The Last Climate Frontier: Leveraging the Arctic Council to make Progress on Black Carbon and Methane

Policy prescriptions for making the U.S. Chairmanship of the Arctic Council count on key climate variables

A Report Prepared for Clean Air Task Force
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INTRODUCTION

Impacts from climate change are threatening the Arctic environment and way of life. Warming in the Arctic is happening twice as fast as at lower latitudes. Sea ice is retreating and vast frozen areas are melting, leading to a variety of adverse effects for ecosystems and communities. Sea level rise, melting permafrost, and the decline in snow cover create feedbacks that can accelerate these adverse impacts. The implications of a melting Arctic are not limited to the region, but affect communities worldwide. The Arctic is now "ground-zero" in the struggle against climate change and failure to protect it adequately could doom other climate mitigation efforts.

Of particular importance, in-Arctic and near-Arctic emissions of short-lived climate forcing pollutants i.e., black carbon and methane have a disproportionate impact on increasing Arctic temperatures and melting. Arctic sources of black carbon have been estimated to have a 10-100 times greater impact on Arctic warming than black carbon from mid-latitude sources. Black carbon deposits darken snow and ice, accelerating melting. Methane is a potent greenhouse gas, with over eighty times the warming impact of carbon dioxide over the near-term. Methane emissions from oil & gas development in the Arctic are projected to rise as development increases over the next few years. So, actions to reduce these emissions will provide a disproportionate benefit to the region. Importantly, most of the sources of these pollutants are within the jurisdiction of the nations that make up the Arctic Council.

The Arctic Council is the international body charged with fostering cooperation among Arctic nations and indigenous peoples. Made up of the littoral Arctic states (Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States), the Council is able to address regional issues of shared interest that extend beyond the borders of individual nations. Because of its mission, geographic focus, and membership, the Council is uniquely positioned to address regional emissions of short-lived climate pollutants. Protecting the Arctic is an important part of the Council's mission, but the direct threat that climate change poses to the region presents the opportunity for this intergovernmental body to take a lead role in addressing the threat.

As the United States prepares to take over the chairmanship of the Council in 2015, we congratulate the Obama Administration for making climate change a central theme of its tenure and encourage the Administration to identify the links between global warming and all other critical Arctic issues. Moreover, in this report, we identify four specific ways that, under U.S. leadership, the Arctic Council can seize the opportunity to curb emissions of black carbon and methane and help buy the Arctic environment precious time as global measures to check greenhouse gas emissions are developed and implemented.

For decades, Arctic nations have cooperated on a variety of issues, primarily related to environmental protection, through the Arctic Council. In addition to the United States, China and India are now official observers, meaning that the world's largest emitter nations are now engaged with the Arctic Council process. The Arctic Council has already made some progress on the issue of black carbon and methane emissions and there exists a strong foundation for expanding efforts to reduce emissions. In recent years, the Council has established the administrative capacity, organization, and reporting systems necessary for joint work on these pollutants. Previous consultation between the member states, scientific experts, permanent participants, and non-governmental organizations has produced studies and assessments that lay the groundwork for action. Now, it is time for the Council to move forward with the steps necessary to achieve reductions in these key pollutants.

As Chair of the Arctic Council, the United States can target emissions in four key economic sectors by taking the following actions:

Oil & Gas Exploration, Production and Development

Support an initiative to reach agreement on and deploy best practices for the oil & gas sector that would limit emissions of black carbon and methane from sources in the Arctic region, including by:
→ Partnering with international initiatives to provide funding & share lessons;
→ Working towards agreement by developers to adhere to best environmental practices through consensus dialogue with all Arctic stakeholders, including oil & gas developers, indigenous groups, environmental non-profit organizations, regulators, governments and others.

Shipping

Facilitate adoption of a resolution by Arctic Council members urging the International Maritime Organization to prohibit the use of heavy fuel oil in the Arctic Ocean. In addition:
→ Update shipping risk assessments in the Arctic, with a focus on the local impacts of emissions;
→ Update study of potential approaches to reduce black carbon emissions from Arctic shipping.

Clean Energy & Energy Efficiency

Assess existing domestic programs and international partnerships efforts to cooperate on clean energy for in-region residential heating through an Arctic Council mechanism:
→ Create a community of practice for reporting and documenting lessons learned in domestic clean energy and energy efficiency initiatives;
→ Identify key areas of need and deliver recommendations to inform the policy and work of international funding mechanisms and initiatives such as Sustainable Energy for All, the Clean Energy Ministerial, and the Nordic Environment Finance Corporation.

Open Burning

Support and lead implementation of new work in the Arctic Council to address emissions from open burning, focusing on support for on-the-ground initiatives to bring established best practices in agricultural education, technology and practice to communities and reduce the incidence of wildfires from agricultural burning. This should include:
→ Advocating for new monitoring and assessment of the contribution of open burning to Arctic black carbon emissions through the Arctic Monitoring and Assessment Program or the Task Force for Action on Black Carbon and Methane.
→ Leading a consultative assembly of stakeholders working in communities around the Arctic region to reduce open burning.
→ Delivering key recommendations to international organizations and initiatives ready to fund projects that will reduce the incidence of wildfires.

BACKGROUND

Climate Change Threatens the Arctic Environment and Way of Life

The mean annual temperature in the Arctic is now 1.5°C higher than the 1971-2000 average; warming is twice that occurring at lower latitudes.[1] The observed rate of sea ice loss over the past few decades lies outside the range of model simulations of the same period and is unprecedented in the past 1.5 millennia.[2] The minimum extent of sea ice is currently declining by an average of 91 600 km per year, roughly equivalent to the area of Maine, or −13.0% per decade relative to the 1979–2000 average.[3] An extrapolation of the trend in sea-ice volume estimates suggests that nearly ice-free Arctic summers could become the norm in as soon as a decade.[4] The ice cover is also younger and thinner, with more than half of it less than a year old. This thin ice cover is less resilient and more prone to melting and retreat in summer than a thick one.[5] Sea ice is integral to the marine ecosystem, and its decline has biological

consequences, first in terms of disruptions in phytoplankton production, which subsequently creates mismatches for higher consumers, including cod, seabirds and marine mammals.[6]

Changes in sea ice cover have affected walrus populations. Where they previously rested while feeding in shallow continental-shelf waters near the coasts of Russia and Alaska, they now are seen going ashore in large numbers along the Chukchi coasts of Russia and Alaska, farther from the feeding grounds.[7] Mass mortality among Pacific walrus along the coast of the Chukchi Sea in Alaska has been attributed to loss of sea ice over the continental shelf.[8]

The Arctic Ocean and adjacent subarctic seas supply food for indigenous peoples whose culture and traditional way of life are affected by the prevalence of open water. They now must travel farther off-shore—over more unstable ice or through increasingly rough seas—to hunt mammals that live in icy habitats. The wave action on thawing and vulnerable shorelines accelerates the coastal erosion and is affecting village, archaeological, and sacred sites.[9]

A steady increase in permafrost temperatures since the mid-20th century has coincided with observations of fluxes of methane from both terrestrial and offshore sources. To this point, these natural emissions have not risen significantly.[10]

Open water from melting sea ice may be influencing weather in lower latitudes by weakening the jet stream – the air current that circles the Northern Hemisphere – and producing extreme weather patterns, such as pounding one region with an unusual flurry of blizzards and/or parching a normally wet area with an extended drought. The precise links between the increasing open water in the Arctic and weather in the middle latitudes remains an open research question deserving of more attention.[11]

The Greenland Ice Sheet contributes roughly 30 percent of all glacier melt sea level rise. Global sea level rise during the period from 1993 and 2010 has doubled from the 1901 to 2010 period Recent observations show evidence for increased ice flow rates in some regions of the Greenland Ice Sheet. [12]

The Arctic Council

The Arctic Council has a long history of promoting cooperation and coordination to address important environmental issues. Cooperation under the Arctic Protection Strategy led to the founding of the Arctic Council. The Arctic Environmental Protection Strategy (AEPS) was adopted in 1991 with the primary objectives of "preserving environmental quality and natural resources, accommodating environmental protection principals with the needs and traditions of Arctic Native peoples, monitoring environmental conditions, and reducing and eventually eliminating pollution in the Arctic Environment."

In the 1996 Ottawa Declaration, the eight Arctic nations - Canada, the Kingdom of Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States of America - established the Arctic Council as an intergovernmental forum to promote cooperation and coordination among members, permanent participants and observers. The members of the Arctic Council are Canada, the Kingdom of Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States of America. Permanent participants include the Arctic first nations of the Inuit Circumpolar Council, the Saami Council, the Russian Association of Indigenous Peoples of the North (RAIPON), the Arctic Athabaskan Council, the Gwich'in Council International and the Aleut International Association. Additionally, a number of observers have been admitted to the Arctic Council over the years, including but not limited to non-arctic states such as the People's Republic of China and the Republic of India, intergovernmental organizations such as the International Union for the Conservation of Nature, and non-governmental organizations such as the World Wildlife Fund and the Circumpolar Conservation Union. Decisions at the Arctic Council, including binding agreements, are only made by consensus of its members with consultation of the permanent

participants. Observers are invited to Arctic Council meetings, engage in Working Groups, propose and fund projects, and make statements at meetings.

Since its inception, the Arctic Council has conducted a series of landmark studies on environmental issues of concern in the Arctic region. Among these are the Arctic Climate Impact Assessment, the Arctic Marine Shipping Assessment, the Arctic Ocean Review, and the Arctic Biodiversity Assessment. Today, the Arctic Council has numerous task forces and working groups dedicated to studying and protecting the Arctic. Four of these groups deal with Black Carbon and Methane, including: the Task Force for Action on Black Carbon and Methane, the Arctic Marine Assessment Program's Expert Groups for Black Carbon and Methane, the Arctic Contaminants Action Program, and the Adaptation Actions for a Changing Arctic group. A number of reports studying the impact of short-lived climate forcers have been released from the Arctic Council following up the work of the Arctic Climate Impact Assessment, including those completed by the Task Force for Short-lived Climate Forcers, the Arctic Monitoring and Assessment Program's Expert Groups for Black Carbon and Tropospheric Ozone and for Methane.

The Arctic Council structure poses challenges to regulating the issue of short-lived climate forcers. It was not built as an inclusive negotiating platform, like the United Nations Framework Convention on Climate Change. Instead, it relies on a smaller, consensus driven decision-making process that can be informed by and inform working level action and recommendations. For example, the Arctic Council reached binding agreements on two issue areas– Marine Oil Pollution Response, and Search and Rescue after years of discussion and study, and is now using the Arctic Council task force structure to make those agreements actionable. It remains to be seen exactly how these agreements will be implemented and acted upon.

The true strength of the Arctic Council has been the ability to elevate, throughout its history, areas of mutual cooperation and regional interest. While conventional security and commercial issues have been a key motivator for many members, due to the global importance of Arctic ice, the value of cooperation on environmental issues like rapid climate change, including local black carbon and methane emissions, is rising. Complemented by international efforts to globally regulate emissions, the Arctic Council brings a regional perspective and emerging ability to implement and cooperate on actionable environmental protection.

