Addressing Short-Lived Climate-Forcing Pollutants for Air Quality and Climate Change

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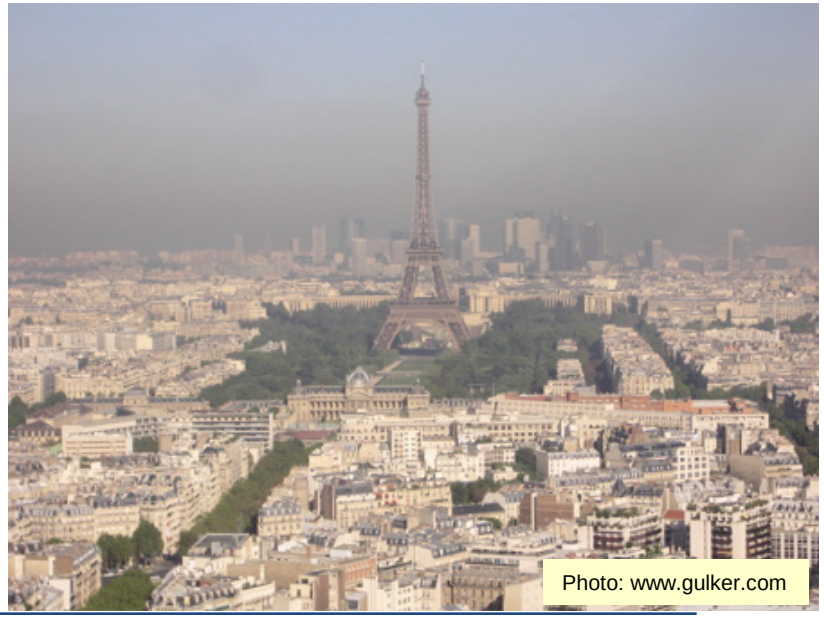


