WHAT IS BLACK CARBON?

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Black Carbon (BC) has emerged as a major contributor to global climate change, possibly second only to CO2 as the main driver of change.[1] BC particles[2] strongly absorb sunlight and give soot its black color. BC is produced both naturally and by human activities as a result of the incomplete combustion of fossil fuels, biofuels, and biomass. Primary sources include emissions from diesel engines, cook stoves, wood burning and forest fires. Reducing CO2 emissions is essential to avert the worst impacts of future climate change, but CO2 has such a long atmospheric lifetime that it will take several decades for CO2 concentrations to begin to stabilize after emissions reductions begin. In contrast, BC remains in the atmosphere for only a few weeks, so cutting its emissions would immediately reduce the rate of warming, particularly in the rapidly changing Arctic. Moreover, reduced exposure to BC provides public health co-benefits, especially in developing countries. Technologies that can reduce global BC emissions are available today.

BLACK CARBON AND CLIMATE CHANGE

BC warms the climate in two ways. When suspended in air, BC absorbs sunlight and generates heat in the atmosphere, which warms the air and can affect regional cloud formation and precipitation patterns. When deposited on snow and ice, it absorbs sunlight, again generating heat, which warms both the air above and the snow and ice below, thus accelerating melting. Because BC remains in the atmosphere for only one to four weeks, its climate effects are strongly regional. Its short lifetime also means that its climate effects would dissipate quickly if black carbon emissions were reduced, thus benefiting most directly the countries or communities that invest in policies to reduce BC emissions.

A recent study suggests that BC may be responsible for more than 30 percent of recent warming in the Arctic,[3] contributing to the acceleration of Arctic sea ice melting. Loss of Arctic sea ice would lead to more rapid warming and possibly irreversible climate change. BC is also driving increased melting of Himalayan glaciers, which are a major source of freshwater for millions of people in the region. BC may also be driving some of the observed reduction of the snowpack in the Pacific Northwest of the United States.

Different types of soot contain different amounts of BC—generally the blacker the soot, the more of a warming agent it is. Fossil fuel and biofuel soot are blacker than soot from biomass burning[4] (e.g., forest fires and wood fuel), which is generally more of a brownish color. Thus, controlling emissions of soot from fuel sources is an effective way of reducing atmospheric temperatures in the short term. Based on current information, the United States is responsible for about 6 percent of global BC emissions; while it has a history of making reductions to improve air quality, further improvements can be made. The majority of BC emissions come from the developing world: China and India together account for some 25–35 percent of emissions.

Control technologies that reduce BC include retrofitting diesel vehicles with filters to capture BC, fuel switching (e.g., from diesel to natural gas in buses), and replacement of inefficient cook stoves with cleaner alternatives. Adopting these alternatives would have positive co-benefits for public health, especially in the developing world. For example, retrofitting or replacing diesel buses and trucks would greatly improve urban air quality in densely populated cities. Replacement of dirty cook stoves with cleaner alternatives, such as solar cookers or newer models that burn fuel more completely, would improve indoor air quality, which is a major health concern in both urban and rural areas of the developing

world.

Reducing BC emissions[5] represents a win-win scenario: it would have an immediate cooling effect on the Earth's climate, potentially delaying temperature increases in the short run and helping reduce the risk of irreversible tipping points in the climate system, and it would reduce air pollution, resulting in fewer premature deaths and fewer missed work and school days.

ENDNOTES

1 Ramanathan, V. and G. Carmichael. 2008. Nature Geoscience, 1:221-227.

2 BC is a carbonaceous aerosol. An aerosol is a suspension of fine solid particles or liquid droplets within a gas. Examples include smoke, air pollution, smog, oceanic haze, and tear gas. Carbonaceous refers to a substance rich in carbon.

3 The Arctic warmed by 1.48 ± 0.28 °C during 1976–2007; BC is estimated to have caused 0.5–1.4 °C of that change (Shindell, D. et. al. 2009. Nature Geoscience, 2:294-300).

4 Soot from biomass burning generally tends to have a cooling effect on the climate.

5 The American Clean Energy and Security Act of 2009 reported out of the U.S. House Energy and Commerce Committee on May 21, 2009, has a significant section on BC emissions, directing the EPA Administrator to investigate BC sources, impacts, and mitigation technologies.

CENTER FOR CLIMATE AND ENERGY SOLUTIONS

The Center for Climate and Energy Solutions (C2ES) is an independent nonprofit organization working to promote practical, effective policies and actions to address the twin challenges of energy and climate change.

2101 WILSON BLVD. SUITE 550 ARLINGTON, VA 22201 703-516-4146 C2ES.ORG