

# Co-Benefits of Climate Change Mitigation Policies

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# Outline

- Definition
- Categories of co-benefits
- Air pollutant pathways
- Economic analysis framework
- State of the literature
- Conclusions
  - Implication for policy

# 1. Definition

- Co-benefits/co-costs refer to:
  - *combined effects of GHG abatement policies both on climate change and other environmental, energy security or social impacts.*
- In practice analysts tend to focus on non-climate impacts.

## 2. Categories

### Many different types of co-benefits

- Human health
- Crop, pasture and forestry yields
- Water availability and quality
- Biodiversity conservation
- Adaptation
- Reduced damages to buildings
- Energy security
- Social and distributive benefits

# Examples from the LULUCF sector

# Examples from the LULUCF sector

- Reducing emissions from deforestation may greatly contribute to biodiversity conservation as most of the Earth's terrestrial biodiversity lives in tropical forest where most deforestation takes place.
- Preserving mangrove forest may provide protection for coastal communities in case of extreme events
- Reforestation can increase water availability and quality (reduced siltation) as well as protect from flooding.
- Increasing soil carbon in agricultural soils can increase resilience in case of drought or flooding.

# Lower GHG, Energy Use & Reduced Air Pollution (1)

## Existing literature:

- Human health benefits in the form of reduced mortality and morbidity from reduced local air pollution (PM)
- Reduced material damage to buildings (acid deposition)
- Lower regulatory costs ( $\text{SO}_x$ ,  $\text{NO}_x$ )

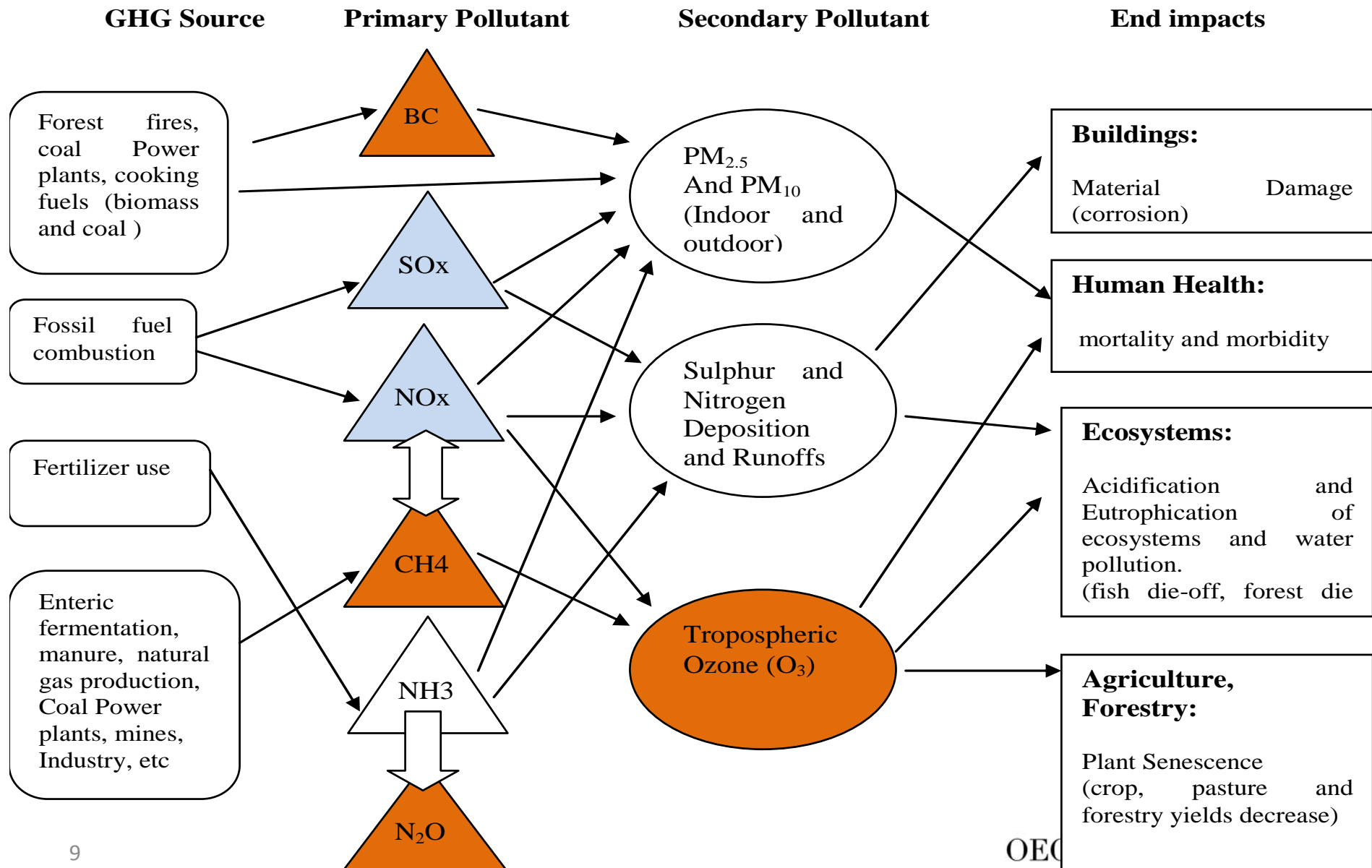
# Lower GHG, Energy Use & Reduced Air Pollution (2)

