Reducing Short Lived Climate Pollutants

Ecologic Webinar
7 March 2019
Outline

• Clean Air Asia
• Short-Lived Climate Pollutants
• Climate and Clean Air Coalition (CCAC)
• Global Agenda
• Questions & Discussion
• Established in 2001 as the premier air quality network in Asia by ADB, World Bank and USAID

• Our mission is to reduce air pollution and greenhouse gas emissions in Asia and contribute to a livable and healthy Asia for all people, both now and in the future.

• An international NGO headquartered in Manila with offices in Beijing and New Delhi and country networks in Indonesia, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka and Vietnam

www.cleanairasia.org
About Clean Air Asia

**Clean Air Asia** is an international NGO based in the Global South that works towards achieving better air quality and livable cities by translating knowledge to policies and actions that enable Asia’s 1,000+ cities to reduce air pollution and greenhouse gas emissions from transport, energy, other sectors.

**Clean Air Asia’s country networks:** China, India, Indonesia, Pakistan, Philippines, Sri Lanka, and Vietnam
Short-Lived Climate Pollutants
WHAT ARE SHORT-LIVED CLIMATE POLLUTANTS?

SLCPs are substances with relatively short lifetime in the atmosphere and a warming influence on near-term climate.

They are powerful climate forcers and dangerous air pollutants, detrimental to human health, agriculture and ecosystems.
Black Carbon (BC) and Co-pollutants from Incomplete Combustion

Black carbon particles are formed from the incomplete combustion of biomass and fossil fuels. It is a powerful climate forcer and dangerous air pollutant.

EMISSIONS
Main BC-rich sources by region and sector (2003)

PRIMARY BLACK CARBON-RICH SOURCES
BC is always emitted with co-pollutant particles, some of which have a cooling effect on climate. The ratio of BC to co-pollutants varies by source and determines if a measure has a net warming or net cooling effect.

- Resident biofuel cooking and heating
- Resident coal cooking and heating
- On-road diesel engines
- Off-road diesel engines
- Industrial coal and brick kilns
- Open burning agricultural fields

BC harms human health
Clean snow and ice reflect sunlight
BC deposits on snow and ice
Sooty mountains absorb light
Increases melting

Sooty clouds absorb light
Changes in cloud and rain patterns

Clean clouds reflect sunlight
 dims light coming to the Earth's surface

BC is a dangerous local air pollutant which can also be transported across the globe

LIFETIME IN ATMOSPHERE
Days

Suspended in the atmosphere, BC particles contribute to global warming by absorbing energy and converting it to heat.
Black Carbon

• Recent studies show that 15% of global PM2.5 emissions is BC
• Transport as a source emissions is approx. 50% BC
• New studies now account for previously unaccounted sources such as:
  o Kerosine Lamps,
  o Gas flaring
  o Diesel Generators
  o Trash burning
• Main sources depends on region however generally
  o Transportation
  o Methane Flaring
  o Household heating / cooking
• Top countries for gas flaring: Russia and Nigeria
BC Impacts

• Warming effect
• Increased rate of melting glaciers through the albedo effect
• BC is almost always emitted with other pollutants such as NOx, NH₄, NMVOC, CO, OC (Brown Carbon).
• Some studies have further linked anthropogenic aerosols, including black carbon, with changes in regional climates and the hydrological cycle.
• Increased frequency of drought and flood.
BC Impacts

• An analysis of the impact of emissions of individual climate-altering pollutants including black carbon, HFC, N₂O, organic carbon, SO₂, and NH₃ on crop yield, shows that **black carbon will have the greatest agricultural damages** per ton on crops in the first decades over the remainder of the 21st century.

• Health impacts:
  - *Streptococcus pneumoniae* and *Staphylococcus aureus*. The study found that exposure of these bacteria to black carbon leads to **structural, compositional and functional changes** that could cause the bacteria to spread from the nose to the lower respiratory tract - an essential process before subsequent infection.
  - Exposure to **BC alters bacteria antibiotic tolerance**, increasing their resistance to antibiotics.
Methane (CH$_4$)

Methane emissions caused by human activities are one of the most significant drivers of climate change. Methane is also the main precursor of tropospheric ozone, a powerful greenhouse gas and air pollutant.

EMISSIONS
and main sources by region and sector (2005)

- Latin America and Caribbean
- N. America and Europe
- Africa
- S. W. and Central Asia
- NE. SE Asia and Pacific

- Fossil Fuels: 29%
- Livestock enteric fermentation: 29%
- Livestock manure: 4%
- Rice cultivation: 10%
- Other agricultural sources: 7%
- Waste treatment: 11%
- Waste water treatment: 9%
- Others: 1%

IMPACTS

Globally, increased methane emissions are responsible for half of the observed rise in O$_3$ levels.

