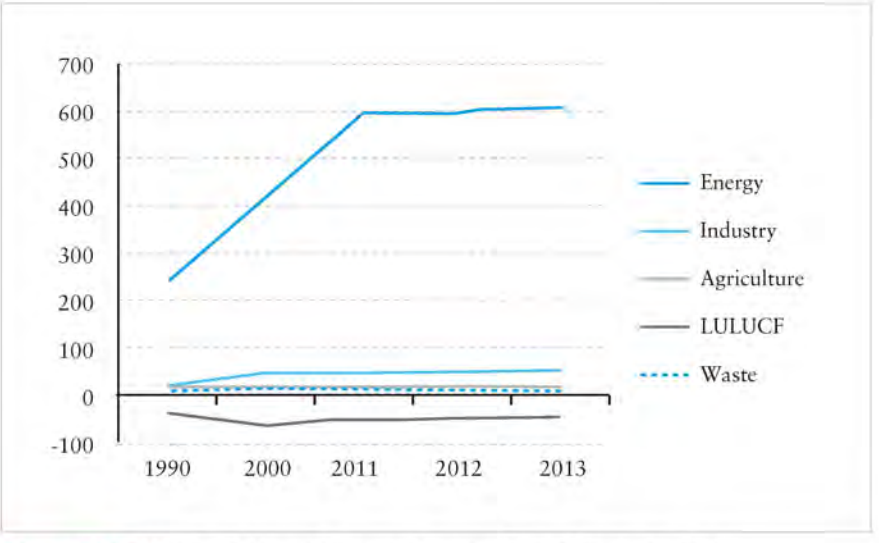

Figure IV.6 GHG Emissions in Recent Years (million CO_2 equivalent)

2011 to 5.61 in 2014. And population growth rate has fallen far below 1% per year. It appears that the current sluggish demand is not a short-term hold-up but rather an outcome of a permanent structural change that prevents demand from rising. Therefore unless there is a big shift in policy, technology, or in global economic conditions, energy demand in Korea will not grow in the future. As a result, GHG emissions will not increase much in contrast to projections in the Master Plan.

GOVERNMENT PLANS REGARDING ITS FUTURE ENERGY MIX, INCLUDING THE ENERGY MASTER PLAN, POWER DEMAND/SUPPLY PLAN, AND NATURAL GAS DEMAND/SUPPLY PLAN (WHAT COULD BE DONE?)

The 2013 framework law regarding low-carbon green growth of 2013 and the energy law of 2011 stipulate that the energy Master Plan should be revised and updated every five years over period of 20 years. Accordingly, the second energy master plan was released in 2014. Its purpose is outlined in the first section of the report:

"The Master Plan is a comprehensive plan that covers all energy sectors, and systematically links and coordinates energy related plans from a macro perspective. As an overarching plan, it presents principles and directions for energy-related plans source-by-source and sector-by-sector. The main purpose of the plan is to provide a fundamental philosophy and vision for mid- to long-term energy policy while suggesting major targets to help realize these ends."

While keeping the 3Es in balance, the plan aims to achieve sustainable development mainly by way of:

- Making most of nuclear energy, which has environmental benefits, such as CO_2 reduction, as well as economic benefits.
- Expanding renewable energy to 11% of primary energy consumption by 2030 through various measures, including the Renewable Portfolio Standard (RPS) and the "One Million Green Homes" project.
- Reducing energy intensity by 46% by 2030, focusing on the industrial sector.
- Reducing electricity demand by 7.6% by 2020 and 12.4% by 2030.

According to the plan's outlook, energy demand is projected to grow at 1.32% per year until 2035, and the government has set up policy priorities accordingly. However, the recent data points to a much slower growth than 1%. Between 2011 and 2014, the average annual growth rate was 0.75%,

Table IV.4 Energy Master Plan (projection)

Source	2011	2025	2030	2035	Average Annual Growth Rate (%)
Coal	83.6	100.2	107.7	112.4	1.24
(share %)	(30.3)	(28.3)	(29.1)	(29.7)	
Oil	105.1	111.0	1.7.1	101.5	-0.15
	(38.1)	(31.3)	(29.0)	(26.9)	
Natual Gas	46.3	64.8	69.8	73.3	1.93
	(16.8)	(18.3)	(18.9)	(19.4)	
Hydro	1.7	1.7	1.9	2.0	0.70
	(0.6)	(0.5)	(0.5)	(0.5)	
Nuclear	32.3	59.6	65.3	70.0	3.28
	(11.7)	(16.8)	(17.7)	(18.5)	
Renewable	6.6	16.8	18.0	18.8	4.44
& Other	(2.4)	(4.7)	(4.9)	(5.0)	
Total	275.7	354.1	369.9	377.9	1.32
	(100.0)	(100.0)	(100.0)	(100.0)	

a surprisingly low figure that puzzled many pundits. It is possible that the forecast in the Master Plan will be way off the mark by 2035, if the past is the best predictor of the future. Moreover, there is little likelihood of a fast-track recovery of the global economy over the next several years. Besides, the demographic trend in Korea indicates that population[2] will grow modestly in the future below an annual growth rate of 1%.

Taking into account the changes in major drivers on which the outlook was based, the government must consider substantial revisions of all long-term energy plans.

Reflection on the current trend and experience of the majority OECD countries suggests that the peak demand will come much earlier than 2035. Some even argue that a "demographic cliff"[3] will arrive as early as 2018 and result in a consumption cliff, which could accelerate both consumption declines and energy demand.

The outlook does not envision any major changes in energy mix, including the relative shares of coal, oil, and natural gas. But it projected that nuclear will play a bigger role in the future with significant increases at an annual growth rate of 3.2%, increasing from 11.7% of total energy production in 2011 to 18.5% in 2035. Renewables are projected grow the fastest, at 4.4% annually. Their share will remain at 5% or less for the projected period in terms of TPES, but is projected to jump to a whopping 20% in the total power generation mix. It will be a major challenge to meet that target.

There is still grave and inescapable uncertainty as to the Korea's nuclear power generation program, especially in the aftermath of the 2011 Fukushima accident in Japan. Nuclear power generation has become politically unpopular and has lost much public support. Construction of additional nuclear power plants will be problematic in Korea for the next two decades. If the planned nuclear program is either revised downward or cancelled totally, additional demand for fossil-fuel energy will inevitably increase to a substantial degree to meet electricity demand.

SCENARIOS ON THE TRAJECTORY OF KOREA'S ENERGY DEMAND: CHALLENGES AND OPPORTUNITIES IN ADDRESSING CLIMATE CHANGE IN THE CONTEXT OF THE ENERGY "TRILEMMA"

The Korean government began to shift its energy and environment policies

towards more sustainable ones in 2010 when then-president Myung Bak Lee announced a national strategy for green growth as part of his future vision for Korea. There are numerous explanations on what triggered the drastic shift in national policy priorities, but still the real causes are not known yet and remain debatable. Many believe the real trigger was politically motivated rather than a carefully considered national vision; nothing more than a new political campaign.

In Korea, however, climate change has been a real issue but does not find its place high on its priority list. It is, by definition, a long-term issue and has not produced a legally binding international treaty. For countries like Korea, preoccupied with postmodern mercantilism, climate change is still regarded as a minor issue. Unless forced to consider it more seriously by international agreements and pressure, Korean officials are less inclined to take actions commensurate with international pledges to meet environmental goals. They tend to avoid taking those actions as long as they can, awaiting actions by peer countries; it is highly unlikely that climate goals would become realities absent substantial international pressure points.

Rapid industrialization and public aspiration for a better life have driven energy consumption in the past 40 years. Unfortunately, concerns over the security of energy supplies have frequently plagued the government, since the absence of indigenous energy resources makes energy supply extremely vulnerable to market risks. It should be noted also that Korea imports its energy entirely through maritime transportation in a quasi-island situation. There is neither power interconnection, nor are there oil and gas pipelines linking with neighboring countries.

Today, climate change adds a new problem of international dimensions to Korea's domestic energy planning: GHG emission reduction is becoming a global norm. By joining the OECD, the Republic of Korea is now considered as a developed nation, despite its status under UNFCCC as a developing (i.e., non-Annex 1) party. Thus, the global community expects Korea to undertake a level of climate change commitment commensurate with its OECD member status. This includes setting up an ambitious GHG-emission reduction target and implementing various climate change policies and measures to help achieve the global goal of stabilizing GHG concentration in the atmosphere below 450 ppm.

In reality, only an aggressive climate change policy by the government could induce timely decoupling of economic growth and GHG emission

reduction that would lead Korea to a smooth transition to a sustainable development path. The transition, however, has its cost, which has at times appeared to be too burdensome to bear.

The additional cost of combating climate change is not negligible in Korea. Its current technology level, combined with a lack of indigenous energy resources, make it difficult to make a sharp turn to combat climate change. First, energy efficiency in Korea has already reached a relatively high level as a result of energy conservation policies over the last 40 years since the onset of the first oil crisis in 1973. Second, Korea is a small country, with a land area roughly equivalent to the state of Utah in the United States. More than 70% of Korea's land is rugged terrain that lacks not only fossil fuel resources, but also potential renewables resources such as good quality wind and sunlight. So-called low hanging fruit to increase energy efficiency is also a scarce resource in Korea.

Aside from the cost incurred in many climate change response measures, Korean key industries face constant challenges and threats from countries like Japan and China in various export sectors including steel, automobile, shipbuilding, and petroleum and petrochemical industries. These industries often argue that their profit margin is very low and any extra cost burden is certain to weaken competitive market power. The pulse of growth in these sectors is currently weak.

It should be also noted that it will be more costly to meet the INDC target if the BAU is revised significantly downward at the same time there are fewer options for significant energy use reductions, even though the absolute volume of the required GHG reduction is reduced. If the downward adjustment of BAU coincides with an economic downturn, as is often the case, the government would find it difficult if not impossible to persuade industries and the public to join the laudable global climate change mitigation efforts.

Following the Porter hypothesis,[4] some insist that strict environmental regulations and stringent government policies could lead to improved commercial competitiveness through innovations and enhanced business performance in certain export industries. However the empirical evidence is inconclusive and, to date, has not attracted the attention of industry leaders.

As the late University of Chicago Professor Milton Friedman once said, "only a crisis—actual or perceived—produces real change," by turning "the politically impossible" into "the politically inevitable." The current Paris

Agreement is not perceived as a real crisis in Korea. As a result, real and drastic changes in the direction of energy policies are not in sight for the next several years. While climate change is still regarded as a net cost to the economy, active participation by government and industry to steer a significantly different course would not come easily without a momentous "crisis."

What, then, could bring about real change? In the short-run, two main issues could prompt the government and the private sector to react to prioritize climate change: bilateral trade; and fine dust particles known as Particulate Matter 2.5, (PM2.5), which adversely affect human health, and are a notable by-product of electricity generation from coal. Environmental issues are often put on the table at bilateral trade negotiations as an indirect compliance enforcement mechanism of the major environmental agreements. Climate change in particular is emerging as a key treaty point in various bilateral trade negotiations. Should climate change become an important international trade issue, it could push the Korean government and the industry to change their approaches to energy production and consumption.

