Buying Time:
Controlling Black Carbon and Methane Emissions in the Arctic

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Executive Summary

The Arctic is unraveling. Since the mid-1960s, the annual mean surface temperature over Arctic land areas has increased at almost twice the global average rate of change. Known as Arctic amplification, this leads to severe climate change impacts that not only foreshadow the severity of impacts to come in other parts of the world, but also directly affect lower latitudes in a number of ways today. Glacial melt, snow cover decline, permafrost thaw, and sea ice retreat all indicate a system in distress. Reducing atmospheric carbon dioxide is the only way to limit long-term climate change, but emissions reductions of short-lived climate pollutants, such as black carbon (BC) and methane, in the Arctic can help slow the unraveling and buy time for adaptation, innovation, and decarbonizing the global economy.

BC and methane have shorter atmospheric lifespans than carbon dioxide, but they have a far greater warming potential per tonne emitted over their short time in the atmosphere. BC and methane emissions come from a variety of sources. While emissions from some sources are already declining, sea ice retreat makes way for increased regional commercial activity. Emissions from growing industries in the Arctic could foil progress made on short-lived climate pollutant emissions in other areas. This paper focuses on two industries with projected near and mid-term growth in the Arctic, shipping and oil and gas, and makes the following recommendations to begin limiting their regional BC and methane emissions in the sensitive Arctic region.

On banning the use of heavy fuel oil (HFO) for shipping in the Arctic

- Climate and marine experts should communicate across their fields to understand the full suite of risks HFO use poses to the Arctic environment.
- Arctic Council Member States should encourage the International Maritime Organization to ban the use of heavy fuel oil in Arctic waters.
- Arctic States, fuel suppliers, and the shipping industry should work in synch as much as possible to facilitate a smooth transition to cleaner fuel use.

On limiting methane releases and flaring from oil production in the Arctic:

- The new Arctic Economic Council (AEC) should claim its space in the region over the next two years by cohosting an Arctic Oil and Gas Development Best Practices Dialogue that includes representatives from industry, governments, indigenous communities and local citizens, and environmental NGOs.
- The AEC should focus the dialogue on developing voluntary guidelines to limit the environmental footprint of regional oil and gas development, in particular with regards to methane releases and flaring.
- Industry should take a leadership role in the dialogue to ensure the guidelines are practical and to guide an informative discussion on infrastructure plans and further needs to operate safely in the Arctic environment.

Finally, Arctic Council Member States should broaden existing efforts to communicate and coordinate with each other, as well as with industry and other stakeholders, on strategic infrastructure planning to stimulate efficient and responsible regional economic development. Taking and building on these actions to restrict regional BC and methane emissions is a feasible climate change mitigation option today that will have disproportionate positive impacts on a global scale, help ensure sustainable and secure Arctic economic development, and build political confidence in conceivable international action on climate change.

Introduction

The Arctic is unraveling. Since the mid-1960s, the annual mean surface temperature over Arctic land areas has increased by more than two degrees Celsius,[1] almost twice the global average rate of change and the environmental "tipping point" for international climate change negotiations. Severe climate change impacts from this Arctic amplification not only foreshadow the severity of impacts to come in other parts of the world, but they also directly affect lower latitudes in a number of ways today. As the Greenland ice sheet melts, sea level rises along the east coast of the United States.

Warmer air and a melting Greenland are not the only indicators of a rapidly changing Arctic. Mountain glaciers, like those in Alaska and the Canadian Arctic, are also melting at an alarming rate and accounting for as much as third of observed sea level rise.[2] Further, this year marked the second lowest June snow cover extent on record (the lowest was in 2012),[3] while a recent review paper models permafrost thaw that could result in an additional 160 gigatonnes of carbon emissions over the course of the century – a rate on par with business-as-usual U.S. annual emissions over the same period.[4] Finally, sea ice continues retreating each summer farther than historical averages, opening up the region to ever-increasing commercial activity. The eight lowest September sea ice extents on record have occurred in the last eight years, with the lowest in 2012.[5] Less snow cover and shorter sea ice extents mean that exposed areas of land and sea are absorbing sunlight that snow and ice would otherwise reflect, driving a self-reinforcing cycle that accelerates climate change in the Arctic and its myriad of global impacts.

