



**The Abdus Salam
International Centre for Theoretical Physics**



2256-2

**Workshop on Aerosol Impact in the Environment: from Air Pollution to
Climate Change**

8 - 12 August 2011

**Introductory talk: Air quality and climate change: How to improve both at the same
time**

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Air quality and climate change: how to improve both at the same time



Elisabetta Vignati

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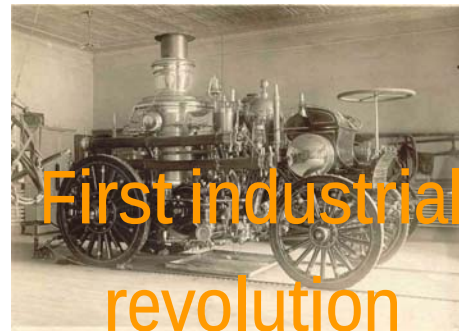
“Accelerated” climate change and air quality are
important environmental issues

mostly originating from the same cause:

the use of fossil fuels

Development of textile and metallurgical sectors
Electricity; chemical products
and internal-combustion engines

agricultural
commercial
craftmade
activities



oil



1760

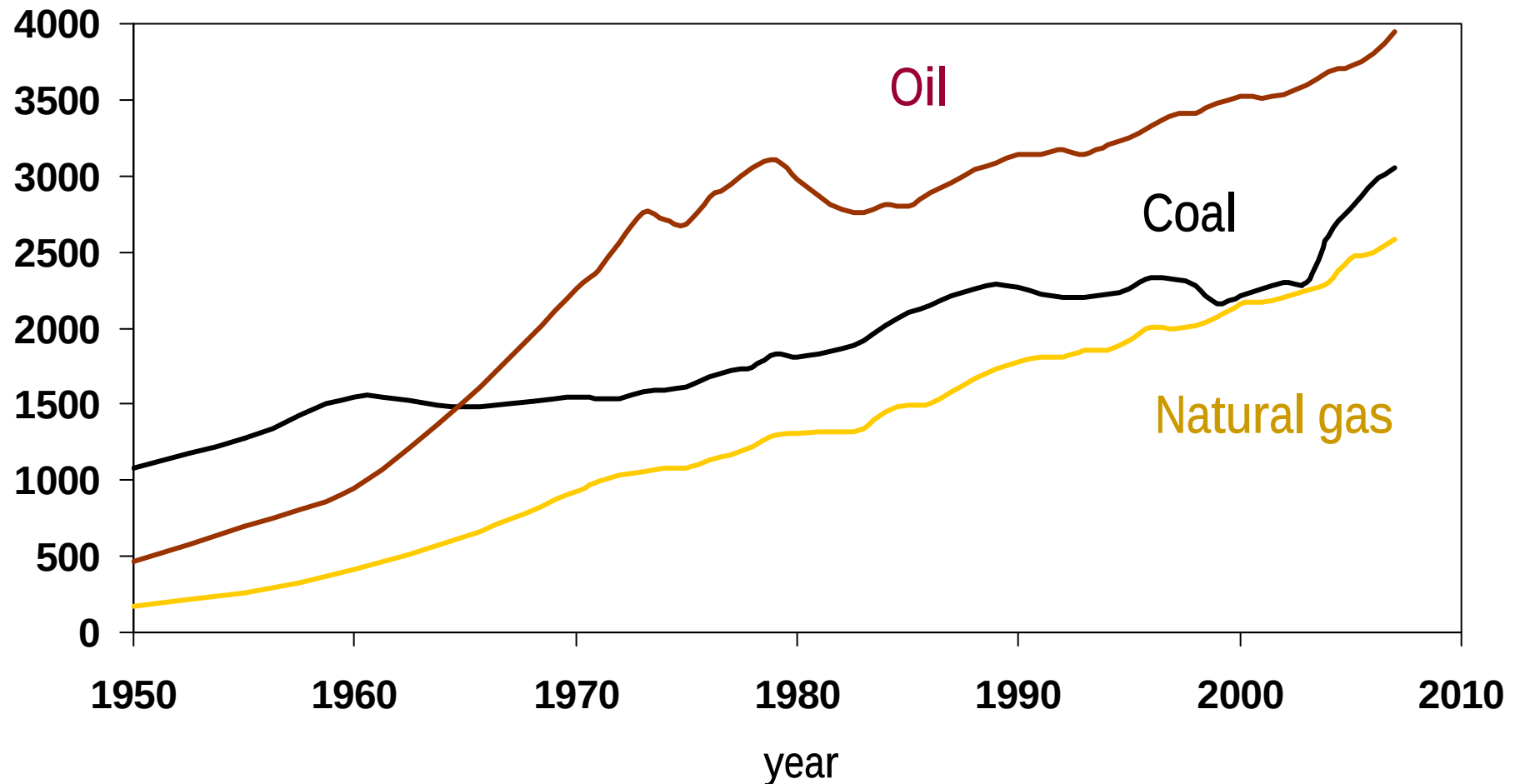
1830

1870

1970

Industrial Revolution

Consumption (million tons oil equivalent)



(Data from U.S. Energy Inf. Admin, BP, Int. Energy Agency, and UN)

Gas

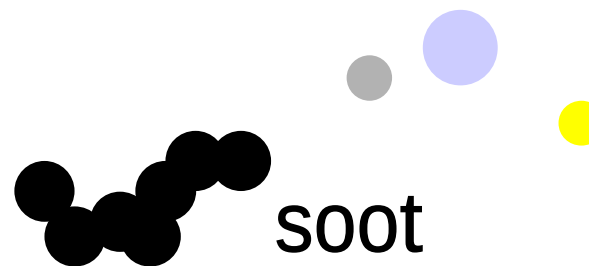
(nitrogen oxides, carbon oxide,....)

