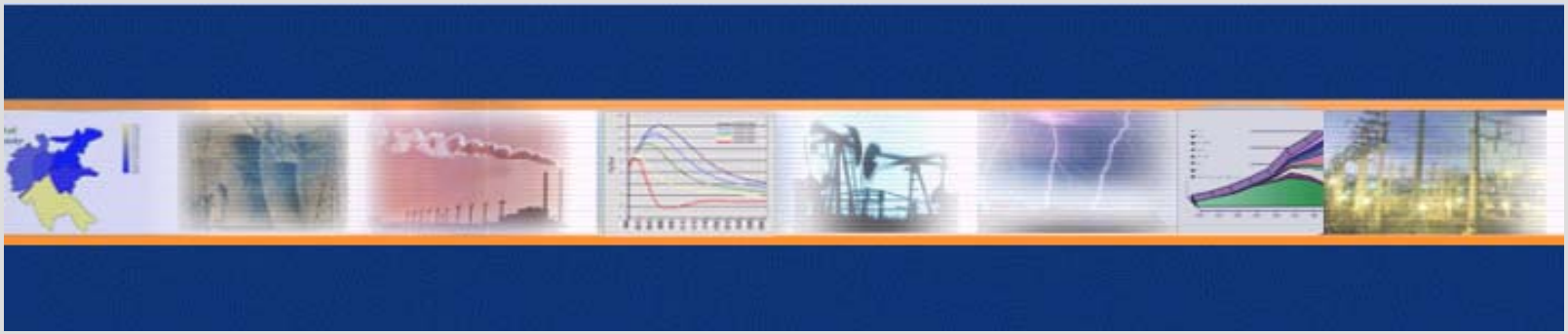
Low Carbon Society (LCS):
Scenario, Modeling and Analysis for India



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What is a “LCS” in the Developing Country context?

LCS is a “**Development Pathway**” which:

a. facilitates achievement of the **national socio-economic objectives and targets,**

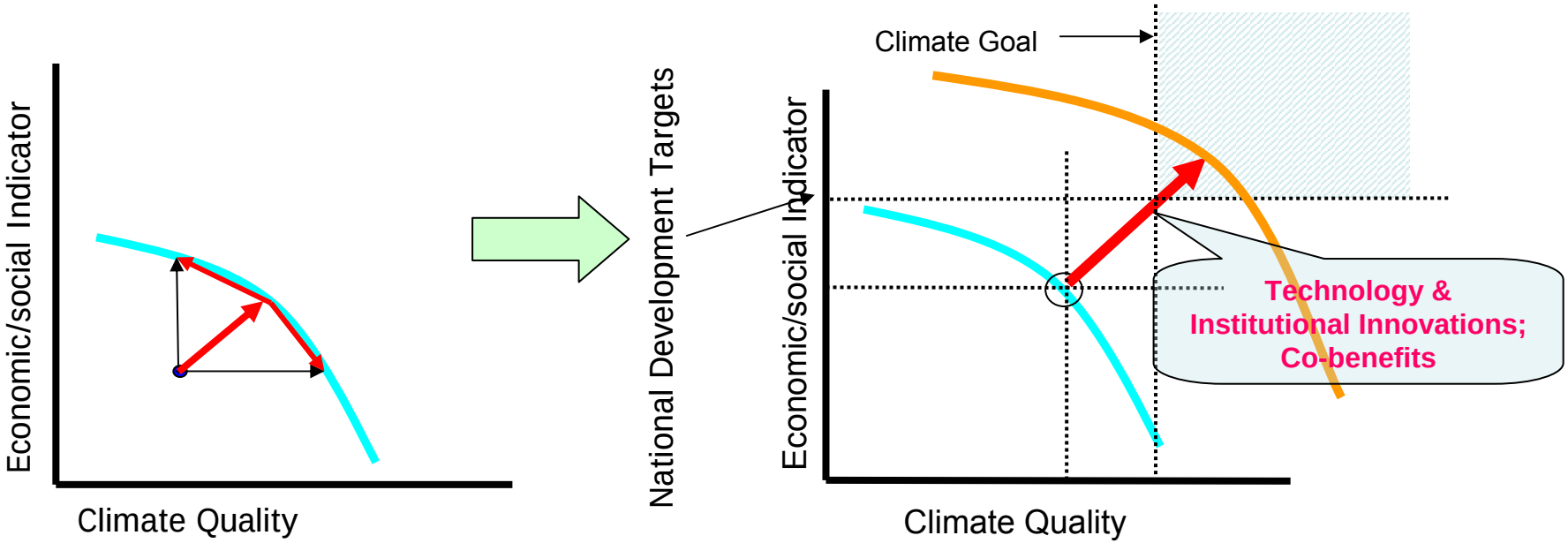
b. while contributing to the achievement of **global objectives and targets** for stabilization of greenhouse gas concentrations in the atmosphere,

c. in a **cost-effective and sustainable** manner.

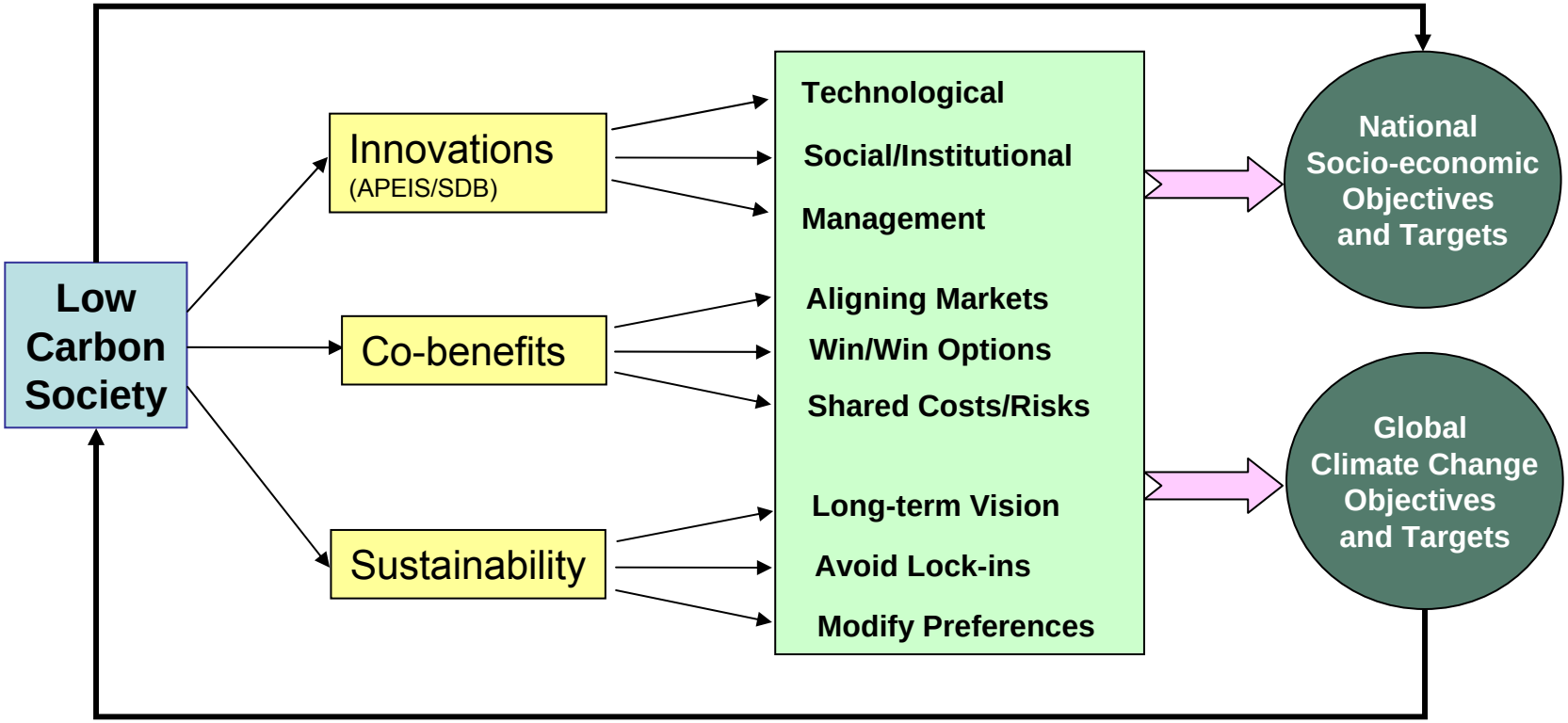
LCS: Conceptual Framework for Developing Countries