## New issues, emerging literature:

- Linkages between CH<sub>4</sub> reduction and tropospheric (surface) ozone events
  - Reduced crop, pasture and forestry yield losses from local air pollution
  - Human health benefits – urban areas
- Linkages between GHG policy and indoor air pollution (IAP)

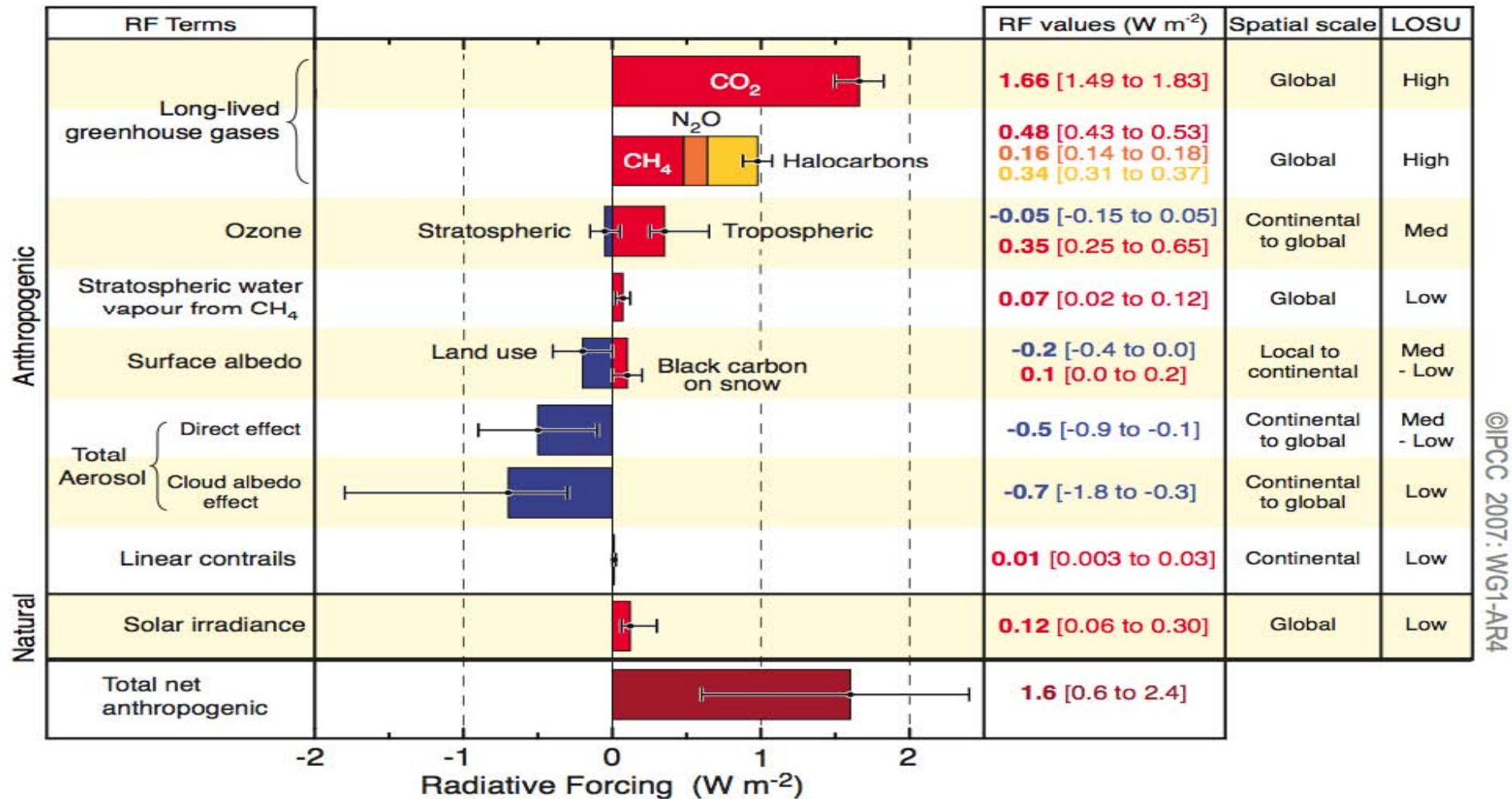


