Climate and Air Quality Co-Benefits of Reducing Black Carbon

Key Messages from EPA's *Report to Congress on Black Carbon* and Other Recent Initiatives

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"Addressing Climate Change in the Near Term: Science of Short-Lived Climate Pollutants and their Control"

Key Messages

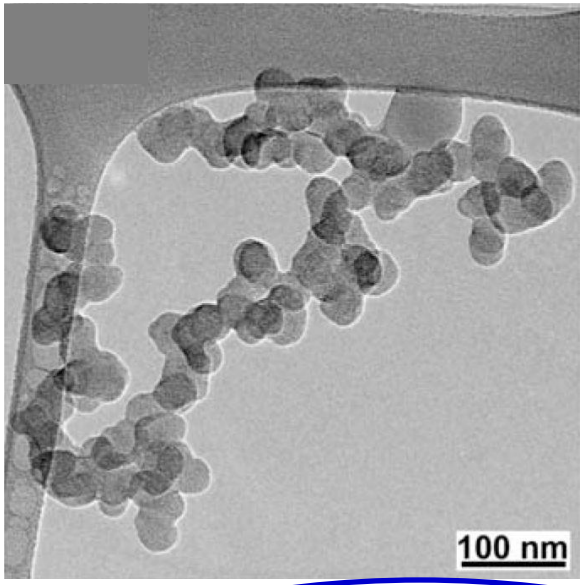
- Targeted reductions in black carbon (BC) emissions can provide significant near-term climate benefits.
- The health and environmental co-benefits are very large.
- Effective control technologies and approaches are available to reduce BC emissions from a number of key source categories.
- U.S. BC emissions have been declining, and additional reductions are expected by 2030 due to controls on mobile diesel engines.
- Controlling direct fine particle ($PM_{2.5}$) emissions from sources can be a highly effective air quality management strategy, with major public health benefits.
- Several major international initiatives are targeting reductions in BC, as well as methane and HFCs.

Source: Reuters

EPA's Report to Congress on Black Carbon

- In October 2009, Congress requested that EPA conduct a comprehensive study on black carbon to evaluate domestic and international sources, and climate/health impacts
- EPA completed this report on March 30, 2012
- Available online at: www.epa.gov/blackcarbon

Key Features of Black Carbon



- Strongly light-absorbing
- Formed by incomplete combustion of fossil fuels, biofuels, and biomass
- Associated with range of climate impacts:
  - Warming
  - Ice/Snow melt
  - Cloud formation/Precipitation

- Emitted directly into the atmosphere in the form of fine particles (i.e., "direct $PM_{2.5}$")
- Remains in atmosphere days to weeks
- Principally a regional pollutant

