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RESEARCH BRIEF

Black Carbon Problems in Transportation: Technological Solutions and Governmental Policy Solutions

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Black carbon particulates in "soot" emissions have significant detrimental impacts on public health, climate change and food production; and diesel engines in the transportation sector are a major source of such emissions. There are cost-effective technologies that can mitigate the emissions, including especially diesel particulate filters. However, a wide range of policies at all levels of government – including local and international – are needed to incentivize the uptake of emission-mitigating technologies.

The adverse effects of black carbon (BC) emissions from diverse sources are significant in human and economic terms (Shindell et al., 2012; United Nations Environment Programme and World Meteorological Organization, 2012; US Environmental Protection Agency, 2012). The health effects include annual premature deaths on the order of millions of people from lung cancer and cardiovascular problems, as well as lost work and health care costs from asthma and other disorders (World Health Organization, 2012). BC also has detrimental effects on food supplies, with the production of rice and others crops reduced by millions of tonnes per year. In addition, BC has significant climate change consequences: Its global warming impact is about 55 percent that of carbon dioxide and thus greater than other greenhouse gases (Bond et al., 2013). BC's Global Warming Potential per tonne is thousands of times greater than carbon dioxide's over a 20-year period (Inter-governmental Panel on Climate Change, 2013). BC aerosols plus BC depositions on snow and ice in the Arctic contribute to glacial melting and thus global sea level rise, and to other climate change impacts (Arctic Monitoring and Assessment Programme, 2015).

Black carbon emissions are underestimated in the transportation sector as a result of a combination of intentional under-reporting for motor vehicles and inadequate measurement methods in aviation; nevertheless, the transportation sector is estimated to be the largest source of BC emissions in developed

countries and an increasing proportion in developing countries. Globally, diesel engines contribute about 90 percent of transportation's BC emissions (Sims, Gorsevski and Anenberg, 2015). Levels of BC emissions in shipping and aviation are expected to increase for the foreseeable future as a result of increases in traffic volumes. (Although diesel fuel is not used in airplanes, there are nevertheless BC emissions from their engines as well as ground support vehicles. Yet, the aviation industry has not recognized BC emissions as a pressing issue on the ICAO agenda.)

There are cost-effective technologies that can mitigate transportation sector BC emissions. Diesel particulate filter (DPF) technology has been used in motor vehicles for years and can be used in ships as well. However, the rate of technology uptake has not been sufficient to reduce the sector's BC emissions to levels consistent with global temperature targets agreed in the Paris Accord.

Governmental policies therefore need to focus on how to incentivize the uptake of mitigating technologies. The paper accordingly concludes with a wide range of policy recommendations:

- Local-level BC emission-reduction initiatives should be adopted, especially in large cities with seaports and airports. These programs should encompass all diesel engine sources of BC in maritime shipping and aviation port infrastructure areas, including off-road vehicles, loading/unloading equipment, and diesel locomotives. These initiatives could be incorporated into on-going and expanding city programs, such as the one in Paris, to reduce air pollution by prohibiting or otherwise limiting diesel-powered vehicles.
- National governments' climate change policies should include measures to reduce BC emissions, including in the transportation sector. Annual meetings of the Conference of the Parties (COP) of the UN Framework Convention on Climate Change (FCCC) as well as other climate change conferences should expand recognition that BC mitigation can be included in countries' Nationally Determined Contributions, as embodied in the Paris Accord.
- At the sectoral level, mitigating BC emissions should be an urgent objective in the International Civil Aviation Organization (ICAO) and International Maritime Organization (IMO). At the FCCC, the agenda of the Technology Transfer Mechanism should include transfers of diesel particulate filter (DPF) technologies in motor vehicles and maritime shipping. DPF tariffs and non-tariff barriers should be included in the final lists of covered items in Environmental Goods Agreement (EGA) negotiations in Geneva. National policies worldwide - and EU regional policies – concerning emissions standards and testing procedures for motor vehicles need to be strengthened.
- At the regional-international level, all maritime shipping Emission Control Areas (ECAs) should include BC emission limits. An Arctic Black Carbon Agreement in the form of a "carbon club" should be developed (Brewer, 2015).
- As for metrics, BC emission measurement deficiencies for motor vehicles and aviation need to be corrected, and a maritime shipping measurement protocol being developed at the IMO should be finalized and adopted.
- As for analytic paradigms that can be used for informing technologically-relevant policymaking, the prevailing climate change paradigm should be revised to include black carbon because of its distinctive physical properties as particulate matter, its multiple detrimental impacts, its localized and regionalized impacts as well as its global impacts, and its industry-specific emission-mitigation technologies.

References

Arctic Monitoring and Assessment Programme of the Arctic Council (AMAP) (2015) AMAP Assessment 2015: Black carbon and ozone as Arctic climate forcers. Oslo, Norway: AMAP.

Bond, T. C., et al. (2013) Bounding the role of black carbon in the climate system: A scientific assessment, Journal of Geophysical Research: Atmospheres, 118: 5380–5552.

Brewer, Thomas L. (2015) Arctic Black Carbon from Shipping. Geneva: ICTSD. Available at www.ictsd.org.

Intergovernmental Panel on Climate Change (IPCC) (2013) Climate Change 2013: The Physical Science Basis. Cambridge University Press, 2013.

Shindell, Drew, et al. (2012) Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security, Science 335: 183-189.

Sims, R., V. Gorsevski and S. Anenberg (2015) Black Carbon Mitigation and the Role of the Global Environment Facility: A STAP Advisory Document. Global Environment Facility: Washington, D.C.

United Nations Environment Programme (UNEP) and World Meteorological Organization (WMO) (2012) Integrated Assessment of Black Carbon and Tropospheric Ozone. Geneva.

US Environmental Protection Agency (EPA) (2012) Report to Congress on Black Carbon. Washington, DC: US EPA.

World Health Organization (WHO) (2012) Health Effects of Black Carbon. By: Nicole AH Janssen, et al. Geneva: WHO.

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