While reducing atmospheric carbon dioxide is the only way to limit long-term climate change, emissions reductions of short-lived climate pollutants in the Arctic can help slow the unraveling and buy time for adaptation, innovation, and decarbonization of the global economy. This paper focuses on two short-lived climate pollutants, black carbon (BC) and methane, and emissions of these from two industries of particular interest due to their projected regional growth, shipping and oil and gas. BC and methane have shorter atmospheric lifespans than carbon dioxide, but they have a far greater warming potential per tonne emitted over their short time in the atmosphere. Methane is 25 times more potent than carbon dioxide as an atmospheric warming agent over 100 years,[6] while BC emissions are of special concern in the Arctic. BC particles not only absorb heat but also darken snow and ice, reducing regional surface albedo and spurring further glacial melt and sea ice retreat.

Emissions from some sources, such as mobile diesel engines, are already declining,[7] and opportunities also exist in the shipping and oil and gas sectors to reduce emissions. However, lack of infrastructure and political will have hindered industry uptake of cleaner practices in the Arctic. If cleaner practices in these industries do not become mainstream, their activity in the region could counteract BC and methane emissions reductions in other sectors and regions. Addressing short-

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[1] Overland et al. (2012), "Air Temperature, Atmospheric Circulation and Clouds [Arctic Report Card: Update for 2012]." Web. Accessed: August 6, 2015.

[2] Gardner, Alex S., et al. (2013), "A Reconciled Estimate of Glacier Contributions to Sea Level Rise: 2003-2009." *Science*, Vol. 340 no. 6134. May 17 (852-57).

[3] Rutgers University, Global Snow Lab, "Snow Cover Anomalies." Web. Accessed: July 30, 2015.

[4] Schuur, E.A.G., et al. (2015), "Climate change and the permafrost carbon feedback." *Nature*, Vol. 520. April 9 (171-79).

[5] Perovich, D., et al. (2014), "Sea Ice [Arctic Report Card: Update for 2014]." Web. Accessed: July 30, 2015.

[6] United States Environmental Protection Agency (2015). "Overview of Greenhouse Gases: Methane Emissions." Web. Accessed: July 30, 2015.

[7] EPA (2012), "Report to Congress on Black Carbon." March (177).

lived climate pollutant emissions is only a near-term solution, but it has the merit of being feasible and the potential to build political confidence in addressing greenhouse gases on a larger scale.[8] This paper provides a few targeted and practical actions for number of players to take in the Arctic that will affect global climate change in the short term and buy time for decision makers to develop and implement longer-term solutions.

Black Carbon and Methane Emissions in the Arctic: An Overview

Alongside other sources, the shipping and oil and gas industries both contribute significantly to global BC and methane emissions. While BC and methane sources are currently limited within the Arctic, the expected increase in commercial activity will lead to greater emissions.[9] Shipping and oil and gas activities in the Arctic have already increased with improved regional accessibility from seasonal sea ice retreat. Shell began exploratory drilling in the Chukchi Sea on July 30 of this year, while transits of the Northern Sea Route (NSR) have generally increased in number, though inconsistently, since the mid-2000s.[10] With nearly sea ice-free Arctic summers possible within the first half of this century,[11] both industries will likely continue to grow. According to the Arctic Council's Arctic Monitoring and Assessment Programme,

> [S]hipping currently accounts for about 5% of black carbon emissions [in the Arctic], but could double by 2030 and quadruple by 2050 under some projections of Arctic vessel traffic. Flaring of excess natural gas at oil and gas fields, an alternative to releasing methane straight to the atmosphere, could account for two-thirds of Arctic emissions of black carbon, and typically also results in emissions of methane from incomplete combustion.[12]

