OXFORD MARTIN POLICY BRIEF

# THE SCIENCE AND POLICY OF SHORT-LIVED CLIMATE POLLUTANTS

*Jason J Blackstock and Myles R Allen*

OXFORD MARTIN SCHOOL

UNIVERSITY OF OXFORD

**Immediate mitigation of Short-Lived Climate Pollutants (SLCPs) could reduce – by about half a degree Celcius – the amount of global climate warming we experience between now and 2050**, with significant co-benefits for human health and agricultural productivity through reduced local air pollution.

**Mitigation of SLCPs would complement, but cannot substitute for, near-term mitigation of $CO_2$.** If combined with simultaneous aggressive mitigation of $CO_2$ emissions, enhanced mitigation of SLCPs could play a key role in keeping global average warming below 2˚C; but without mitigation of $CO_2$, reductions in SLCPs can only delay, but not prevent, a substantially greater warming in the longer term.

**Attempts to create 'equivalence' between SLCP and $CO_2$ mitigation could have perverse consequences.** $CO_2$ emissions accumulate in the climate system, while SLCPs do not. Policy frameworks that attempt to treat them as equivalent could create incentives for inappropriate substitution between $CO_2$ and SLCP mitigation.

In February 2012, the international Climate and Clean Air Coalition (CCAC) was launched to promote the mitigation of Short-Lived Climate Pollutants (SLCPs). The mandate of the CCAC (and other similar initiatives) builds upon several decades of scientific research – summarised in a comprehensive UNEP-WMO report last year[i] – that clearly demonstrate the damages to climate, human health and agriculture caused by SLCPs.

The near-term societal benefits from SLCP mitigation would be significant, with the associated costs projected to be quite low. But as international SLCP mitigation efforts scale up to capture these benefits, there remain important questions about how these efforts fit within the broader climate policy landscape:

*What is the relationship between SLCP mitigation and the mitigation of carbon dioxide (and other very long-lived greenhouse gases)?*

*How might that relationship be translated into practical policy frameworks? What would be the impacts of the different alternatives?*

*What does any of this mean for UNFCCC and the negotiations towards a new international climate framework by 2015?*

This policy brief summarises the key scientific knowledge relevant to these questions, and discusses some of the broad policy implications that warrant further attention.

## WHAT ARE SHORT-LIVED CLIMATE POLLUTANTS (SLCPs)?

The term SLCP refers to a set of potent climate warming agents (listed below) that have atmospheric lifetimes of between a few days and roughly a decade. Black carbon and tropospheric ozone are also major contributors to local air pollution near their sources, causing significant damage to human health and agricultural productivity. Because of their short atmospheric lifetimes, any reduction in SLCP emissions would quickly result in an equivalent reduction in SLCP concentrations in the atmosphere, giving rapid reduction in the associated climate warming and air pollution impacts.

*Black Carbon* is a component of soot released by the incomplete combustion of fuels and biomass that remains in the atmosphere for days to weeks; it heats the atmosphere and accelerates melting of ice and snow it deposits on by absorbing sunlight and radiating heat, and harms humans who inhale it.

*Tropospheric Ozone* is a potent greenhouse gas produced by the reaction of hydrocarbons (particularly methane) with specific precursor gasses (e.g. nitrogen oxides and carbon monoxide) that remains in the atmosphere for hours to days, and harms humans and crops exposed to it.

*Methane*, in addition to generating tropospheric ozone, is a potent greenhouse gas that remains in the atmosphere for roughly 12 years before being oxidised to $CO_2$.

*Hydroflurocarbons (HFCs)* are a set of very potent climate warming greenhouse gasses that are industrially produced (mainly for use in refrigeration and insulating foam); different HFC molecules have lifetimes ranging from roughly a year to several hundred years, with a current use-weighted average of roughly 15 years.