Not only can the Arctic Council strengthen environmental policymaking by elevating regional action, but robust cooperation to reduce short-lived climate pollutants can in turn strengthen the Arctic Council. Improved governance and international relationships should be a key focus of the United States Chairmanship in the Arctic Council, and work together on short-lived climate pollutants is a worthy point of cooperation. All Member states are committed to a safe, peaceful, protected Arctic. Additionally, the work of the Arctic Council in reporting and assessments has been extensive. The current Task Force for Action on Black Carbon and Methane is moving towards creating a reporting mechanism around short-lived climate pollutants that, if signed by Ministers in 2015, will need to be enhanced with action. The next Chairmanship will require strong leadership and cooperation to move the Council forward towards this action.

In addition, the Arctic Council now hosts a number of international observers, including China, India, South Korea, Japan and Singapore. These observers can be brought in for actionable work on environmental issues under the current Arctic Council framework. Working groups and task forces, assessments, expert consultations, and participation in best practices work are and should be open to observer countries. By allowing observers, states and otherwise, to be a part of the action at the working level, the Arctic Council can leave open the future possibility that observer action on environmental issues could be strengthened to the point where non-Arctic

states are able to participate optionally in what are currently "member state only" efforts, such as declarations or binding agreements.

In 2015, the United States will assume the Chairmanship of the Arctic Council for a period two years. Admiral Robert Papp, the U.S. Special Representative for the Arctic, has announced that the U.S. will make climate change a priority[13] and will continue to work on black carbon and methane reductions in the Arctic. This is a worthy platform – the United States can strengthen Arctic Council governance through this focus. To do that and to improve action on climate change in the Arctic, United States should now seek to populate that broad agenda with strong, sound initiatives that will achieve real reductions in Arctic short-lived climate forcer emissions.

A Summary of Black Carbon and Methane Emissions in the Arctic

The Arctic is warming twice as fast as the rest of the globe.[14] Black carbon and methane are both short-lived climate pollutants that have a strong impact on warming in the Arctic, and as such, provide an opportunity to slow warming in the Arctic.

Black carbon is dark, fine particulate matter that contributes to Arctic warming by absorbing sunlight in the atmosphere. Black carbon then settles on snow and ice, darkening the white surface and amplifying melting and warming. Some scientists believe that black carbon is the second most important greenhouse gas, after carbon dioxide.[15] Arctic sources of black carbon have been estimated to have a 10-100 times greater impact than mid-latitude sources.[16] Radiative forcing of black carbon increases with latitude and is largest for Arctic Council nations.[17] Because of Arctic climate effects, measures taken to reduce black carbon in the Arctic will have the greatest impact per unit of emission.[18] Major sectors that contribute to black carbon emissions include land transport, residential heating, shipping, and open burning, [19] and flaring. [20]It is possible, including additional impacts from reduced albedo on Arctic snow from black carbon, that Arctic warming could be reduce by 1.2 °C after 15 years of eliminated black carbon emissions.[21]

Methane is a potent greenhouse gas, with over 80 times the warming potential per pound of carbon dioxide over a 20-year period. Anthropogenic methane emissions have contributed to global warming

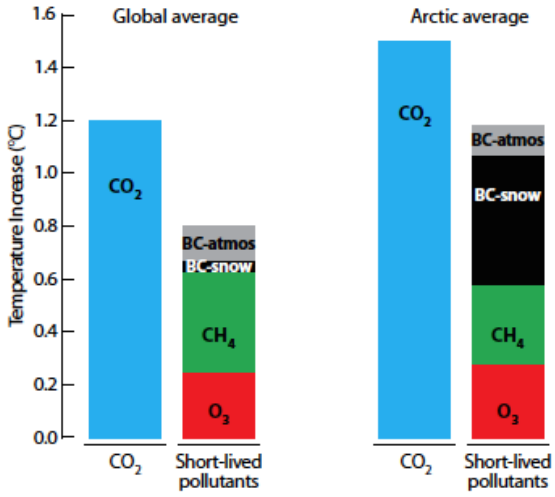


***Figure 1**. Impact of Short-Lived Pollutants on Arctic Climate (Source: Quinn, AMAP 2008)*

significantly, about half of temperature rise that to carbon dioxide. Methane emissions remain in the atmosphere long enough to mix with other gases, meaning that global atmospheric concentrations are largely uniform. Methane emissions in Arctic nations are largely concentrated in the oil & gas sector.[22]

Strategies to mitigate black carbon and methane in the Arctic should complement efforts to reduce carbon dioxide emissions. Current black carbon emissions in Arctic countries are expected to decline by 37% by 2020 due to current air pollution legislation alone, but only small reductions are expected beyond that point.[23] Studies have projected that a low black carbon emissions scenario would require new legislation for certain key sectors, including in residential heating, the enforcement of existing bans on agricultural burning, [24] and the accelerated deployment of technologies in the transportation sector. [25] Implementation of these

measures could result in additional black carbon emission reductions of 51% by 2030, and do not include reductions for diesel engine retrofits, shipping or flaring.[26] These within and near-Arctic sources represent additional and significant black carbon reduction opportunities.

The Arctic Council's Arctic Monitoring and Assessment Program (AMAP) experts estimated that Arctic nations are responsible for 10% of global black carbon emissions. The United States and Russia are in total responsible for 90%, or 600 gigatons per year of black carbon emitted from Arctic nations.[27] Total numbers for anthropogenic black carbon emissions in the Arctic region estimated by AMAP in 2011 are approximately 3 to 7 gigatons per year of black carbon. [28] A new AMAP report is expected in early 2015.

In the Arctic, production of black carbon is driven by different economic sectors depending on the state or region. Black carbon emissions in Alaska total 2220 Mg.[29] Black carbon emissions in the Yukon, Northwest Territories and Nunavut are less than in Alaska by a factor of 10, at 230 Mg.[30] In Greenland, where the radiative forcing of black carbon may be greater due to the snow and ice environment, black carbon emissions total 26 Mg. [31] Total Russian black carbon emissions in the Arctic are estimated to be between 3000 and 4000 Mg.[32] Iceland produces 670 Mg of black carbon per year. [33] Finally, emissions in Svalbard are estimated to be around 61 Mg of black carbon, and emissions in the Faroe Islands are 42 Mg. [34]

Data suggest that a dominant international source region of black carbon is high latitude Eurasia, from where high concentrations are transported to the Arctic in late winter and early spring. [35] These northern source regions in Europe and eastern Asia allow for black carbon to be lifted on the Arctic front and deposited over ice and snow surfaces, as in Figure 1. As a result, average concentrations of black carbon in Arctic Eurasia are 3-4 times those in Arctic Canada.[36] But transport of black carbon to the Arctic also comes from lower latitude sources.[37]

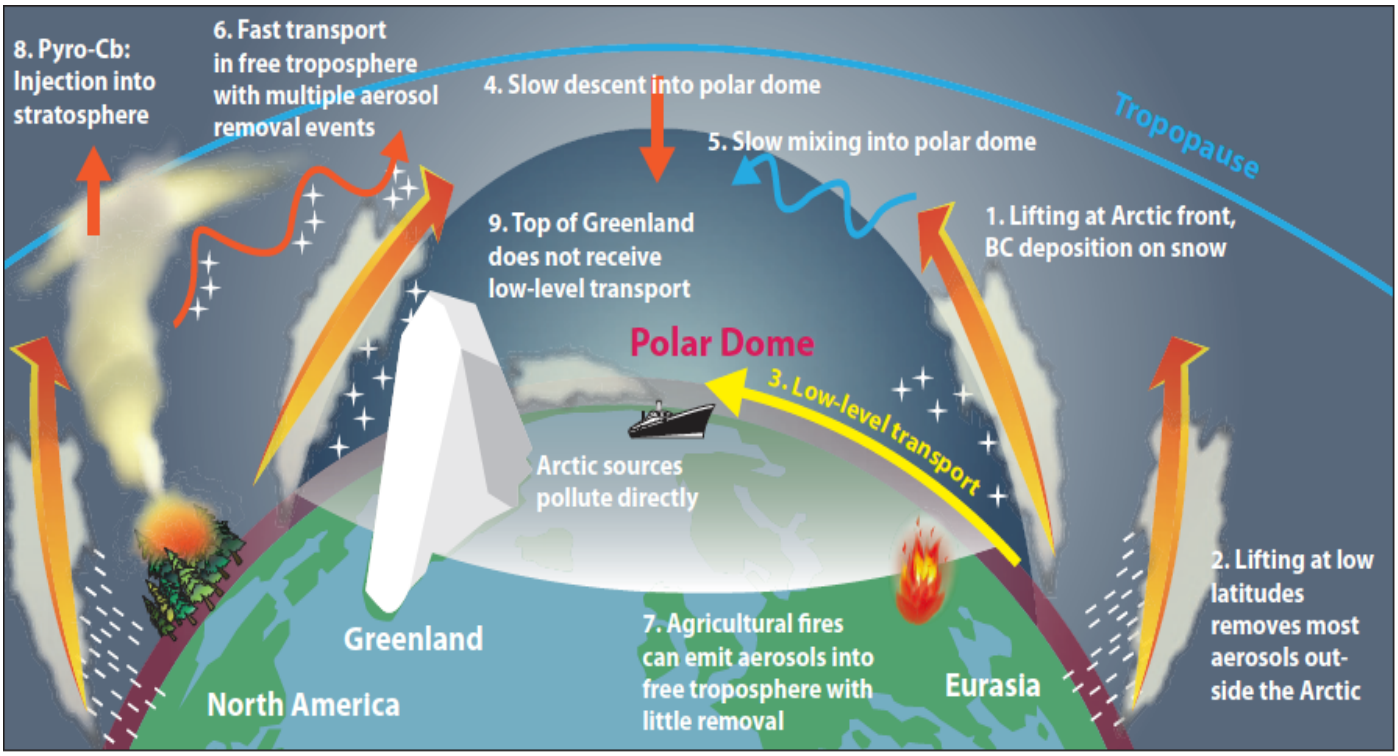
The Arctic Council has reported that the "largest black carbon emission sources in Arctic nations are forest burning and wildfires, and on-road diesel vehicles, followed by residential burning".[38] The same report, along with Stohl, et. al. noted that flaring, particularly at high latitudes, could also be a significant source of black carbon emissions.[39]

Individual Arctic states each have a different distribution of emission sources. In Svalbard, shipping constitutes 90% of black carbon emissions. [40] In Alaska, black carbon is primarily produced by marine vessels (61% of total emissions), followed by open or prescribed burning (10%), heat generation and residential emissions (10%) and land transport (10%).[41] In the Canadian Arctic, 61% of black carbon emissions are attributed to land transport and 14% to residential heating.[42] In Greenland, marine transport in fisheries and shipping were 68% of the total, followed by land transport (13%) and domestic heating (11%).[43] Fishing vessels were also the largest source of black carbon in the Faroe Islands at 61% of the total emitted.[44] In Svalbard, shipping constitutes 90% of emissions. [45]

Other nations have less certain sector-specific inventories, but contributing economic sectors can be estimated nonetheless: off-road land transport in Iceland is consistently estimated to be the largest source of emissions.[46] Oil & gas flaring is the largest source of black carbon emissions in Russia, with estimates as high as more than 90 gigatons per year.[47]

Currently, the Arctic Council's Task Force for Action on Black Carbon and Methane is preparing a framework for Arctic states to report on national action plans to reduce black carbon and methane emissions, building on global emissions reporting and inventories now required under the Convention on Long-Range Transboundary Air Pollution (CLRTAP) and the United Nations Framework Convention on Climate Change (UNFCCC). Amendments were made in 2012 to CLRTAP's Gothenburg Protocol to establish emissions standards for fine particulate matter, including black carbon.