BC emissions, the result of incomplete combustion of fossil fuels and biomass, have a particularly strong impact on the Arctic region even over their short atmospheric lifespan of just days. This local impact translates to global climate change by stimulating Arctic amplification and its effect on lower latitudes. BC sources north of 60°N include residential combustion, flaring from oil and gas activities, biomass burning, and transport, among others.[13] Some aerosols co-emitted with BC can have a cooling effect, but "[e]ven aerosol sources with negative globally averaged climate forcing, such as biomass combustion, can produce positive climate forcing in the Arctic because of their effects on snow and ice."[14] Because snow and ice typically reflect sunlight, BC emissions near the Arctic allow the particles to settle on otherwise reflective surfaces and absorb heat, contributing to accelerated melt and local warming. Further, the ratio of BC to co-emitted species in a plume depends on the activity; flaring usually has higher ratios of BC in its emissions than shipping or open

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[8] Victor, David G., Durwood Zaelke, and Veerabhadran Ramanathan (2015), "Soot and short-lived pollutants provide political opportunity." *Nature Climate Change.* Macmillan Publishers Limited, advance online publication, July 13.

[9] Sand, Maria, et al. (2013), "Arctic surface temperature change to emissions of black carbon within Arctic or midlatitudes." *Journal of Geophysical Research: Atmospheres*, Vol. 118. July 30 (7788-7798).

[10] Northern Sea Route Information Office: Transit Statistics (2015). Web. Accessed: August 3, 2015.

[11] Overland and Wang (2013). "When will the Arctic summers be nearly sea ice free?" *Geophysical Research Letters*, vol. 40. May 21(2097–2101)

[12] AMAP (2015). "Arctic Climate Issues 2015: Short-lived Climate Pollutants (Summary for Policy-makers)." AMAP Secretariat. April.

[13] Stohl, A., et al. (2013), "Black carbon in the Arctic: the underestimated role of gas flaring and residential combustion emissions." *Atmospheric Chemistry and Physics*, Vol. 13. July 10 (8833-8855).

[14] Bond, T.C., et al. (2013), "Bouding the role of black carbon in the climate system: A scientific assessment." *Journal of Geophysical Research: Atmospheres*, vol. 118. (5380-5552).

burning.[15] Ultimately, BC emitted at high latitudes could "almost give a fivefold increase in Arctic surface temperature response compared to emitting the same amount of BC at midlatitudes."[16]

The direct impacts of methane emissions are farther reaching, as methane typically mixes with other gases and has an atmospheric lifespan of years rather than days.[17] Because of its high global warming potential relative to carobn dioxide, methane emissions anywhere in the world contribute significantly to near-term global climate change impacts. Fossil fuel production and use are the primary sources of anthropogenic methane emissions worldwide.[18] The majority of methane emissions in the Arctic come from Russia and the United States, and together Arctic countries account for around 20% of global emissions.[19] The global oil and gas sector is responsible for around a third of all global anthropogenic methane emissions from production, leakage, and flaring.[20] Flaring is a source of not only methane, but also BC and carbon dioxide.

Governments and industries alike have already recognized the significance of short-lived climate pollutants. For both BC and methane, there are efforts already underway to reduce emissions from certain sources. For example, in 2012 the U.S. Environmental Protection Agency estimated that BC emissions from mobile sources north of 40°N would decline 85% by 2030 due to existing regulations (not including potential increases in commercial shipping activity).[21] On methane, the World Bank has had a number of governments, oil companies, and development institutions endorse its "Zero Flaring by 2030" initiative, which aims to end routine flaring by 2030 through cooperation among endorsers. Arctic endorsers of the initiative include Norway and the Russian Federation, along with a number of oil companies active in the region.[22]

However, the Arctic climate is changing fast. Even a limited increase in regional BC emissions from sources like shipping would have notable local and global climate impacts.[23] Furthermore, previous efforts to limit flaring in the Russian Arctic have proved difficult to implement, and Russia remains the top flaring country in the world.[24] Limiting increased regional BC and methane emissions from shipping and oil and gas would complement existing efforts to limit short-lived climate pollutants in other sectors and regions and help to mitigate near- and long-term climate change impacts in the Arctic and beyond.

15 *Ibid.*
16 Sand, et al. (2013).
17 EPA, 2015.
18 AMAP (2015).
19 *Ibid.*
20 *Ibid.*
21 EPA (2012).
22 The World Bank (2015), "Zero Routine Flaring by 2030." Web. Accessed: August 3, 2015.
23 Sand, et al. (2013).
24 The World Bank (2015).

