Markus Amann
International Institute for Applied Systems Analysis (IIASA)

Greenhouse gas – Air pollution Interactions and Synergies

GAINS

Lessons on co-benefits in Europe, China and India

IUAPPA
Workshop on Air Pollution and Climate Change, Stockholm, September, 17-19, 2008

The development of GAINS
is supported by the EU-LIFE (www.ec4macs.eu) and the EU FP6 programmes

GAINS: A tool for a systematic assessment of the interactions between AP and CC

- Quantification of sectoral emission control potentials and costs,
  - considering physical and economic interactions between pollutants.
  - assessing impacts on air quality effect and climate indicators

- Search for least-cost mix of mitigation measures to meet air quality and/or GHG targets

- GAINS implementations for
  - Annex 1 countries:
    - 27 EU countries, Belarus, Croatia, Norway, Switzerland, Ukraine (completed)
    - Australia, Canada, Iceland, Japan, New Zealand, Russia, US, Turkey (end 2008)
  - China (with ERI), India (with TERI), Pakistan (completed)

The GAINS model: The RAINS multi-pollutant/ multi-effect framework extended to GHGs

	PM	SO_2	NO_x	VOC	NH_3
Health impacts: PM	√	√	√	√	√
O_3			√	√	
Vegetation damage: O3			√	√	
Acidification		√	√		√
Eutrophication			√		√

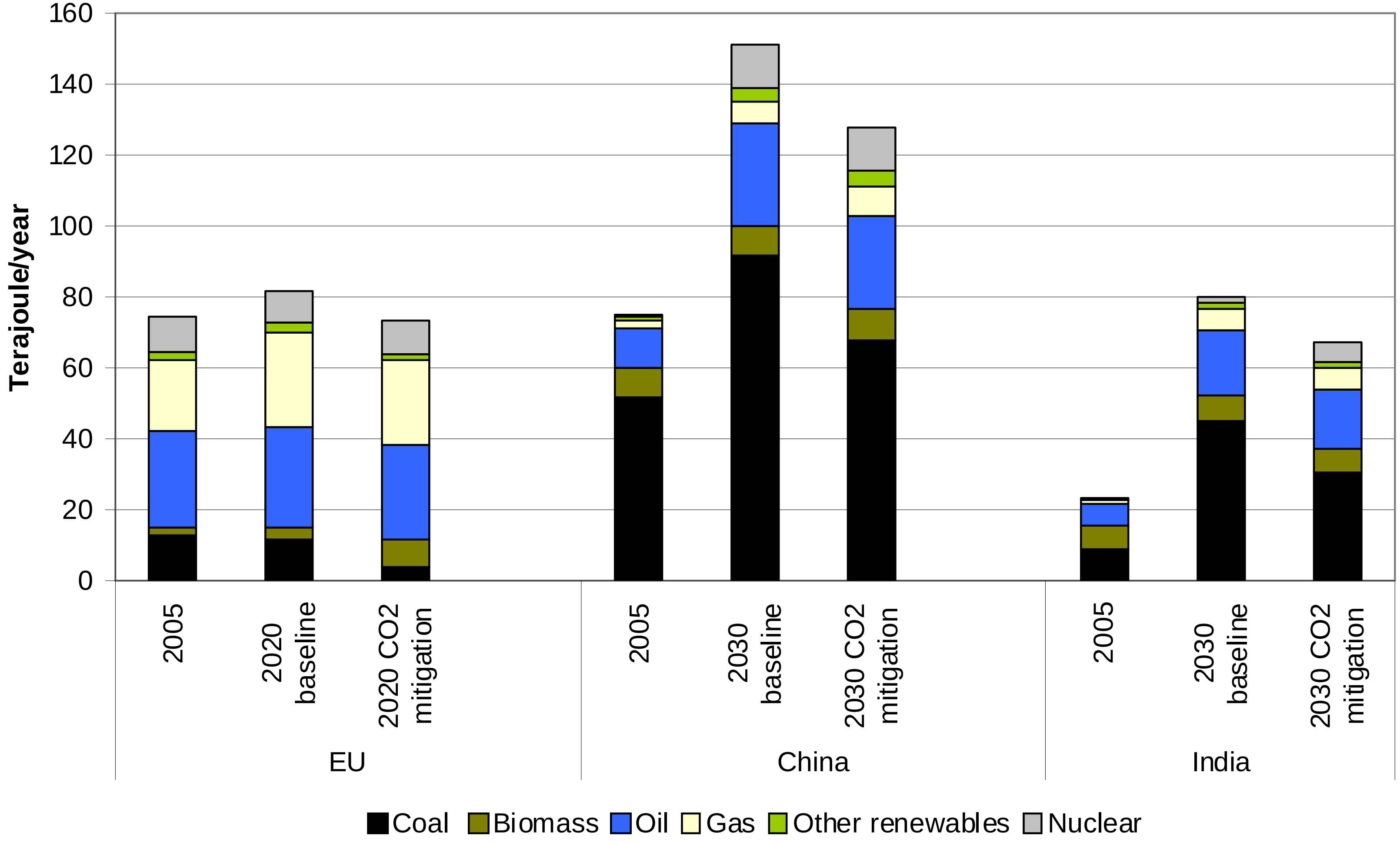
The GAINS model: The RAINS multi-pollutant/ multi-effect framework extended to GHGs

	PM	SO_2	NO_x	VOC	NH_3	CO_2	CH_4	N_2O	HFCs PFCs SF_6
Health impacts: PM	√	√	√	√	√				
O_3			√	√			√		
Vegetation damage: O_3			√	√			√		
Acidification		√	√		√				
Eutrophication			√		√				
Radiative forcing: - direct						√	√	√	√
- via aerosols	√	√	√	√	√				
- via OH			√	√			√		