***Figure 2**. Schematic illustration of processes relevant for transport of BC into the Arctic based on the study by Stohl (2006). Source: AMAP 2011*



However, the black carbon reduction goals for 2020 under CLRTAP are voluntary. Fortunately, the Arctic Council's ongoing work on black carbon and methane has left it well positioned to take action to accelerate efforts to reduce these short-lived climate pollutants. The Arctic Council should support continued progress under CLRTAP and the UNFCCC towards comprehensive inventories of black carbon and methane, and the reporting of national mitigation action plans through the renewed Task Force for Action on Black Carbon and Methane. But additional action will be necessary to significantly reduce black carbon emissions and reduce Arctic warming by two-thirds by 2030, according to the United Nations Environment Programme. Through targeted cooperation in areas of mutual interest, the Arctic Council can accelerate deployment of known technologies and practices to slow Arctic warming.

Member states provide funding for Arctic Council meetings, working groups and task forces, but there are additional financial instruments that may be available to support action to reduce black carbon and methane in the Arctic Council. One option is the Arctic Project Support Instrument (PSI), managed by the Nordic Environment Finance Corporation (NEFCO), and designed to attract resources and partners to projects approved by the Arctic Council's Arctic Contaminants Action Program (ACAP) to prevent and mitigate pollution in the Arctic. The EPA has provided $1 million for projects to reduce black carbon emissions from diesel sources in Russia through the Arctic Project Support Instrument.[48] Total pledges to the Arctic Project Support Instrument stand at $19.6 million, and the Russian Federation recently delivered its pledged $10 million that will go towards supporting programs and projects to reduce black carbon and methane. Arctic PSI funded-projects are required to be action-oriented and primarily are intended to identify and develop project concepts. Project funds from the PSI are provided in the form of

grants or loans and can be requested by any relevant stakeholder. Since it is the explicit purpose of PSI financing to support "specific priority projects of the Arctic Council" and to "[enable] more extensive pollution mitigation undertakings," there will certainly be an opportunity for a number of the key sector efforts discussed in this report to be undertaken with financial backing from ACAP and the Arctic PSI. [49]

Modeling outputs show that aggressive action to reduce black carbon emissions from near Arctic sources could lower local warming in the next fifteen years by over 2 °F, [50] slowing the melt of the Arctic glaciers and ice sheets and reducing incidence of sea level rise in the near future. In addition, complementary to existing international efforts to monitor and reduce black carbon and methane, interventions in key sectors could build on existing international cooperation to reduce climate change as well as the ongoing work of the Arctic Council. For example, international transport of black carbon to the Arctic can be addressed through the global deployment of policies and programs that successfully reduce local black carbon emissions in Arctic economic sectors.

This report will focus on specific efforts in each of four key sectors (oil & gas, shipping, residential heating and open burning) that the United States, as Chair of the Arctic Council, and other Arctic states could champion in 2015-2017.

REDUCING EMISSIONS FROM THE OIL & GAS SECTOR

Emissions from Upstream Oil & Gas

Arctic black carbon and methane emissions result from different practices in oil & gas exploration and production. Oil & gas exploration and production account for 20% of global anthropogenic methane emissions, the second largest source of such emissions after agriculture.[51] Methane is over 80 times more potent than CO_2 over 20 years. In oil & gas exploration, production and development, methane comes from venting and leakage. Black carbon emissions from oil & gas largely come from flaring, and from other support operations including transport and power generation.[52]

Figure 3. *Resource basins in the Arctic Circle region. (Source: Energy Information Agency)*

Oil & Gas Exploration, Production and Development in the Arctic

Emissions from oil & gas development represent a significant mitigation opportunity. The Arctic region contains 13% of the world's undiscovered conventional oil and 30% of its undiscovered conventional natural gas reserves.[53] Estimates total 90 billion barrels of oil and 1,669 trillion cubic feet of natural gas.[54]

The same United States Geological Survey noted that approximately 84% of those reserves are expected to occur offshore. 70% of undiscovered oil resources are located in Arctic Alaska, the Amerasia Basin, West Greenland-East Canada, the East Greenland Rift Basin and the East-Barents Basin, depicted in Figure 1. Additionally, 70% of undiscovered natural gas is estimated to occur in the West Siberian Basin, the East Barents Basin and Arctic Alaska.[55]

There are a number of barriers that slow Arctic oil & gas exploration, production and development. Arctic projects require long lead times, often 3 times longer than in other regions. Current sanctions have put a temporary hold on work in the Russian Arctic. It was recently reported that Exxon-Mobil left nine out of ten projects around the Russian Federation, including a large recent find in the Russian Arctic, due to sanctions imposed by the United States.[56]

Despite sanctions and the significant safety risks and environmental challenges associated with Arctic oil & gas operations (particularly offshore) plans to pursue development in the Russian and North American Arctic are going forward. Shell has invested over $4.5 billion in exploration in the Alaska Arctic,[57] and earlier this fall filed plans in readiness for drilling in the

2015 open water season in the Chuckchi Sea.[58] Russia recently announced plans to invest $400 billion on Arctic oil & gas development in the next two decades.[59] These projections indicate that despite existing barriers and without action, flaring and venting in the Arctic region will only increase.

Current Efforts to Address Upstream Oil & Gas Emissions

There are a number of ongoing international efforts that seek to address methane and black carbon emissions from the oil & gas sector. These include the Climate and Clean Air Coalition, the Global Gas Flaring Reduction Partnership, the Global Methane Initiative, and the Natural Gas STAR Program, among others.

The ***Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC)*** has found that black carbon emissions from oil & gas operations accelerate warming of the polar ice cap.[60] The CCAC has an initiative under way called the Technology Demonstration and Evaluation for the Recovery of Hydrocarbons that could be leveraged to support deployment of best practices for reduction of black carbon emissions by reducing flaring in Arctic oil & gas development and focusing on recovery of high value liquids from flaring. The current CCAC initiative will be implemented by a number of organizations with ties to the Arctic, including the World Bank's Global Gas Flaring Reduction Partnership (GGFRP), the International Cryosphere Climate Initiative, the Petroleum Technology Alliance of Canada, the Stockholm Environmental Institute, and Carleton University.[61] The next logical step would be to link the work of the Arctic Council Task Force for Action on Black Carbon and Methane, as it continues under the U.S. Chairmanship, to this initiative, and expand the initiative to include additional Arctic partners.

The CCAC has also created a Methane Partnership, a voluntary initiative to reduce methane emissions in the oil & gas sector. Among the founding companies of the Methane Partnership are leaders in Arctic upstream oil & gas development – Statoil & ENI. The Methane Partnership was founded to provide a credible mechanism for companies to address their emissions and communicate their progress to stakeholders. The Methane Partnership includes important international technical partners such as the U.S. EPA's Natural Gas Star Program, the Global Methane Initiative, and the Global Gas Flaring Reduction Partnership. Companies that join the Methane Initiative voluntarily commit to surveying their upstream operations for sources of methane, evaluating cost-effective technologies for implementation and abatement, and reporting progress annually to the Partnership. The Methane Partnership then makes these efforts publicly available on their website. CCAC partners are committed to supporting companies with technical assistance, development of policies and practices to promote and support emission reduction activities around the globe. The goal of the CCAC Methane Partnership is to "create a global standard in controlling methane emissions in oil and gas systems."[62]

The ***Global Gas Flaring and Reduction Partnership (GGFRP)*** is an international partnership focused on reducing flaring. The flagship global initiative of the World Bank's GGFRP is "zero routine flaring by 2030."[63] The goal of the GGFRP is to create opportunity for reutilization of gas through work with governments, oil companies and development institutions. Governments provide the regulatory and operating environment to encourage companies to make upstream investments that can abate methane and black carbon emissions and reduce flaring. Additionally, participating governments require that development plans "incorporate sustainable utilization or conservation of the field's associated gas without routine flaring."[64] Companies in the GGFRP commit to developing new resources incorporating the same utilization and conservation of associated gas. In existing oil fields, companies are expected to seek viable solution to end flaring by 2030. Development initiatives are expected to use financial instruments and other tools at their disposal to facilitate implementation. The GGFRP also has efforts underway to do public reporting of

annual progress.[65] The GGFRP's focus on overlooked opportunities to recover valuable light hydrocarbon liquids and promote uptake and implementation of technologies to manage stranded gas is an important approach to consider in the Arctic.

The ***Global Methane Initiative (GMI)*** is a "voluntary, multilateral partnership that aims to reduce global methane emissions and to advance the abatement, recovery and use of methane as a valuable clean energy source." The GMI is an international network of private sector members, development institutions, universities, non-governmental organizations and governments. These groups work together to "build capacity, develop strategies and markets, and remove barriers to project development for methane reduction" in participating countries. The GMI focuses on the five main global methane emissions sources, including oil & gas systems. The U.S. Environment Protection Agency is the chair of the steering committee and the administrative support group; Canada, Mexico and Russia are the co-chairs of the oil & gas subcommittee.

As a leader of both the steering committee and the administrative support group at the Global Methane Initiative (GMI), the E.P.A. is involved in guiding the work of the GMI at many levels, including hosting the effort at the E.P.A. The oil & gas subcommittee action plan of the GMI outlined specific action including sharing of existing studies and successful projects, conducting market assessments, identifying cooperative activities to increase methane recovery and use, and identifying project finance opportunities.[66]

The GMI Project Network consists of organizations, stakeholders, and institutions that have an interest in supporting methane abatement projects in participating countries. "Project Network members share their technical expertise, experience, and financial resources and are encouraged to attend subcommittee meetings and participate in developing sector-specific Action Plans. They also participate in specific activities such as capacity building, technology transfer, and outreach."[67] A number of Project Network members are involved in Arctic oil & gas methane and black carbon emission abatement efforts, including Clean Air Task Force, Carbon Limits, the World Bank (host institution for the Global Gas Flaring Reduction Partnership), ConocoPhilips – Canada, British Petroleum, and American Petroleum Institute.