Ozone, O_3

burning oil and coal



Carbon dioxide, CO_2



soot

Aerosol particles

Methane, CH_4

extracting and burning natural gas

Ozone, O_3

Carbon dioxide, CO_2



use of fossil fuel

% of total anthropogenic emissions

CO_2

natural
gas

19%

oil

38%

coal

43%

80

CH_4

coal
45%

oil

15%

natural
gas
40%

25

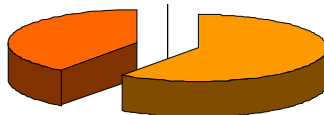
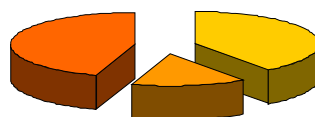
BC

as proxy for soot

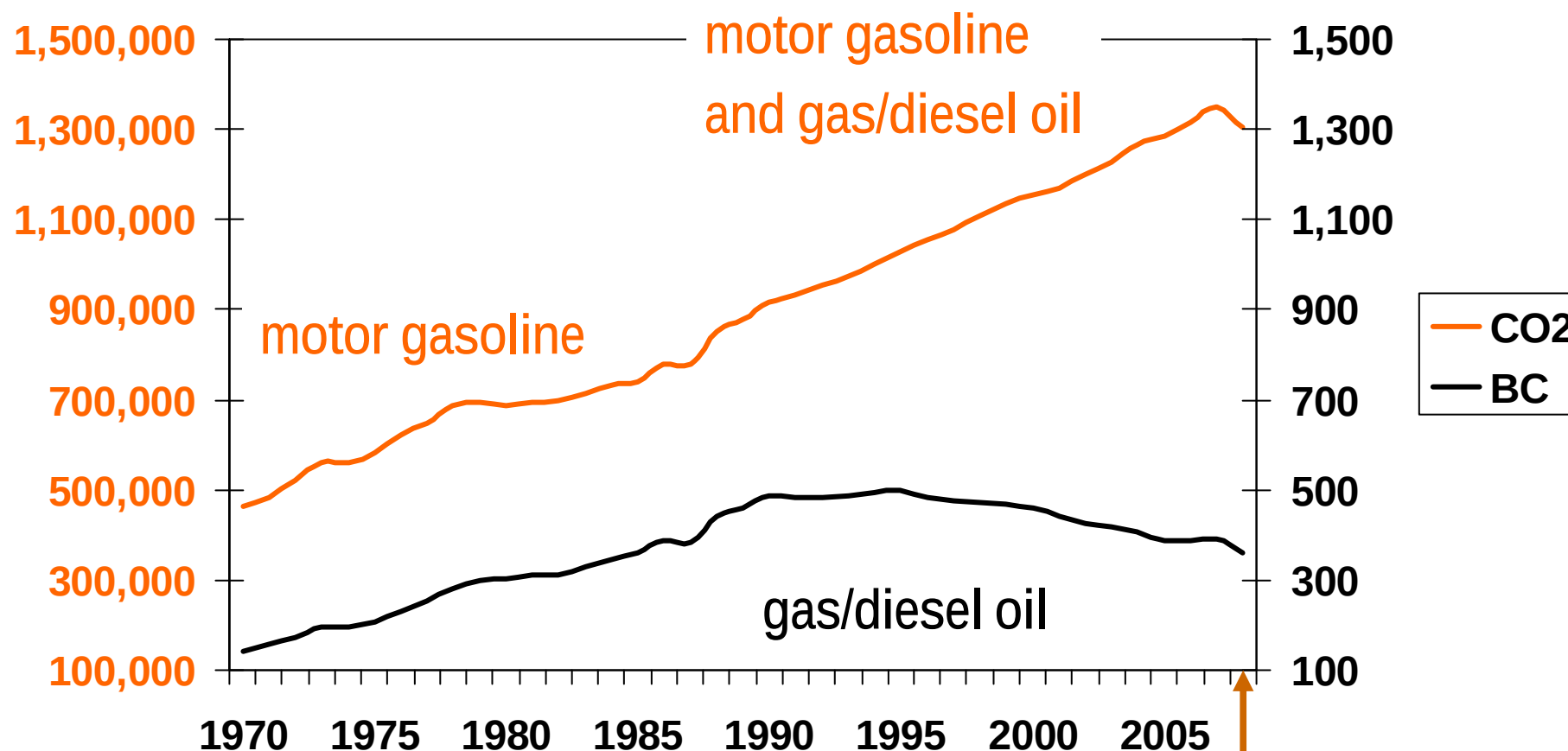
coal
40%

oil
60%

40



kilo tons carbon / year



economic crisis

(Source: EDGAR database)