Some key results

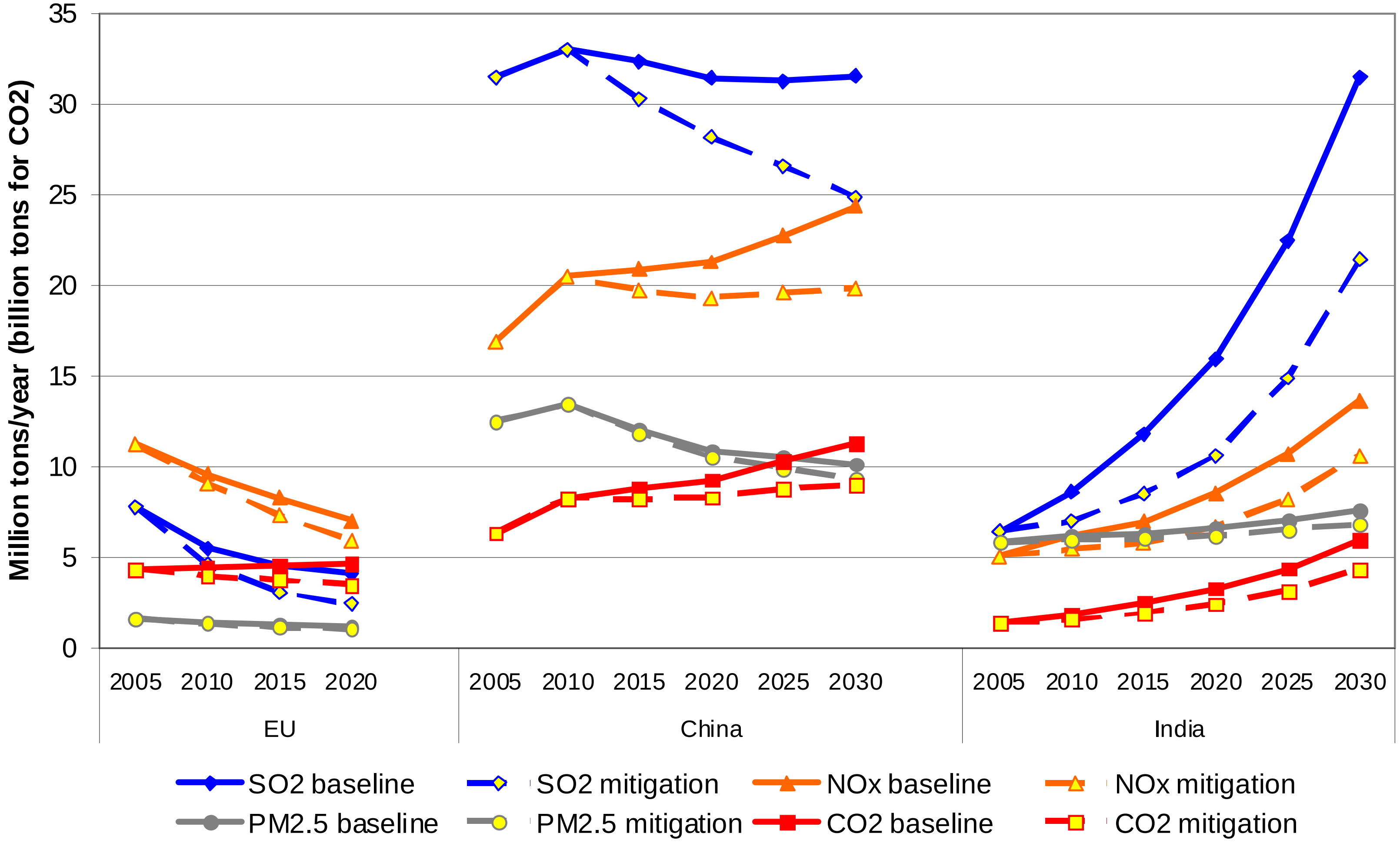
for Europe, China and India

Energy consumption for low CO_2 strategies
Source: GAINS model based on national projections



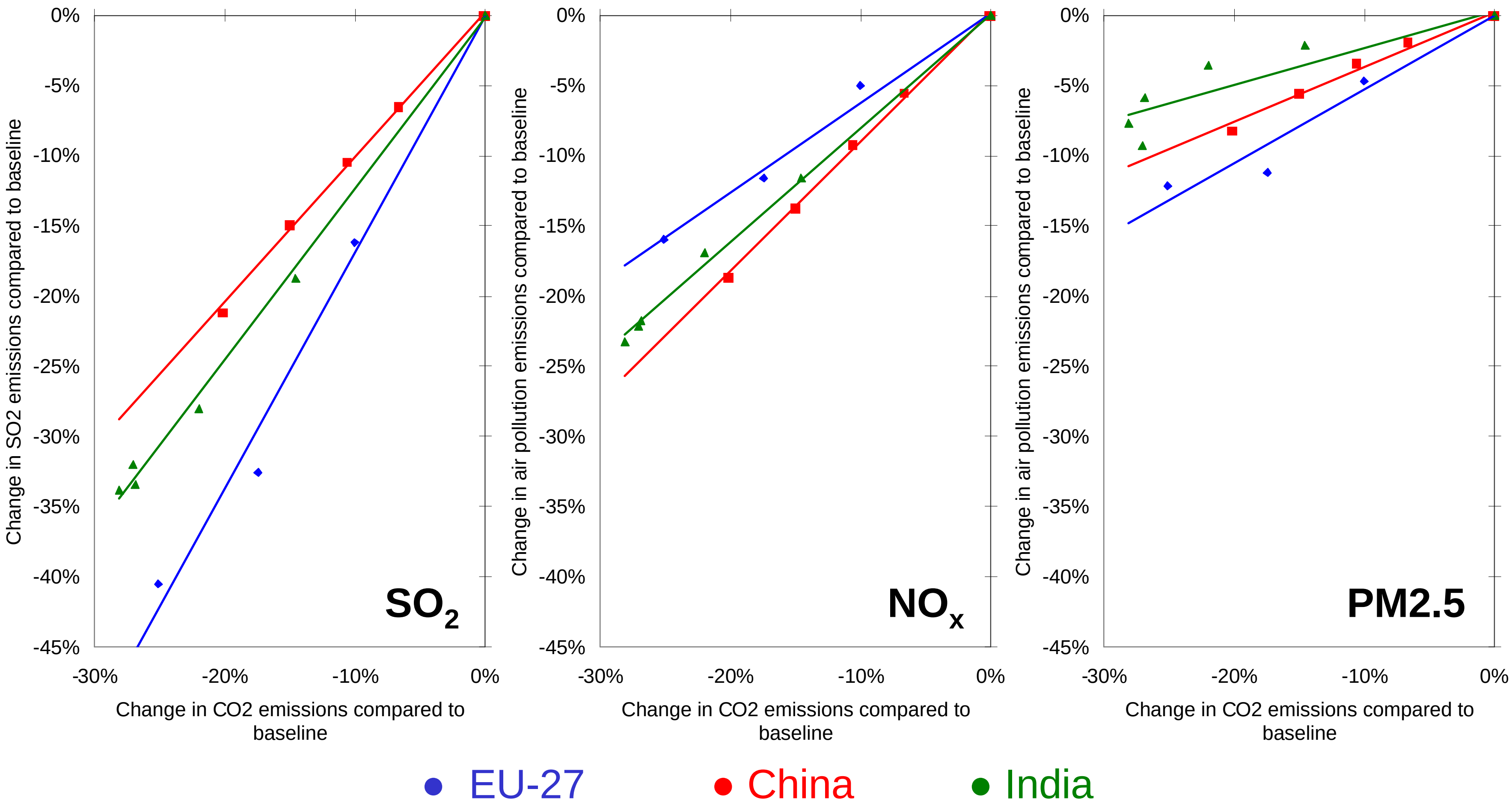
CO_2 and air pollution emissions

GAINS baseline and mitigation cases



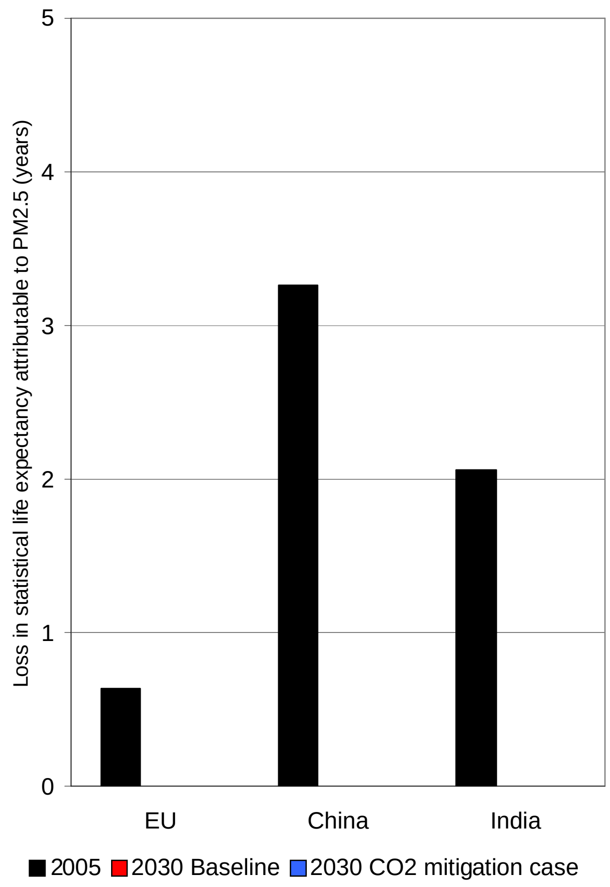
Co-control of air pollution with CO_2 mitigation

