

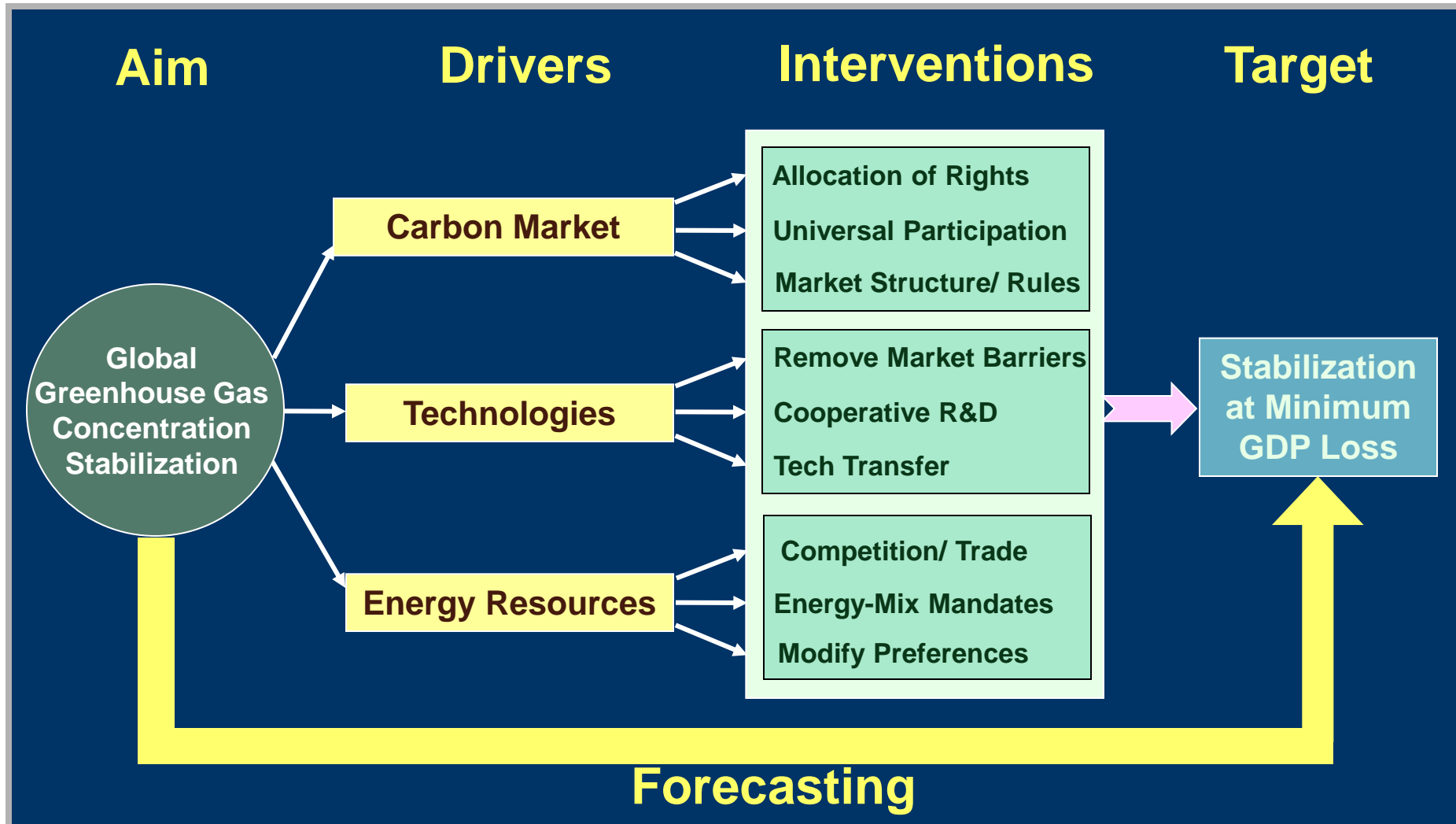
Low Carbon Scenarios for India

P.R. Shukla
Indian Institute of Management
Ahmedabad, India