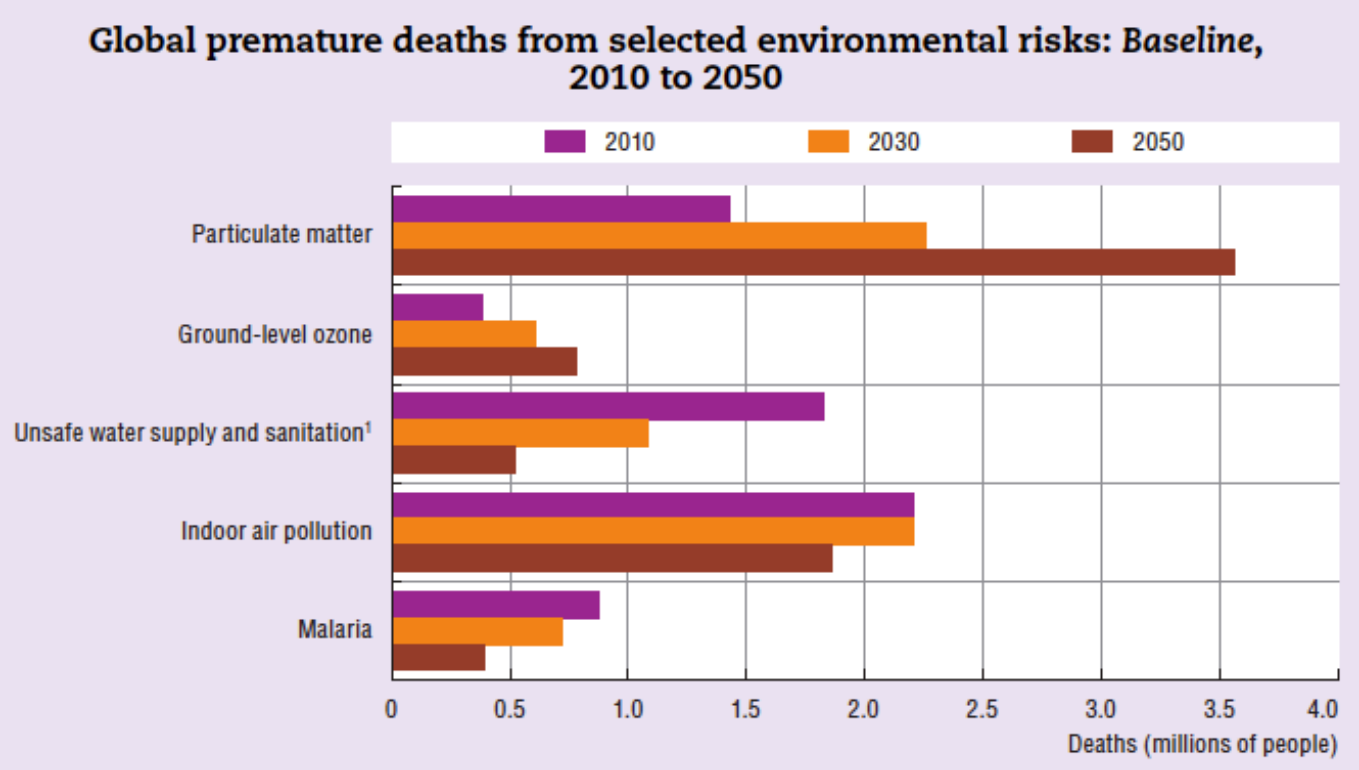
Photo: www.gulker.com

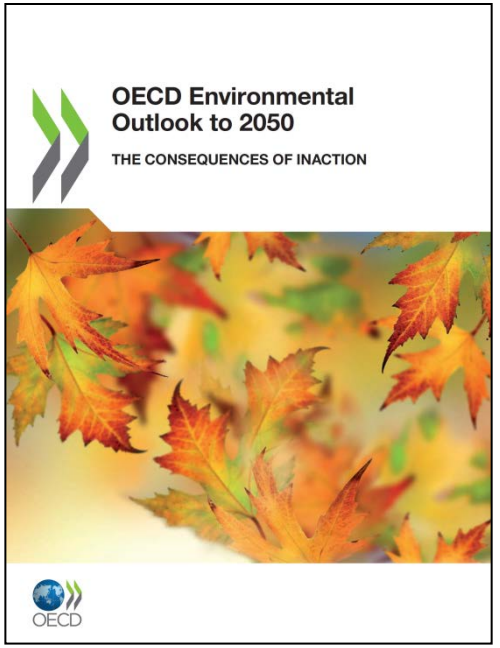
SLCPs: Short-Lived Climate-forcing Pollutants

- Gases:
  - Methane (CH_4)
  - Ozone (O_3)
  - Hydrofluorocarbons (HFCs)
  - Nitrogen Oxides (NO_x)
  - Carbon Monoxide (CO)
  - Volatile Organic Compounds (VOCs)
  - Sulfur Dioxide (SO_2)

- Aerosol Particles:
  - Soot (incl. Black Carbon ("BC"))
  - Sulfate (SO_4^{2-})
  - Nitrate (NO_3^-)
  - Ammonium (NH_4^+)