Climate change

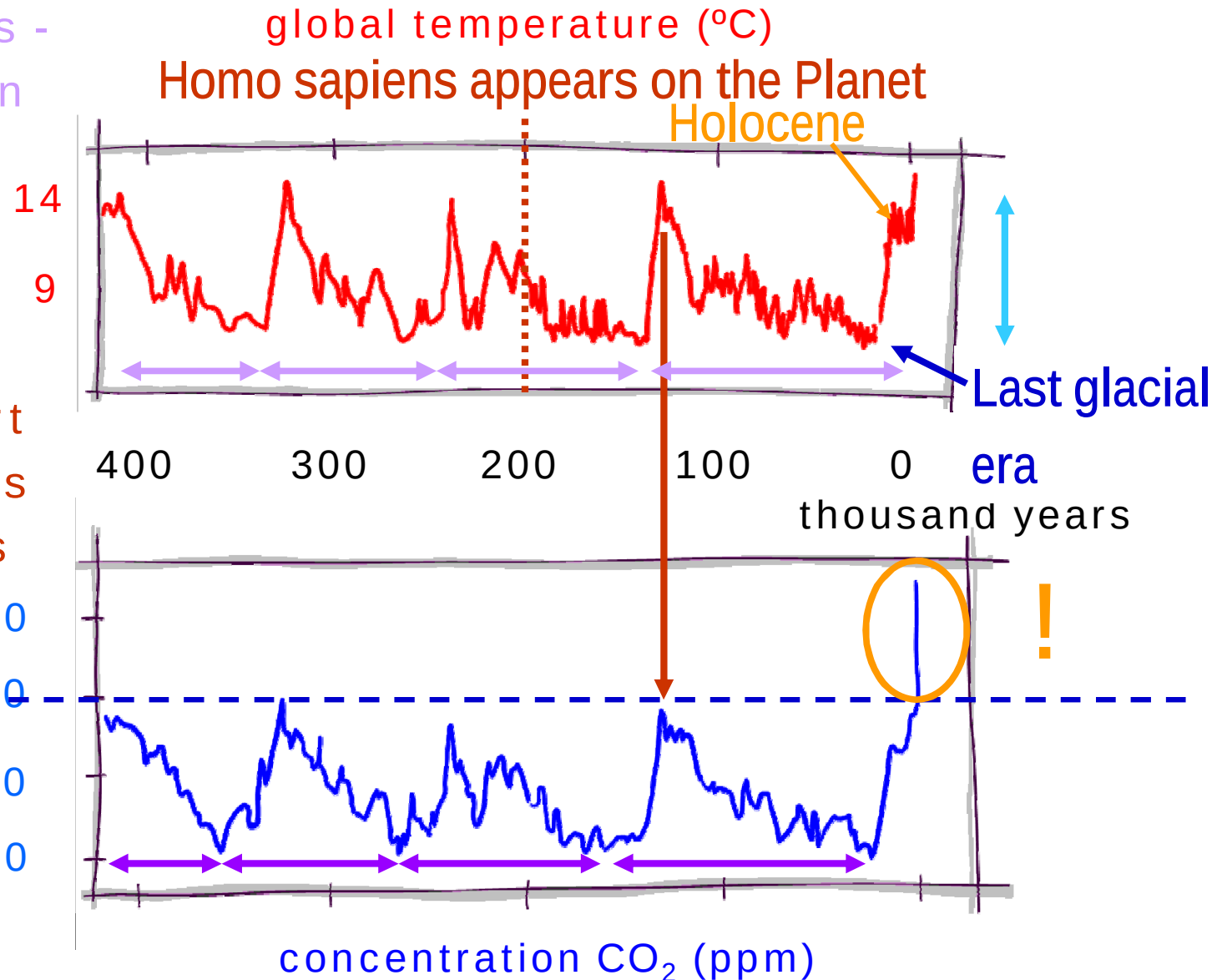
Carbon dioxide

100.000 year cycles -
Earth orbit variation

5 °C separate a
glacial from an
interglacial era

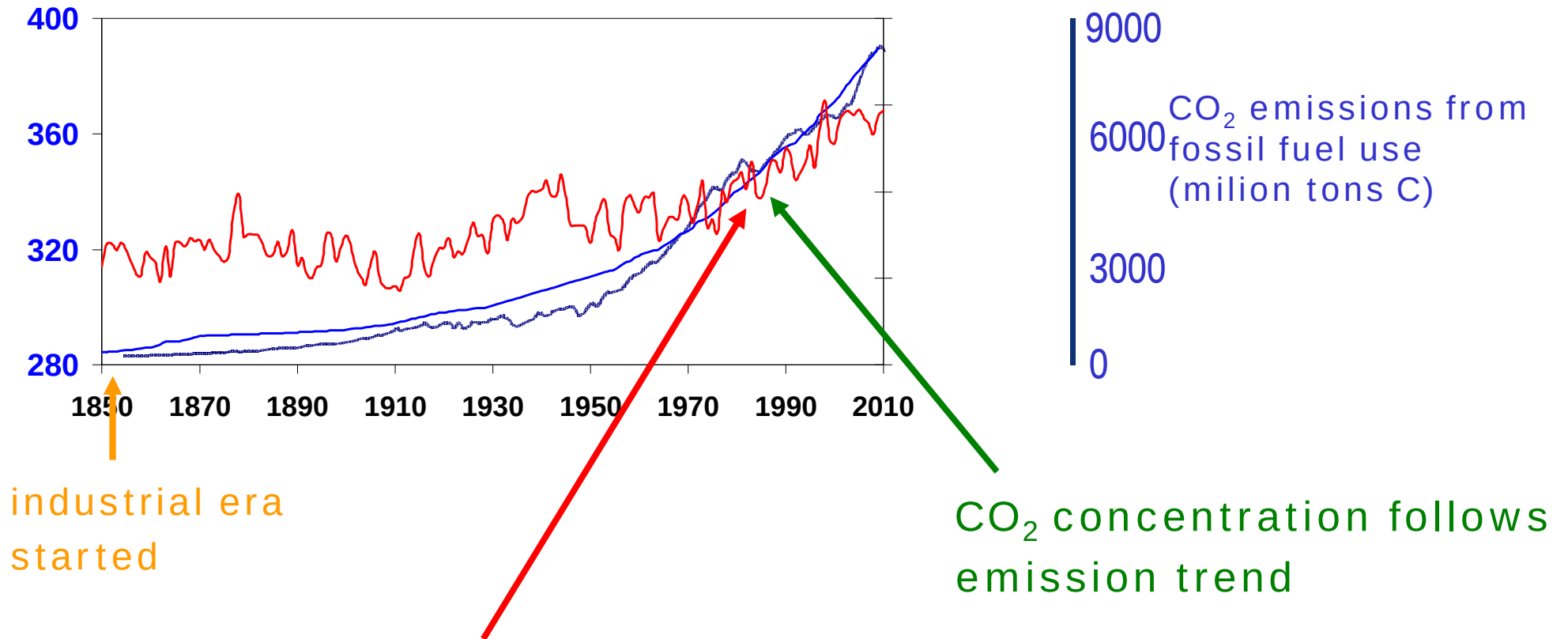
Variations of T start
a few hundred years
before CO₂ changes

Cycles similar to
temperature



concentration CO₂ (ppm)