While methane does not cause direct harm to human health or crop production, its role as precursor gas contributes greatly to the health and agricultural impacts of O$_3$.
Methane

Sources: agricultural activities (enteric methane, rice paddies), fossil fuel industry (significant increase 2000-2009)
Methane concentrations started increasing in the atmosphere in 2007 and surged in 2014-2015
Russian oil industry – significant contributor to global methane emissions
Continued increase in methane emissions could thwart efforts in reducing CO$_2$ emissions.
While CO$_2$ mitigation efforts must continue, they should be done simultaneously with methane mitigation actions, in order to increase the chance of meeting climate targets
Methane

GLOBAL METHANE BUDGET

TOTAL EMISSIONS

558 (540-568)

- 105 (77-133) Fossil fuel production and use
- 188 (115-243) Agriculture and waste
- 34 (15-53) Biomass burning
- 167 (127-202) Wetlands
- 64 (21-132) Other natural emissions

TOTAL SINKS

548 (529-555)

- 515 (510-583) Sink from chemical reactions in the atmosphere
- 33 (28-38) Sink in soils

EMISSIONS BY SOURCE

In million-tons of CH₄ per year (Tg CH₄/yr), average 2003-2012

- Anthropogenic fluxes
- Natural fluxes
- Natural and anthropogenic

CH₄ ATMOSPHERIC GROWTH RATE

10 (9.4-10.6)
Methane Impacts – Climate Change

• Recent studies have showed that methane’s impact on climate change has been largely **undervalued** because previous studies excluded its **shortwave absorption characteristics**
  o In 2013 IPCC assessment GWP of methane was at 28, the study done by Etminan et. Al. says it should be 32 (~25% increase)

• Since methane is **not absorbed in the carbon cycle** unlike CO$_2$, indicates that methane have a stronger warming potential than current GWP suggests.

• Despite the short lifetime of methane in the atmosphere, at least half of the **methane-induced thermal expansion** of the ocean - which is one of the factors responsible for sea-level rise - persist for more than 200 years even after emissions have completely ceased. This means that continued emissions of methane and other short-lived gases continues, will lock-in levels of sea-level rise,
Methane Impacts – Crop Yields

Crop yield losses are due primarily to non-CO2 climate pollutants such as methane. Responsible for the formation of tropospheric Ozone – impact on crops and biodiversity Ozone related health impacts.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Response to CO2</th>
<th>Response to CH4</th>
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<tbody>
<tr>
<td>Heat</td>
<td>↓</td>
<td>↓</td>
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<tr>
<td>Drought</td>
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<tr>
<td>Fertilization</td>
<td>↑</td>
<td>–</td>
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<tr>
<td>Ozone</td>
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</table>
Tropospheric Ozone ($O_3$)

Tropospheric Ozone ($O_3$) is a major air and climate pollutant. It causes warming and is a highly reactive oxidant, harmful to crop production and human health. $O_3$ is known as a "secondary" pollutant because it is not emitted directly, but instead forms when precursor gases react in the presence of sunlight.

**IMPACTS**

- $O_3$ precursors can be carried round the globe, making it a transboundary pollution problem.
- Tropospheric $O_3$ warms the atmosphere.
- $O_3$ damages plants and affects agricultural production:
  - Reducing photosynthesis
  - Reducing the plants ability to sequester carbon
  - Reducing health and productivity of crops

$O_3$ air pollution causes over 150 thousand premature deaths every year, and millions more chronic diseases, particularly in children and the elderly.

**SOURCES**

- Sunlight
- Methane ($CH_4$)
- Carbon monoxide (CO)
- Non-methane volatile organic compounds (NMVOC)
- Nitrogen oxides ($NO_x$)

Lifetime in atmosphere:

- Stratosphere: 50 km
- Troposphere: 10 km
Hydrofluorocarbons (HFCs)

HFCs are man-made fluorinated powerful greenhouse gases rapidly building up in the atmosphere. They are used as replacements for ozone-depleting substances (ODS) in air conditioning, refrigeration, foam-blowing, fire retardants, solvents, and aerosols.

CONSUMPTION by sector

While HFCs have caused less than 1% of total global warming to date, production, consumption, and emissions of these factory-made gases are growing at a rate of 8% per year.

PROJECTED GROWTH

The demand for air conditioning and refrigeration is increasing as the world warms and as wealth increases.

The use of HFCs is rapidly growing because they are widely adopted as replacements for Ozone Depleting Substances (ODS), such as Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs), whose use is being phased out under the Montreal Protocol.
SLCPs have negative impacts on:
Public health
Food security
Global warming
Ice and Snow melting
Weather patterns

Which threatens economic security of large populations throughout the world.
**WHAT ARE THE BENEFITS OF CUTTING SLCPs EMISSIONS?**

### ANNUAL BENEFITS
FROM LARGE-SCALE SLCPs MITIGATION BY 2030

<table>
<thead>
<tr>
<th>Category</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLIMATE</strong></td>
<td>0.6°C AVOIDED WARMING</td>
</tr>
<tr>
<td></td>
<td>Reduce rate of sea-level rise by 20% by 2050</td>
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<td></td>
<td>Reduce rate of melting</td>
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<tr>
<td><strong>HEALTH</strong></td>
<td>2.4 MILLION AVOIDED PREMATURE DEATHS ANNUALLY FROM OUTDOOR AIR POLLUTION</td>
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<td>Reduce air pollution - world’s largest environmental health risk</td>
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<tr>
<td><strong>CROPS</strong></td>
<td>52 MILLION TONNES OF AVOIDED CROP LOSSES FROM 4 MAJOR STAPLES YEAR</td>
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Climate and Clean Air Coalition
Founded in 16 February 2012 with 7 initial country partners, the Climate and Clean Air Coalition (CCAC) is the only global forum whose mission is to support the fight against SLCPs.

