

Appendices



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**The Secretary of Energy**

Washington, DC 20585

October 25, 2013

Mr. James T. Hackett
Chairman
National Petroleum Council
1625 K Street, NW
Washington, DC 20006

Dear Mr. Hackett:

Building the foundation for a clean energy economy will require unprecedented actions by industry and government to strengthen the nation's oil and natural gas infrastructure, tackle the issues of climate change, and protect our environment. To provide useful input into upcoming policy decisions, I request that the National Petroleum Council undertake strategic, short term studies on three topics: *Natural Gas and Oil Infrastructure Resilience*, *Maximizing the Climate Benefits of Natural Gas*, and *Arctic Research*.

Natural Gas and Oil Infrastructure Resilience. Superstorm Sandy, wildfires and floods have underscored the importance of having resilient oil and natural gas infrastructure and effective ways for industry and government to communicate to address energy supply disruptions. Key questions to be addressed on this topic include:

- What vulnerabilities have recent storm activity exposed in US energy infrastructure?
- What legal, procedural, and physical gaps need to be addressed by industry and government to improve response to disruptions?
- What strategies should be pursued to increase energy system resilience to storms and other potential disruptions?
- What actions can be taken to address the interdependencies between oil and natural gas systems and other critical infrastructure?

Maximizing the Climate Benefits of Natural Gas. The vital role that domestic natural gas resources are poised to serve in a clean energy economy will hinge on maximizing the climate benefits of increased natural gas use. Key prerequisites will include gaining a better understanding of the extent of methane leakages in the natural gas value chain from the well head to the consumer, as well as focusing attention on reducing these leakages. Key questions to be addressed on this topic include:

- What technologies and practices can be adopted or further developed to improve the detection and measurement of methane emissions from natural gas systems?
- What technologies and practices can accelerate reductions in methane leakage in natural gas systems?



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Arctic Research. A core component of the Administration's National Strategy for the Arctic Region released in May 2013 includes responsibly developing Arctic oil and gas resources to ensure energy security. In 2015 the United States will assume chairmanship of the multi-nation Arctic Council. The National Petroleum Council's input would be invaluable to assist us as we explore:

- What research should the Department of Energy pursue and what technology constraints must be addressed to ensure prudent development of Arctic oil and gas resources while advancing U.S. energy and economic security and ensuring environmental stewardship?

For the purposes of these studies, I am designating Deputy Secretary Daniel Poneman to represent me. He will provide the necessary coordination between the Department of Energy and the National Petroleum Council and oversee the Department's engagement. Acting Assistant Secretary Christopher Smith is the Designated Federal Official for this advisory committee and he will work with Deputy Secretary Daniel Poneman and the Council staff to identify leads for each of the studies. I understand that dialogue between the Department and the Council may be necessary to further define the scope of the studies.

Sincerely,

A handwritten signature in black ink, appearing to read 'Ernest Moniz', written over a light gray rectangular background.

Ernest Moniz

DESCRIPTION OF THE NATIONAL PETROLEUM COUNCIL

In May 1946, the President stated in a letter to the Secretary of the Interior that he had been impressed by the contribution made through government/industry cooperation to the success of the World War II petroleum program. He felt that it would be beneficial if this close relationship were to be continued and suggested that the Secretary of the Interior establish an industry organization to advise the Secretary on oil and natural gas matters. Pursuant to this request, Interior Secretary J. A. Krug established the National Petroleum Council (NPC) on June 18, 1946. In October 1977, the Department of Energy was established and the Council was transferred to the new department.

The purpose of the NPC is solely to advise, inform, and make recommendations to the Secretary of Energy on any matter requested by the Secretary, relating to oil and natural gas or the oil and gas industries. Matters that the Secretary would like to have considered by the Council are submitted in the form of a letter outlining the nature and scope of the study. The Council reserves the right to decide whether it will consider any matter referred to it.

Studies undertaken by the NPC at the request of the Secretary include:

- *Enhancing Emergency Preparedness for Natural Disasters* (2014)
- *Advancing Technology for America's Transportation Future* (2012)
- *Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources* (2011)
- *Facing the Hard Truths about Energy: A Comprehensive View to 2030 of Global Oil and Natural Gas* (2007). *One Year Later: An Update On Facing the Hard Truths About Energy* (2008)
- *Observations on Petroleum Product Supply* (2004)
- *Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy* (2003)
- *Securing Oil and Natural Gas Infrastructures in the New Economy* (2001)
- *U.S. Petroleum Refining – Assuring the Adequacy and Affordability of Cleaner Fuels* (2000)
- *Meeting the Challenges of the Nation's Growing Natural Gas Demand* (1999)
- *U.S. Petroleum Product Supply – Inventory Dynamics* (1998)
- *Future Issues – A View of U.S. Oil & Natural Gas to 2020* (1995)
- *Research, Development, and Demonstration Needs of the Oil and Gas Industry* (1995)
- *Marginal Wells* (1994)
- *The Oil Pollution Act of 1990: Issues and Solutions* (1994)
- *U.S. Petroleum Refining – Meeting Requirements for Cleaner Fuels and Refineries* (1993)
- *The Potential for Natural Gas in the United States* (1992)
- *Petroleum Refining in the 1990s – Meeting the Challenges of the Clean Air Act* (1991)
- *Industry Assistance to Government – Methods for Providing Petroleum Industry Expertise During Emergencies* (1991).