Very recently, local air pollution has captured national attention, as the number of days with smog in the Seoul area is increasing steadily. Seoul residents have begun to witness health impacts from the local air pollutants such as SOx, NOx, and PM2.5. The major emitters of these airborne pollutants are coal-fired power plants. Power plants in the vicinity of Seoul are reported[5] to be one of the main contributors to local air pollution, discharging massive amounts of PM2.5, which are invisible but extremely harmful to the human respiratory system. Children and the elderly are particularly vulnerable, as these pollutants more easily penetrate their lung tissue. Local air pollution, then, could provide another political motivation for change.

Suppose the nation decides to reduce GHGs to the committed level in its INDC. What could be most viable options that could be adopted? Given the resource constraints in both fossil and renewable energies in Korea, a fuel- switching option to natural gas from oil and coal appears most suitable. Natural gas is economically viable and publicly acceptable, since Korea already owns relevant technologies and experience to expand natural gas consumption.

CONCLUSIONS

Korea's energy demand appears to be stagnant, slowing down substantially for the last few years with little promise of upward movement. It remains to be seen if the current low growth rate is temporary. In view of the recent trend, the future demand is not likely to increase sharply, as the major drivers for growth are not as strong as they used to be: population, per capita GDP, and anticipated climate change measures.

To achieve the GHG target in Korea's INDC the nation must mobilize significant resources, but in reality there seems almost no sense of urgency to fulfill the stated goals of the INDC.

There is reasonable confidence in projections that energy demand in Korea will increase at a very slow pace in the future, deviating downward considerably from the outlook of the 2nd Energy Master Plan. Unless there is a major shift in energy policy, the impact of the Paris Agreement on Korea's future energy mix is likely to fall short of bringing significant change.

Notes

1. Angus Maddison (2007)
2. Between 1990 and 2010 the population in Korea had grown at 0.5% per annum.
3. "Demographic cliff" refers to the sharp drop that is expected to come when fewer heads of household are in the peak age group (between 45 and 49).
4. According to the Porter hypothesis, strict environmental regulations can induce efficiency and encourage innovations that help improve commercial competitiveness.
5. The Korea Times reported, citing a study, that the nation's permissible levels of fine dust and ultrafine particles are twice what the World Health Organization recommends.

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The Arctic as a Future Global Natural Gas Supply Hub

Keun-Wook Paik

PHASING OUT FOSSIL FUELS IN RESPONSE TO GLOBAL CLIMATE CHANGE

In June 2015, the Group of Seven industrial powers agreed that the world should phase out fossil fuel emissions this century, in a move hailed as a historic decision in the fight against climate change.[1] The announcement that emerged from the 2015 Paris conference clearly supported the idea of a binding commitment to tackle global climate change. The aim of the Paris Conference was to come up with a global response to a global problem: Earth's atmosphere is growing warmer due to greenhouse gas emissions generated by human activity. This agreement confirms a target to keep the rise in average global temperature below 2°C. The Paris agreement therefore asks all countries to review these contributions every five years from 2020. Countries will not be able to lower their targets, and are in fact encouraged to raise them. The 2016 G7 meeting in Japan set a deadline for ending most fossil fuel subsidies, pledging to end government support for coal, oil and gas by the end of 2025.[2]

A big question emerging from the Paris COP21 meeting is how effective it will be without Asia's big coal consumers' commitment to the drastic reduction of their coal use. BP Energy Outlook 2016 reports that global coal use witnessed 3% growth during the last two decades, but the growth rate until 2035 will slow to 0.5%. The report added that China's coal demand growth by 2030 will be 0.2%, while it had recorded 8% growth from 2000-2014. By 2035, it predicted that China will still account for 50% of global coal demand.[3] In other words, a drastic step rather than a Business-as-Usual (BAU) approach should be taken to reduce China's dependence on coal. The most ideal solution is maximization of gas use by China. The same should be done by India.

During the BP Statistical Review of World Energy 2016 announcement in June 2016, BP's Group Chief Economist Spencer Dale said that the path towards renewable energy in the base case of the Energy Outlook implies a quicker pace of penetration than any other fuel source in modern history.

But even in that case, renewable energies within primary energy barely reach 8% in 20 years' time. The simple message from history is that it takes a long time—several decades—for new energies to gain a substantial foothold in the global energy arena.[4] Without a drastic reduction of dependence on coal by Asian countries, in particular China and India, any initiative by OECD countries to encourage a phase-out of fossil fuel will have very limited success.

CHINA'S 13th FYP AND THE ROLE OF GAS

In early March 2016, China announced a total energy consumption cap of five billion tons of coal equivalent. This came after the success of the 12th Five-Year Plan from an energy perspective, in which energy and carbon targets were met and surpassed. Between 2011 and the end of 2015, energy intensity (energy consumption per unit of GDP) fell by 18.2% and carbon intensity declined 20%. These declines are due in large part to a drop in coal consumption: down 3.7% in 2015, following a 2.9% decrease in 2014. The reduced consumption levels suggest that achieving a five-billion metric ton energy cap may not be insurmountable.[5] Clearly it is a clear reflection of complacency among Chinese energy planners, and it was a big disappointment that there was no sign that Beijing energy planners were taking any additional steps to strengthen the importance of natural gas in China's energy mix.

In an article placed on the website of the British investment research company "Trusted Sources," Stephen O'Sullivan correctly pointed out that gas prices need to fall further to improve Asia's environment.[6] His point was that one of the key routes to improving Asia's physical environment is to replace coal in power generation by natural gas. He argued that price alone is unlikely to persuade energy users to switch to a more environmentally friendly fuel like gas. As in Japan and Korea, China plans to introduce a carbon trading system in 2017, although there is no clear view on what the carbon price is likely to be. The most promising solution to achieve multiple governments' aim of fuel switching and environmental improvement is the introduction of an effective carbon pricing mechanism, which raises the price of coal sufficiently to allow gas to be competitive in the power generation market. Politically and technically, however, this could be a complex and lengthy challenge across Asia.

In a paper prepared for 2016 Pacific Energy Summit (PES) conference, Mark C. Thurber at Stanford University pointed out that reforming gas prices in both India and China is not easy. He writes that India is very likely to have the most difficulty replacing coal. Liberalization of gas prices could encourage more development of domestic gas, but this is challenging due to the political power of gas-consuming industries. Moreover, India's electricity sector is still not very market-based in how it procures fuel, which makes it ill-equipped to pay for higher-priced domestic or imported gas. In China, further liberalization of natural gas prices and a greater willingness to let the market decide which end users can utilize natural gas will create the right incentives for continued expansion of the gas supply. Thurber concluded that broader movement in Asia toward pricing based on gas-on-gas competition rather than oil indexation could help create the conditions for expansion of gas consumption over the long term, although current low oil prices may have dulled the perceived urgency of such reform.[7]

There are many factors that will shape China's energy future, but here I identify two factors that are fundamentally important: The first is the drastic reduction of coal's share in China's energy balance, to well below 50% by 2030; and the second is a rapid expansion of natural gas use with China's bold initiative for the conversion of LNG into a global commodity. At present, however, China is pursuing a kind of status-quo approach for fossil fuel industry's phase-out. If China takes a bold step to maximize the diversification of global LNG supplies, a big change of global LNG supply pattern will be possible, even though China alone cannot introduce the major change. The revolutionary change can be materialized only when the three main gas importers of Northeast Asia—Japan, Korea and China—agree to cooperate for the new model of global LNG supplies. A consensus on a gas consumers' alliance in Northeast Asia is being made and it is very encouraging.

PROJECTION OF LNG SUPPLY GLUT AND ASIAN GAS CONSUMERS ALLIANCEINITIATIVE

Asia's gas consumers do not wish to utilize expensive LNG, even if the only alternative is "dirty" coal. This is why the three main gas importers aim to form an alliance that could play a pivotal role in lowering the

development cost of new LNG supply sources, by introducing a new financing format based on the sovereign funds' provision. However, the main LNG producers are paying their highest attention to the LNG supply glut until the early 2020s, which will not help the substantial rebound of LNG pricing. In a paper presented at the LNG 18 conference, the authors argue that substantial amounts of LNG supply will reach the market by 2020. That supply may well exceed Asia's appetite for LNG, which had relied mostly on increasing demand from China, India and Southeast Asia, and will present uncertainties in terms of growth due to price sensitivity. The flexibility of some new supplies, notably from the United States, means that many companies may be left with large amounts of surplus LNG.[8]

If global LNG supply volumes are balanced by the market and controlled due to the delay of the new supply projects, Asian gas consumers will have no leverage whatsoever against the controlled global supply volume. Japan learned first-hand the excessive financial burden from expensive LNG in the wake of the 2011 Fukushima disaster. It was no surprise when Japan's JERA Co, the world's biggest importer of LNG,[9] said in late February 2016 that it is in talks with other LNG companies to create an alliance of buyers that account for more than one-third of global trade, according to Hiroki Sato, vice president of the fuel department of JERA, which is a joint venture between Tokyo Electric Power Co. and Chubu Electric Power Co. JERA is also seeking to cooperate with Kogas and CNOOC on LNG procurement and investment. The deal will benefit smaller companies outside the group, as lower prices would be passed on to other buyers, Sato said. The alliance members would also be able to swap or trade cargo among themselves to help balance supply between their operations.[10]

JERA's initiative will be very effective if it is combined with China's bold step to introduce its real leverage to change the way global LNG supply options. Generally speaking, there will be a rapid slow-down of green-field LNG project development if the return rate of investment for the new gas supply development is not attractive enough and oil price is not high enough. This will be a recipe for the typical repeat of boom-and-bust cycles. Assuming the depressed oil price is maintained, it would provide a golden opportunity to take the initiative to diversify LNG supply hubs, based on Asian consumers' sovereign funds financing for the development of new LNG supply hubs. Ultimately, the question of how to make natural gas become more widely traded and consumed lies in the balancing act

between the interests of producers and consumers.

Asian consumers like China, India and ASEAN countries can easily find that coal remains a preferred alternative, if natural gas prices are not competitive and attractive. At the end of February 2016 Reuters reported that a ton of hard coal equates to roughly $27/MMBtu of thermal energy, and a ton cost around $51.29. To generate the same amount of energy from LNG would cost about $121.50, based on an Asian spot LNG price of $4.50/MMBtu. The competitiveness of coal may partially explain why Japan's thermal coal imports rose 4.8% last year while LNG imports fell 3.9%.[11] Without a drastic policy change, dependence on coal will not go away easily. The consequence will be the continuation of an addiction to coal by Asian countries. Only when affordable gas supplies are guaranteed will the expansion of gas use in Asia, and in particular China, India and ASEAN countries, materialize.