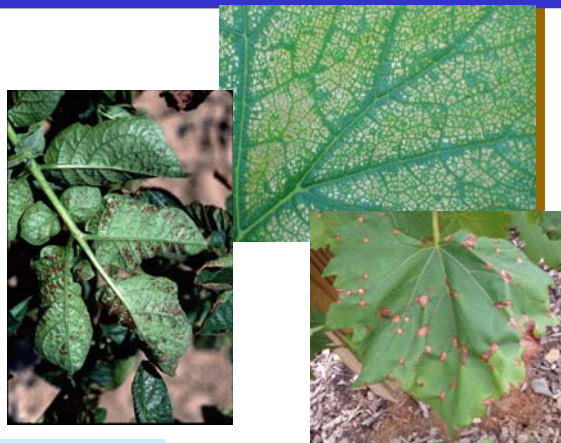
temperature (°C)



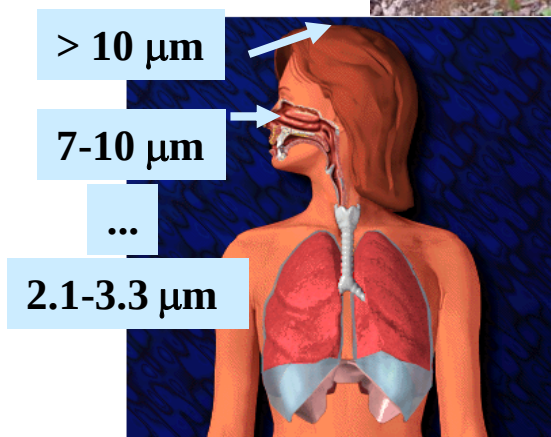
Air quality: effects on health
and agriculture

Climate change

Ozone



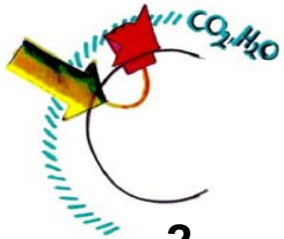
Aerosol
particles



Carbon dioxide

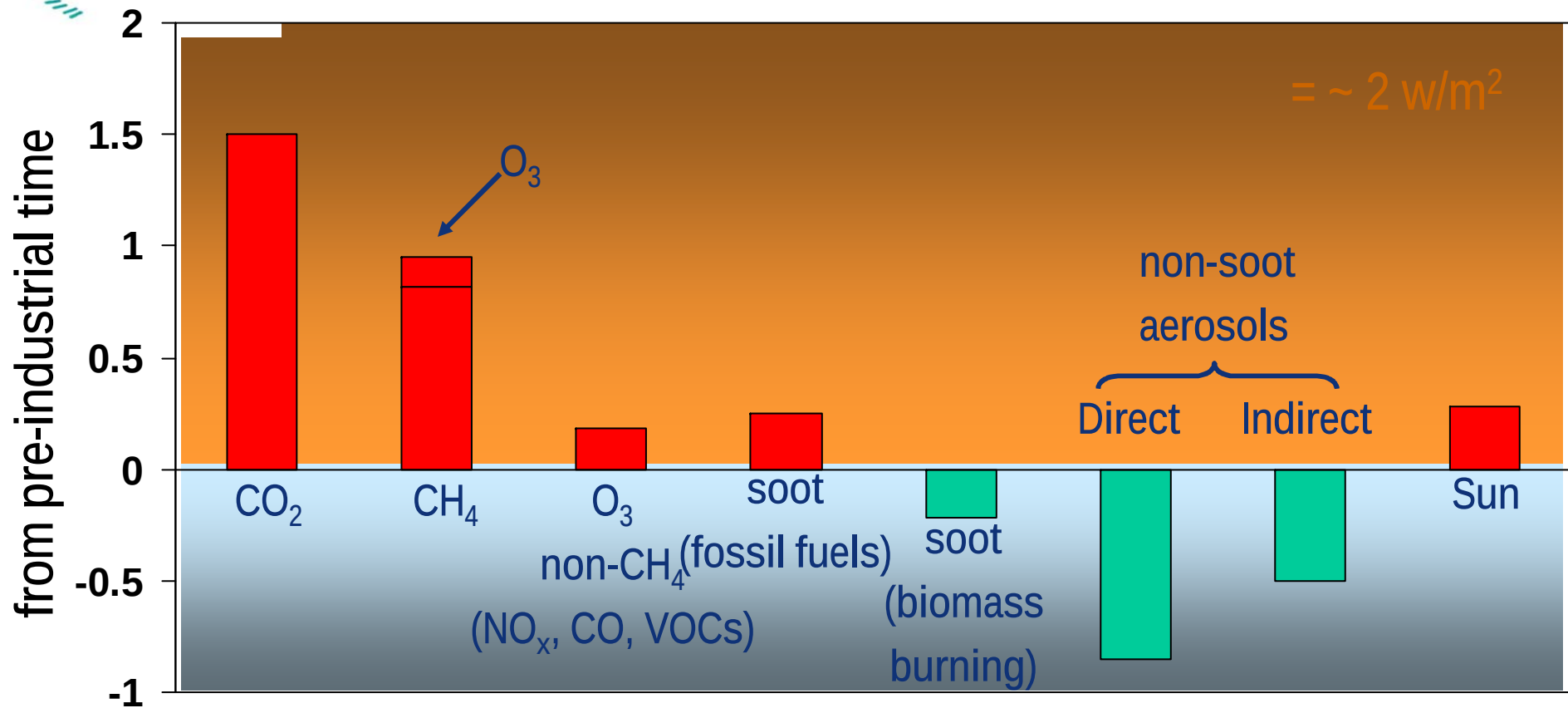
What is their effect on the radiation balance?

