Spring 2008

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Marcel de Armas

Maria Vanko

Sustainable Development Law & Policy

Volume 8
Issue 3 *Spring 2008: Environmental Change in Polar Regions* Article 18

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*by Marcel De Armas & Maria Vanko**

Introduction

Climate change is impacting the Arctic earlier and more intensely than any other area of the planet. Winter temperatures have increased as much as three-to-four degrees Celsius in the past fifty years[1] and are projected to increase four-to-seven degrees Celsius over land areas and seven-to-ten degrees over the Arctic Ocean by the end of the century.[2] One industry that looks likely to benefit, at least in the short term, from the effects of the diminished Arctic sea ice is shipping.

As the region warms, there is an expectation of increased industrial development and resource extraction, as well as tourism, including the cruise industry.[3] The opening of Arctic shipping lanes will reduce global shipping time and costs, shortening the journey between Japan and the United Kingdom by as much as five thousand miles.[4]

Over the past century, Arctic sea ice has diminished considerably and continues to decline, making shipping and increased resource development in the Arctic a reality. A direct human influence that decreases reflectivity of Arctic and other ice is the soot, or black carbon ("BC"), that is produced when fossil fuels are burned.[5] BC emissions significantly contribute to the melting Arctic, and reducing such emissions may be "the most effective way we know to retard Arctic warming."[6]

Because BC is relatively-short lived in the atmosphere, regulation of this pollutant is an important strategy to prevent abrupt climate change. BC produced from burning conventional fuels is largely unregulated and plays a significant role in climate change. As increased shipping and industrial development in the Arctic becomes a reality, there is an urgency to include the shipping industry under a comprehensive global climate change agreement and to include BC in such an agreement. This Article explores the need to include reducing BC emissions and the shipping industry in a post-2012 comprehensive climate change regime.

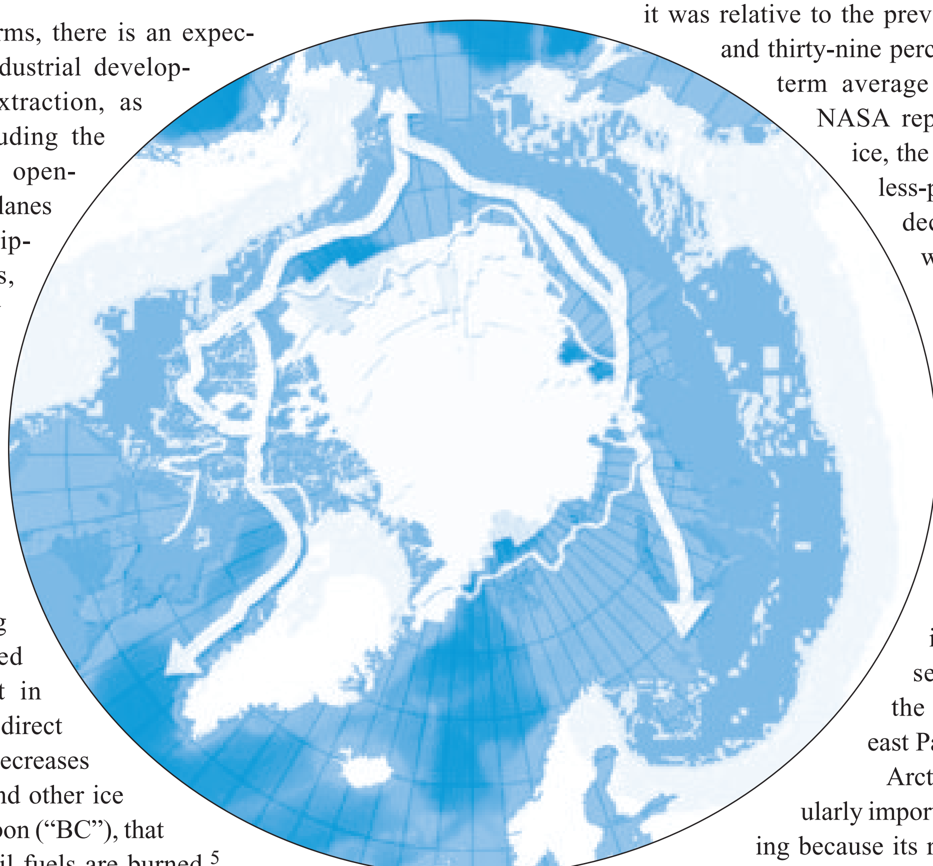

Image of the potential Northwest and Northeast Shipping Passages; photo courtesy of ACIA.