The NPC does not concern itself with trade practices, nor does it engage in any of the usual trade association activities. The Council is subject to the provisions of the Federal Advisory Committee Act of 1972.

Members of the National Petroleum Council are appointed by the Secretary of Energy and represent all segments of the oil and gas industries and related interests. The NPC is headed by a Chair and a Vice Chair, who are elected by the Council. The Council is supported entirely by voluntary contributions from its members.

Additional information on the Council's origins, operations, and reports can be found at www.npc.org.

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Appendix B

Study Group Rosters

STUDY PARTICIPATION

Study group participants contributed in a variety of ways, ranging from full-time work in multiple study areas, to involvement on a specific topic, or to reviewing proposed materials. Involvement in these activities should not be construed as endorsement or agreement with all the statements, findings, and recommendations in this report. Additionally, while U.S. government participants provided significant assistance in the identification and compilation of data and other information, they did not take positions on the study's policy recommendations.

As a federally appointed and chartered advisory committee, the National Petroleum Council is solely responsible for the final advice provided to the Secretary of Energy. However, the Council believes that the broad and diverse study group participation has informed and enhanced its study and advice. The Council is very appreciative of the commitment and contributions from all who participated in the process.

This appendix lists the individuals who served on this study's Committee, Coordinating Subcommittee, and Subgroups, and participated in the study's technology workshops, as a recognition of their contributions. In addition, the National Petroleum Council wishes to acknowledge the numerous other individuals and organizations who participated in some aspects of the work effort through outreach meetings or other contacts. Their time, energy, and commitment significantly enhanced the study and their contributions are greatly appreciated.

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* Replaced Daniel B. Poneman.

** Replaced Paolo Scaroni.

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Drue Pearce	Senior Policy Advisor	Crowell & Moring LLP

* Replaced Robert Swenson.

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**ALASKA TECHNOLOGY WORKSHOP –
FAIRBANKS, ALASKA, NOVEMBER 11, 2014**

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Ken Johns	Chief Operating Officer	Cully Corporation
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Doreen Lampe	Executive Director	Inupiat Community of the Arctic Slope
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Bill Maddock	Arctic Engineering and Technology Coordinator	BP
Patrick Mekiana	Director	Nunamiut Corporation, Inc.
Mark C. Moyer	Drilling Technical Manager	ExxonMobil Development Company
Mark D. Myers	Commissioner Alaska Department of Natural Resources	State of Alaska
John F. Payne	Executive Director, North Slope Science Initiative Co-Lead Circumpolar Biodiversity Monitoring Program Bureau of Land Management	U.S. Department of the Interior
Drue Pearce	Senior Policy Advisor	Crowell & Moring LLP
Lori Polasek	Marine Mammal Scientist, Science Department	Alaska SeaLife Center
James P. Poplin	Technical Advisor, Pt. Thomson Project	ExxonMobil Development Company
Kristin Ryan	Director, Spill Prevention and Response Alaska Department of Environmental Conservation	State of Alaska
Courtney Sanborn	Special Projects Coordinator	University of Alaska
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William Schnabel	Interim Director, Institute of Northern Engineering	University of Alaska
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ALASKA TECHNOLOGY WORKSHOP

James A. Slutz	Senior Study Coordinator	National Petroleum Council
Bert Stedman	Immediate Past Chairman	The Energy Council
Betty Swan	Chairperson	Cully Corporation
Richard Ungarook, Sr.	Corporate Secretary	Ukpeagivik Inupiat Corporation
Peter K. Velez	President	Peter Velez Engineering LLC
Donald A. Walker	Professor, Department of Biology and Wildlife Institute of Arctic Biology	University of Alaska
Mitchell M. Winkler	Arctic Technology Program Manager, Projects and Technology	Shell International Exploration & Production Inc.

Appendix C

Study Recommendations by Type

The recommendations in the Executive Summary of this report, *Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources*, are discussed by three broad themes:

- Environmental Stewardship
- Economic Viability
- Government Leadership and Policy Coordination.

This appendix categorizes the study’s recommendations by type with color coding to assist readers with a particular interest in:

- Research
- Regulatory improvement
- Leadership/policy opportunities.

There are 32 recommendations in the Executive Summary, made up of 13 research, 3 regulatory, and 16 leadership/policy recommendations. In addition to these recommendations, there are an additional 60 research recommendations in the research chapters. These are summarized in the overview sections of Parts Two and Three of the report.