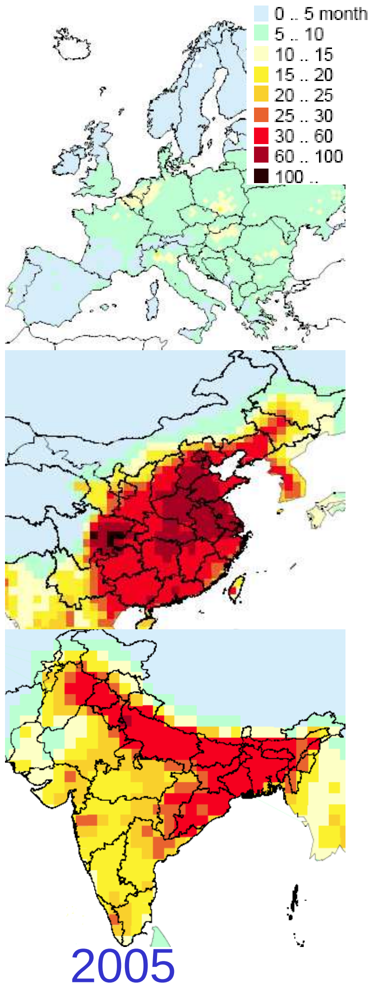
assuming current legislation on air pollution



Health impacts from air pollution

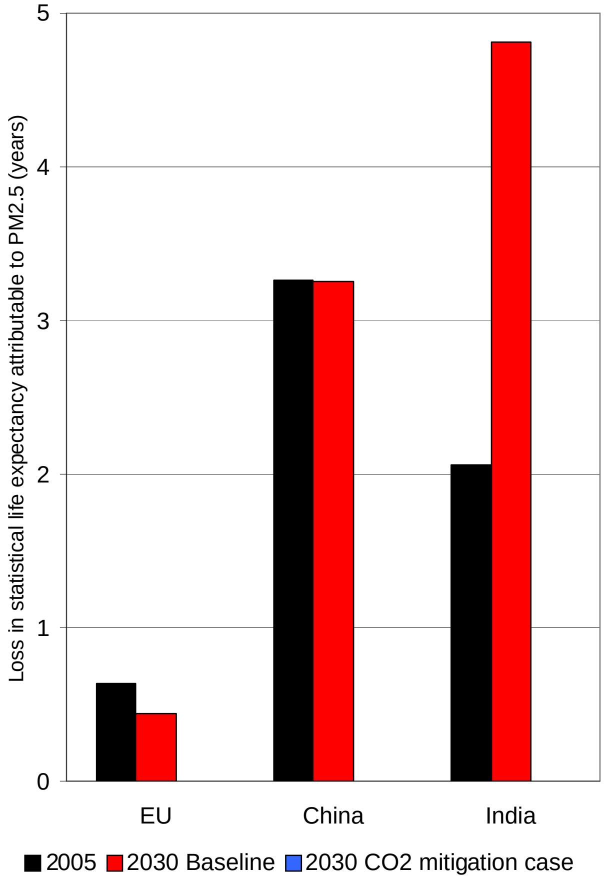
Loss in statistical life expectancy 2005

