Black Carbon Symposium

November 14, 2012 • San Francisco, CA & New York, NY

Preparatory Briefing Paper

The Black Carbon Symposium is designed to provide scientific information on black carbon and its impacts to human health and global climate change. The purpose of this meeting is to create a robust dialogue between scientists and policy-makers on black carbon. We hope that the meeting will generate priorities for policy-relevant research and ideas on how local and state air agencies in the United States can address black carbon as part of their efforts to reduce fine particle ($PM_{2.5}$) pollution. As an attendee, we hope you will take the opportunity to read through this briefing paper before coming to the meeting to give you basic background and to help you think through what opportunities you see in your work to reduce black carbon.

Background from EPA Report to Congress on Black Carbon

Black carbon (BC) is the most strongly light-absorbing component of particulate matter (PM), and is formed by the incomplete combustion of fossil fuels, biofuels, and biomass. BC is emitted directly into the atmosphere in the form of fine particles (PM2.5). The United States contributes about 8% of the global emissions of BC. Within the United States, BC is estimated to account for approximately 12% of all direct PM2.5 emissions in 2005. BC contributes to the adverse impacts on human health, ecosystems, and visibility associated with PM2.5. BC influences climate by: 1) directly absorbing light, 2) reducing the reflectivity ("albedo") of snow and ice through deposition, and 3) interacting with clouds. The direct and snow/ice albedo effects of BC are widely understood to lead to climate warming. However, the globally averaged net climate effect of BC also includes the effects associated with cloud interactions, which are not well quantified and may cause either warming or cooling. Therefore, though most estimates indicate that BC has a net warming influence, a net cooling effect cannot be ruled out. Recent estimates of BC emissions by source category in the United States and globally are shown in Figure A. Most U.S. emissions of BC come from mobile sources (52%), especially diesel engines and vehicles. In fact, 93% of all mobile source emissions came from diesels in 2005. The other major source domestically is open biomass burning (including wildfires), although residential heating and industry also contribute.

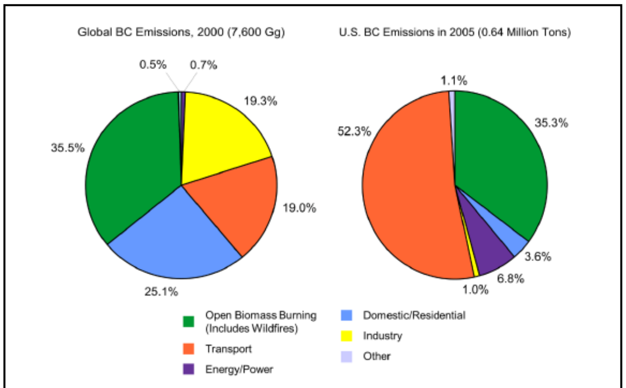

Figure A. BC Emissions by Major Source Category. (Source: Lamarque et al., 2010 and U.S. EPA)

Sensitive regions such as the Arctic and the Himalayas are particularly vulnerable to the warming and melting effects of BC. BC is emitted with other particles and gases, many of which exert a cooling influence on climate. Therefore, estimates of the net effect of BC emissions sources on climate should include the offsetting effects of these co-emitted pollutants. This is particularly important for evaluating mitigation options. BC's short atmospheric lifetime (days to weeks), combined with its strong warming potential, means that targeted strategies to reduce BC emissions can be expected to provide climate benefits within the next several decades. The different climate attributes of BC and long-lived greenhouse gases make it difficult to interpret comparisons of their relative climate impacts based on common metrics.

Based on recent emissions inventories, the majority of global BC emissions come from Asia, Latin America, and Africa. Emissions patterns and trends across regions, countries and sources vary significantly. Control technologies are available to reduce BC emissions from a number of source categories. BC mitigation strategies, which lead to reductions in PM2.5, can provide substantial public health and environmental benefits. Considering the location and timing of emissions and accounting for co-emissions will improve the likelihood that mitigation strategies will be properly guided by the balance of climate and public health objectives. As illustrated in Figure B, the ideal reduction strategies will also depend on a range of constraining factors.