"For developing countries, the 'good news' is that their environment and natural resources policies are often so bad that there are reforms which would be both good for the economy and good for the environment."

Joseph Stiglitz, in Foreword to "Economic Development and Environmental Sustainability: New Policy Options" Eds. Lopez and Toman, Oxford University press, 2006



Low Carbon Society Roadmap



Specifics of the roadmap would differ across countries. What is important is to communicate transparently the qualitative story and its quantification (i.e. modeling)

Low Carbon Society: Scenario Development for India

Key areas for interventions:

- Demographics
  - Lower Population Growth (e.g. investment in women's education)
  - Higher investment in social infrastructures (e.g. health, education)
- Conservation
  - Efficient technology, Substitutions, Recycling, Pricing, Dematerialization
- City Planning
  - Architecture/ Building Codes; Land use policies; Public Transport
- Infrastructure choices
- R&D, technology transfer and selective technology push
- Incentives for environmental industry
- Influencing consumer preferences/ behavior

How sustainable development policies influence LCS?

E.g. Education, Employment and Productivity nexus

- Policies for public private partnership → higher (public and private) investments in education → Increases supply of education services
- Incentives for education for women and socially and economically backward sections enhances demand for education
- Women's education reduces fertility rates & this together with family planning campaigns lead to lower population (than in reference & some others cases)
- The increases in labor participation rates and enhanced skill profiles maintains labor supply and higher productivity in next few decades
- Rural development policies (including education, employment, infrastructure push and reduced risk for investments) break through the rural/ urban dualism

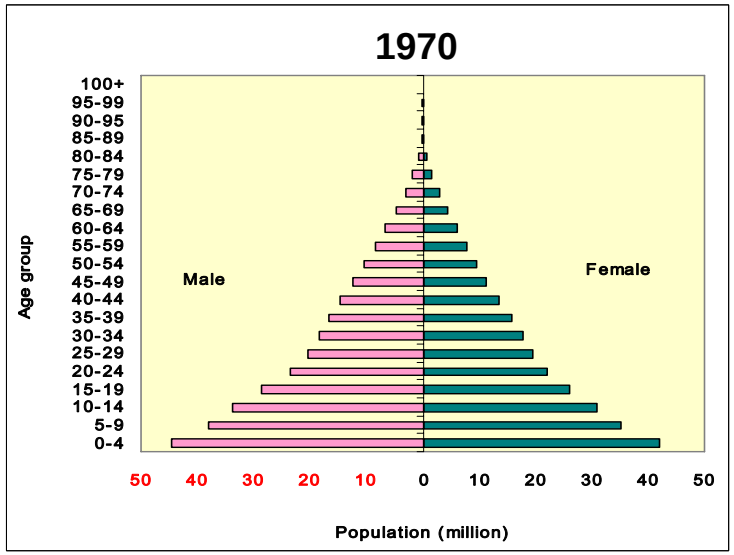
(Likewise for other drivers, the sustainability scenario story differ)

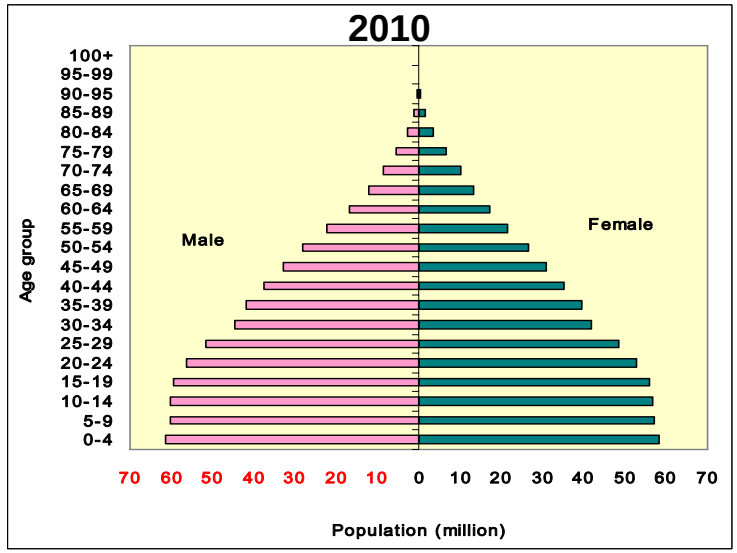
Scenario Drivers

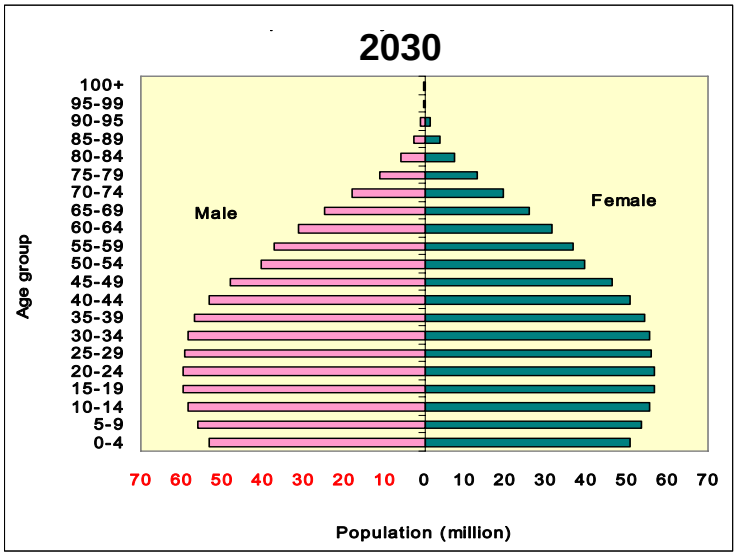
- **Factors of Production**
  - Labor Supply, Land-Use, Capital (Savings/ Investments)
- **Inputs: Resources supply/ Technologies**
  - Energy
- **Intermediate goods & investments**
  - Infrastructures
  - Energy (& Carbon) Intensive Sectors
- **Final Demand/ Behavior**
  - Private Consumption (Income effects/ preferences)
  - Government expenditure
- **Governance**
  - Rents
  - Taxes
  - Geopolitical Risks
- **Global/ External**
  - Trade
  - Geopolitical Risks