On June 14, Dharmendra Pradhan, the Indian minister of petroleum and natural gas, said, "For the next two to three decades, gas is going to be a major part of the energy basket for Asian energy consumers. We want to bring together the countries and form a network which can together source reasonable, rational and affordable LNG." He added that talks with Japan and Korea have begun and China may also come onboard as a partner. India's state-owned GAIL Ltd is spearheading the talks on India's behalf, which follow a similar attempt in 2013.[12] This announcement, made by India rather than China, was a pleasant surprise, but was also a kind of indirect confirmation that while the environment to form Asia's Gas Consumers Alliance (AGCA) ripens, no concerted initiative is being taken to capitalize on this momentum.

ARCTIC LNG DEVELOPMENT POTENTIAL

The role of the Arctic region in global oil and gas supply over the next decades is becoming a subject of increasing interest as the potential of the region's geology is revealed and the shrinking of the ice cap makes drilling an increasingly feasible activity. The lack of existing infrastructure and the likely high cost of any development in geographically remote and climatically harsh conditions mean that the economics of any new project will depend to a large extent on the size of discoveries and the oil price, which, in turn, will be affected by the development of other sources of oil

supply and alternative energies.

The Arctic is often referred to as a single unified region, although it is a large geographical area populated by approximately four million people, divided among eight countries that differ significantly in terms of climate, economy and way of life. The Arctic states are Iceland, Sweden, Finland, Norway, Russia, Greenland (Denmark), the United States (Alaska) and Canada, of which the last five border the Arctic Ocean (littoral states). Of all these countries, Russia has the largest Arctic population—approximately two million—followed by the U.S. (Alaska) with approximately 650,000 inhabitants, Norway with 469,000, Canada with 120,000 and Greenland with 58,000. There is no single universally accepted definition of the Arctic, although it is commonly referred to as the geographic region above the Arctic Circle at 66° 32" North. That definition, however, excludes Iceland, which is located just below the Arctic Circle.[13]

Currently the United States, Norway and Russia are producing oil and gas from Arctic waters.

- In 2013 the U.S. federal offshore portion of the Northstar development in Alaska's Beaufort Sea produced 654,638 barrels of oil and 28.99 billion cubic feet of natural gas, which represented about 17% of total production from the federal/state unit.
- Norway started production from Snohvit in the Barents Sea in 2007. In 2012 production was 189 billion cubic feet of gas, three million barrels of natural gas liquids, and 5.4 million barrels of condensate.
- Russia shipped its first offshore Arctic oil in April 2014, from the Prirazlomnoye field, which is expected to produce 120,000 barrels per day by 2020.[14]

In 2008, the United States Geological Survey (USGS) published the first comprehensive assessment of potential hydrocarbon reserves for the entire area north of the Arctic Circle. According to the assessment, Arctic resources account for about 22% of the world's undiscovered technically recoverable oil and gas resources, including 13% of undiscovered oil, 30% of undiscovered natural gas and 20% of undiscovered natural gas liquids. This implies an estimated 90 billion barrels of undiscovered technically recoverable oil, 1,670 tcf (47 tcm) of technically recoverable natural gas and 44 billion bbls of technically recoverable natural gas liquids in 25 geologically defined areas north of the Arctic Circle that are thought to

have potential for hydrocarbons. Approximately 84% of those resources are expected to occur offshore.[15]

The breakdown by country shows that Russia has by far the largest share of these Arctic resources (see Table IV.5 below). The West Siberian shelf alone contains 32% of the total of 412 billion barrels of oil equivalent (BOE) of Arctic resources, while other Arctic regions in Russia account for another 26%, meaning the country's overall share is 58%. Of the remaining 42%, Alaska has approximately 18%, Greenland 12% and all other Arctic-region countries, including Norway, 12%. Of course, it must be remembered that the assessment methods are based on geological assumptions and estimates, which implies a large degree of uncertainty. Indeed, according to the USGS, the biggest challenge has been the lack of information, as in some areas there are almost no data.

So far, oil and gas activities in the Arctic have resulted in the production of over 25 billion barrels of liquids (bbl) and 550 trillion cubic feet (tcf) of natural gas. Additionally an existing reserve base of 38 bbl and 920 tcf is estimated. The Arctic is also estimated to contain an additional 525 billion barrels of BOE of conventional resource potential, and 426 billion BOE of undiscovered conventional liquids and gas. This 426 billion BOE represents about 25% of the remaining global undiscovered conventional resource

Table IV.5 Summary of Global Arctic Natural Gas Potential

(Unit: tcf)

		Natural Gas		
		Discovered	Undiscovered	Total Gas
United States	Onshore	99.7	91.3	191.0
	Offshore	28.1	133.8	166.8
Canada	Onshore	12.3	11.9	24.2
	Offshore	11.1	76.5	87.6
Russia	Onshore	183.7	166.2	349.9
	Offshore	177.4	977.8	1155.3
Greenland	Onshore	0.0	6.2	6.2
	Offshore	0.0	129.9	129.9
Norway	Onshore	0.0	1.2	1.2
	Offshore	7.9	112.2	120.1
Total		520.0	1,712.0	2,232.0

Source : National Petroleum Council, Arctic Potential : Realising the Promise of U.S. Arctic Oil and Gas Resources, 2015, p.1-6.

potential. It is estimated that approximately 75% of the total global Arctic conventional resource potential is offshore and 25% onshore. The majority of the Arctic resource potential is expected to be gas, with about 30% estimated to be liquids. Russia is estimated to have by far the largest Arctic resource potential and will continue to be a dominant player in Arctic oil and gas development.[16]

CHINA'S LOAN FOR GAS FOR ARCTIC LNG SUPPLY HUB DEVELOPMENT

The Need of Loans to Develop Gas Rather than Coal Resources

Under any circumstances, China is set to minimize its dependence on coal use. However, China's energy loans are highly concentrated in fossil fuel extraction and power generation, especially coal. According to a recent GEGI study, Chinese development banks have provided upwards of $28 billion in financing for global coal projects—projects that accentuate climate change and social risks. Using conservative estimates of the climate and local health costs of coal plant emissions, the study authors calculate that the yearly social cost of Chinese overseas coal-fired power plants amounts to $29.7 billion. Assuming a power plant lifetime of 30 years, total social costs could range from $117 billion to $892 billion.[17]

In the same month, a study by the Center for International Environment and Resource Policy (CIERP) at the Fletcher School at Tufts University elaborated that between 2001 and 2016, Chinese financial institutions supported the construction of more than 50 coal-fired power plants abroad. A majority of these power plants (58%) used sub-critical coal technology, which is the most energy inefficient form of coal-fired power plant, and therefore the type that is most carbon intensive. Almost all of the rest were super-critical plants, which are approximately 12% more efficient than sub-critical plants. On an annual basis, this fleet of more than 50 coal-fired power plants is estimated to release 594 million tons (mt) of CO_2, which is equivalent to 11% of total U.S. emissions in 2015 and 6% of total Chinese emissions in 2014 (latest year available). Taken together, China's policy banks (such as the China Development Bank and China Export and Import Bank) financed overseas coal plants that would be the eighth largest emitter of carbon dioxide emissions—more on an

annual basis than Canada, Brazil, Saudi Arabia, or the United Kingdom. If a 30-year lifetime of these plants is assumed, these plants will cumulatively emit 17,828 mt CO_2, equal to more than triple the total of U.S. emissions in 2015, 1.5 times Chinese emissions in 2014, or slightly more than U.S. and Chinese emissions combined on an annual basis.[18] Interestingly, when the above study was published, China had already decided to make a loan to develop gas for the Yamal LNG project in late April, and in May China decided to finance 85% of Pakistan's LNG terminal and pipeline projects. The deal was signed between Pakistan's Inter-State Gas System (ISGS) and CNPC. China Petroleum Pipeline Bureau (CPP) will construct the pipeline and will also build LNG terminal at Gwadar. The project will cost around $2 billion.[19]

Yamal& Arctic LNG, and Loan for Gas

On April 29 in Beijing, 2016, Yamal LNG signed credit agreements with the Export-Import Bank of China (China Exim Bank) and China Development Bank in the amount of €9.3 billion and 9.8 billion yuan for 15 years. The firm said in a statement that the interest rates for the credit lines are EURIBOR 6M +3.3% per annum for the period of construction and 3.55% after the full commissioning of Yamal LNG and SHIBOR 6M +3.3% and 3.55% per annum, respectively. Earlier in the framework of raising project financing, 150 billion rubles were received on a return basis from Russia's National Welfare Fund (NWF). An agreement was also signed with Sberbank and Gazprombank to provide a credit line in the amount of €3.6 billion for 15 years. Yamal LNG CEO Yevgeny Kot said that, "The project is being implemented in accordance with the confirmed schedule, the first train of the LNG plant is 65% ready, and we are in the most intense stage of construction and installation work. The signing of the agreements with the Chinese banks is allowing us to implement the project without raising additional funds from shareholders."[20]

In June 2016 at the Saint Petersburg Economic Forum, Novatek boss Mikhelson confirmed that the partners in the Yamal LNG project—Total, CNPC and Silk Fund—had also shown interest in the development of the projected Arctic LNG. Mikhelson added that a technological concept proposal for the project is due to be completed in the course of 2016. This will include LNG output capacity, licenses and equipment. Michelson elaborated that the capacity of the projected plant could be six million tons

of LNG per year. The first production phase project could be launched in 2022, followed by a second and third phase in 2024 and 2025, respectively. Novatek said that while the production from Yamal LNG is based on long-term supply contract with customers, the gas from the Arctic LNG will be sold on the spot market.[21]

The Arctic LNG plant will be based on resources from the Gydan Peninsula, and first of all the Salmanovskoye and Geofizicheskoye fields, both located on the eastern bank of the Ob Bay. The total resources of the fields amount to about 380 bcm. In addition to South Tambey, Salmanovskoye and Geofizicheskoye fields, Novatek controls several other major resources in the area. Among them are the East-Tambey and North-Ob fields, both of them located offshore in the Ob Bay, and believed to hold up to 1.8 tcm of gas. In 2014, Novatek established a subsidiary named the Arctic LNG-1. The same year the entity won the license to the Tryekhbugornoye field, a deposit with resources exceeding one tcm of natural gas. The new Arctic LNG plant in Gydan could be based on a floating solution designed for the shallow waters of the Ob Bay. The Russians are reportedly also in contact with Norwegian engineering company Kværner about the project. A part of the expanded LNG plans in the Arctic is the construction of the KolskayaVerf (Kola Yard) in Murmansk, a construction yard for LNG modules. The new yard will cost $500 million.[22]

Arctic LNG as a supply hub for Asia

China's bold step to take 29.9% of equity of Yamal LNG and to offer a $12 billion loan for the Yamal LNG project made the Arctic a potential future LNG supply hub for Asian gas consumers. In fact, companies from China, Japan and Korea have been exploring the commercial viability of LNG supply via the Arctic Sea Route. It is not an exaggeration to say the three big LNG buyers in northeast Asia are showing a strong consensus opinion when it comes to the reduction of LNG import price and opening the new LNG supply option, including the Arctic LNG supply.

As discussed earlier, JERA announced LNG cooperation among Japan, Korea and China. At the end of 2015, Korea's Ministry of Trade, Industry and Energy(MOTIE) made very clear that it will initiate Korea-Japan-China gas cooperation to improve gas import conditions.[23] India also expressed interest in pursuing LNG cooperation with Japan and Korea.