Limiting the Environmental Footprint of Arctic Shipping

Shipping activity in the Arctic is already on the rise, and a regional ban on the use of heavy fuel oil (HFO) would help curb future BC emissions and protect the Arctic marine environment from HFO leaks and spills. Using the NSR (Figure 1) [25] reduces transit time and associated costs between Northeast Asia and Northwest Europe by about a third.[26] Table 1[27,28] shows the number of vessels that have used the NSR since 2010. In 2013, transits across the NSR peaked with 71 vessels. Despite the ultimate decline in transits in 2014, expectations had remained high. Russian authorities issued over 600 permits for that summer, which was a climb from just under 400 in 2013.[29] The decline in 2014 was primarily due to sea ice conditions; the NSR opened up much later than it had in previous years, shortening the window of opportunity for transits. While sea ice retreat will likely continue to be inconsistent year to year, the overall extent trend remains negative. This trend coupled with the sustained interest in permits suggests that NSR transits will rise again in summers with quicker sea ice retreat.

Table 1: Northern Sea Route Transits, 2010-2014

Year	Number of Vessels (Russian-Flagged)	Flag States Represented
2010	4 (2)	3
2011	41 (26)	10
2012	46 (18)	8
2013	71 (46)	12
2014	22 (16)	5

Figure 1: Arctic Shipping Routes

Despite the time and cost savings, NSR transits still pale in comparison to those through the Suez Canal. In September 2013 alone the Suez Canal had a traffic volume of 641 vessels, a far cry from the NSR's 71 for the entire year.[30] Barriers to increased traffic along the NSR include not only ice conditions, but also the legal status of the route in the international arena and lack of navigational aids, among others. Even so, a small shipping activity increase in the sensitive Arctic region can have a disproportionate impact on Arctic climate. The NSR will likely continue to serve as a seasonal shipping route, and commercial trade transits are not the only type of projected shipping increase. Arctic tourism seems to be growing in popularity, fish stocks are migrating northward with warming ocean temperatures, and oil and gas activities require large support fleets.

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[25] Ahlenius, Hugo (2006), "Development of Fossil Fuel Resources in the Arctic." UNEP/GRID-Arendal. Web. Accessed: August 3, 2015.
[26] Bekkers, Eddy, et al. (2015), "Melting Ice Caps and the Economic Impact of Opening the Northern Sea Route." *CBP Netherlands Bureau for Economic Policy Analysis*. May (4).
[27] Northern Sea Route Information Office: Transit Statistics (2015).
[28] Marchenko, Nataliya (2014), "Northern Sea Route: Modern State and Challenges." Proceedings of the ASME 2014 33rd International Conference on Ocean, Offshore and Arctic Engineering. June 8-13.
[29] McMillan, Terri (2015), "Breaking through the ice: An assessment of Northern Sea Route opportunities." *MarEx*. February 10. Web Access: August 3, 2015.
[30] Suez Canal Authority: Traffic Statistics. Web Access: August 3, 2015.

Air and Sea: Co-Benefits of HFO Regulation
An HFO-use ban in the Arctic would both reduce BC emissions and decrease risk to the Arctic marine environment. The amount of BC emitted from shipping varies depending on engine load, but the physical conditions in the Arctic are not conducive to constant speed and efficient fuel use.[31] Navigating through ice-infested areas can require varying the engine load in relatively short periods of time, and studies show that BC emissions increase if ships reduce engine load without retuning.[32] Measuring BC emissions from shipping can be challenging, but Lack et al. note that several studies have observed up to 80% reductions in black carbon emissions due to shifting from residual fuels to distillate fuels. On the other hand, scrubbers only result in a 40-70% reduction, depending on sulphur content of the fuel.[33]

A rise in shipping traffic also increases the potential for both intentional and unintentional fuel discharge, with significant impacts to the marine environment. Impacts include possible long-term sediment contamination and direct mortality of fur-bearing marine mammals.[34] Det Norske Veritas, an international risk management company, has assisted the Arctic Council's Protection of the Arctic Marine Environment (PAME) Working Group in developing three reports on HFO-use in the Arctic. The first report concludes that "the consequences of HFO spills are likely to be more severe than spills of marine diesels" and "[i]n light of the particular HFO properties, significant risk reduction will be achieved if the onboard oil type is of distillate type rather than HFO."[35] Given the co-benefits of reduced BC emissions and reduced risk to the marine environment, policymakers should avoid being stove-piped in their expertise. Communication between climate experts and marine experts and a comprehensive understanding of HFO impacts in the region will be essential in achieving an Arctic HFO-use ban.

