SMHI

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# Introduction to Short-Lived Climate Pollutants

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# Definitions

- SLCF – Short-Lived Climate Forcers

  Gases and particles that have atmospheric lifetimes from a few days to a decade and warming or cooling effects on climate

- NTCF – Near-Term Climate Forcers

  Those compounds whose impact on climate occurs primarily within the first decade after their emission (IPCC, 2013)

- SLCP – Short-Lived Climate Pollutants

  Short-lived climate pollutants are agents that have relatively short lifetime in the atmosphere - a few days to a few decades - and a warming influence on climate (CCAC)

| Substance | Atmospheric Lifetime |
| --- | --- |
| Carbon Dioxide **($CO_2$)** | Up to 60% Less than 100 years<br>Up to 25% more than 1000 years |
| Methane **($CH_4$)** | 12 years |
| **HFCs** (various) | 15 years (average of mix) |
| Tropospheric Ozone **($O_3$)** | 4 - 18 days |
| Aerosols including, sulfate, Black Carbon **(BC),** Organic Carbon **(OC)**, …. | 3 - 8 days |

RCP4.5 2100

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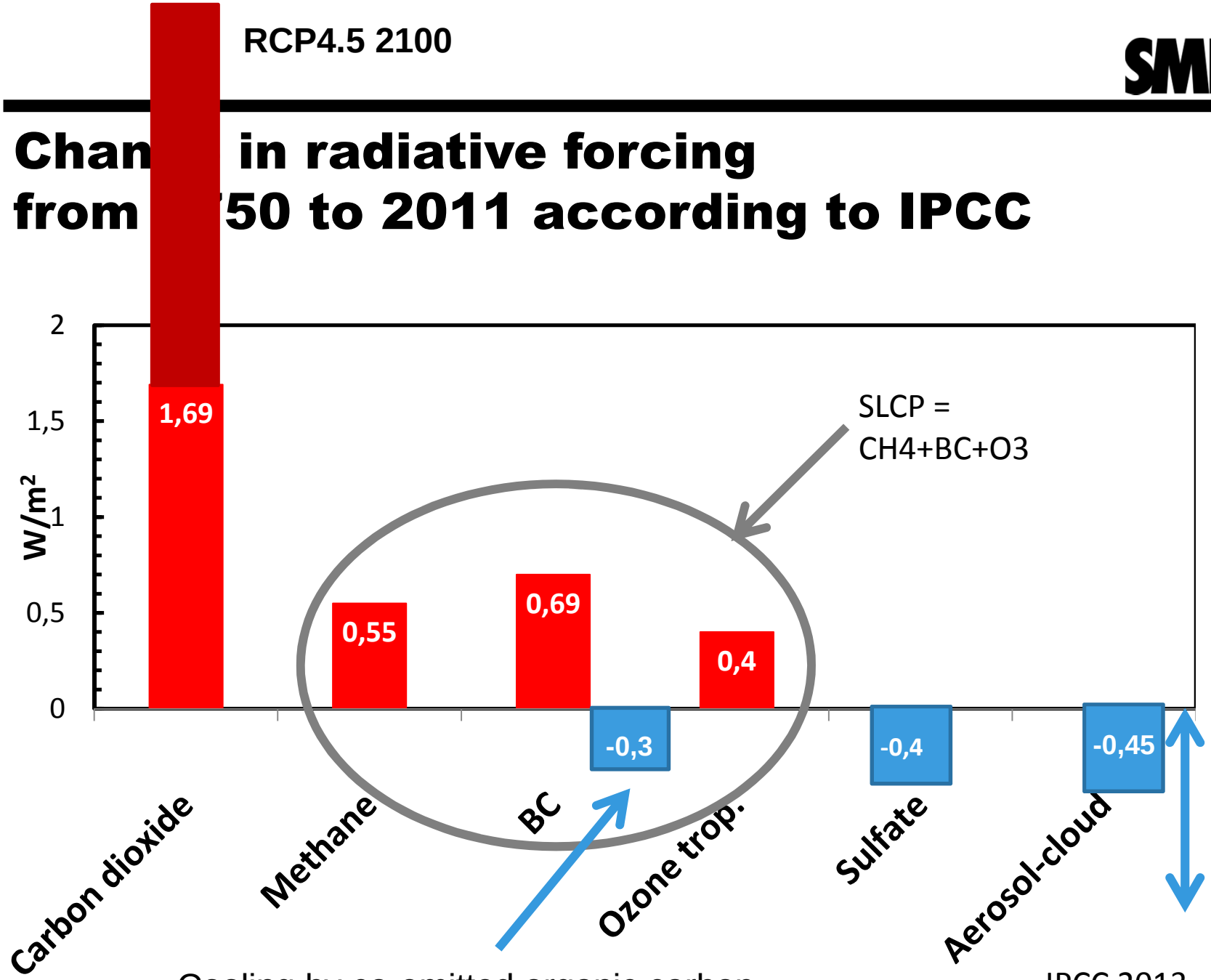
# Chan in radiative forcing from 50 to 2011 according to IPCC