In parallel with Yamal LNG supply, if the Arctic 2 LNG mainly with spot cargos materializes, the LNG supply via the Arctic route during the 2020s will be quite a substantial volume.

In Asia, there are a number of large-scale, under-utilized sovereign funds exploring quality investment opportunities. If the sleeping sovereign funds from Asia's main gas consumer countries can be utilized to replace the commercial loans with high interest rates normally provided by the Western banking sector, the special lending with low interest rates for a frontier LNG project development will open the door to reduce the LNG production costs significantly and return the benefit to the gas consumers rather than commercial lenders. This new way of funding is definitely applicable to the Arctic LNG development and the offshore gas development in East Africa, in particular in Mozambique where virtually all Asian gas consumers are taking equity stakes in Mozambique Block 1 (Japan, India and Thailand) and Block 4 projects (China and Korea). The difference between Arctic and East Africa LNG development lies in a fact that both Japan and Korea are not taking any equity stake in Arctic LNG project. Once the first cargo of Yamal LNG supply to Asia is successfully implemented in 2017, the equity investment by Japan and Korea in Arctic LNG project will be much more likely. If the special rate lending from JBIC (Japan Bank for International Cooperation), Korea Eximbank, and CDB (China Development Bank) is applied to Arctic area's spot cargo development and Mozambique Block 1 and 4's combined eight trains development (40 mt/y) rather than four trains, it will open a new era of frontier LNG development with sovereign funds loans. During the second half of the last decade, the U.S. shale revolution has introduced a new chapter in global LNG supply business. There is also a very good opportunity to introduce another revolution for frontier LNG supply development during the second half of this decade. If Korea and Japan take a similar step in parallel with China's initiative, it looks the conversion of the Arctic into a future LNG supply hub may become a viable reality.

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Technological Innovation and Infrastructure Development in Arctic Oil and Natural Gas Development

Mark D. Myers

Many drivers will affect the future of oil and gas development in the Arctic including demand and price, the size, distribution and properties of the Arctic oil and gas endowment, the existence, availability and cost of Arctic-appropriate technology for exploration, production and transportation, access to the resource (infrastructure, sea ice and geopolitics) and the ability to manage the environmental risks, particularly oil spills. Recognizing that these drivers are interconnected, this paper will focus primarily on two of these drivers: technology and infrastructure. While there are many valid definitions of the Arctic based upon geo-political boundaries, temperature, and ecosystems, this paper will use the definition of the Arctic as the area north of the Arctic Circle in order to be consistent with the USGS historical resource assessments.

Rather than being somewhat homogeneous, the Arctic has substantial variations in ecosystem properties that affect the ability to extract oil and gas. For example, continuous permafrost in the onshore and nearshore environments dominates much of the Arctic in Western Canada, Alaska and Western Russia. This area's coastlines and coastal bathymetry are generally unsuitable for deep-water ports, and the presence of significant nearshore and offshore sea ice during more than half the year presents additional challenges. In contrast, the coastal regions of Norway and Iceland are relatively ice-free, have discontinuous to non-permafrost bearing substrate, and coastlines that are suitable for deep-water ports. These differences strongly influence the technology, infrastructure and approaches used in oil and gas development. However, most Arctic oil and gas development shares common challenges including: distance from market; lack of existing in-place infrastructure; winter darkness; high-value sensitive ecosystems; and severe weather. These challenges mean that initial development costs are high. Therefore the corresponding minimum economic field size needs to be very large and the resource base needs to be world class in order to attract investment capital, particularly for the needed transportation infrastructure

necessary to bring the oil and gas to market.

KNOWN AND ESTIMATED RESOURCE ENDOWMENT OF THE ARCTIC

Four of the eight Arctic countries—Russia, Norway, United States and Canada—have proven oil and natural gas resources at locations north of the Arctic Circle. The majority of the proven oil and gas resources are located in Russia, Alaska and Canada. More than 400 oil and gas fields have been discovered north of the Arctic Circle in onshore locations in Canada, Russia and Alaska, with cumulative produced oil and remaining proven reserves of approximately 240 billion barrels. This is equivalent to 10% of the world's known conventional petroleum reserves. In 2008 the United States Geological Survey completed a systematic probabilistic-based assessment of the conventional technically recoverable undiscovered resource base of the 6% of the earth's landmass that is north of the Arctic Circle. The sum of the mean estimates for all geologic provinces was 90 billion barrels of oil, 1669 trillion cubic feet of gas and 44 billion barrels of natural gas liquids. These mean undiscovered resource numbers equal 13% of the world's estimated undiscovered conventional oil and 30% of the estimated undiscovered conventional gas. 84% of this undiscovered resource base was estimated to be offshore. More than 70% of the undiscovered oil was estimated to occur in five provinces: Arctic Alaska, Amerasia Basin, East Greenland Rift Basins, East Barents Basins and West Greenland-East Canada. More than 70% of the undiscovered natural gas was estimated to occur in three provinces, the West Siberian Basin, the East Barents Basins, and Arctic Alaska.[1]

There remains much uncertainty about the distribution and amount of undiscovered oil and gas resource base in the Arctic due to the overall lack of geotechnical information, particularly geologic data from exploration wells. For example, even in some of the most explored basins such as the North Slope of Alaska, the density of exploration wells drilled is about three wells per 1000 square miles as compared to 250 wells per 1000 square miles in the petroleum perspective area of Wyoming.[2] In several large Arctic basins only a few or no exploration wells have been drilled. However, in many of these underexplored basins the key geologic elements of source rock, reservoir, and large geologic structures have been identified.

While their petroleum potential remains uncertain they appear to be very attractive from a geological perspective.

ARCTIC UNCONVENTIONAL OIL AND GAS RESOURCES

In addition to conventional oil and gas there is increasing evidence that the Arctic also has a significant endowment of unconventional oil and gas, including permafrost associated gas hydrates, shale oil and gas, and tight and basin- centered oil and gas. Limited data exists on these resources and the potential resource base has only been recently quantified for some of these resources by the USGS in Arctic Alaska. The USGS estimates that the North Slope of Alaska has a fully risked mean undiscovered technically recoverable resource of 85 TCF of natural gas from permafrost associated hydrates,[3] 940 million barrels of oil and 42 TCF of gas from shale.[4] While these resources are likely decades away from commercial exploitation, in some cases they are known to be present within close proximity to existing oil production facilities and given the development of appropriate technology could provide production that would extend the useful life of these facilities.

PRODUCTION, INFRASTRUCTURE AND INNOVATION

The proven and potential oil and gas resources of the Arctic, coupled with the ability of oil companies to obtain large blocks of leases and licenses to explore, provides the opportunity for a successful discovery to substantially increase the reserve base of even the largest multinational oil companies. The governments of Arctic nations, states or regions that have significant oil and gas potential are generally supportive of prudent development of these resources due to the direct and indirect economic benefits including taxes, royalties, associated employment, availability of local energy supply and the development of new infrastructure. These and other factors have historically led to significant, yet cyclic exploration and development investment in the Arctic due to price and demand volatility.

The first significant natural gas production in the Arctic began in Russia in 1969 followed by oil production from both West Siberian Basin and the

North Slope of Alaska in the 1970s. Norway began gas and condensate production in 2007, followed by oil production in 2016. In both Russia and Alaska, initial Arctic production began onshore followed by offshore production. All Norwegian production is offshore.[5] These developments typically took from nearly one to more than two decades from initial discovery to initial production. For example, the first production on the North Slope of Alaska occurred in 1977 from the Prudhoe Bay Field following the completion of the Trans-Alaska Pipeline (TAPS) and the oil tanker loading facility at the ice-free deep-water port of Valdez, located 800 miles to the south. Discovered in 1968, with initial estimated reserves of approximately 10 billion barrels of oil, the Prudhoe Bay Field is the largest in North America. Plans to produce it began in 1968. Construction didn't begin until 1975 following the 1973 signing of the Trans Alaska Pipeline Authorization Act as a direct response to the OPEC oil embargo and the associated fourfold increase in the price of domestic gasoline.[6] Since that time, more than 17 billion barrels of oil have been produced through TAPS from nine different oil and gas units.[7]

Significant technological innovation was applied to the early development of the Prudhoe Bay field including extensive use of direction drilling, hydraulic fracturing, the use of water flood, large scale gas cycling, miscible gas and water alternating gas injection and other secondary and tertiary recovery techniques. Other innovations included effective passive insulation systems for drill pads, buildings, the vertical support members of gathering lines and TAPS that prevent the thawing of permafrost and associated thermokarsting; modular construction for major facilities; and delivery of these large modules by sea lift in the limited open water sea lift season. Later innovations in the 1990's included extensive use of high resolution 3D and 4D seismic surveys and seismic attribute analysis, multilateral and horizontal drilling, the dramatic decrease in drill pad size and wellhead spacing, extensive use of temporary ice roads for access to exploration drill sites and pads, the use of ice roads for roadless area development and resupply. As exploration and development moved to shallow water offshore in Alaska in the 1980's and 1990's, the use of ice islands, gravel islands, and moveable bottom-founded drilling structures were developed so that drilling could be done safely in the shallow water nearshore during the months where landfast and shear zone ice conditions are present. Two examples of these mobile drilling structures are the Concrete Island Drilling Structure (CIDS) and the Single Steel Drilling

Caisson (SSDC).[8] Recent exploration drilling activities by Shell in the Chukchi Sea deployed into the Arctic two additional layers of well control and oil spill prevention technology new to Arctic Alaska offshore drilling: capping stacks and the Arctic Containment System (ACS). The ACS was onsite during drilling operations and consisted of a staging and processing system mounted on a floated barge, high pressure hoses designed to connect to a capping stack, and a containment dome. The ACS served as a last line of defense against a serious loss of well control.[9] In Russia, new innovative infrastructure being constructed for Arctic offshore production and transportation includes ice-resistant concrete substructure drilling and production platforms, development of ice-class oil and ice-capable LNG tankers, and the construction of year round offshore loading facilities.[10] In Norway, the Snohvit gas and condensate field located on the Barents Sea shelf at 340 meters water depth pioneered the use of seabed production facilities on the Arctic shelf. The gas and condensate is produced through the subsea facilities, which is connected to onshore processing and LNG facilities by a 143 kilometer-long sea- floor pipeline.[11]

NEW TECHNOLOGY AND INFRASTRUCTURE NEEDS

Although the technology exists today to develop a significant portion of the conventional Arctic oil and gas potential, additional work is needed to both validate and improve that technology for Arctic conditions.[12] Additionally, given environmental changes as a result of rapid Arctic warming, more benchmark data is needed on marine organisms, bathymetry, coastal topography and sea ice along with better meteorological, sea ice, and ocean current modeling and forecasting. Implementation of an integrated Arctic observing network is needed to provide this crucial benchmark data. In addition to traditional methods for acquiring data, such as satellite and aircraft, ships, and fixed instrumentation, the observing network could make extensive use of unmanned aerial systems (UAS) and autonomous underwater vehicles (AUV) and community-based monitoring that includes local and traditional knowledge. Ideally the Arctic observing system would use a set of international standards for collection, sharing and integration and include industry monitoring data from oil and gas activities.[13] This approach to an Arctic observing system would dramatically increase the spatial and temporary resolution of observations and in turn increase the

understanding of the complex linkages and coupling within the Arctic environment and provide for enhanced capacity to adaptively manage oil and gas activities.