The ***Natural Gas STAR Program*** is a voluntary partnership of oil and natural gas companies interested in adopting cost-effective technologies, improving operational efficiency, and reducing emissions of methane.[68] Partnership with the Natural Gas STAR program means that companies commit to "improving environmental performance through implementation of cost-effective technologies and practices to reduce methane."[69]For offshore petroleum development, Natural Gas STAR provides technical documents that promote technology transfer, share best practices, and provide a full list of emission mitigation options. Natural Gas STAR participating companies include Shell, ConocoPhilips, ExxonMobil, BP and Chevron.

In addition to these ongoing international efforts, a number of oil & gas producer associations are also engaged in reducing short-lived climate pollutants from the upstream oil & gas sector. Notably, the International Petroleum Industry Environmental Conservation Association (IPIECA) provides good practice guidance and support to its members, which include Arctic offshore lease-holders such as Eni, Statoil, Shell and ExxonMobil. Additionally, the International Oil & Gas Producers Association (OGP) has an Arctic Committee focused on developing a long term strategy for addressing key Arctic issues for the upstream industry. [70]

Arctic Council Work to Reduce Black Carbon and Methane from Upstream Oil & Gas

Within the Arctic Council, there are a number of existing Task Forces and Working Groups, as well as other ancillary initiatives, that could assume responsibility for reducing black carbon

and methane emissions from oil & gas exploration, production and development. The Task Force for Action on Black Carbon and Methane has a mission to reduce short-lived climate pollutants in the Arctic region. , and is finalizing a strong Arctic mechanism to summarize national reporting, collect inventories and possibly even set national targets and benchmarks for emission reductions If agreement is reached by April 2015 for a mechanism through which Arctic states can submit national action plans outlining proposed action to reduce black carbon and methane, this Task Force, should it continue, will be in need of a new mandate. A possible future work plan for the Task Force could include coordinating with international efforts like the CCAC & GGFRP, supporting and advising Arctic states on how to link national planning to those efforts, and even sustaining as a home for Arctic-specific initiatives that build on other efforts.

The AMAP Expert Group for Black Carbon and Tropospheric Ozone and the AMAP Expert Group for Methane are currently completing reports that will summarize the state of black carbon and methane emissions in the Arctic. These Expert Groups provide an important and independent scientific perspective to the Arctic Council, and should continue to perform an advisory role to actionable initiatives as they take shape and are implemented at the Arctic Council. Regular meetings and specific work products from AMAP may not be necessary, but these two Expert Groups will need to play an important review role for reporting and initiative planning.

The newly minted Arctic Economic Council (AEC), an initiative of the Canadian government, is well positioned to be involved in these discussions through appointed members, including Rosneft. The AEC should be inclined to support and engage in best practices efforts that will lead to improved environmental performance, given the current widespread criticism that has been leveled at its members for exploiting the fragile Arctic region.[71] Additionally, this organization provides an opportunity to establish an advisory role for business to improve environmental practices in the Arctic region. Most importantly, to achieve implementation of best practices on the ground in the Arctic, any effort to reduce emissions from oil & gas will need to support of the companies responsible for exploration, production and development.

Next Steps for Reducing Upstream Oil & Gas Methane and Black Carbon Emissions in the Arctic

The United State should lead an effort to coordinate new Arctic Council work to reduce emissions from upstream oil & gas with support from other international initiatives. Prioritizing the application of best practices could result in significant, near-term emission reductions.

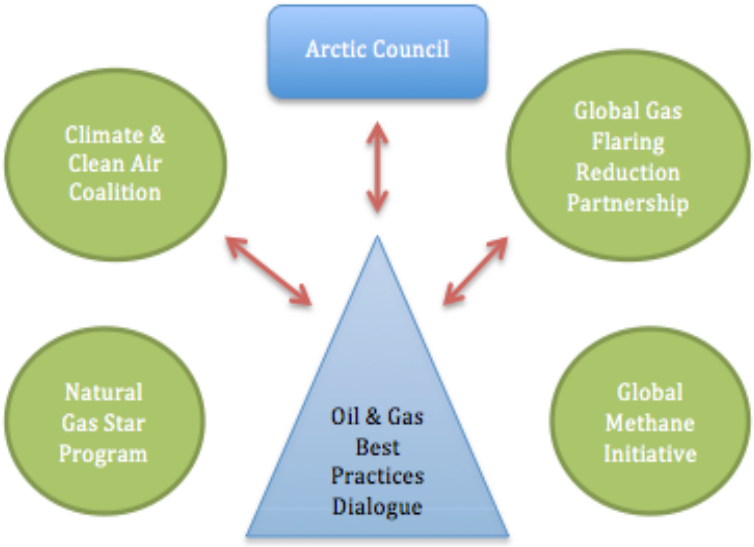
There is a strong business case for reducing methane and black carbon emissions from Arctic exploration and production.[72] A recent study by Carbon Limits estimated that methane emission reductions in Arctic oil & gas exploration, production and development present negative abatement costs, meaning application of technologies that result in methane emission reductions will result in economic gains to companies.[73] The same report noted that methane abatement costs for the majority of cases are below $30 per ton of carbon dioxide equivalent. By comparison, black carbon abatement is more costly than methane abatement. But the high environmental cost to the climate system of flaring in the Arctic means a strong policy case can support private sector action and dissemination of best practices.

Work to reduce black carbon and methane emissions from oil & gas exploration, production, and development in the Arctic will necessarily have to adapt the work of the GGFRP, the GMI, Natural Gas STAR and the CCAC to fit the standing Arctic Council model of cooperation. Collaborative initiatives to reduce flaring (or, for that matter, any programs to reduce black carbon in the Arctic) must be presented in and formatted in a way that is consistent with the inclusive, consensus-style collaboration of Arctic Council working groups and task forces. In particular, since the GGFRP is a collaboration of governments and companies

only – an Arctic Council effort must include permanent participants and observers, including non-government organizations.

Most importantly, an Arctic initiative focused on black carbon and methane emissions from the oil and gas sector must achieve serious, practical reductions in leaks, venting, and flaring in the Russian Arctic. Engagement with multinational companies that share lease holdings and technology with Russian companies should be a focal point for cooperation. Additionally, where possible, existing engagement with Russian companies through the Arctic Economic Council, oil & gas industry associations, or other international forums should be leveraged to ensure complete regional cooperation.

Diagram 1. *An Arctic Council-led best practices dialogue for reducing black carbon and methane from upstream oil & gas could receive funding from and provide policy recommendations to a number of existing international initiatives.*



Reductions in leaks, venting, and flaring should be achieved through the application of a number of best practices. Among these are: bringing gas to market through pipelines, and viable alternatives to flaring including capture and export of marketable products (e.g., liquids), CNG or mini-LNG production and transport, maximum use of gas onsite for running equipment, electricity production, and trucking, reinjection into geologic formations [74] Only where and to the extent that none of these alternatives is feasible should flaring be allowed.

An early voluntary agreement by major oil and gas producers to adhere to these best practices should be the key goal of an Arctic Council effort under the U.S. Chairmanship. Convening an Arctic oil & gas dialogue would create a partnership between leading oil and gas companies, pragmatic environmental organizations, key research and consulting institutions, national and state (provincial/oblask) officials, and other Arctic stakeholders, aimed at reducing the short-lived climate pollutant emissions footprint of Arctic hydrocarbon production. Through the key tenant of consensus policy-making, the Arctic Dialogue will develop and recommend solutions for best-practice production, management and utilization of oil & gas upstream.

Work to reduce black carbon and methane emissions from oil & gas exploration, production and development in the Arctic through dissemination of best practices will necessarily have to adapt the work of the GGFRP, the GMI, Natural Gas STAR and the CCAC to fit the standing Arctic Council model of cooperation. Most importantly, collaborative initiatives to reduce leaks, venting, and flaring (or, for that matter, any programs to reduce methane and black carbon in the Arctic) must be presented and formatted in a way that is consistent with the inclusive, consensus-style collaboration of Arctic Council working groups and task forces. For example, the GGFRP is a collaboration of governments and companies only – an Arctic Council effort must include permanent participants and observers, including non-government organizations. To avoid "initiative fatigue" on the part of oil & gas companies and industry associations, this project should build on other international efforts as much as possible. But this program will need to stand alone to ensure the participation of all needed Arctic states and stakeholders. Member states and companies will need to be a part of the consultation process and program design, in the very the early stages of implementation, and

in any resulting oversight and reporting mechanisms.

A best practices dialogue to address emissions from upstream oil & gas should focus on building a "floor" of practices that developers agree to observe throughout the Arctic until protective regulations can be promulgated by each of the Arctic states. Identification of these practices will be undertaken by consensus of participating companies, organizations and individuals. The broad objectives of this work should be to: create a community of stakeholders; engage in long-term, regular, and facilitated dialogue concerning oil & gas development in the Arctic that ensure environmental protections, focused on reducing short-lived climate pollutants.

Other similar efforts have seen the benefit of multi-stakeholder efforts that are independently facilitated. In the United States, this policy model has been used to reduce air emissions in the Marcellus Shale region, through the Center for Sustainable Shale Development. In order to make a dialogue such as this successful, the focus needs to be on joint development of the scope, plans, and goals of the effort with other Arctic Council member states and stakeholders in the first meetings of a dialogue. In addition to a voluntary agreement to reduce emissions through consensus recommendations, this type of a stakeholder dialogue could facilitate other Arctic-specific work on upstream oil & gas – scientific and technical advisory, briefings and educational sessions, joint field visits, and demonstration projects. Technical cooperation in the difficult Arctic operating environment is of particular interest to oil & gas companies preparing for exploration, production and development in the region.

The administrative costs of a dialogue at the Arctic Council could be funded through a number of the current international efforts that deal with black carbon and methane emissions. The Climate and Clean Air Coalition's Methane Partnership is assembling possible sources for funding methane reduction projects, and the Global Gas Flaring Reduction Partnership is preparing a possible Arctic-focused project through its existing World Bank program. Alternatively, the dialogue could be framed as an independent project, with implementing agencies and partners seeking a grant from the Arctic Project Support Instrument, to be approved by the Arctic Contaminants Action Program. A final option would be to ask participants to fund the effort as has been done in domestic efforts like the Center for Sustainable Shale Development.

The climate forcing effects of locally emitted black carbon in the Arctic and the global contribution to climate emissions of methane from upstream oil & gas present a meaningful abatement opportunity. An effort to reduce these emissions should be undertaken now, early on in the stages of Arctic offshore and ice-bound exploration, development and production. Moving an effort forward under the United States Chairmanship gives upstream companies an opportunity to participate in an Arctic initiative, preserving the long-term "social license to operate" of oil & gas companies in the region. Most importantly, U.S. leadership to facilitate discussion around and reach agreement to reduce black carbon and methane reductions from upstream oil & gas activities in the Arctic can move forward action regionally and reduce practices that accelerate Arctic warming.

ADDRESSING RISING BLACK CARBON EMISSIONS IN THE SHIPPING SECTOR

The Price of Heavy Fuel Oil in the Arctic

Combustion of heavy fuel oil (HFO) by ships traveling in the Arctic and near Arctic regions creates black carbon emissions, damaging human health and contributing to local Arctic warming and increasing the pace of Arctic snow and ice melt. A ban on HFO use by Arctic shipping, with the resulting switch to low-sulfur marine distillate fuel, could produce reductions of shipping black carbon emissions by up to 80%.[75] Such a ban would also facilitate the use of more effective emission control technologies such as particulate filters, reducing black carbon and other particulate emissions even further.