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Earth: a system searching for the balance

Agents forcing the planet equilibrium (watt/m^2)



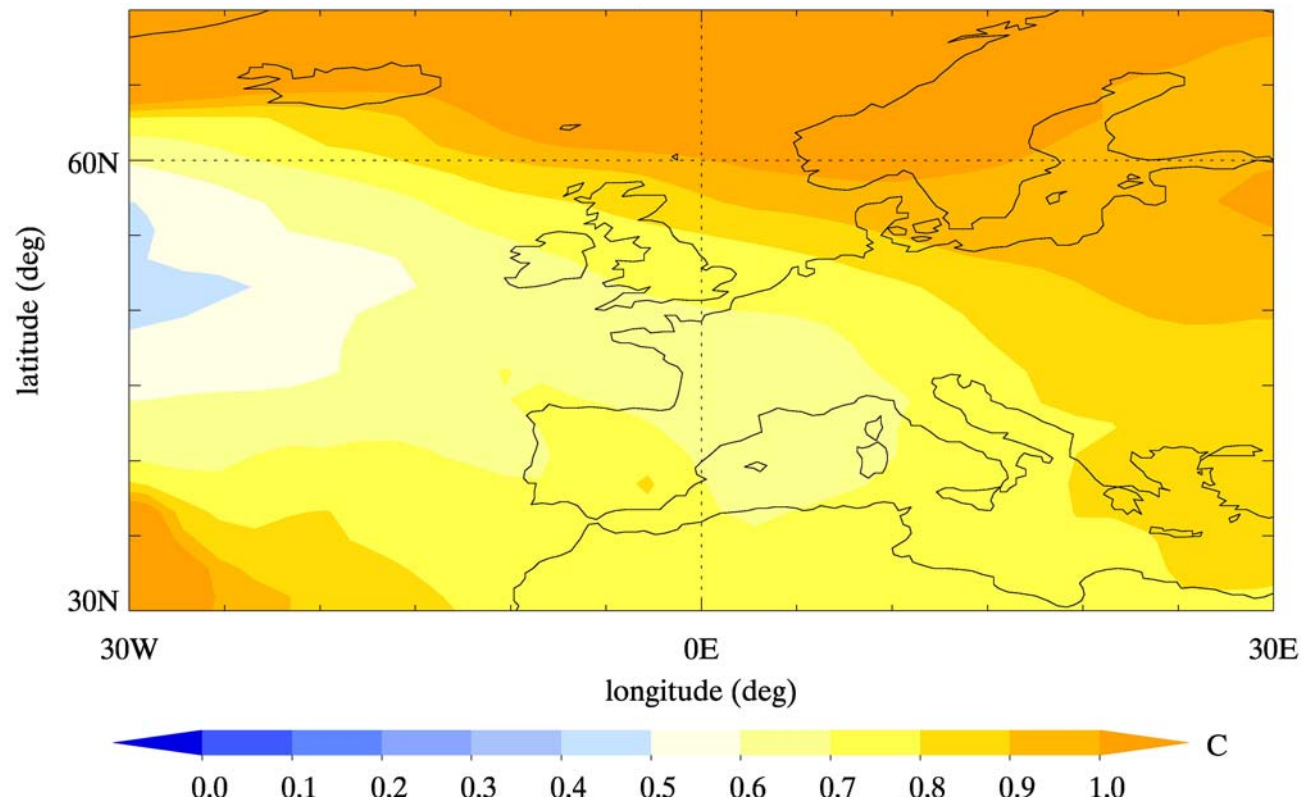
(Hansen et al., JGR, 2005) Natural forcings from glacial to interglacial era = 6.5 w/m^2

What if we reduce pollutants, no matter what?

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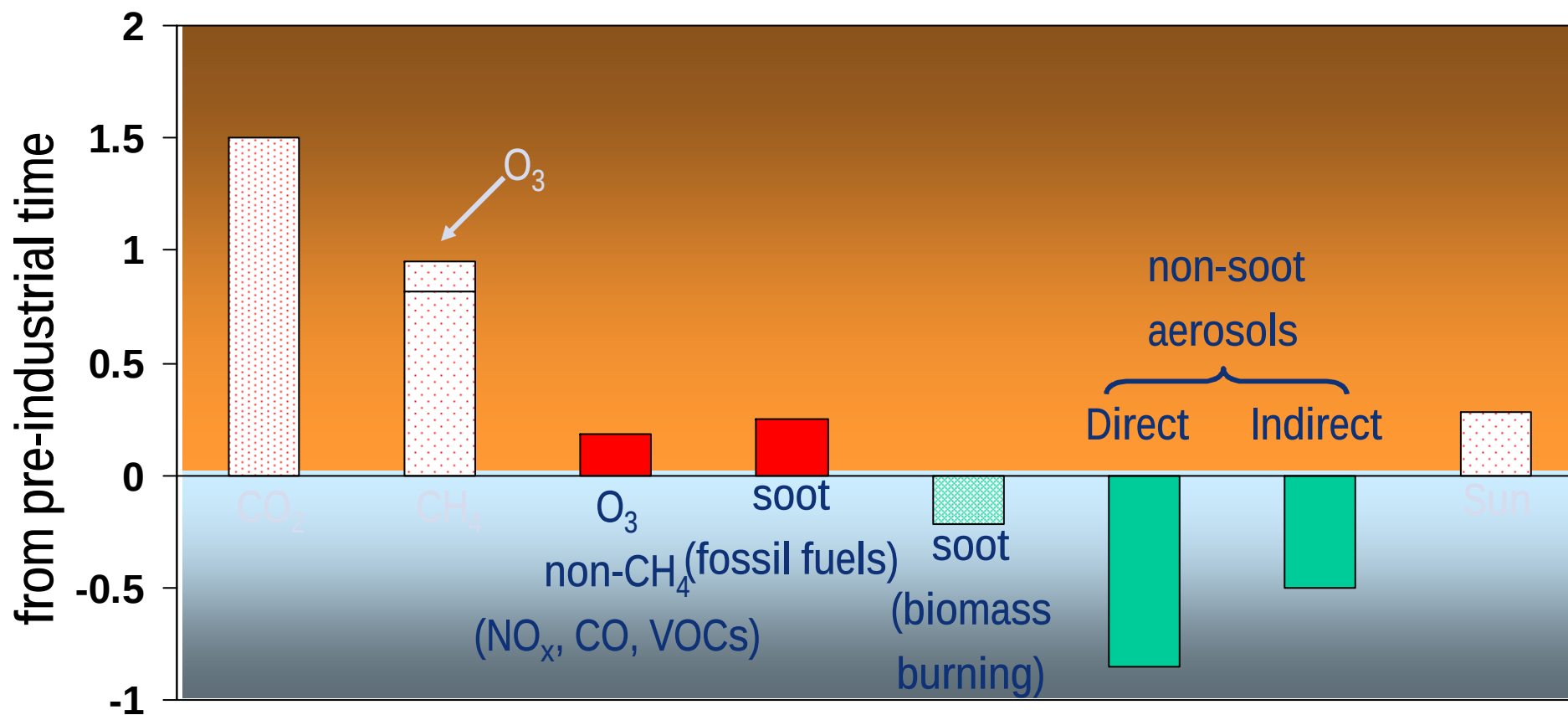
What would the temperature difference be over Europe compared to now?