One of the greatest challenges associated with expanding Arctic oil and gas development is the increased risk of a serious oil spill into the Arctic marine environment due to the escalation of ship traffic and more offshore wells and additional coastline facilities such as fuel storage tanks. Given many factors, including the overall lack of infrastructure, the extreme environmental conditions, sensitivity of the rapidly changing ecosystem, long distances and the complex interaction sea ice and oil, mounting an effective oil spill response in the marine Arctic environment presents a particularly difficult challenge. Oil spill response options in the Arctic marine environment need to be effective over a range of conditions depending on the oil type and volume, spill location, and environmental conditions including the proximity of the spill to sensitive marine ecosystems, species, culturally sensitive sites, sea ice and open water conditions. This requires a complete oil spill toolbox be readily available for early response. Such a toolbox needs to include the ability to detect, monitor and model oil spills even in the winter darkness and within areas containing significant sea ice. The toolbox needs the capacity for a variety of response methods, including biodegradation and dispersants, in situ burning, mechanical recovery and natural recovery.[14] To improve their effectiveness in the Arctic, all these tools would benefit from additional research and development. Detection, monitoring and modeling of oil spills under ice, and oil spill trajectory models need much improvement. The limitations of mechanical recovery in a variety of ice conditions need to be better understood. In situ burning needs improved ignition and more refinement in the understanding of how to effectively use chemical herders to concentrate oil for burning at a variety of scales, and with different oil types and weathered states. Biodegradation and dispersants need additional testing to better understand the toxicity of the combination of dispersants and the dispersed oil on key Arctic species, to improve methods for applying dispersants for oil spills in ice, and to better define the rates of hydrocarbon degradation in offshore Arctic environments. Finally, the lack of infrastructure in many parts of the Arctic, including communications, traffic monitoring, human capacities and prepositioned response equipment is a significant liability in the event of a large oil spill.[15]

The Arctic is warming at more than twice the rate of lower latitudes.

The average annual surface air temperature over land north of 60 degrees N in 2015 was 2.8°C higher than at the beginning of the 20th century. This dramatic warming creates challenges and opportunities for the development and transportation of natural gas.[16] Associated with these warming conditions are shorter winters, destabilization of permafrost, decreased area, volume and seasonal coverage of sea ice, increased rates of coastal erosion, and an earlier spring break-up of rivers and lakes. Challenges to exploration and development include a decreased tundra travel open season (due to a shorter period of time that ice roads and pads remain viable), damage to pipelines, roads, gravel pads and other infrastructure from subsidence and frost heaving related to thawing permafrost, and damage to shoreline facilities caused by increased coastal erosion. On the positive side, the decrease in sea ice provides for a longer open water season in much of the Arctic Ocean. This increases the time available for offshore exploration, construction of offshore facilities and pipelines, resupply and the shipping of large modularized facilities by sealift, and the seasonal transport of LNG by tanker directly from the Arctic. Future development of new Arctic natural gas resources will require the design and construction of facilities capable of safe operations in a rapidly changing environment.

The long-term potential of the Arctic's unconventional resources is very significant but many aspects are still poorly understood. Continued research is particularly important in understanding and characterizing methane hydrates. The in-place volume of natural gas in methane hydrate worldwide is estimated to be far greater than the entire world's conventional natural gas resources.[17] Arctic sandstone reservoirs hold the most promise for near-term recovery of natural gas from methane hydrate, because the hydrate is concentrated near the base of the permafrost in onshore and near-shore sandstone reservoirs with high porosity and permeability. In addition, portions of these reservoirs are located onshore within range of existing oil and natural gas production infrastructure. Hydrate in marine sands elsewhere in the world are found in at water depths of greater than 460 meters and are considered more difficult to develop because of higher costs and challenging technical issues associated with deep water exploration and production.[18, 19] In areas of Arctic oil and gas production underlain by permafrost, including the onshore North Slope of Alaska, the risk of encountering and destabilizing relatively shallow gas hydrates when drilling for conventional natural gas or oil at deeper depths is well understood. In order to safely drill through zones containing hydrates, seismic and

nearby well log data are used to map potential hydrate accumulations prior to drilling. During well drilling and completion operations, specific drilling and casing techniques are used to prevent destabilization of any hydrates encountered. The information on hydrates derived from this hazards mitigation work, coupled with dedicated research efforts on hydrate resource characterization, have provided insight into some of the fundamental questions about the resource but many questions remain. Because of the ability to evaluate methane hydrates onshore and within existing infrastructure at locations with low risk of geologic failure, the U.S. Department of Energy (DOE) methane hydrate program has supported field tests that have included the drilling of two successful test wells and one short-term production test on the North Slope. The results of these field experiments have increased understanding into the geology, reservoir characteristics and behavior, and the production feasibility of methane hydrates. The first long-term production test is currently being planned for the Prudhoe Bay field. If successful, this test will greatly enhance the understanding of the methane hydrate reservoir behavior away from the well bore, the sustainability of production at controlled rates, environmental impacts of production, and completion and production technology. The DOE recently confirmed this future test as a program priority.[20, 21]

COMPLETION OF ONGOING INFRASTRUCTURE PROJECTS IN RUSSIA AND ALASKA ARE KEY TO INCREASED ARCTIC NATURAL GAS PRODUCTION

In Alaska, engineering design work and permitting work continues on the AK LNG project from the Point Thomson and Prudhoe Bay fields to a proposed new LNG facility on the Kenai Peninsula in south central Alaska. AK LNG has four major elements: pipelines from Point Thomson and Prudhoe Bay to a gas treatment facility in the vicinity of Prudhoe Bay, the gas treatment facility capable of processing 3.5 BCF per day; an 800-mile natural gas pipeline; and a three-train LNG processing and dock facility. The project is a joint public-private partnership among the State of Alaska, Exxon Mobil, Conoco Phillips, and BP that is designed to produce about 20 million tons per annum of LNG for export. Additionally the project will supply natural gas to Alaskan communities along the pipeline route. The

initial 20 years of gas supply will come from 33 TCF of gas that is currently being cycled as part of oil and condensate production at the fields. The DOE has conditionally granted the project an export license to non-Free Trade Agreement countries. Currently the project is six months away from completing preliminary engineering, at which time the project partners will determine if they will enter the front-end engineering and design phase (FEED), which is estimated to cost $1.5-2 billion.[22]

In Russia, recently completed and projects currently under construction will greatly expand gas production from the Yamal peninsula. The 1,100 km Bovannenkovo-Ukhta gas pipeline was commissioned in 2012, connecting Yamal with a pipeline network to Europe. An expansion of that system is underway.[23] Construction of the Yamal LNG project continues to advance. The project will use ice class LNG tankers with the capacity to manage ice up to 2.1 meters thick. The project is designed to deliver up to 16.5 million tons per annum of LNG with year round delivery through the Kara and Barents Sea to Europe with seasonal deliveries to Asia via the Northern Sea Route via the Kara and Barents Seas. Initial project start-up for the first liquefaction train is scheduled for 2017.[24]

Conclusions: The current world conditions of low oil and gas prices, slow demand growth, and over supply create challenges for Arctic oil and gas development. While the pace of exploration and development has slowed, large oil and gas infrastructure projects both onshore and offshore continue to advance in Arctic countries with large proven and potential oil and gas resources. These projects are often very innovative and incorporate significant technological advancements from previous projects. This new infrastructure and technology strategically anchors long-term development in these prolific hydrocarbon basins. One of the greatest remaining technological and infrastructure challenges to Arctic oil and gas development is responding to oil spills in the marine environment, particularly in ice covered waters.

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Long-Term Oil and Gas Price Projections: Implications for Russian Arctic Oil and Gas Development

Tatiana Mitrova

INTRODUCTION

Fundamental changes in global gas markets as a whole and in the international gas trade in particular convinced many experts that Arctic gas projects are now too challenging and expensive and therefore no longer attractive for investors. These changes include the shale gas revolution, a steady transition from long-term oil-linked contracts to the hub-based prices in Western Europe, and some signs of similar process beginning in Asia, as well as an evolving gas glut and approaching LNG oversupply, Indeed, current gas prices both in Europe and in Asia are in the range of $4-5/MBtu. In the United States prices have even fallen below $3/MBtu, which is far below break-even prices for the majority of new Arctic gas

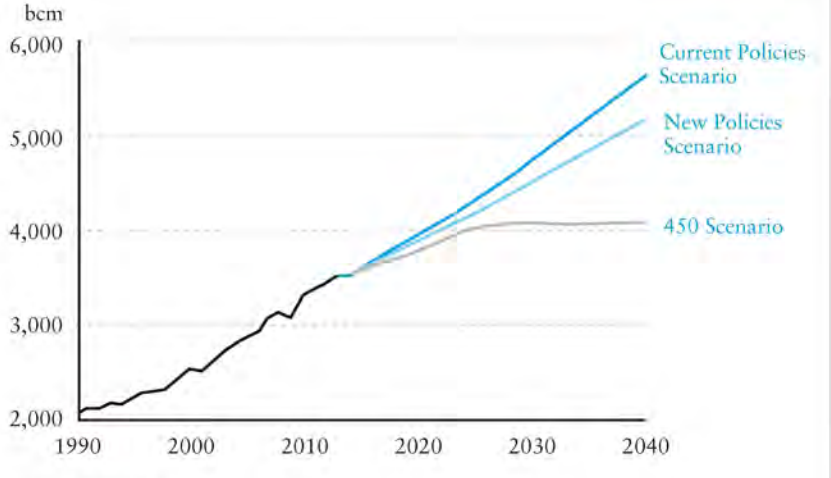


Figure IV.7 World Natural Gas Demand by Scenario

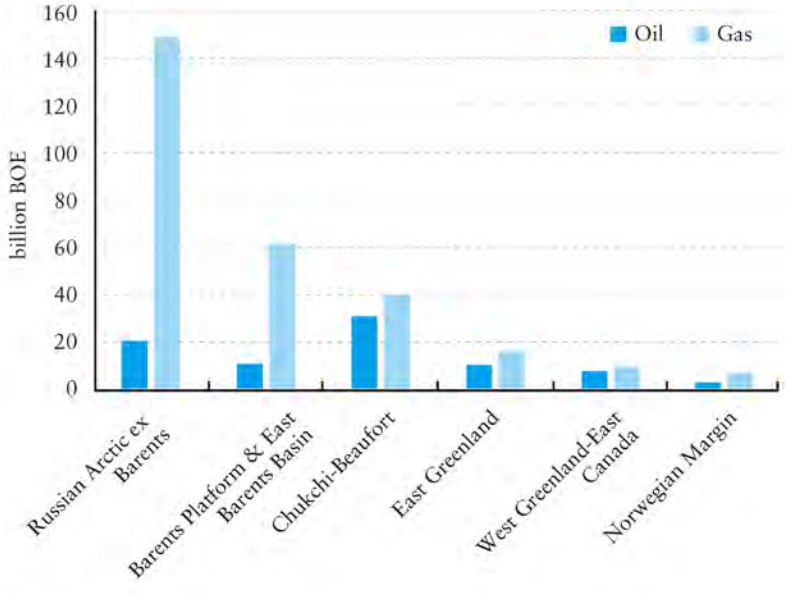
projects, which are estimated in the range of $7-12/MBtu (including both production and transportation costs).[1]

This commonly held opinion seems to be shortsighted. In the longer-term perspective up to 2030/2040, the prospects for new Arctic gas production and for gas prices still remain quite promising under various scenarios for international climate policy development (Figure IV.7). This projection assumes that gas demand will continue to increase in the non-OECD economies, and a number of technological innovations will result in cost reductions for the next generation of Arctic projects.

