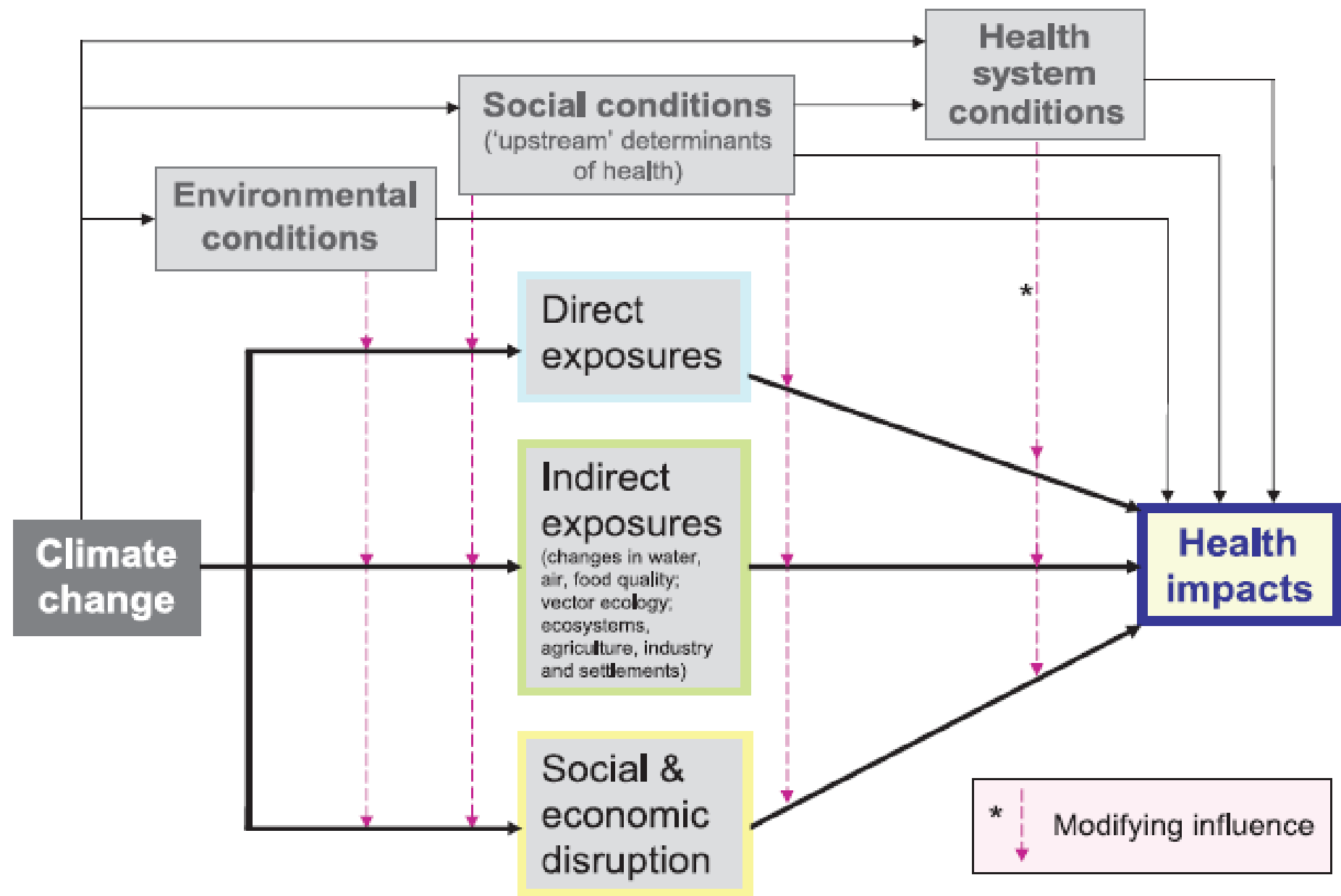


Meeting Health Goals While Blunting Climate Change: The Co-benefits Story

Kirk R. Smith

Professor of Global Environmental Health
University of California, Berkeley

AAAS Forum on Science and Technology Policy
Washington DC,, April 30, 2009












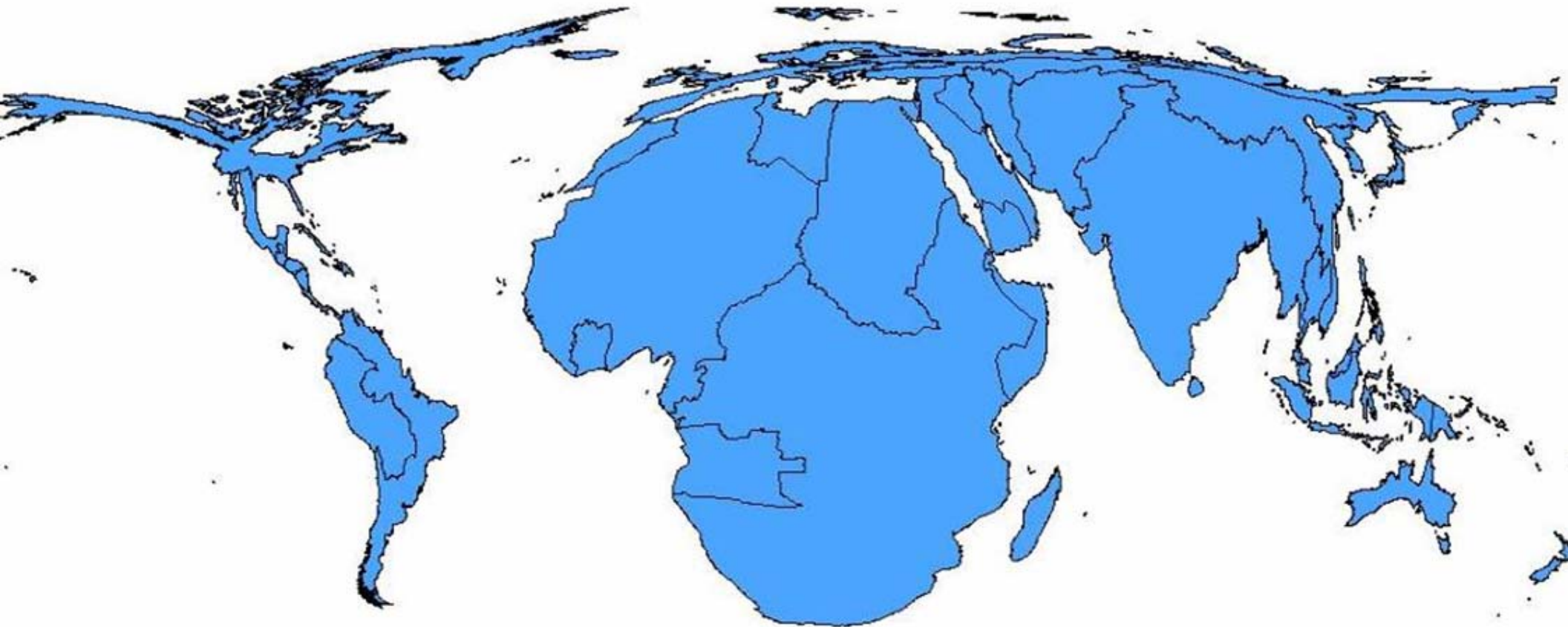
	Negative impact	Positive impact
Very high confidence		
Malaria: contraction and expansion, changes in transmission season		
High confidence		
Increase in malnutrition		
Increase in the number of people suffering from deaths, disease and injuries from extreme weather events		
Increase in the frequency of cardio-respiratory diseases from changes in air quality		
Change in the range of infectious disease vectors		
Reduction of cold-related deaths		
Medium confidence		
Increase in the burden of diarrhoeal diseases		

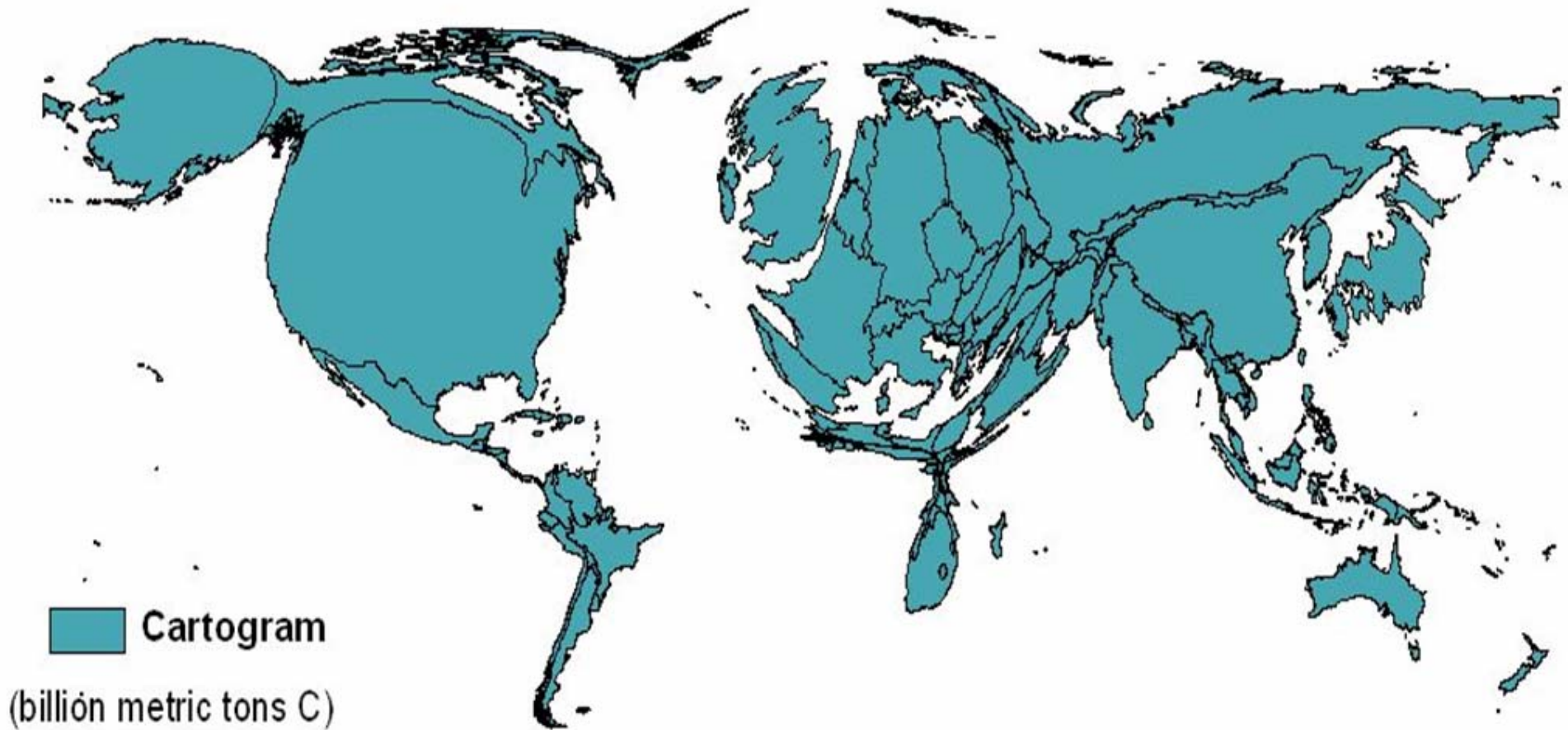
Figure 8.3. *Direction and magnitude of change of selected health impacts of climate change (confidence levels are assigned based on the IPCC guidelines on uncertainty, see <http://www.ipcc.ch/activity/uncertaintyguidancenote.pdf>).*

Cartogram of Climate-related Mortality (per million pop) yr. 2000



Data from the WHO Comparative Risk Assessment, 2004

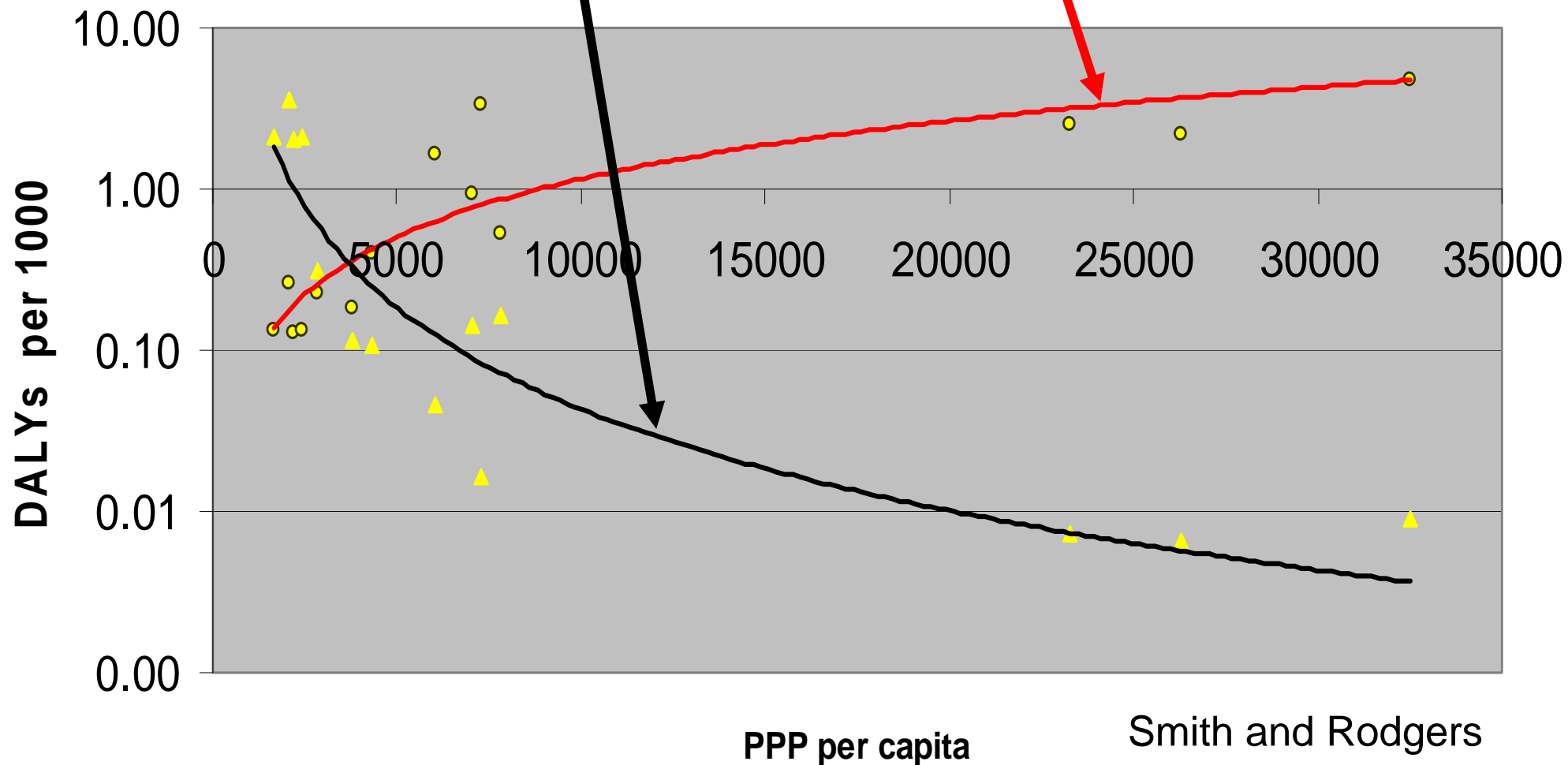
Cumulative CO₂ emissions from fossil fuels (as depleted by natural processes)



Patz JA, Gibbs HK, Foley JA, Rogers JV, Smith KR, 2007, **Climate change and global health: Quantifying a growing ethical crisis**, EcoHealth 4(4): 397–405, 2007.