# 3. Air Pollutant Pathways



# Added layers of complexity -- Both cooling and warming effects of aerosols

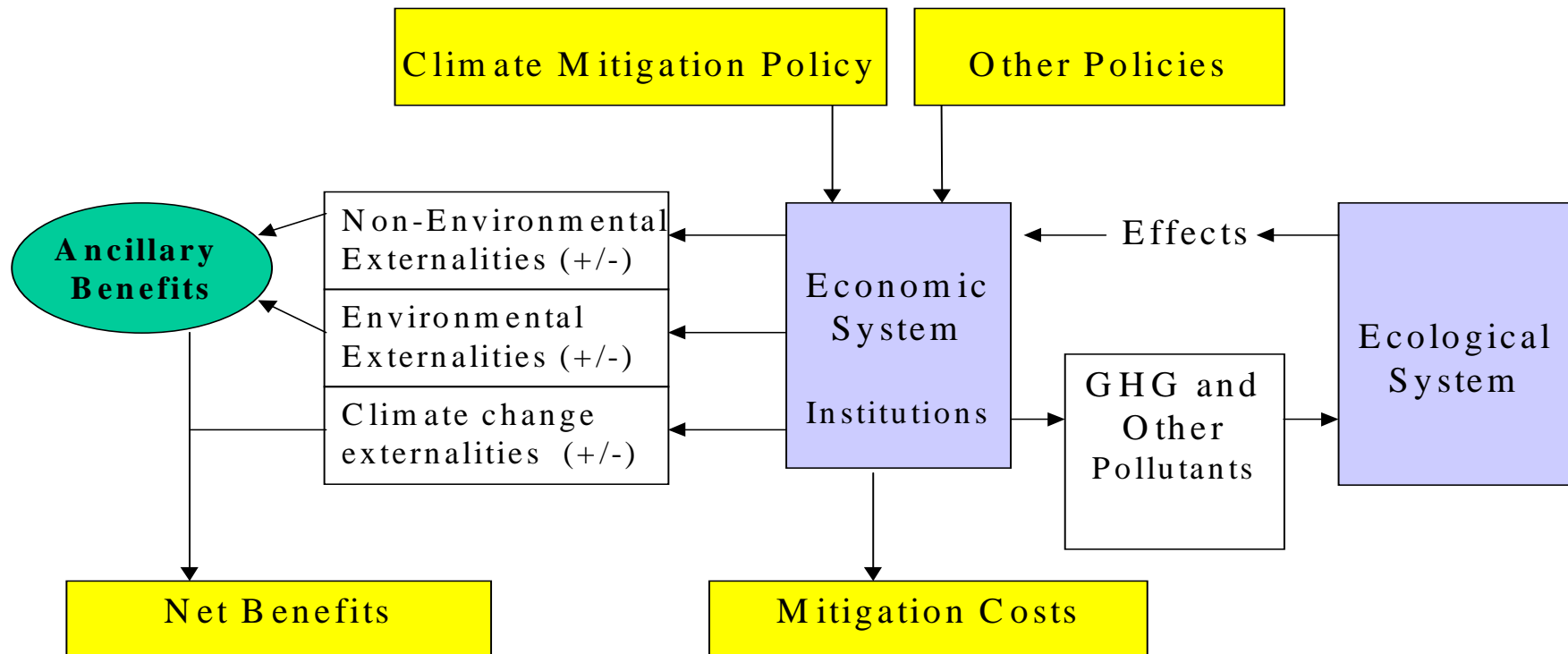
## Radiative Forcing Components



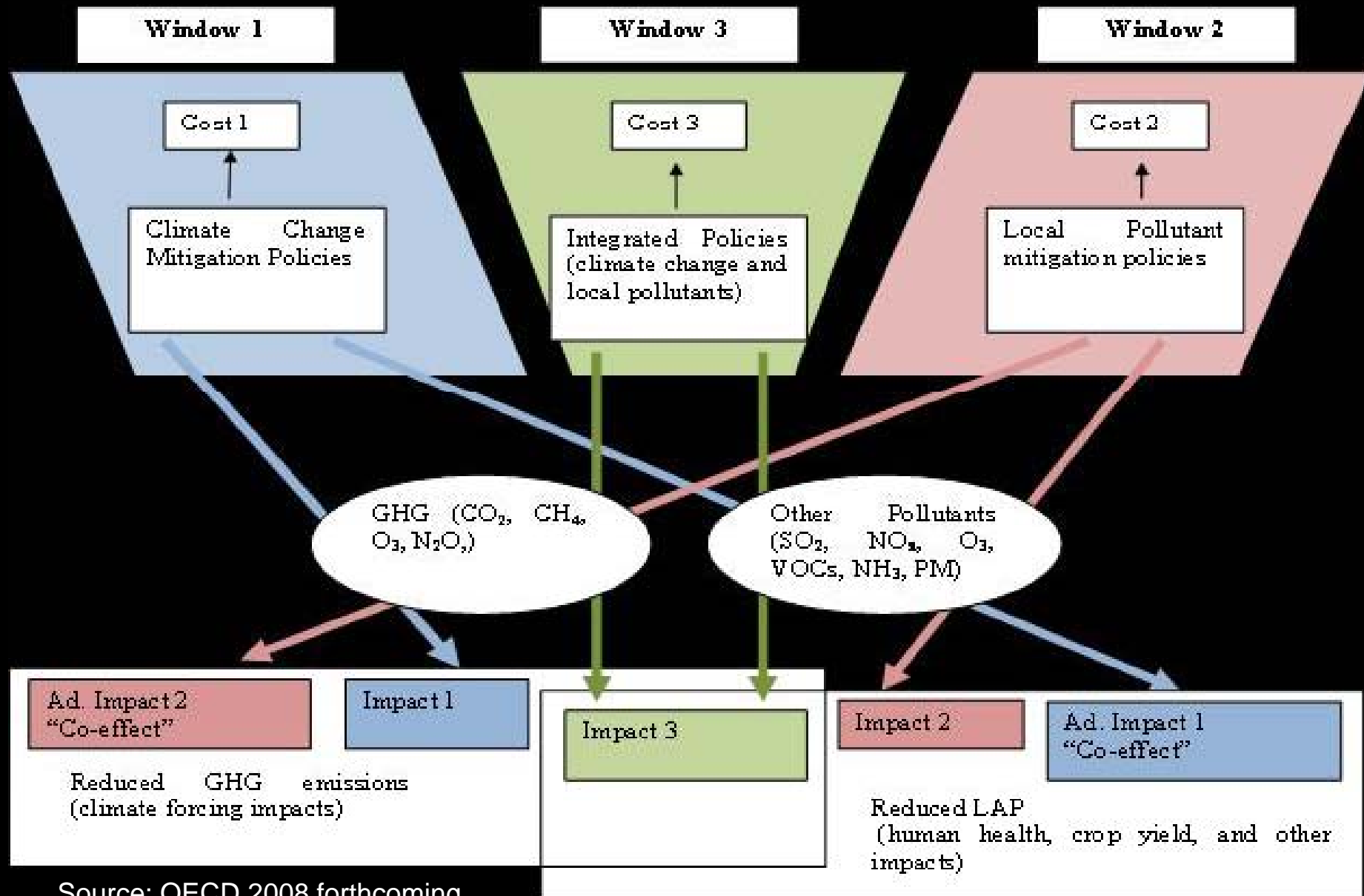
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# 4. Economic Analysis Framework

