Black Carbon, Climate, and Air Pollution: Implications for Public Policy

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Washington DC

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Why should we care? - Public health

Overwhelming evidence that fine particles cause mortality, other serious health effects at low levels

- PM- 63,000 to 88,000 early US deaths/yr*
- Black carbon sources 20- 50% of fine particles
- Stronger US standards in 2006 may get tighter
- Traffic emissions particularly important
- Globally, BC sources cause over 1 million early deaths (WHO, 2004)
  - Asian domestic cooking a major contributor

*(EPA, 2009)
Arctic temperature increase twice global average

Arctic summer sea ice area decreased by 40% since 1979

Summer sea ice gone by 2040?

Warming amplified
- darker surfaces under melted ice
- releasing stored methane

Greenland, Alaskan, Canadian ice melting increases sea level rise
Black Carbon contribution to Arctic warming

Key sources:
- Spring biomass burning (Russia);
- Diesels, domestic fossil/biomass, industry
- Europe and N. Asia most important for polar ice, US significant for Greenland

(Shindell et al., 2009)
Why should we care?

Retreat of the Himalayan and other glaciers in the “Third Pole” of Central Asia

• Glaciers - significant source of water for over 100 million
• Tibetan plateau **warming at 2 to 3 times global average**
• Threats
  – Direct warming by BC and GHG, altered monsoons, snow and ice darkening
  – Water supply related to monsoon, glacier melt, flooding, reductions over time
  – region already facing shortages
  – India, China, other Asian sources
• Ultimately, a global security issue
Potential role of black carbon sources in climate strategies

• BC reductions cannot substitute for global CO2 reductions
• BC reductions can provide nearly immediate, significant benefits for regional climate and public health
• Extent of climate benefits of BC source reduction on a global scale less certain, most certain for snow/ice covered areas
• Targeted regional programs for near-term concerns
  – Rapid shrinkage of Arctic sea ice and snow
  – Retreat of the Himalayan glaciers
  – Countering warming from sulfate reductions

http://www.pewclimate.org/science/black-carbon-primer
Domestic Policy Implications

• Slowing Arctic Melting
  – Retrofitting and maintaining existing diesels in the US - and Europe; biodiesel fuels
  – Shift springtime agricultural burning

• Implementing US fine particle standards (PM$_{2.5}$)
  – Current - relies heavily on regional SO$_2$ reductions (least cost)
  – The downside for climate
  – Consider strategies, guidance for a more balanced program, place more emphasis on existing diesels, other sources of black carbon and organic particles
Looking Forward

• Consider public health *and* climate change – looking for win-win solutions
• The need for a comprehensive view of source/sector emissions
• Look globally for regional solutions
  – US in 8 nation Arctic Council assessment of black carbon strategies – *how and when to implement?*
  – No international group to assess strategies for the Asian ‘Third Pole’ – and significant political hurdles
  – Connect local, regional and global solutions
  – Move forward on coordinated policy assessments recognizing important uncertainties, continue research and monitoring in parallel to reduce them
Supplementary Material
(for wonks only)

• Summary of ongoing US and international assessments for black carbon (and ozone)
• Examples of win-win solutions
  – Diesel electrification
  – Using regional sulfur dioxide cap and trade program (e.g. CAIR) incentives to reduce black carbon
• Using black carbon reductions to counter “unmasking”
Ongoing Assessments

• Black carbon report to Congress due April 2011 (Carper)
  – Inventory major BC sources, assess climate impacts
  – Metrics for comparing climatic effects of BC emissions to effects of CO₂
  – Identify cost-effective approaches to reduce black carbon emissions
  – Analyze benefits to climate, other environmental, and public health benefits

• Pending legislation for NAS Arctic BC report, NOAA research program(S.1538, 1562); State Department BC Arctic Initiative

• International assessments
  – Report on Bounding the Role of BC in Climate Change (Summer 2010)
  – Convention on Long Range Transboundary Air Pollution (UNECE/LRTAP)
    • Task Force on Hemispheric Transport of Air Pollution (June 2010)
    • Ad Hoc Expert Group on Black Carbon (Dec 2010)
  – UNEP Black Carbon and Ozone Assessment (February 2011)
A win-win example – truck stop electrification

- Diesel trucks idle at overnight stops. Nationally, diesel idling emits an estimated 11 million tons of CO₂, 180,000 tons of NOx, and 5000 tons of fine particle annually, in addition to consuming more than 1 billion gallons of fuel.
- Net fuel savings, lower cost to drivers
- What if conservation-related reduction allowances could be used to pay for this, diesel retrofits, and related programs in cities?

EMISSIONS REDUCTIONS ACHIEVABLE BY TRUCK ELECTRIFICATION (PERCENT)

<table>
<thead>
<tr>
<th>Type</th>
<th>NOX</th>
<th>PM</th>
<th>VOC</th>
<th>CO</th>
<th>CO₂</th>
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<tbody>
<tr>
<td>Idling Emissions (grams/truck/hour)</td>
<td>122</td>
<td>2.19</td>
<td>36.4</td>
<td>118</td>
<td>10,070</td>
</tr>
<tr>
<td>Emissions to generate equivalent electrical power (grams/hr)</td>
<td>6.04</td>
<td>0.035</td>
<td>0.054</td>
<td>0.481</td>
<td>3,014</td>
</tr>
<tr>
<td>Percent emissions reduction</td>
<td>95.0%</td>
<td>98.4%</td>
<td>99.9%</td>
<td>99.6%</td>
<td>70.1%</td>
</tr>
</tbody>
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Win-win – combining conservation, regional SO$_2$ program markets to reduce black carbon and CO$_2$

- 2004 Clean Air Interstate Rule (CAIR): a cap-and-trade program for SO$_2$ emissions (mostly power plants) in Eastern States
  - CAIR goal: meet EPA ambient fine particle standards at least cost
  - What happens if an eastern state imposes energy conservation programs to reduce CO$_2$ emissions?
    - Power plant SO$_2$ emissions also go down from reduced demand
    - The SO$_2$ emissions ‘credits’ generated could be retired - lowering the SO$_2$ cap, and causing near-term warming despite the CO$_2$ reductions
    - The state could sell the SO$_2$ credits to some other source in the region under the cap – this would eliminate the near-term warming...or
    - The $$ from the credit sale could be used to retrofit diesels in populated areas resulting in additional climate and health benefits

- An opportunity: original CAIR rule overturned by Courts, both EPA and Congress are working on replacement program
Using BC to counter ‘Unmasking’

- Cooling by sulfate, nitrates, and organic particles masks some of warming expected from greenhouse gases and black carbon.

- Reductions in SO$_2$ – needed to reduce health and acid rain impacts - are ‘unmasking’ the warming already built into the system.

- IPCC modeling (left) shows masking of about 1 degree C from all sulfates. Increase in surface air temperature is immediate with assumed SO$_2$ reduction.

- SO$_2$ emissions forecast to continue decline under current programs.

- A crash CO$_2$ reduction program would not curb the projected increase for decades.

- Control of selected BC and ozone sources could partially counter the SO$_2$ unmasking in real time, while adding significantly to net benefits from improved public health.