Air Pollution Impacts on Health

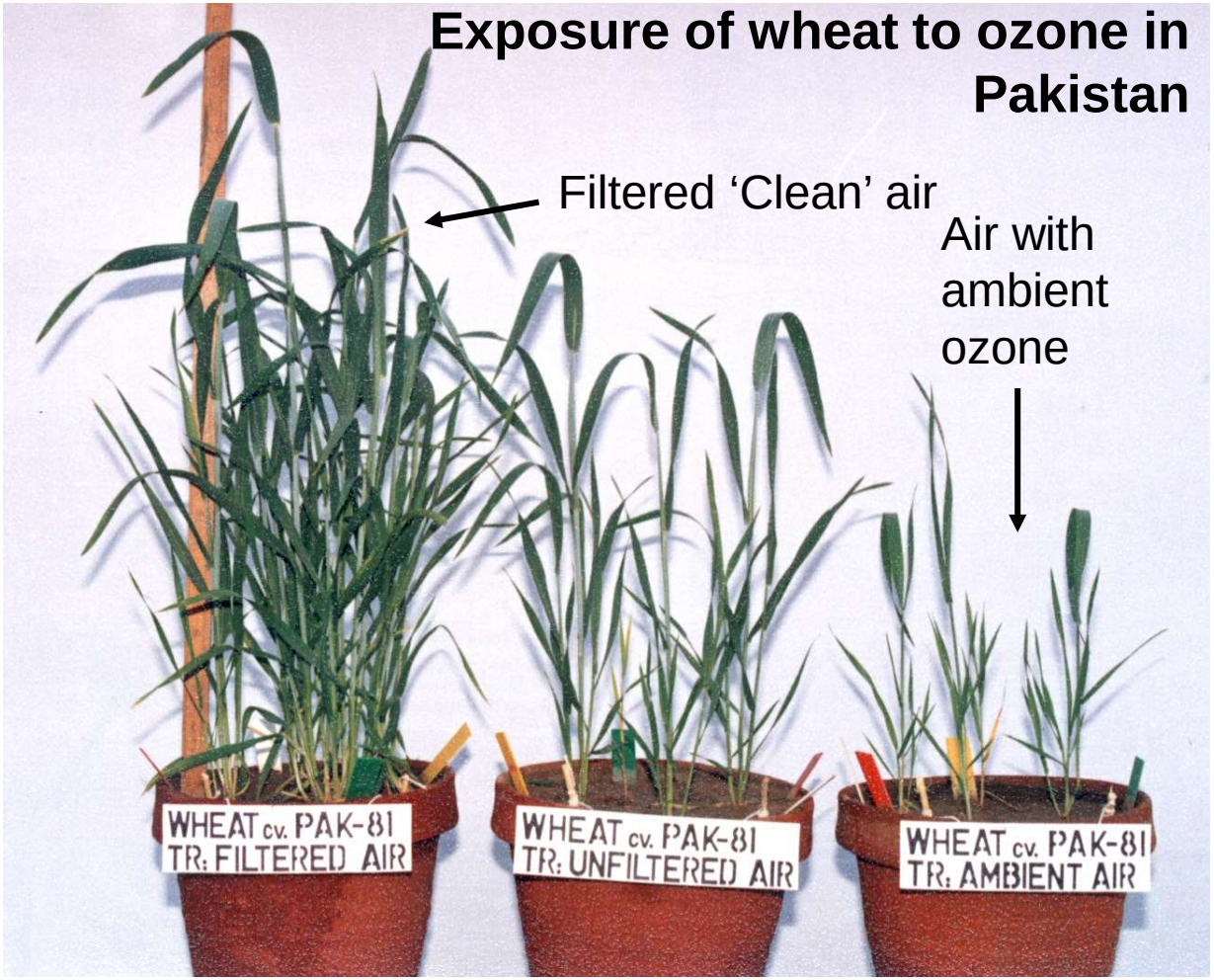




Outdoor air pollution is projected to soon be the top environmental cause of mortality worldwide, ahead of dirty water and lack of sanitation.

(OECD, 2012)

Air Pollution Impacts on Agriculture



Ozone injury to grapevine leaves

➔ These impacts on crop yields are compounded by the fact that high ozone levels also reduce agricultural worker productivity, by 10% or more in many regions according to a recent study.

(Pictures courtesy of J. Kuylenstierna, SEI/CCAC)

Reduced Visibility:
Kathmandu (top) and Berlin (bottom)