The Arctic Thaw

In 2007, the Arctic summer sea ice extent reached a record minimum level, with coverage twenty-three percent lower than it was relative to the previous record set in 2005 and thirty-nine percent lower than the long term average from 1979 to 2000.[7] NASA reports that perennial sea ice, the thicker, older ice that is less-prone to melting, steeply decreased over the 2008 winter season, despite cold temperatures.[8] This perennial ice once covered as much of fifty percent of the Arctic, and now covers less than thirty percent.[9] Sea ice researchers now believe that the Arctic summers could be completely ice free in as early as 2030, consequently opening both the Northwest and Northeast Passages.[10]

Arctic sea ice plays a particularly important role in global warming because its reflectivity helps reduce the absorption of solar radiation, thereby reducing atmospheric temperature.[11] The loss of sea ice results in greater heat absorption due to the decreased reflectivity of the surface. Humans influence the reflectivity of snow and ice by burning fuels—e.g., coal, oil,

** Marcel De Armas & Maria Vanko are J.D. candidates, May 2008, American University Washington College of Law.*

gas, waste, and wood—and creating BC that settles on the snow and ice.[12] BC darkens the surface of the ice which decreases reflectivity and increases the absorption of solar radiation, thus resulting in faster heating and melting.[13] A thawing Arctic will in turn lead to additional greenhouse gas ("GHG") emissions as carbon dioxide ("CO_2") and methane that are stored in the permafrost are released as it melts.[14]

Black Carbon

A recent study has found that BC provides the second strongest contribution to current global warming, after CO_2 emissions.[15] Fortunately, BC is short lived in the atmosphere, usually lasting a few days to a couple of weeks in the atmosphere compared to CO_2, which has a lifetime of one hundred or more years.[16] Unfortunately, BC is a highly forcing agent of climate change,[17] and has pernicious localized impacts that are not exclusive to the Arctic. BC exacerbates desertification and flooding,[18] hastens melting of ice sheets and glaciers,[19] perturbs monsoon season,[20] and contributes to hundreds of thousands of deaths a year and adverse health effects for many more.[21] While most aerosols have a global cooling effect by reflecting sunlight, BC absorbs sunlight, thus heating the surrounding air and contributing to regional heating and climate change.[22] Even though BC is not always emitted with other aerosols, it tends to intermingle with them, thus masking BC's radiative forcing. Thus, a targeted effort to reduce BC would be important even if other aerosols continue to exist in atmospheric brown clouds.

A recent study has found that BC provides the second strongest contribution to current global warming, after CO_2 emissions.

The Intergovernmental Panel on Climate Change ("IPCC") estimated BC's global warming potential between 0.2 and 0.4 watts per square meter ("W/m^2").[23] However, recent studies suggest that this amount is underestimated and inaccurate. A recent study found climate forcing of BC is 0.9 W/m^2; this "is as much as 55% of the CO_2 forcing and is larger than the forcing due to the other [greenhouse gases] such as CH_4, CFCs, N_2O or tropospheric ozone."[24] The effects of BC have previously been underestimated because BC is emitted with other aerosols—e.g., sulfate particles.[25] These aerosols mixed with BC reflect sunlight; as a result they increase the probability that the light will be absorbed by soot particles nearby, hence they are reflecting the light to the BC.[26] Furthermore, when BC gets into the upper atmosphere, it absorbs light reflected by the surface—especially snow, glaciers, and ice sheets—and clouds, thus contributing to the warming of the planet.[27] This highlights BC's warming potential because not only does it absorb heat from the sun, but it absorbs heat that was to be reflected back to outer space.