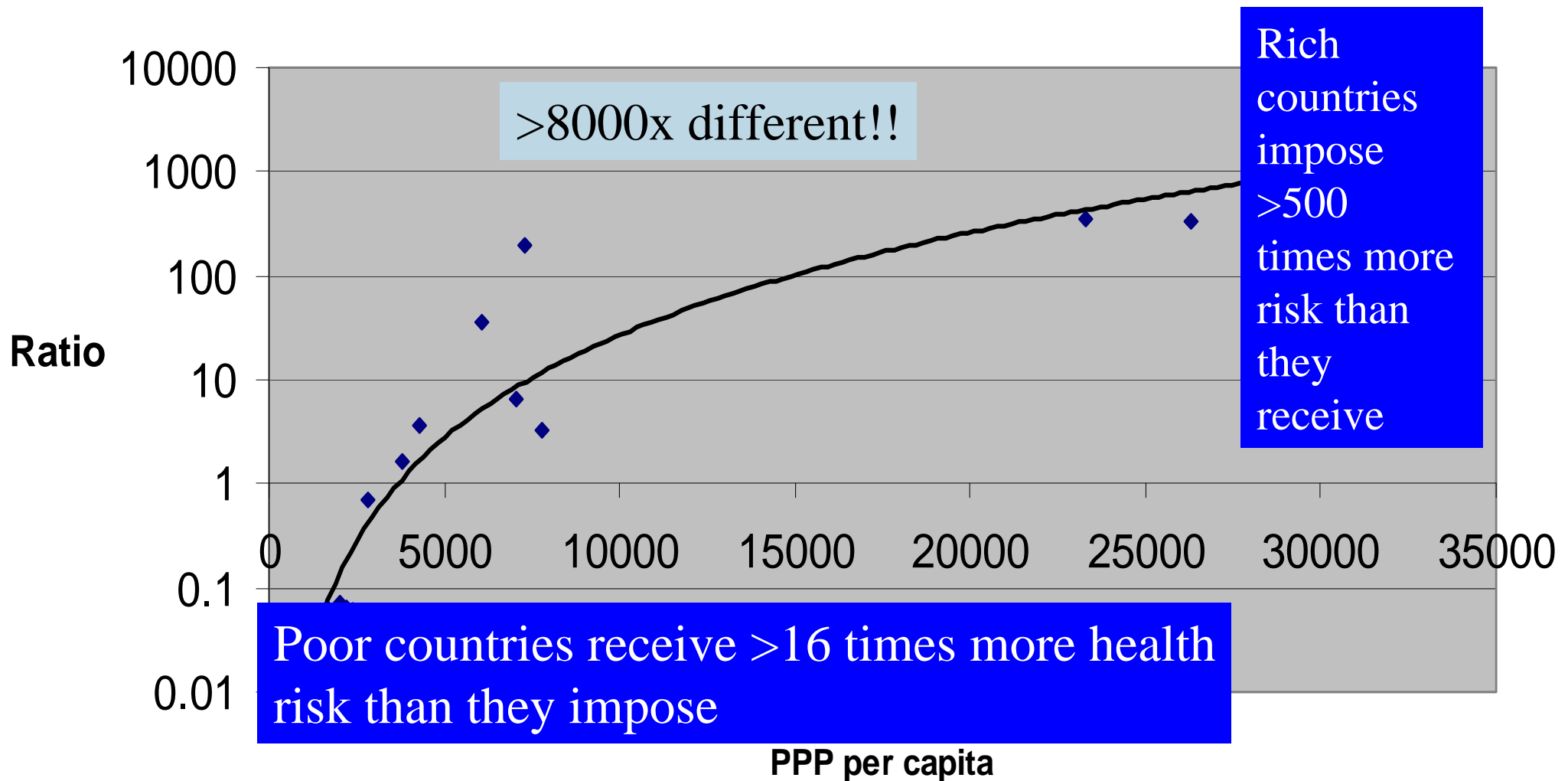
Distribution of Health Impacts from Climate Change

(Experiencing versus Imposing)



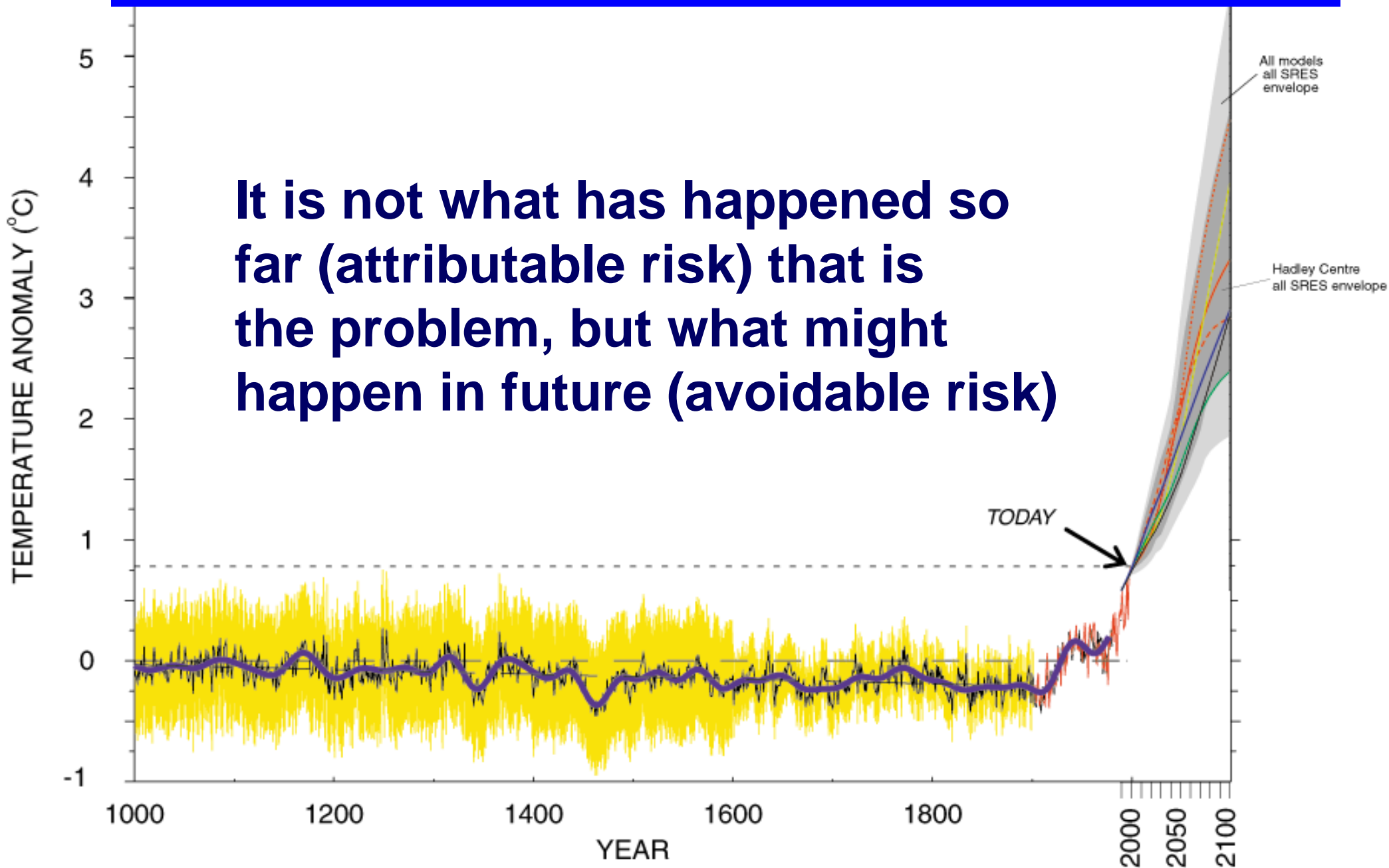
Distribution of Health Impacts from Climate Change

(Ratio: Imposing/Experiencing)



1000 years of Earth temperature history...and 100 years of projection

It is not what has happened so far (attributable risk) that is the problem, but what might happen in future (avoidable risk)



Categories of Health Impacts

- 1) **Direct impacts** through changing weather patterns (e.g., storms, floods, temperature extremes)
- 2) **Indirect impacts** through natural systems including changes in water supply and quality, air pollution, and ecosystems leading to shifts in disease vectors.
- 3) **Systemic impacts** operating through human systems including shifts in food supplies, refugee patterns, coastal and agricultural livelihoods, and the health impacts of society's responses to climate change, such as geo-engineering, carbon taxes, biofuel production, etc.
- 4) **Low-probability high-consequence impacts** such as extremely rapid climate change or sea level rise due to threshold phenomena in Earth's systems, e.g., runaway methane emissions from the tundra or rapid loss of parts of the Antarctic ice sheet.
- 5) **Co-benefits:** Achieving health- and climate-protection benefits with the same policies and projects

Co-benefits: Being Smart about Mitigation

- **Link with broader society**: Guide mitigation measures so they help achieve other important societal goals, including health protection.
- **Spread costs**: Helps reduce the cost of mitigation by sharing cost with other sectors.
- **No-regrets**: providing a short-term more certain return (health) on a long-term more uncertain investment (climate protection)
- **Political bridge** over the international divide between developed and developing countries

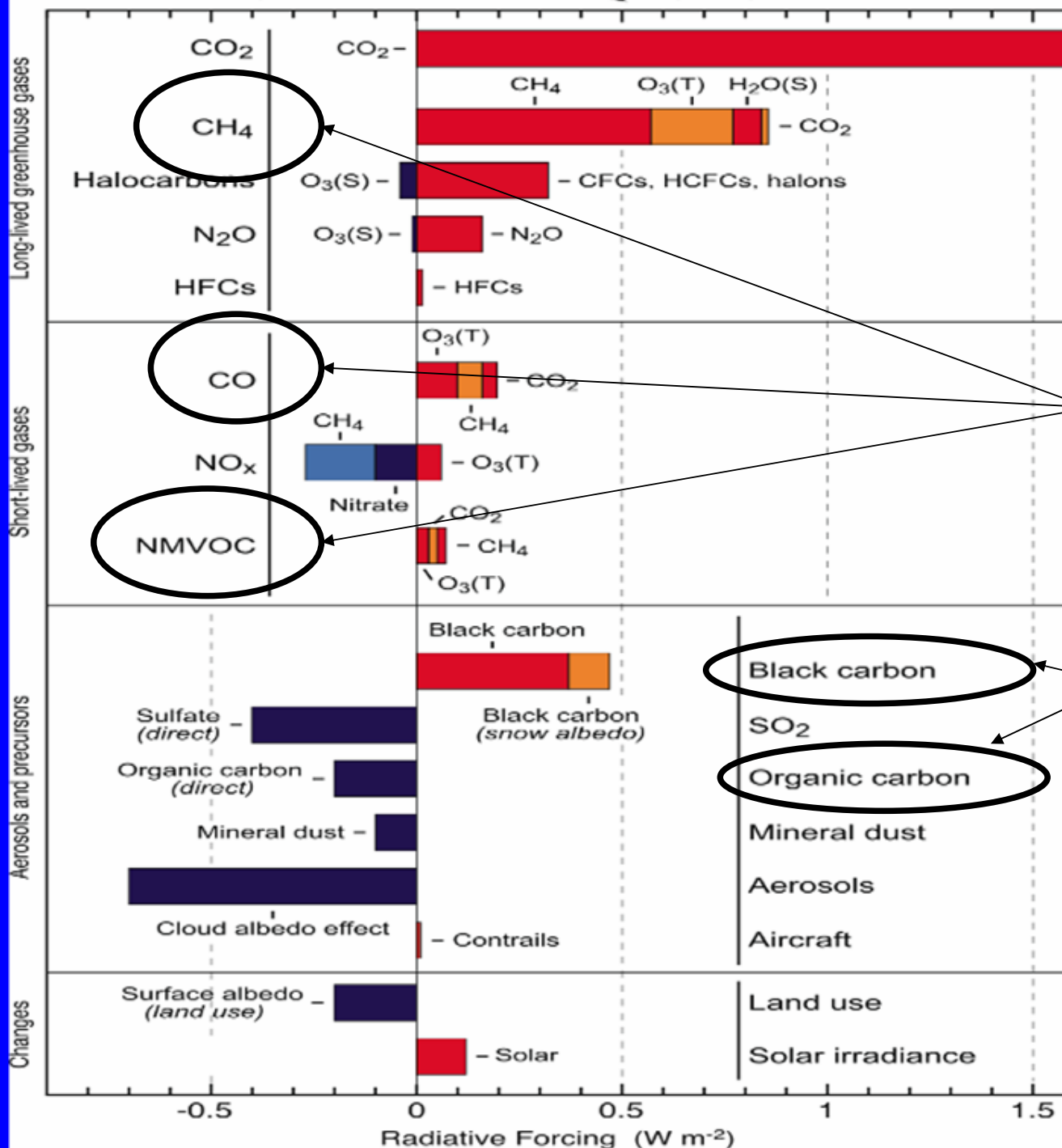
Major Categories of Co-benefits

- There is no sector that does not have at least some relation to energy, health, and climate
- Here, however, are listed examples only in sectors that have potentially significant positive impacts on health and climate protection.
- I do not include climate mitigation measures that may have significant negative impacts on health, such as promoting biofuels from agricultural land, etc.