These considerations are especially important for Russia, which has the largest Arctic gas resources in the world, as well as extensive experience in developing challenging onshore projects in this region. It also has the most developed gas production and transportation infrastructure in the Arctic. As the current cyclical oversupply is ultimately absorbed, gas prices are expected to return back into the range of $9-12/MBtu in Europe and in Asia by 2030.[2] The two main drivers of Russian Arctic gas development, then, are expectations of rising prices, combined with the need to demonstrate economic activity in the Arctic in order to preserve Russia's status as an important Arctic power.

The geography of Russia's Arctic regions is extensive, covering more than half of the total Arctic Ocean coastline. According to USGS estimates, the West Siberian shelf alone contains 32% of total Arctic hydrocarbon resources, while other Arctic regions in Russia account for another 26%, bringing the country's overall share to 58% (Figure IV.8).[3] Interestingly, as Henderson (2014) points out, of the potential Russian Arctic resources, more than half is located in the West Siberian basin and, equally important, almost 80% is gas.[4] That leaves 50 billion bbls of potential oil resources, and underscores the high probability of finding gas in new, unexplored areas. Given this geographical spread and resource availability, it is little surprise that the Russian government regards Arctic gas as an instrument of huge domestic and geopolitical importance.

From 2009-2013, the Russian government invested considerable resources into hydrocarbon development in the Arctic region. That clearly made sense in a high-price environment, especially since output in the core regions of West Siberia and European Russia continues to gradually decline and needs to be replaced in order to maintain total production volumes and budget revenues. According to the "Energy Strategy of the Russian Federation up to 2030"[5] which is the document setting out Russian energy



Source: USGS, 2008.

Figure IV.8 Arctic Oil and Gas Resources

policy, one of the most important strategic initiatives of the government in the energy industry is the "Exploration of the Arctic continental shelf and northern regions, which should help stabilize oil and gas production after a possible downturn in the traditional producing areas of Western Siberia in 2015-2030."[6]

From 2011-2013, the government provided a number of inviting fiscal incentives for companies to foster exploration and production activities in the Arctic, including unlimited Mineral Extraction Tax (MET) and export duty exemptions as well as property tax and amortization holidays.

Driven by this state policy, several large-scale projects were initiated between 2008-2013: apart from the Yamal mega-project lead by Gazprom and Prirazlomnoe lead by Gazprom Neft, they also include several huge international projects which were initiated in partnerships with the Western majors: Shtokman (Gazprom, Total, Statoil); Yamal LNG (Novatek, Total); joint ventures between Rosneft and ExxonMobile; and ENI and Statiol for Kara, Barents and Okhotsk Seas exploration. At that time, expectations

of the Russian authorities were very optimistic. In the beginning of 2014 President Vladimir Putin himself has emphasized that, "Russia intends to increase its influence in the Arctic and that one important way to do this is through the exploitation of its hydrocarbon resources in the region."[7]

But with the rapid deterioration of the relationship between Russia and the West after the Crimean referendum led to the introduction of international sanctions against Russia, all of the Arctic oil projects, which are the main target of the sanctions, were suspended. One result was to raise the profile of natural gas in the Russian Arctic. International sanctions are not only restricting technology transfer, but even more importantly, they limit the ability of Russian companies to attract international financing for capital-intensive Arctic projects, while Russian domestic financial markets remain very weak.

This fundamental geopolitical change in Russia's relations with the West was aggravated by dramatic changes in global energy markets over the last couple of years. These changes came as a big surprise for many traditional producers, including Russia. The shale gas revolution, coupled with an energy demand slowdown in Europe and the introduction of new market competitors (especially the rapid expansion of the LNG industry) combined to limit Russia's gas export niche and force the Russian authorities to review their vision of gas market futures. One result was to make much more modest projections, both in terms of future export prices and volumes.[8] Expectations of high gas export growth rates, similar to those observed in 2000-2008, are gone. Moreover, massive investments, which were made during the high stage of the price cycle, are now resulting into huge stranded gas production capacities in Russia. In 2015-2016, according to Gazprom, the capacity of these stranded sites is estimated at 150-170 bcm.[9]

Furthermore, Rosneft and Novatek have extremely ambitious plans for gas production expansion. This means that by 2020 the potential excess gas production capacities in Russia could reach up to 260 bcm—nearly twice current Russian gas export volumes to Europe (Table IV.6).

Given this situation, any new gas investments in the Russian Arctic sector face huge challenges: there is simply no market for this gas in the time horizon prior to 2025. Nor are there any viable financing options or new technologies available. Although this paints a pessimistic picture, some bright spots remain.

Table IV.6 Under-Unutilized gas Producing Capacities in Russia (Unit: bcm)

Company	Production in 2015, bcm	Unutilized Potential and Capacities Additions under Development by 2020, bcm
Gazprom	406	~155
Novatek	52	~48
Rosneft	42	~48
VIOCs (APG)	46	~15
TOTAL	635.5	266

Source: Author

DEVELOPMENT OF RUSSIAN ARCTIC GAS RESOURCES, COSTS AND FINANCIAL CONSIDERATIONS

The Russian Arctic territory is so vast that it cannot be considered as a homogenous region for the purpose of this analysis. There are many different definitions of the "Arctic," including "north of the Arctic Circle (66° 33'N)" (see dotted line on the Map 1). Some scientists define the Arctic as the area north of the arctic tree line (green line on the Map 1), where the landscape is frozen and dotted with shrubs and lichens. Other researchers define Arctic based on temperature. Using this definition, the Arctic includes any locations in high latitudes where the average daily summer temperature does not rise above 10 degrees Celsius (50 degrees Fahrenheit).

Depending on the definition of "Arctic," the Urengoy, Yamburg, and basically the whole traditional Nadym-Pur-Taz area (blue zone on Map 2), which collectively provide nearly 85% of the current Russian gas output, could be regarded as being part of the Arctic. Russian companies have produced huge volumes of gas in this area for several decades. It is the heart of the Russian gas industry, with rather low costs of production ($0.3-1/MBtu), and utilizing predominantly Russian technologies. Gas transportation infrastructure is already in place here and has been amortized already—so there is no doubt that gas production in this area will continue in any price environment.

Bovanenkovo (Gazprom) and South-Tambei (Novatek) gas fields in Yamal also belong to this grouping, where major investments are completed, and lifting costs are not really high ($1.4-1.6/MBtu). Transportation costs are higher than in Nadym-Pur-Taz, but these are sunk costs as well; the Bovanenkovo-Ukhta pipeline is built already, while

Source: https://nsidc.org/cryosphere/arctic-meteorology/arctic.html

Figure IV.9 Map 1 – Three Definitions of the Arctic: the Tree Line; the 10 Degrees Celsius Isotherm, and the Arctic Circle at 66° 34' North

Yamal-LNG plant is 60% completed.[10] These fields will also produce under almost any price scenario. Taken together, it is clear that for the foreseeable future, the bulk of Russian gas production and exports will still be coming from the Arctic.

The area of Sakhalin and Sea of Okhotsk (green zone on Map 2) is another area that could be considered as "Arctic-like." At least in the justifications of U.S. sanctions, the Yujno-Kirinskoe field was regarded as Arctic (with regard to sanctioned technologies) due to the severe climate

Source: Author

Figure IV.10 Map 2 – Different Zones in the Russian Arctic

conditions. In this part of the Russian offshore, new gas developments are also looking rather attractive due to the market proximity and existing LNG and pipeline infrastructure. Still, the issue of sanctions might prevent Western companies from participation in new project development.

With this in mind, only the third, red zone on Map 2 (including the Barents and Kara Sea, as well as Ob-Taz Bay offshore development) is actually challenged by the new price and geopolitical environment. Some of the projects have been officially postponed (e.g. Shtokman). Others are formally still ongoing (for example, Rosneft's exploration in Kara Sea), but mainly to demonstrate Russia's activity in the region rather than as realistic commercial projects. The new offshore projects in this area are associated with high production costs (above $3/MBtu), high transportation costs ($3-5/MBtu), and also numerous technological, economic and environmental uncertainties and risks. The Shtokman gas field, which has been indefinitely postponed due to worsening gas market conditions and high costs, would still remain pertinent for any discussion of gas fields located in the high latitude offshore regions of Russia.

The two key factors that will define future Russian gas development in the Arctic are investment and technology availability. Even for the comparatively simple on-shore Arctic gas projects, the required investment is impressive: up to $120 billion for the Yamal mega-project, $27 billion for

Yamal-LNG (and potentially the same for doubling liquefaction capacities in Novatek's Arctic-LNG project). Most of these investments incurred significant delays compared to the initial plans and schedules, which seems to be a common trend in this complicated and challenging area. Some of these projects have huge infrastructure components, which makes delays understandable: operators have to develop their production in remote frontier areas where no infrastructure exists at all. Once they decide to engage in a project, they have also to build all the infrastructure necessary for its implementation.