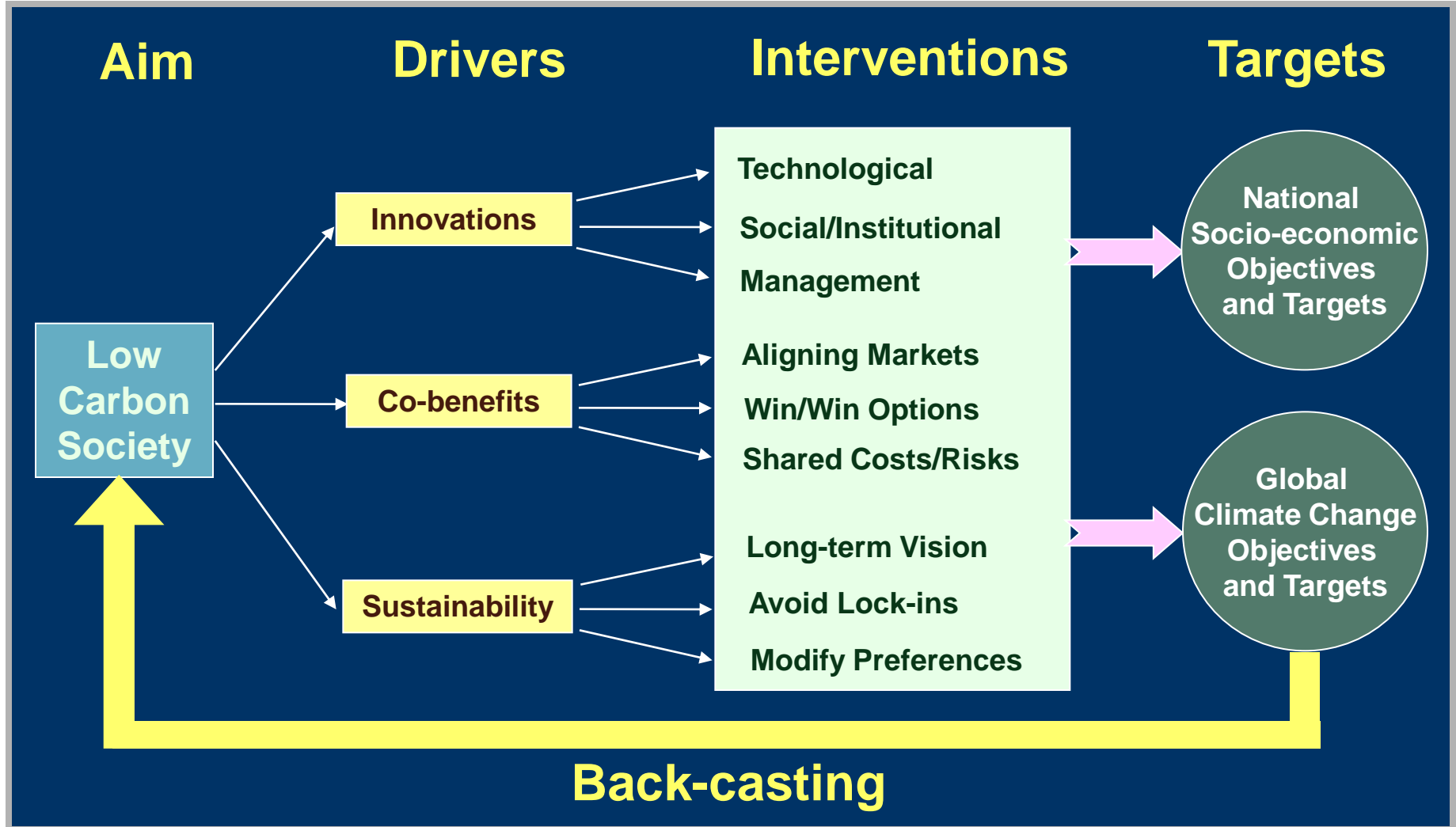
Presented in the **“LCS•RNet 1st Annual Researchers Meeting’**
Bologna, Italy, October 12-13, 2009