Cooling by co-emitted organic carbon

IPCC 2013

# Health effects of air pollution - Global Burden of Disease study

- Fine particles more significant public health risk than previously known
- Ranks among top ten global health risks and among top five or six in Asia
- Contributing annually over 3.2 million premature deaths worldwide and over 74 million years of healthy life lost
- Surface ozone cause about 0.6% increased mortality for 10 ppb increased ozone concentration


**Lim et al. The Lancet, 2012**

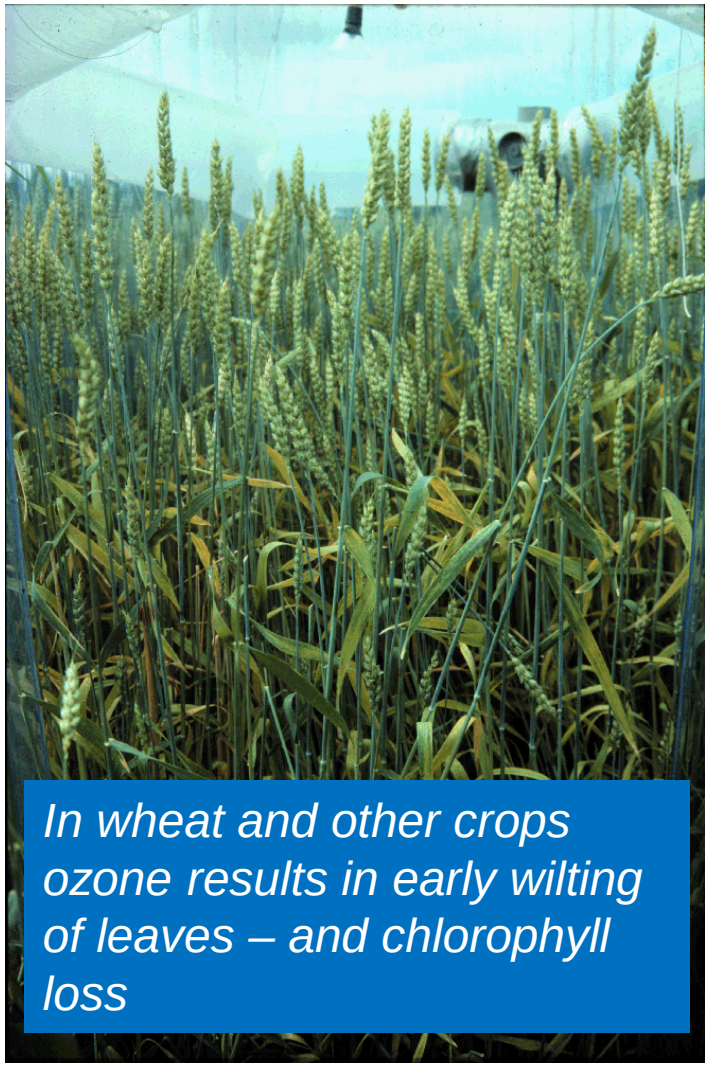
# Health effects of black carbon vs PM2.5 for short-term exposure