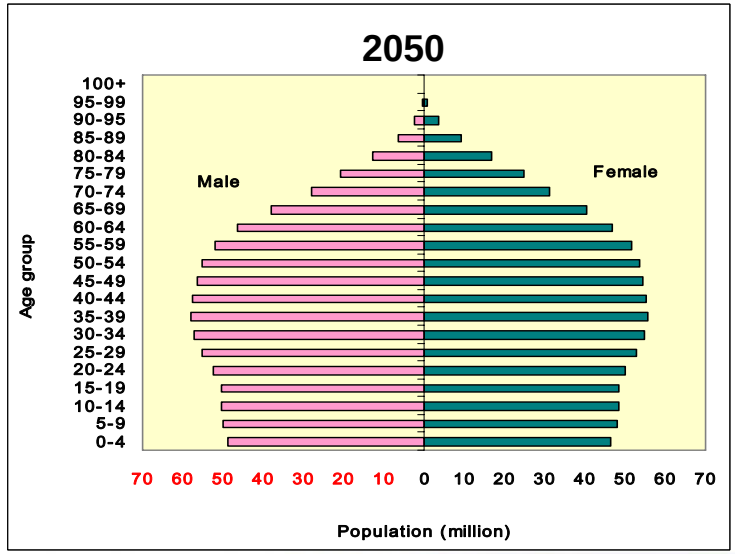
Demographic Transitions, Human Capital, Productivity, Growth and Sustainability