**Figure 1 - Ancillary Effects of Climate Mitigation: A Conceptual Framework**



# Three “Windows” of Analysis

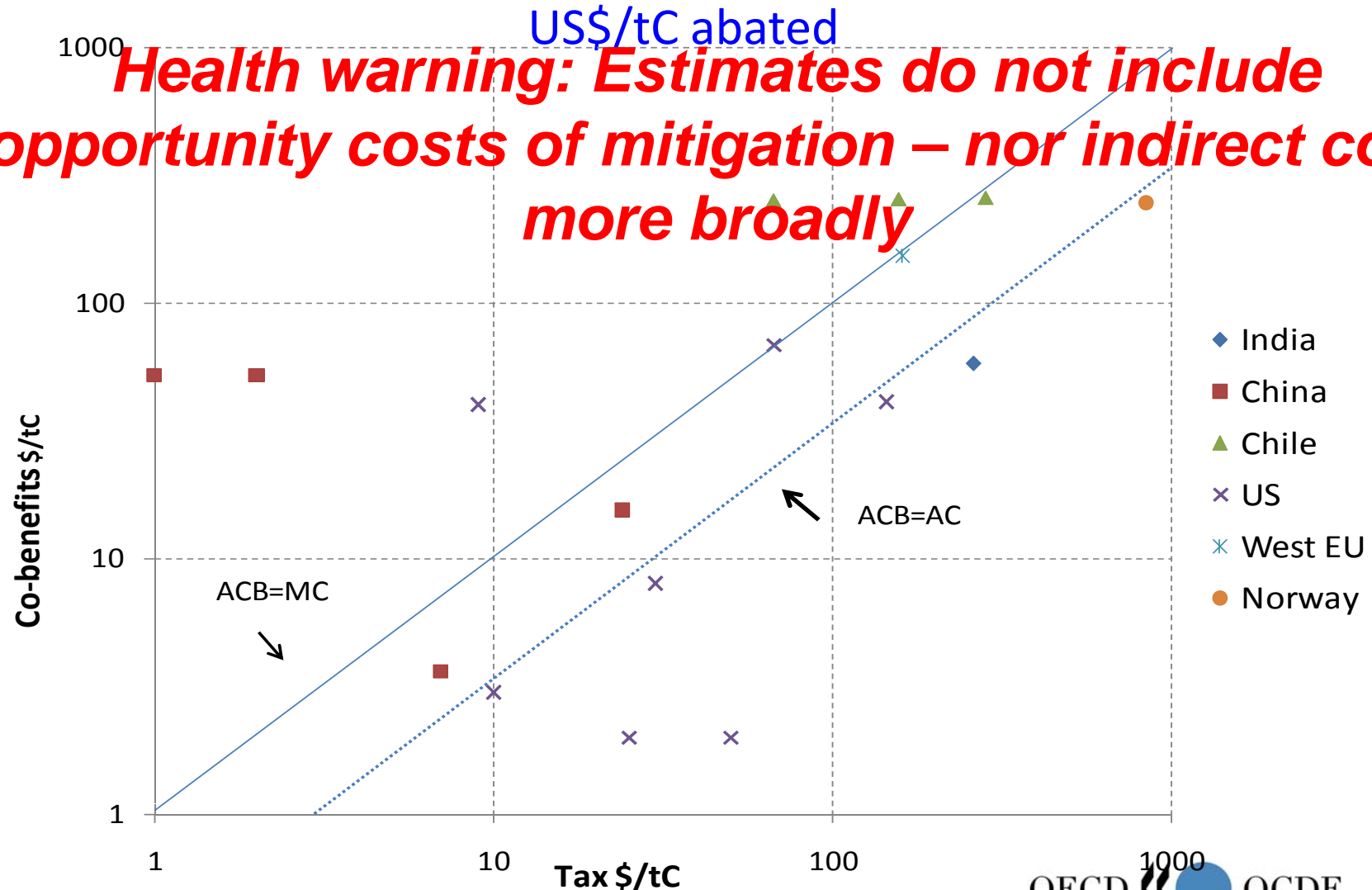


Source: OECD 2008 forthcoming

# 5. State of the literature

## Window 1: large co-benefits

**Health warning: Estimates do not include opportunity costs of mitigation – nor indirect cost more broadly**



# Window 3: Optimal policy for human health

Source: Bollen et al. 2007

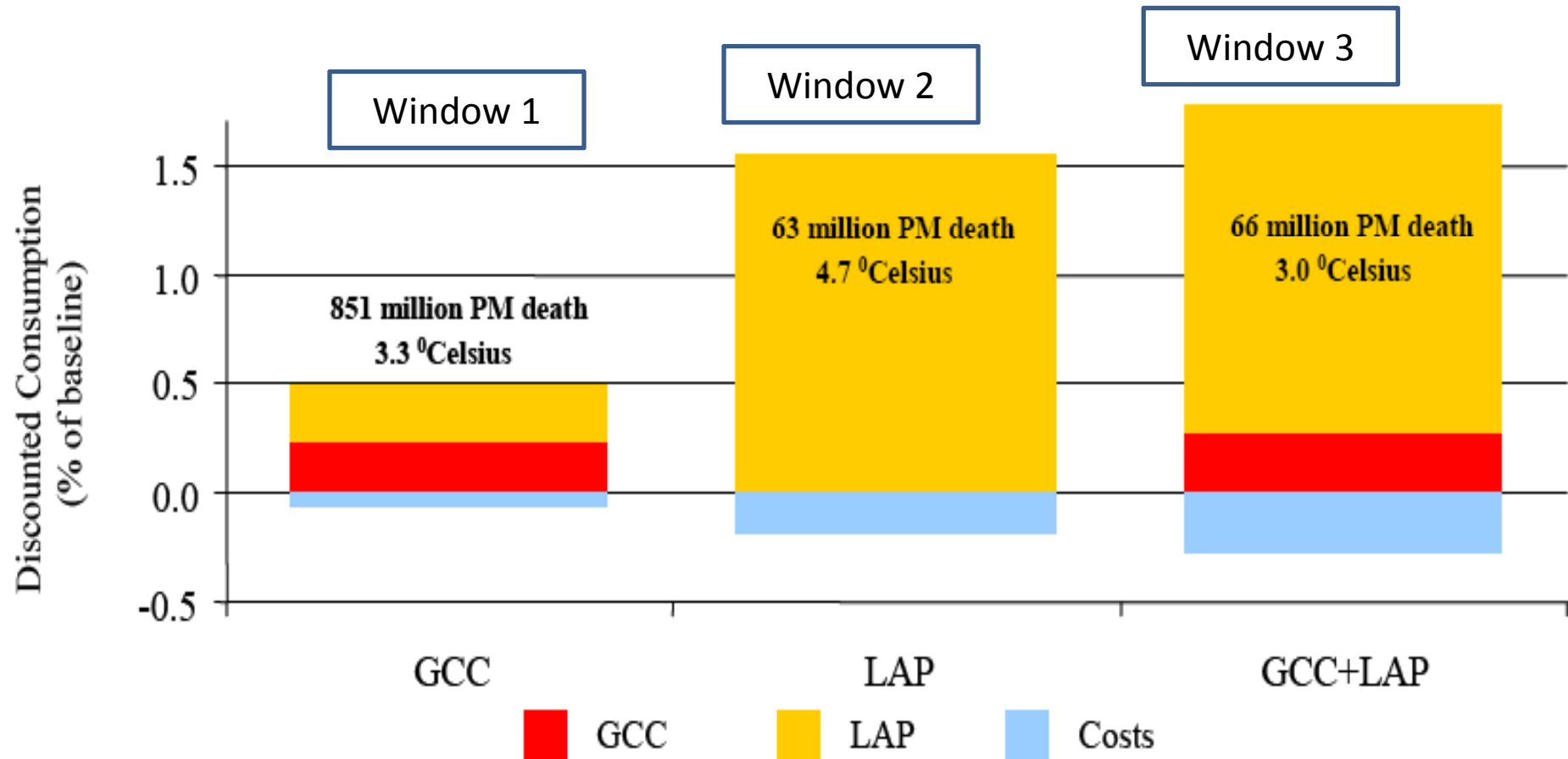