The United States, as Chair of the Arctic Council next year, should support action following on the work of the Task Force for Oil Pollution and Prevention that includes submission of an Arctic Council member states declaration to the International Maritime Organization (IMO) recommending the adoption of a ban on heavy fuel oil in the Arctic Ocean as part of the next round of the IMO's Polar Code negotiations. Such a ban is already in place for ships sailing in the Antarctic region.

Banning HFO use by ships in the Arctic will have other benefits beyond reducing black carbon emissions. Most importantly, accidental oil spills and discharges are a major concern in the Arctic Ocean. An HFO spill in the Arctic could severely harm the region's unique ecosystems and species, many of which are already threatened or endangered, as well as Arctic indigenous peoples and coastal residents. While spills of distillate marine fuel would also be harmful, the impacts would be expected to be substantially less than those from an HFO spill.[76] An HFO ban would also reduce the disposal of sludge, a heavy fuel oil byproduct, which currently accounts for nearly 85% of illegally discharged oil from shipping,[77] or 255,700 metric tons worldwide in 1999.[78]

Rising Shipping Activity in the Arctic

Global climate change has caused a substantial drop in Arctic sea ice extent and thickness in recent decades.[79] These trends have made

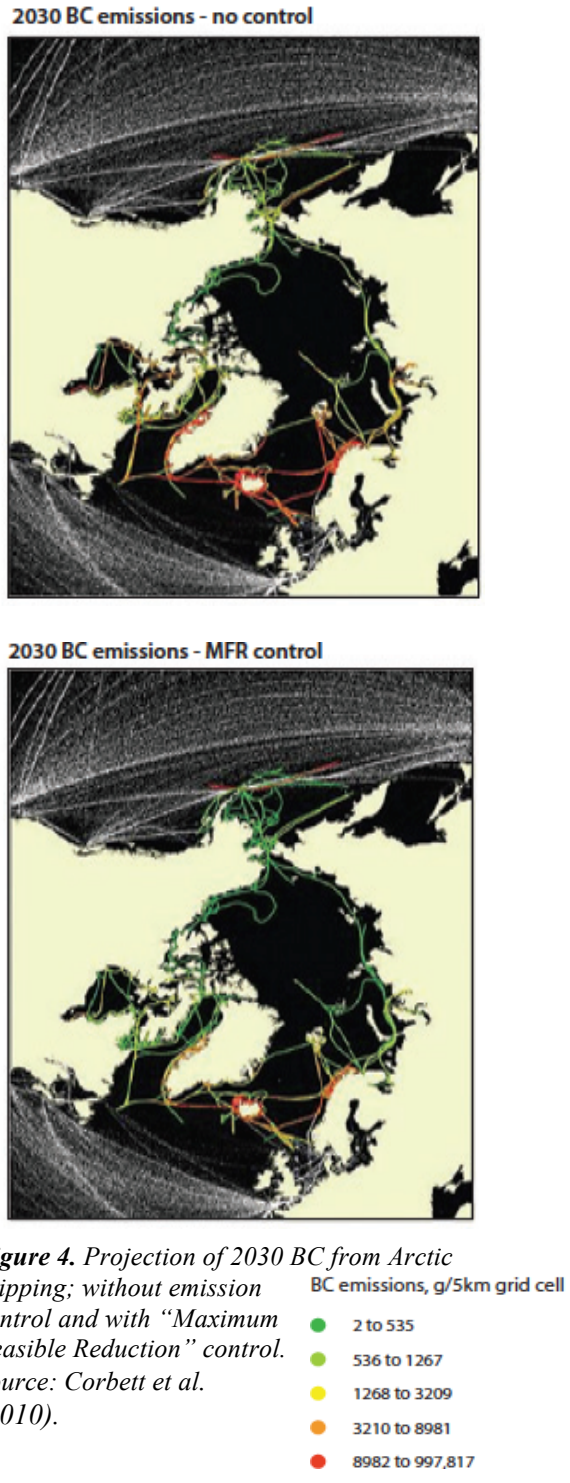


Figure 4. *Projection of 2030 BC from Arctic shipping; without emission control and with "Maximum Feasible Reduction" control. Source: Corbett et al. (2010).*

shipping increasingly viable within the Arctic Circle, with possible distance savings of up to 50% for the Northern Sea Route along Russia's northern coastline.[80] Although there are various uncertainties and challenges facing shipping operations in the Arctic that may slow development, such as the lack of key infrastructure and regulation of vessel traffic, as shipping traffic increases so too will black carbon emissions.

Currently, Arctic shipping does not account for a significant amount of black carbon emissions when compared with other sectors. However, shipping represents an increasing local source of Arctic pollution,[81] and emissions from ships as far south as 40 degrees may impact Arctic climate.[82] Since 2010, Arctic shipping traffic has seen double-digit expansion,[83] and it has been estimated that black carbon from Arctic shipping could increase from 1 gigaton to 5 gigatons per year in the next few decades.[84] As a result, Arctic shipping emissions of black carbon have been projected to increase by 2030 to more than three times BC emissions from Arctic oil and gas operations using best practices, with additional disparity expected by 2050.[85]

As a result, increased shipping traffic, combined with the projected decline in black carbon emissions from other sectors, such as land transport, could dramatically increase the relative importance of Arctic shipping emissions in the coming years. Thus, future ship traffic in the Arctic will be one of the important sources of direct emissions of black carbon into the Arctic.[86] Moreover, because Arctic shipping emissions occur farther north than many other sources of emissions, they may have an even stronger regional impact.[87] Without meaningful controls, projected black carbon emissions from shipping could have a dramatic impact on Arctic warming (see figure 3).

The Arctic ice environment is a particular challenge for shipping emissions, because there is an inverse relationship between engine load and black carbon emissions.[88] As ice conditions vary, the cycle of high loads, ice breaking activity and lower load operation can result in higher black carbon emissions.[89] As mentioned above, switching from heavy fuel oil to distillate fuel or biofuels has been shown to result in a potential 80% decrease in black carbon emissions.[90] Thus, studies have found that among "…the most effective measures for reducing BC from Arctic shipping would be through the use of… higher quality fuel."[91]

Ongoing Work to Reduce Black Carbon and Methane Emissions in Shipping

The ***IMO*** is the international body responsible for negotiating the new Polar Code to govern shipping traffic in the Arctic Ocean. This November, the section on "safety measures for ships operating in polar waters" will be up for adoption.[92] The IMO will finalize its work on a (quite limited) section on pollution prevention next year. However, despite numerous proposals to include a more robust and comprehensive set of environmental measures as part of the Polar Code, the initial version of the Code contains very little in the way of environmental measures, and nothing at all to limit air pollutants such as black carbon, regulate marine fuel quality or mitigate climate change. The IMO is planning to conduct a second phase of Polar Code negotiations in the next few years. It will be critical that robust environmental provisions are included in the Polar Code this time around, including a ban on the use of HFO by Arctic shipping.

At the Arctic Council, there have been several efforts to address issues related to shipping. First was the Arctic Marine Shipping Assessment (AMSA), which was written in 2009 and provided policy advice and recommendations on marine safety and environmental protection as related to shipping. At the Kiruna Ministerial, an update on the status of implementation of those report recommendations was offered to the AMSA. This updated report outlined key progress on a few main issues areas: enhancing marine safety, protecting Arctic people and the environment, and building Arctic infrastructure. In response to the AMSA, the Protection of the Arctic Marine Environment Working Group

(PAME) identified "options for mitigating the risk of vessel use and carriage of heavy fuel"[93] In accordance with the recommendations from AMSA, PAME also monitors and supports the development of a Polar Code at the IMO. Additionally, PAME and member governments have undertaken a number of projects to support and complement the Polar Code, including those that identify the risks associated with vessel use and carriage of heavy fuel oil, as well as the environmental impacts – all with the objective of developing recommendations for member governments to pursue at the IMO.[94] The Arctic Council is also facilitating work to survey the use of marine resources by indigenous peoples through the Arctic Biodiversity Assessment, discussing protection of key areas from marine traffic through possible special designation of protected Arctic marine areas, addressing the regional infrastructure deficit, improving search and rescue capabilities, and working on oil spill prevention.

The Task Force for Oil Pollution and Protection was founded to explore ways for the Arctic Council to "advance oil pollution prevention in the Arctic."[95] And it is currently developing an action plan for oil pollution prevention that is expected to focus on safety measures that will prevent oil pollution from maritime and petroleum activities. The Task Force is building on previous work by the PAME and EPPR Working Groups, including a set of recommendations on the prevention of marine oil pollution in the Arctic. In addition to producing an action plan, the Task Force is expected to work on creating relative cooperative arrangements to carry out those deliverables by the Iqaluit Ministerial in 2015. [96]

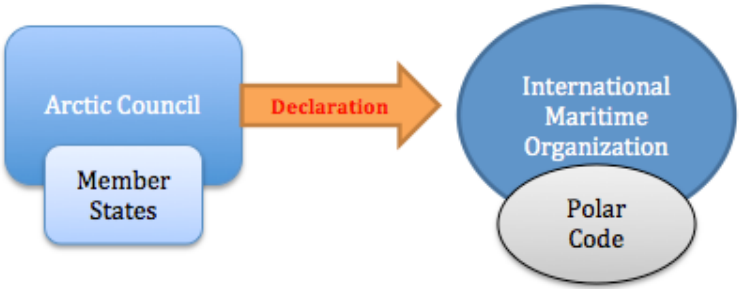
Next Steps to Reduce Emissions from Shipping in the Arctic

Because discussions to include new environmental protections in the International Maritime Organization (IMO) Polar Code are already underway, and because the Arctic Council is not in a position to regulate international shipping, Arctic Council member states should be encouraged to take steps to ensure strong action at the IMO. The Arctic Council can do this by sending strong policy signals, such as a member state declaration supporting a heavy fuel oil ban, and also by expanding its own technical work on shipping emissions.

Technical shipping work in the Arctic Council's PAME and EPPR working groups could focus on updated studies of the impact of black carbon emissions on the Arctic environment and climate, as well as BC control options, which could then be carried forward, publicized and provided to the IMO and other parties and bodies interested in the environmental impacts of international shipping on the Arctic. Such a control options document could serve as a roadmap for implementing cost-effective reductions in shipping emissions of black carbon.

To reduce black carbon emissions in the Arctic Ocean, the International Maritime Organization should be urged to include a ban on the use of heavy fuel oil by Arctic shipping in the Polar Code. Such a ban would clear the way for cleaner combustion and enable the implementation of more effective control technologies. To lead on this effort at the Arctic Council and the International Maritime Organization, the United States will need to signal that it is serious about the negotiations and assessments, and will need to make a strong case to other Arctic Council members and observers.