LCS: Alternate Visions and Approaches

LCS: Conventional Climate Centric Vision & Approach



LCS: Sustainability Vision & Approach



LCS Scenarios and Modeling Framework

INDIA: National Climate Change Action Plan

8 National Missions:

1. Solar Energy (100 MW PV/yr; 1000 MW Thermal by 2017)
2. Enhanced energy efficiency (10000 MW saving by 2012)
3. Sustainable habitat
4. Water Sector (20% water use efficiency improvement)
5. Sustaining the Himalayan eco-system
6. A “Green India” (6 Mil. Hectare afforestation; Forest cover from 23 to 33%)
7. Sustainable agriculture
8. Strategic knowledge for climate change

LCS Scenarios with Sustainability

- **Focus on:**

- Mainstreaming climate actions in development plans/policies/processes
- Behavioral Changes, Innovations, Co-benefits and Co-operation
- Up-front decisions to avoid long-term lock-ins

- **Sustaining Capital Stocks**

- Natural, Man-made, Human & Social

- **Use Systems Approach for Analysis**

- Integration, Holistic/Long-term Vision, Dynamic Assessment

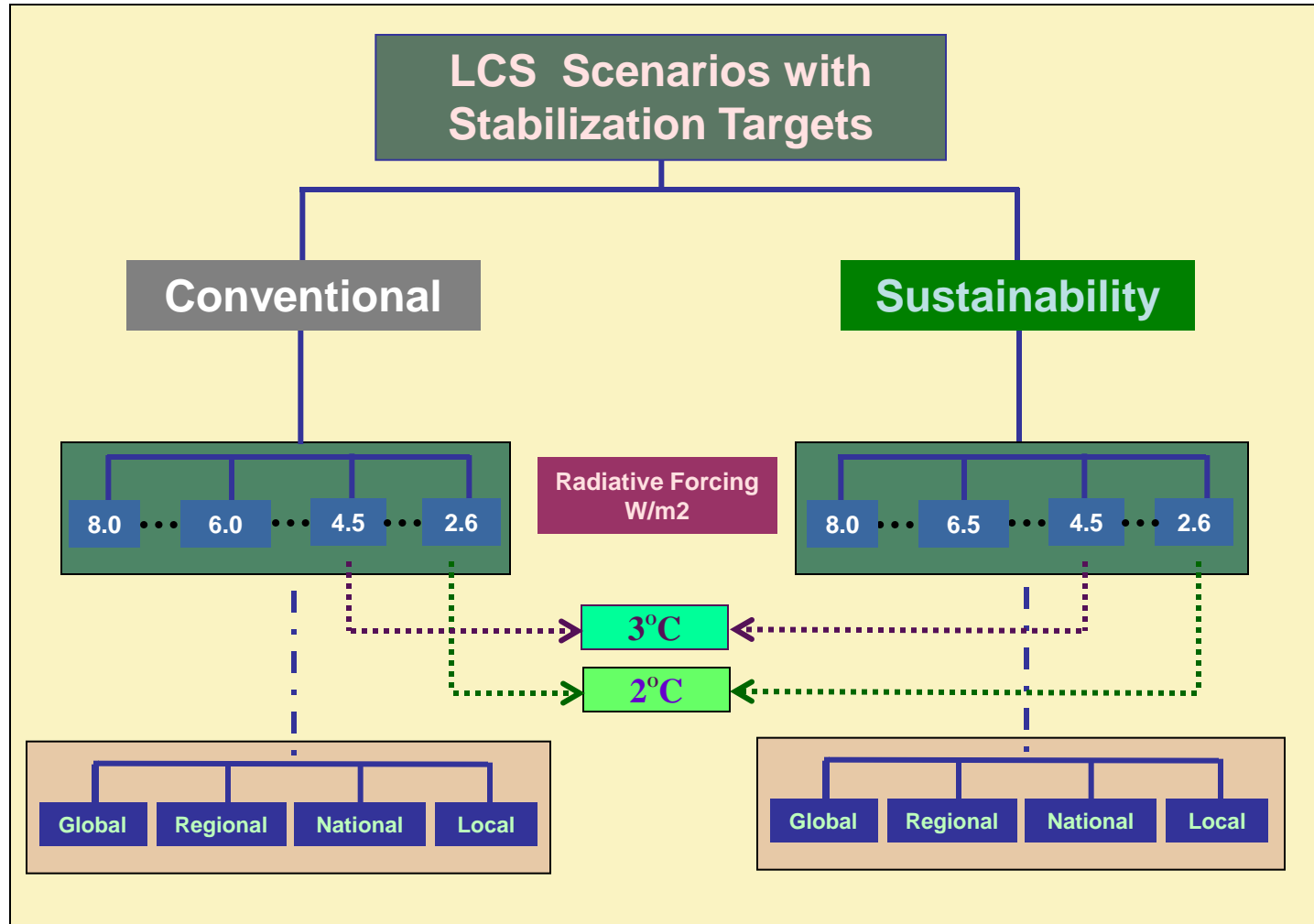
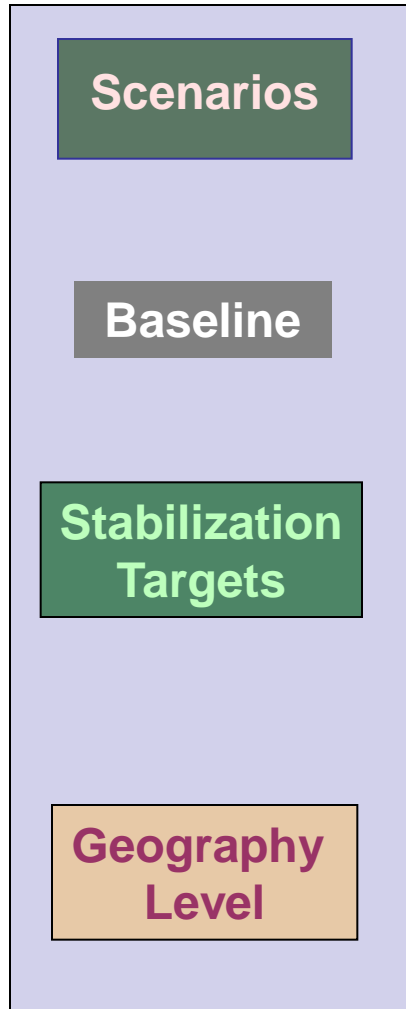
- **Interventions to influence Drivers of Change**