temperature difference (2030-2000) following Current Legislation



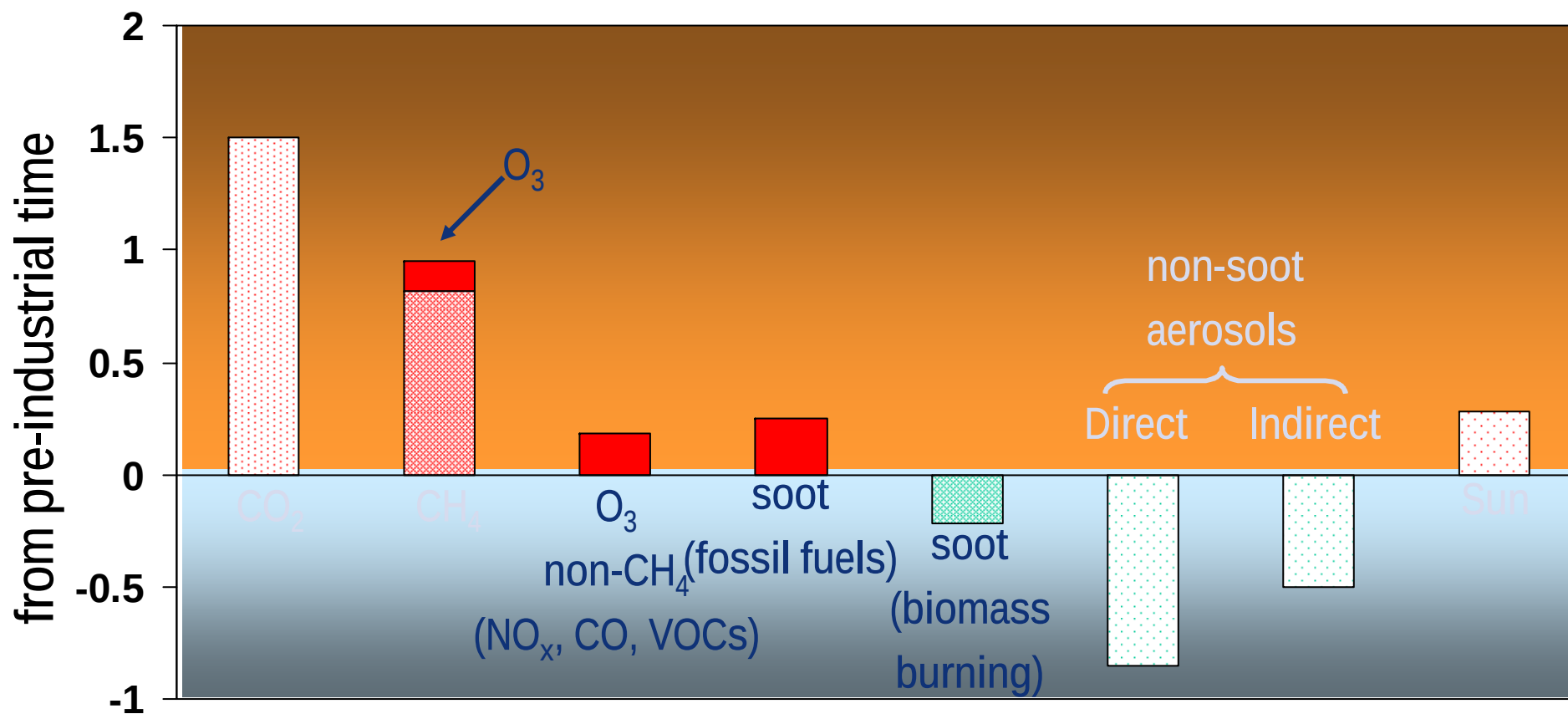
temperature will rise!

Tackling unconditional pollutants' forcing



Improving air quality but worsening climate change

Tackling warming short lived climate forcers



Do we achieve also important benefits for health and agriculture?



http://www.unep.org/dewa/Portals/67/pdf/BlackCarbon_SDM.pdf



- Chair:** **Drew Shindell:** NASA Goddard Institute for Space Studies, USA
- Vice Chairs:** **Frank Raes:** EC Joint Research Centre, Ispra, Italy
V. Ramanathan: Scripps Institute, Univ. of California, USA
Kim Oanh: Asian Institute of Technology (AIT), Thailand
Luis Cifuentes: Pontificia Universidad Católica ,Chile
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- UNEP Coordinator:** **Volodymyr Demkine,** UNEP DEWA, Nairobi, Kenya
- Lead Authors:** Emissions: **David Streets:** Aragonne National Labs. USA
Atmospheric processes: **David Fowler:** CEH, UK
Impacts: **Lisa Emberson:** SEI, UK
Policy Measures: **Martin Williams:** Kings College.UK
- Lead Modelers:** Emissions: **Markus Amann:** IIASA **Greet Maenhout:**JRC
Climate: **Drew Shindell:** GISS. **Elisabetta Vignati** – JRC
Health: **Susan Anenberg:** US EPA
Crops: **Rita van Dingenen:** JRC
Economic Valuation: **Nicholas Muller** Middlebury College

soot from fossil fuel burning contains a low
component of “negative” forcings

no further reduction of SO₂



only limiting emissions of warming agents



14 emission reduction measures in 3 groups

Workshop on Air

CH4 measures

Extraction and transport of fossil fuels

Waste management

Agriculture

BC technical measures

Transport (Diesel particle filters for road and off-road vehicles as part of a move to worldwide adoption of Euro 6/VI standards)