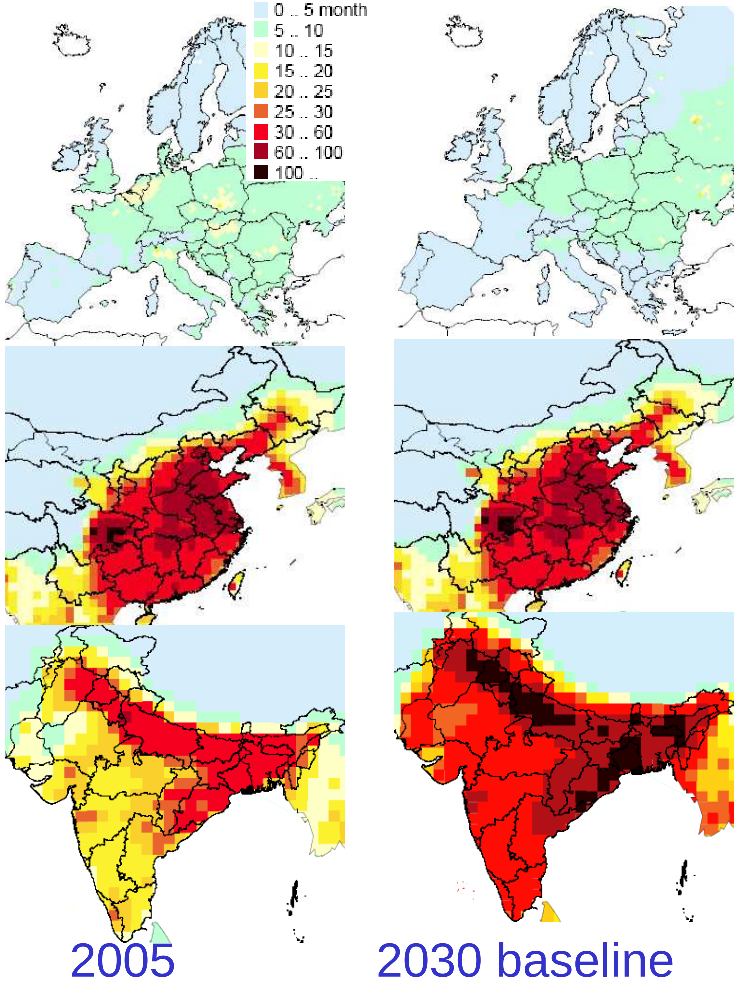




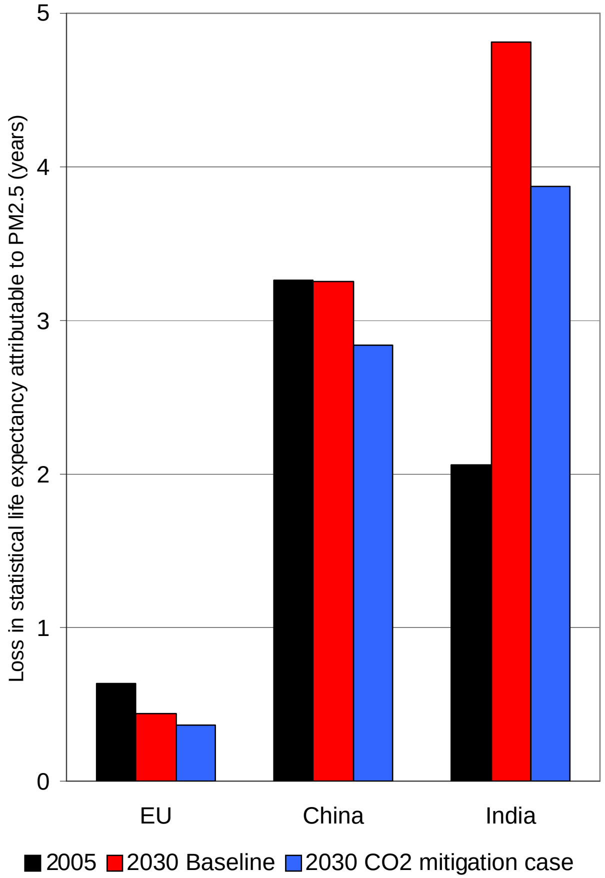
Health impacts from air pollution

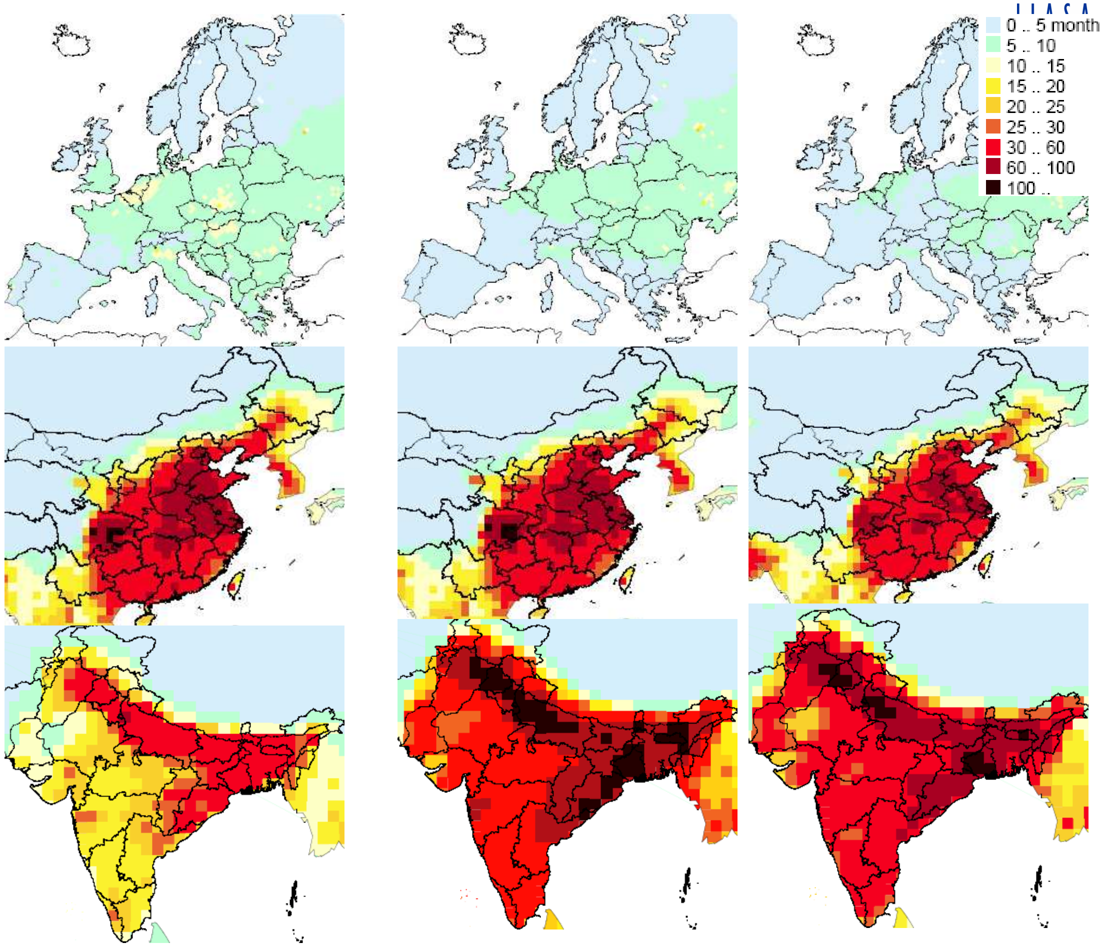
Loss in statistical life expectancy 2030 baseline





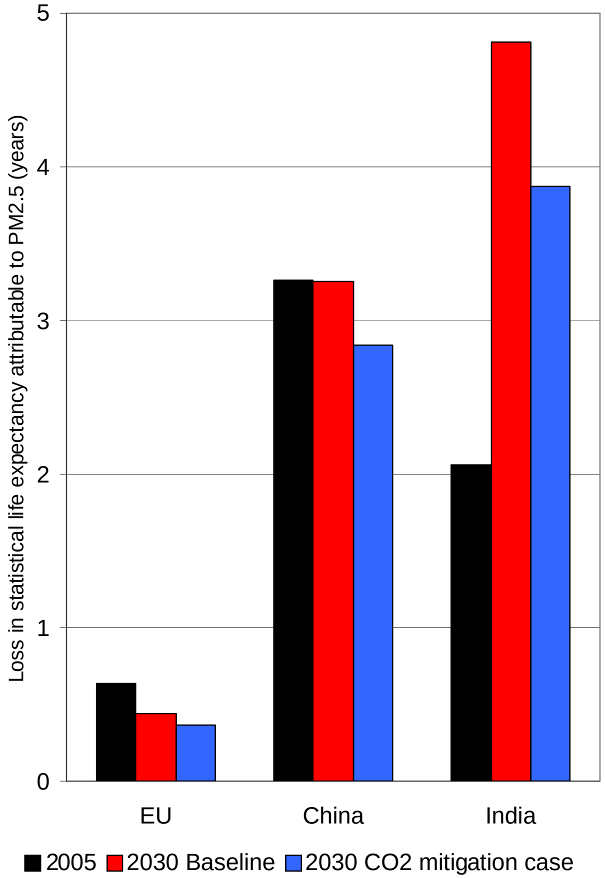
Co-benefits of CO_2 mitigation on health impacts
through reduced air pollution, 2030

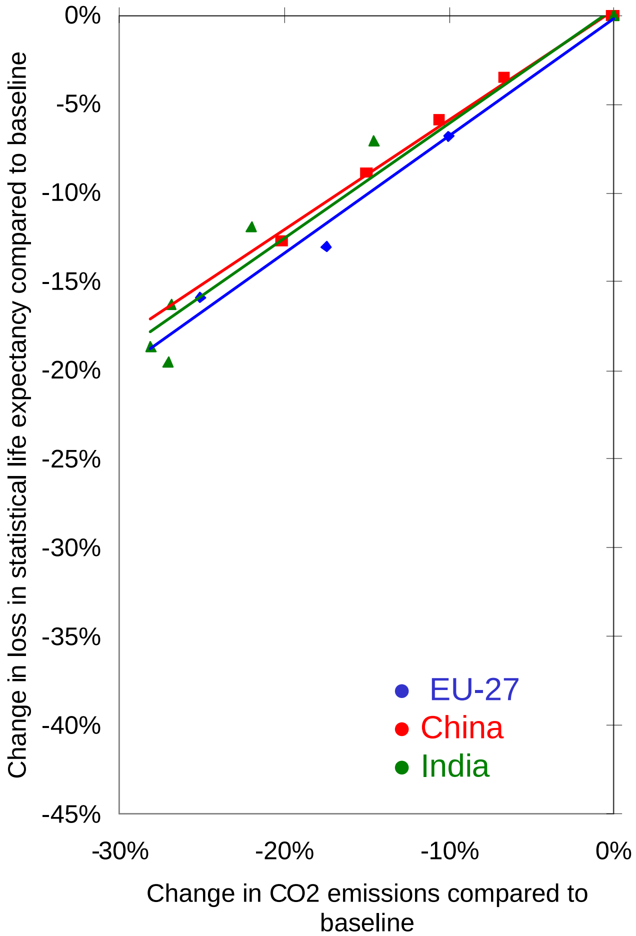




2005 2030 baseline 2030 low CO_2

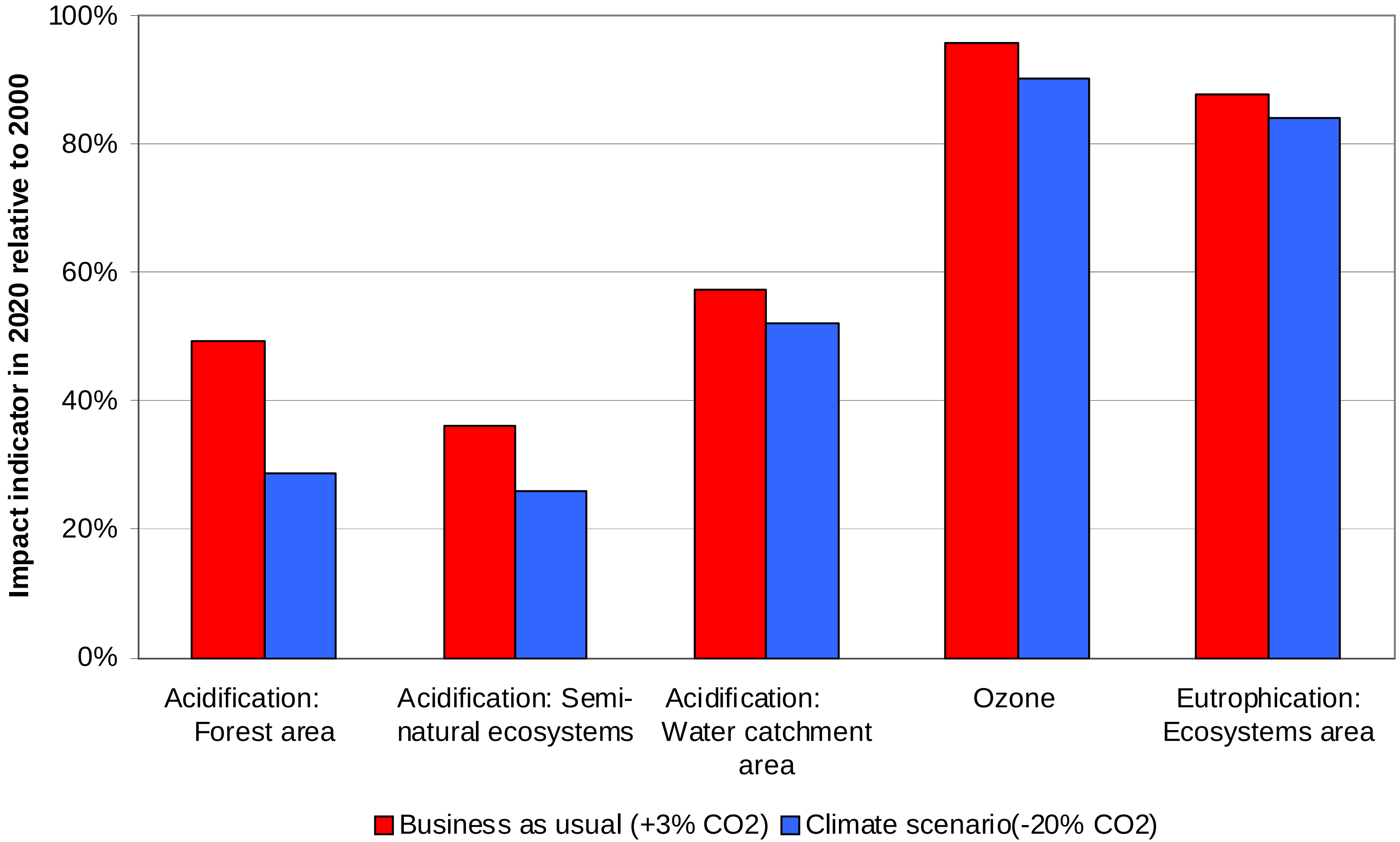
Co-benefits of CO_2 mitigation on health impacts
through reduced air pollution, 2030