Air Pollution from Energy Use

- Household solid fuels
 - Large source of ill-health worldwide in poorest populations – 1.6 million premature deaths
 - Non-renewable biomass and coal carbon emissions
 - Poor combustion leads to non-CO₂ GH-related emissions
- Outdoor emissions from energy systems
 - 0.8 million premature deaths
 - Most well documented benefits, climate and health
- Products of incomplete combustion are the most important points of interaction

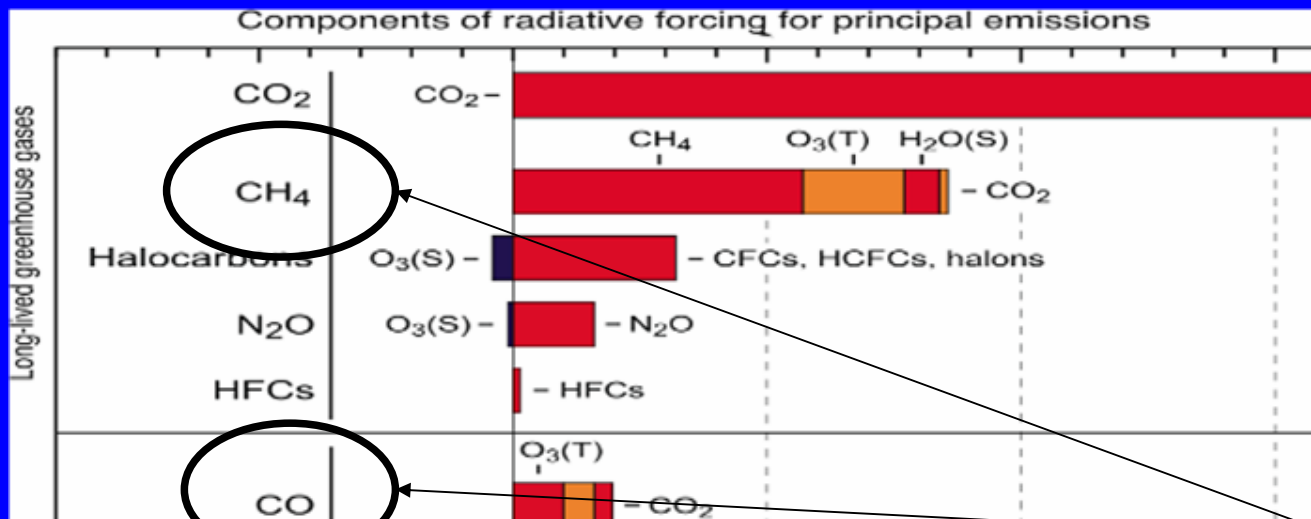
Components of radiative forcing for principal emissions



Warming in 2005
from emissions
since 1750

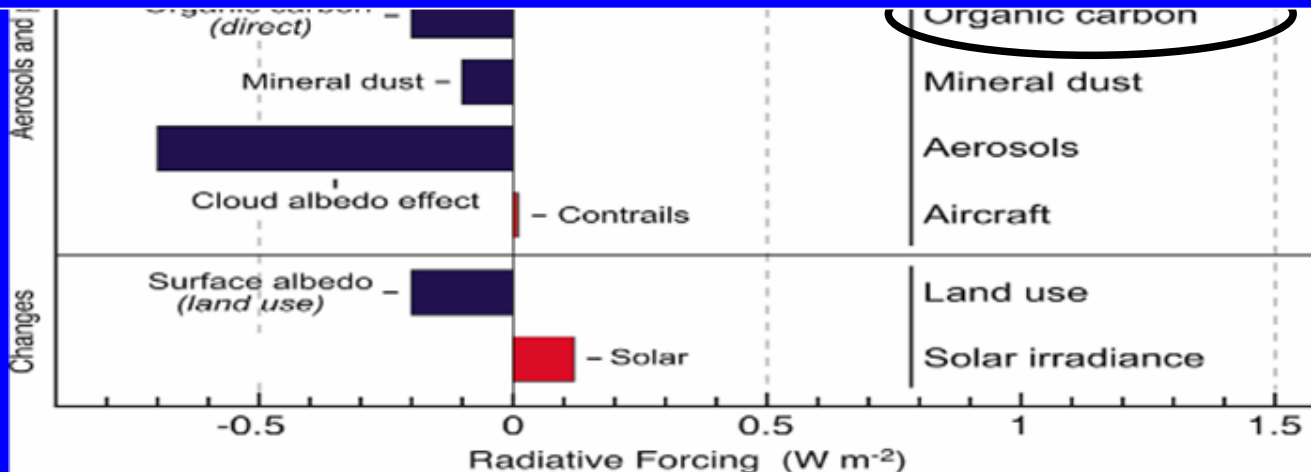
A large part from
PIC: products of
incomplete
combustion

IPCC, 2007



**Warming in 2005
from emissions
since 1750**

The climate change problem is caused not only by too much complete combustion of fossil fuels (CO₂), but also by too much incomplete combustion of all fuels (PIC)



IPCC, 2007

Where do these PIC come from?

From forest and savannah fires –
not directly human caused in general

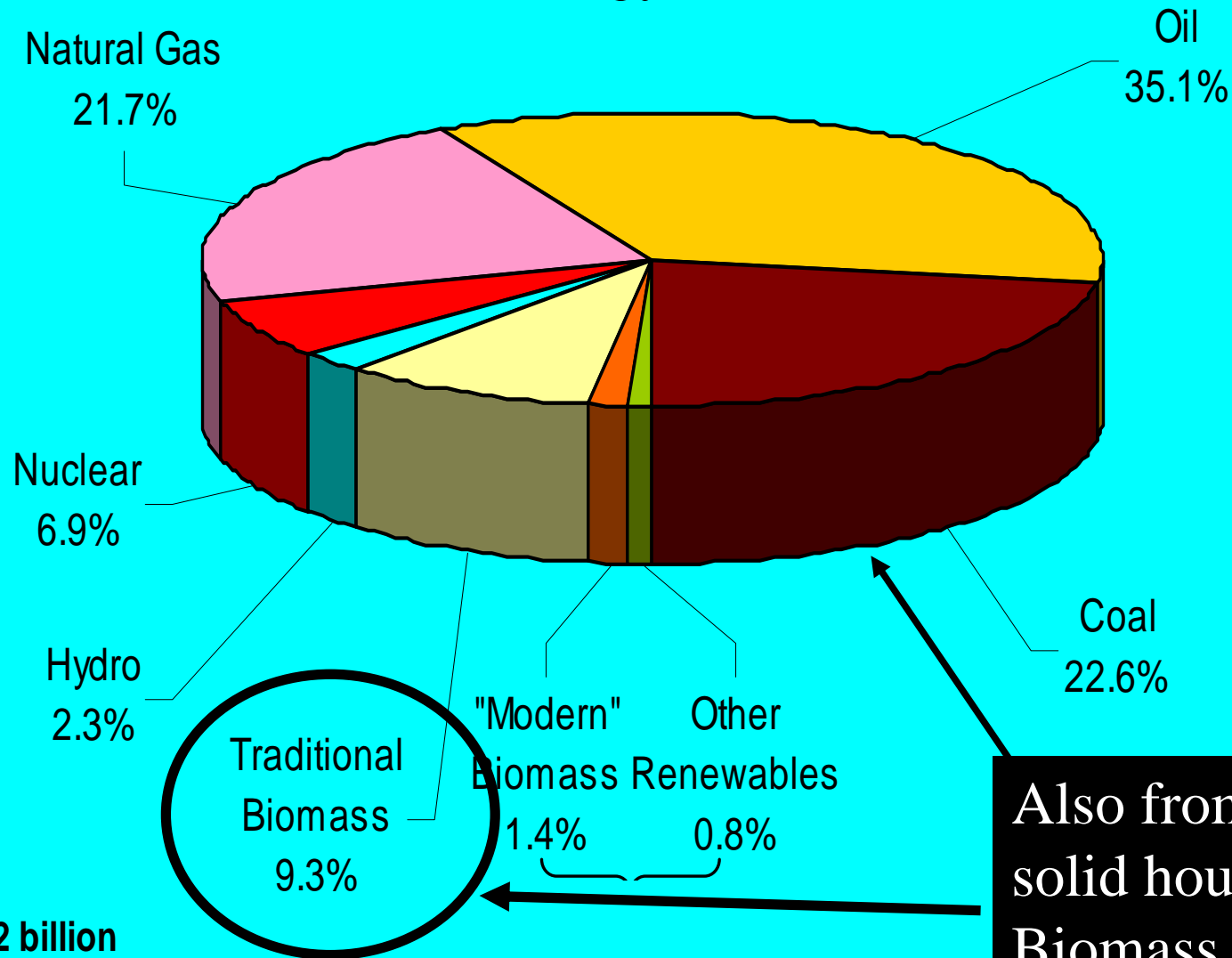
Where else?

Popula

Total e

Per cap

World Energy – 2001



Also from
solid household fuels
Biomass and coal

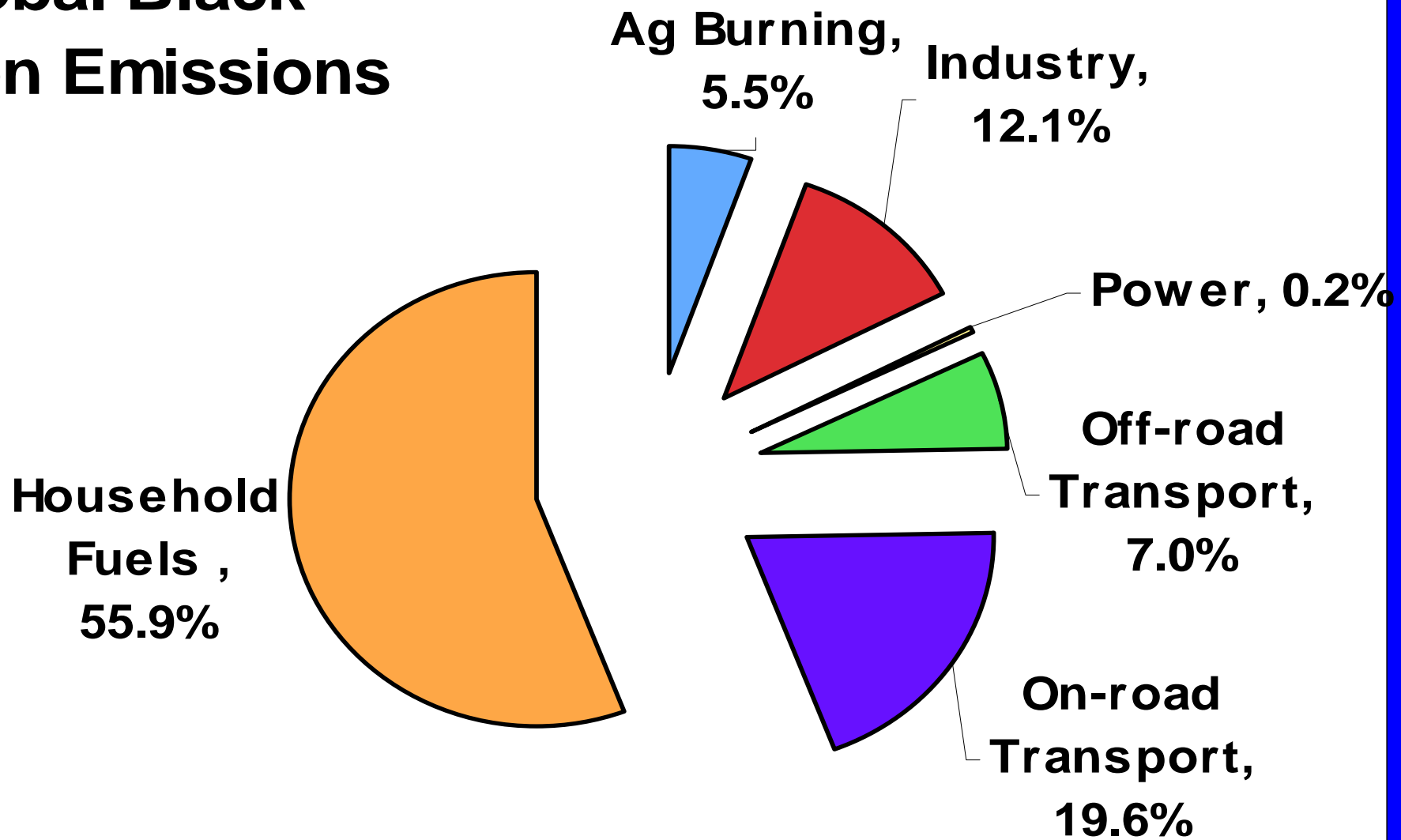
Population: 6.102 billion

Total energy use: 10.2 Gtoe

Per capita energy consumption: 1.67 toe

World Energy Assessment, 2004

Global Black Carbon Emissions



No forest fires

Total 6600 gigagrams
in 2000

BC Campaign Data

INDIA

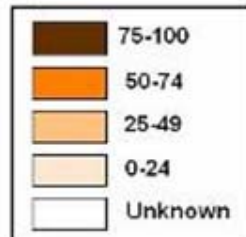
Biomass Fuels

More than
75% of
households

2+ million tons methane
per year of 300 Mt
total global human emissions

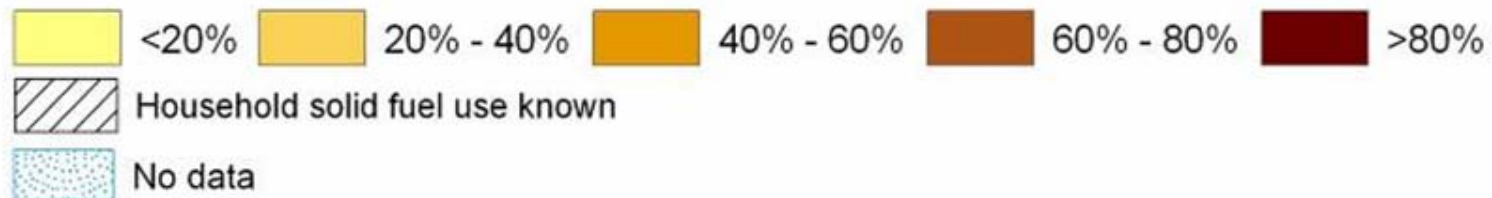
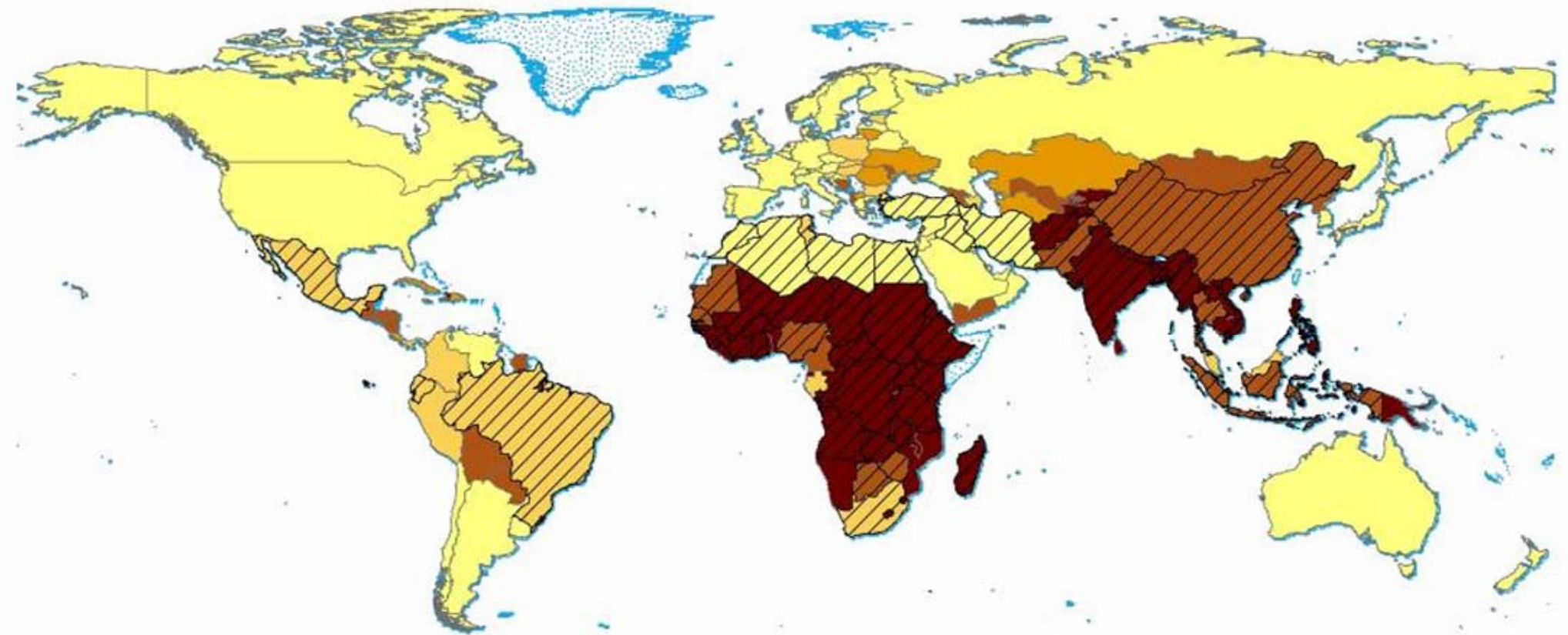
50-74% of
households

Percentage of Bio-fuel user households



2000 Census

National Household Solid Fuel Use, 2000



Diseases for which we have
epidemiological studies showing
a link to household biomass use

ALRI/
Pneumonia
(meningitis)

Low birth
weight

Asthma

Early
infant
death

Birth defects?