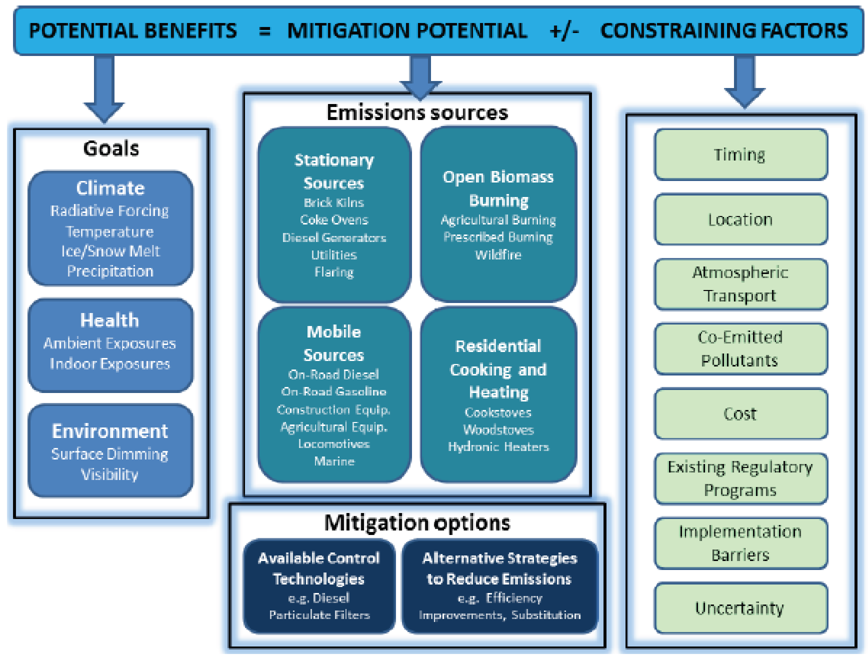

Figure B. Policy Framework for Black Carbon Mitigation Decisions. (Source: U.S. EPA)

Achieving further BC reductions, both domestically and globally, will require adding a specific focus on reducing direct PM2.5 emissions to overarching fine particle control programs. The United States will achieve substantial BC emissions reductions by 2030, largely due to controls on new mobile diesel engines. Diesel retrofit programs for in-use mobile sources are a valuable complement to new engine standards for reducing emissions. Other source categories in the United States, including stationary sources, residential wood combustion, and open biomass burning also offer potential opportunities. A variety of other options may also be suitable and cost-effective for reducing BC emissions, but these can only be identified with a tailored assessment that accounts for individual countries' resources and needs.

Despite some remaining uncertainties about BC that require further research, currently available scientific and technical information provides a strong foundation for making mitigation decisions to achieve lasting benefits for public health, the environment, and climate.

Science as a Foundation for Policy Development

Already, there is interest in developing locally appropriate mitigation strategies to address BC as a climate and health pollutant. The California Air Resources Board has discussed BC in their Low Emission Vehicle III Standard, and explored approaches for quantifying the BC climate co-benefits of this rule. Because BC comprises part of ambient $PM_{2.5}$, there is significant overlap with existing programs. Owing to this, significant progress has been made already towards reducing BC emissions. However, because the composition of $PM_{2.5}$ varies by source, considering the BC climate co-benefit can lead to greater emphasis on reducing direct $PM_{2.5}$ emissions from particular source categories. For this reason, local air districts may want to consider BC emissions explicitly within their existing $PM_{2.5}$ air quality planning efforts. Agencies with existing or emerging greenhouse gas regulations may also want to consider how BC reductions could complement those programs, while accounting for the remaining uncertainties in BC forcing and net forcing effects of co-emitted pollutants.