- **Risk increase per 1 µg/m3**
  - all cause mortality
    - BC: 1.45%
    - PM2.5: 0.19%
  - cardiovascular mortality
    - BC: 1.77%
    - PM2.5: 0.29%

- **Overall >6 x higher risk for BC compared to PM2.5**

# Effects of ozone on vegetation

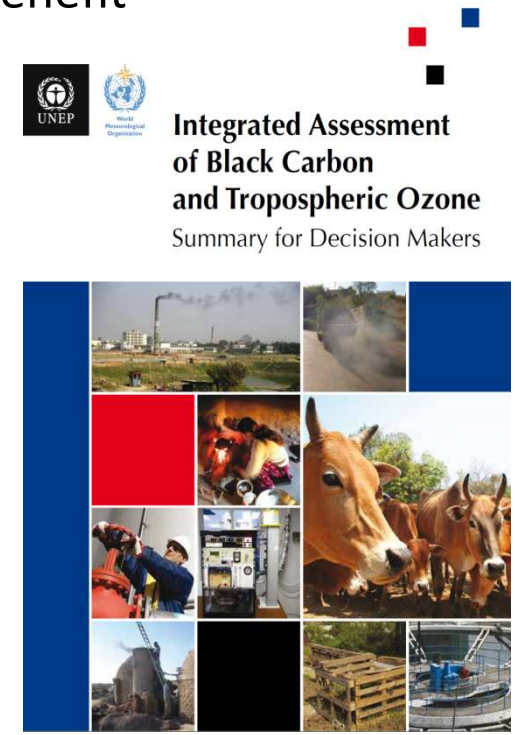
- Ozone negatively affects crops (including crop quality), forest trees and other plants
- Typical estimated production losses are on the order of 10%
- Plant ozone uptake through stomata is crucial for the effects
- Ozone is likely to have a substantial effect on vegetation carbon uptake – and can thus also contribute significantly to global warming



*In wheat and other crops ozone results in early wilting of leaves – and chlorophyll loss*

# In the 2012 UNEP/WMO assessment 16 measures were identified that substantially reduces emissions and achieve multiple benefits

