

## **Arctic Black Carbon Initiative Overview of Potential Demonstration Projects**

**Background:** Black carbon (BC), or soot, is a short-lived warming agent that affects climate globally and is particularly damaging to the Arctic, where it is thought to be responsible for up to 50% of 20<sup>th</sup> century warming. Because its atmospheric residence time is relatively short (days to weeks), decreasing BC emissions offers an opportunity to reduce near-term warming, and technologies are readily available for this purpose. Furthermore, while CO<sub>2</sub> reductions are essential over the long-run, it is generally understood that decreasing long-lived greenhouse gases alone will not be sufficient to slow cryospheric melting in the Arctic. Simultaneous action on BC and other short-lived climate forcers is also essential. Because BC particles are of respirable size, BC mitigation would have important public health co-benefits for Arctic communities.

Recognizing the potentially substantial climate benefits from black carbon mitigation, the United States pledged \$5 million dollars in Copenhagen for cooperative efforts to reduce black carbon in the Arctic. The Arctic Council provides the ideal forum for pan-Arctic cooperation to address BC, enhancing the impact of our Copenhagen commitment. The Arctic Council Short Lived Climate Forcers Task Force (SLCF TF) is in the process of identifying BC sources across all member states, as well as mitigation options that could be undertaken as part of their voluntary contribution to reducing overall emissions. If agreed by the Senior Arctic Officials (SAOs) in connection with the Tromsø mandate<sup>1</sup>, the Arctic Council could implement proposed activities, such as those described below, as appropriate. Implementation of demonstration projects either could be undertaken outside the normal working group structure - by national experts in the Member States working together and reporting to the SAOs - or could be undertaken through the working group structure with national experts reporting to the working groups who would then report to the SAOs.

**Goals and Objectives:** This initiative is intended to implement mitigation measures identified in the ongoing analysis of the Arctic Council Short-Lived Climate Forcers Task Force, as well as other on-going assessments including a UNEP-funded global assessment of BC and tropospheric ozone and a U.S. EPA report to Congress on BC.

The goals of these assessments and this initiative are to identify the most cost-effective mitigation options for BC sources affecting the Arctic and initiate emission reduction actions. This initiative will make investments to: 1) fill information gaps in available analyses; 2) identify barriers to implementation and develop approaches to overcome them; 3) demonstrate technological and non-technological mitigation options; and 4) where possible, lay the groundwork to quantify the climate and public health benefits of BC mitigation strategies. A mix of projects will be funded based on the available analyses and the mutual interests of the United States, other Arctic governments, and

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<sup>1</sup> “**Urge** implementation of early actions where possible on methane and other short-lived climate forcers, and **encourage** collaboration with the Methane to Markets Partnership and other relevant international bodies taking action to reduce methane and other short-lived forcers,”

selected partner organizations. The focus of these activities will be on those emission sources that appear to contribute the most to BC emissions, based on option analyses to date, and will likely include:

- 1) Diesel engines, including on-road and off-road engines and port operations
- 2) Stationary sources, including district heating and heavy industrial facilities
- 3) Wildfires and agricultural fires

Action in these sectors is likely to have the added benefit of achieving reductions in other long lived greenhouse gases (CO<sub>2</sub>) as well as medium- and short-lived climate forcers (e.g., methane and ozone) and conventional pollutants (SO<sub>2</sub> and NO<sub>x</sub>).

The United States is currently exploring project options for the initiative, and our agencies would welcome a discussion with their counterparts in other Arctic Council nations on topics of mutual interest. In this document we provide an informal list of concepts for Arctic collaboration. We see the list as a beginning of a dialogue to reduce black carbon in the Arctic, and we look forward to continued discussion with other country partners. Finally, we note that it would not be possible to achieve all listed project concepts using only the \$5 million dollars that the U.S. pledged at Copenhagen. It will be necessary to focus on high mitigation potential topics of mutual priority, and for some projects, matching funds may be required.

## **Proposed Activities**

### **Diesel engines**

Although black carbon emissions inventories are relatively uncertain, diesel emissions are the largest inventory component by far in many developed countries. Controls and strategies to reduce diesel black carbon are well known and are commercially available. Filter-based PM standards are in place in some countries, including the United States, and are already bringing about black carbon reductions. Reducing diesel PM emissions also would bring significant health benefits to Arctic communities.

**Inventories and Demonstration Projects:** Under the Black Carbon Initiative, experts from U.S. agencies could work with their counterparts in other Arctic countries to develop targeted baseline emissions inventories and retrofit demonstration projects. These projects could involve both on-road and off-road diesel engines, including marine vessels and cargo handling equipment at ports. One example could include retrofitting stationary diesel engines -- often used for electricity generation -- and small to medium-sized shipping vessels in the Arctic and/or Sub-Arctic. There are a wide range of diesel retrofit projects of on-highway and non-road vehicles and marine vessels underway in the U.S. The demonstration projects would likely utilize low sulfur diesel fuel to facilitate use of advanced emission control technologies.