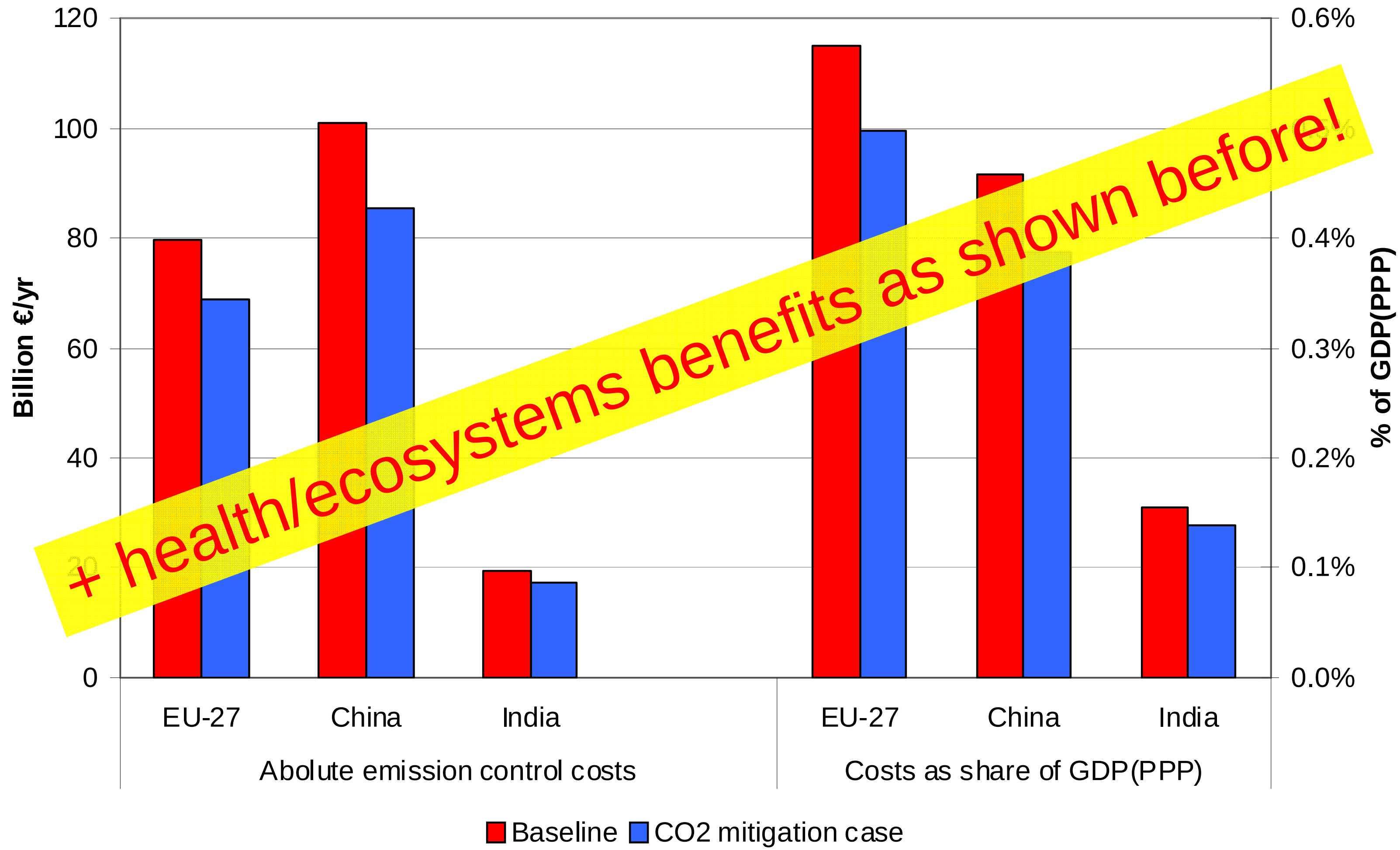
Co-benefits of CO_2 mitigation on ecosystems

through reduced air pollution, EU-25 2020



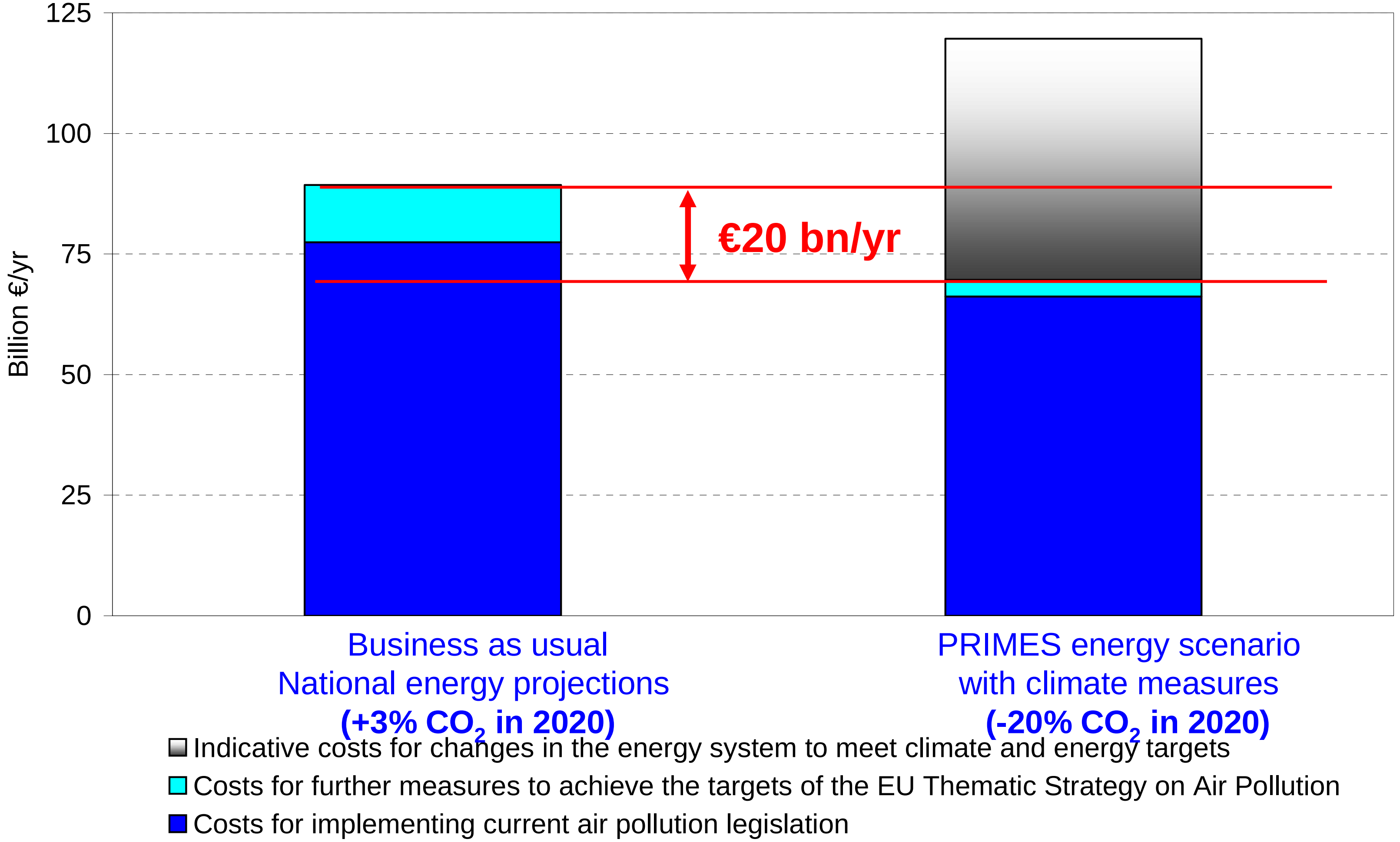
Cost-savings in air pollution control costs