Legend: ■ Lead Agency □ Supporting Agency ● Primary Topic Area ○ Additional Topic Area						
Recommendation	DOE Action	Action by Other Federal Agencies	Potential Coordinating Agencies	Topic Area		
				Research	Regulatory	Leadership/Policy
ENVIRONMENTAL STEWARDSHIP						
Oil Spill Prevention and Source Control						
Industry and regulators should work together with government agencies and other stakeholders to synthesize the current state of information and perform the analyses, investigations, and any necessary demonstrations to validate technologies for improved well control. <ul style="list-style-type: none"> • The benefits and risks of advanced control technologies should be assessed relative to the current practice of a same season relief well. Alternatives include subsea shut-in devices independent of the standard blowout preventer. These alternatives could prevent or significantly reduce the amount of spilled oil compared to a relief well, which could take a month or more to be effective. This assessment should consider the benefits and risks of leaving the well secured using these technologies over the winter season. • DOE should work with industry and DOI to perform this assessment, engaging the National Laboratories, the National Academies, and other stakeholders as appropriate. Assessment techniques could include those used in the nuclear, aviation, and petrochemical industries, such as precursor analysis and Quantitative Risk Assessment, where DOE already has expertise. 	■	■	DOI (BSEE), DOE	●	○	

Recommendation	DOE Action	Action by Other Federal Agencies	Potential Coordinating Agencies	Topic Area		
				Research	Regulatory	Leadership/Policy
<ul style="list-style-type: none"> Future regulation and permit requirements should be informed by the results of this analysis including required demonstrations and testing. DOI, DOE, and the National Laboratories should witness these demonstrations of improved well control devices and include appropriate observers from the stakeholder community. 						
Oil Spill Response in Ice						
<p>Government agencies should participate in the ongoing and future oil spill response Joint Industry Programs. As an example, the ongoing Arctic Oil Spill Response Technology JIP (2012-2016) includes projects to:</p> <ul style="list-style-type: none"> Conduct field testing, using relatively small amounts of oil, to further test the efficacy of tactics and strategies for spill response. Advance remote sensing technology for tracking of spilled oil. Improve and enhance fate and effects models and model inputs for varying sizes of oil spills. Advance research in support of other options to mechanical recovery including dispersants, in-situ burning, and chemical herders. 	■	■	DOI, DOC (NOAA), DOE, DHS (Coast Guard)	●	○	
<p>Regulators should continue to evaluate oil spill response technologies in Arctic conditions, considering past and ongoing research. Future regulations and oil spill response plans should consider this evaluation such that other technologies could be used as primary response options.</p> <ul style="list-style-type: none"> A Net Environmental Benefit Analysis (NEBA)-based decision process should be used collaboratively by government decision-makers with industry assistance to assess and approve all available oil spill response technologies to achieve the greatest reduction of adverse environmental impacts. Preapproval options should be reviewed and provided to facilitate rapid response for dispersants and in-situ burning where supported by NEBA. 	□	■	DOI, DHS (Coast Guard)	●	○	
<p>Consistent with the Oil Pollution Act of 1990, the Interagency Coordinating Committee on Oil Pollution Research (ICOPR) should play a stronger role in conducting, coordinating, prioritizing, and supporting oil spill response research and technology development, across federal and state agencies, with industry and academia, and internationally.</p>	□	■	ICOPR, DHS (Coast Guard), Others	○		●
<p>Recognizing the importance of field trials and the need to coordinate timely permits across multiple agencies (federal, state, local), ICOPR or the new Arctic Executive Steering Committee (AESC) could facilitate a collaborative process to conduct Arctic field oil release experiments.</p>	□	■	DOE (National Laboratories), AESC, ICOPR, Others	○	○	●
<p>The National Laboratories should pursue development of oil simulants to facilitate field testing of oil spill response technologies in lieu of using crude oil.</p>	■	□	DOE (National Laboratories), ICOPR, Others	●		