Diagram 2. *A declaration supporting the ban of heavy fuel oil from Arctic Council states should be delivered to the International Maritime Organization.*



also would minimize the possibility of a disastrous heavy fuel oil spill, which could set back shipping, oil & gas work, and other economic development opportunities in the region for years.

The Arctic Council has already consolidated cooperation between Arctic states around shipping assessments, updates and progress reports, as well as oil spill pollution and prevention. It is reasonable to expect that regional cooperation to ban the use of heavy fuel oil can build on existing cooperation in the Arctic.

A key precedent for banning heavy fuel oil in the Arctic Ocean is the existing ban on heavy fuel oil in the Antarctic Ocean. Decision 8 (2005) "Use of Heavy Fuel Oil (HFO in Antarctica" stated that the International Maritime Organization should examine a "mechanism for restricting the use of heavy fuel oil" in Antarctic waters, with concern for the risk of fuel discharge and the "high potential of environment impacts associated with a spill and emission of HFO in the Antarctic Treaty area." At the Arctic Council, the U.S. and other states should work towards a declaration supporting a heavy fuel oil ban in the Polar Code that resembles this language. To accomplish this, the Arctic Council should build on the action plan to be delivered by the Task Force on Oil Pollution and Prevention and increase cooperation on shipping and on the study of emission control options.

To fund these projects and additional studies, the Arctic Council has a number of resources at its disposal. The ongoing work of the Protection of the Arctic Marine Environment, the Emergency Prevention, Preparedness and Response, and Conservation of Arctic Flora and Fauna Working Groups could support these efforts.

In view of the above, the United States should advocate for the adoption of a declaration to ban heavy fuel oil in the Arctic Ocean and should support a renewed focus of work in the Arctic Council on the assessment of environmental and climate impacts from black carbon emissions from ships and on control options to reduce those emissions.

LIMITING SHORT-LIVED CLIMATE POLLUTANT EMISSIONS FROM RESIDENTIAL HEATING

Sacrificing Wages and Wellness for Heat in the Arctic

Diesel fuel burning from land transport represents a declining percentage of black carbon emissions in the Arctic.[97] Under existing domestic regulations around the Arctic, black carbon emissions are projected to decline by approximately 35% in the next few decades [98] largely due to new particulate matter controls on new diesel engines and improved diesel fuel quality. Nevertheless, the Summary Report to the Arctic Council from the Task Force on Short-Lived Climate Forcers noted that "residential combustion is projected to remain or become the key anthropogenic source of black carbon" in the Arctic.[99]

In addition to impacting the climate, burning diesel fuel has significant negative health impacts. The World Health Organization recently reclassified diesel engine exhaust as a carcinogenic due to its documented connection to increased rates of lung and bladder cancer.[100]

Impacts on Arctic communities go beyond health – in Alaska, some rural villagers spend more than 50% of their take-home pay on imported fossil fuels.[101] Space heating and cooling accounts for 60% of all energy consumed in buildings in cold climates, particularly in Russia.[102] In a business as usual scenario, it has been estimated the Alaska will spend $5 billion on diesel fuel in the next 20 years.[103]

Current Efforts to Expand Access to Clean & Renewable Energy and Improve Energy Efficiency in Arctic Communities

A number of efforts to reduce the use of diesel fuel, expand the access to clean and renewable energy and increase energy efficiency in the Arctic are already underway. In the United States, the cost of improving energy efficiency programs has dramatically declined in recent years, even in the Arctic. The Alaska Housing Finance Corporation has reduced energy costs in over 17,000 homes by 33% and created almost 4,000 jobs.[104] Wind-diesel hybrid systems in extreme cold climates have been demonstrated to substantially reduce the use of costly diesel fuels. Newly installed systems in St. Paul, Alaska have instantaneous wind penetration levels close to 100% and the addition of wind to Kodiak, Alaska's diesel-hydro system is now saving that community more 1.5 million gallons of diesel per year.[105] Kodiak now gets 89% of its power from renewables, including wind and hydro, which have generated savings of $3.6 million in the past two years.[106]

Alaska has set two goals related to clean energy: meeting 50% of its electricity needs through renewable energy by 2025; and reducing energy consumption per capita by 15 percent by 2020. A number of funding mechanisms exist to reach these goals. The Alaskan Energy Efficiency Revolving Loan Fund was created and funded with $250 million. The Alaskan legislature also established the Emerging Energy Technology Fund to support technologies with commercial viability and plans to continue the program through 2019. Finally, the Renewable Energy Grant Fund is an additional clean energy financing mechanism for Alaska that commits $50 million per year to clean energy projects.[107] In total, the Alaska legislature has appropriated more than $300 million to clean energy projects and programs.

Throughout the United States, the U.S. Department of Agriculture (USDA) has existing programs that apply to rural electric cooperatives, including the Energy Efficiency and Conservation Loan Program, which provides rural utilities up to $250 million to lend to residential and commercial customers for energy efficiency improvements and renewable energy systems. In addition, the U.S. Department of Energy (DOE) has national programs like the Advanced Research Projects Agency-Energy that also contributes to funding projects that accelerate the deployment of clean and renewable energy.

Other Arctic nations also have experience with increasing access to clean energy in Arctic communities. Norway currently gets 97% of its electricity from renewable sources.[108] And in

2012, Sweden met its target of 50% renewable energy use eight years ahead of schedule.[109] If all Arctic nations were to support similar programs, Arctic consumers could realize significant energy savings by reducing their reliance on diesel fuel.

Finally, at the Arctic Council, Canada has focused its Chairmanship on "development for the people of the North." The Sustainable Development Working Group at the Arctic Council is primarily responsible for improving conditions in Arctic communities and advancing sustainable development goals.[110] The Sustainable Development Working Group, among its many guiding principles and areas of activity, focuses on adaptation to climate change and energy for Arctic communities. On clean energy, the Sustainable Development Working Group is tasked with considering future projects and activities.[111] The Arctic Council is already piloting wind-diesel hybrid projects in rural communities and exploring energy efficient buildings in cold temperatures.

Next Steps for Expanding Access to Clean & Renewable Energy in Arctic Communities

A number of existing domestic and international initiatives can be scaled up to expand access to clean energy in the Arctic and simultaneously reduce black carbon emissions. There is a need to grow Arctic expertise in technologies for clean and renewable energy production, to create economic and environmental sustainability in Arctic communities, and to avoid emissions creation through either the burning of diesel fuel and through the waste of stranded gas resources.

As the Arctic Council Chair, the U.S. can build on and leverage existing international energy partnerships, such as SE4ALL, the Clean Energy Ministerial, and the U.S.-Canada Clean Energy Dialogue.

Out of a partnership of these international efforts and the Arctic Council, new and unique projects for Arctic communities could be assessed. A focus in the Arctic Council will need to be assessing specific options for the phasing out of high cost diesel products in residential heating. Consistent with our recommendations for deploying alternatives to flaring in the first recommendation above, utilization of natural gas, often a stranded by-product of oil development & exploration in the Arctic, could provide one possible solution.

Among those programs that need to be examined are the current work on energy efficiency in cold buildings, programs for building weatherization, use of stranded natural gas from the Arctic for residential heating, emerging energy technologies, and renewable energy projects (potentially including microgrids, distributed generation, CHP, wind-diesel hybrid power systems, wind-solar-gas systems and advanced building technologies). The Arctic Council should also seek to leverage its structure to convene stakeholders, including private sector representatives from the Arctic Economic Council under the Sustainable Development Working Group to assess clean and renewable energy options for the Arctic

All Arctic nations could benefit from cooperation on clean & renewable energy. Russia, which has the highest rates of urbanization and is projected to make the largest investment in Arctic infrastructure over the next

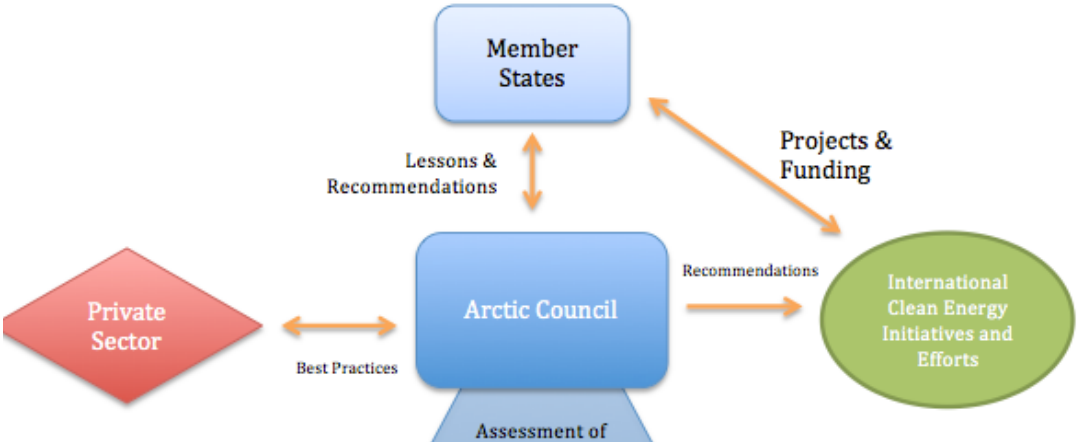


Diagram 3. *An assessment of clean and renewable energy options (with a focus on eliminating reliance on diesel) should be coordinate at and disseminated by the Arctic Council, with the support of the private sector and member states*

decades, has the most to gain by reducing energy costs. It currently faces the greatest risk to infrastructure investment from permafrost melt, so exploring possible clean energy solutions is an excellent opportunity to boost cooperation in the Arctic Council. Russia and other Arctic states could benefit greatly from the sharing of best practices for cold building energy efficiency. Additionally, initiatives & assessments that deal with clean energy, energy efficiency and renewable energy fit well with Canada's current focus on development for the people of the North. The Nordic states, as leaders in energy efficiency, also bring a substantial amount of interest and expertise in clean energy to the Arctic Council.

Through the Sustainable Development Working Group at the Arctic Council, the United States should facilitate the creation of a community of practice (CoP) to share and disseminate clean energy best practices. The focus of this assembly should be to explore possible solution for the displacement of diesel with clean, renewable energy options. This effort and assessment should involve private sector representatives to the Arctic Economic Council as well as others to share technology and share best practices. The Arctic Council has the unique ability to convene experts from all sectors to do an assessment and follow-on discussion of application for real, scalable opportunities to displace diesel in the Arctic.

This would build on Canada's efforts to encourage development for people of the North, but will focus Arctic Council cooperation once again on its environmental mandate. In addition, there are already domestic efforts ongoing in Alaska and around the Arctic that could be expanded to create this international community of practice at the Arctic Council. One example is the Renewable Energy Alaska Project, which is leading a CoP for wind and wind-diesel hybrids. The Sustainable Development Working Group's Community of Practice assessment should assemble lessons that inform the financing of projects, through public-private partnerships and other opportunities, around the Arctic region.