Residential

Industry

BC non-technical measures

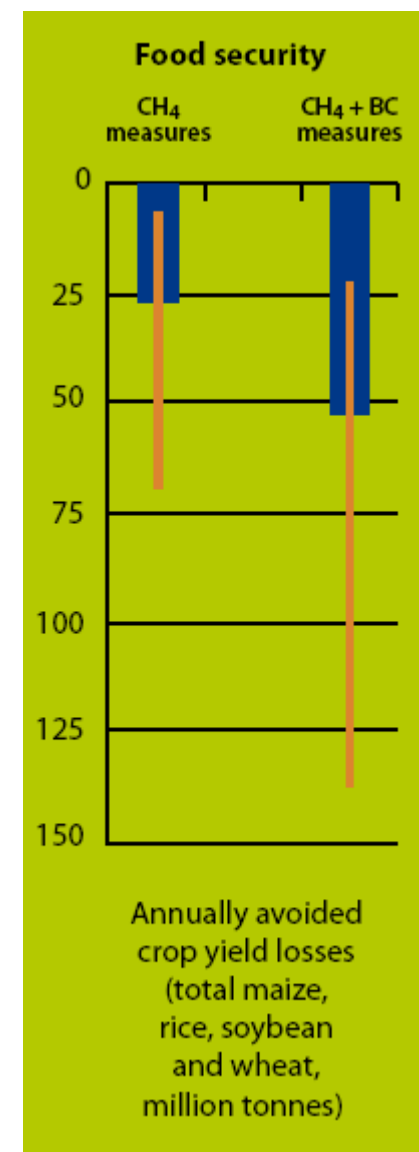
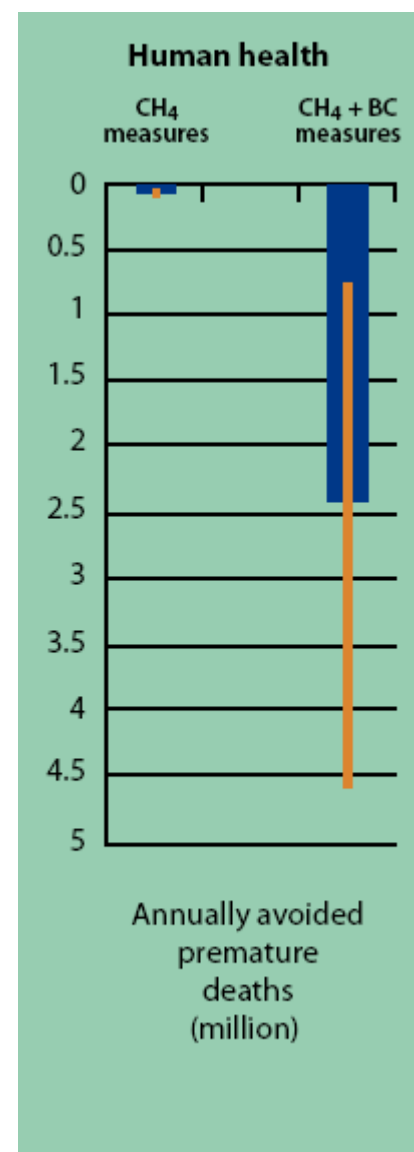
Transport (Elimination of high-emitting vehicles in road and off-road transport)

Agriculture

Residential

a global picture

2030 implementing the specific measures
compared to 2030 current legislation



Substantial differences affecting climate

Reducing emissions of

O₃ (precursors) soot

CH₄

CO₂

which have a mean lifetime in the atmosphere of

from hours to weeks

8-10 years

of decades ... in reality...

has the effect

immediate on

on ozone

slow:

concentrations and

concentrations

hundreds of years

climate, especially

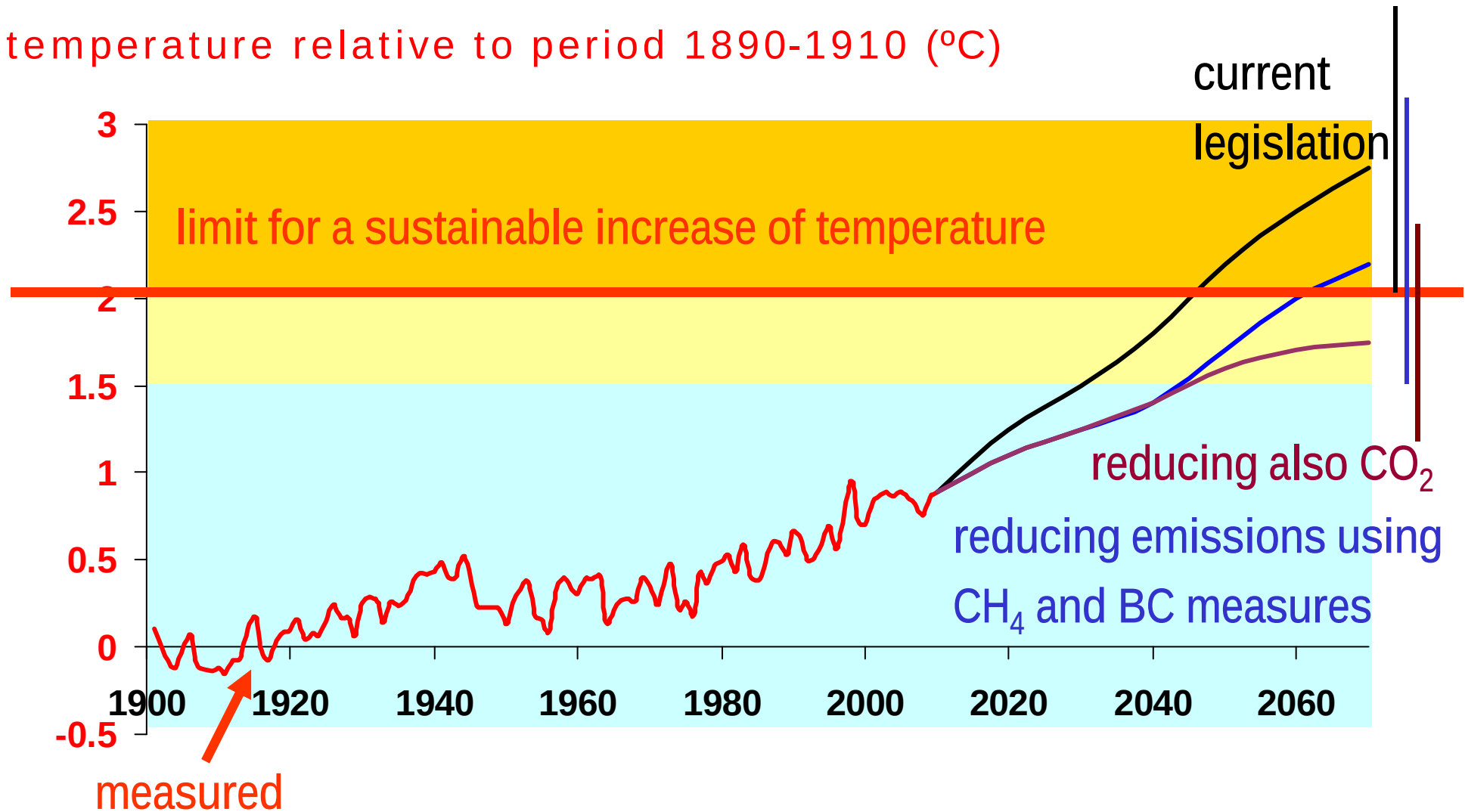
worldwide

are necessary

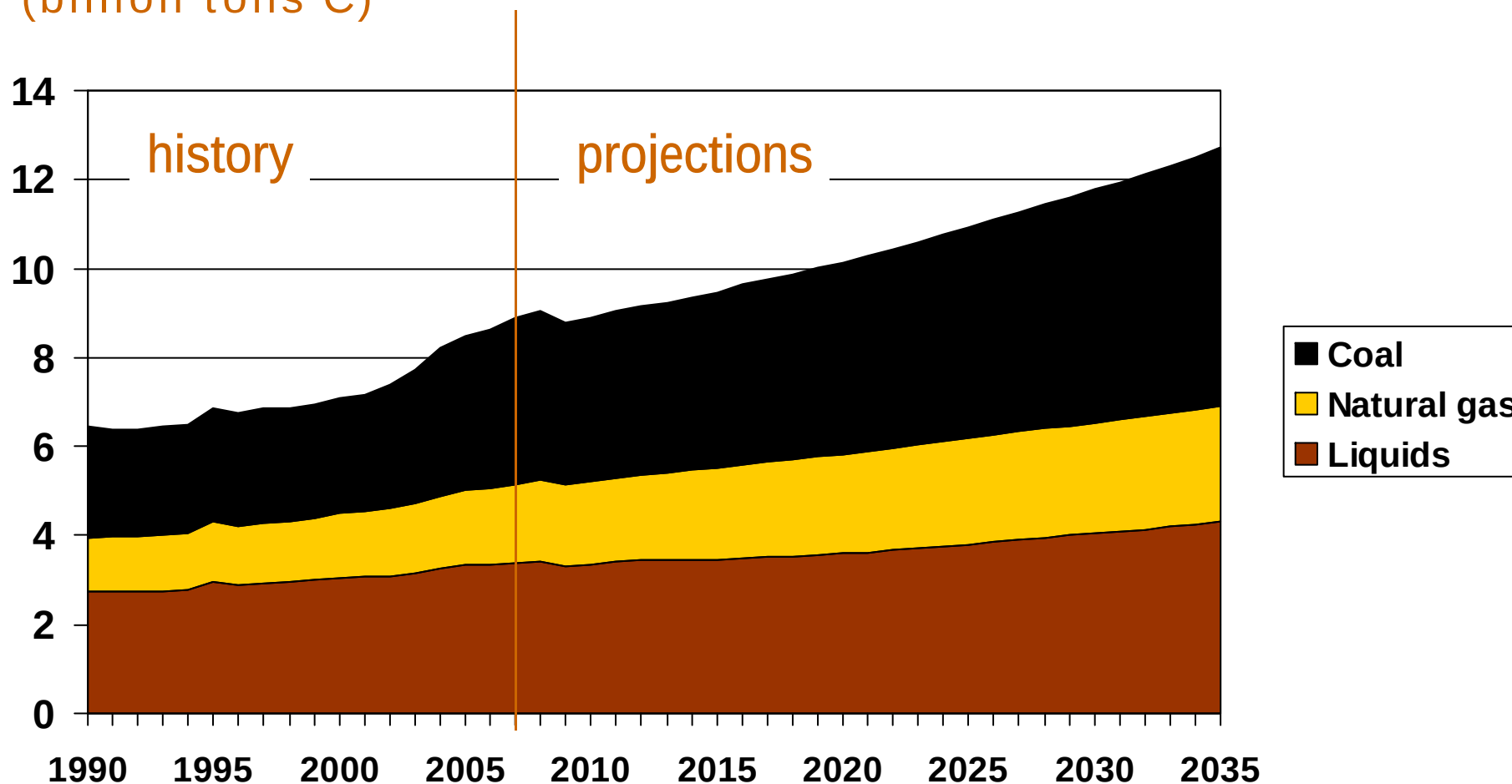
locally

to affect climate

temperature relative to period 1890-1910 (°C)



World energy-related carbon dioxide emissions by fuel type (billion tons C)



(Data from EIA, International Energy Statistics database (as of November 2009), web site: www.eia.gov/emeu/international. Projections: EIA, World Energy Projection System Plus (2010))

- Air quality degradation and accelerated climate change have the same sources
- Air pollutants: reduction of their emissions is relatively easy, the effect on climate and air quality are immediate, mostly close to sources but not only
- Carbon dioxide: emission reductions require structural changes and are less easy to implement, the effect on climate takes quite some time before taking place

Therefore we have to start NOW the reductions of both to avoid a future which might be not sustainable

Thanks!