Recommendation	DOE Action	Action by Other Federal Agencies	Potential Coordinating Agencies	Topic Area		
				Research	Regulatory	Leadership/Policy
Industry and the federal government including the National Laboratories should collaborate to determine if any existing military technology or other research in the area of remote sensing, including satellite access, can be made available and commercialized for oil spill response.	■	■	DOE (National Laboratories), DOD, Others	●		○
Increasing Knowledge of Arctic Ecology and Human Environment						
Trustee agencies, such as U.S. Fish and Wildlife Service and U.S. National Marine Fisheries Service, could execute multi-year population assessment and monitoring of key Arctic species including the Pacific walrus, ice seals, polar bears, and beluga whales.		■	DOI (FWS), DOC (NMFS)	●		
Under its legislative mandate to coordinate scientific data that will provide a better understanding of the ecosystems of the North Slope of Alaska, the North Slope Science Initiative (NSSI) should work with trustee agencies, industry, and other stakeholders to define, develop, and maintain an ecological monitoring program to detect and interpret change in the Arctic ecosystem.	■	■	NSSI, Others	●		
DOE, other governmental entities, the National Laboratories, and the oil and gas industry should execute additional studies of fate and effects of oil under Arctic conditions and upon Arctic species: toxicity of oil, oil residue, and dispersants to key Arctic species, including Arctic cod and plankton, the rate and extent of biodegradation of oil in Arctic environments, and the interactions of oil with under-ice communities.	■	■	DOE (National Laboratories), DOC, DOI, EPA, Others	●		
The federal government, namely the National Marine Fisheries Service, should work collaboratively with industry and other stakeholders to develop a coordinated strategy for industry and government research on interactions between energy development and key species. <ul style="list-style-type: none"> Specifically, the improved understanding of the response of ice-dependent species to specific industry activities (ice management, seismic, drilling, etc.) will inform operational planning and permitting as well as designations and management of critical habitats. The National Marine Fisheries Service should join the Bureau of Ocean Energy Management (BOEM) in participation as an observer in the Sound and Marine Life joint industry program. 	□	■	DOI (NMFS), Others	●	○	○
An updated Social Impacts Assessment protocol is needed to improve consistency and ability to integrate baseline data across agencies, industry, and communities. <ul style="list-style-type: none"> The Department of State, via the Senior Arctic Official and the Arctic Council Sustainable Development Working Group, should update the Social Impacts Assessment protocol, leveraging the state of Alaska's coordinated framework for a Health Impact Assessment, recently developed by the Alaska Department of Natural Resources and Department of Health, in partnership with federal agencies, the Alaska Native Tribal Health Consortium, and local boroughs. 		■	DOS, HHS, CEQ, Others		○	●

Recommendation	DOE Action	Action by Other Federal Agencies	Potential Coordinating Agencies	Topic Area		
				Research	Regulatory	Leadership/Policy
<ul style="list-style-type: none"> The Council for Environmental Quality could include this updated protocol in the existing Environmental Impact Assessment protocol under the National Environmental Policy Act (NEPA). 						
The NSSI's mandate is to provide scientific information on both environmental and social science to its 14 federal, state, and local government members and to the public. Recognizing the importance of improved collaboration and coordination of human environment research activities, enhancement of NSSI capacity and capability in social science should be pursued to enable the NSSI to deliver on its mandate.		■	NSSI, Others	○		●
The NSSI should work with Interagency Arctic Research Policy Committee and other stakeholders to establish appropriate protocols and gather best practices for the effective collection and integration of traditional knowledge, existing science, community engagement, and resource management.	■	■	NSSI, IARPC, Others	●		
Industry, government, and academia should work to establish data sharing agreements and promote use of platforms such as Alaska Ocean Observing System and University of Alaska Fairbanks/NSSI catalog.	■	■	All	●		
ECONOMIC VIABILITY						
Technologies to Safely Extend the Drilling Season						
<p>Industry and regulators should work together with other government agencies and stakeholders to synthesize the current and evolving state of knowledge and perform the analysis, investigations, and any necessary demonstrations to validate technologies and capabilities that could safely extend the useful drilling season length.</p> <ul style="list-style-type: none"> These technologies include recent advancements in source control and containment and improvements in oil spill response in ice discussed earlier. The capabilities include the drilling rig, ice management vessels, and emergency and oil spill response capability. 	□	■	DOI (BSEE), DOC, DHS, Others	●		
Lease Terms Appropriate to Arctic Conditions						
<p>DOE, working in collaboration with DOI and with input from other stakeholders, should conduct an assessment of the timelines required to progress an offshore exploration prospect from lease through a decision to proceed to development. This assessment should be completed before the next lease sale.</p> <ul style="list-style-type: none"> These timelines should include the time to plan, permit, and safely execute seismic surveys, exploration drilling, and any necessary appraisal wells, as well as conduct and interpret results from these activities. The time required to complete engineering studies, including an economic feasibility assessment, to enable a development decision should also be included. 	■	■	DOE, DOI (BOEM, BSEE)	●	○	○