- Assess and influence Processes
- Institutions (to reduce transaction costs/risks and to sustain change)

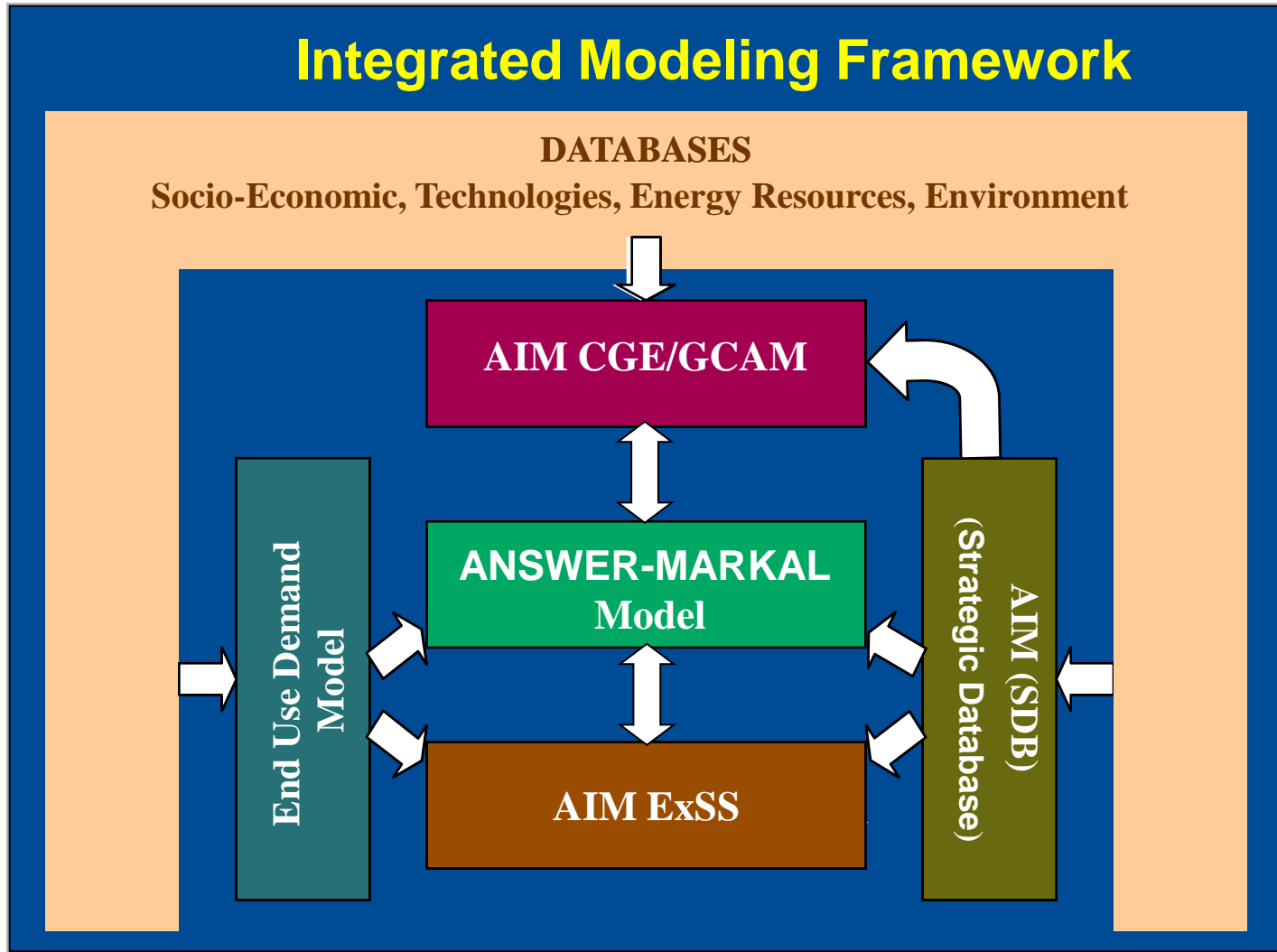
- **Shaping Stakeholder and Societal Preferences**