Historically North America and Western Europe were responsible for BC emissions, however, developing nations, particularly in Asia, are now the main source of BC emissions.[28] China and India alone account for twenty-five to thirty-five percent of global BC emissions.[29] BC emissions and its effects vary by region. For example, the "majority of soot emission in South Asia is due to biofuel cooking, whereas in East Asia, coal combustion for residential and industrial uses plays a larger role."[30] China highlights the rapid growth of BC emissions in developing countries; between 2000 and 2006 China doubled its BC emissions.[31] In comparison, the United States emits about twenty-one percent of the world's CO_2, but only 6.1 percent of the world's soot.[32]

One reason for the reduced BC emissions in North America and Western Europe is air quality standards, technology standards, and restrictions on particulate emissions.[33] These standards are lacking in the shipping industry and typically in the developing world. Outside of the shipping and power generation industries, the major sources of BC include: (1) biomass burning—burning of forests and savannas; (2) residential biofuels and coal—used for heating and cooking; (3) diesel engines—emits 25 to 400 times the amount of particulate matter than a gasoline engine.[34]

Black Carbon Controls May Prevent Abrupt Climate Change and Provide Localized Public Health Benefits

By reducing BC emissions the world may buy some additional time before severe effects of climate change are felt, possibly allowing for the reduction in GHG emissions to a sustainable level. If unchecked, Arctic warming has the potential for catastrophic global impacts, such as sea-level rise; a complete melting of the Greenland ice sheet would raise ocean levels by seven meters.[35] Implementing controls to limit BC emissions may help prevent the climate system from passing the tipping points for abrupt climate changes, such as the disintegration of the Greenland and/or Antarctic ice sheets.[36] The quickest impact on reducing BC emissions and to provide climate benefits would be to focus on the shipping and power generation sectors in East Asia that have the potential for the BC to settle in the Arctic. Tackling the agricultural and residential sources will require addressing the underlying cause of poverty.

Tackling biomass burning, and residential cooking and heating may prove to be difficult, since sources involve thousands or millions of individuals with limited resources.[37] However, there is the possibility of increased financial and development assistance to otherwise reduce the emissions through technologies such as low-cost fuel-efficient stoves, and the development of electricity grids. Reducing BC emissions would also provide strong positive benefits for public health in developing nations. Exposure to BC from cooking over open fires has been linked to pneumonia in young children, chronic bronchitis in women, and increased blood pressure.[38] Switching to non-BC emitting cookers, such as solar or bio- or natural gas may result in a seventy to eighty percent reduction in BC heating over South Asia; a twenty to forty percent reduction in East Asia; and potentially reduce 400,000 annual fatalities among women and children that are attributed to smoke inhalation.[39] These preventable deaths are in addition to the thousands of cardiopulmonary and lung cancer deaths attributed to particulate matter ("PM"), including BC, emissions from ships near the coastlines of Europe, East Asia, and South Asia, in 2002 estimated at 60,000.[40]

The Global Climate Treaty Regime, the Shipping Industry, & Black Carbon

The United Nations Framework Convention on Climate Change and Kyoto Protocol

The United Nations Framework Convention on Climate Change ("UNFCCC") was adopted in 1992 and entered into force in 1994 as a framework for action and cooperation on the issue of climate change.[41] The Objective of the UNFCCC and any related legal instrument is the "stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[42] While the UNFCCC does not currently limit BC emissions or identify BC as a defined GHG, its framework sets forth principles and mechanisms that enable it to address BC emissions, even as the science underpinning BC and its contribution to climate change is refined. Furthermore, the Kyoto Protocol does not regulate the shipping industry, thus undermining its goal of emission reductions while allowing a large emitter to keep emitting.

The Kyoto Protocol is a product of the UNFCCC and sets binding limits of CO_2 and other greenhouse gases for developed country parties for the period of 2008–2012.[43] Under the Kyoto Protocol, developing nations do not have to reduce their emissions, but can participate in the Clean Development Mechanism ("CDM"), which enables the developed member countries to invest in emission-reductions in developing countries, resulting in credits, that can count toward their emission goals.[44] BC emissions are not regulated under the Kyoto Protocol,[45] thus developing country reduction activities will not qualify for CDM credits. However, some CDM projects have incidental BC emission reductions so long as they also qualify for CO_2 credits.[46]

With its limited time frame and participation, the Kyoto Protocol was meant as only a first step to solving the climate problem.[47] With the Kyoto Protocol set to expire in 2012, it is important to consider controlling global BC emission, as well as recognize the role of the shipping industry, as the Conference of Parties ("COP") to the UNFCCC crafts a post-2012 climate agreement is written.