Demographic Transitions in India: Age/Gender Profile

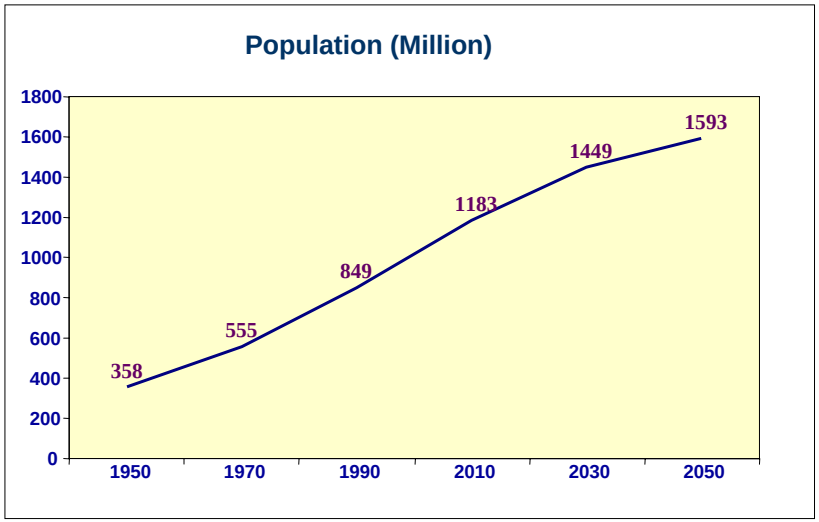


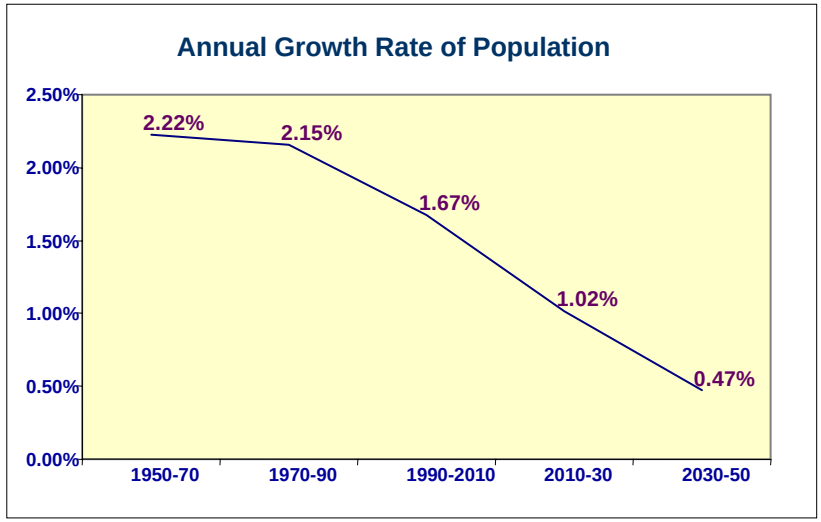


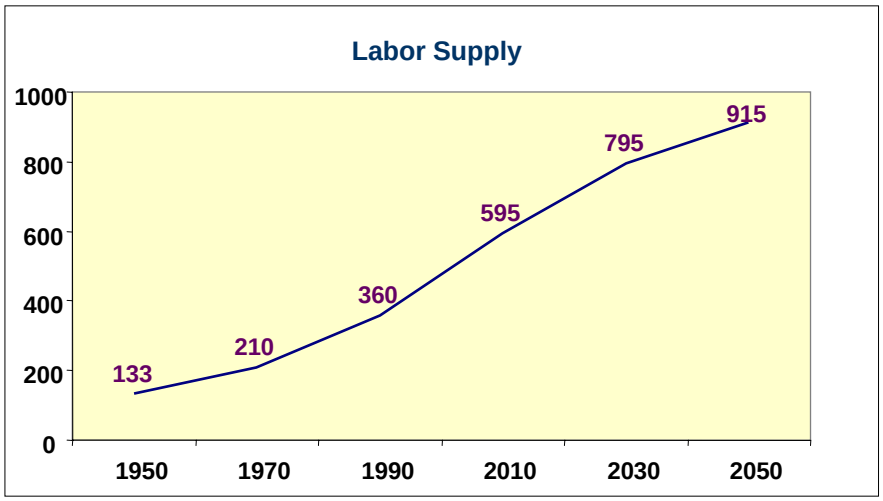


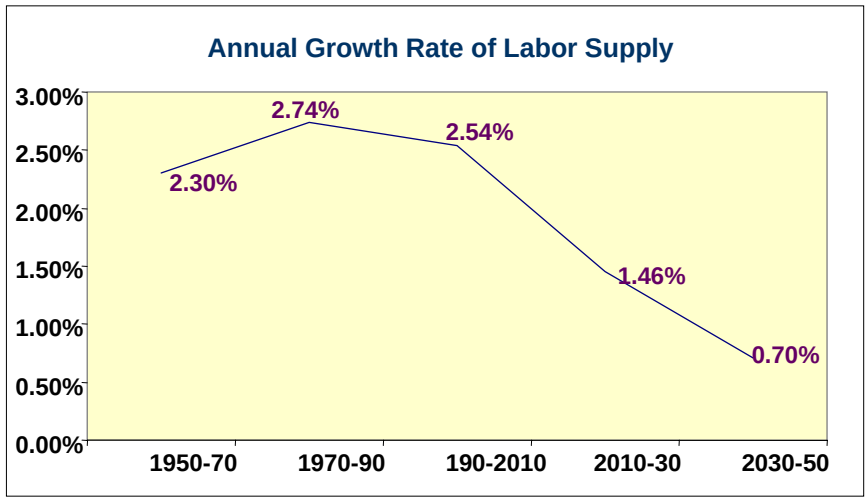


Population and Working Age Population



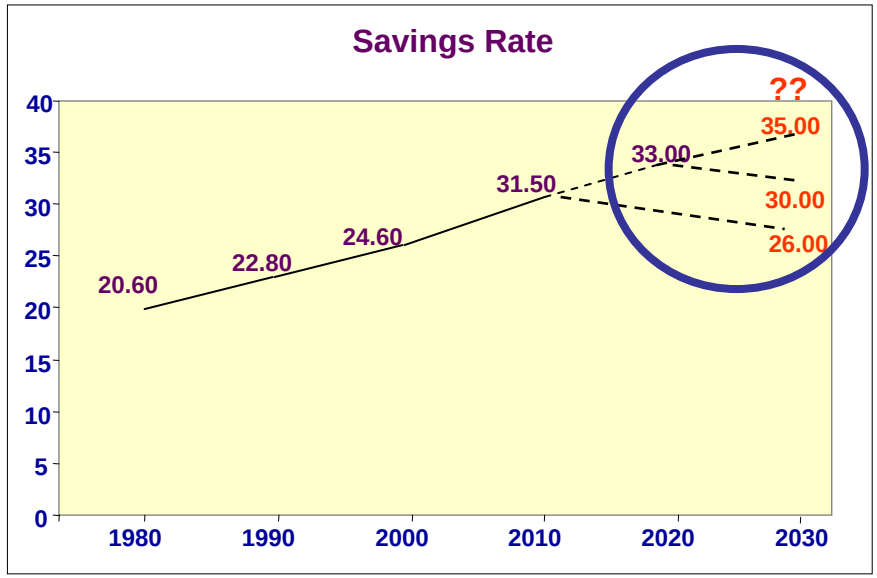




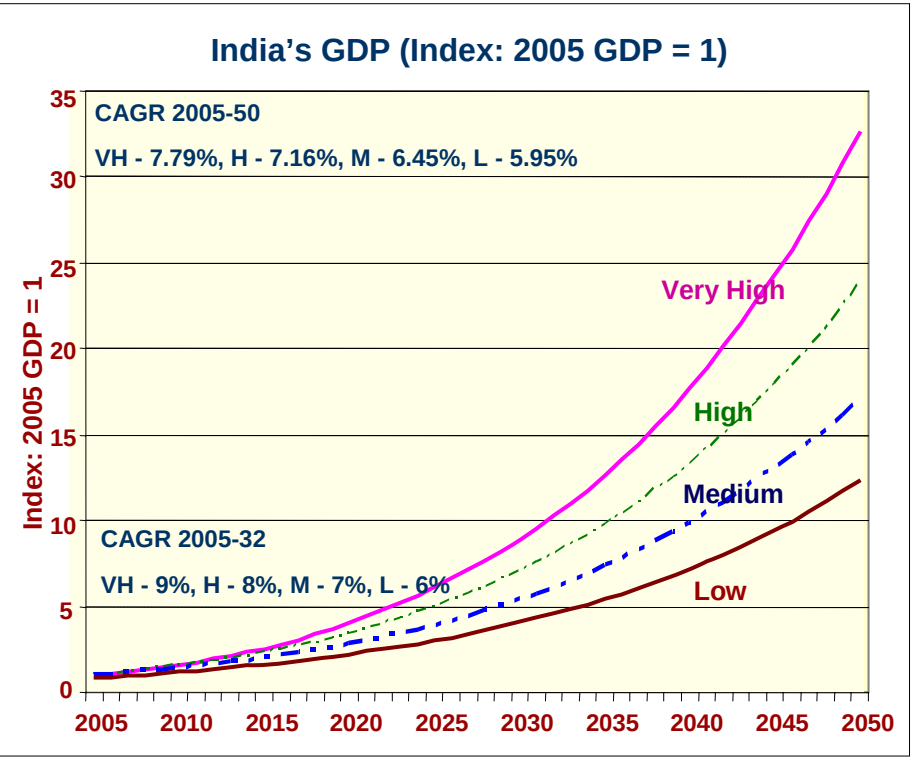


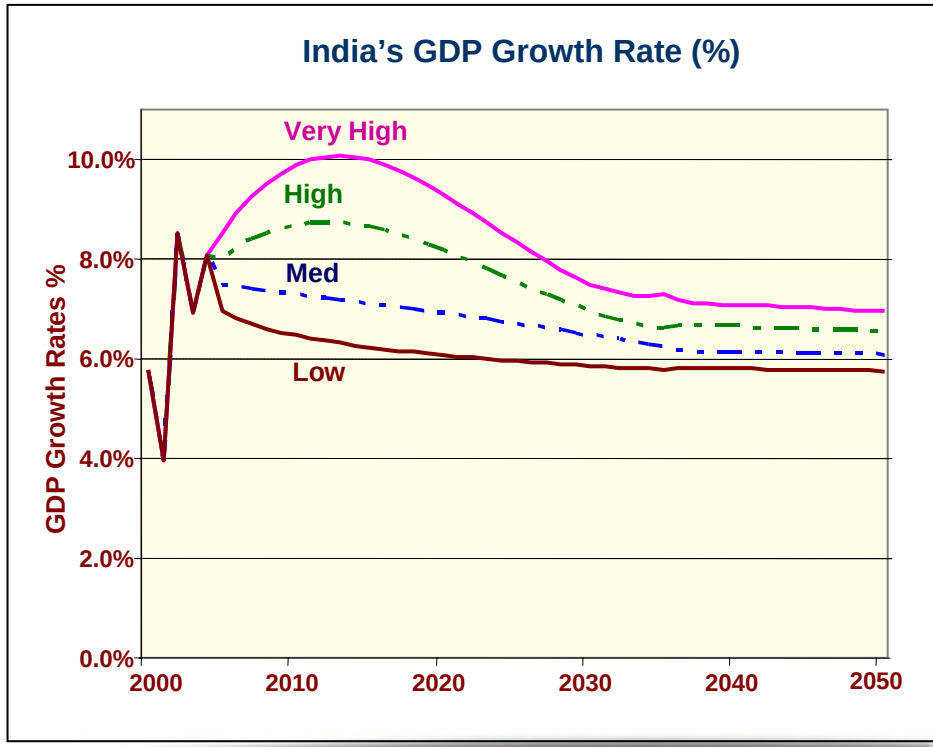
Growth Scenarios

- Human Capital
  - Government Expenditure in Education
  - Private Expenditure in Education
  - Urban / Rural & Gender-wise Education Expenditure
  - (Net) Migration by Labor Classes (intra & inter county)
- R&D
  - Government/ Private Expenditure
  - Knowledge Flows
- Technology
  - Backbones (infrastructures)
  - Learning, transfers, deployment
- Saving/ Investments
  - Social Security
  - Lifestyles, Behaviors
- Governance
  - Institutions
  - Laws
  - Policies