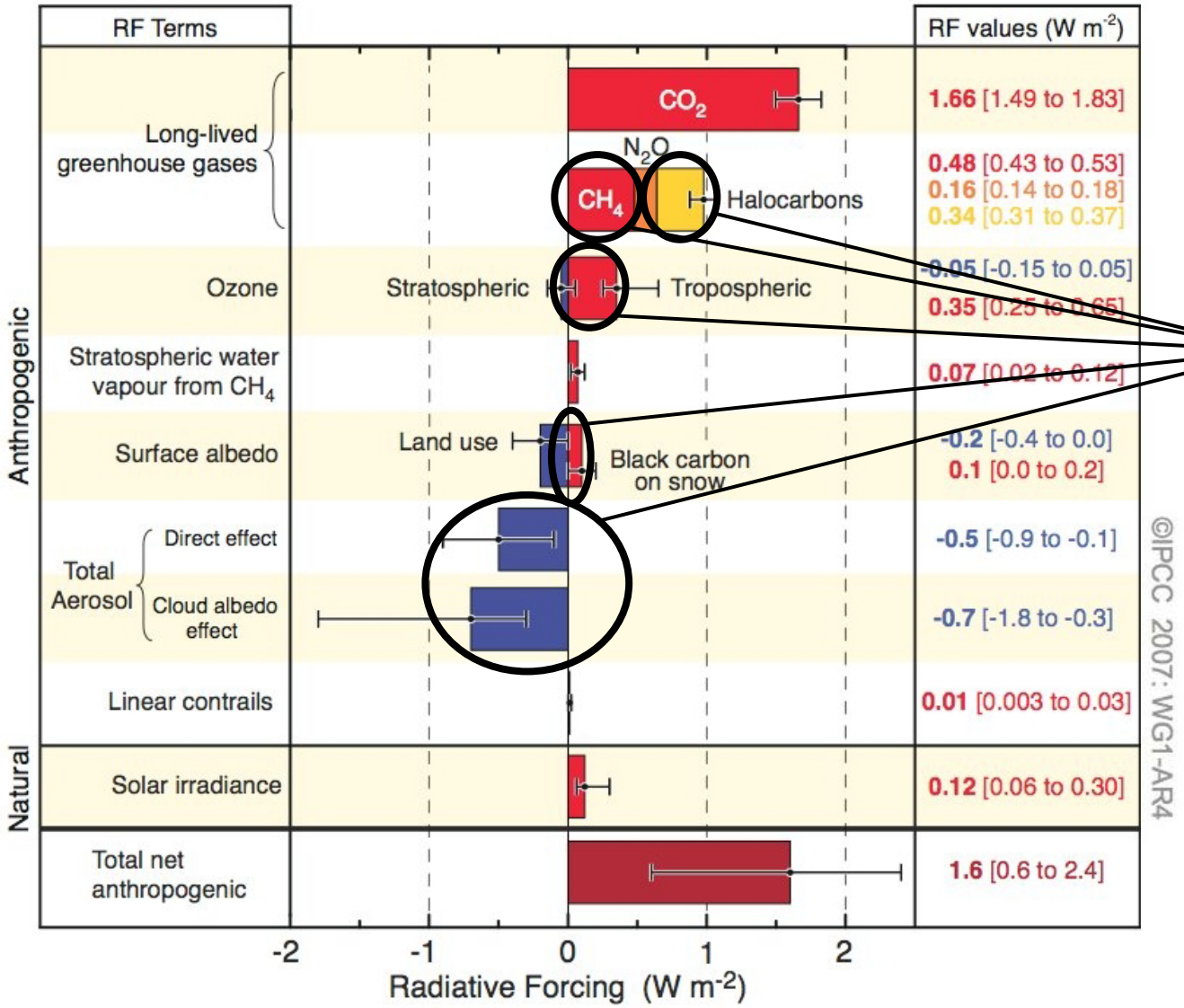
Photo: Pradeep Dangol

Photo: Bidya Banmali

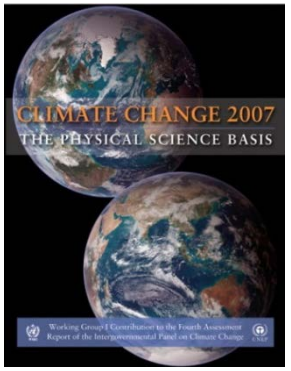
Source: http://flickrhivemind.net/

Photo: Janos Balazs, Source: www.pixelio.de

Mean Change in the Global Surface Energy Balance, 1750 to 2005

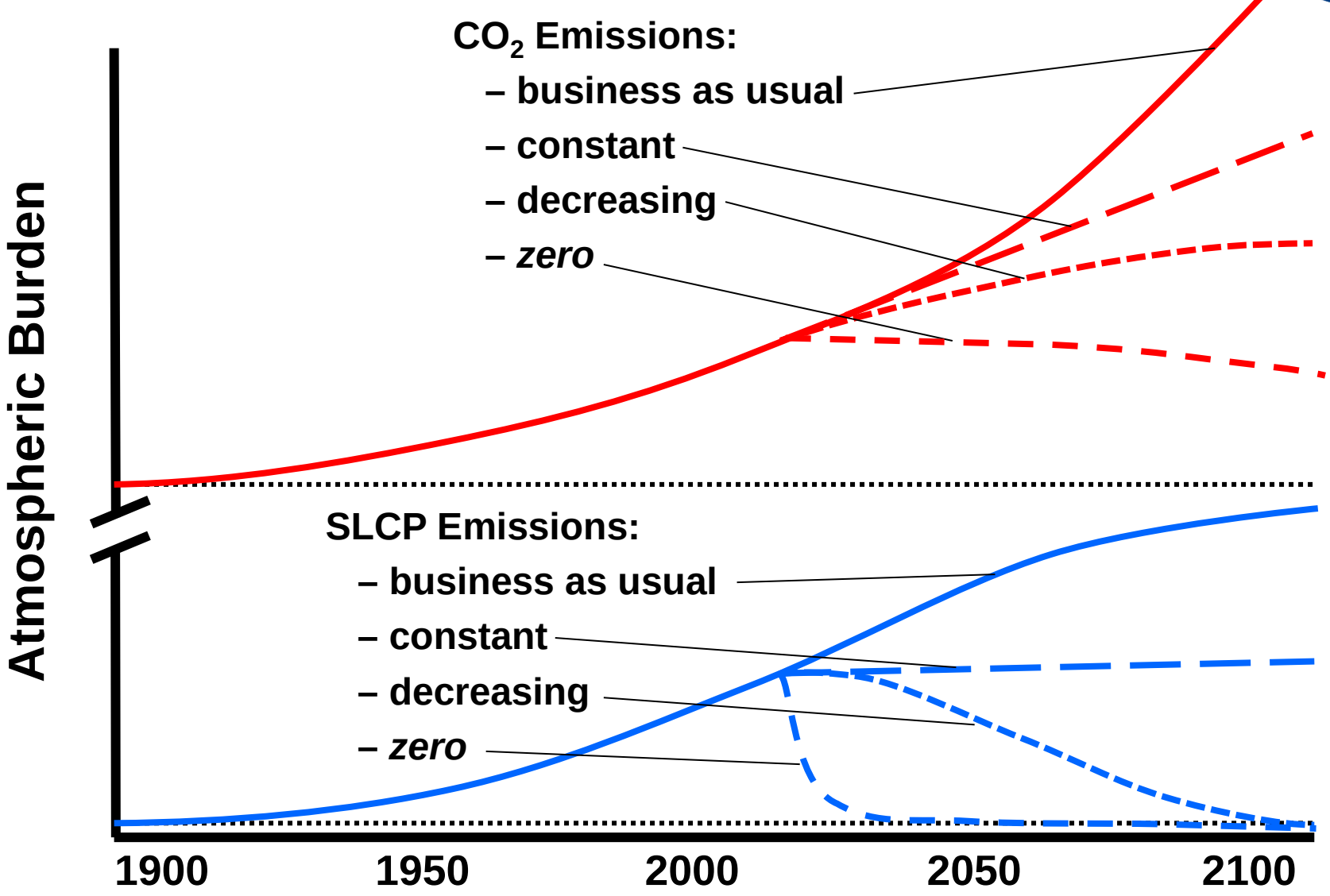


SLCPs



[IPCC, 2007]

SLCPs: Short-Lived Climate-forcing Pollutants



Sources of the Main Warming SLCPs

Substance	Source
Soot/Black Carbon (BC)	Combustion Processes, e.g..: • Diesel Engines • Fireplaces