Health Effects of Black Carbon

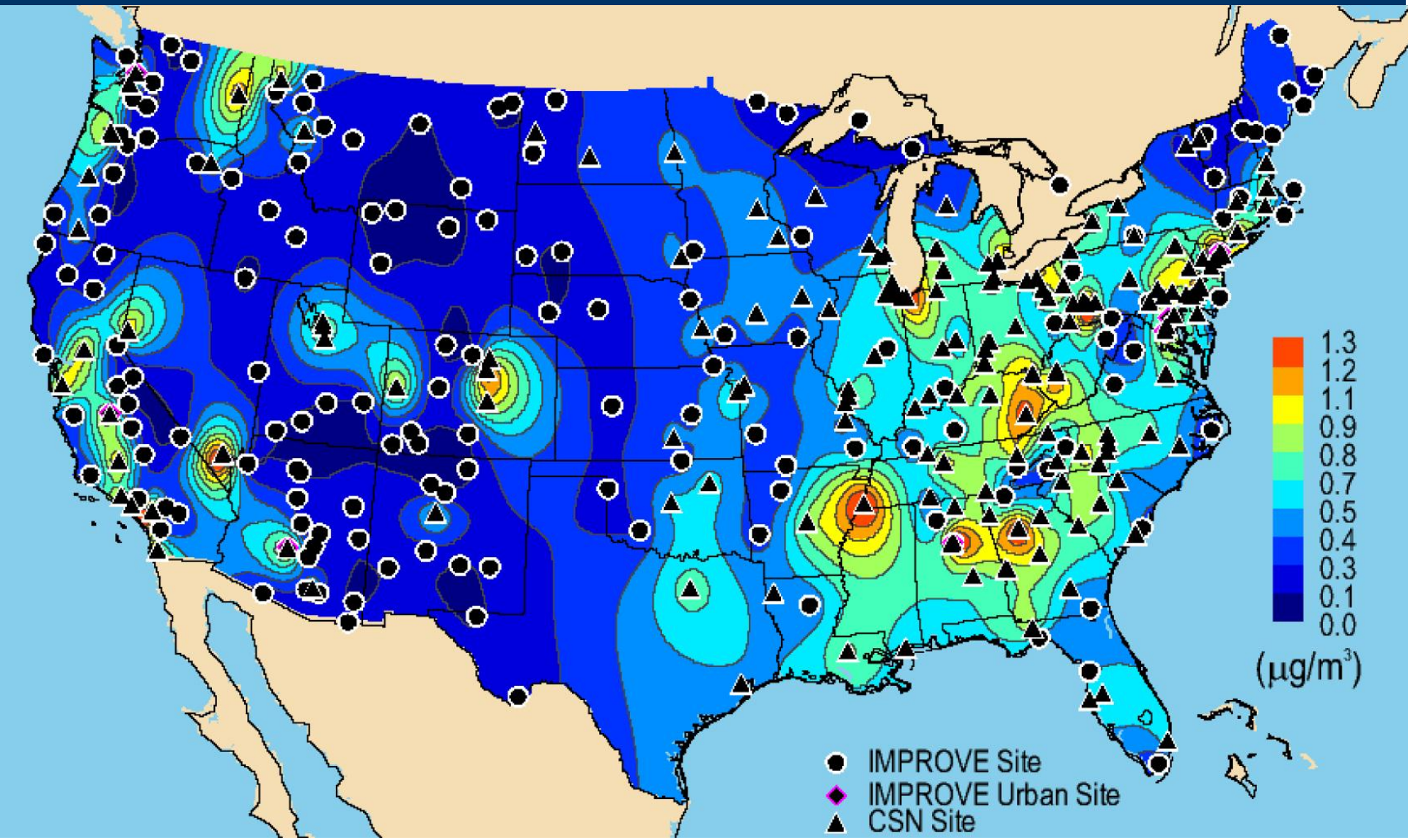
Brick Kiln in Kathmandu

- BC contributes to the adverse impacts on human health, ecosystems, and visibility associated with $PM_{2.5}$.
- Exposures to $PM_{2.5}$ are associated with a broad range of human health effects, including respiratory and cardiovascular effects and premature death.