Recommendation	DOE Action	Action by Other Federal Agencies	Potential Coordinating Agencies	Topic Area		
				Research	Regulatory	Leadership/Policy
<ul style="list-style-type: none"> The assessment should consider the season length limitations imposed by the Arctic operating environment and ecological/subsistence considerations, as well as approaches used by other Arctic nations with similar geological and operating environments. If warranted based on this assessment, congressional action to amend the Outer Continental Shelf Lands Act to reflect the lease term for Arctic operations could be pursued. For existing leases, the Department of the Interior could clarify suspension authority. 						
Effective Policies and Regulations						
<p>Policies and regulations should encourage innovation by providing for incorporation of technological advancements.</p> <ul style="list-style-type: none"> Where authority already exists to consider industry proposals that provide for equivalent or better levels of safety and environmental protection, such as that already established in 30 CFR 250.141, use of that authority should be encouraged. BSEE should continue to review existing and new regulations to identify candidate areas for implementation of performance-based regulation, considering lessons from other jurisdictions. Staff development in Arctic-specific operational and regulatory requirements should be pursued within regulatory agencies. 		■	DOI, EPA, DOC, DHS, Others	○	●	○
<p>Policies and regulations should reflect improved ecological understanding from ongoing research and monitoring. Regulators could use their authority to designate or update appropriate mitigations based on more recently developed science.</p>		■	DOI (BLM, BSEE, FWS), DOC (NMFS), EPA, Others	○	●	
<p>Regulators should identify, prioritize, coordinate, and communicate specific information requirements to the operators in a timely manner.</p>	□	■	DOI, DOC, EPA, Others		●	
<p>The Administration should champion policies that enable effective and efficient logistics and infrastructure. Examples of current regulatory requirements that unnecessarily constrain Arctic development include:</p> <ul style="list-style-type: none"> Limited access to federal lands for oil and gas transportation systems where no practical alternative exists. Presupposing oil transport solutions for potential new discoveries. The Jones Act rules on tankers and support vessels mandate largely unavailable and noncompetitively priced ships, unduly increasing the cost of operations in the U.S. Arctic. 	□	■	AESC, DOI, DOC (MARAD), DOT, Others		○	●
Enabling Infrastructure						
<p>Local, state, and federal government agencies should coordinate infrastructure planning by carrying out, where possible, joint scenario planning to identify the intersection of mutual needs such as airfields, ports, roads, and communications, to identify opportunities for investment synergies. Planning needs and considerations should include those from the oil and gas industry, Navy, Coast Guard, and local stakeholders, and include options to extend the life of the TAPS pipeline.</p>	■	■	DOE, DOC, DOD, DOI, DOT, Others	○		●

Recommendation	DOE Action	Action by Other Federal Agencies	Potential Coordinating Agencies	Topic Area		
				Research	Regulatory	Leadership/Policy
Recognizing the potential for increasing needs in the Arctic from all industries, the U.S. Coast Guard icebreaker fleet and presence should be expanded and extended into the shoulder season to promote transportation safety, national security, and a longer exploration season.		■	DHS (Coast Guard)			●
Recognizing the potential for increased vessel traffic in Bering Strait in the future, actions should be taken now to improve vessel safety: <ul style="list-style-type: none"> The United States should support implementation of the International Maritime Organization Polar Code to ensure that vessel traffic traversing the Bering Strait is suitably designed and constructed per the requirements of the code. NOAA should complete hydrographic mapping of the region. U.S. Coast Guard should improve regional navigational and communication aids and continue development of comprehensive Arctic marine traffic awareness systems. 		■	DOD, DOT, DHS, DOC	○		●
NOAA should maintain at least the current capability of polar observing weather satellites and evaluate the merits of a new publicly accessible synthetic aperture radar satellite.	□	■	DOC (NOAA), DOD, Others	○		●
Recognizing the potential of unmanned aircraft to significantly improve current monitoring and sensing capabilities, all stakeholders should work with the Federal Aviation Administration (FAA) Investigative Program to support permitting the use of unmanned aircrafts in the Arctic. This technology is currently available and would improve safety and efficiency of logistics support, oil spill response, ice characterization, and environmental monitoring.		■	DOT, DOD, Others	○	○	●
GOVERNMENT LEADERSHIP AND POLICY COORDINATION						
Domestic Leadership and Policy Coordination						
The Arctic Executive Steering Committee should: <ul style="list-style-type: none"> Reaffirm U.S. commitment to prudent Arctic oil and gas development and U.S. leadership in the region. Assess alignment across federal agencies in advancing prudent Arctic oil and gas development. Request DOE and Department of Commerce to partner to inform U.S. policymakers across federal departments and agencies about the economic, energy, and national security benefits of prudent Arctic oil and gas development, consistent with the DOE's mandate and the Department of Commerce's recently announced Arctic Affinity group. Clarify the process by which it will collaborate with the state of Alaska, Alaska Native tribal governments, and other stakeholders. 	■	■	AESC, DOE, DOC, Others			●
The Arctic Executive Steering Committee as part of its mandated gap analysis should: <ul style="list-style-type: none"> Request regulators to compile a comprehensive and integrated inventory of regulatory requirements for offshore Arctic oil and gas exploration and development. 	■	■	AESC, DOE, DOI, Others		○	●