Ozone	Chemical Reactions: • NO_x • Methane, CO, VOC
Methane	• Pipelines • Biogas Plants • Landfills • Argriculture and Ruminants (Cows) • etc.
Hydrofluorocarbons (HFCs)	• Air Conditioners • Refrigerators • Foaming Industry • Aluminum Producers • etc.

Main *European* Sources of BC (Soot)

Diesel Trucks and Cars

➔ **Now Mostly Clean in Europe**

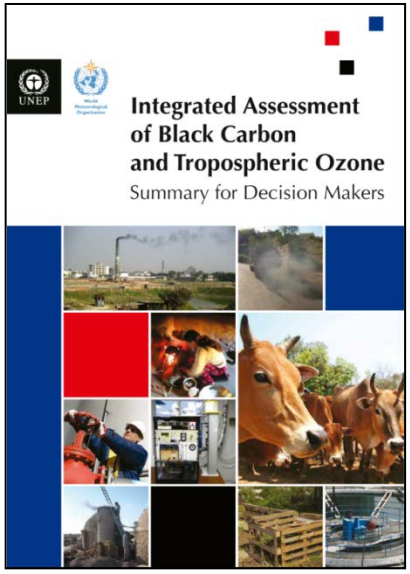
Domestic Wood Burning

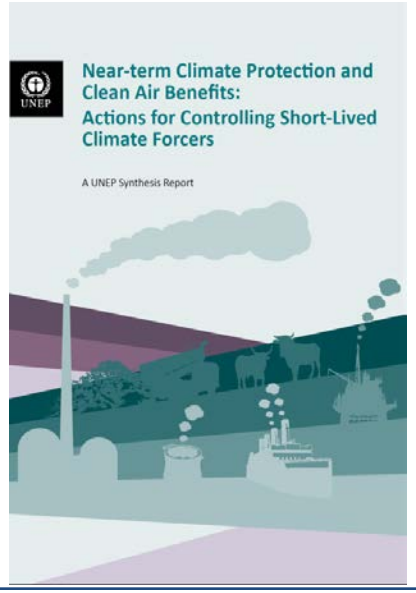
Offroad Vehicles: Ships and Construction Machines