Cognitive
Impairment?

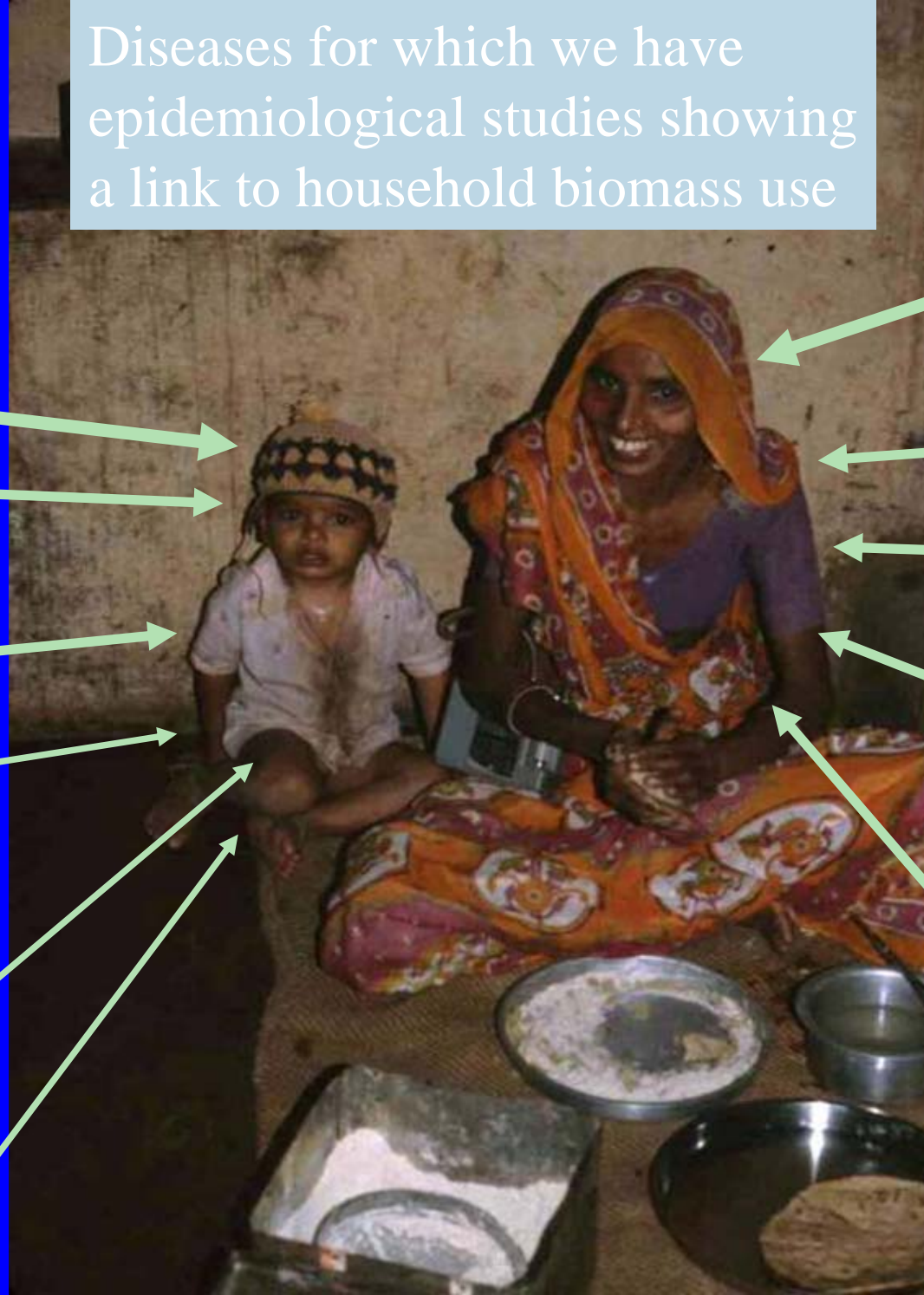
Chronic
obstructive
lung disease

Tuberculosis

Blindness (cataracts,
trachoma)

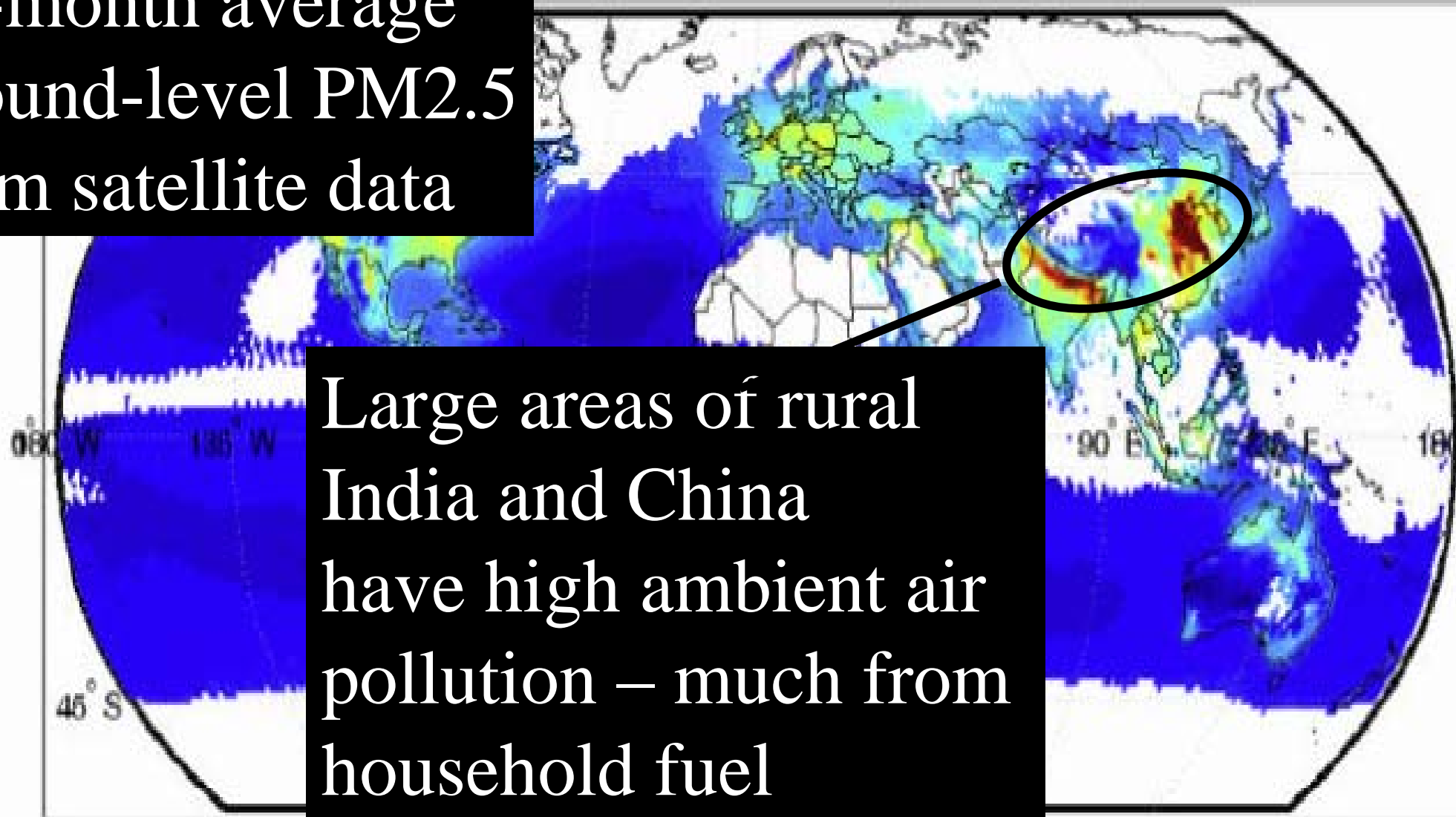
Cancer
(lung, NP, cervical,
aero-digestive)

Heart disease

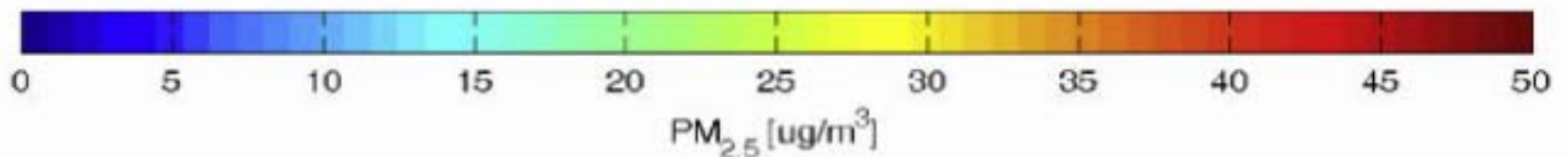


20-month average
ground-level PM_{2.5}
from satellite data

MODIS

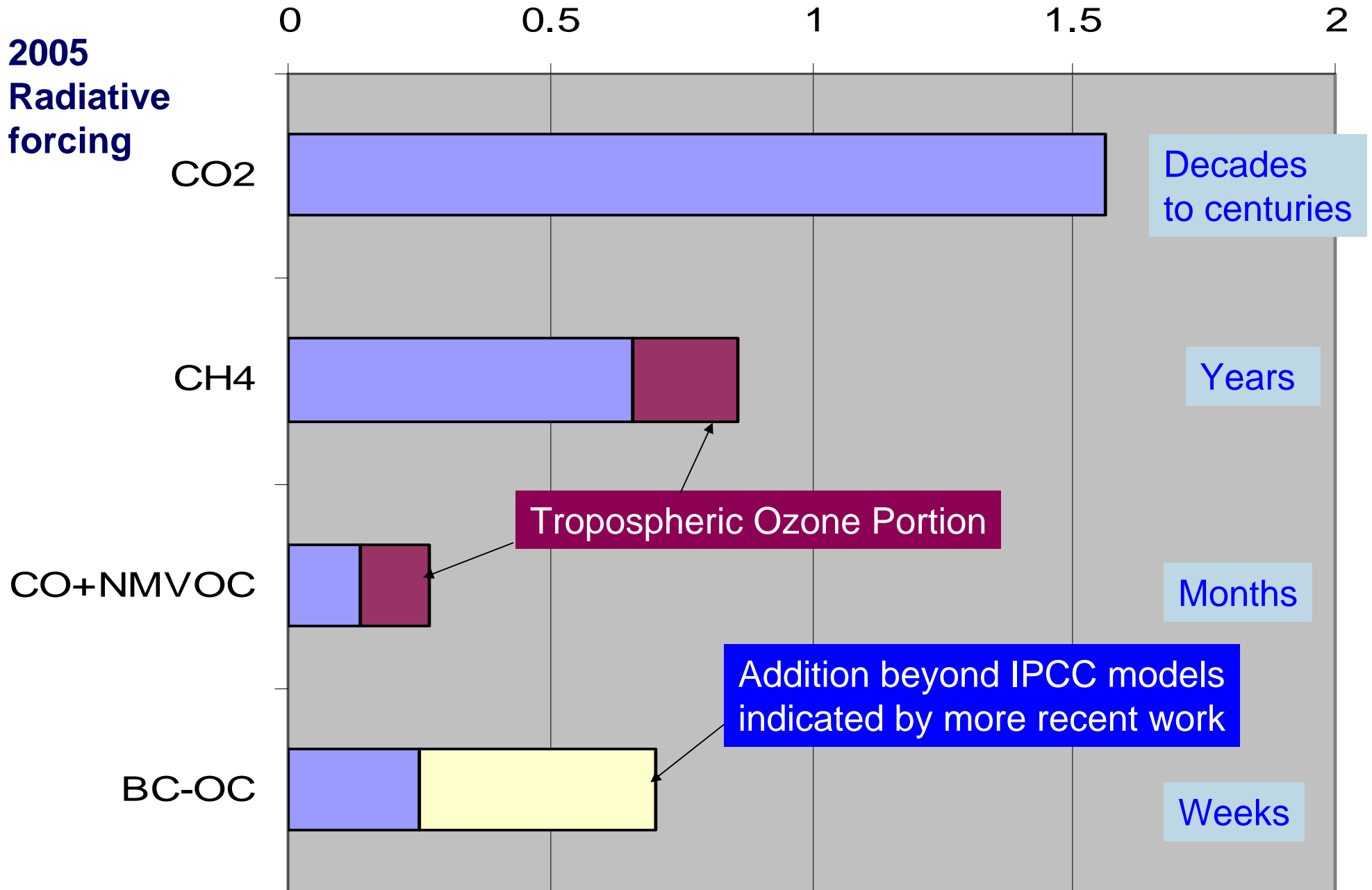


Large areas of rural
India and China
have high ambient air
pollution – much from
household fuel

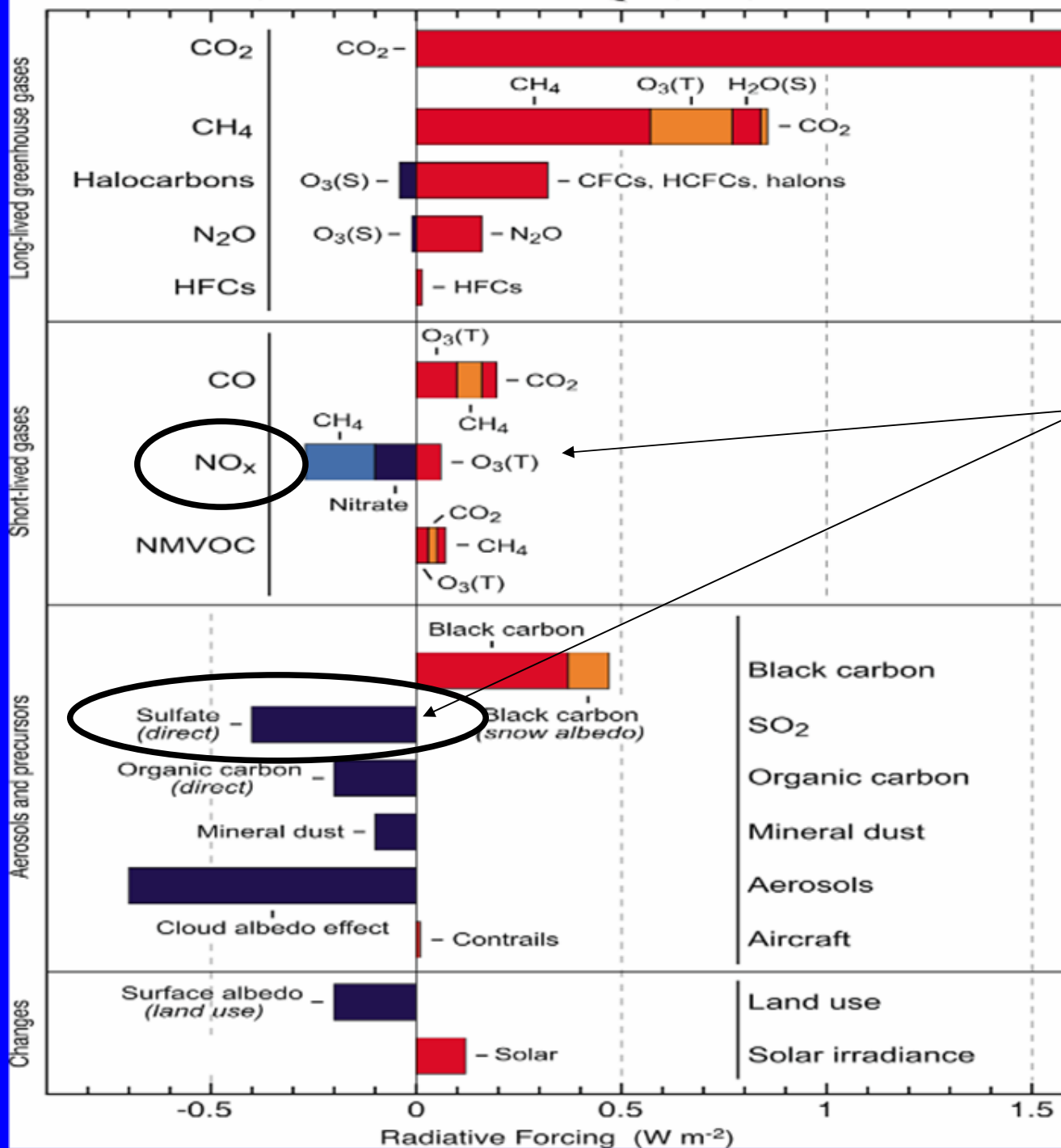


The Climate Implications of PIC

2005
Radiative
forcing



Components of radiative forcing for principal emissions



**Warming in 2005
from emissions
since 1750**

Another set of
pollutants related to
combustion of fuels
-- but with cross
benefits