for implementation of current legislation in 2030



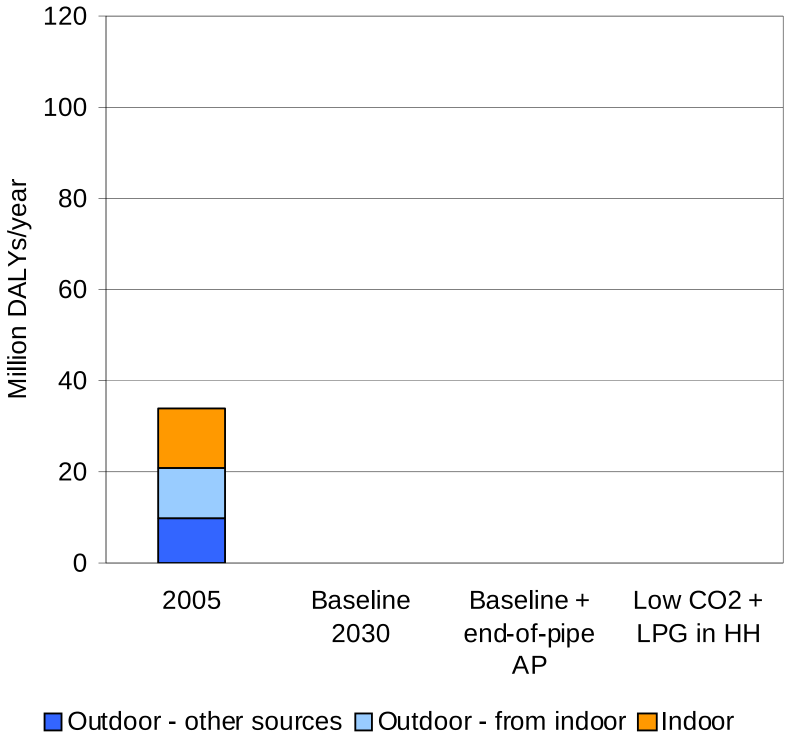
Emission control costs to meet the EU air quality and climate targets

EU-27, 2020 (Source: IIASA's GAINS model)

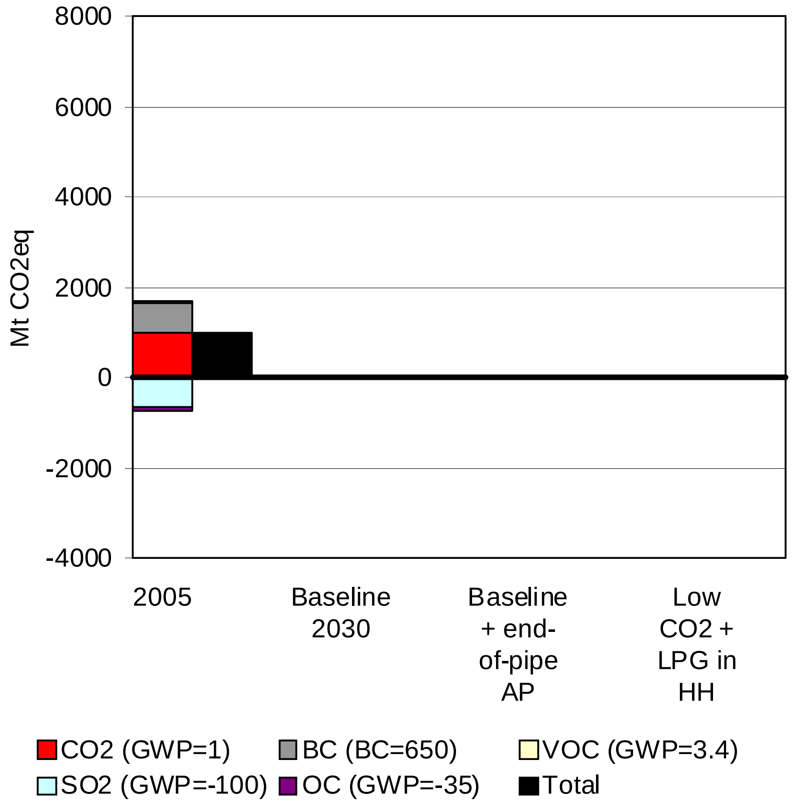


Trade-offs between air pollution and GHG mitigation
India

Health impacts from air pollution (Disability-adjusted life years)



Global radiative forcing of emissions (integrated over 100 yrs)



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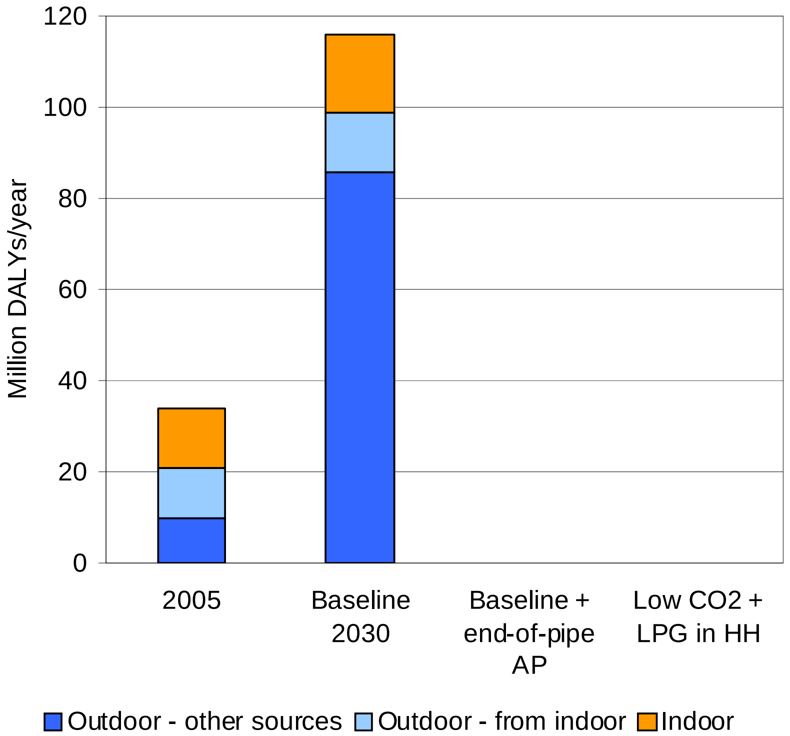