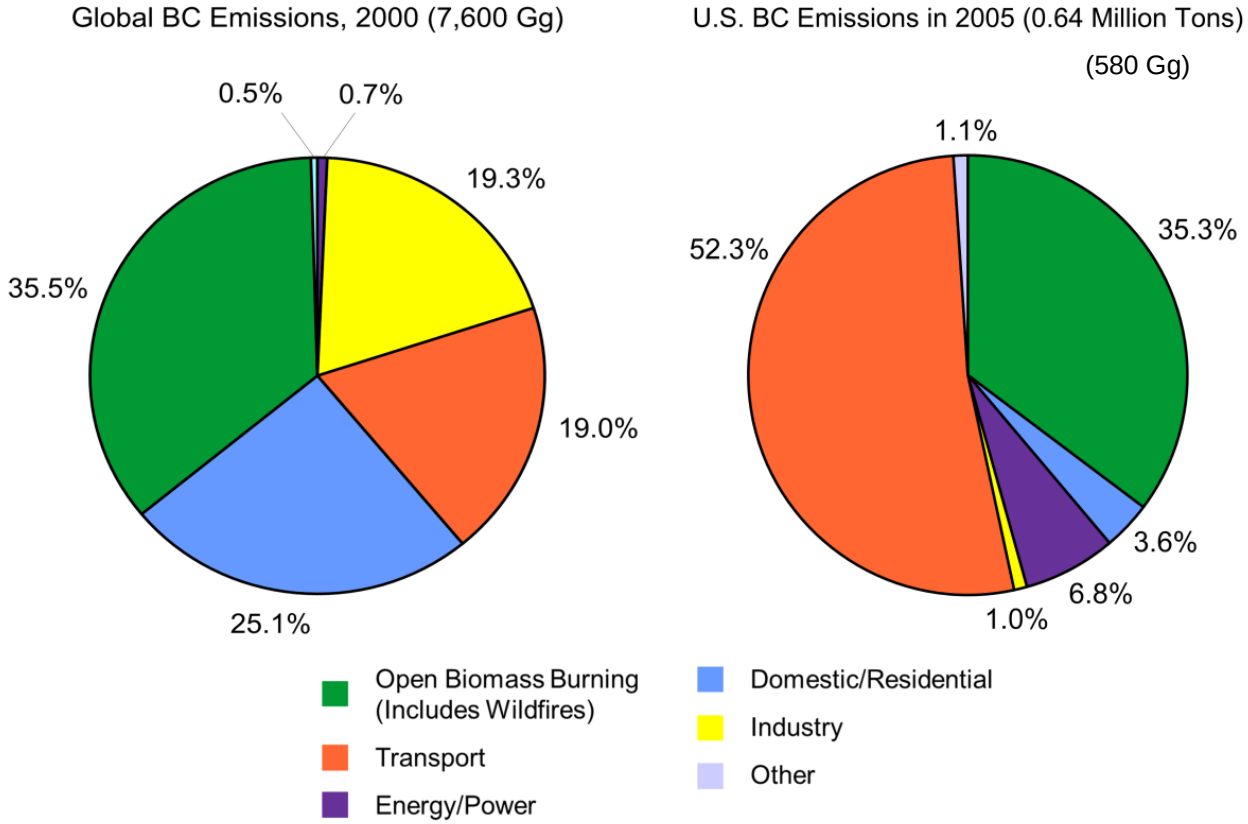
- According to the World Health Organization (WHO), indoor smoke from solid fuels is one of top 10 mortality risk factors globally, contributing to approximately 2 million deaths each year (mainly among women and children).
- Emissions and ambient concentrations of directly emitted $PM_{2.5}$ are often highest in urban areas, where large numbers of people live.

Traditional Cookstove in India

Annual Mean BC Concentrations (µg/m3) for 2005-2008



Black Carbon Emissions



- 75% of global BC emissions come from Asia, Africa and Latin America.
- U.S. currently accounts for approximately 8% of the global total, and this fraction is declining.
- Emissions patterns and trends across regions, countries and sources vary significantly.
- In the U.S., BC emissions ~12% of all direct $PM_{2.5}$ emissions nationwide.
- Mobile sources are the largest U.S. BC emissions category (with 93% of mobile source BC coming from diesels).

Potential Benefits of BC Mitigation

- Targeted strategies to reduce BC emissions can be expected to provide climate benefits within the next several decades, and may be particularly important for sensitive regions such as the Arctic.
- Reductions in BC and GHGs are complementary strategies for mitigating climate change.
- The health and environmental benefits of BC reductions are also substantial.
  - Average public health benefits of reducing directly emitted $PM_{2.5}$ in the U.S. are estimated to range from $290,000 to $1.2 million per ton $PM_{2.5}$ in 2030.
  - Globally, $PM_{2.5}$ reductions due to BC mitigation measures could potentially lead to hundreds of thousands of avoided premature deaths each year.