Projects developed to address diesel engines may involve one or more of the following elements:

- Develop a baseline inventory for BC sources in a particular city, region, or port, focused on one of the following:
  - on-road diesel engines
  - off-road diesel engines
  - stationary diesel engines
  - marine vessels
- Identify candidates for diesel retrofit demonstrations in the city/region/port and selected source category
- Implement diesel retrofit demonstration, including
  - identifying source of ultra-low sulfur diesel fuel
  - procuring and installing retrofit control technology
  - measuring changes in emissions
- Estimate air quality, health, and climate benefits of emission reductions
- Establish online platforms that each Arctic nation could use to track performance characteristics of small diesel generators, modeled in part on the Alaska Energy Data Inventory (<http://akenergyinventory.org/>)

**Stationary sources, including district heating and heavy industrial facilities**

While significant uncertainties remain regarding black carbon emissions from stationary sources, such as district heating plants and heavy industrial facilities, in areas where these sources are not well-controlled, they may offer some of the most rapid and cost effective means of getting emission reductions. Many stationary sources comprise well-understood processes with demonstrated and readily-available control technologies. Controlling these sources can also be cost effective because of the significant public health benefits that accrue when emissions of particulate matter, sulfur dioxide, and nitrogen dioxide are reduced. These benefits are well understood and relatively easily quantifiable. Less certain, but also potentially significant, are the climate benefits, particularly given that many of the particle emissions fall on ice or snow.

**Source testing, modeling, and improved technologies:** Under the Black Carbon Initiative, experts from Arctic Council countries could, for example, collaborate to conduct location specific-source testing, emission characterization, and modeling for older or under-controlled facilities. The results of the measurement and inventory work could be used to establish a pilot program targeting priority sources. The pilot program could install control equipment and measure emissions reductions, and estimate benefits for air quality, public health, and climate. This program could also provide a forum for Arctic communities that have successfully tackled district heating and industrial emissions to share their experiences with others across the Arctic.

Projects developed to address stationary source emissions of BC may involve one or more of the following elements:

- Develop a baseline inventory for BC sources at a particular facility or in a particular city, region, or port, including:
  - performing source testing at individual facilities

- Identify candidates for control technology demonstrations at the specific facility/city/region/port of interest.
- Implement control technology demonstration, including
  - procuring and installing retrofit control technology
  - measuring changes in emissions
- Estimate air quality, health, and climate benefits of emission reductions
- Establish a Pan-Arctic Combined Heat and Power/District Heating and Cooling Application Network (PAAN) that seeks to rapidly minimize black carbon emissions from existing equipment, to expand deployment of highly-efficient, low-emissions CHP/DHC systems and to provide efficiency assessments for existing infrastructure.

### **Wildfires and Agricultural Fires**

The contribution of open fires to black carbon in the Arctic is an area that requires both research and, where appropriate, informed mitigation action. Wildfires and agricultural burns encompass a diverse set of issues, and the project areas identified below represent a subset of possible areas for Arctic cooperation. We welcome further discussion.

**International Scientist and Farmer Exchanges on Black Carbon Emissions from Agricultural Burning:** The USDA Foreign Agricultural Service (FAS) could discuss options for scientific exchanges and a farmer-to-farmer exchange between the United States and other Arctic Council nations, for collaboration on monitoring and reducing the amount of black carbon contributed by agricultural burning in and around the Arctic. The FAS activities include a trilateral planning workshop, five agricultural scientific exchange scholars, and a farmer-to-farmer exchange program. The proposed FAS activities are envisioned to stimulate new scientific information and science-based tools for monitoring and reducing black carbon emissions from agricultural burning in and around the Arctic. The activities could also heighten farmers' awareness of the impact of agricultural burning on the Arctic environment and pragmatic steps to reduce black carbon emissions from agricultural burning.

**Enhanced cooperation on wildfires:** Under the auspices of the Black Carbon Initiative, funded projects would place particular emphasis on the black carbon benefits of effective fire management, but these projects would have multiple benefits for health and safety, resource management, and greenhouse gas emissions as well. Activities could include: (1) building capacity and coordination in managing and responding to wildfire, (2) strengthened municipality-level fire wardens and brigades, (3) improved training and capacity to prevent escape of agricultural burns, and (4) work on models to improve estimation of wildfire severity, fuel consumption, emissions, ecosystem impacts, and effect of climate change on wildfires in the Arctic and surrounding regions.

**Identification of necessary conditions for Arctic transport of smoke:** The U.S. Forest Service proposes a comprehensive, 30-year back-trajectory modeling study to identify the source regions, timing, plume injection height, and meteorological conditions necessary for Arctic transport of smoke. This work is already underway for the United States.

Under the Black Carbon Initiative, it could be extended to include Canada, Russia, and other Arctic Council partners. The study would seek to improve understanding of the locations and meteorological conditions that contribute black carbon to the Arctic, and to help us to understand whether there are certain locations and/or seasons where fires are *unlikely* to contribute black carbon to the Arctic. To this end, participating scientists would produce an “Atlas” of Arctic transport potential, would identify regions of fire with high Arctic transport potential, and would diagnose weather patterns associated with transport events. Results could be applied to assist with smoke management in the context of Arctic black carbon reductions.

### **Observations**

Arctic Council nations already engage in active environmental monitoring of the Arctic relevant to black carbon. These efforts are highly complementary to those envisioned for the Black Carbon Initiative, and we take this opportunity to call for enhanced cooperation to sustain and extend measurements relevant to black carbon in the Arctic.

**Atmospheric Observatories:** The U.S. National Oceanic and Atmospheric Administration (NOAA) will engage a network of atmospheric observatories around the Arctic rim, formally established during the International Polar Year, to provide high quality measurements of black carbon (BC) and evaluate source areas. The International Arctic System for Observing the Atmosphere (IASOA) is a network of observing sites already in operation with several existing sensors and samplers that support BC science. NOAA intends to enhance the BC observations at several of these sites, and use its own unique instrumentation to produce highly accurate reference data so that past and future observations with the simpler sensors most often used in the field can be tied together to gain an accurate pan-Arctic perspective. Further, NOAA will employ transport models and measurements of chemical tracers to estimate the sources of BC observed at the IASOA sites. Enhanced participation in these efforts, under the Black Carbon Initiative, would contribute to a valuable forum for scientific exchange.