- Information, Awareness, Debates to arrived at informed choices

LCS Scenarios

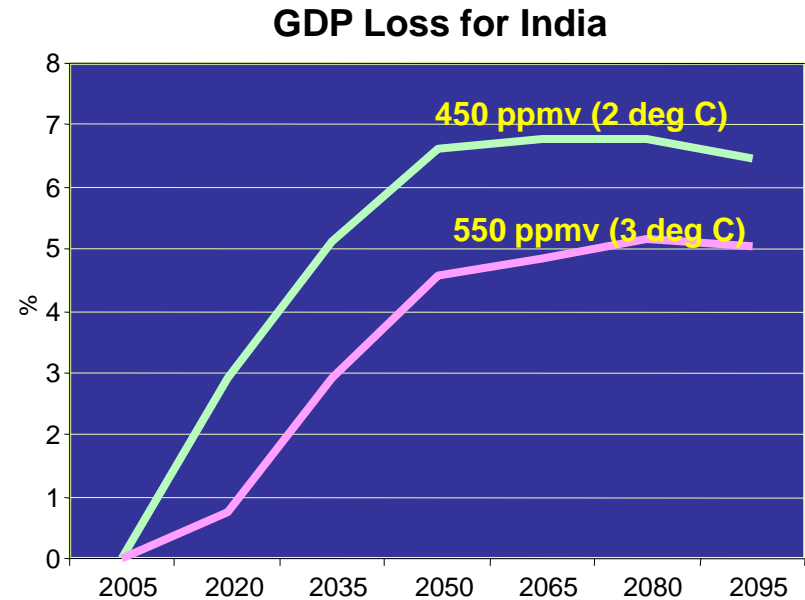
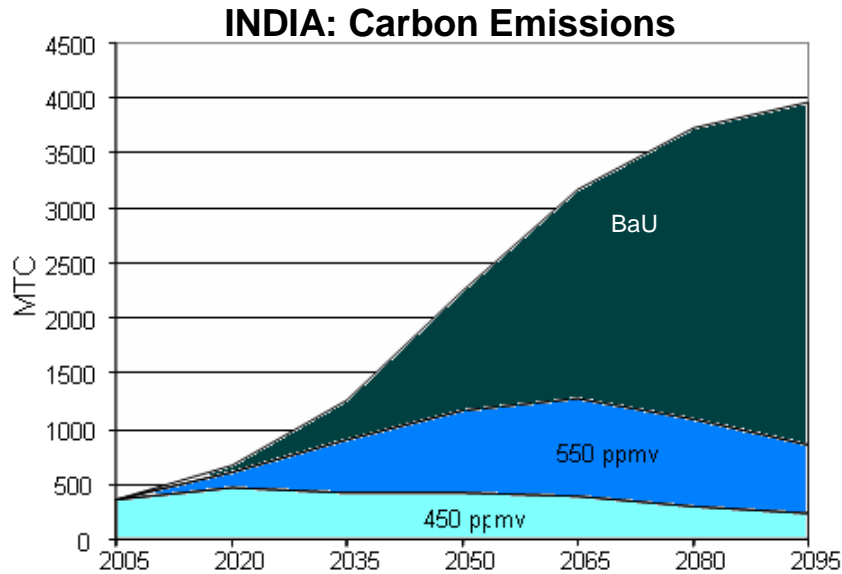
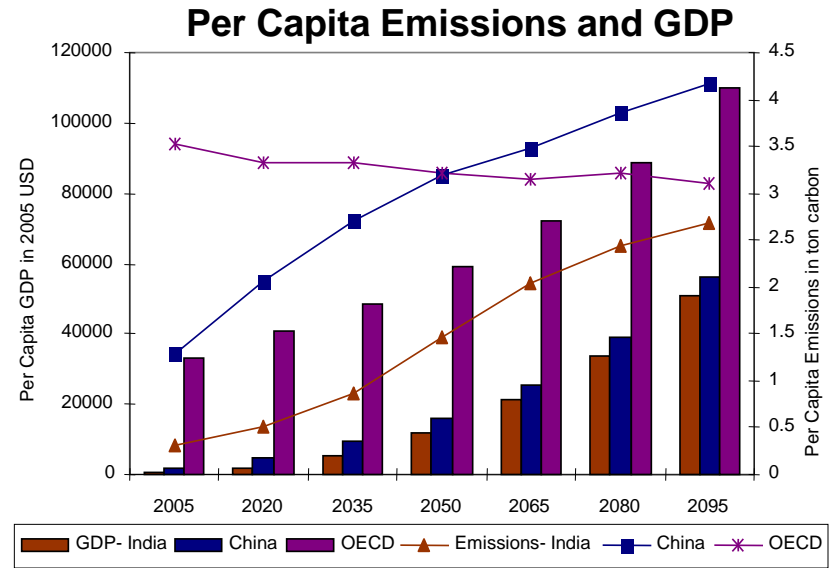
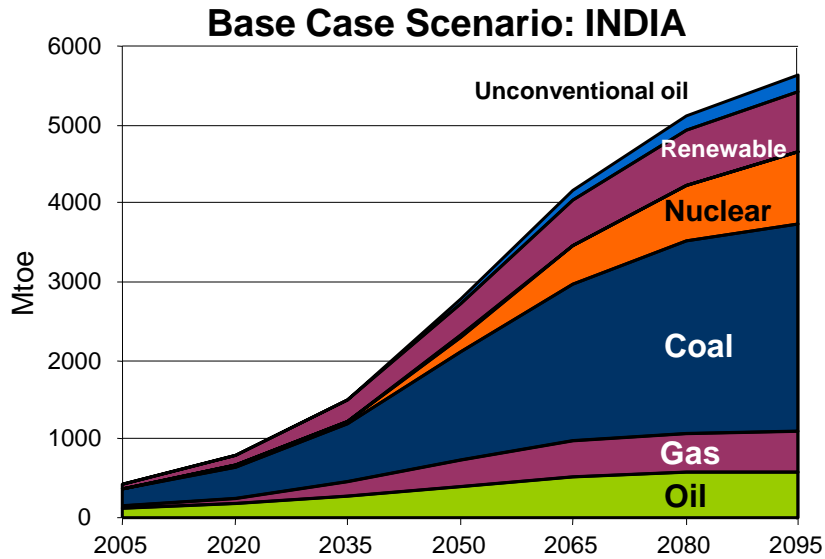