Mitigating BC: Key Considerations

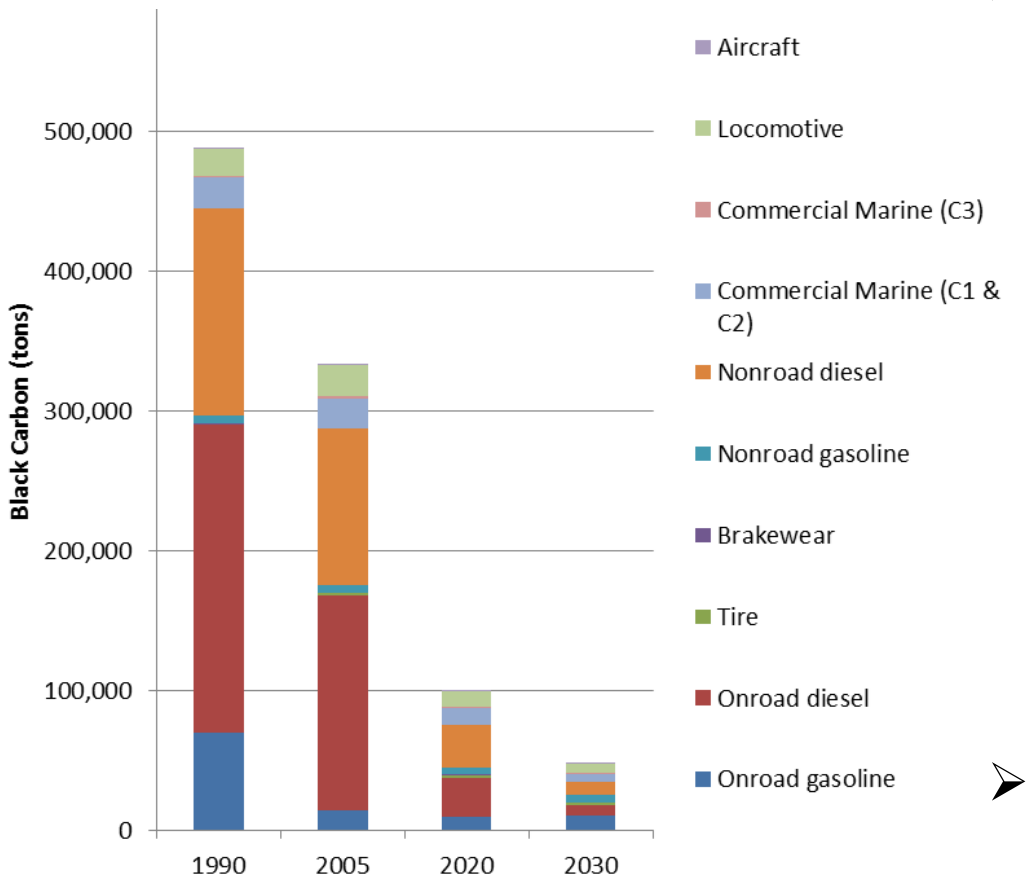
- For both climate and health, it is important to consider the location and timing of emissions and to account for co-emissions.
- Available control technologies can reduce BC, generally by improving combustion and/or controlling direct $PM_{2.5}$ emissions from sources.
- Some state and local areas in the U.S. have already identified control measures aimed at direct $PM_{2.5}$ as particularly effective strategies for meeting air quality goals.
- Though the costs vary, many reductions can be achieved at reasonable costs. Controls applied to reduce BC will help reduce total $PM_{2.5}$ and other co-pollutants.

BC Mitigation Opportunities: United States

- Total U.S. BC emissions will be reduced substantially by 2030, largely due to controls on new mobile diesel engines.

- More limited mitigation potential in other source categories, due to smaller remaining emissions or limits on the availability of effective BC control strategies.
  - Stationary sources: emissions have declined 70% since the early 1900s
  - Residential wood combustion: emissions standards (NSPS) for residential wood heaters currently under review
  - Open biomass burning

U.S. Mobile Sources



U.S. Mobile Source Emissions

- BC emissions from U.S. mobile diesel engines controlled via:
  - Emissions standards for new engines, including requirements resulting in use of diesel particulate filters (DPFs) in conjunction with ultra low sulfur diesel fuel.
  - Retrofit programs for in-use mobile diesel engines, such as EPA's National Clean Diesel Campaign and the SmartWay Transport Partnership Program.
- Projected reduction 2005-2030: 86% (due to existing regulations)

BC Mitigation Opportunities: Global

Global

- Key opportunities:
  - residential cookstoves in all regions
  - brick kilns and coke ovens in Asia
  - mobile diesels in all regions
- A variety of other opportunities may exist in individual countries or regions.