## TANGIBLE BENEFITS FROM SLCP MITIGATION

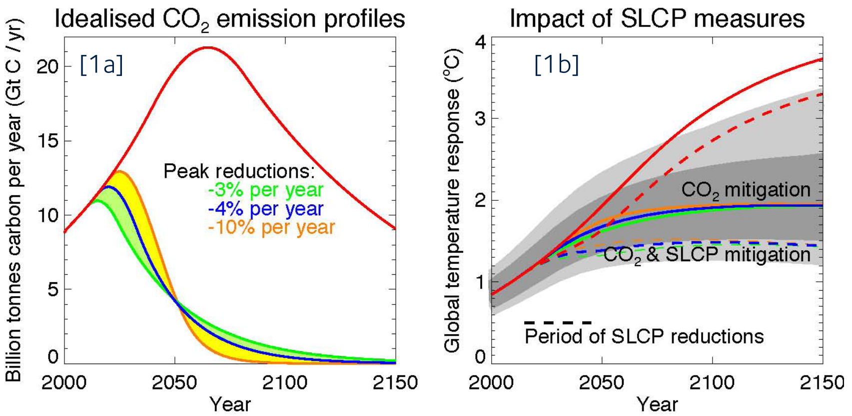
### *Climate Benefits: Reduced Near-Term Warming and Regional Impacts*

If comprehensively implemented over the next two decades, SLCP mitigation strategies have the potential to reduce global average climate warming between today and 2050 by ~0.6˚C [range: 0.3–0.8˚C].[ii] The dashed curves in Figure 1b (diagram overleaf) all show the climate warming that immediate SLCP mitigation would avoid relative to four different $CO_2$ emission trajectories without SLCP mitigation (shown by the solid lines).

In addition, because of the local nature of some SLCP climate forcing – particularly from black carbon – a reduction in the unique climate impacts caused by SLCP forcing would occur within the countries where the SLCP emissions are reduced (e.g. slower loss of glaciers and annual snow pack; reduced change to regional precipitation patterns).

### *Air Pollution Benefits: Human Health and Food Security*

Comprehensive mitigation of methane (which reduces tropospheric ozone production) and black carbon would also reduce air pollution damages to humans and crops, avoiding ~2.4 million [range: 0.8-4.6 million] premature deaths and ~50 million [range: 25-125 million] tonnes of staple crop losses every year.[iii] These benefits would be accrued mostly within the countries where SLCP emissions were reduced, further adding to domestic incentives to implement these mitigation strategies.




*(1a) Three carbon emission trajectories consistent with cumulative $CO_2$ emissions limited to one trillion tonnes of carbon, with the later mitigation starting dates showing the greater annual mitigation rates required to keep below the cumulative limit (for green mitigation begins in 2015, for blue in 2020; and for orange 2030). Red curve shows mitigation delayed until after 2050, with cumulative carbon emissions exceeding three trillion tonnes.*

*(1b) The solid curves show projected global climate warming from the four $CO_2$ emission trajectories in (a), with the same colour dashed curves showing the additional global climate warming that can be avoided by immediate and comprehensive SLCP mitigation in each cases. Grey shaded regions show the 66% [dark grey] and 90% [light grey] confidence range around the temperature projection for the solid blue curve. Similar confidence ranges apply to all temperature projections.*

## SLCP mitigation can complement, but cannot substitute for, near-term CO2 mitigation

It is, however, important to put these benefits in the context of the broader climate landscape. In contrast to SLCPs, the very long lifetime of $CO_2$ (hundreds to thousands of years) means that $CO_2$ will continue to build up in the atmosphere until emissions are reduced to almost zero. Only if aggressive global mitigation of $CO_2$ emissions begins soon can the cumulative amount of $CO_2$ emitted into the atmosphere remain low enough – below about one trillion tonnes of carbon – to avoid more than 2˚C warming caused by $CO_2$ alone[iv]. (See www.trillionthtonne.org for further information.)