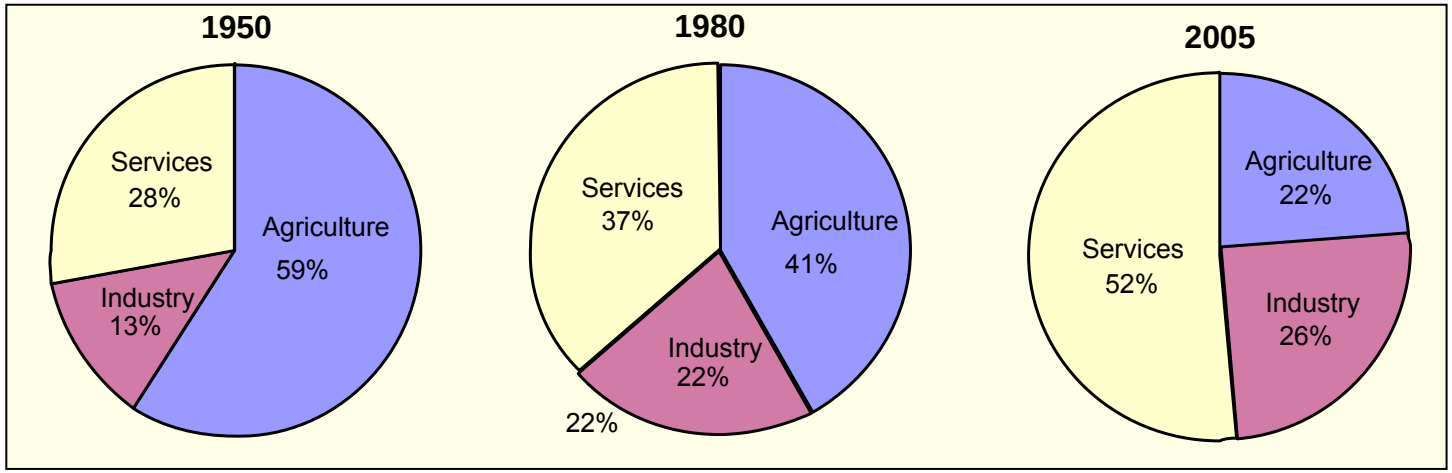
India's Economic Growth: Future GDP Projections



