Climate and Air Quality Benefits of Addressing Methane and Black Carbon: key findings of the UNEP /WMO report

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What are short-lived climate pollutants?

- Black carbon
- Tropospheric ozone
- Methane
- some Hydrofluorocarbons (HFCs)
Stratospheric \( \text{O}_3 \) deposition

8 – 15 km

chemical production:

- \( \text{CH}_4 \)
- CO
- VOCs
- \( \text{NO}_x \)

chemical destruction:

deposition

troposphere

Stratospheric \( \text{O}_3 \)

Tropospheric Ozone – formed from precursor emissions
What are short-lived climate pollutants?

**Characteristics**
- Relatively short-lived in the atmosphere
- Act as air pollutants (except HFCs)
- One of the causes of global warming (mainly in the near term)

**Multiple benefits of reducing SLCPs:**
- Reduce air pollution - Protect health and crops
- Slow down near-term global warming, reduce regional impacts of climate change
What could happen with no further policies to reduce emissions?

Global and regional temperature changes relative to 2009 projected under the reference scenario for different global regions.
A package of 16 measures can substantially reduce emissions and achieve multiple benefits

- Mitigation measures ranked by net climate impact (using GWP) of emission changes
- Considering CO, CH$_4$, BC, OC, SO$_2$, NO$_x$, NMVOCs, and CO$_2$
- Picked the top measures – about 90% of warming benefit

**Black carbon measures**

- addressing emissions from incomplete combustion
  - BC, OC, methane, CO, NMVOCs

**Methane measures**

- reducing methane emissions

No technical breakthroughs
These measures already implemented in many countries
Cost-effective
The measures aiming at reducing methane emissions

- Intermittent aeration - paddy
- Recovery from wastewater
- Recovery from oil and gas
- Recovery from landfill
- Recovery from livestock manure / feed
- Coal mine methane capture
- Reducing pipeline leakage
The measures aiming to reduce black carbon emissions

- Improved biomass stoves
- Modern coke ovens
- Remove big smokers / DPF
- Cooking with clean fuel
- Improved brick kilns
- Pellet biomass heating stoves
- Coal briquettes replacing coal
- Reduce agricultural burning
- Reduce flaring
Effect of measures on global emissions projected in 2030 relative to Reference emissions in 2030

- 9 BC measures fully implemented in 2030
- 7 Methane measures fully implemented in 2030

[Bar chart showing percent reduction in global emissions for BC, OC, Other PM2.5, CO, NOx, CH4 compared to reference scenario in 2030]
Result for Global Temperature Change:

CO$_2$ and SLCF measures are complementary strategies.

Source: UNEP/WMO (2011). Integrated Assessment of Black Carbon and Tropospheric Ozone. UNEP, Nairobi
Annual average surface temperature change (°C) from implementing all measures

- Dark areas: where the biggest temperature benefit occurs
Regional Climate Changes: Preventing Disturbance of Rainfall Patterns

Change in atmospheric forcing at 2030 relative to the reference case in the two models

- Dark areas: where the biggest energy change to warming of the atmosphere occurs
- This drives regional weather pattern changes
The share of global temperature reduction from methane measures

- Recovery from coal mines
- Oil and gas production
- Gas pipelines
- Municipal waste

Relatively low uncertainty re. temperature impact
The share of global temperature reduction from implementing black carbon measures

North East Asia, South East Asia and Pacific

North America and Europe

Bigger uncertainty for impact on climate
2.4 million avoided premature deaths - from reducing outdoor PM alone

approx. equal number avoided from reducing indoor air pollution
2.4 million avoided premature deaths - from outdoor PM

Africa
200 thousand deaths/yr

Premature mortality avoided (1000s of deaths)

93% in region
87% in region
95% in region
98% in region
99% in region

S, W & C Asia
1.15 million deaths/yr
Health Benefits by Country

Annually avoided premature deaths per 100,000 people
Avoid loss of 52 million tonnes (within a range of 30–140 million tonnes), 1–4 per cent, of the global production of maize, rice, soybean and wheat each year.
How much does it cost?
Costs of implementing 16 measures

50% of black carbon and methane emission reductions:
Low cost or no-cost → Recovery of methane, better fuel efficiency

Black carbon measures
• Improved stoves
• Upgraded brick kilns

Methane measures
• Recovery from fossil fuel production (coal mines; gas distribution)
• Waste / landfill management
SLCPs as a way to achieve MDGs and Beyond

Issue of Short-Lived Climate Pollutants is closely linked to many pressing development needs:

• Health
• Sustainable energy access
• Food security
• Urban development: waste, sanitation/ sewerage, and sustainable transport
• Adverse climate change impacts
Conclusions

- **Addressing SLCPs is a development issue** – countries reducing emissions will benefit from improved health - avoid 2.4 million premature deaths; +INDOOR!; crop yields - avoid > 50 million tonnes loss every year.

- 16 identified measures, implemented by 2030, would **reduce global warming by 0.5°C** (0.2-0.7°C) in 2050 halving the warming projected by the Reference Scenario.

- Substantial regional climate benefits: e.g. in the **reduce warming by about 0.6 °C in Africa** (range 0.2-1.3°C by 2040), African and Asian rainfall patterns.

- Near-term measures would **improve the chance of not exceeding 2°C target**, but contingent on ambitious CO₂ reductions, starting now (**complementary strategies**; **not alternatives**).

- The identified **measures are all currently in use** in different regions around the world;

- Many **measures achieve cost savings** over time.

- **much wider and more rapid implementation** is required to achieve the benefits outlined.
‘An Integrated Assessment of Black Carbon and Tropospheric Ozone’

‘Near-term Climate and Clean Air Benefits: Actions for Controlling Short-Lived Climate Forcers’
http://www.unep.org/publications/ebooks/SLCF/