Figure 1a shows three $CO_2$ emission trajectories (green, blue and orange) that are consistent with the one trillion tonne cumulative limit. All three curves clearly show that urgent global action to reduce $CO_2$ emissions is critical; the longer mitigation is delayed, the faster emissions will need to fall. Temperature responses (solid curves in figure 1b) show how all three trajectories cause similar warming despite different peak emissions: unlike SLCP emissions, $CO_2$ emissions in any given decade affect peak warming only insofar as they contribute to the cumulative total.

The 'trillion-tonne plus SLCP mitigation' curves in Figure 1b (dashed green, blue and orange) show that if aggressive $CO_2$ mitigation begins early, and is maintained until emissions are close to zero, comprehensive SLCP mitigation substantially reduces the long-term risk of exceeding 2˚C (even more for 1.5˚C).

In contrast, the red curves in Figure 1 (a & b) show the consequence of allowing $CO_2$ emissions to continue to rise past 2050. Under this scenario, the climate warming avoided by SLCP mitigation (the dashed red curve in 1b) is quickly overshadowed by $CO_2$-induced warming.

Hence SLCP mitigation can complement aggressive $CO_2$ mitigation, but it is neither equivalent to, nor a substitute for, near-term $CO_2$ emission reductions.

## Policy implications: both SLCP and CO2 mitigation yield benefits, but are not equivalent

*Understanding their limits*

Immediate and comprehensive SLCP mitigation offers numerous tangible societal benefits at low cost. In addition to the clear health and agricultural benefits, reducing the rate of climate warming over the next several decades can make an important contribution to limiting the risk of exceeding 2˚C (and especially 1.5˚C) global average warming if accompanied by measures to limit long-term warming by mitigating $CO_2$ emissions.

However, the global climate warming that SLCP mitigation can avoid is limited, both in magnitude and duration; almost all of the climate benefits would be realised within two decades of SLCP mitigation being completed. But because it takes far longer for the climate benefits of $CO_2$ mitigation to be realised, near-term aggressive mitigation of $CO_2$ is also required, simultaneous to SLCP mitigation, to prevent the climate benefits of SLCP mitigation being overwhelmed by $CO_2$ warming around mid-century.

*Be wary of 'equivalence' metrics providing perverse incentives*

Policy frameworks for relating SLCP and $CO_2$ mitigation should be very wary of technical metrics that attempt calculate 'equivalence' between given amounts of SLCP and $CO_2$ mitigation. Such metrics could create perverse incentives for corporations or countries to reduce SLCP emissions ***instead of*** – rather than ***in addition to*** – reducing $CO_2$ emissions: for example, attempts to price SLCP mitigation within carbon markets could lead to inappropriate substitution for $CO_2$ mitigation. Climate risk reduction measures must ensure that $CO_2$ and SLCP mitigation remain separately incentivised and regulated, with built in technical and political mechanisms to prevent substitution.

*Mitigation of $CO_2$ must remain the top priority to combat climate change*

Any effective climate policy regime should recognise the considerable potential benefits of SLCP mitigation, but in the absence of urgent action to limit cumulative emissions of $CO_2$, such initiatives are too quickly overshadowed. Action on SLCPs has tangible climate benefits, but not if taken in isolation.

[i] UNEP-WMO Report (2011). ***Integrated Assessment of Black Carbon and Tropospheric Ozone***

[ii] Combination of (~0.5˚C [range: 0.2˚C to 0.7˚C]) projection for black carbon and methane mitigation (UNEP-WMO Report) and ~0.1˚C projection of HFC mitigation (Ramanathan and Xu, 2010; IASS SLCP Workshop Report, 2012)

[iii] UNEP-WMO Report

[iv] Allen et al., ***Nature***, v458, p1163 (2009)

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**Author contacts:** *Jason Blackstock - jason.blackstock@insis.ox.ac.uk | Myles Allen - myles.allen@ouce.ox.ac.uk*

**Further information:** *www.oxfordmartin.ox.ac.uk*

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