Precedents for HFO Regulation
Antarctic waters already benefit from a ban on HFO use and carriage that went into effect in August 2011. Negotiations for the Antarctic HFO ban began in the International Maritime Organization (IMO) in 2006 in response to a request from the Antarctic Treaty Consultative Parties for the IMO to "take steps to reduce the use of heavy fuel oil in Antarctic waters because of the high risk of fuel release…due to conditions such as icebergs, sea-ice and uncharted waters and the high potential of environmental impacts associated with a spill of heavy fuel oil."[36] In the end, the IMO amended Annex I, Regulations for the Prevention of Pollution by Oil, of the International Convention for the Prevention of Pollution from Ships (MARPOL). Regulation 43 became part of a new chapter titled "Special requirements for the use or carriage of oils in the Antarctic area."

The IMO's recently adopted Polar Code does not afford the Arctic the same protection as it does the Antarctic with regards to HFO, despite physical similarities (e.g. uncharted waters) at the two poles. Rather, "[s]hips are encouraged to apply regulation 43 of MARPOL Annex I when operating

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31 Lack, D. A. and J. J. Corbett (2012), "Black carbon from ships: a review of the effects of ship speed, fuel quality and exhaust gas scrubbing." *Atmospheric Chemistry and Physics*, Vol. 12. May 4 (3985-4000).
32 *Ibid.*
33 *Ibid.*
34 Office of Response and Restoration (2015), "Oil and Chemical Spills: Oil Spills: Oil Types" U.S. National Oceanic and Atmospheric Administration. Web Access: August 3, 2015.
35 Det Norske Veritas (2011), "Heavy fuel in the Arctic (Phase 1)." Report for PAME.
36 Antarctic and Southern Coalition (2009), "ASOC Press Briefing: IMO to Consider Ban on Heavy Fuel Oil in Antarctic Waters." ASOC Secretariat, June.

in Arctic waters."[37] While an HFO-carriage ban will be near impossible while as much as 13% of undiscovered oil reserves[38] remain in the region, the time may be ripe to build regional consensus for negotiating an HFO-use ban for vessels operating in Arctic waters.

During negotiations for the Antarctic HFO ban, many in the cruise industry argued against it by citing fuel cost, fuel availability, and profitability reductions. Similar challenges to using distillate fuels region-wide exist in the Arctic, and Member States will need to work in synch with industries to facilitate a smooth transition to cleaner fuel use. As a start, most of the 18 members of the Association of Arctic Expedition Cruise Operators (AECO) already minimize or eliminate HFO use,[39] and Norway has implemented an HFO-ban in Svalbard with very few exceptions.[40] Though AECO only represents a niche area of Arctic cruise tourism, its member practices still raise the bar and present an opportunity for them to share lessons learned on avoiding HFO-use.

A Push from Arctic States

Made up of the eight countries with jurisdiction in the Arctic and six indigenous organizations, the Arctic Council has become the region's foremost forum for multilateral dialogue. In 1996 the Member States and Permanent Participants established the Arctic Council under two equal mandates: sustainable development and environmental protection. In recent years, the Arctic Council has worked consistently on both HFO and BC in a number of working groups and task forces, but work volume has not yet translated into conclusive action on reducing the environmental threats that HFO presents in the Arctic. However, the United States has committed to focusing on climate change during its Arctic Council Chairmanship, and multiple initiatives under this focus will have the opportunity to address the potential impacts of HFO use in the Arctic.

In recent years, PAME has "encouraged continued research at IMO on black carbon emissions, with respect to a technical definition of black carbon and appropriate methods and control measures."[41] Looking ahead, PAME has a number of activities in its 2015-2017 work plan that could result in further encouragement to also better protect the marine environment from HFO, including following up on previous HFO reports, compiling information on the environmental impacts from HFO-related maritime incidents in the Arctic, and describing the technical challenges and risks associated with HFO use in cold climates.[42] The results of these activities may provide PAME with sufficient evidence to suggest that the Arctic Council Member States encourage the IMO to ban the use of HFO in the Arctic.

