International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

science for global insight

Human Well-being and the Macro-economic Effects of Investing in Cleaner Air in India

Bringing together socio-economic and geo-physical pollution modeling

Markus Amann, Wolfgang Schöpp
Mitigation of Air Pollution and Greenhouse Gases Program
Warren Sanderson, Erich Striessnig
World Population Program

Economic growth and environmental quality – a dilemma?

Expenditures for environmental protection are often perceived as an impediment to economic development:

- diversion of economic resources from productive investments
- slower economic growth
- less private consumption
- decreased human well-being.

Non-material benefits for human well-being, ecosystems and their life supporting functions are difficult to quantify.

How will the gains in life expectancy, labor force and productivity from cleaner air affect economic growth?

Cooperation between

- IIASA's Air Pollution program
- IIASA's Population program

The GAINS (GHG-Air pollution Interactions and Synergies) model

An integrated perspective on the multi-pollutant/multi-effect nature of air pollution and GHG mitigation

	PM (BC, OC)	SO_2	NO_x	VOC	NH_3	CO	CO_2	CH_4	N_2O	HFCs PFCs SF_6
Health impacts: PM (Loss in life expectancy)	√	√	√	√	√					
O_3 (Premature mortality)			√	√		√		√		
Vegetation damage: O_3 (AOT40/fluxes)			√	√		√		√		
Acidification (Excess of critical loads)		√	√		√					
Eutrophication (Excess of critical loads)			√		√					
Climate impacts: Long-term (GWP100)							√	√	√	√
Near-term forcing (in Europe and global mean forcing)	√	√	√	√	√	√				
Black carbon deposition to the arctic	√									

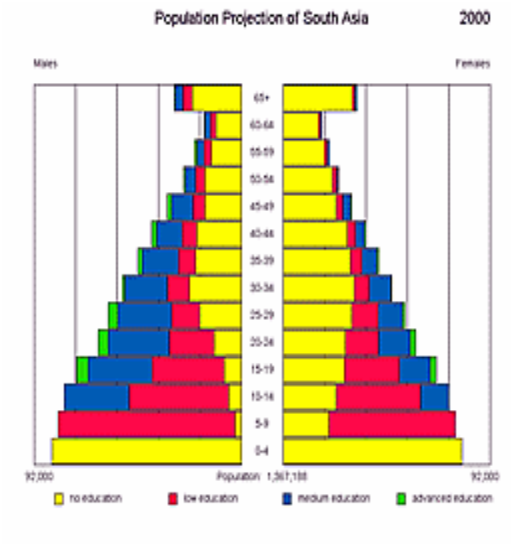
- GAINS links drivers (human activities) with mitigation options, pollution control costs, and health/environmental impacts
- Employed for policy analyses for the LRTAP Convention, EU, UNFCCC and Climate and Clean Air Coalition (CCAC)

The SEDIM model

An innovative model of economic growth

An overlapping generation model with emphasis on human capital

- Productivity modeled through a technology frontier approach using a Cobb-Douglas production function with labor and capital
- Demographic dynamics and education as explicit factors for economic growth
- Life expectancy influences labor force and capital formation (via savings behavior)



Two air pollution control scenarios for India

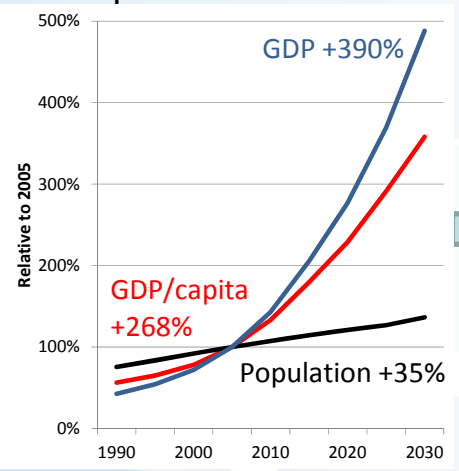
For the latest economic and energy projection of the Indian government up to 2030:

1. No change in today's Indian air pollution legislation in the future
2. EU air emission legislation would be introduced up to 2020, and maintained afterwards

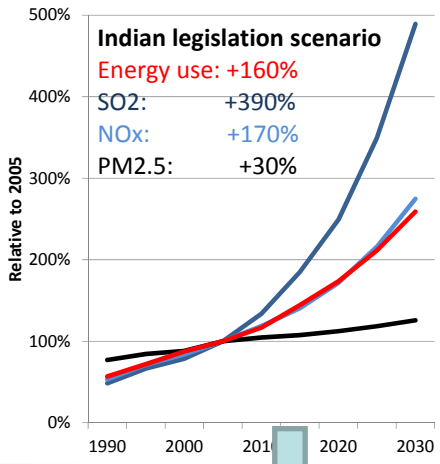
How do pollution controls improve human health?