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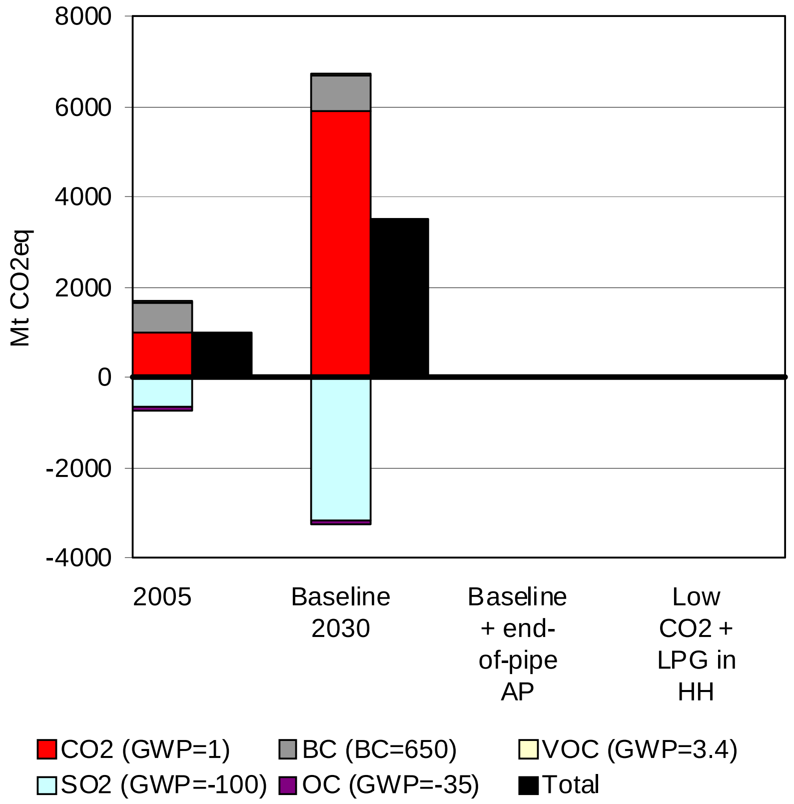

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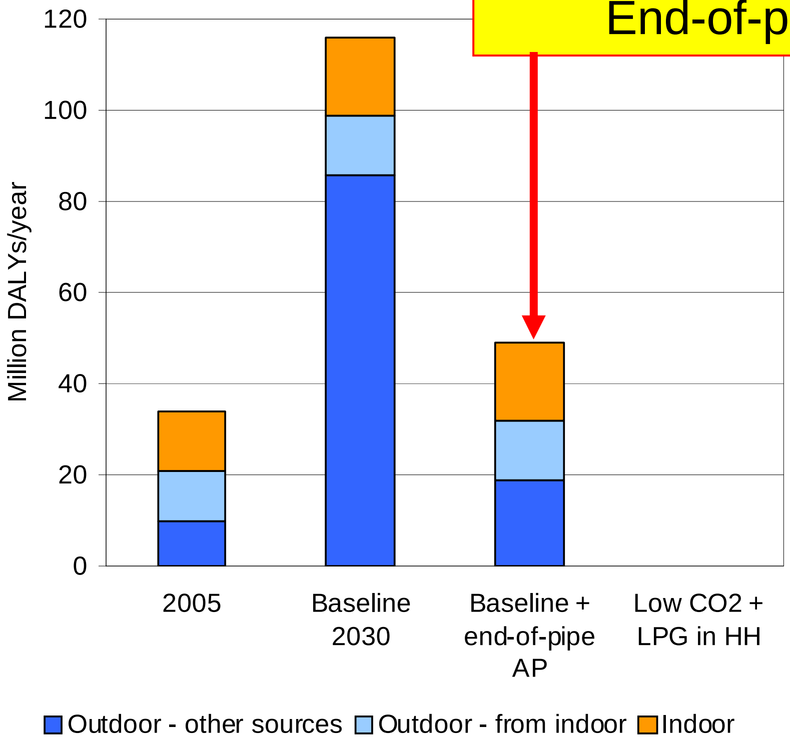

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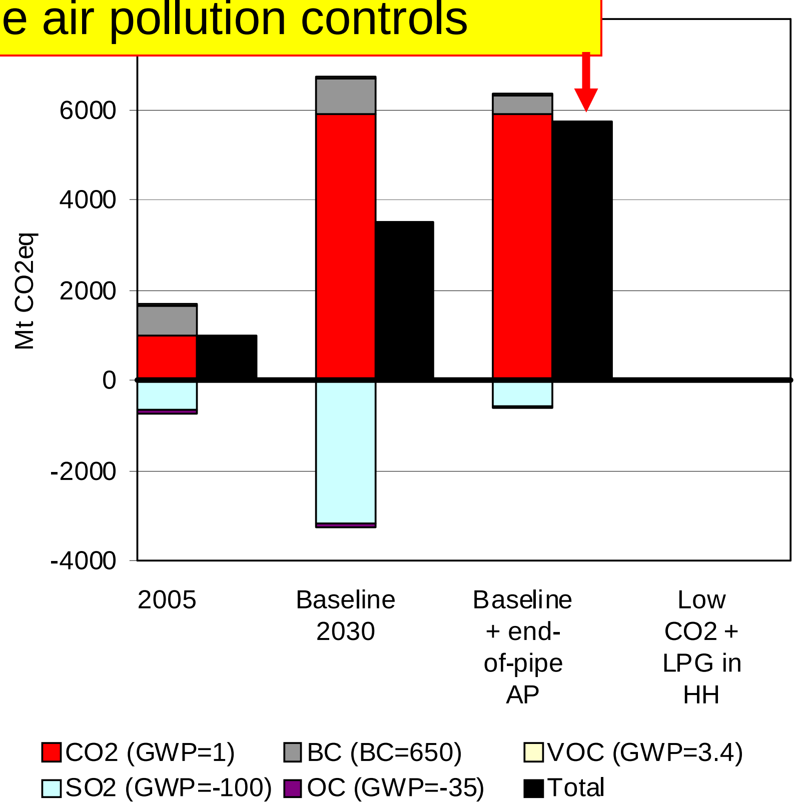
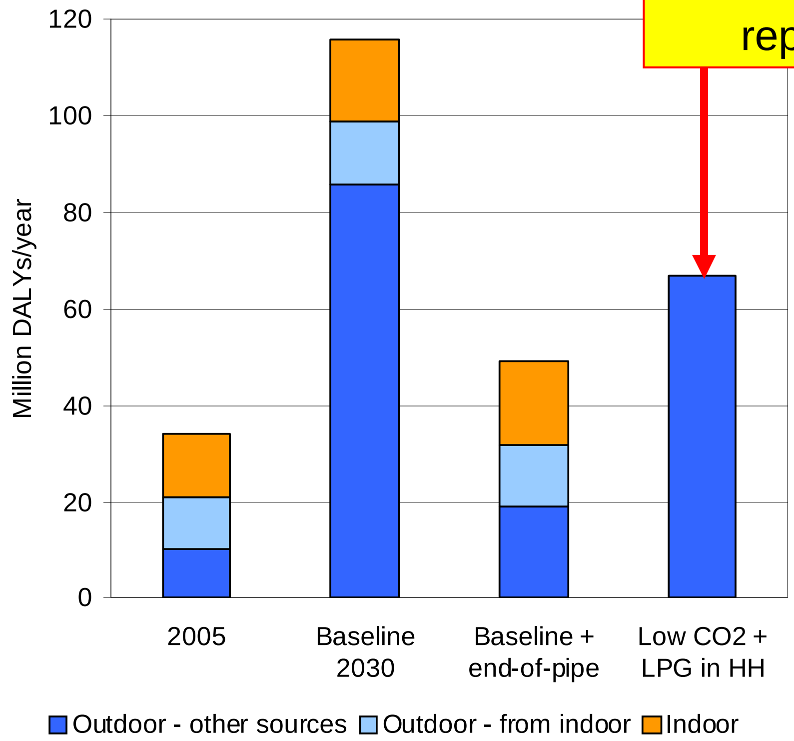