IPCC, 2007

Modifying the Built Environment

- Obesity, traffic accidents, and lack of physical activity responsible for 3+ million additional premature deaths annually
- Reduce vehicle use (air pollution, obesity, safety, etc)
- Change urban design to increase physical activity (obesity, air pollution, safety)
- Improve energy efficiency of buildings (avoid health risks of energy poverty)

Redirecting Diet Preferences

- Livestock responsible for 20+% of global greenhouse emissions – methane from animal digestion plus operation of meat/dairy feed/supply systems
- Converge on lower mean global red meat consumption
 - Suggested 90 g/d – Lancet 2007
 - Major health benefits: heart disease, stroke, obesity, bowel and breast cancer
- Similar benefits to convergence in global dairy consumption
- China/India have the major global growth potential

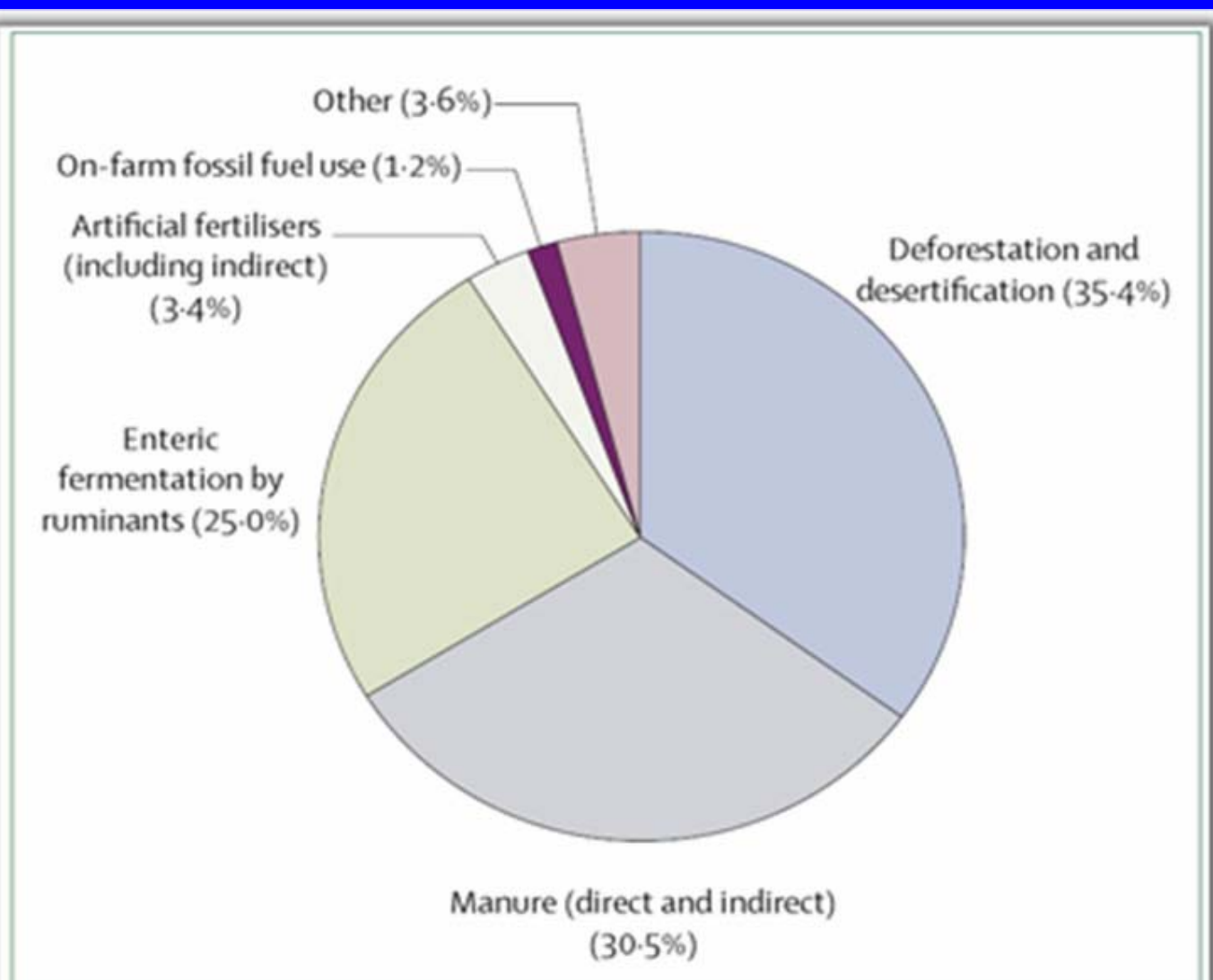
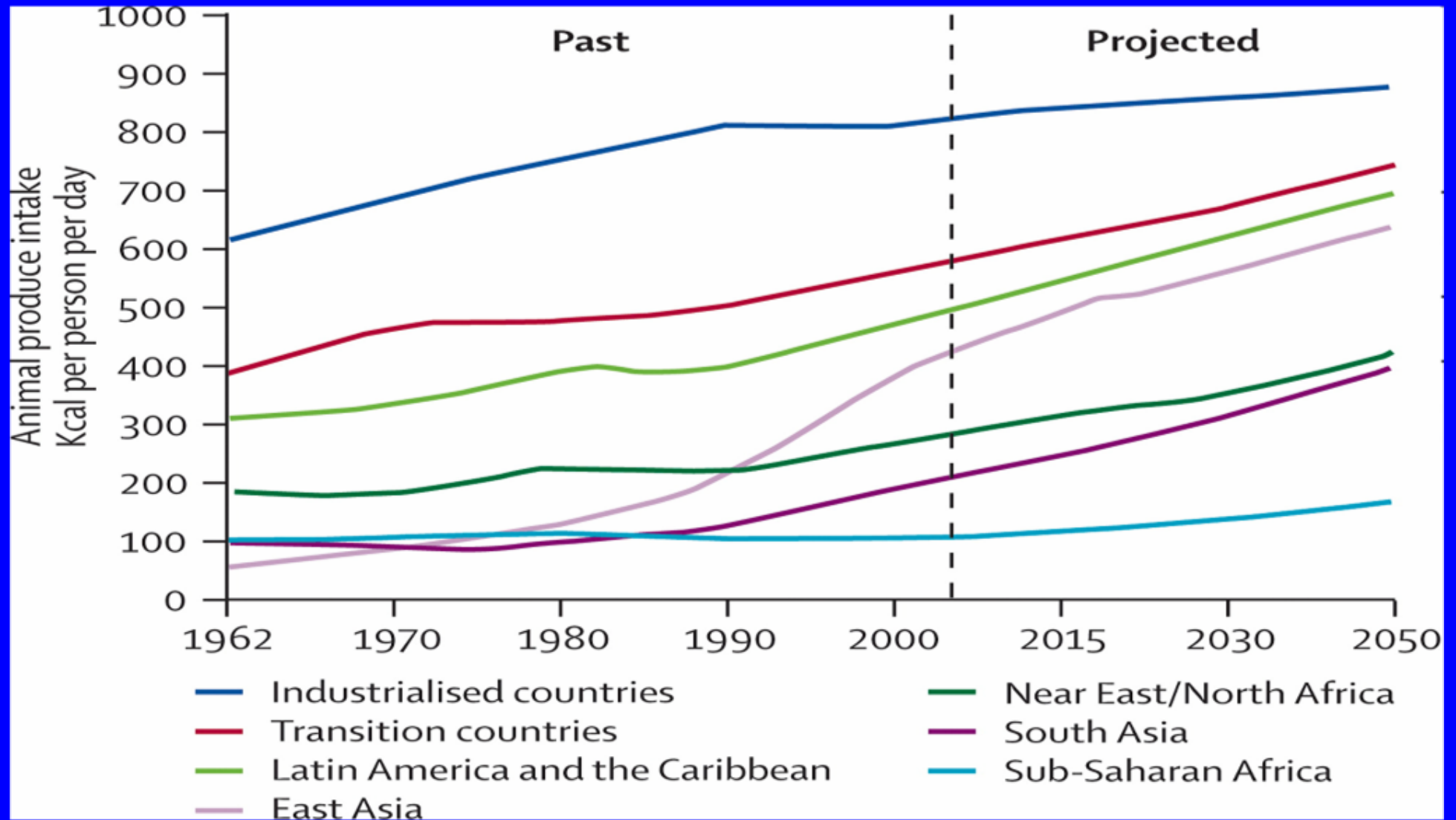


Figure 2: Proportion of greenhouse-gas emissions from different parts of livestock production

Adapted from FAO.⁴²

Trends in consumption of livestock products per person



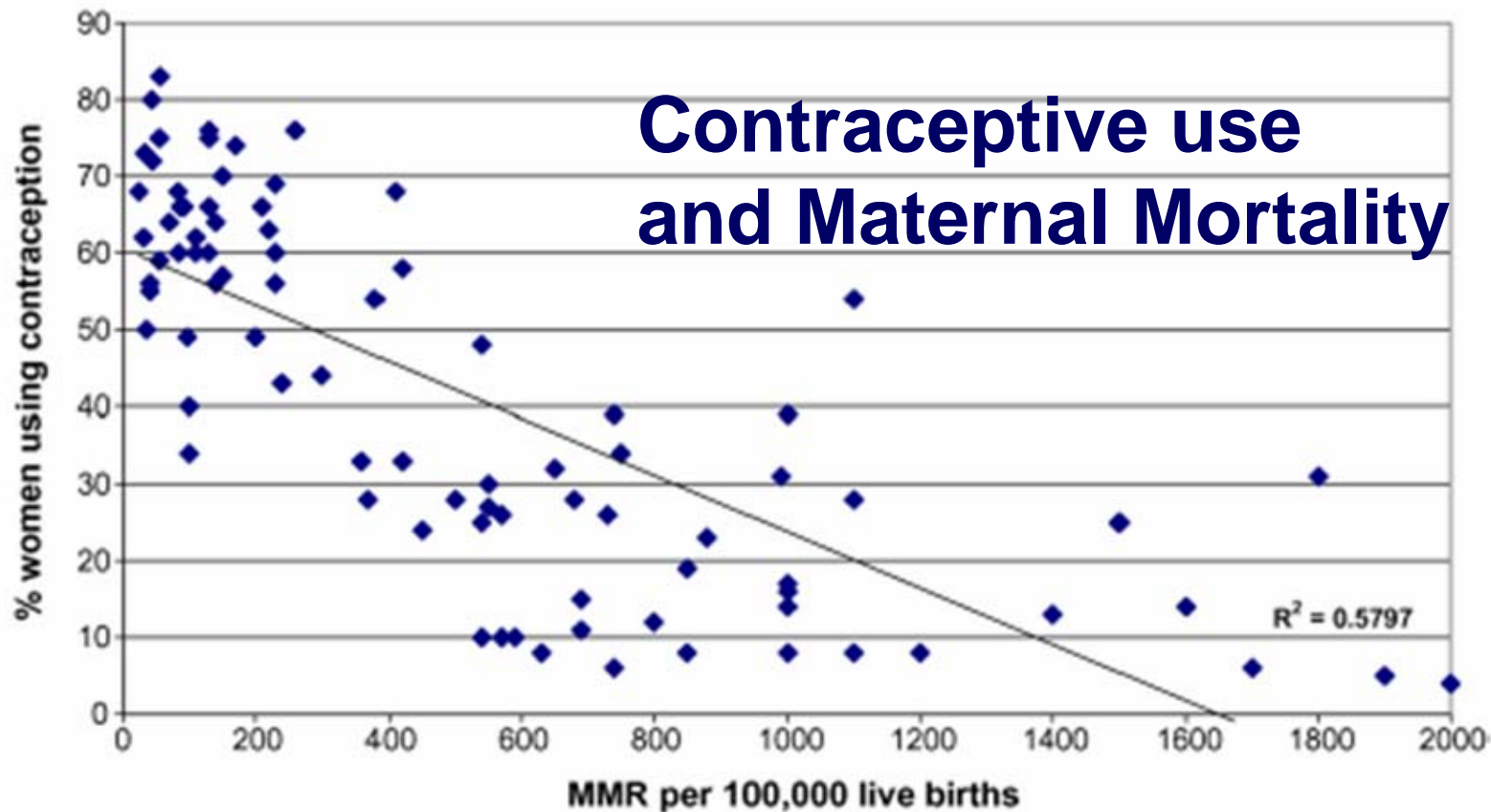
Most cost-effective GHG control device is probably a condom

- Many tens of millions of women wish to have fewer children, but do not have access to contraceptives
- Giving them access could mean 1-2 billion fewer people by 2100 – a major reduction of stress on the Earth
- Many health benefits, particularly child and maternal mortality, to smaller, more planned families