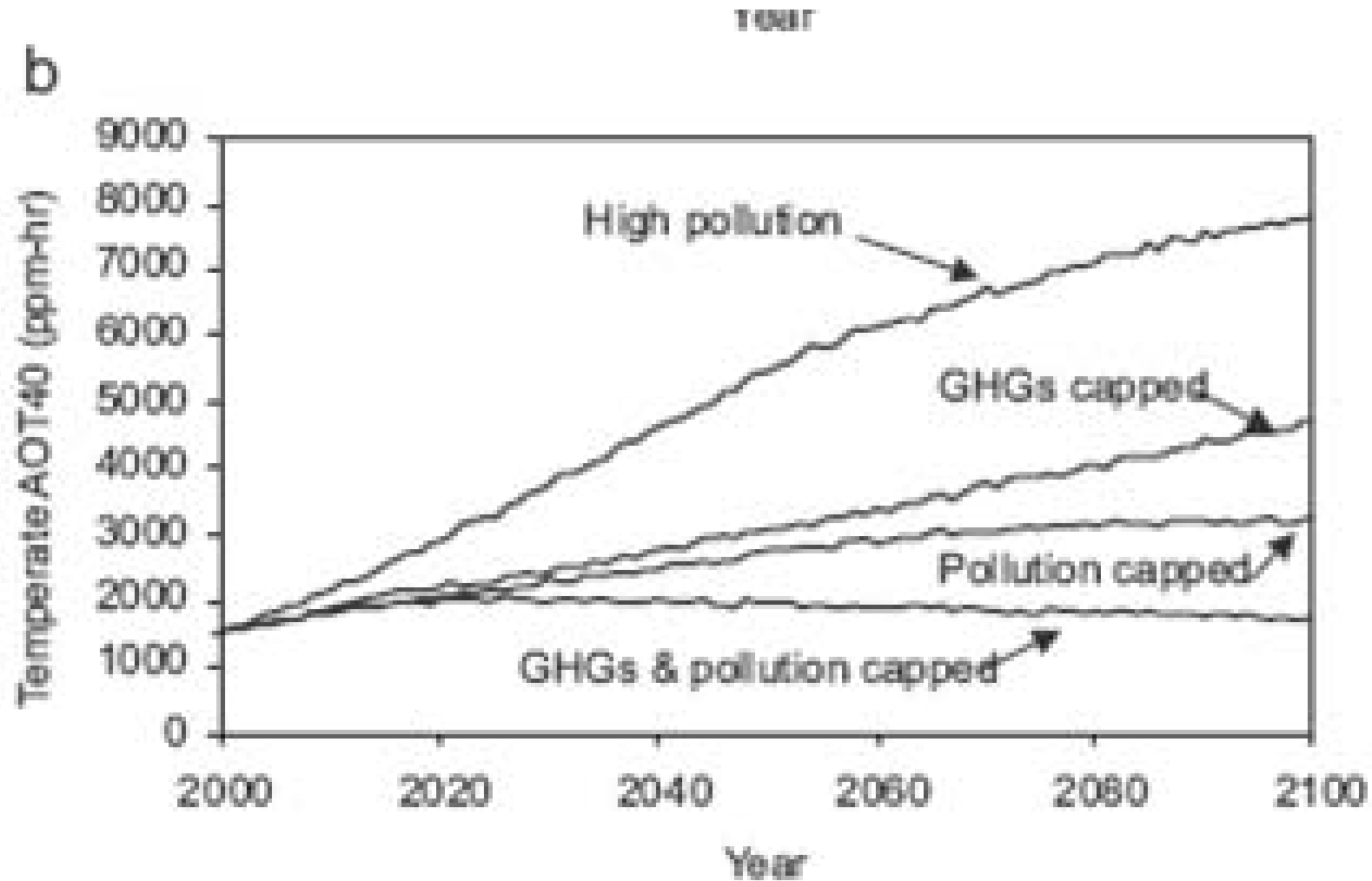


Figure 4. Changes in costs, benefits, and global welfare for three scenarios (GCC, LAP, and GCC + LAP), expressed as percentage consumption change in comparison to the baseline.