In the current geopolitical climate, the future involvement of the international majors in the Russian Arctic is becoming increasingly questionable, as all the technologies for Arctic offshore drilling and production are subject to sanctions by the United States and by the European Union. Attracting international financing for these projects is also affected by the sanctions, while both the Russian domestic financial market and the capital investment capabilities of the energy companies are very limited. Now, it seems that only internal financial resources and/or loans from Russian financial institutions and Chinese banks are becoming the major sources of financing for Russian Arctic projects. As a result, without any official termination or moratorium, some of the projects are already being effectively postponed. In several of the most critical cases, the government is directly subsidizing "strategically important projects" out of the National Welfare Fund (NWF). However, it is very difficult to understand the criteria for these decisions; for example, only the Yamal-LNG project run by Novatek managed to receive 150 billion rubles from the NWF.[11]

Geopolitical isolation has changed the list of potential partners for Russian Arctic development. In December 2014 president Putin invited Indian companies to participate in the Arctic offshore gas production and LNG development.[12] This call for cooperation did not have any real outcome. Two years later, in June 2016, Russian Foreign Minister Sergey Lavrov extended an official invitation to potential Chinese partners.[13] In 2014 many in Russia had been confident that the Chinese would flock to take advantage of Russia's rift with the West by buying up assets, issuing loans, and sharing technologies.[14] Russian companies were looking to China for equipment, supplies, and financing. But 2015 brought a more sobering reality. From the financial side, China was quite cautious, preferring not to challenge its relationship with the United States. This

was a huge disappointment for the Russian government, but in 2016 the situation started to improve. Novatek's Yamal LNG received Chinese financing, starting with a small loan of €730 million that came from the Silk Road Fund following the announcement of the equity deal.[15] But after that, a significant delay occurred as negotiations concerning other Chinese financing were continually extended, with numerous missed deadlines. This meant that the Yamal LNG partners had to supply $12.5 billion of equity financing,[16] augmented by a $2.3 billion loan from Russia's National Welfare Fund.[17] Chinese backing finally materialized at the end of April 2016, with two institutions (China Development Bank and China Eximbank) offering two 15-year loans, one of €9.3 billion and one for Yuan 9.8 billion (€1.3 billion).[18] When added to the €3.6 billion credit line offered by two Russian banks, (Sberbank and Gazprombank),[19] the project has now secured the $20 billion in project financing that was initially targeted, and seems set to proceed on schedule. However, it is also clear that China has extracted additional value from the deal by ensuring that a significant amount of Chinese equipment will now be used on the project. It has been reported that as much as 70-80% of the equipment modules are being constructed in Chinese shipyards. Although it seems that the major LNG technology is still coming from the United States, it is also now apparent that Chinese financing has ensured that much of the remaining work will be done by Chinese companies.[20]

CONCLUSIONS

The new political and economic environment is posing serious obstacles for the future of some Russian Arctic gas projects. The majority of the "High Arctic" offshore projects will be most likely postponed. This may not be a tragedy, since further exploration and research activity is needed in the Arctic in the coming decades in order to prepare for hydrocarbon production in a safe, sustainable and commercially efficient way. It seems that oil and gas companies still have a long way to go to ensure that resource extraction can be viable economically and occur safely while protecting sensitive Arctic ecosystems.

On the other hand, onshore production in the traditional Nadym-Pur-Taz and even on the Yamal Peninsula is commercially viable and safe, so they are likely to continue despite market conjuncture and geopolitical

tensions.

In conclusion, new conditions have instilled a much more cautious attitude on the part of gas producers concerning their investment decisions, as well as much stricter cost control. Under the circumstances, the importance and potential for technological innovation that increases safety and reduces costs in Arctic natural gas production and transportation cannot be overestimated.

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The Role of Arctic Gas in Sino-Russian Political and Economic Relations

Yang Jian

Sino-Russian cooperation in the field of Arctic energy had caused widespread concern, largely due to two factors: Firstly, because of the Crimea issue and the Ukraine crisis, Western countries imposed a series of severe economic sanctions on Russia that began in 2014. As a consequence, Russia does not have access to technology, markets and capital it needs from the United States and other Western countries to support its Arctic energy development plans. Will China, which is not a party to the sanctions but remains one of the most important world economies with both available capital and a large potential market, use this opportunity to participate in Russian Arctic development projects without international competition? Would China's choice to partner with Russia cripple the effect of the sanctions against Russia? Additionally, would China's cooperation in the Arctic be seen as a sign that the Sino-Russian strategic coordination partnership is strengthening? Would these new Sino-Russian relations lead to a new alliance bloc?

THE DEVELOPMENT OF SINO-RUSSIAN POLITICAL AND ECONOMIC RELATIONS: BACKGROUND AND MOTIVATION

In 2016 we witnessed the further improvement of Sino-Russian relations. The increasing mutual trust between the top leaders of China and Russia provides political support for more bilateral economic cooperation and policy coordination in the international arena. The two economies are complementary in many ways, and combined with this accumulated foundation of political good will, are both driving forces that promote greater economic cooperation. Ultimately, Western countries' sanctions and containment policy are providing an external force to promote a closer strategic partnership between China and Russia.

Russian President Vladimir Putin paid a state visit to China on June 25, 2016. Chinese President Xi Jinping and his Russian counterpart agreed to

beef up mutual support and enhance political and strategic mutual trust. They vowed to steadfastly deepen their comprehensive strategic partnership and coordination, and to provide more mutual political support.

Even though the two countries have not formed a formal alliance, the two leaders agreed that the two countries should more closely coordinate on major international and regional issues, in order to jointly safeguard the security of the region. The two countries are ready to extend mutual support and understanding on issues concerning each other's core interests and major concerns. China and Russia have vowed to resolutely safeguard the purposes and principles of the UN Charter, basic norms of the international relations, global strategic balance and stability, as well as international justice.

Putin called for more cooperation in trade, energy, high technology and people-to-people exchanges, as well as supporting the construction of the Eurasian Economic Union (EEU) and the Belt and Road Initiative. Xi Jinping said the two countries should deepen pragmatic cooperation and alignment of interests, and assist each other in dovetailing the Belt and Road Initiative and Eurasian Economic Union to promote broader regional economic cooperation, noting that both nations are both major world economies and emerging markets. Xi and Putin also witnessed the signing of more than 30 cooperation deals, covering sectors such as economy and trade, foreign affairs, infrastructure, technology and innovation, agriculture, finance, energy, media, Internet and sports.

When Chinese Premier Li Keqiang met with Putin, Li said that China was ready to align with Russia's EEU strategy and reach institutional arrangements on trade and investment on an early date. He also vowed to expand the scope of energy cooperation in areas such as oil and gas, nuclear energy, coal and electricity. He also spoke about promoting mutual investment and cooperation on large projects, as well as establishing more financial cooperation in currency swaps, payment systems, and within multilateral frameworks.

On December 2015, after the meeting between Chinese Premier Li Keqiang and Russian Prime Minister Vladimir Medvedev, the two countries issued a joint statement to illustrate their support of a comprehensive strategic coordination partnership between the two countries. The statement read, "The two sides stressed that no matter how the international and regional situations change, the two sides will continue to regard strengthening mutual relations as their diplomatic priority; firmly

support each other's efforts to safeguard their respective core interests with respect to national sovereignty, security, and development; improve mutual understanding and friendship between the two peoples; strengthen coordination in international and regional affairs; translate their close high-level political ties into tangible results in practical cooperation and cultural and people-to-people exchanges; and make concerted efforts to address external risks and challenges to national rejuvenation, so as to jointly promote world peace, development, and prosperity." In the joint statement, the two prime ministers showed their willingness for the first time to cooperate in developing the Northern Sea Route (NSR) into a competitive commercial sea route in the future, which indicates that the Sino-Russian cooperation in the Arctic might be undergoing a transition to a more operational phase.

Currently, however, China and Russia are not willing to elevate the relations between the two countries to the alliance level when it comes to security and military issues. As early as 1982, China formulated a policy of not making or joining any alliance with any nation, which it has maintained during its period of rapid development over the last three decades. Maintaining good political and economic relations with the United States, Japan, Europe, Russia, and other countries at the same time is also in line with China's security interests and development interests. That is why China insists that developing a strategic partnership between China and any other country should not be seen as a threat to any third party. China believes that setting and joining any alliance will hamper China's ability to develop and maintain good relations with the rest of the world. China does not expect any conflict between the big powers or the blocs of power that could create an embarrassing situation where China was forced to choose sides. The last thing China wants is for the world to begin a new Cold War.

Both Chinese and Russian scholars believe that forming a military alliance will lead to new risks instead of increased security. Such an alliance would restrict the members from diplomatic independence and freedom. In 2010, Sino-Russian relations were defined as a comprehensive coordination and strategic partnership. This concept absorbs the experiences and lessons of the historical interaction between China and Soviet Union and conforms to the characteristics of each country's social development, as well as various international realities. This strategic relationship has a functional flexibility and a wide range of opportunities for developing concrete policies

in the future. If China and Russia face a common external challenge in the international arena, then this relationship can become closer, while there are no long-term binding mutual obligations. There is no need to form a military alliance between China and Russia. The present relationship is sufficient to help China and Russia meet both external challenges and the needs of strategic coordination.

Since 2014, Western countries have imposed economic sanctions against Russia because of the Ukraine issue. The U.S. has additionally taken a containment policy with regard to China because of the South China Sea issue. These simultaneous actions created the external force that drove China and Russia to establish a closer strategic relationship. But China's strategic research community clearly knows that the strategic alliance between China and Russia does not serve the interests of the United States, nor does it serve the interests of Europe. The United States will eventually react to this development in as-yet uncertain ways.

China will not object to Russia's military deployment in its sovereign Arctic territory. We believe that Russia's military deployment in the Arctic is an expression of Russia's legitimate rights to protect its national interests. From the perspective of Arctic governance, Russian military deployment provides enhanced Arctic governance ability, especially by enhancing the Russian Arctic search-and-rescue capabilities that help to offset the shortcomings of infrastructure and shortages of labor in that region.

FACTS ABOUT SINO-RUSSIAN ENERGY COOPERATION

Energy cooperation in the Arctic region between China and Russia is indeed happening. This cooperation is not specifically part of the framework of China's Arctic policy, but instead fits into the framework of China's multi-channel energy imports. Because Russia designates its Arctic region as its most important energy development base for the future, then it stands to reason that Sino-Russian energy cooperation obviously extends to the Russian Arctic region. The most important decisions related to energy cooperation in the Arctic were made at the bilateral level. With the support from both governments, specific oil companies from both sides negotiated agreements in accordance with each country's respective interests. The important Arctic policy makers, including the relevant agencies affiliated with the Ministry of Foreign Affairs and the State Oceanic Administration,

were not involved in the negotiations.

In May 2015, leaders of the two countries signed a landmark Sino-Russian joint statement, which read in part: "The two sides will continue to find common ground for promoting regional economic integration within their respective economic initiatives, the Silk Road Economic Belt and the Eurasian Economic Union, to ensure sustainable growth in the Eurasian region while strengthening mutual trust and cooperation on the basis of equality." The statement also "committed to opening up a common economic space."[1]

In the long term, Sino-Russian cooperation in the Arctic aligns with the interests of China's development. Firstly, Sino-Russian cooperation in the Arctic is complementary to both countries' economies. Russia's Arctic energy and NSR development are activities with global significance that can drive the social and economic development in the region and also be conducive to promote world trade. Such development projects need capital and technology investment, and Chinese capital is currently evaluating suitable projects all over the world. The cooperation incorporates commitments from each side to realize common development. Secondly, China's aspiration for sustainable development and environmental ecological security leads to higher demand for oil and natural gas imports from Russia. Establishing a long-term stable arrangement for oil and gas supply is in line with China's national interests. Thirdly, the exploitation of oil and gas resources in the Arctic Ocean is accompanied by the construction of the NSR. For China, the value of this Arctic sea route will continue to increase with the further exploitation of Arctic oil and gas resources as well as normal business shipping in the NSR.