The very age groups that

Risk of
Maternal
Mortality

Contraceptive use and Maternal Mortality



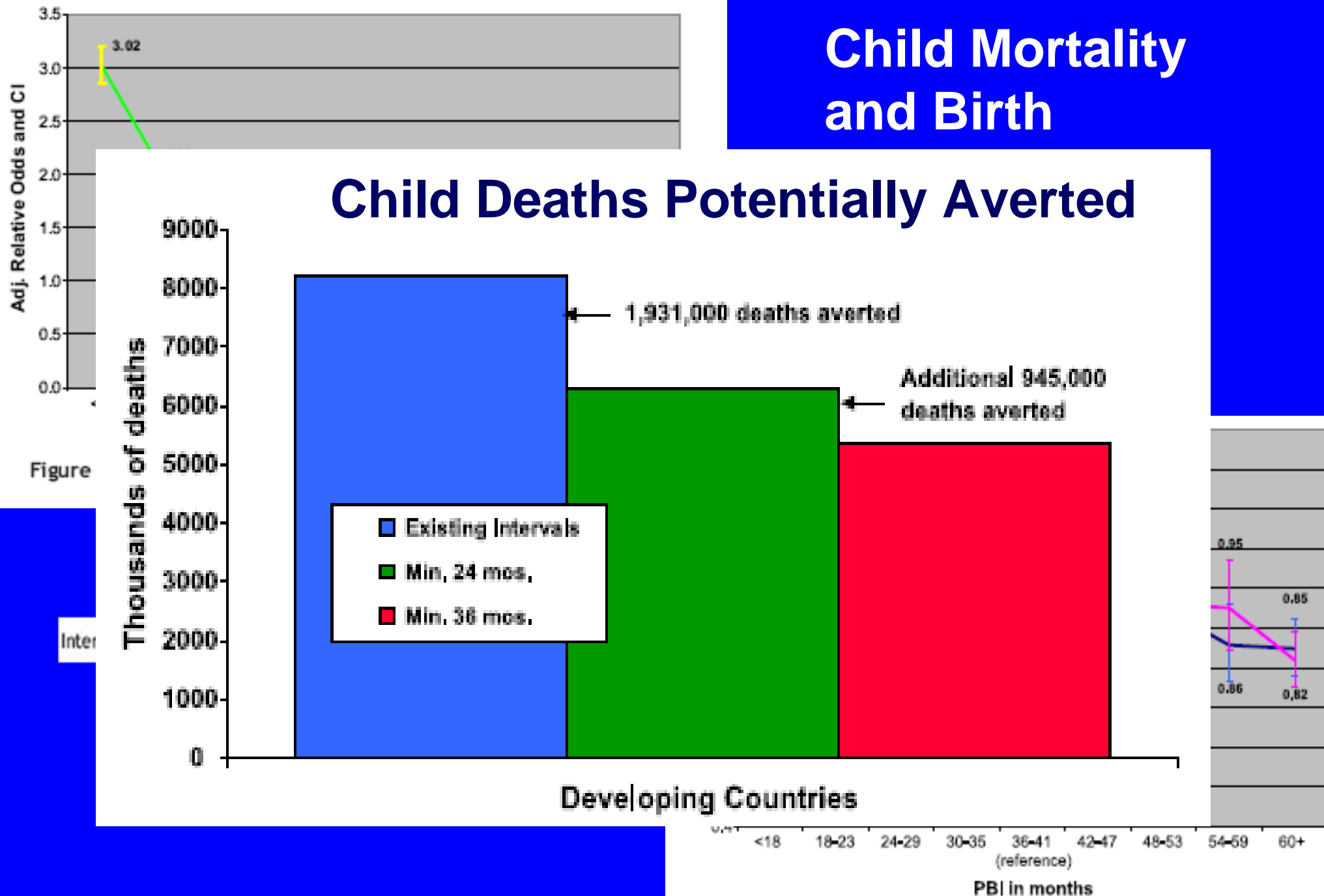
13

Age of Mother

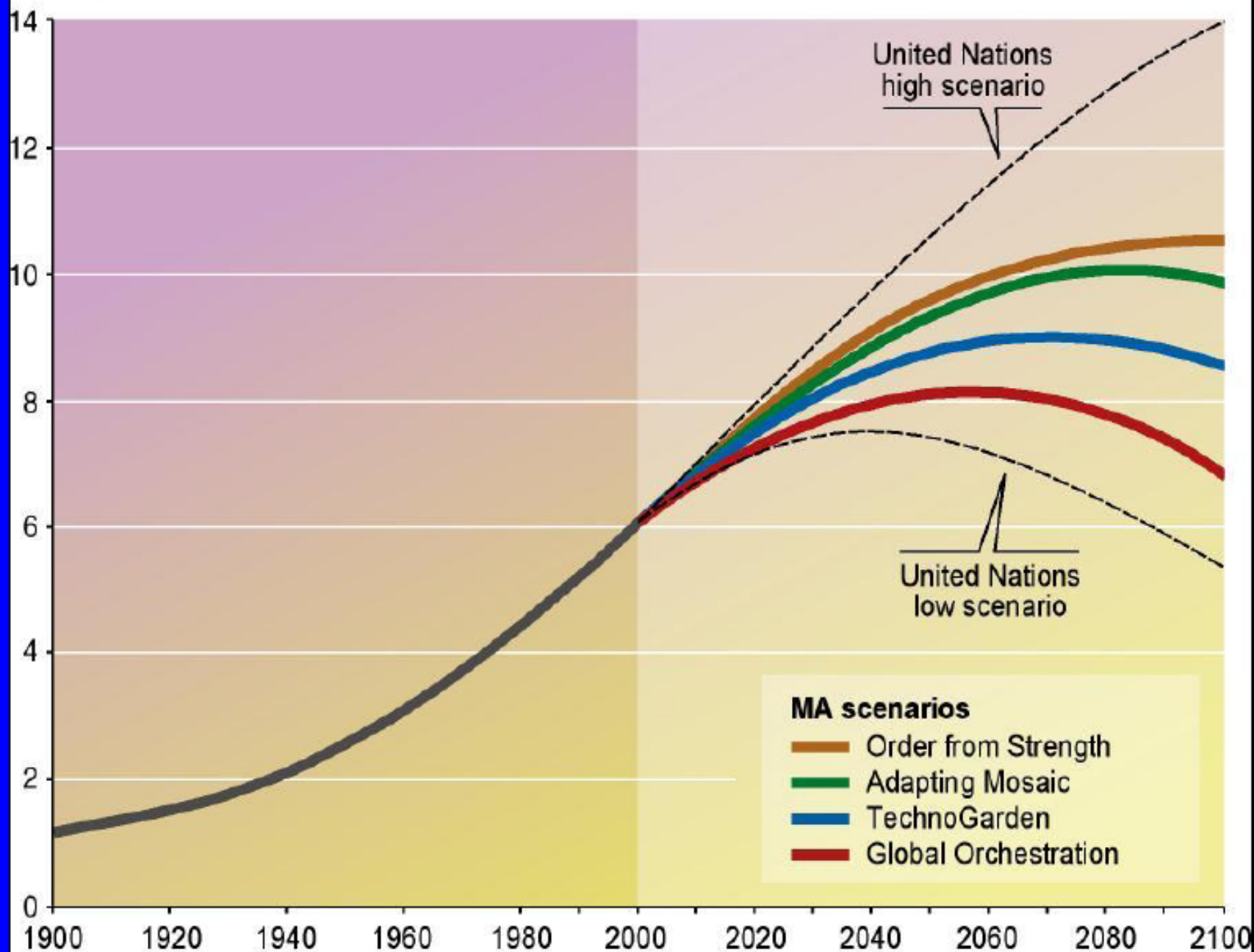
45

Child Mortality and Birth

Child Deaths Potentially Averted

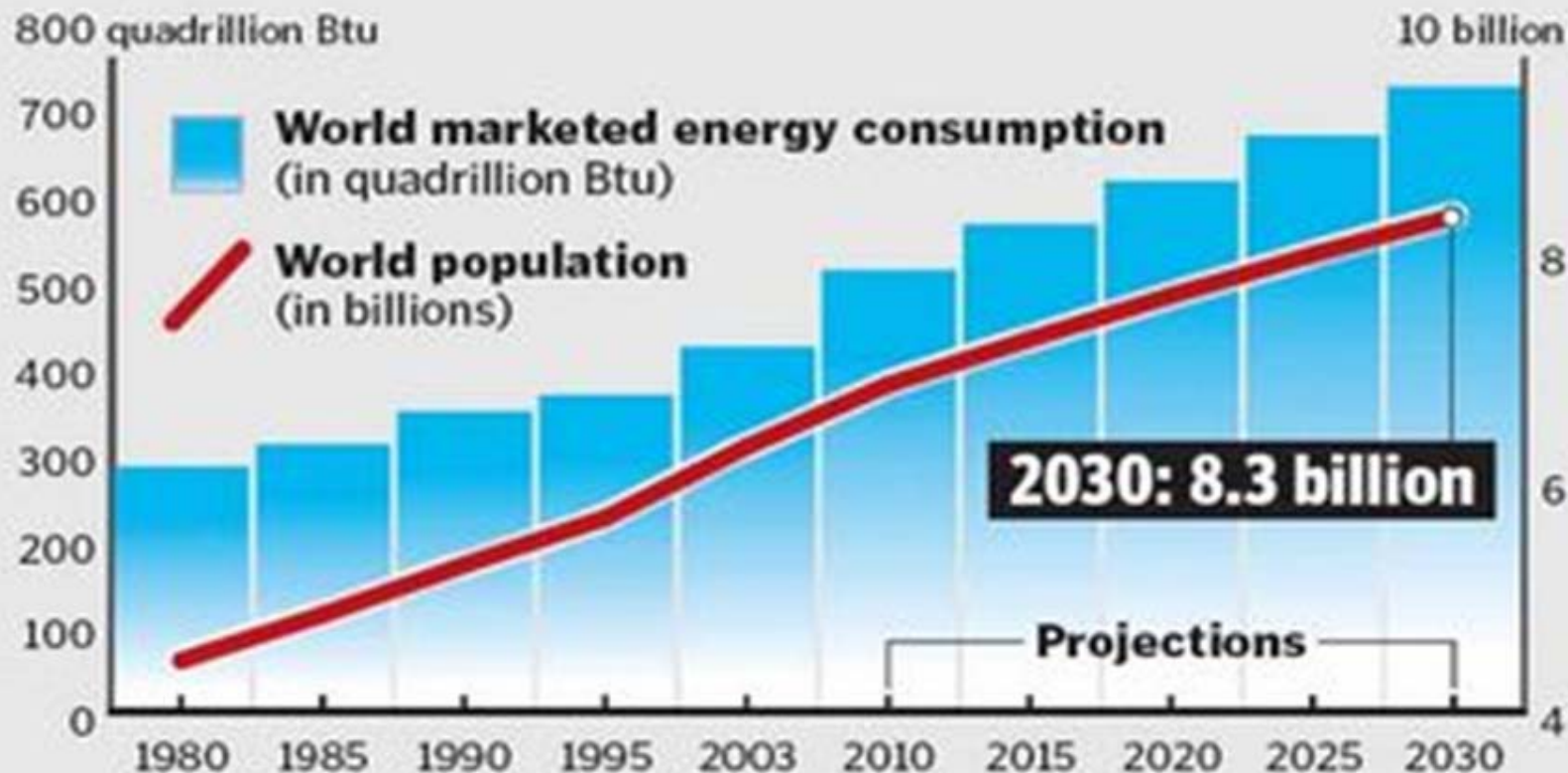


Billion persons



Energy consumption projected to increase

As the world's population goes up, the demand for energy grows at a similar rate.



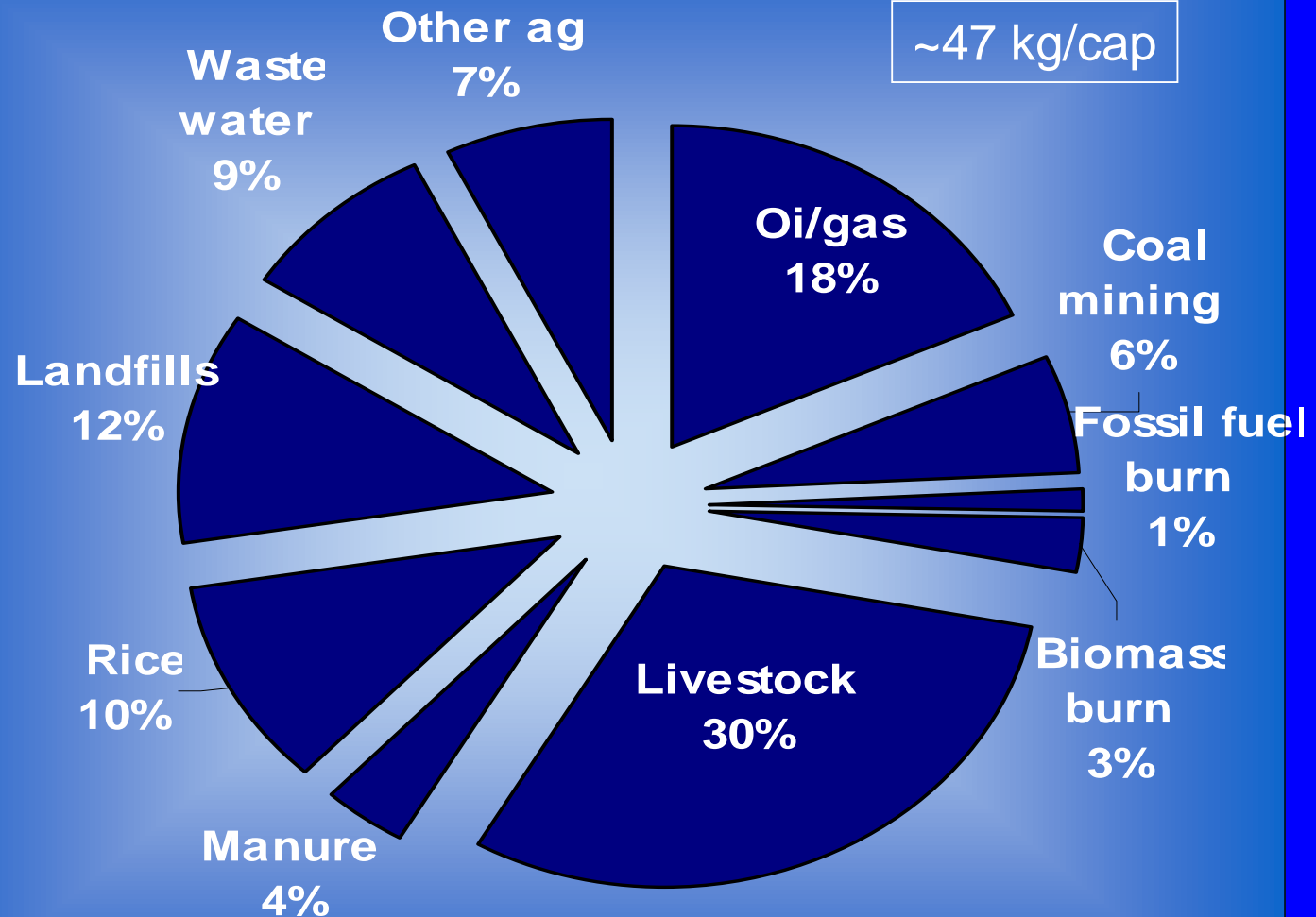
Sources: Energy Information Administration; System for the Analysis of Global Energy Markets

Access to Reproductive Services

- Not population control, but reproductive rights
- All countries on the way to replacement fertility this century
- Just a matter of making it possible to happen sooner rather than later in the century
- Large health benefits can be accrued