Integrated Modeling Framework



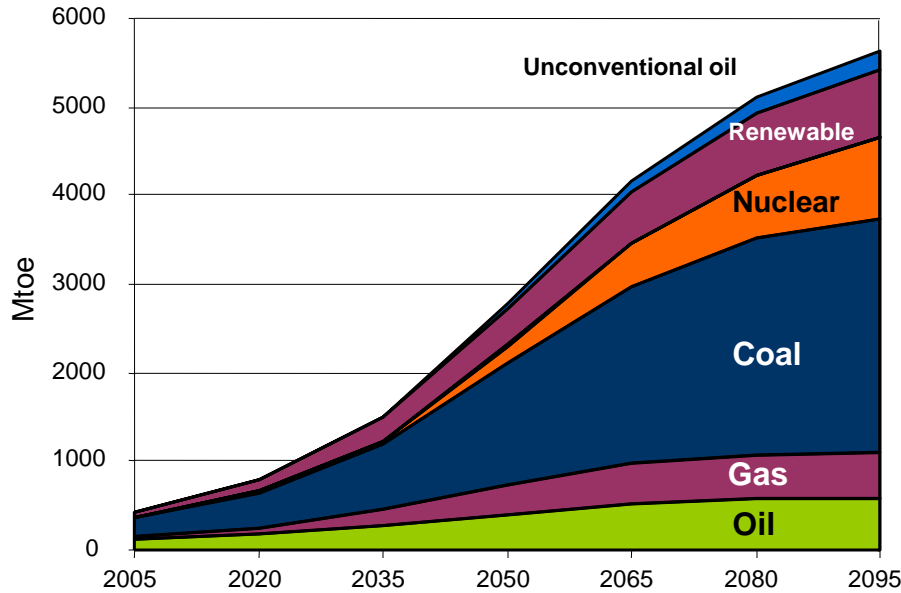
LCS Transition in INDIA: Analysis

Global & National Analysis: GCAM & AIM/CGE



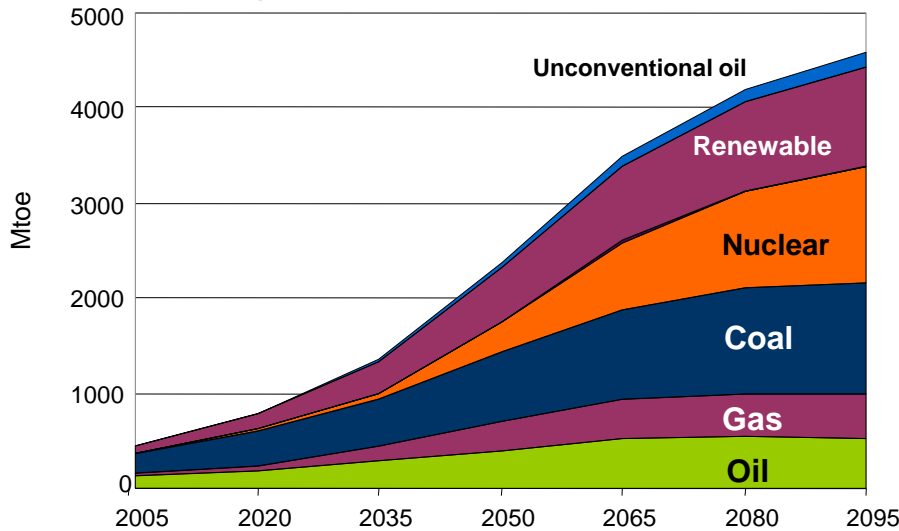
Global & National Analysis: GCAM & AIM/CGE