Supporting Arctic communities in achieving their goals for development, sustainability and protected livelihoods will be an essential component of U.S. leadership in the Arctic Council. Reducing emissions of black carbon from the residential sector is an important step in curbing Arctic warming and an opportunity for the United States to support circumpolar communities.

CURBING OPEN BURNING AND BLACK CARBON EMISSIONS IN THE ARCTIC

Forest and Agricultural Fires Transport Black Carbon into the Arctic

Open burning, which includes agricultural, forest and grassland fires, is the primary source of black carbon in the Canadian and Russian Arctic, according to the Task Force on Short-Lived Climate Forcers.[112] Forest fires, or wildfires, are uncontrolled areas of fire in the wilderness. Agricultural fires are a prescribed management tool for controlled burning used by the agricultural community to clear chaff or the byproducts of a harvest. Both of these contribute to black carbon emissions and are interrelated. Although exact relative estimates of anthropogenic and natural forest fire emission sources are not known, in Russia for example, officials have stated that 98% of forest fires are attributable to agricultural burning.

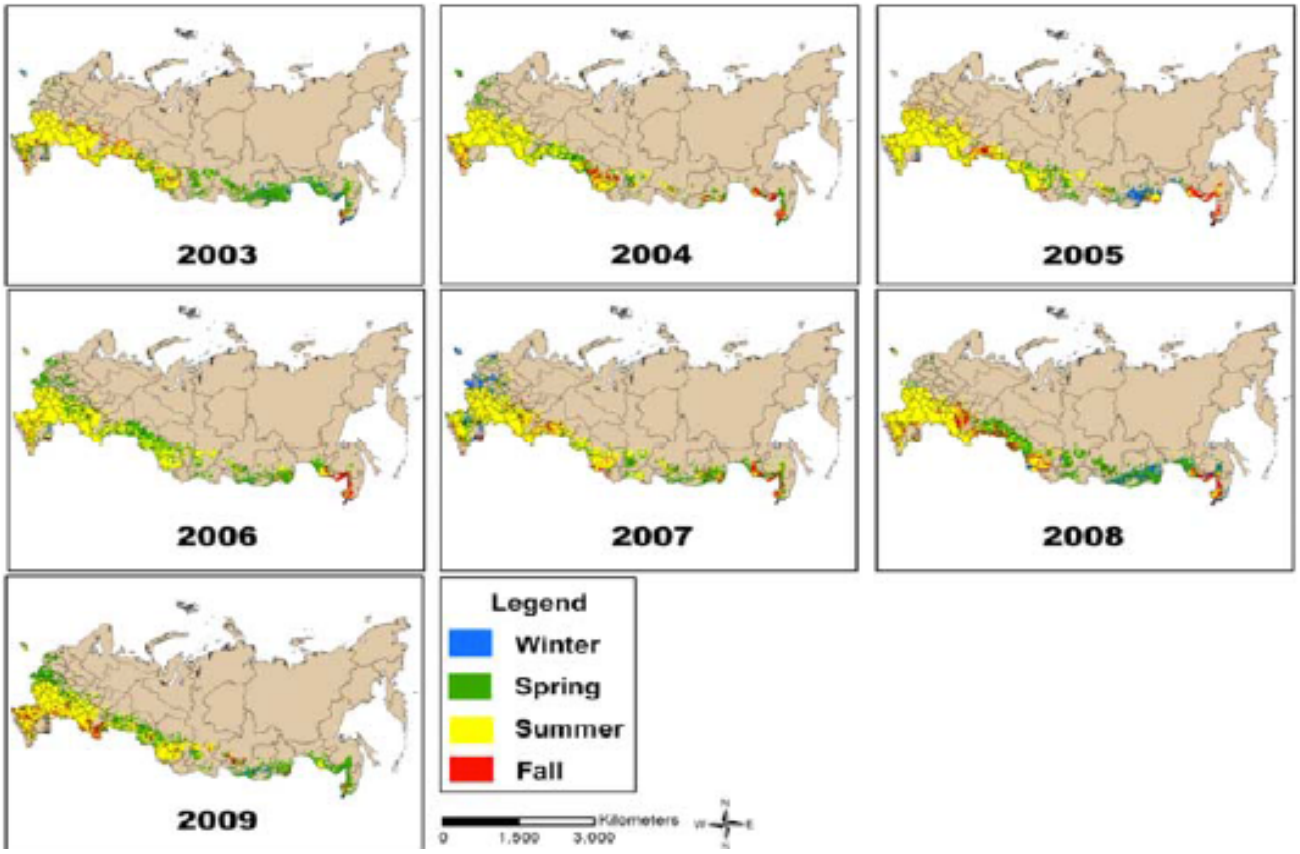
Arctic black carbon emissions in this sector may be largely attributable to bordering regions and the result of long-range transport.[113] Within the Arctic, forcing per unit of black carbon emissions is dominated by forest, grassland and agricultural fires.[114] Additionally, there is strong interannual variability in Arctic climate forcing from open burning.[115] High emission fluxes are concentrated at 60˚N latitude during the summer months.[116]

Research is underway to complete inventories of agricultural burning and forest fires, to gain a more complete understanding of anthropogenic vs. natural fire occurrences. Globally, it is estimated that agricultural and open burning contribute a third of global anthropogenic black carbon emissions, or as much over 3 million metric tons annually.[117]

The residence time of black carbon from open burning is particularly long and so is the potential for transport to the Arctic, because convection over fires can lift black carbon into the tropopause (see figure 4). For the sub-Arctic boreal region, it has been estimated that emissions could range from 380 to 580 teragrams of carbon per year (TgC/y).[118] Russian boreal forest accounts for over 80% of the carbon emissions in boreal forest.[119] Annual fluctuations in Arctic black carbon levels can be directly attributed to massive burning events in lower latitude regions, including in 2004 to forest fires in North America, in 2006 to agricultural fires in Europe, and in 2008 to agricultural and boreal fires in Russia and Kazakhstan. [120] In Canada this year, the Department of Environment and Natural Resources in the Northwest Territories spent $55 million fighting fires, which is eight times the amount of money budgeted. Fires this season in Canada's province of British Columbia led to the 3rd largest loss of timber on record, consuming 3,590 square kilometers of forest.[121] The provincial government allocated $63 million but has now spent more than $293 million fighting fires in 2014, nearly double what was spent last year. As this report went to press, those fires were 75% contained, but still burning. Annual forest fire emissions in Canada are estimated to be around 1450 megatons.[122] These fires will have an impact on sea ice and ice sheet melt in Greenland and northern Canada.

Russia's worst fire season in recent memory was in 2010, when numerous lives were lost to forest fires. There are no official federal reports that document the total extent of agricultural burning across Russia, and no single agency tracks composite data on field fires, but the Moderate Resolution Imaging Spectroradiometer instruments (MODIS) fire monitoring data clearly show that much of the country burns intensively at least half of the year, with seasonal upticks in cropland fires throughout the country's agricultural regions, especially in the spring prior to planting. A 2012 study used satellite data to calculate black carbon emissions from cropland burning in Russia estimates that between 2490 and 22,200 metric tons of black carbon are emitted in the Arctic each spring as a result of cropland burning in European Russia and West Siberia. Forest fires (up to 90% of which are caused by escaped agricultural fires) contribute still more. [123]

Figure 5. *Seasonal cropland (IGBP cropland class from MODIS 1 km Land Cover data set) burning in the Russian Federation as detected by the MODIS Burned Area Product (MCD45A1). (Source: J. McCarty.)*



Current Efforts to Reduce Black Carbon Emissions from Open Burning

At the Arctic Council, the study of emissions from open burning falls under the purview of the Arctic Monitoring and Assessment Program's Expert Group for Black Carbon and Tropospheric Ozone. The Arctic Council does not currently have an action plan in place for addressing open burning. However, projects funded through the Arctic Contaminants Action Program by the Nordic Environment Finance Corporation (NEFCo) Project Support Instrument could be leveraged to facilitate programs, led by local and regional actors that already deal with open burning around the Arctic, to continue to engage with local stakeholders

There are a number of other international forums that deal with reducing emissions from open burning. The Climate and Clean Air Coalition has a global Agricultural Initiative. A number of groups have regularly participated in workshops that address open burning in Eurasia, where efforts and work on reducing fire incidence are coordinated. At the most recent International Fire Management Week meeting, participants agreed to a series of recommendations that could be implemented by programs supported through the Arctic Council. These included, but were not limited to, determining the norms for fire prevention operation plans in areas around settlements, agreement on the need for development of concepts for the use of fire on agricultural and other non-forested lands of the Russian Federation, and that "international expertise in the field of fire management needs to be used, including the system of statistical accounting and classification of vegetation fires proposed by GFMC."[124] Among the organizations supporting those recommendations were the Federal Forestry Agency in Roslezkhoz, the Global Fire Monitoring Center, the All Russian Institute of Continuous Education in Forestry (VIPKLH), Vice Governor of Krasnoyarsk Krai, Minister of Natural Resources and Forest, the Krasnoyarsk Krai Forestry Agency and the Krasnoyarsk Forest Fire Center. This series of workshops was organized by the Federal Forestry Agency ROSLEZKHOZ of Russia and the Global Fire Monitoring Center (GFMC), both cooperating partners under the bilateral Russian-German Agreement on Cooperation in Sustainable Forest Management and under the framework of the UN International Strategy for Disaster Reduction (UNISDR) and the UN Economic Commission for Europe (UNECE).[125]

Russia is seeking to address open burning issues at both the local and national level, which means there is a significant opportunity for information sharing, monitoring, and discussions around lessons learned on agriculture and wildfire burning at the Arctic Council.

A number of non-governmental organizations are working to educate the public about open burning around the Arctic region. Pacific Environment along with Greenpeace have had pilot programs and run study tours for nearly five years aimed at reducing agricultural burning. The International Cryosphere Climate Initiative (ICCI) has been working with partner organizations on a number of initiatives that seek to limit open burning, including organizing conferences to present and discuss alternatives in St. Petersburg, a study tour in Sweden for Russian farmers and scientists, production of materials for farmers to assist with the procurement of alternative agricultural equipment that could eliminate the need for burning, and finally, pilot programs in north-central oblasts that will "develop and demonstrate viable and appropriate alternatives to agricultural burning." ICCI's programs will focus on establishing demonstration projects, offering courses and materials on alternatives to open burning, and developing micro-financing options to aid farmers as they transition to new methods.[126]

The U.S. Forest Service's International Program, as a part of the Arctic Black Carbon Initiative, has also implemented a number of community-led efforts in Russia and Eurasia. These pilot projects have yielded some important lessons for policy design and implementation for future interventions and support mechanisms. In Russia, NGO leaders have been able to bring

greater public attention the issue of burning in Russia and the threats it poses to public health and safety. Those implementing these campaigns have noted improved government transparency and response to open burning.