Recommendation	DOE Action	Action by Other Federal Agencies	Potential Coordinating Agencies	Topic Area		
				Research	Regulatory	Leadership/Policy
<ul style="list-style-type: none"> Recognizing the significant progress by the Interagency Working Group on coordination of permitting in Alaska, the Arctic Executive Steering Committee should, as part of its gap analysis: <ul style="list-style-type: none"> Review lessons learned for application to broader coordination of opportunities and identify areas for improvement Recalibrate the existing Interagency Working Group to refine its mission and enhance its capabilities to coordinate Arctic activities and permitting. Review the effectiveness of DOE participation in the working group. 						
<p>The Department of Energy should designate a senior advisor to support its representative on the Arctic Executive Steering Committee and be a focal point for Arctic policy, including:</p> <ul style="list-style-type: none"> Producing a department-wide Arctic strategy that clarifies its implementation of the National Strategy for the Arctic Region (NSAR). Advancing prudent Arctic oil and gas development. Coordinating with the U.S. Arctic Council Chairman. Coordinating the department's Arctic science and technology, integrated analysis, and research agenda and effecting full coordination and engagement of the National Laboratories. 	■	□	DOE, Others	○		●
<p>The Department of Energy should engage Alaska institutions including the state of Alaska in the planning and conduct of its Arctic initiatives and consider public-private partnerships and data sharing platforms similar to the Alaska Ocean Observing System.</p>	■		DOE, Others	○		●
U.S. Chairmanship of the Arctic Council						
<p>As Arctic Council members implement the two internationally legally binding agreements on search and rescue (2011) and on oil pollution preparedness and response (2013), the U.S. government should encourage engagement and participation with the international energy industry in the conduct of its search and rescue table top exercise in May 2015 and the full-scale exercise in the summer of 2016.</p>	□	■	DOS, AESC, DHS (Coast Guard), DOD, Others			●
<p>The U.S. government should seek to strengthen the Arctic Economic Council's formal interaction and engagement with the Arctic Council as well as to promote its business advisory role.</p>	□	■	DOS, DOC, Others			●

Notes: The Potential Coordinating Agencies shown in the table above are provided to illustrate the breadth of federal government agencies and related organizations that could potentially have roles in implementing these recommendations and the list may not be comprehensive. State and local government agencies, not shown, could also have important roles.

List of Agencies: Department of Energy (DOE); Department of the Interior (DOI), Bureau of Land Management (BLM), Bureau of Ocean Energy Management (BOEM), Bureau of Safety and Environmental Enforcement (BSEE), and Fish and Wildlife Service (FWS); Department of Commerce (DOC), National Marine Fisheries Service (NMFS), and National Oceanic and Atmospheric Administration (NOAA); Department of Defense (DOD) including Navy; Department of Health and Human Services (HHS); Department of Homeland Security (DHS) including U.S. Coast Guard; Department of State (DOS); Department of Transportation (DOT), including Federal Aviation Administration (FAA) and Maritime Administration (MARAD); Environmental Protection Agency (EPA); Executive Office of the President (EOP), Council on Environmental Quality (CEQ); Interagency Arctic Research Policy Committee (IARPC); Interagency Coordinating Committee on Oil Pollution Research (ICOPR); North Slope Science Initiative (NSSI); Arctic Executive Steering Committee (AESC).

Appendix D

List of Topic Papers

On March 27, 2015, the National Petroleum Council (NPC) in approving this report, *Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources*, also approved the making available of certain materials used in the study process, including detailed, specific subject matter papers prepared or used by the study's Technology & Operations Subgroup. These 46 Topic Papers were working documents that were part of the analyses that led to development of the summary results presented in the report's Executive Summary and Chapters 5 through 8.

These Topic Papers represent the views and conclusions of the authors. The National Petroleum Council has not endorsed or approved the statements and conclusions contained in these documents, but approved the publication of these materials as part of the study process.

The NPC believes that these papers will be of interest to the readers of the report and will help them better understand the results. These materials are being made available in the interest of transparency.

This appendix provides a list of the Technology & Operations Subgroup's 46 Topic Papers, which are available for viewing and downloading from the Arctic Potential report section of the National Petroleum Council's publicly accessible website (<http://www.npc.org>). The Subgroups that prepared Chapters 1 through 4 and Chapters 9 and 10 did not develop Topic Papers.

Chapter 5

Characterization and Measurement of the Ice Environment

- 5-1 Climate Change and Projected Impact on Arctic Ice Conditions
- 5-2 Industry Needs with Respect to Ice Measurements and Data Collection
- 5-3 Summary of Current Ice Characterization Research: U.S.
- 5-4 Summary of Current Ice Characterization Research: Canada
- 5-5 Summary of Current Ice Characterization Research: Norway/Russia/Europe
- 5-6 Current Practice – Technology Utilized for Characterizing and Measuring Ice

Chapter 6

Offshore Arctic Exploration and Development Technologies

- 6-1 Scope of Arctic-Related Technologies Covered
- 6-2 Historical Background on Arctic Exploration and Production Technology Development
- 6-3 Research Being Done by Foreign Governments
- 6-4 Exploration Data Acquisition in the Arctic Offshore
- 6-5 Development Drilling and Production Platforms
- 6-6 Arctic Subsea Pipelines and Subsea Production Facilities

- 6-7 Offtake and Tankering
- 6-8 Ice Management
- 6-9 Arctic Operations Common Operational Picture
- 6-10 Recently Published Lists of Arctic Technology/
Research Needs
- 6-11 Assessment of Relevant Areas of Current U.S.
Government Technical Research Expertise/
Capabilities
- 6-12 Overview and Background of Arctic Personnel
Safety and Offshore Survival in Emergencies
- 6-13 Overview and Background of Escape,
Evacuation, and Rescue of Offshore Personnel
in the Arctic