Other Arctic Council initiatives should complement PAME's shipping work. The work of the Expert Group on Enhanced Action for Black Carbon and Methane Reductions will provide a better idea of BC emissions volume and sources in the Arctic, while follow up action on the Framework Plan for Cooperation on Prevention of Oil Pollution from Petroleum and Maritime Activities in the Marine Areas of the Arctic may also guide the Arctic Council toward a stronger stance on HFO use.

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37 MEPC 68/6/2 Annex (2015), "Draft International Code for Ships Operating in Polar Waters (Polar Code)." MEPC Secretariat, January (43).

38 United States Geological Survey (2008), "90 Billion Barrels of Oil and 1,670 Trillion Cubic Feet of Natural Gas Assessed in the Arctic." Press release, July 23.

39 Lang, Ilja Leo (2015), AECO Office Manager in Denmark, personal correspondence. July 21.

40 *Ibid.*

41 PAME (2015), "Status on Implementation of the AMSA 2009 Report Recommendations." Arctic Council, April.

42 Arctic Council (2015), "Senior Arctic Officials' Report to the Minsters." April 24 (69).

Further, any additional action to reduce regional BC emissions in the tourism and oil and gas industries would help engender a welcoming atmosphere for such a stance.

At the 65th meeting of the IMO's Marine Environmental Protection Committee in 2013, the Committee discussed an Arctic HFO ban but ultimately decided that it was "premature to regulate the use the heavy fuel oil (HFO) on ships operating in Arctic waters."[43] With the first phase of the Polar Code negotiations completed and Arctic shipping conditions becoming ever more favorable over time, a united front from the Arctic States on HFO use could provide the needed momentum to push the IMO to action on this important issue.

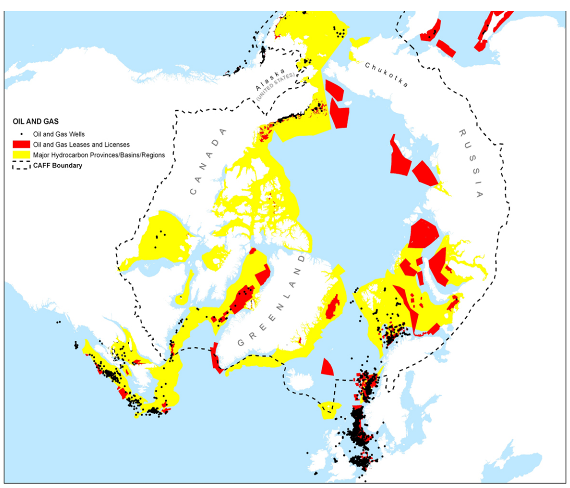
Emissions Reductions Opportunities for the Arctic Oil and Gas Sector

There is already a fair amount of oil and gas activity in the Arctic, and it is also expected to increase alongside shipping due to both sea ice retreat and approved extended continental shelf claims at the United Nations. On top of intended gas production, crude oil production often includes some associated natural gas production as well. In remote areas or areas with limited infrastructure for natural gas capture, storage, and transport, the associated gas is often vented or flared as an alternative to venting. On a global scale flaring emits millions of tons of carbon dioxide into the atmosphere each year,[44] and it also emits BC and methane if there is poor combustion in the flare. Venting and flaring both waste a valuable energy resource and contribute to global climate change unnecessarily.