Sensitive Regions

Arctic:

- mobile sources (diesel engines and Arctic shipping)
- residential heating (wood)
- open biomass burning

Himalayas:

- residential cooking
- industrial sources (e.g., coal-fired brick kilns)
- mobile diesels

Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants

- Announced by Secretary Clinton and Administrator Jackson February 16, 2012
- Goal is to accelerate reductions in BC, methane, and HFCs
- Administered by UNEP
- Participants: U.S., Canada, Sweden, Mexico, Ghana, Bangladesh, Colombia, Japan, Nigeria, the European Commission, Norway, World Bank, G-8
- On April 24, 2012, announced 5 major initiatives:
  - Diesel emissions reductions (black carbon)
  - Brick kilns (black carbon)
  - Landfills (methane)
  - Oil and Gas (methane)
  - HFC alternatives

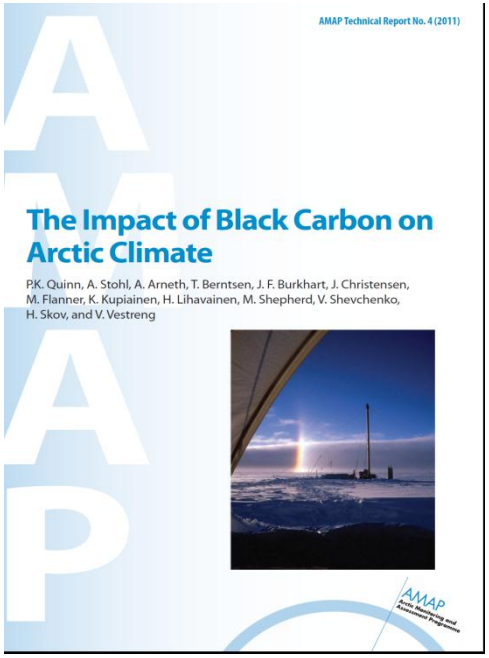
Other International Efforts

Gothenburg Protocol

- In May 2012, the Convention on Long-Range Transboundary Air Pollution (LRTAP) adopted new PM requirements as part of revisions to the Gothenburg Protocol, including specific language on BC

Arctic Council

- Task Force on Short Lived Climate Forcers (2011) 3-0a_TF_SPM_recommendations_2May11_final.pdf
- Arctic Monitoring and Assessment Program (AMAP): The Impact of Black Carbon in the Arctic (2011) (www.amap.no)
- Short-Lived Climate Forcers Project Steering Group (under the Arctic Contaminants Action Program (ACAP), see http://www.epa.gov/international/io/arctic.html)



International Efforts (cont.)

International Maritime Organization (IMO)

- Considering whether to control BC emissions from ships (particularly in the Arctic)

Global Alliance for Clean Cookstoves

- Announced by Secretary Clinton September 2010
- Administered by UN Foundation
- Goal: 100 million clean and efficient stoves by 2020

Efforts on Methane

Global Methane Initiative (formerly Methane to Markets Partnership)

- Voluntary international public-private partnership (since 2004) to advance cost-effective, near-term methane recovery and use as a clean energy source in five sectors (oil & gas, landfills, coal mines, agricultural waste, and wastewater)
- Participants: US and ~40 other countries (including top 10 methane emitters and 70% of global anthropogenic methane emissions) www.globalmethane.org

US EPA Domestic Activities

- Voluntary Partnership Programs
  - Landfill Methane Outreach Program
  - Coalbed Methane Outreach Program
  - Natural Gas STAR
  - AgSTAR Voluntary Program
- NSPS regulations: certain sectors are subject to non-methane VOC control requirements that have significant methane reduction co-benefits (e.g. landfills, oil and gas)

Efforts on HFCs

- Use of HFCs is increasing as replacements for ozone-depleting substances (ODS) in air conditioning, refrigeration, fire suppression, solvents, foam blowing agents, and aerosols
- North American proposal to amend Montreal Protocol to address HFCs introduced May 2012
  - Changes trajectory away from rapid HFC growth
  - Leverages Protocol's expertise
  - Controls byproduct emissions of HFC-23
- EPA programs:
  - Significant New Alternatives Policy (SNAP) program reviews and lists ODS alternatives; many can substitute for high-GWP HFCs
    - Substantial number of climate-friendly alternatives coming to SNAP
  - Responsible Appliance Disposal (RAD) Program
  - GreenChill Partnership with food retailers to decrease impacts on the ozone layer and climate system