By February 2013 the coalition already had 50+ members. It is a partnership between States, international organizations and NGOs.
Four Key Objectives of the Coalition

1. Raising awareness of short-lived climate pollutant impacts and mitigation strategies

2. Enhancing and developing new national and regional actions including by identifying and overcoming barriers, increasing capacity, and mobilizing support

3. Promoting best practices and showcasing successful efforts

4. Improving scientific understanding of short-lived climate pollutant impacts and mitigation strategies
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<thead>
<tr>
<th>Country</th>
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<td>Australia</td>
<td>Bangladesh</td>
<td>Benin</td>
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<td>Canada</td>
<td>Central African Republic</td>
<td>Chad</td>
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<td>Colombia</td>
<td>Cote d'Ivoire</td>
<td>Denmark</td>
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<td>Ethiopia</td>
<td>European Commission</td>
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<td>Germany</td>
<td>Ghana</td>
<td>Guinea, Republic of</td>
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<td>Ireland</td>
<td>Israel</td>
<td>Italy</td>
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<td>Jordan</td>
<td>Kenya</td>
<td>Korea, Republic of</td>
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<td>Liberia</td>
<td>Maldives, Republic of the</td>
<td>Mali</td>
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<td>Moldova</td>
<td>Mongolia</td>
<td>Morocco, Kingdom of</td>
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<td>New Zealand</td>
<td>Nigeria</td>
<td>Norway</td>
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<td>Peru</td>
<td>Philippines</td>
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<td>Rwanda</td>
<td>Sweden</td>
<td>Switzerland</td>
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<tr>
<td>United Kingdom</td>
<td>United States of America</td>
<td>Uruguay</td>
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CCAC INITIATIVES

7 sectoral and 4 cross-cutting initiatives
Global Agenda and Why We Need to Reduce SLCPs
**Climate Policy Success**

<table>
<thead>
<tr>
<th><strong>Pull Third Lever: ACE</strong> (Atmospheric Carbon Extraction)</th>
<th>2030 - 2050</th>
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<tr>
<td>- Forest Degradation Reversal &amp; Afforestation</td>
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<td>- Soil Restoration and Eco-System Management</td>
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<td>- CO\textsubscript{2} Direct Air Capture and Storage</td>
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<tr>
<th><strong>Pull Two Levers: Carbon &amp; SLCPs</strong></th>
<th>2020 - 2050</th>
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<tbody>
<tr>
<td>- Lever 1 - Decarbonize the global economy with renewables</td>
<td>Today - 2030</td>
</tr>
<tr>
<td>- Lever 2 - Cut short-lived climate pollutants to maximum extent possible (black carbon, methane, tropospheric ozone, &amp; HFCs)</td>
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<tr>
<th><strong>Enhance Sister Agreements</strong></th>
<th>2016 and Beyond</th>
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<td>- Kigali HFC Amendment to the Montreal Protocol</td>
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<td>- ICAO agreement on aircraft emissions</td>
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<td>- IMO efforts on shipping emissions</td>
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<td>- Sub-national and city-scale climate action plans</td>
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<th><strong>The Paris Agreement</strong></th>
<th>2015 and Beyond</th>
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<tr>
<td>- Nationally Determined Contribution (NDC) mitigation pledges</td>
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A climate policy pathway for near- and long-term benefits

D. Shindell\textsuperscript{1}, N. Borgford-Parnell\textsuperscript{2}, M. Brauer\textsuperscript{3}, A. Haines\textsuperscript{4}, J. C. I. Kuylenstierna\textsuperscript{5}, S. A. Leonard\textsuperscript{6}, V. R...
Pathway to the Target

Climate-related damages to public health, ecosystems, & infrastructure.

Temperature (°C) relative to preindustrial

SDGs for poverty reduction, agriculture & food security, healthy lives, sustainable & modern energy, liveable cities
Pathway to the Target

Early mitigation of SLCPs *helps to meet SDGs* and, within the goal of climate action;
(i) reduces damages due to climate change over the next few decades, including those dependent upon the pace of climate change such as biodiversity losses;
(ii) slows amplifying feedbacks such as snow/ice-albedo that are highly sensitive to BC;
(iii) reduces the risk of potential non-linear changes such as release of carbon from permafrost or ice sheet collapse;
(iv) increases the probability of staying below 2°C through mid-century;
(v) reduces long-term cumulative climate impacts;
(vi) reduces costs of meeting temperature targets relative to late SLCP mitigation;
(vii) stimulates progress toward the long-term 2°C target through achievement of near-term benefits
Thank you!

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