Agricultural Waste Burning

Mitigation Possibilities?
➔ 16 Key Global Measures for CH_4 and BC

Measure[1]	Sector
CH_4 measures	
Extended pre-mine degasification and recovery and oxidation of CH_4 from ventilation air from coal mines	Extraction and transport of fossil fuel
Extended recovery and utilization, rather than venting, of associated gas and improved control of unintended fugitive emissions from the production of oil and natural gas	
Reduced gas leakage from long-distance transmission pipelines	
Separation and treatment of biodegradable municipal waste through recycling, composting and anaerobic digestion as well as landfill gas collection with combustion/utilization	Waste management
Upgrading primary wastewater treatment to secondary/tertiary treatment with gas recovery and overflow control	
Control of CH_4 emissions from livestock, mainly through farm-scale anaerobic digestion of manure from cattle and pigs	Agriculture
Intermittent aeration of continuously flooded rice paddies	
BC measures (affecting BC and other co-emitted compounds)	
Diesel particle filters as part of a Euro VI package for road and off-road diesel vehicles	Transport
Elimination of high-emitting vehicles in road and off-road transport	
Replacing coal by coal briquettes in cooking and heating stoves	Residential
Pellet stoves and boilers, using fuel made from recycled wood waste or sawdust, to replace current wood-burning technologies in the residential sector in industrialized countries	
Introduction of clean-burning biomass stoves for cooking and heating in developing countries[2, 3]	
Substitution of clean-burning cookstoves using modern fuels for traditional biomass cookstoves in developing countries[2, 3]	
Replacing traditional brick kilns with vertical shaft kilns and Hoffman kilns	Industry
Replacing traditional coke ovens with modern recovery ovens, including the improvement of end-of-pipe abatement measures in developing countries	
Ban of open field burning of agricultural waste[2]	Agriculture





[UNEP, 2011]

7 Key Global Measures for Reducing CH_4 Emissions

Intermittent aeration of rice paddies

Recovery from wastewater

Recovery from oil and gas

Recovery from landfills

Recovery from livestock manure /change feed

Coal mine methane capture

Reducing pipeline leakage

(Courtesy of J. Kuylenstierna, SEI/CCAC)

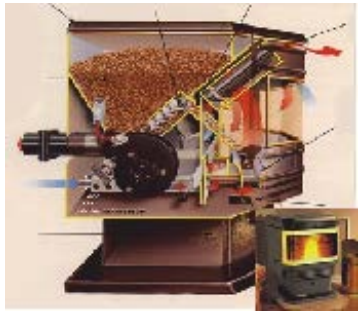
9 Key Global Measures for Reducing BC Emissions