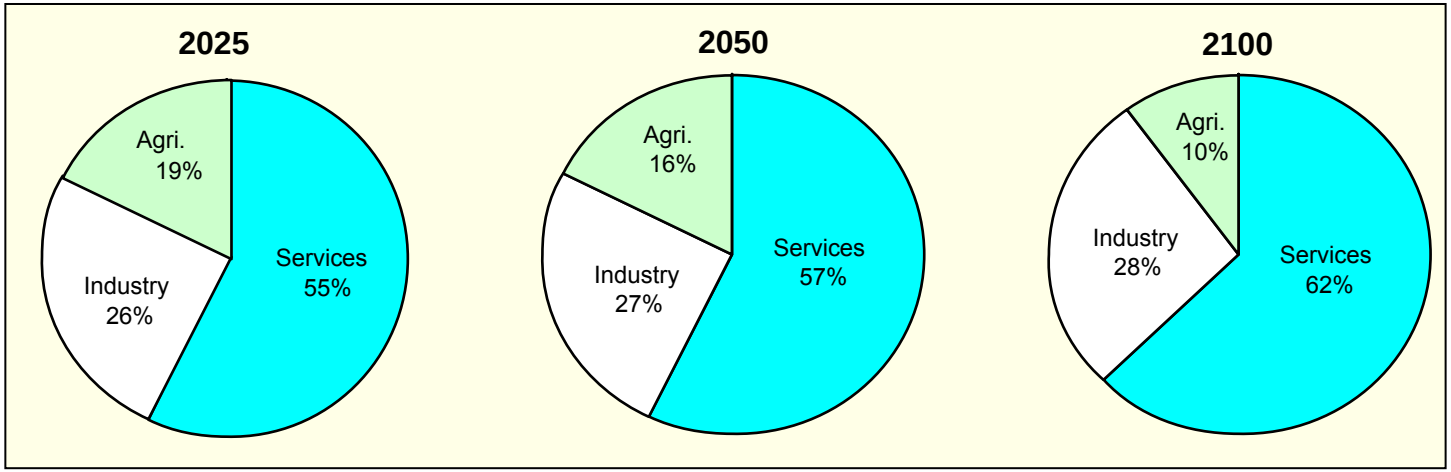


Changing Structure of the Economy

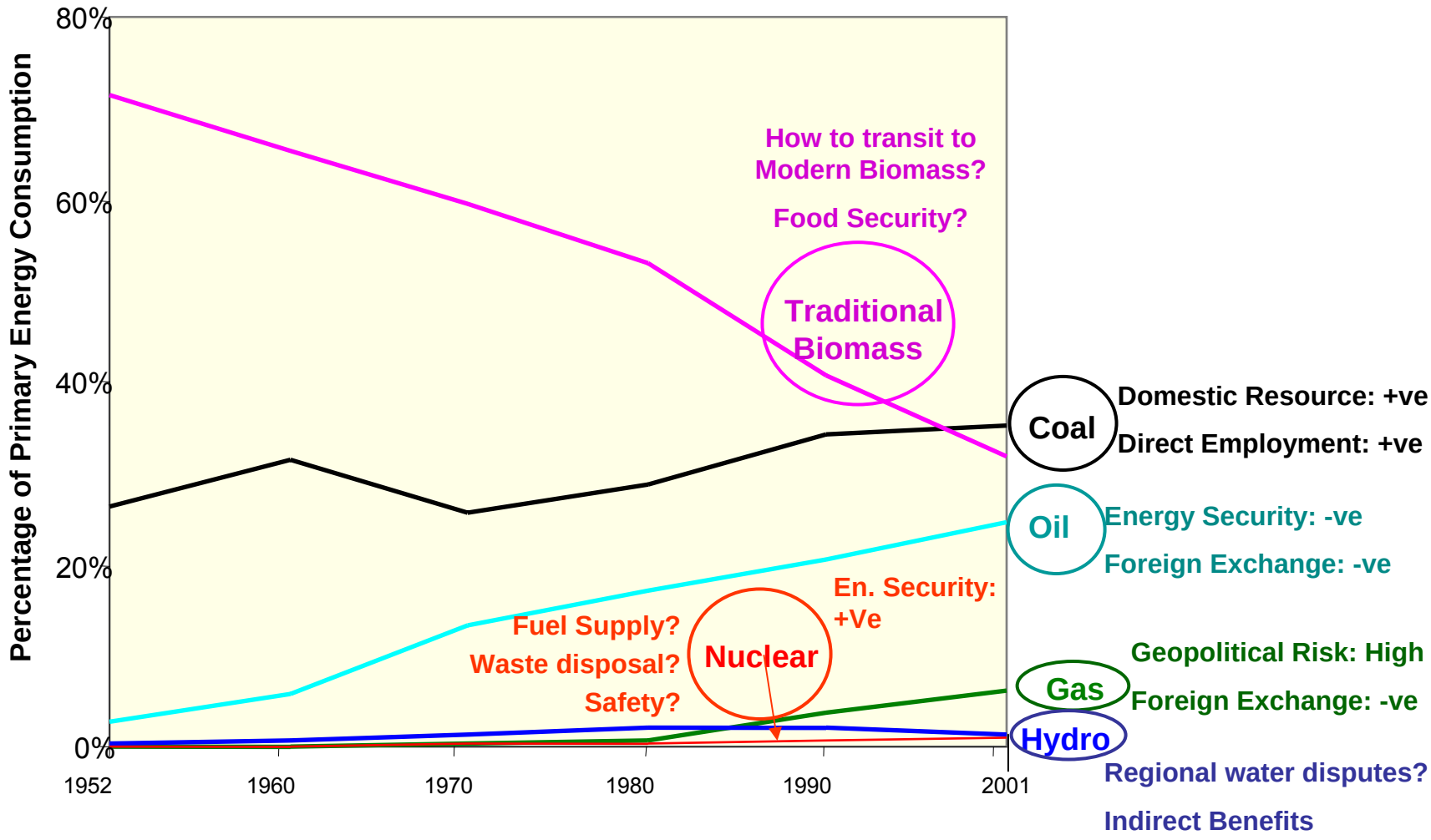
History



Future



Changing Structure of Energy Use

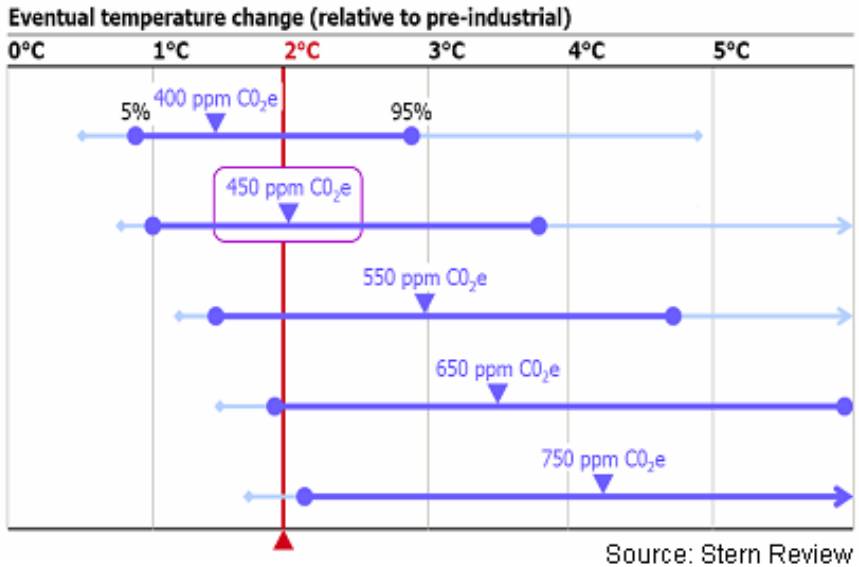


Modeling & Analysis of Low Carbon Development Path

Low Carbon Society (LCS) Scenario

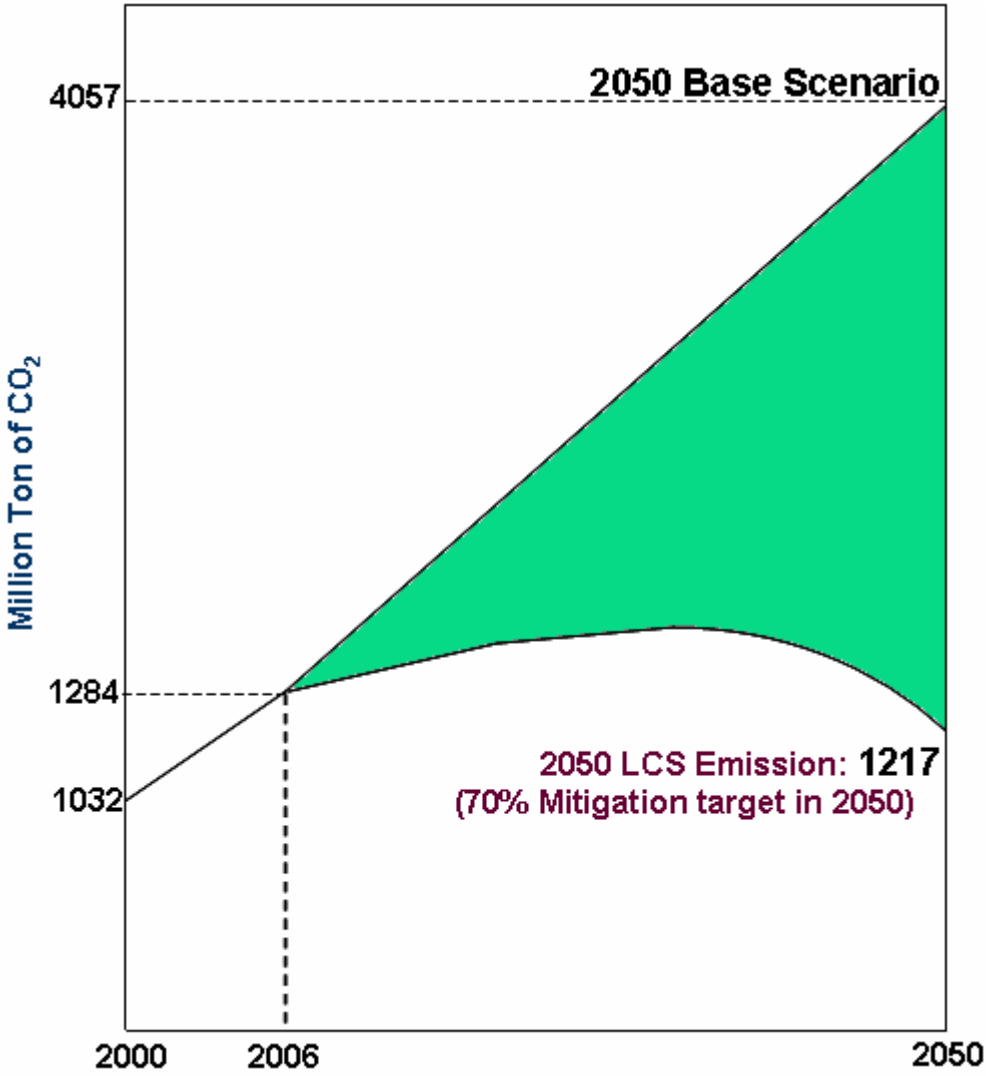
Drivers of India's LCS Scenario

- Carbon Market Signal (e.g. from 2°Centigrade Global Target)
- Energy Device Efficiency (Demand and Supply-side)
- Dematerialization
  - Building Materials and Design
  - Reduce (demand), Recycle & Reuse (3R) Materials
- Infrastructure investments
  - Avoid lock-ins
  - Shift demand (e.g. transport modal split)
- R&D and Technology Transfer
  - Leapfrog (to the efficiency frontier)
  - Innovations (to shift the efficiency frontier)
- Planning & Governance
  - Facilitate change in Lifestyles & Behaviors
  - Institutions, Laws, Policies