Table 2: Top 5 Flaring Countries, 2007-2012

Country	Flaring Trend
Russia	Decreased
Nigeria	Slightly Decreased
Iran	Stable
Iraq	Increased
United States	Increased

Figure 2: Arctic Hydrocarbon Basins



In the absence of industry guidelines or national regulations, increased oil and gas activity in the Arctic will inevitably lead to increased methane releases and flaring. Shell ventures into the Chukchi Sea this summer under significantly weaker air emissions regulations than in 2012, while Russia was the top gas flaring country in the world from 2007-2012 (Table 2).[45] The United States was also in the top five flaring countries for that same period. The 2008 U.S. Geological Survey study concluded that Russia and the United States hold the largest

43 MEPC 65/WP.1 (2013), "Draft Report of the Marine Environment Protection Committee on its Sixty-Fifth Session." MEPC Secretariat, May (52).
44 The World Bank (2011), "Global Gas Flaring Reduction Partnership: Improving Energy Efficiency and Mitigating Impact on Climate Change." GGFR Informational Brochure.
45 World Bank Group (2015), "Global Gas Flaring Reduction Partnership (GGFR)." Web. Accessed: July 31, 2015.

hydrocarbon reserves (Figure 2[46]).[47] The harsh and variant physical conditions in the Arctic pose challenges to using associated gas on-site or making gas capture, storage, and transport to market economically viable, but it is not impossible.

Norway has essentially banned flaring, with the exception of safety purposes, by prohibiting companies from selling their recovered oil until they find a use for the associated gas.[48] In this case, rather than an existing transportation option allowing for easier lawmaking, this regulation actually prompted the development of a pipeline network between Norway and the rest of Europe.[49] However, this top down approach may not be an immediate option in all Arctic countries, and nor will a pipeline network be conceivable in all geographic areas. Ultimately, in the absence of norms or regulations, factors like the purity of the associated gas or market price will largely determine the economic viability for industry of reducing methane releases and eliminating flaring.

The GGFR: A Precedent for a Positive and Productive Arctic Dialogue

Industry should lead the way now in responsible resource extraction by working alongside regulators, indigenous communities and local citizens, and practical environmental NGOs in developing its own set of best practices guidelines for operating in the fragile and sometimes unpredictable Arctic environment. Many of the region's biggest oil and gas producers, including Statoil and Eni, are partners of the World Bank's Global Gas Flaring Reduction Partnership (GGFR), a public-private partnership that shares best practices and works to decrease routine gas flaring in the oil and gas industry. Canada, Norway, Russia, and the United States are also GGFR partners, and Norway and Russia have further endorsed the World Bank's "Zero Routine Flaring by 2030" initiative alongside many of the GGFR partner companies.

As a result of its participation in GGFR, the Russian government greatly increased penalties for flaring more than 5% of associated gas from oil production in 2012.[50] However, enforcement of these policies has been challenging, and Russia still remains the top flaring country in the world.[51] Lack of infrastructure and harsh conditions in the Arctic make best practices in other parts of the world difficult to apply at high latitudes. The relatively unexplored Arctic region requires special consideration and its own inclusive and comprehensive dialogue on best practices to reduce emissions from flaring. With industry at the table from the start, regulators can make practical and well-informed policy decisions down the road.

Building a Foundation for Coordinated Action in the Arctic

Building on the GGFR model, an Arctic best practices dialogue that includes a wide range of stakeholders should result in foundational voluntary guidelines that precede formal policy and set high standards for companies interested in investing in Arctic resource extraction. As industry buy-in would be essential to success, the recently established Arctic Economic Council (AEC) may provide a good setting for such a dialogue. The AEC includes business representatives from all

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[46] Rogers, Sarah (2013), "New research shows Arctic whale habitat losing ground to industrial development." *Nunatsiaq Online* (Image courtesy of WWF). Web. Accessed: July 31, 2015.
[47] EY (2013), "Arctic oil and gas." *EYGM Limited.* (3).
[48] Norwegian Petroleum Directorate (2009), "Significant gas resources go up in smoke." Web. Accessed: July 31, 2015.
[49] Norwegian Petroleum Directorate (2008), "No to flaring – an international challenge." Web. Accessed: July 31, 2015.
[50] Josefson, Jennifer, et al. (2014), "Oil and gas regulation in the Russian Federation: overview." *Energy and Natural Resources Multi-Jurisdictional Guide 2014*. Thomas Reuters, June 1.
[51] World Bank (2015).

eight Member States and six Permanent Participants of the Arctic Council, and it has indicated its willingness to support the U.S. Chairmanship initiatives in its 2015-2017 work plan, including by developing best practices guidelines for Arctic energy development.[52]