Chapter 7

Logistics and Infrastructure

- 7-1 Current Research/Activity Catalogue
- 7-2 Multi-Mode Transportation Limitations
- 7-3 Managing the Ice Picture
- 7-4 Aviation and Support Limitations in the Arctic
- 7-5 Operational limitations Due to
Compliance with the Jones Act
- 7-6 Search and Rescue Operational Support and
Limitations
- 7-7 Marine and Aviation Basing Limitations in the
Arctic
- 7-8 Roads to Resources Program – State of Alaska
- 7-9 Overland Pipeline Options
- 7-10 Communications Solutions in the Arctic
- 7-11 Power Solutions in the Arctic
- 7-12 Ice Classified Marine Vessels for Arctic
Operations

- 7-13 Future U.S. Navy and USCG Operations in the
Arctic
- 7-14 Future Marine and Aviation Support Bases
Supporting Chukchi Sea/Arctic Operations
- 7-15 The Mobile, Multi-Purpose Supply Base Option
- 7-16 The Nexus of Western Science and Traditional
Knowledge – Gaining the Support of the Alaskan
Native Population
- 7-17 Construction Materials between the Chukchi
Sea and Dalton Highway

Chapter 8

Arctic Offshore Oil Spill Prevention, Control, and Response

- 8-1 Overview and Background of Oil Spill Response
Issues Covered
- 8-2 Summary of Current Oil Spill Response
Research Activity (Industry and Government)
- 8-3 Behavior of Spilled Oil – Current Practice/
Operational and Technology Constraints,
and Opportunities
- 8-4 Dispersants – Current Practice/Operational and
Technology Constraints, and Opportunities
- 8-5 In Situ Burn – Current Practice/Operational
and Technology Constraints, and Opportunities
- 8-6 Mechanical Recovery – Current Practice/
Operational and Technology Constraints,
and Opportunities
- 8-7 Arctic Oil Spill Response Overview
- 8-8 Toxicity of Oil to Arctic Organisms and
Natural Oil Biodegradation
- 8-9 Field Oil Spill Response Experiments and
Releases to Test Technology, Procedures, and
Practices
- 8-10 Arctic Well Integrity and Spill Prevention
Methods and Technology

Acronyms and Abbreviations

ACEX	Arctic Coring Expedition	ASAMM	Aerial Survey of Arctic Marine Mammals
ACHP	Advisory Council on Historic Preservation	ASRC	Arctic Slope Regional Corporation
ACNFS	Arctic Cap Nowcast/Forecast System	AUV	autonomous underwater vehicle
ADCP	Acoustic Doppler Current Profiler	BBO	billion barrels of oil
ADDAPS	Alaska Deep-Draft Arctic Port System	BBOE	billion barrels of oil equivalent
ADEC	Alaska Department of Environmental Conservation	BBNGL	billion barrels of natural gas liquids
ADF&G	Alaska Department of Fish and Game	BCB	Bering-Chukchi-Beaufort
ADNR	Alaska Department of Natural Resources	BLM	Bureau of Land Management
ADOTPF	Alaska Department of Transportation & Public Facilities	BOE	barrel of oil equivalent
AEC	Arctic Economic Council	BOEM	Bureau of Ocean Energy Management
AEIS	Arctic Ecosystem Integrated Survey	BOP	blowout preventer
AESC	Arctic Executive Steering Committee	BSEE	Bureau of Safety and Environmental Enforcement
AEWG	Alaska Eskimo Whaling Commission	CAA	Conflict Avoidance Agreement
AIDJEX	Arctic Ice Dynamics Joint Experiment	CAB	chemistry and benthos (focus of COMIDA-CAB program)
AKMAP	Alaska Monitoring and Assessment Program	CAFF	Conservation of Arctic Flora and Fauna (Arctic Council Working Group)
ALCC	Arctic Landscape Conservation Cooperative	CARA	Circum-Arctic Resource Appraisal
AMAP	Arctic Monitoring and Assessment Program (Arctic Council Working Group)	CEQ	Council on Environmental Quality
ANCSA	Alaska Native Claims Settlement Act	CFR	Code of the Federal Register
ANIMIDA	Arctic Nearshore Impact Monitoring in Development Area	CHAOZ	Chukchi Acoustic, Oceanographic, and Zooplankton study
ANWR	Arctic National Wildlife Refuge	CIDS	Concrete Island Drilling Structure (<i>also</i> Concrete Island Drilling System)
AOGCC	Alaska Oil and Gas Conservation Commission	CIS	Canadian Ice Service
APD	Application for Permit to Drill	COMIDA	Chukchi Sea Offshore Monitoring in Drilling Area program
API	American Petroleum Institute	COP	common operational picture
ARCUS	Arctic Research Consortium of the United States	CRI	caisson retained island