Incorporating BC into a Post-2012 Climate Treaty under the UNFCCC

Currently, BC is not included in the UNFCCC framework, but with the new research surrounding BC, it is imperative that it is included in the post-Kyoto framework. This may include amending the UNFCCC to include BC as a GHG. BC reductions can provide important climate insurance, particularly with respect to slowing the melting of the Arctic. As a framework agreement, the UNFCCC is the institutional framework for successive protocols and amendments. The UNFCCC sets forth a series of principles to guide successor agreements, which will be revised as time and science progresses. One of the overarching principles to the UNFCCC is the precautionary principle, which urges parties to take precautionary measures to "anticipate, prevent, or minimize the causes of climate change and prevent its adverse effects."[48] The principle provides that where there are "threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures."[49] The growing scientific knowledge surrounding BC's contribution to anthropogenic interference with the climate system combined with the precautionary principle embodied in the UNFCCC is grounds to incorporate BC regulations into the successor-Kyoto agreement.

Addressing BC emissions under the Kyoto Protocol is also salable under the common-but-differentiated responsibilities principle embodied in the UNFCCC. The UNFCCC requires parties to be guided "on the basis of equity and in accordance to their common but differentiated responsibilities and respective capabilities."[50] Accordingly, under the UNFCCC, full consideration is to be given to the specific needs and circumstances of developing country parties.

Under the common-but-differentiated responsibility principle, as implemented in the Kyoto Protocol, developing country Parties do not have to make any binding emission reductions. This approach would not necessarily be successful for controlling global emissions of BC. In particular, the developed (Annex I) Parties to the Kyoto Protocol generally have already implemented strategies to reduce PM emissions, through domestic statutes like the U.S. Clean Air Act. Since the bulk of BC emissions comes from the developing world and economically viable and tested technology already exist to reduce BC emissions from stationary sources, both developed and developing countries should take steps to reduce BC emissions and hopefully prevent abrupt climate change events.

There is the ability to control BC emissions from the developing country Parties available through the mechanisms that bind all Parties, developed and developing, to the UNFCCC. The UNFCCC provides that all Parties will, inter alia, implement national plans that include measures to mitigate climate change[51] and promote and cooperate in technology transfer.[52] The framework also provides that the extent to which developing country Parties will implement their commitments is linked to developed country's commitment of financial resources and technology transfer, taking into account that social development and poverty eradication are the paramount priorities of the developing country Parties.[53]

The Bali Action Plan, agreed upon by the 13th Conference of Parties to the UNFCCC, encourages the development and transfer of technology to developing country Parties in order to promote access to affordable environmentally sound technologies.[54] The process should recognize the climate benefits and poverty eradication, social development, and health co-benefits of providing technology assistance to developing country Parties to limit their BC emissions. Such environmentally sound technologies may include lower-BC emitting stoves for heating and cooking, scrubber technology for power plants, and better fuel refining technology. This may open a viable mechanism to promote technology transfer of cooking stoves to address the climate impacts, as well as the health and development benefits of the world's poor.

By reducing BC emissions the world may buy some additional time before severe effects of climate change are felt.

The Shipping Industry

As mentioned earlier the Kyoto Protocol does not set limitations on BC emissions, nor does it set any limitations on the global shipping industry. Ocean going vessels are instead regulated under the International Maritime Organization ("IMO"), which has been slow to place any GHG measurement, monitoring, or limitations on the industry. Indeed, there is no current, comprehensible and reliable data on global GHG emissions from international shipping.[55] However, reports indicate GHG emissions from the shipping industry are not insubstantial. For example, one study estimates GHG emissions from ocean-going vessels are at least three percent of the world's total,[56] an aggregate total higher than many of the developed-country Parties to the Kyoto Protocol. The study suggests that amount may be underreported as the estimates are based upon sales of bunker fuel, which is suspected to be underreported.[57] Indeed, that suggestion seems to have validation in a report that was leaked to the press from the International Association of Independent Tanker Owners ("INTERTANKO"). INTERTANKO's report suggests that emissions are twice what previously believed, and may total 1.2 billion tons per year, or as much as six percent of the world's total.[58]

In fact, these reports and estimates are worse than they appear, because ship emissions are usually released in clean environments.[59] Some of these environments suffer disproportionately from shipping's emissions, such as the Arctic ecosystem with its ice and snow loss. As the Arctic loses ice-cover, even small amounts of emitted and deposited BC will further exacerbate Arctic melting.