Improved biomass stoves

Modern coke ovens

Remove mega-emitters / DPF

Cooking with clean fuel



Pellet biomass heating stoves

Improved brick kilns

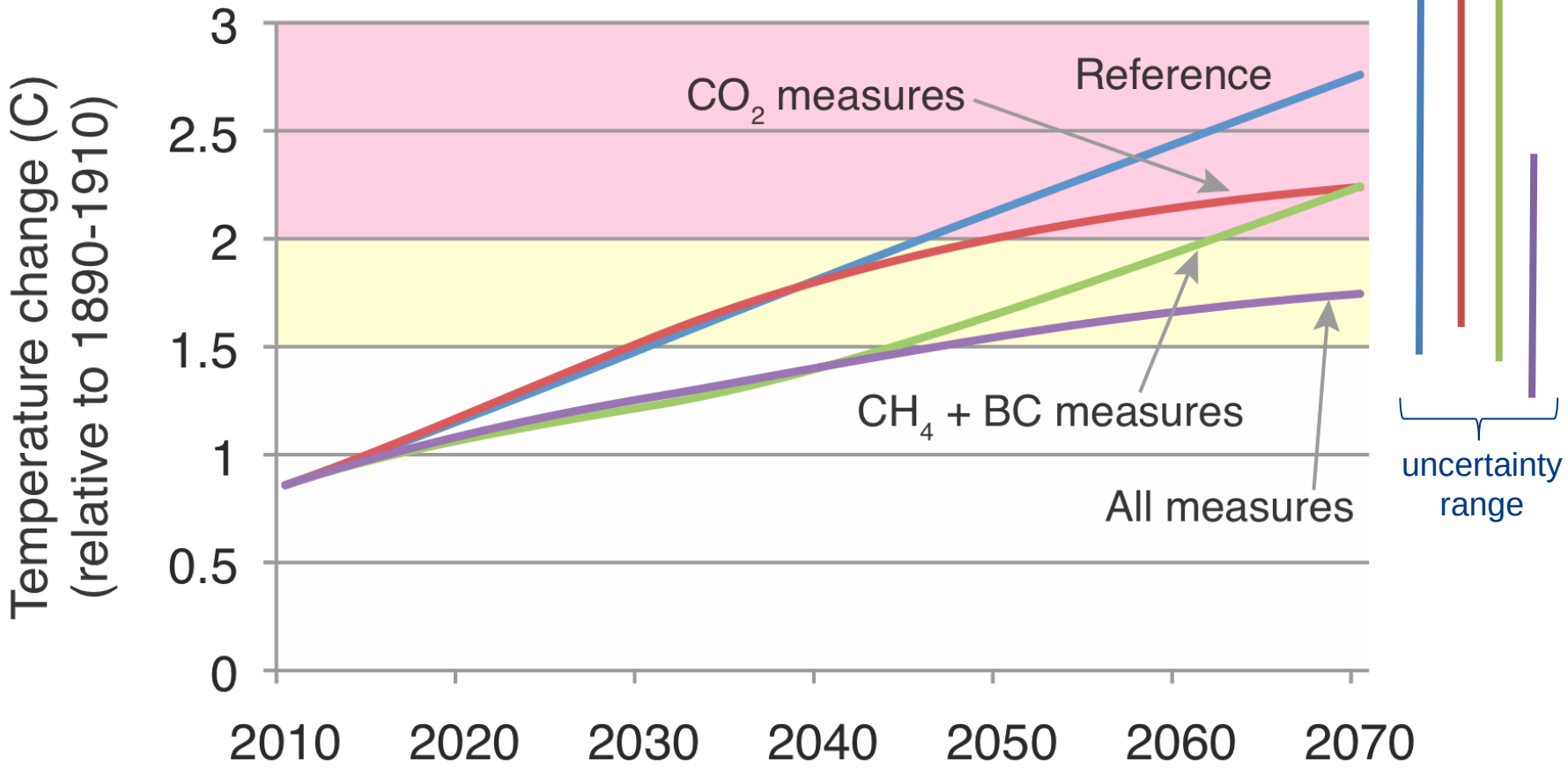
Coal briquettes replacing coal

Reduce agricultural burning

Reduce flaring

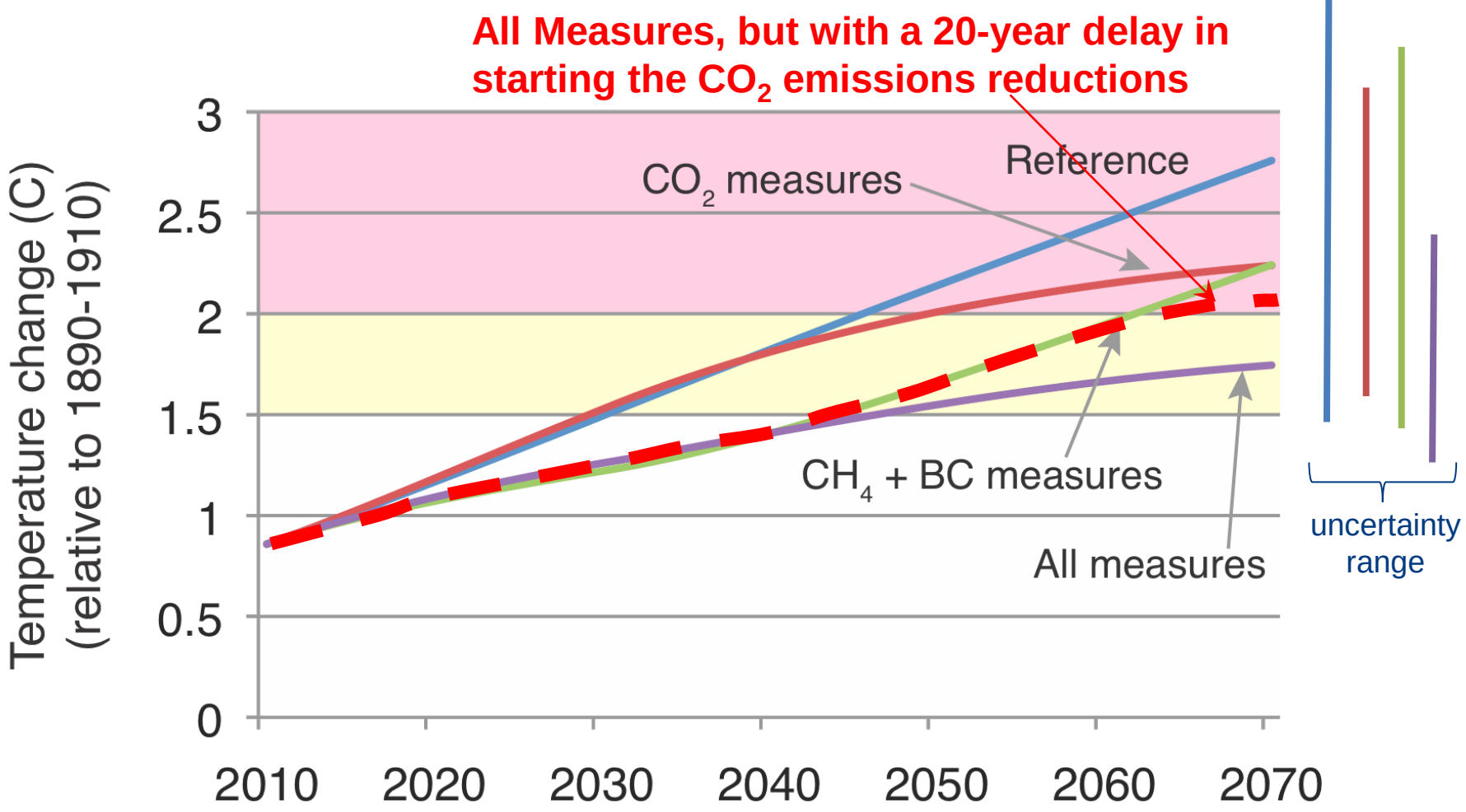
(Courtesy of J. Kuylenstierna, SEI/CCAC)

Mitigation Possibilities for CO_2 and SLCPs (BC + CH_4)