Global Anthropogenic Methane Emissions ~2005

Total ~ 305 million tons



~47 kg/cap

Growing at
~1.5%
per year

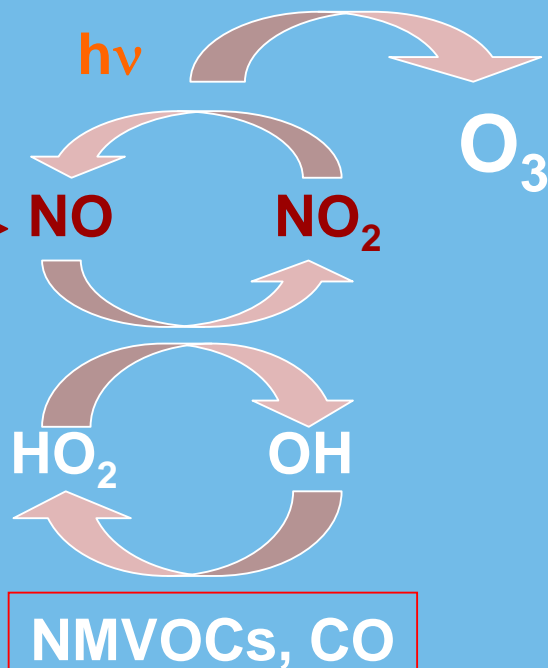
USEPA, 2006

Methane Reduction

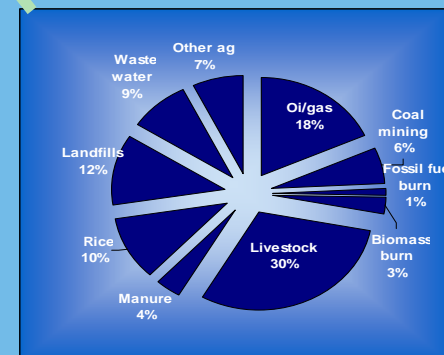
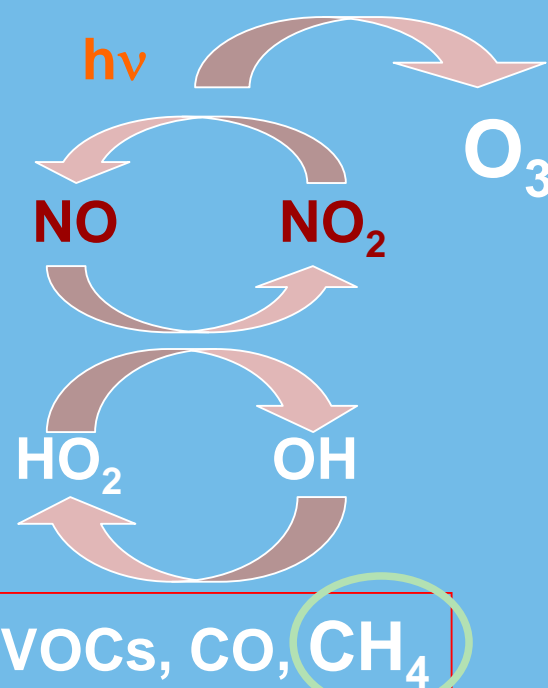
- Major and probably undervalued global GHG
- Major cause of rise in global tropospheric ozone concentrations – important health-damaging and crop-damaging pollutant
- Livestock major source, as noted above
- Leaks: Coal mines, gas pipelines, etc.
- Waste management: Landfills, wastewater
 - Other health benefits here also
- Incomplete combustion: biomass and coal in households

Methane as a Global Ozone Precursor

Urban

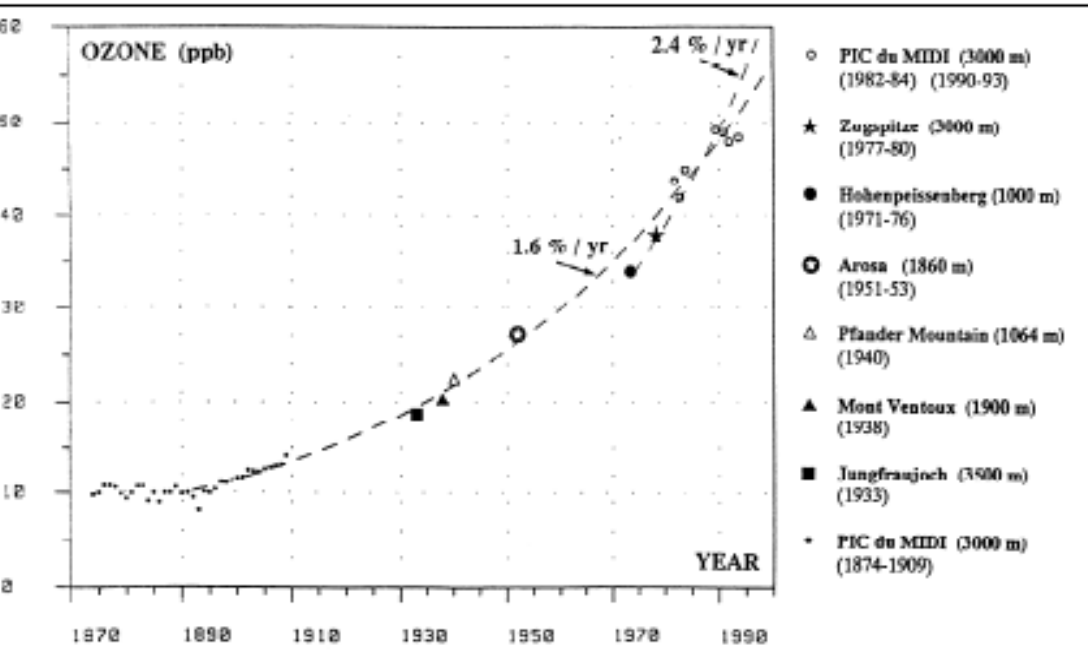


Global



Background Ozone is Growing ...

... and Will Continue to Grow!

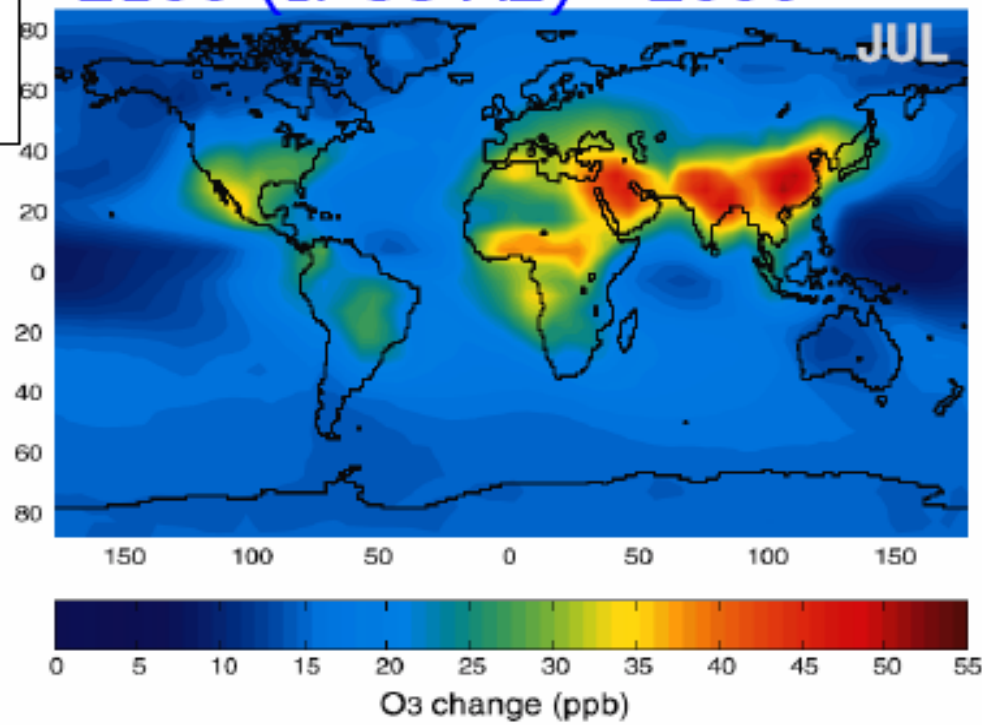


Ozone trend at European mountain sites, 1870-1990 (Marenco et al., 1994).

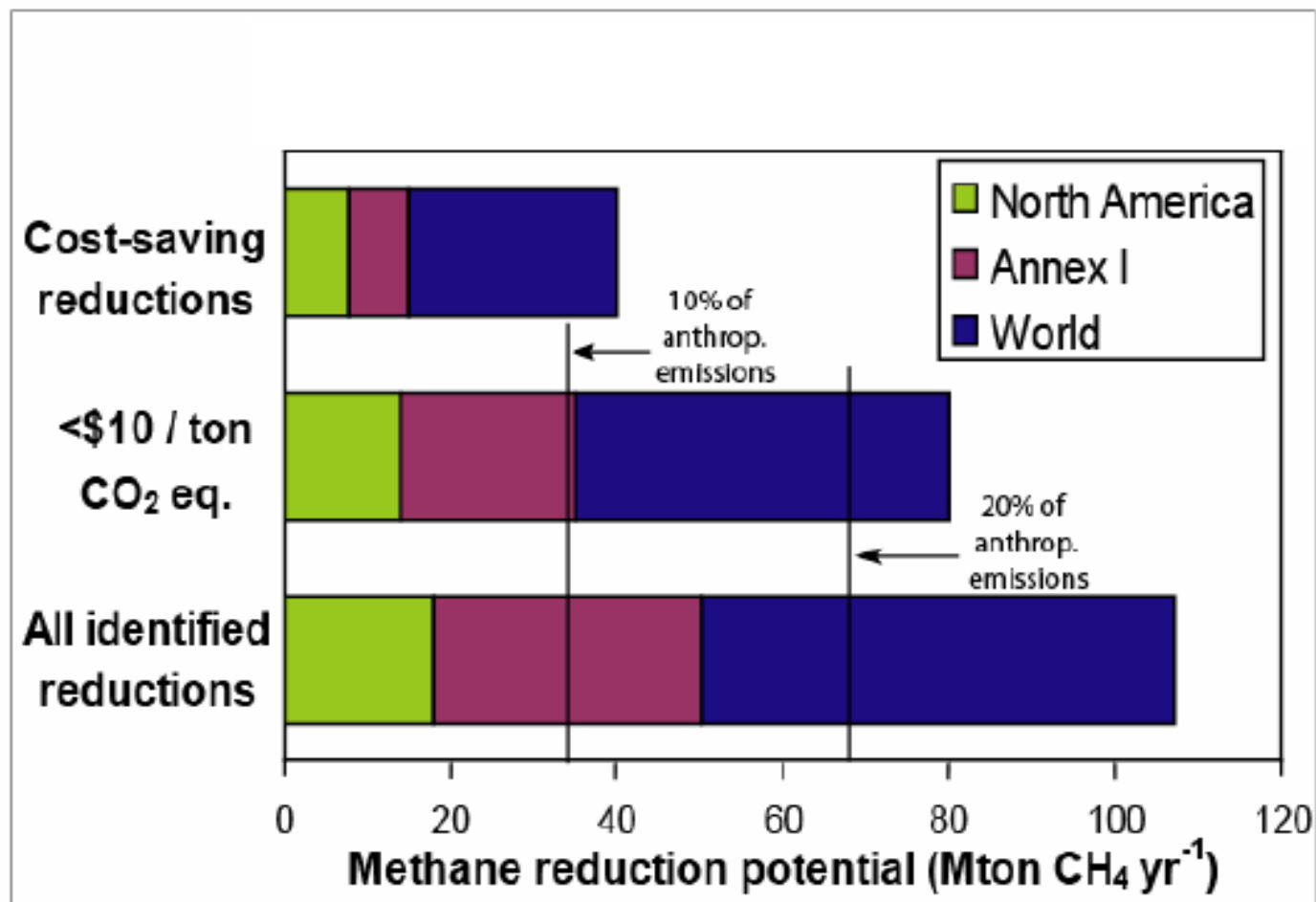
Mauzerall 2007

Historic and future increases in background ozone are due mainly to **increased methane and NO_x emissions** (Wang *et al.*, 1998; Prather et al., 2003).

2100 (IPCC A2) - 2000



How Much Can Methane Be Reduced?



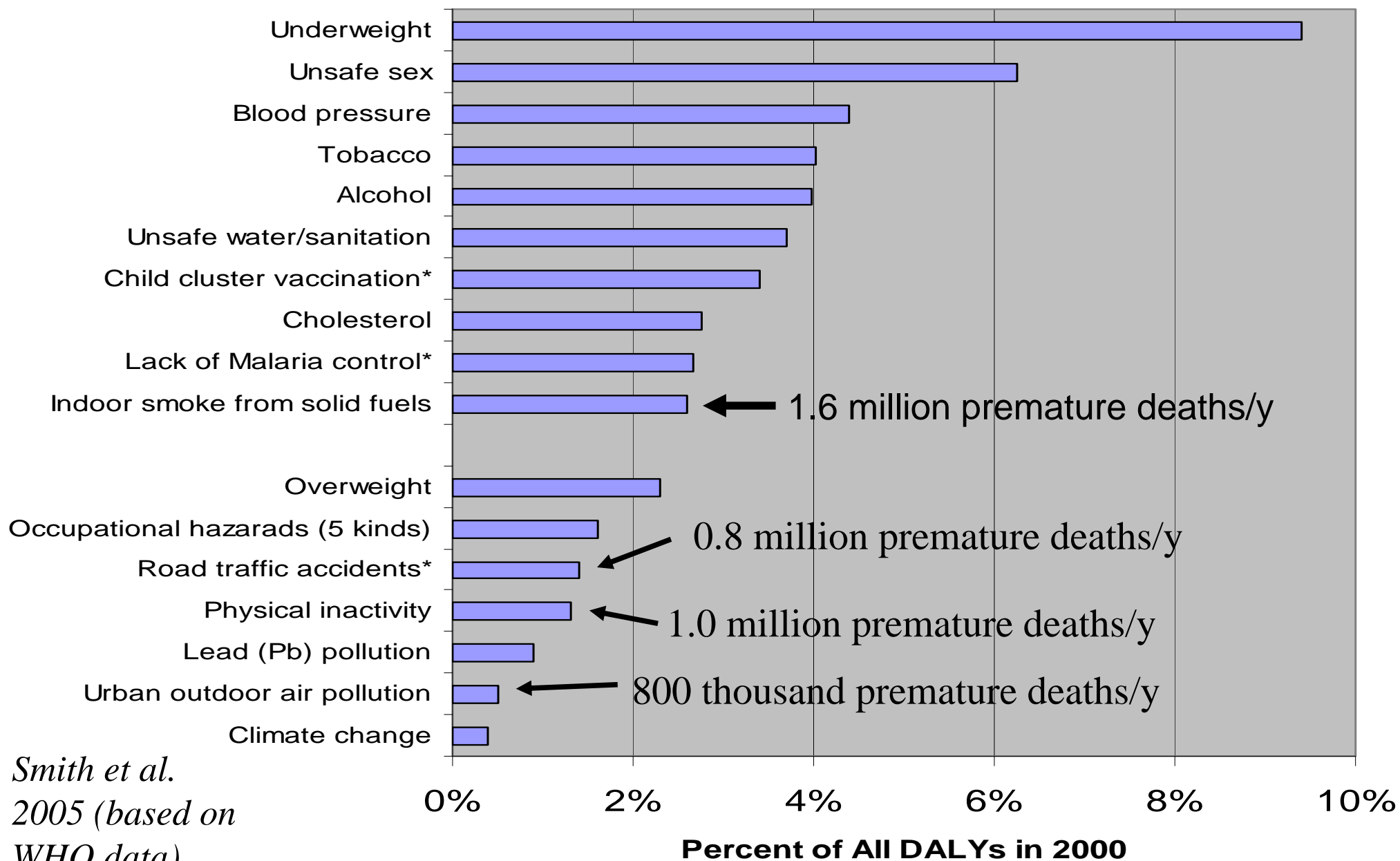
West & Fiore
(2005)