# Window 3: Optimal Policy for Ozone

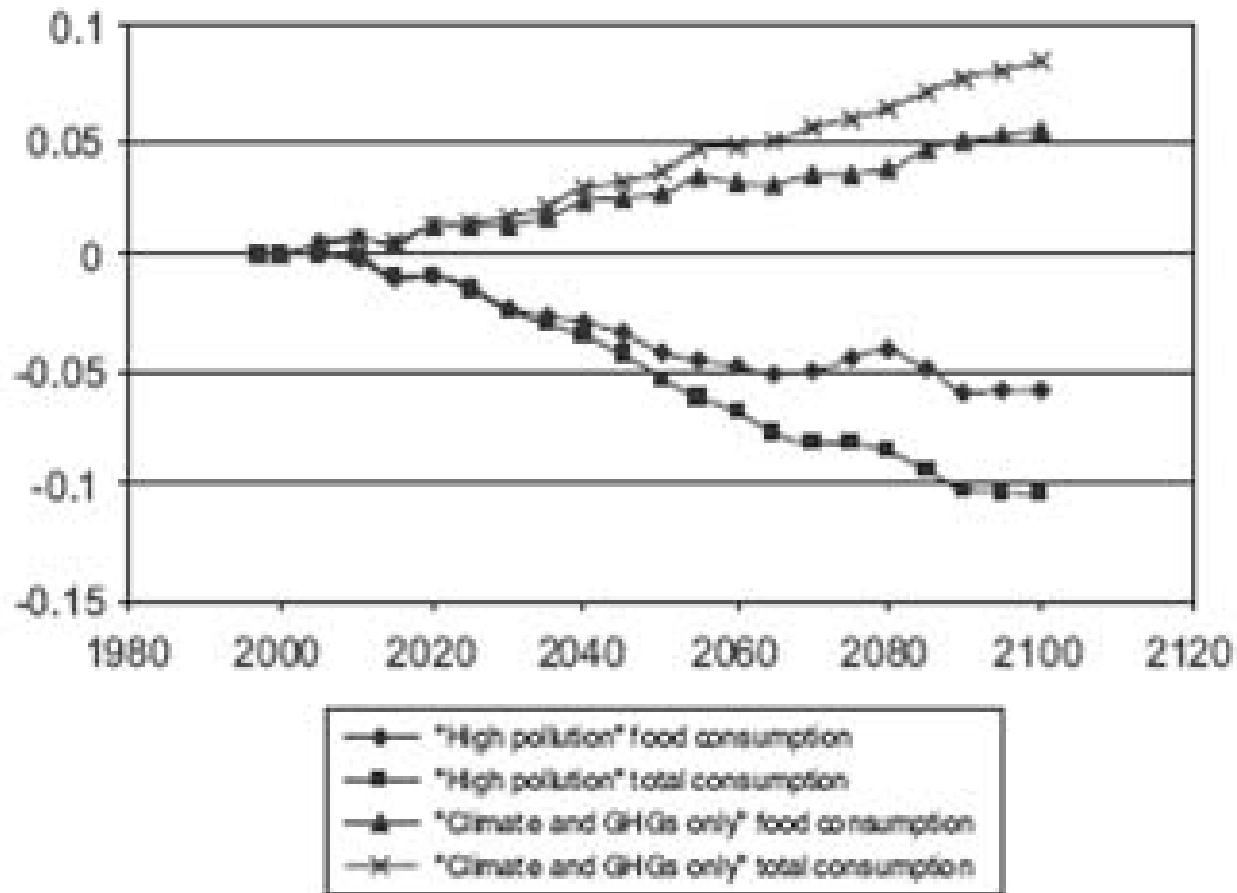
## Change in peak ozone concentrations by scenario