Source: Stern Review

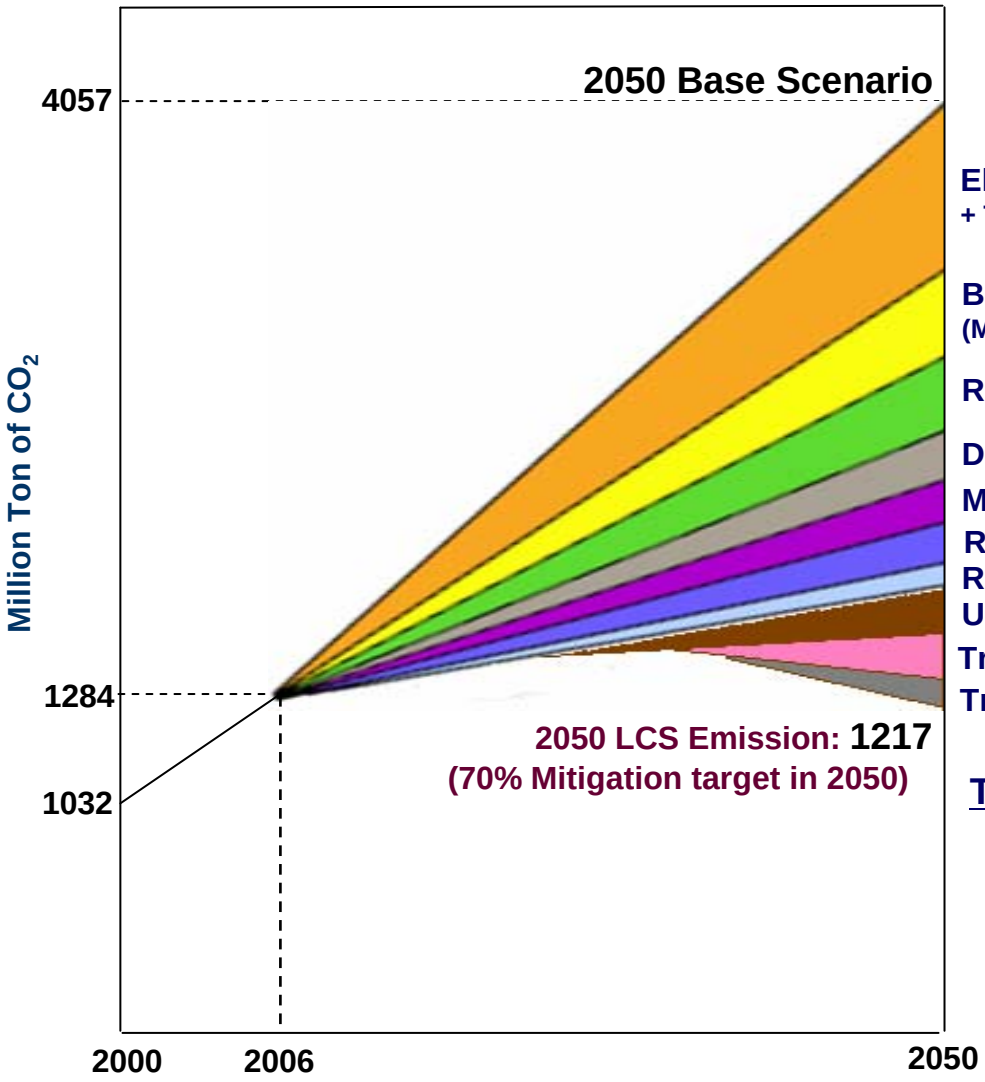
Carbon Emissions: Base vs. LCS Scenario for India



India's Cumulative Carbon Emission from 2000-2050

	Billion Ton of CO_2
Reference Scenario:	127.2
LCS Scenario:	64.3
Cumulative Mitigation in LCS:	62.9
% Cumulative Mitigation in LCS:	49.5%
% Mitigation in LCS in 2050:	70.0%

Mitigation in LCS Scenario for India



Mitigation in LCS (in 2050)	
Electricity (Supply + T&D Efficiency)	745
Buildings (Materials/Design)	384
Renewable Energy	328
Device Efficiency	274
Material substitutions	207
Recycling	173
Reduced Consumption	90
Urban Planning	265
Transport (Modal shift)	272
Transport Infrastructure	102
Total CO_2 Mitigation	**2840**

Mitigation through “dematerialization” in LCS Scenario

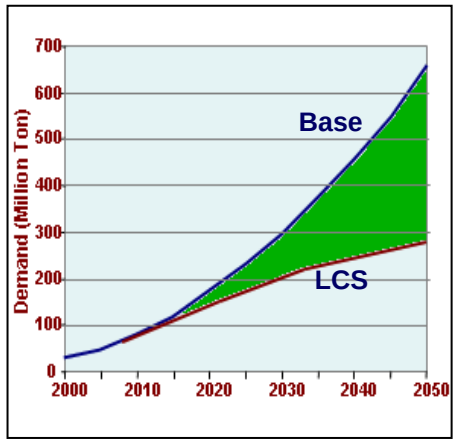
- **Dematerialization in LCS vis-à-vis Base Scenario is contributed by multiple direct and indirect policies, most of which belong to the policy packages relating to “sustainable development”.**
- **Change in building materials and design contribute significantly to dematerialization and energy efficiency in construction**
- **In addition, three other key contributors to mitigation through dematerialization are:**

	Mitigation (MT CO_2) in 2050
Material Substitutions	207
Reduced Consumption	173
Recycling	90

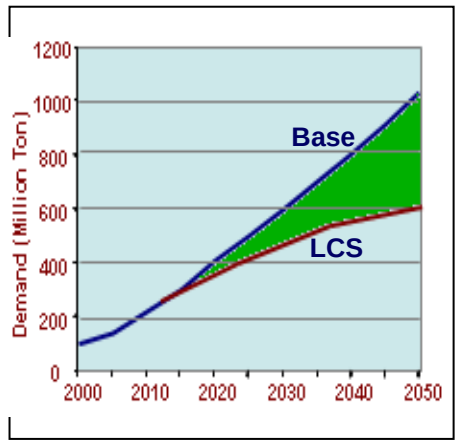
- **Energy and carbon intensive materials - of which the substitutions and reduced consumption contribute most to mitigation in the LCS scenario - are steel, aluminum, cement, fertilizer and paper.**
- **Recycling reduces the energy and carbon intensity of the materials, besides delivering environmental co-benefits.**