CSESP	Chukchi Sea Environmental Studies Program	GPR	ground penetrating radar
CTD	conductivity, temperature, and depth	GPS	global positioning system
D&P	development and production	HFR	high frequency radar
DHS	Department of Homeland Security	HSE	health, safety, and environmental
DMLW	Division of Mining, Land & Water (ADNR)	IACS	International Association of Classification Societies
DMTS	Delong Mountain Transportation System	IAP	Integrated Activity Plan
DOC	U.S. Department of Commerce	IARPC	U.S. Interagency Arctic Research Policy Committee
DOD	U.S. Department of Defense	IASC	International Arctic Science Committee
DOE	U.S. Department of Energy	IAWG	Interagency Working Group
DOI	U.S. Department of the Interior	IBEEV	Ice Breaking Emergency Evacuation Vessel
DOS	U.S. Department of State	ICCOPR	Interagency Coordinating Committee on Oil Pollution Research
DOT	U.S. Department of Transportation	IFR	Instrument Flight Rules
DWT	deadweight tons	IMO	International Maritime Organization
E&A	exploration and appraisal	IOGP	International Association of Oil & Gas Producers
E&D	exploration and development	IPNSAR	Implementation Plan for the National Strategy for the Arctic Region
E&P	exploration and production	IPS	ice-profiling sonar
EER	escape, evacuation, and rescue	IR	infrared
EEZ	exclusive economic zone(s)	ISB	in-situ burning
EIS	Environmental Impact Statement	ISER	Institute of Social and Economic Research
EL	exploration license	ISO	International Organization for Standardization
EMI	electromagnetic induction	JIP	joint industry program(me)
EPA	U.S. Environmental Protection Agency	LNG	liquefied natural gas
EPPR	Emergency Prevention, Preparedness and Response	LMRP	Lower Marine Riser Package
ESA	U.S. Endangered Species Act	MARAD	Maritime Administration
EWC	Eskimo Walrus Commission	MARPOL	IMO Marine Pollution regulations (International Convention for the Prevention of Pollution from Ships)
FAA	Federal Aviation Administration	MMBOE	million barrels of oil equivalent
FEED	front-end engineering design	MMS	Minerals Management Service
FERC	Federal Energy Regulatory Commission	MODIS	Moderate Resolution Imaging Spectroradiometer
FLIR	forward-looking infrared	MODU	mobile offshore drilling unit
FPSO	floating production, storage, and offloading (<i>or</i> offtake)	MVFR	Marginal Visual Flying Rules
FSO	floating storage and offloading (<i>or</i> offtake)	NASA	National Aeronautics and Space Administration
GAO	U.S. Government Accountability Office		
GBS	gravity-based structure		
GOM	Gulf of Mexico		

NCAR	National Center for Atmospheric Research	PRNL	Petroleum Research Newfoundland-Labrador
NCP	National Oil and Hazardous Substances Pollution Contingency Plan (commonly called the National Contingency Plan)	PSA	Petroleum Safety Authority (Norway)
NEB	National Energy Board (Canada)	R&D	research and development
NEBA	Net Environmental Benefit Analysis	RIAWG	Regional Interagency Working Group
NEPA	National Environmental Policy Act	ROV	remotely operated vehicle
NGO	nongovernmental organization	RPD	Revised Permit to Drill
NMFS	NOAA's National Marine Fisheries Service	SAO	Senior Arctic Official
NOAA	National Oceanic and Atmospheric Administration	SAR	synthetic aperture radar
NPC	National Petroleum Council	SDC	steel drilling caisson
NPDES	National Pollution Discharge Elimination System	SIRAM JIP	Subsea Ice Risk Assessment and Mitigation Joint Industry Program
NPR-A	National Petroleum Reserve–Alaska	SIWO	Sea Ice for Walrus Outlook
NRC	National Research Council	SIZONet	Seasonal Ice Zone Observing Network
NSAR	National Strategy for the Arctic Region	SLAR	side-looking airborne radar
NSB	North Slope Borough	SOLAS	IMO Safety of Life at Sea regulations (International Convention for the Safety of Life at Sea)
NSF	National Science Foundation	SSDC	single steel drilling caisson
NSSI	North Slope Science Initiative	SSRW	same season relief well
NTL	Notice to Lessees	TAPS	Trans-Alaska Pipeline System
NWAB	Northwest Arctic Borough	TCF	trillion cubic feet
OBC	ocean bottom cable	TEMPSC	Totally Enclosed Motor Propelled Survival Craft
OBN	ocean bottom nodes	UAF	University of Alaska Fairbanks
OCS	Outer Continental Shelf	UAS	unmanned aerial system
OCSLA	Outer Continental Shelf Lands Act	USACE	U.S. Army Corps of Engineers
OSR	oil spill response	USARC	U.S. Arctic Research Commission
OTC	Offshore Technology Conference	USCG	U.S. Coast Guard
PacMARS	Pacific Marine Arctic Research Synthesis	USFWS	U.S. Fish and Wildlife Service
PAME	Protection of the Arctic Marine Environment (Arctic Council Working Group)	USGS	U.S. Geological Survey
PRB	Polar Research Board	USN	U.S. Navy