c

# Climate change, ground-level ozone & agriculture

## Macro-economic consumption effects



### A change in sign:

- Positive - GHG only
- Negative if both O<sub>3</sub> & GHG

### Total macro-

### economic effects

of policies depend on trade & resource allocation decisions

**General-equilibrium effects** matter in the assessment of co-benefits

Source: Reilly et al 2007

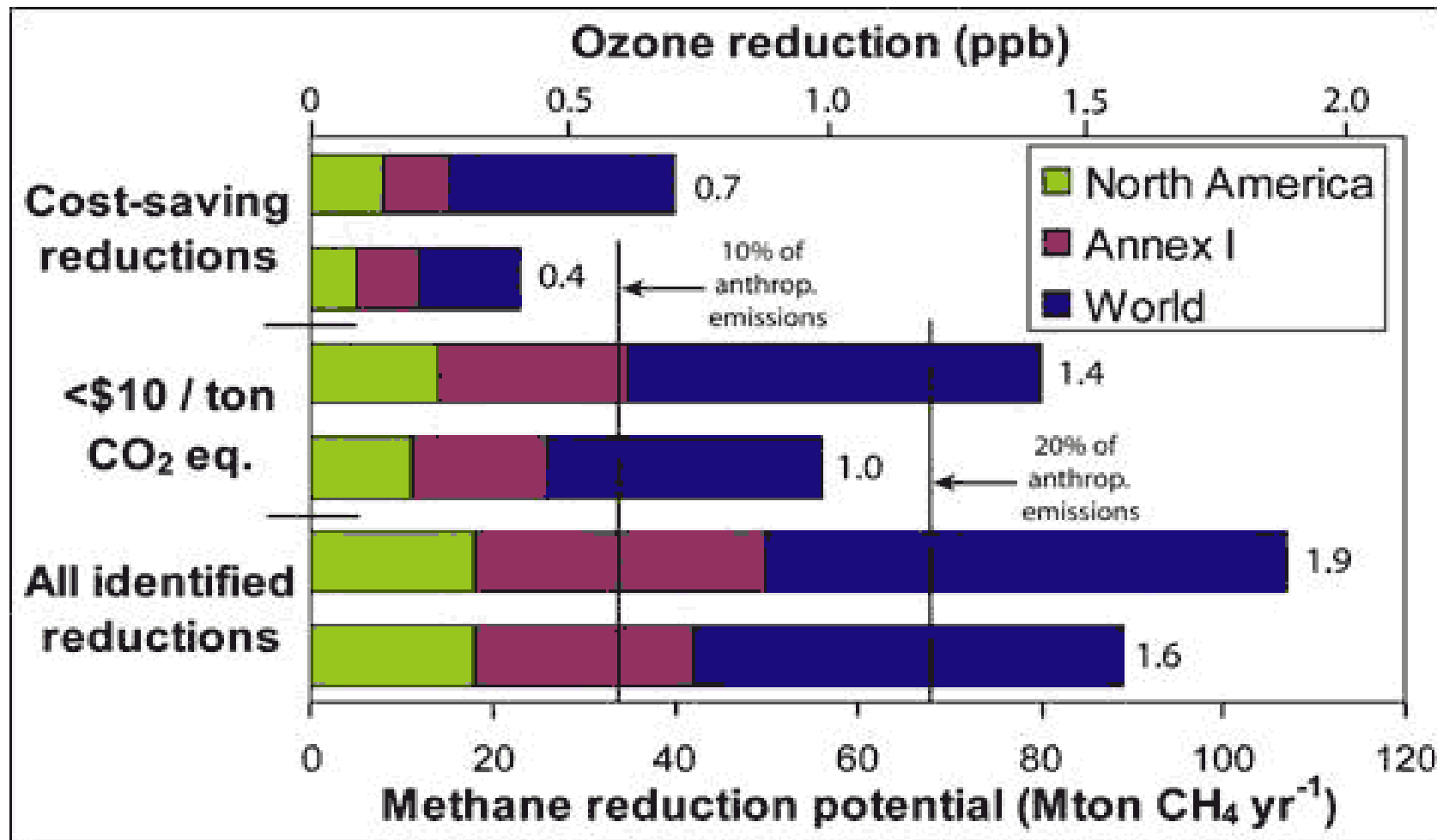
Reference scenarios - change in food & total consumption relative to agricultural production



# Indoor air pollution - a key health issue in developing countries

- Health effects more significant than outdoor air pollution in many developing countries (WHO 2004)
- 2.5 million people depend on traditional biomass (Stern 2006)
- Question: ***how will GHG policies interact with indoor air pollution?***
  - Exempting biomass fuels from GHG regulatory regime could have perverse effects on health
  - Some evidence of asymmetries – limited kwh access
  - No comprehensive modelling of this interaction

# Example: mitigating CH<sub>4</sub> – at what cost?



# Example: connecting climate & LAP actions -- CH<sub>4</sub> , indoor air pollution & human health

**Biodigester Technology**  
A basic anaerobic digester for hog manure in China can reduce CH<sub>4</sub> emissions (and background surface ozone) while substituting dirty cooking fuels with bio-gas. This reduces indoor air pollution (PMs) and helps boost water quality through lower nitrogen and phosphorus runoff (Srinivasan 2006).



## Main synergies and trade-offs depend on policy design and end-points

- Synergies:
  - Energy efficiency: win-win-win
  - Transport: the key pathway to reduce PM
  - CH<sub>4</sub> mitigation (waste, coal & gas supply): interactions with tropospheric ozone (agriculture & health effects)
  - Indoor air pollution?
- Trade-Offs:
  - Transport: biofuels can increase PM and Nox
  - Indoor air pollution?

## 6. Implications for Policy & Further Analysis: Sector Approaches

- Policy design is key to optimise synergies and minimise trade-offs
  - Carbon tax or other GHG market instruments will not internalise all externalities
- The complexity of interactions between GHG/LAP may be best addressed at the, sector project or technology specific level
  - Methane, PM (indoor & outdoor)
  - Transport, household cooking
- How mitigation occurs determines to co-benefits: pathway dependent
- Integrated LAP & climate policy a way forward
- How can sector approaches be designed to harvest high co-benefits?