A partnership between the AEC and the World Bank to facilitate an Arctic-specific best practices dialogue would bring many of the key players in Arctic economic development to the table. For example, Rosneft, the Russian state-run oil company, is missing from both World Bank initiatives, but Rosneft's Vice-President is a representative to the AEC. Likewise, many of the companies operating in the Arctic that lack representation to the AEC, such as Shell, are partners to GGFR. An AEC-World Bank partnership would still not be inherently comprehensive in Arctic interest representation, but it would serve as a solid foundation. The dialogue itself would also need to include other specific groups (e.g. non-GGFR Arctic Council Member States, environmental organizations) to guarantee a robust dialogue. Furthermore, multiple parties at the table will open to the door to discussing coordinated action among and between nations, industry, and other stakeholders that could optimize regional economic development for sustainability and efficiency.

Outcomes of the dialogue should include best practice guidelines for oil and gas development in the Arctic that limit methane releases and flaring as much as possible. Industry's significant contribution to the guidelines will not only level the playing field between companies and avoid a race to the bottom for environmental standards, but also generate motivation to comply. Additionally, the dialogue should include an informative discussion on specific infrastructure plans and further needs to operate safely and efficiently in such an isolated environment. This discussion could pave the way for further in-depth regional discussion on strategic and cooperative infrastructure planning for responsible economic development in the Arctic.

Leveraging Infrastructure Development for Cleaner Practices

Efficient and coordinated infrastructure development will also help limit sources of greenhouse gas emissions, including those of BC and methane, in the Arctic. The demand for modern infrastructure in the region is already outpacing development in many countries. Smart infrastructure planning and development will support oil and gas developers in limiting methane releases and using or capturing, storing, and transporting associated gas, while ship operators will have an easier time avoiding the use of HFO if assured of alternative fuel availability at frequently-visited ports.

Arctic Council participants should build on existing solid efforts for regional infrastructure planning, such as PAME's development of an Arctic Regional Reception Facilities Plan for ship waste management,[53] and cooperate more broadly with multiple industries and other stakeholders in the region to avoid ad-hoc, irresponsible, and overly redundant infrastructure development in a sensitive and quickly changing environment. For example, oil and gas operations could share some support vessels between proximate fields, reducing both collision risk and fuel emissions with less ships on the water. Strategic coordinated infrastructure planning and development throughout the region, with an eye toward a future of cleaner practices in all industries, will help ensure a peaceful and stable Arctic with long-term prospects for economic prosperity.

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52 Arctic Economic Council (2015), "The Arctic Economic Council." Presentation to the Arctic Council Ministers, April 24. Web. Accessed: July 31, 2015.

53 PAME (2015), "PAME Work Plan 205-2017." Arctic Council.

Conclusion

The Arctic is showing less resilience to climate change impacts than lower latitudes, and the economic face of the region is changing. Sea ice retreat is opening up new shipping lanes and access to previously unattainable resources. While economic development could ultimately prove positive for the four million people living in the Arctic, an Arctic race for resources could also exacerbate climate change in an already unraveling environment. Two sectors with significant predicted growth in the region are shipping and oil and gas development. The transboundary nature of climate impacts calls for international action to limit future greenhouse gas emissions from these sources. Notable barriers exist to adopting cleaner practices, and governments, industry, and local stakeholders will need to communicate and cooperate to enable a smooth transition. In both shipping and oil and gas, industry and government must work on parallel tracks to slow the pace of change in the fragile Arctic environment, stimulate secure and sustainable economic development in the region, and buy time for adaptation and innovation for decarbonizing the global economy.

On a centennial timescale, reducing atmospheric carbon dioxide is the only way to avoid increased climate change impacts for generations to come. However, as negotiators head to Paris this December to finalize a global climate deal, the potential of short-lived climate pollutant emissions reductions should not be underestimated. In a region changing twice as fast as the rest of the world, increased local economic activity has the potential to even further accelerate the pace of change in the Arctic with serious consequences for lower latitudes. Limiting regional BC and methane emissions, particularly from the shipping and oil and gas industries, is a feasible climate change mitigation option today that will have disproportionate positive impacts on a global scale and build political confidence in conceivable international action on climate change.