[UNEP, 2011; Shindell et al., 2012]

Mitigation Possibilities for CO_2 and SLCPs (BC + CH_4)

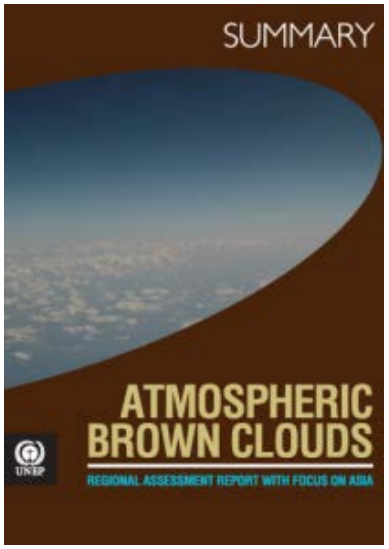


[UNEP, 2011; Shindell et al., 2012]

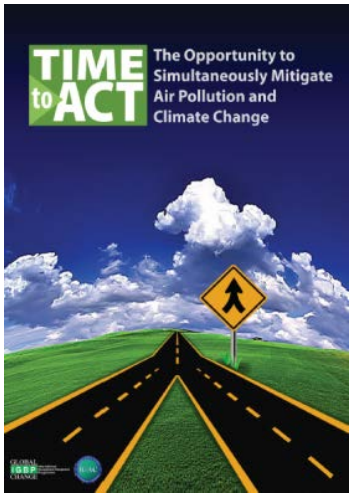
Current Activities and Intiatives

The Climate and Clean Air Coalition

http://www.unep.org/ccac/



http://www.rrcap.unep.org/abc/



http://www.igacproject.org/AirPolClim

ClimPol

http://climpol.iass-potsdam.de