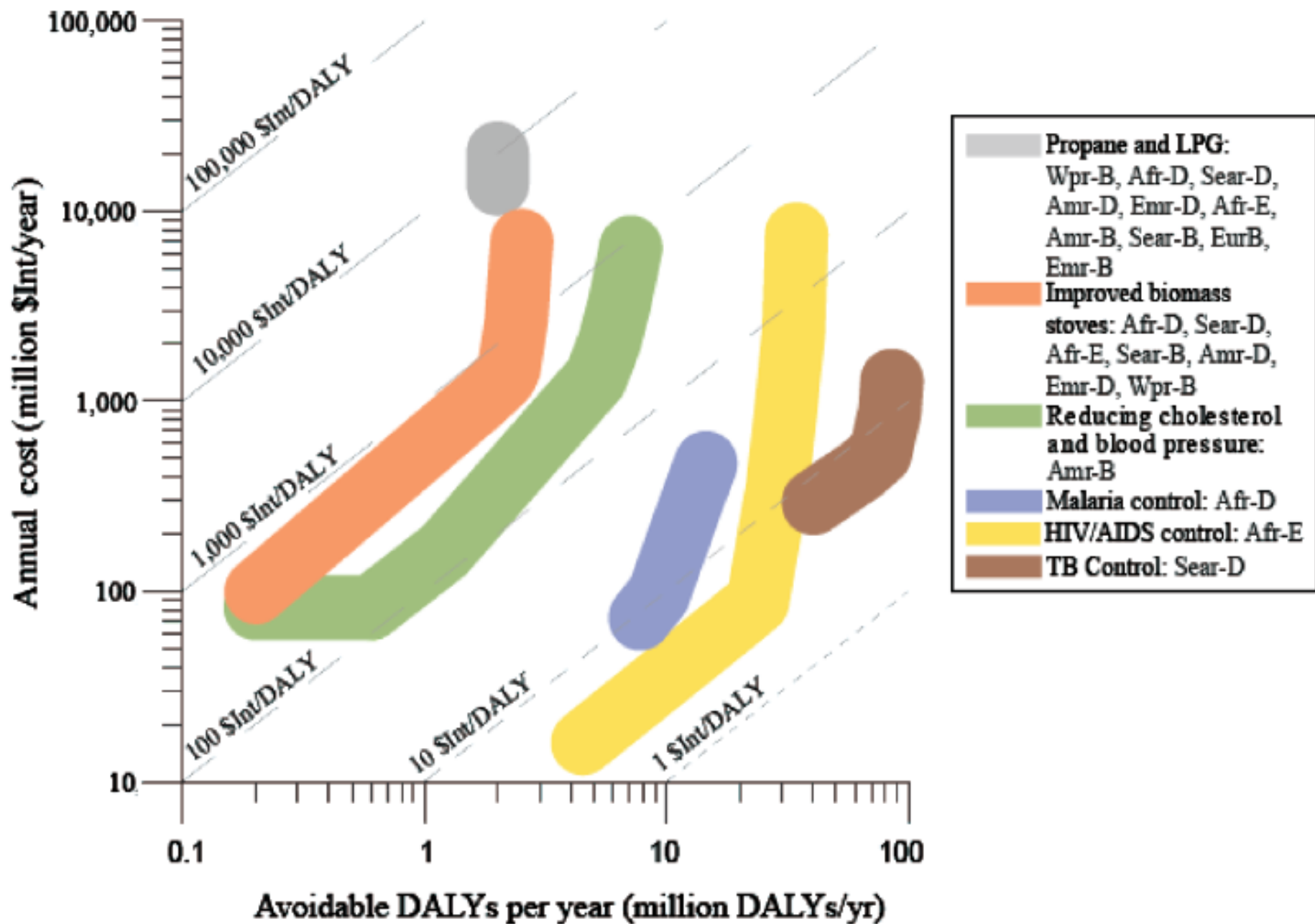
Methane reduction potential from IEA (2003), for coal, oil and gas operations, wastewater, and landfills; maximum technically feasible in 2010.

Need for Comparability

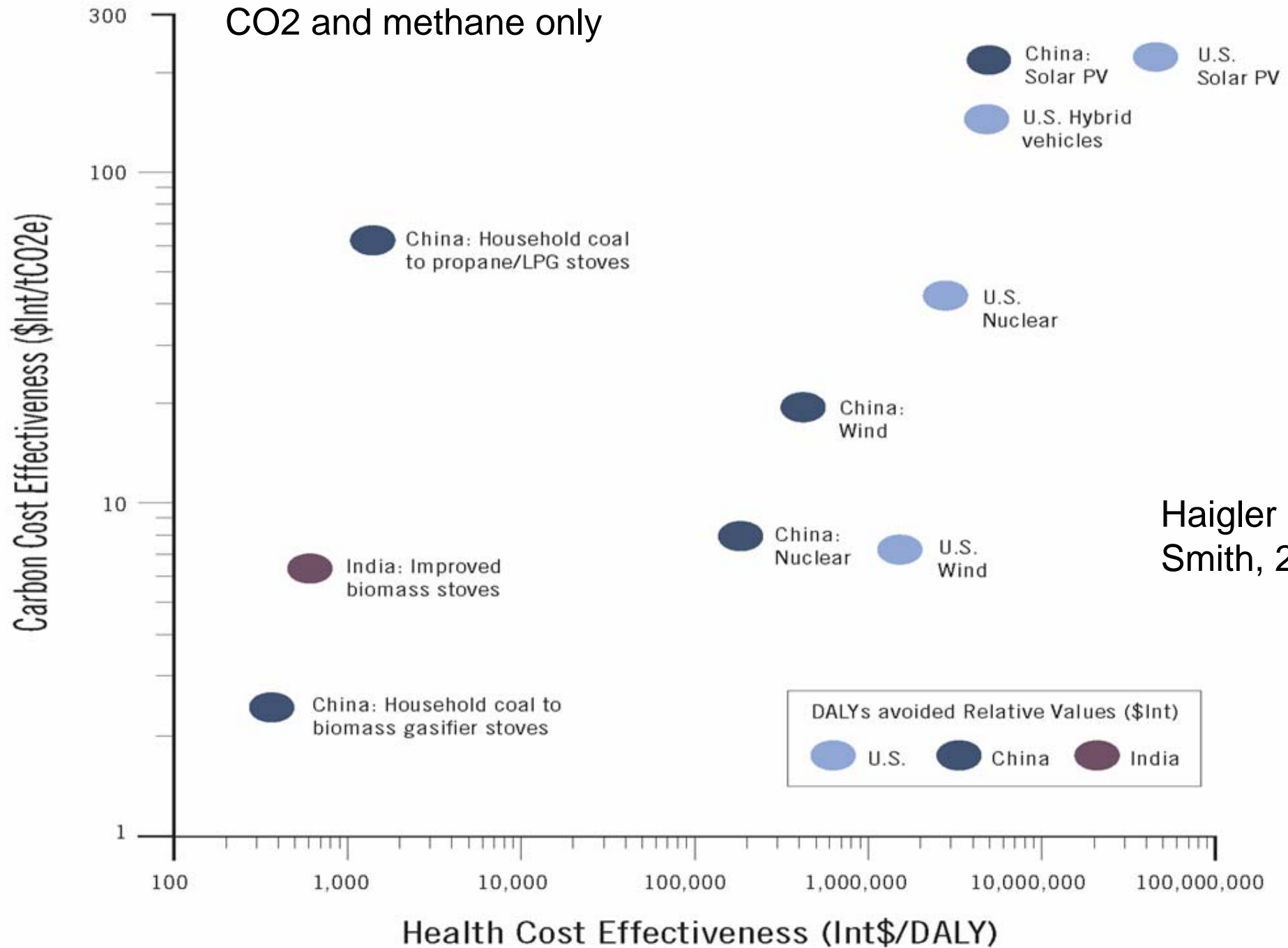
- Current co-benefits analyses are difficult or impossible to combine into common frameworks for comparison.
- Different, unstated, or unclear
 - Exposure-response relationships
 - Ill-health extrapolation methods, e.g., total mortality versus cause-specific; age adjustment or not; etc.
 - System boundaries in time and space
 - Discount rates
 - Financial analysis methods
 - Sets of GH pollutants: sometimes Kyoto only, 20-, 100-year, or unstated time horizons, sometimes other GH pollutants with ad-hoc warming potentials

Global Burden of Disease from Top 10 Risk Factors plus selected other risk factors



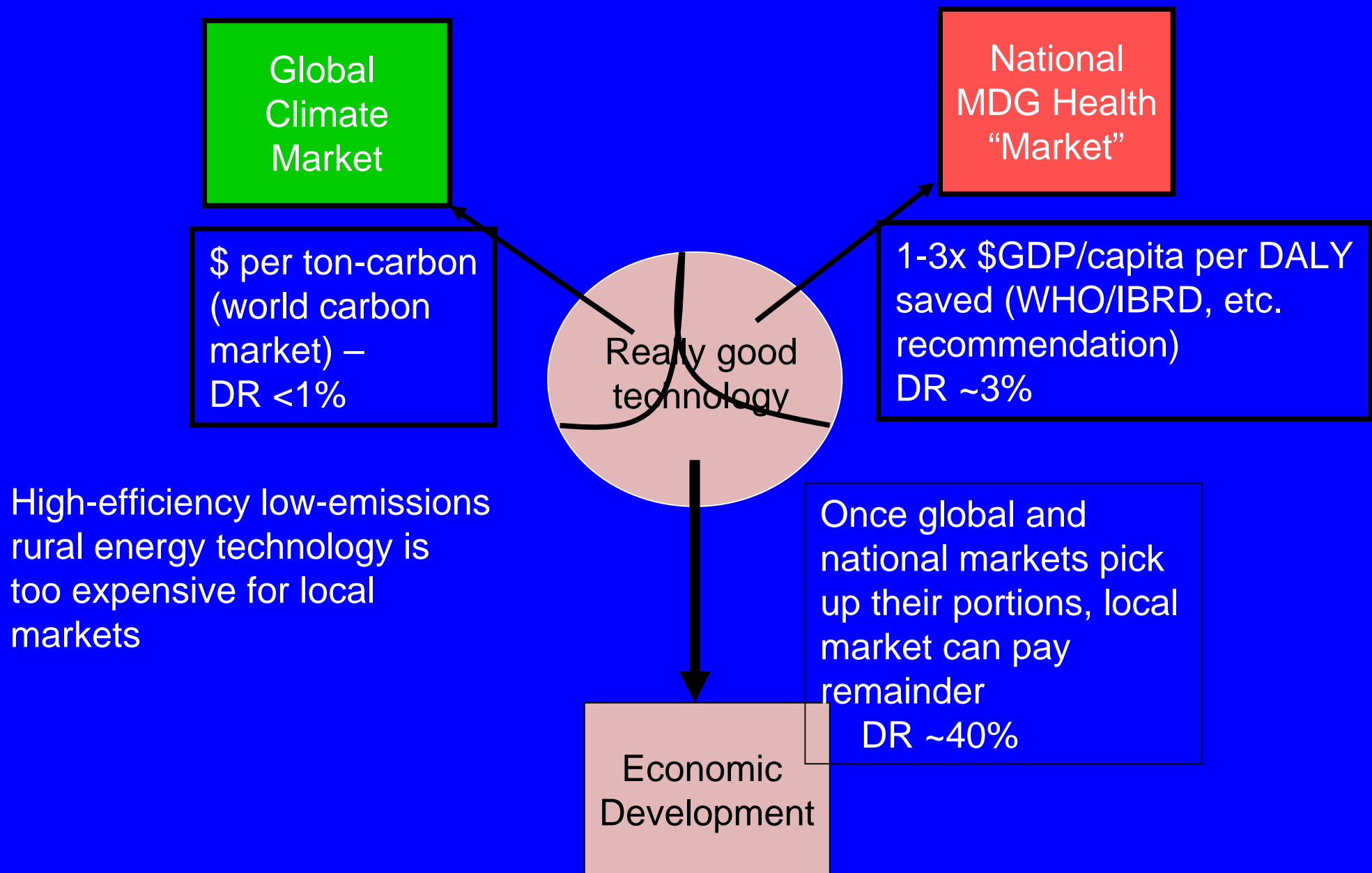


CO2 and methane only



Haigler and
Smith, 2008

Paying for Rural Energy Development

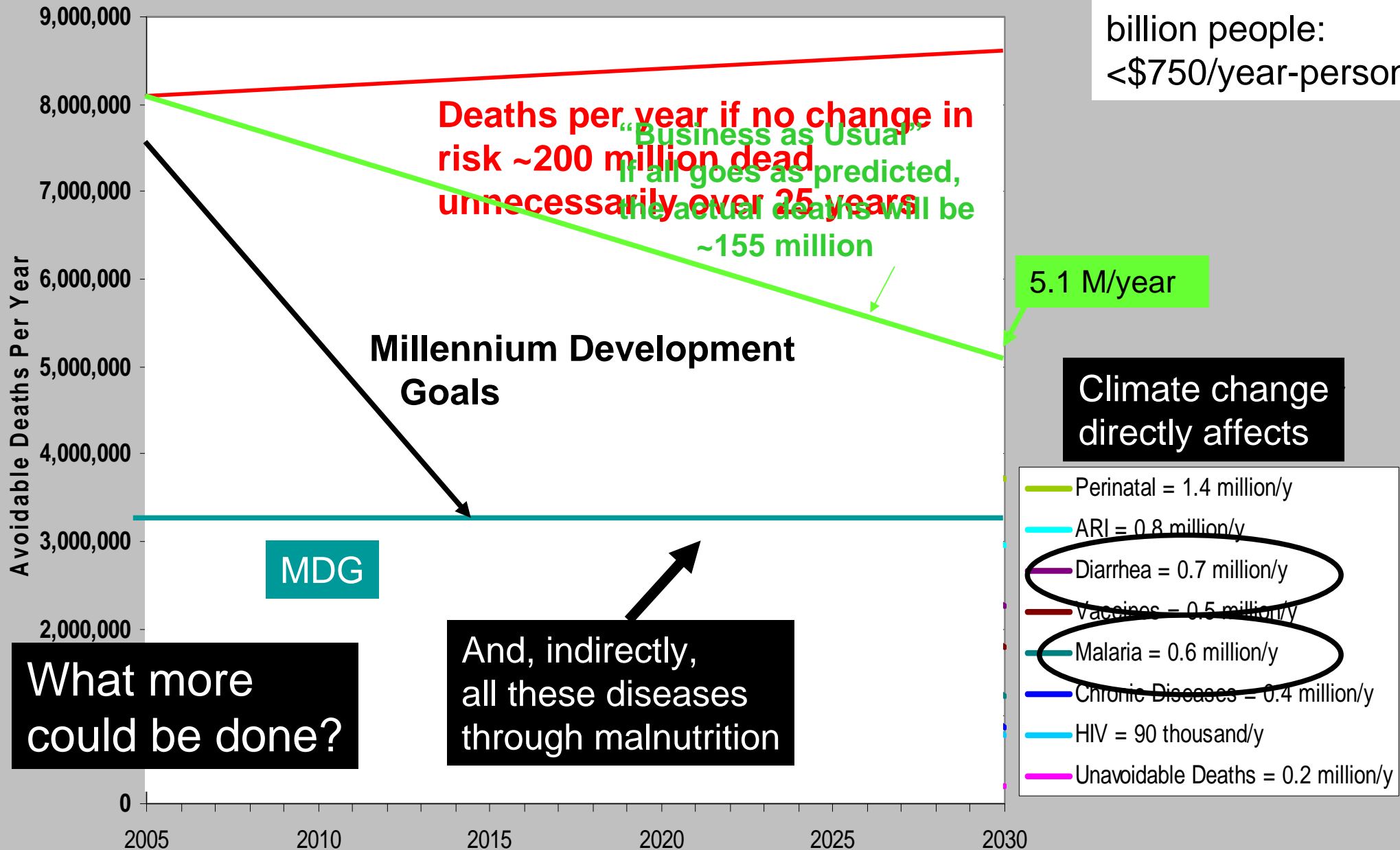


World Views Not The Same

- Climate change mitigation is aimed to avoid changing climate from today – current climate is thus the de facto “ideal”
- The current global health situation, however, is neither ideal nor acceptable, but much change is already needed
- The implications of this difference in perspective is often not recognized when co-benefits projects are framed.

Child Mortality Wedges: 2005-2030

Children in the poorest nations with 2.7 billion people: <\$750/year-person



**Papers and presentations at
<http://ehs.sph.berkeley.edu/krsmith/>**

Thank you