China's Arctic energy cooperation with Russia also presents some difficulties: first, because of the fragile ecosystem and harsh climate conditions, the standards in labor safety, human health and environmental protection for economic activities in the Arctic region are very high and strict. China's related enterprises lack experience in exploiting oil and gas in the Arctic region. In addition, the Russian Arctic region lacks sound infrastructure to carry out Arctic economic development. In 1990s, due to the collapse of the Soviet Union and a lack of sufficient financial support, the main infrastructure, especially transportation, industrial and energy infrastructure, were almost paralyzed and became inoperable in some instances. The Arctic shipping system built by the Soviet Union was destroyed, and reconstruction work is arduous. Furthermore, Russia's

poor economic performance, combined with the global oil price collapse and Western economic sanctions, make it more difficult to calculate the investment returns from Russian oil and gas projects.

The Sino-Russian energy cooperation committee established in 2008 is responsible for the negotiations and dialogue in the field of energy cooperation. By the end of February 2016, the Committee had held 12 meetings of the representatives led by the deputy prime ministers of both parties.

Sino-Russian energy cooperation has achieved many positive results. In November 2010, a Sino-Russian crude oil pipeline started its trial operation. After 15 years of negotiations, the Sino-Russian oil pipeline supply agreement on the East Siberia-Pacific China branch oil pipeline was finally signed in September 2012. According to the agreement, Russia will export of 1500 tons of crude oil annually through the pipeline to China in the coming 20 years. On March 22, 2013, President Xi and President Putin signed a joint statement in Moscow, hailing this mutually beneficial cooperation. The two sides reached a series of consensus agreements to increase crude oil supply to China, including the construction of a natural gas pipeline, an agreement for China to import LNG from Russia, and a construction joint venture to build refineries, factories, and other projects. In the same year, PetroChina joined the largest natural resources project in the Russian Arctic region, the Yamal liquefied natural gas project, by purchasing shares of it, which became the prelude of the North Sino-Russia energy cooperation in the Arctic region. On May 21, 2014, Chinese and Russian governments signed a memorandum on a Sino-Russian joint project for gas supplies in China's eastern region. China National Petroleum Corporation and Gazprom also signed a related contract. According to the memorandum and the provisions of the related contract, Russia will provide 38 billion cubic meters of natural gas per year to China through gas pipelines, beginning in 2018. The contract will last for 30 years and the annual highest projected supply will reach 60 billion cubic meters.

According to Russia's 2030 energy strategy, by 2030 Russia's oil output will reach 535 million barrels, of which 330 million barrels will be for export. Natural gas annual production capacity will reach 940 billion cubic meters, with 368 billion cubic meters of natural gas for export. At that point, Russia will increase its exports of oil and gas to East Asian countries, including China, Japan, Korea and other Asia-Pacific countries. Exports of oil and petroleum products to East Asia will increase from 6% to 22-25%;

the export share of natural gas will increase from 0% to 19-20%.[2]

The Yamal LNG project is one of the world's largest natural gas exploration and development projects. This project, which Putin has emphasized, is Russia's key project for its Arctic development strategy. In general, the Russian federal government provides financial support to major energy resource projects. The Sabetta airport, which services gas fields in Russia's far north, is built by means of public-private partnership led by the government. The Yamal LNG project includes a set of other projects, including gas field development and liquefied natural gas production, transportation, trade, financing, and upstream and downstream integration. The most important one is the construction of a large liquefied gas factory and the port of Sabetta. According to the plans, the project will include construction of a liquefied natural gas plant with three production lines and annual output of 27 billion cubic meters. LNG plant construction will be completed and put into production in 2017. The LNG products will be exported to the Asian and European markets via the NSR.

The Yamal LNG project will run for at least 35 years. According to the contract, 27% of the Yamal liquefied gas will be exported to China, 36% exported to other Asia-Pacific countries, and about three million tons of product will sold to the Indian market. In order to guarantee LNG transportation to the Asian market, Nova Tektronix Inc. will be equipped with two nuclear-powered escort icebreakers.

In January 2014, the China National Petroleum Corporation (CNPC) acquired a 20% stake in the project. After the completion of the transaction, the Russian company Novatek holds 60% of the shares in the Yamal LNG project, and the French oil company Total holds a 20% stake, while CNPC holds 20% of the shares. In December 2015, China Silk Road Fund and Nova Tektronix Inc. signed an equity transfer agreement of the Yamal project of 9.99% of the shares. Silk Road Fund became the fourth equity holder after Novatek (50.1% stake), France's Total (20% stake) and CNPC (20% stake). Within the framework of this transaction, Novatek will also receive loans from Silk Road Fund for a period of 15 years for project financing. In July 2016, the Yamal LNG project received €0.78 billion from two Chinese banks, China EximBank and China Development Bank. Over the next 15 years these two Chinese banks will provide the Yamal project loans with a credit line of €93 billion and 98 billion Chinese yuan. The loan contract signed with the Chinese banks guarantees the source of external funding necessary for the project, and enables the project

to be implemented in accordance with the approved agenda. The agreement with the Chinese banks makes it possible to carry out the project without attracting additional funds from shareholders.

FACTORS AFFECTING SINO-RUSSIAN ARCTIC ENERGY COOPERATION

The first factor that affects Sino-Russian Arctic energy cooperation is the fact that each country has different views on market price principles. In March 2008, during the first meeting between China and Russia energy negotiators, the Chinese side proposed that Sino-Russian energy cooperation should adhere to three principles: the principle of comprehensive and long-term cooperation; market price principles; and mutual benefit (a "win-win" principle). The most important one is the market price principle, as price is always the core issue of project negotiations. The two sides have different understandings and judgments on how to define "market price principle." A lot of cooperative projects between China and Russia in the field of energy have been postponed or abandoned because of failure to reach agreements on prices.

The second factor is the lack of mutual understanding and policy communication between the two sides. In establishing energy cooperation, the two sides should strive to understand each other's energy development planning, policies, laws and regulations, taxation, market status, and trends. Taking each other's interest into consideration will contribute to successful cooperation. At present, the understanding of the two energy administration authorities of each other's energy development planning and industrial policy is not sufficient. As for business leaders, their understanding about each other's social and economic development, investment environment, and market research is also insufficient. This lack of shared understanding will create negative impacts on decision making and the timing of cooperation.

The third factor is that Western countries' sanctions also have a negative impact on China's investment and project cooperation with Russia. The current unstable political and economic situation has made the Russian market less appealing to some Chinese companies. The ruble's decline against main world currencies, the plunge in the world oil prices, and the economic sanctions imposed by Western countries collectively

contribute to a decline in the Chinese private sector's willingness to invest in Russia.

China's economy is experiencing its most important structural adjustment since the reforms and opening-up policies that started more than thirty years ago. The Chinese government began to emphasize a new model of development and concepts, including innovation, attention to environmental issues, coordination, openness and sharing. On the one hand, China will maintain its huge demand for raw materials and energy. In recent years, China's dependence on crude oil from foreign countries increased annually. In 2015, China became the world's largest oil importing country, depending on 60% of its demand from foreign sources. In the field of energy resources, there is a great advantage of recognizing complementary goals between China and Russia, and there remains great potential for further cooperation. On the other hand, China's new round of development places a higher strategic priority on a more diversified and specific demand from overseas energy markets. These factors will greatly affect the trend of cooperation between China and Russia in the Arctic energy sector.

Maintaining the secure supply of natural gas will be the most important part of China's energy security. Russian oil and gas resources have become an important consideration in the diversification strategy of China's energy imports. Strengthening energy cooperation between China and Russia in the field of oil and natural gas is one of the important components of the development of a comprehensive strategic coordination partnership between China and Russia. The steady supply of Russia's natural gas in the future will meet the needs of China's economic development and environmental protection, whenever the global economy moves towards prosperity again. At present, the low level of oil prices is good news for China. The adjustment of China's economic structure itself contributes to the decline of oil prices. China's access to energy sources from the global market is now more diversified.

There is a huge demand in Russia for sophisticated, multi-functional and digitalized equipment that can improve productivity. Russian manufacturers are unable to produce these by themselves due to the lack of related know-how and technologies. Russia also clearly understands that no matter what happens in the development of Arctic energy or the large-scale commercial use of the northern sea route, it will benefit from global economic prosperity and major Western economies in terms of technology,

market and financial support. They are more convinced that Western companies possess better technology than Chinese companies. Russia's expectations for China, then, are temporary. It is likely that, as the world energy markets and international political situation continues to evolve, this nascent Sino-Russian cooperation will be subject to dynamic revision in the coming years and decades.

After participating the Arctic energy project, China will evaluate its experience and wait for new imput instead of being immediately eager to expand. China understands from its own historical process of opening its markets to attract foreign investment that the further opening of the Russian market is an inevitable trend. In the process, two economic systems and two sets of technical standards will gradually be resolved. The gap in technical level between Russia and the developed economies of the world will be narrowed. In the short run, as global oil prices declined, economic interaction between Western countries and Russia was reduced as a result of economic sanctions. Investment in the Russian Arctic region is not likely to deliver profits in the short term. For China, more opportunities in Russian Arctic energy projects will emerge only when more enterprises, especially Western companies, return to the Russian Arctic. Only then will China's current investment strategy reveal its long-term significance.

The strategic partnership between Russia and China provides a good foundation for the present and future cooperation in the Arctic region of Russia. Russia has been worried about China's involvement in the Arctic, and new global realities have forced the Russian government to re-evaluate. The initiative to cooperate with China in the field of Arctic resources and infrastructure is an opportunity for China. China should fully understand the difficulty, challenging requirements, and strategic significance of Sino-Russian Arctic cooperation. We should identify and carry out cooperation in the field of Arctic resources, NSR and scientific investigation at the national level, to avoid the chaos of the border trade in the early 1990s.

In considering Sino-Russian cooperation in the Arctic, we should abide by the following principles: First, invest according to our capabilities. The investment in the early stage of Russian Arctic development should focus on the overall plan, and be implemented in stages; second, it is important to understand and grasp the policy changes and development trends in the Arctic region in a timely manner, to avoid any losses caused by blind investment and any potential crisis of confidence or trust.

Bilateral cooperation leads to multilateral cooperation. While China

and Russia strengthen their Arctic bilateral cooperation, we should actively explore opportunities for cooperation with the United States, Canada, Norway and other members of the Arctic Council, and communicate with other Asia Pacific countries such as Japan, Korea, and India. The significant progress in the Sino-Russian bilateral cooperation in the Arctic will promote the Arctic's peaceful development and international cooperation. Good multilateral cooperation will be conducive not only to deepening the Sino-Russian bilateral cooperation, but also to the healthy development of the governance of the entire Arctic.

Notes

1. Joint declaration of People's Republic of China and Russian Federation on the construction of the Silk Road Economic Zone and the construction of the Eurasian Economic Union., *People daily*, May 9, 2015.
2. Энергетическаястратегияроссиинапериоддо2030 года http://www.minenergo.gov.ru/activity/energostrategy/

The Korea Maritime Institute (KMI) is a government-affiliated research organization under the umbrella of the National Research Council for Economics, Humanities and Social Science (NRC) in the Republic of Korea. Since its establishment in 1984, KMI has been a major think-tank in the development of national maritime and fisheries policies including shipping and logistics, port development, coastal and ocean management, maritime safety and security, and fisheries affairs.

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ISBN 978-89-7998-135-3