A recent workshop, conducted by the Clean Air Task Force and Bellona/Russia, resulted in a list of key best practices from pilot projects in Eurasia that should be applied to future projects and to regional efforts to reduce black carbon emissions from open burning. Reducing black carbon emissions by encouraging farmers to harvest hay or use fertilizers instead of engaging in open burning could be cost-effective for farmers.[127] A number dealt with the need to prevent agricultural burning: development of infrastructure, markets, incentives and awareness for alternative uses of residues; education of farmers (on crop rotation, conservation agriculture practices, organic farming, and other alternatives); education of farmers and the wider public on the negative impacts of burning, particularly local effects (and health effects). There were also recommendations that dealt with fire management: review of national legislation hampering effective fire management expand resources for fire monitoring, fire management decision support, and fire response; promotion and support of community-based fire management, including participation by civil society, with a balance between local control and enforcement of laws, such as with a fire warden or community fire brigade system.[128] The workshop also determined that further lessons from ongoing pilot projects and efforts need to be evaluated and (ideally) shared to inform the development of future projects.

Programs that work to reduce agricultural burning in Arctic nations have sought to achieve long-term changes in behavior by developing public monitoring, creating fire prevention programs, working with local authorities to enforce bans and penalties, and create new burning restrictions where there are none.[129] A number of these programs were implemented with the help and support for local non-governmental organizations. In combination with high level political movement and improved regulation and enforcement in Russia, including a 2013 Presidential Decree requiring agricultural and forestry enterprises to prevent fires on their land, these programs have been able to reduce burning to the lowest ever monitored levels.[130]

Reducing Open Burning, Reducing Arctic Black Carbon

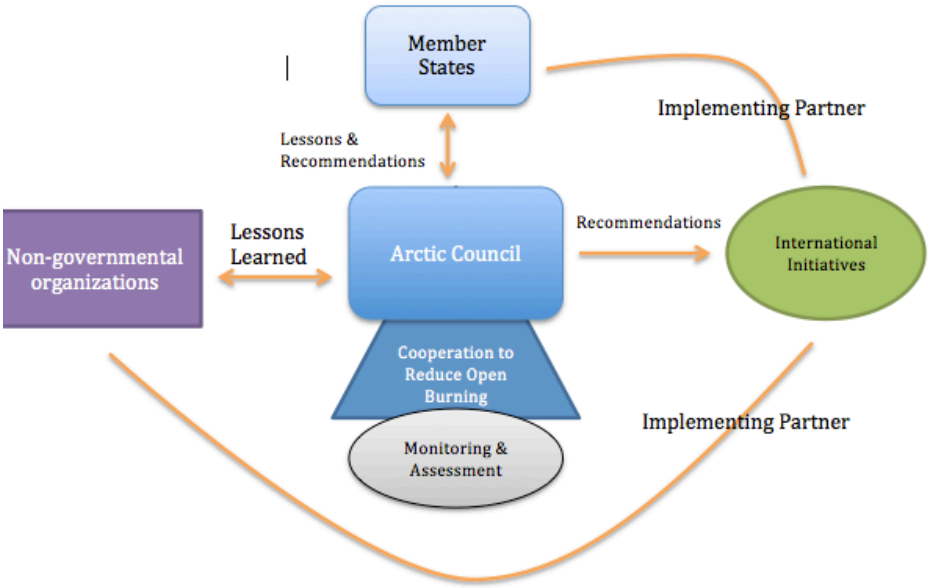
As Chair of the Arctic Council, the United States should support dedicated funding for pilot projects that will limit open burning by addressing agricultural fires. A key effort, as projects by non-governmental organizations and governments continue to yield important lessons on addressing opening burning, will be to consolidate lessons and begin discussions at the Arctic Council to share best practices on efforts to eliminate open burning at high latitudes. The United States has a number of lessons to share from the implementation of the Arctic Black Carbon Initiative, which the U.S. Forest Service International Programs Office led. In Russia, there are a number of communities engaged in efforts that could also bring those lessons to the table.

The Arctic Council provides the ideal intergovernmental forum to discuss barriers to implementation of best practices on agricultural burning, including financial problems, lack of modern equipment, and lack of education and/or awareness of alternatives. ICCI found in their work that only one-third of farmers in Eurasia were "aware of alternative waste recycling systems in operation in Europe and the USA" but that "the majority of farmers were interested in receiving information about modern methods of agricultural waste management and cleaning fields for planting.""[131]

Additional community-based efforts to reduce agricultural burning and black carbon emissions in Russia have yielded lessons that could support an exchange of best practices in the Arctic Council. A number of Russian non-governmental environmental conservation organizations have been able to design, implement and lead projects to reduce or eliminate agricultural and open biomass burning in target regions across the country where intentionally-set fires threaten forests and

populated areas. The Arctic Council provides a great forum for exchange of these ideas and lessons. Additionally, focusing on international support for Eurasian farmers would be a worthy effort for the Arctic Contaminants Action Program or the NEPCO Project Support Instrument to put some funding towards.

Diagram 4. *Domestic lessons from efforts should be brought to the Arctic Council by member states and community non-governmental organizations, summarized, and recommendations delivered to other international initiatives, finally informing on-the-ground project selection by implementing partners*



In Canada and the United States, best practices sharing around fire management could improve wildfire management and also reduce black carbon emissions.

The United States, as Chair of the Arctic Council, should advocate to the Arctic Contaminants Program that more funding be put towards programs to address open burning, and that program findings and lessons be reported to and discussed in the Arctic Council. There are two logical foci for programs that will address opening burning: the sources of open burning and fire management. If the Arctic Council's Task Force for Action on Black Carbon and Methane continues beyond the 2015 Ministerial, conducting workshops and open sessions to share those lessons could be a part of their mandate.

Existing pilot projects have made a number of important achievements. These include policy movement and increased government transparency in different regions, the issuance of new burning bans and restrictions, and better enforcement of existing regulations. But there is still a lack of municipal funds to adequately manage wildfires and enforce burning restrictions. Through the Arctic Contaminants Action Program and other international forums like the Climate and Clean Air Coalition, the Arctic Council states can push to provide financial incentives to help farmers avoid agricultural burning through successful subsidy programs that help provide no-till fertilizers[132] and assist municipalities in providing better fire management. Key best practices that should be examined and discussed include engagement of rural populations and municipalities, fire prevention, education and mitigation, engagement of government agencies, community engagement through education and trainings, and raising awareness of alternatives to agricultural burning.

In addition to creating financial incentives to reduce agricultural burning, implementation of community level programs by non-governmental organizations will be an important way to achieve gains to reduce black carbon emissions from open burning. These local community efforts should be coordinated at the national level and complemented by Arctic Council and international efforts that focus on the need to curb open burning and slow climate change around the Arctic region. Additionally, improving health impacts in communities could be a strong piece of the message supporting Arctic Council action to curb open burning.

Arctic Council work to curb emissions from open burning should be enhanced by greater information sharing and analysis of emission sources. The Task Force for Action on Black

Carbon and Methane and the Arctic Monitoring and Assessment Program's Expert Group on Black Carbon and Tropospheric Ozone should include open burning as a target sector for improved emissions reporting and analysis. And the United States should lead by providing reporting from the Department of Energy, the U.S. Department of Agriculture, and the Environmental Protection Agency. Current work on the Adaptations for a Changing Arctic study should include research on the climate impacts of fires in Eurasia and North America. Specifically, this work needs to address gaps in current monitoring and the forcing impacts of black carbon long-range transport and deposition in the Arctic. There are a number of American experts that could be consulted to improve measurement of regional open burning coordinated through the Arctic Council, including those working on new effort to map of burned areas currently underway at the Agricultural Research Service and the University of Maryland. Building on this improved research, mitigation efforts should focus on high transport sites through programs that will focus on improving local engagement and regional access to information that can improve knowledge about open burning.

The Arctic Council is the only intergovernmental organization capable of uniting the science and regional best practices to reduce black carbon emissions from open burning in the Arctic. As Chair the United States should advocate for the development of new monitoring and assessment of open burning through the Arctic Monitoring and Assessment Program or the Task Force for Action on Black Carbon and Methane. Additionally, only the Arctic Council is capable of assemble non-governmental groups working in communities around the Arctic region for consultation to share lessons and deliver key recommendations to inform funding of future projects. In concert with expanded monitoring, the United States should lead the assembly of key lessons from stakeholders to inform funding of regional projects by ready international groups and initiatives, such as the Nordic Environment Finance Corporation and the Climate and Clean Air Coalition.

Focusing on an effort to reduce open burning will allow the U.S. Chairmanship to work on issues of mutual concern among Arctic states while accumulating capital to take on some of the harder diplomatic issues in the space. Preventing open burning is an area of common interest for Russia, Canada and the United States, and an excellent opportunity for Arctic Council leadership.

CONCLUSION

Reducing black carbon and methane emissions in the Arctic is an essential part of the broader effort to combat global warming. And Arctic warming could be substantially slowed if these black carbon emissions in the region are substantially reduced.

As Chair of the Arctic Council, the United States is well positioned to lead a regional effort to reduce black carbon & methane emissions from key sectors. Specifically, the United States should:

- Support an initiative to reach agreement on and deploy best practices for the oil & gas sector that would reduce emissions of black carbon and methane from sources in the Arctic region, including by:
  → Partnering with international initiatives to provide funding & share lessons;
  → Working towards voluntary agreement to adhere to best practices through consensus dialogue with all Arctic stakeholders, including developers, indigenous groups, environmental non-profit organizations, regulators, governments and others in the private sector.

- Facilitate adoption of a resolution by Arctic Council members urging the International Maritime Organization to prohibit the use of heavy fuel oil in the Arctic Ocean. In addition:
  → Update shipping risk assessments in the Arctic, with a focus on the local impacts of emissions; and
  → Update study of potential approaches to reduce black carbon emissions from Arctic shipping.

- Assess existing domestic programs and international partnerships efforts to cooperate on clean energy for in-region residential heating through an Arctic Council mechanism, by:
  → Create a community of practice for reporting and documenting lessons learned in domestic clean energy and energy efficiency initiatives; and
  → Identify key areas of need and deliver recommendations to inform the policy and work of international funding mechanisms and initiatives such as Sustainable Energy for All, the Clean Energy Ministerial, and the Nordic Environment Finance Corporation.

- Support and lead implementation of new work in the Arctic Council to address emissions from open burning, focusing on support for on-the-ground initiatives to bring established best practices in agricultural education, technology and practice to communities and reduce the incidence of wildfires from agricultural burning. This should include:
  → Advocating for new monitoring and assessment of the contribution of open burning to Arctic black carbon emissions through the Arctic Monitoring and Assessment Program or the Task Force for Action on Black Carbon and Methane.
  → Leading a consultative assembly of stakeholders working in communities around the Arctic region to reduce open burning.
  → Delivering key recommendations to international organizations and initiatives ready to fund projects that will reduce the incidence of wildfires.

The United States is assuming the chairmanship of the Arctic Council at a critical time. For climate change, the Arctic is the lynchpin - the future of the Arctic will determine the future of all coastal communities, from Miami to Norfolk to Shanghai. It is critical that the U.S. finds a way to leverage its Chairmanship to lead the Council into action on the critical areas of black carbon and methane.

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