Trade-offs between air pollution and GHG mitigation
India

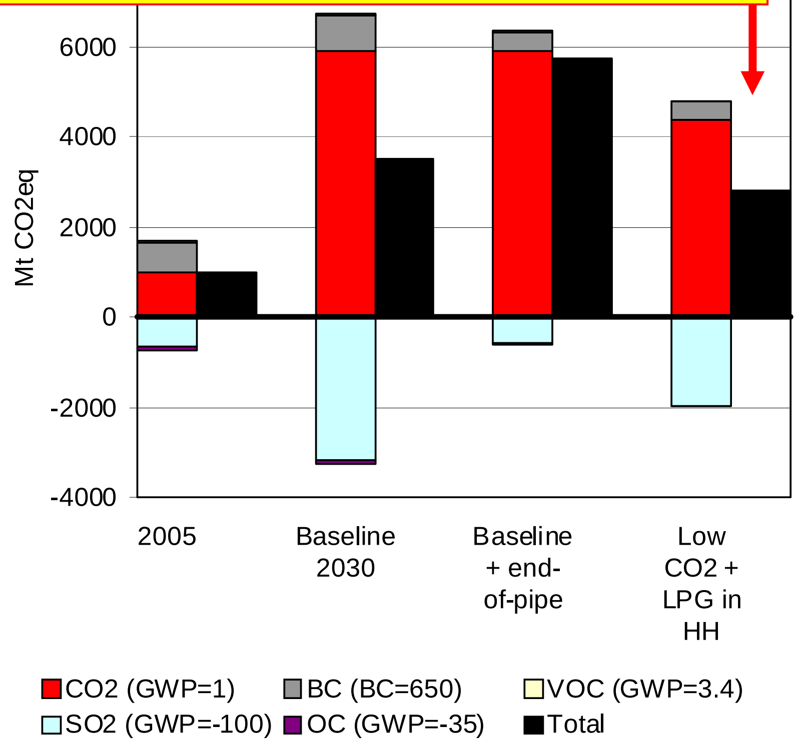
IIASA

Health impacts from air pollution (Disability-adjusted life years)



Global radiative forcing of emissions (integrated over 100 yrs)

Low CO_2 strategy and replacement of solid fuels in households



Lessons

- A joint perspective on AP control and GHG mitigation reveals
  - co-controls between CO_2 and SO_2, NO_x, PM emissions,
  - co-benefits of CO_2 mitigation on health and ecosystems,
  - cost savings for air pollution control from CO_2 mitigation.

- There are important trade-offs:
  - Increased diesel and biomass use may deteriorate air quality.
  - Reduction of SO_2 emissions counteract decrease in radiative forcing from GHG mitigation (most relevant in developing countries).

- Joint strategies can be designed that maximize synergies and minimize trade-offs.

Implications

If AP and CC strategies are designed and analyzed separately …

- Incomplete assessment of benefits (co-benefits ignored)
- Double-counting of costs
- Incomplete assessment of mitigation potential
- Overlooking the "2^{nd} best" options
- Running into trade-offs (diesel, bio-fuels, aerosols)

If independent AP and CC strategies are analyzed together ...

+ Correct assessment of costs

+ Correct assessment of benefits

± Discovery of trade-offs, but no prevention

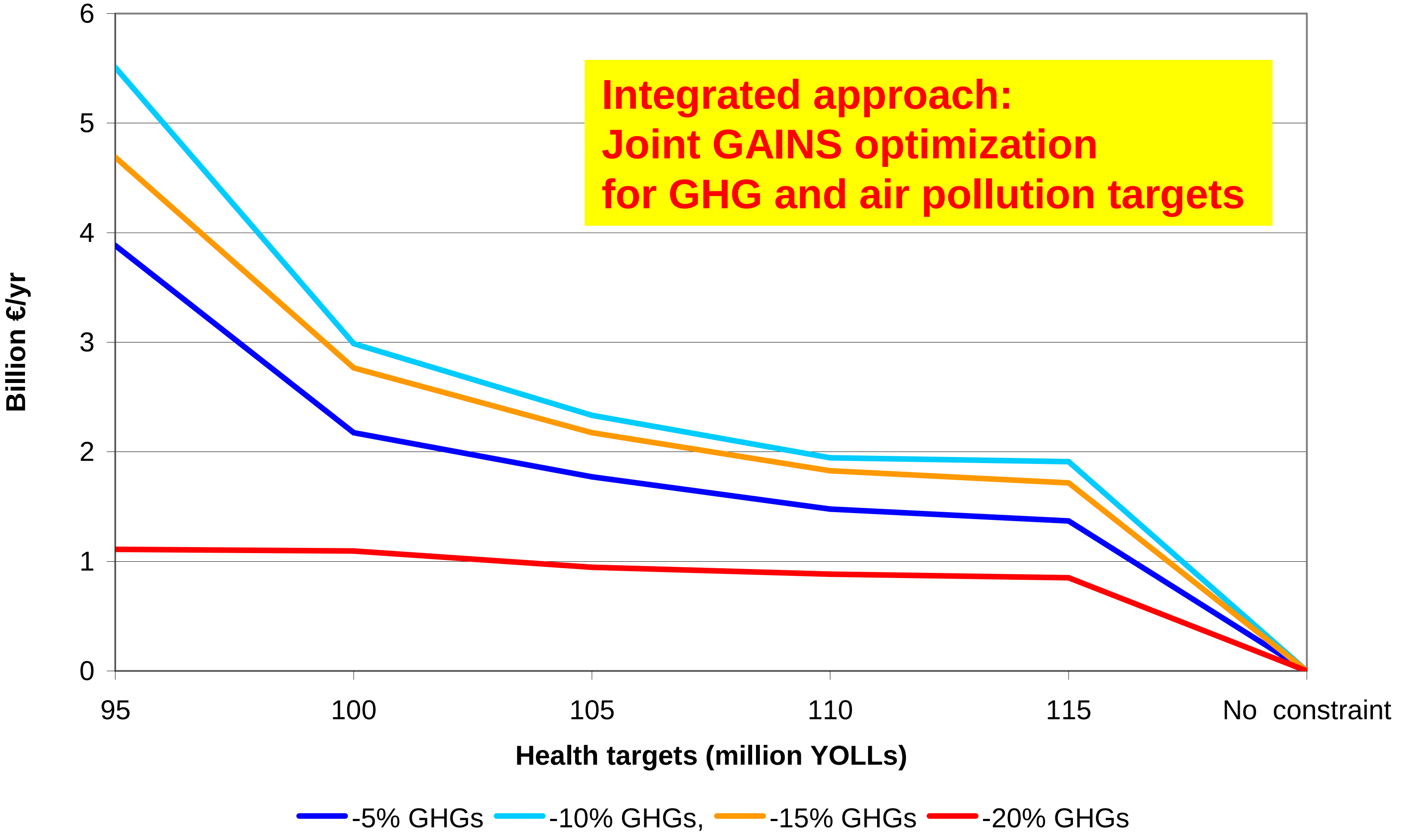
- Overlooking the 2nd best options

If AP and CC strategies are designed together ...

- Correct assessment of costs
- Correct assessment of benefits
- Discovery and prevention of trade-offs
- Increased cost-effectiveness

Cost savings from an integrated approach

GAINS estimates, EU-25, 2020



If AP and CC strategies are designed together …

\+ Correct assessment of costs

\+ Correct assessment of benefits

\+ Discovery and prevention of trade-offs

\+ Increased cost-effectiveness

– But increased analytical and institutional complexity

– Which aspects need to be dealth with

  – internationally
  – domestically?

Conclusions

- In addition to *physical* interactions, there are strong *economic* linkages between air pollution control and GHG mitigation.

- They allow for improved cost-effectiveness of mitigation strategies:
  - Separate design and analysis of AP and GHG mitigation strategies is likely to result in inefficient solutions
  - Combined analysis of separate strategies:
    Correct accounting, but possibly inefficient allocation
  - Combined analysis of joint strategies:
    Efficient allocation, but institutional and analytical complexities

- GAINS offers a tool for a systematic assessment:

http://gains.iiasa.ac.at/