Materials Demand in Base vs. LCS

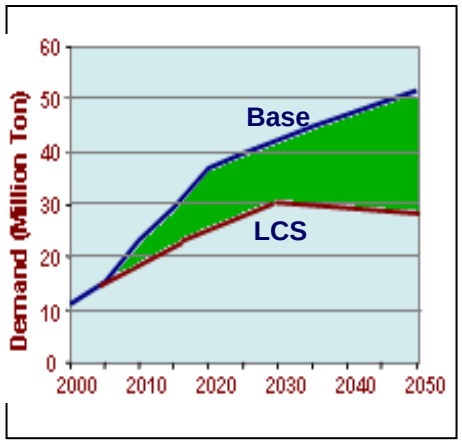
Steel



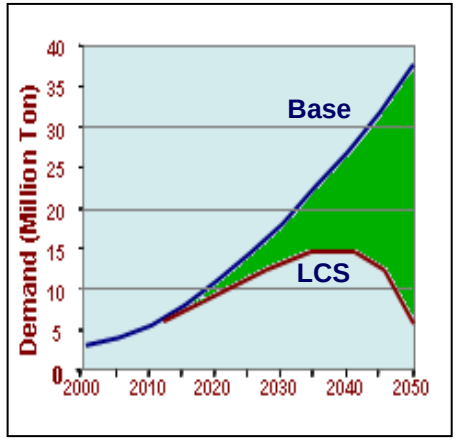
Cement



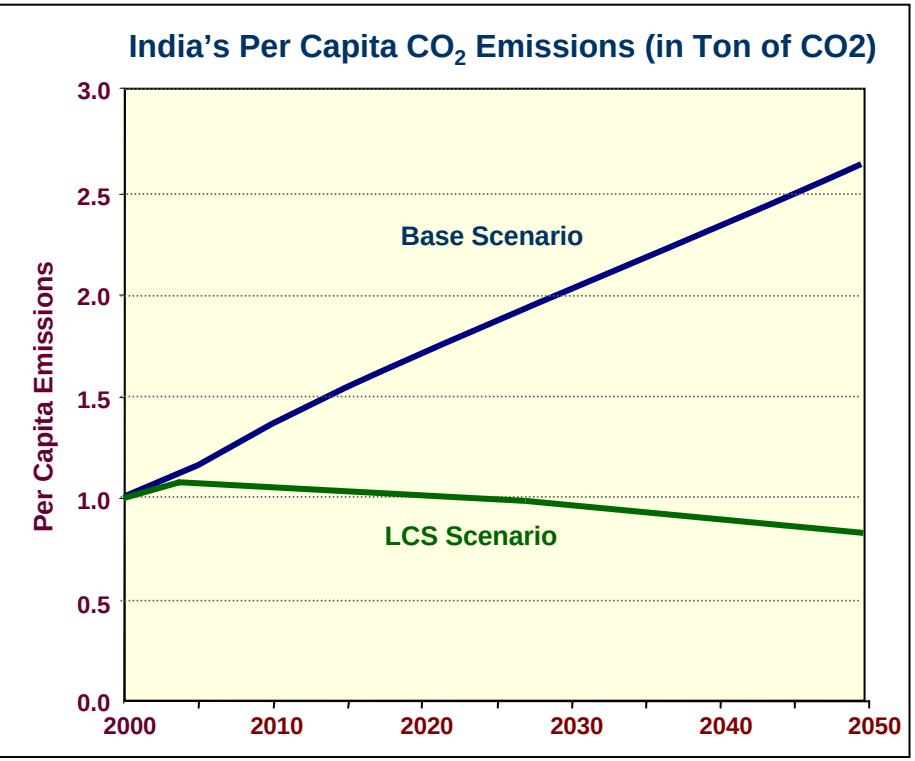
Fertilizer

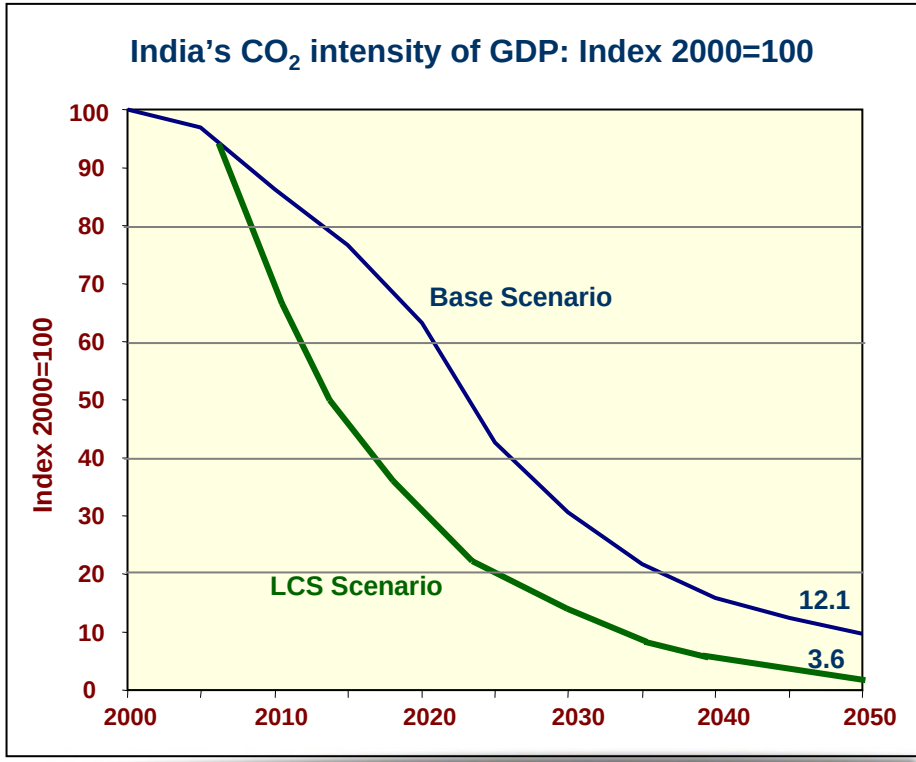


Paper

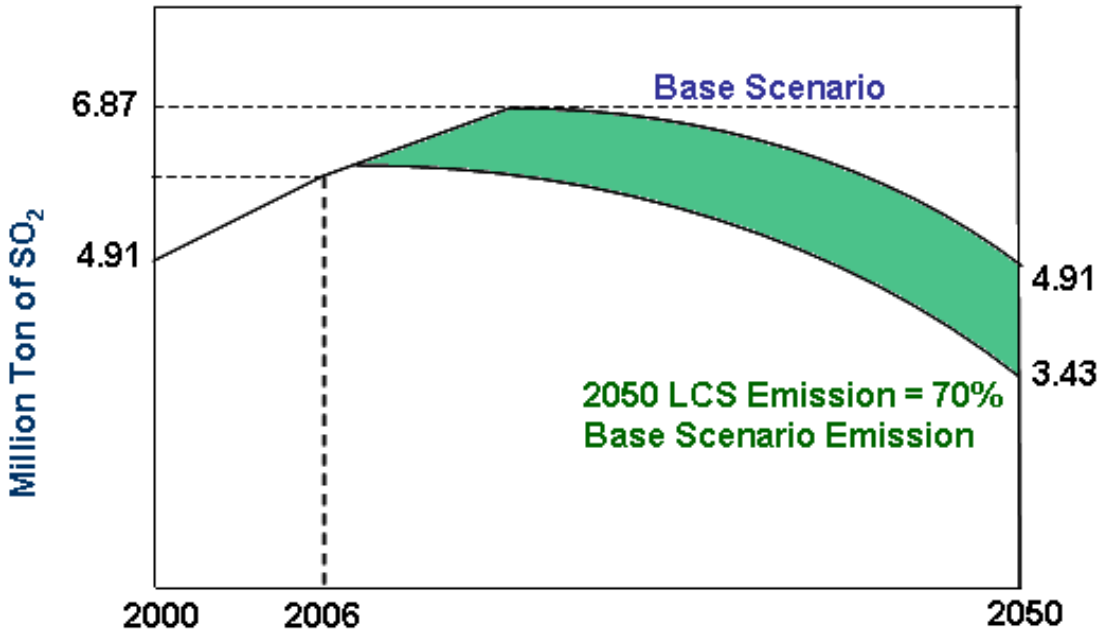


CO2 Intensities: Base vs. LCS Scenario





SO2 Mitigation Co-benefits of LCS Scenario



Joint Mitigation (Period 2007-2050)

Mitigation Regime	Co-benefits
SO_2 mitigation alone in Reference Scenario	Little carbon mitigation
SO_2 Co-benefit in LCS Scenario	LCS policies generate benefits equivalent to 30% lower SO_2 in 2050 and cumulative saving in SO_2 Emissions Reduction equivalent to $11.2 billion over period 2006-2050

Conclusions: LCS Scenario

LCS in Developing Countries Context

- LCS actions are primarily development centric and facilitate achieving **national sustainable development** and **global environmental** objectives **simultaneously** and **cost-effectively**

LCS Scenarios in Developing Countries Context

- LCS scenario storyline for developing countries rests on **innovations, co-benefits** and **sustainability**
- The key issues in **near-term** is to gain **co-benefits** and avoid **lock-ins** and in the **long-run** to transit to a **sustainable development pathway**

LCS Modeling and Analysis for India

- India will have low **per capita emissions** throughout the century
- Significant opportunities exist in India (and South-Asia) for aligning **sustainable development and climate** actions which can deliver **co-benefits** in the short-term and avoid **lock-ins** in the long-term

LCS Roadmap for Developing Countries

- **Mainstream** climate change and development through Sustainable Development objectives and targets
- LCS Roadmap will include adaptation measures

Thank you