The few GHG regulations on the shipping industry that the IMO has proposed are still in its nascent stages, particularly for BC. The IMO International Correspondence Group on Greenhouse Gas Related Issues noted the high Global Warming Potential ("GWP") of BC, however, deferred to the ongoing revision of MARPOL Annex VI to address this issue. Unfortunately, the revised MARPOL Annex VI does not as of yet address BC. The revised proposal, which can be adopted by member governments in October 2008 and entered into force by 2010, would cap the sulfur content of marine fuels by 0.5 percent world wide by 2020; limitations would fall in stages to 3.5 percent by 2012, currently sulfur limit is 4.5 percent.[61] This is clearly insufficient and counterproductive to all the efforts the global community has put into reducing acid rain and GHG emissions. Moreover, it avoids the issue of PM, including BC, which kills thousands of individuals annually and would be one of the most destructive forces aiding global warming in the Arctic, if the shipping industry increases it presence in the Polar Regions. The Arctic would be the more susceptible of the two poles because of the interest in the Northwest and Northeast Passage shipping routes.

Either through the IMO, the post-Kyoto framework, or at the very least at the national level the shipping industry should be required to implement some easy and practicable steps to reduce BC emissions. The simple installation of scrubbers on ships or reducing to an ultra-low sulfur fuel would be a step in the right direction to reduce ships' BC emissions.[62] Additionally, even without technology changes, shipping companies could require their fleets to reduce their speed—ships that slow down by ten percent use twenty-five percent less fuel.[63] Ports should encourage (or require) ships to reduce their engine use as they approach the shore and the port, and once the ship is at the port, the port should require ships to rely on shore power instead of their engines—relying on shore power will reduce particulate emissions because of regulations in many industrialized countries and will eliminate carbon and particulate emissions if shore power is generated by renewable sources, such as wind or solar.[64]

Moreover, countries and the shipping industry need to keep innovating ways to reduce emissions and copy successful approaches by other companies. Two items shipping industry should keep an eye on to reduce emissions and fuel costs is the use of high tech kites to harness the winds, thus reducing fuel consumption,[65] and the possibility of switching to alternative fuels for short routes or for routes that can quickly develop the infrastructure to supply alternative fuels.[66]

Conclusion

With the increasingly ice free Arctic and the increase in under-regulated shipping undermining the efforts of many countries to reduce emissions, there needs to be a change in the approach taken to regulate shipping. It seems as if the industry is unwilling to regulate itself, and its regulatory body, the IMO, is moving to slow and ignoring global action on climate change. In addition, we are rapidly learning about BC's threat to our climate and planet, luckily we can do something about it now. BC is proving to have negative effects on human health and fragile ecosystems, such as the Arctic. Yet industrialized countries have been reducing their BC emissions for many years and should encourage and assist developing countries to do the same.

The concern for the Arctic is particularly acute, because climate change's impacts are disproportionately felt at the poles and because of the large amounts of sea ice loss. This ice loss implicates shipping due to its interest in the Northwest Passage and the Northeast Passage. Ships without appropriate control technology would emit large amounts of BC that would rest on the Arctic ice, speed up ice and snow melting, and reduce surface albedo; this would speed up the cycle of Arctic melting and global warming overall.[67] Because BC can have such a disastrous effect on the Arctic, and predictions that it is the second or third largest warming agent, behind CO_2 and methane, it is necessary for the IMO or any post-Kyoto framework to include shipping and BC, because every reduction helps. Currently the technology exists to reduce BC emission from industry and shipping, which would create an immediate benefit for the global fight against climate change due to its short atmospheric lifespan. The question remains, however, if the political will to require some changes is available.

Endnotes: Mitigating Black Carbon

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27 Ramanathan & Carmichael, *supra* note 15, at 222–23.

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