- 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 /change feed

Coal mine methane capture

Reducing pipeline leakage

# The measures aiming to reduce black carbon (incomplete combustion) emissions

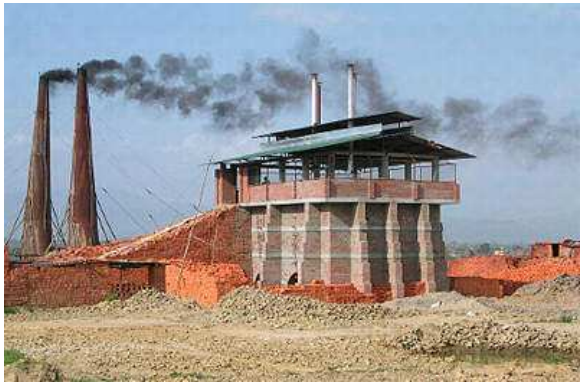

Remove big smokers / DPF


Reduce flaring

Modern coke ovens

Cooking with clean fuel

Pellet biomass heating stoves



Improved brick kilns

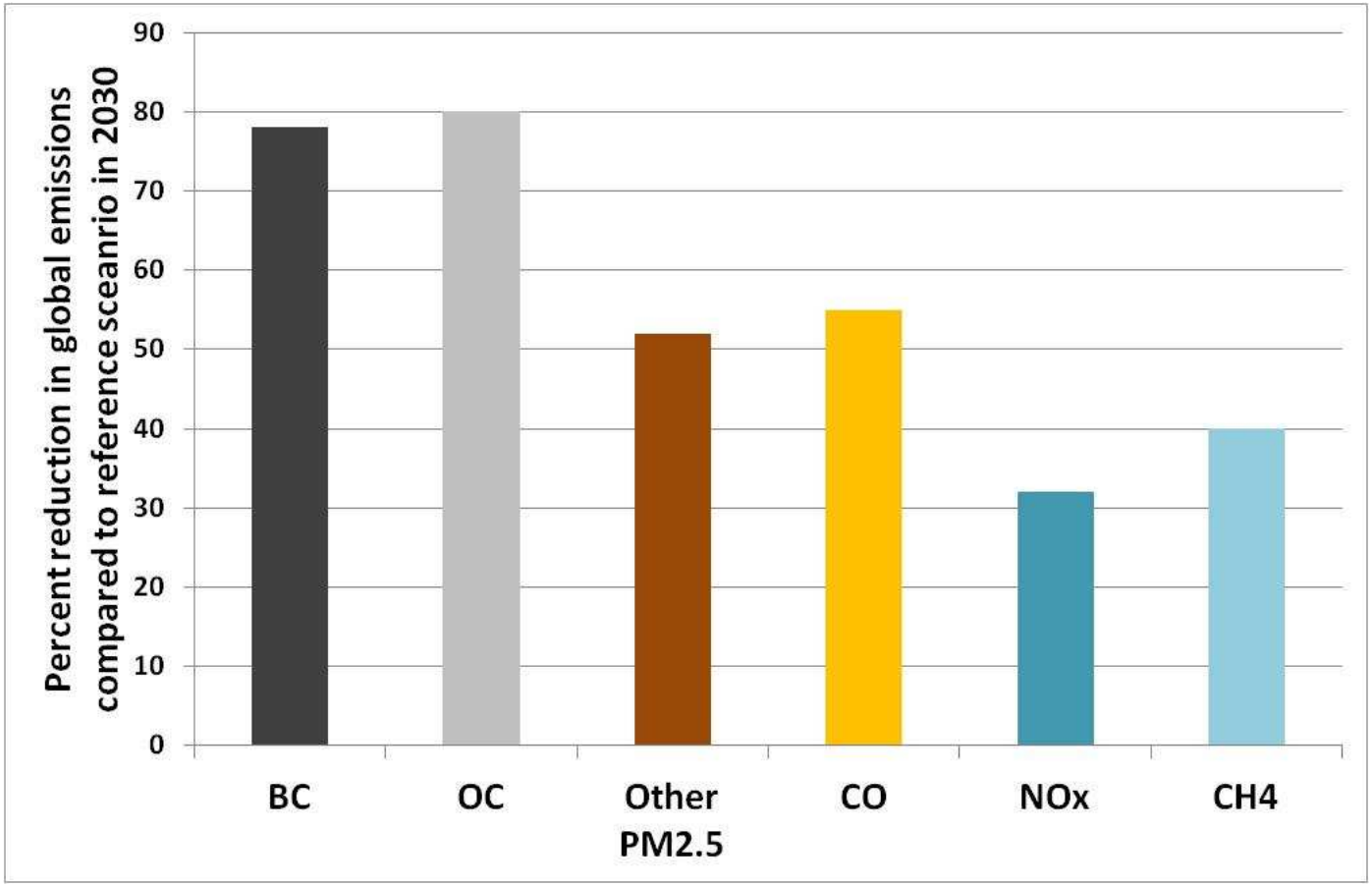
Coal briquettes replacing coal

Reduce agricultural burning

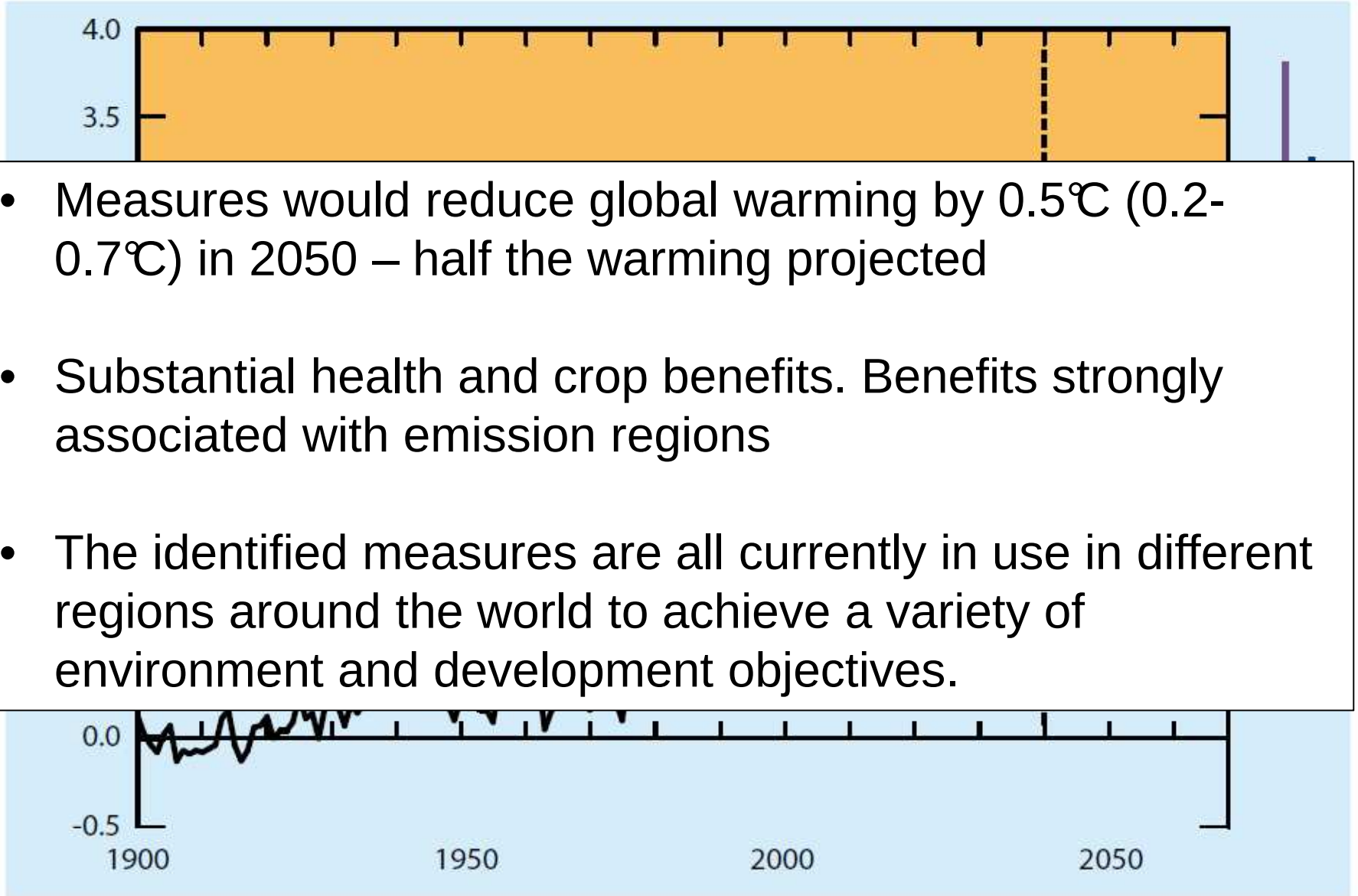

Improved biomass stoves

# Projected emission reductions in 2030, % global

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



## Result for Global Temperature Change: $CO_2$ and SLCP measures are complementary strategies




- Measures would reduce global warming by 0.5℃ (0.2-0.7℃) in 2050 – half the warming projected
- Substantial health and crop benefits. Benefits strongly associated with emission regions
- The identified measures are all currently in use in different regions around the world to achieve a variety of environment and development objectives.

**Combined results from two different climate models**

Thank you for your attention!