GAINS-Asia calculations

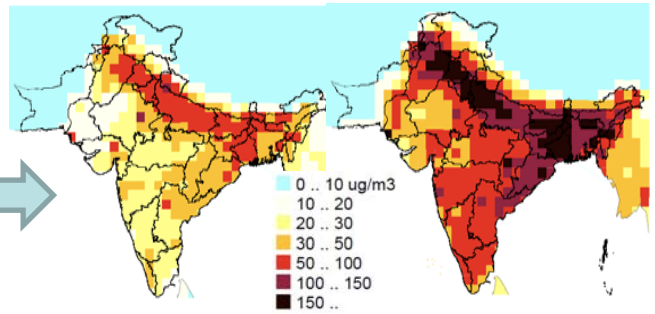
Population and GDP



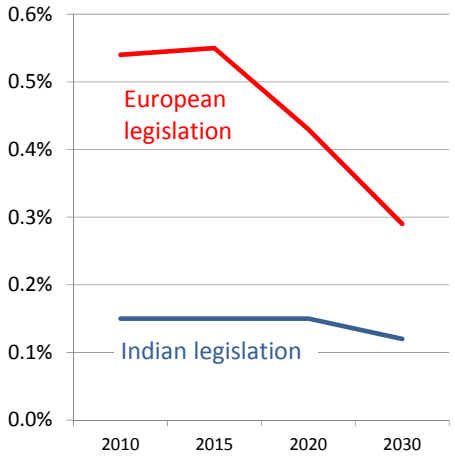
Energy use and emissions



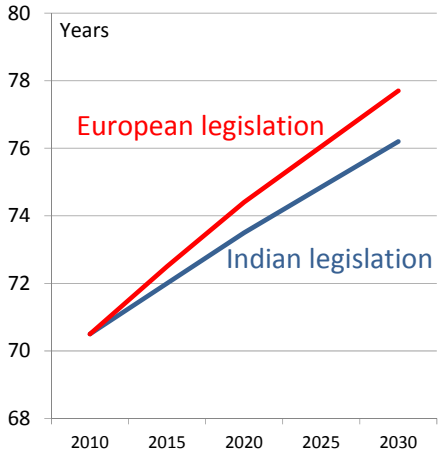
Ambient PM2.5 concentrations from anthropogenic sources



Air pollution control costs as % of GDP



Cohort life expectancy at birth



For presentation purposes uncertainty ranges are omitted in these graphs

How do pollution controls feed back on economic growth?
SEDIM results

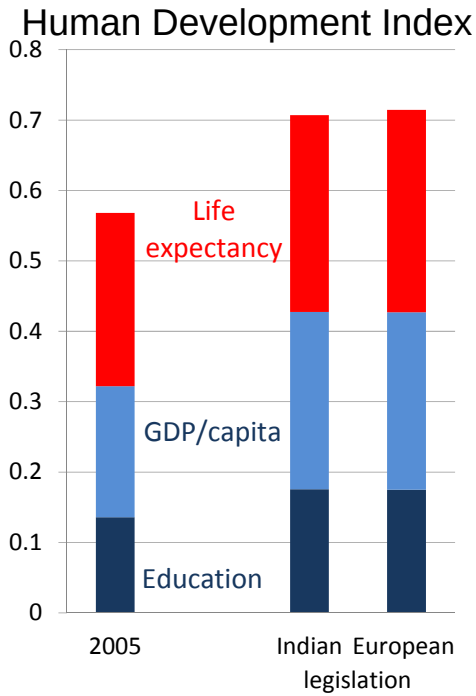
Up to 2030, implementation of European air legislation in India would:

- divert additional ~100 bn $/yr, i.e., 0.15 - 0.4% of GDP for air pollution control
  - Less capital for productive investments
- reduce morbidity and mortality, and increase longevity by 1.5 years
  - Larger labor force and higher productivity
  - More capital formation due to more savings as people prepare for longer life

As a consequence, in 2030

- GDP would be 0.6% higher than in the baseline,
- although per-capita GDP would grow by only 268.0% instead of 268.2% as more people are alive.

- If measured by the Human Development Index (HDI), these GDP losses are more than compensated by the gain in life expectancy



Conclusions

- We developed more holistic insights into the impacts of environmental investments on human well-being

- We show that air pollution investments in developing countries have only very small net impacts on economic growth as improved health conditions will increase labour force and productivity

- If measured by the Human Development Index, the large increase in longevity outweighs the small decrease in per-capita GDP

  These air pollution investments will increase human well-being despite their diversion of productive resources

- Impacts would be even more positive if mitigation focused on productive investments (e.g., energy efficiency improvements for climate change)