Energy in Base Case Scenario: INDIA

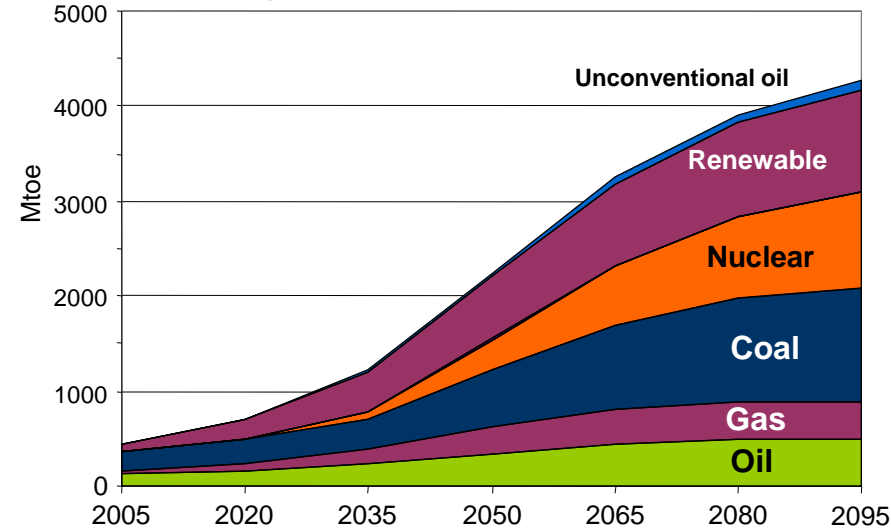


Electricity Production (in EJ) and CCS Share (in %)		2005	2035	2065	2095
Total Electricity Production (in EJ)	BAU	2.55	12.43	43.14	65.43
	450 ppmv	2.55	10.78	43.86	67.35
	550 ppmv	2.55	10.51	39.58	61.91
Coal w/CCS (in %)	450 ppmv	0.00	29.71	36.20	33.38
	550 ppmv	0.00	6.20	21.31	29.08
Gas w/CCS (in %)	450 ppmv	0.00	5.38	5.06	4.03
	550 ppmv	0.00	1.63	2.75	2.85
Biomass w/CCS (in %)	450 ppmv	0.00	5.72	10.67	11.83
	550 ppmv	0.00	0.71	3.19	5.54

Energy in 550 ppmv Scenario: INDIA



Energy in 450 ppmv Scenario: INDIA



National Analysis: MARKAL & End-Use Models

Base Scenario: Growth of Economy and Population

From 2005-2050:

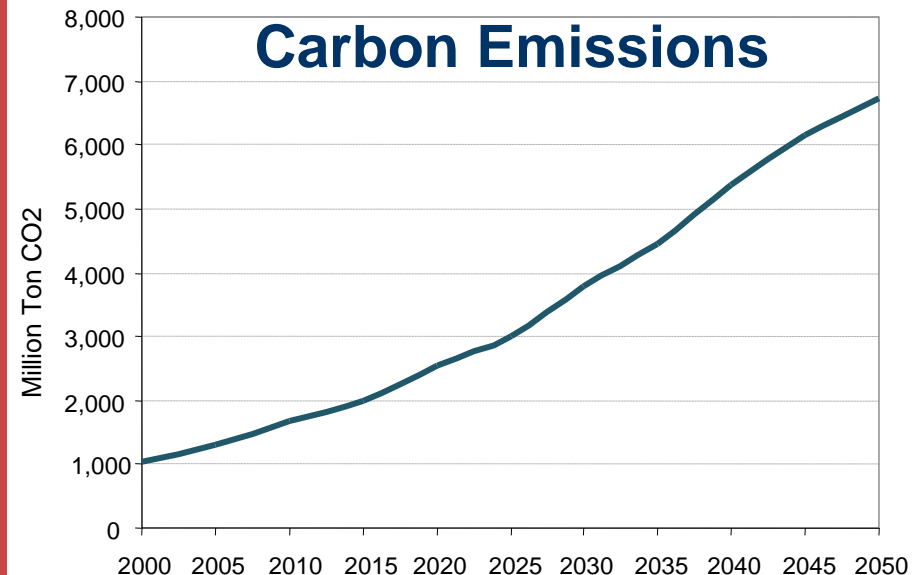
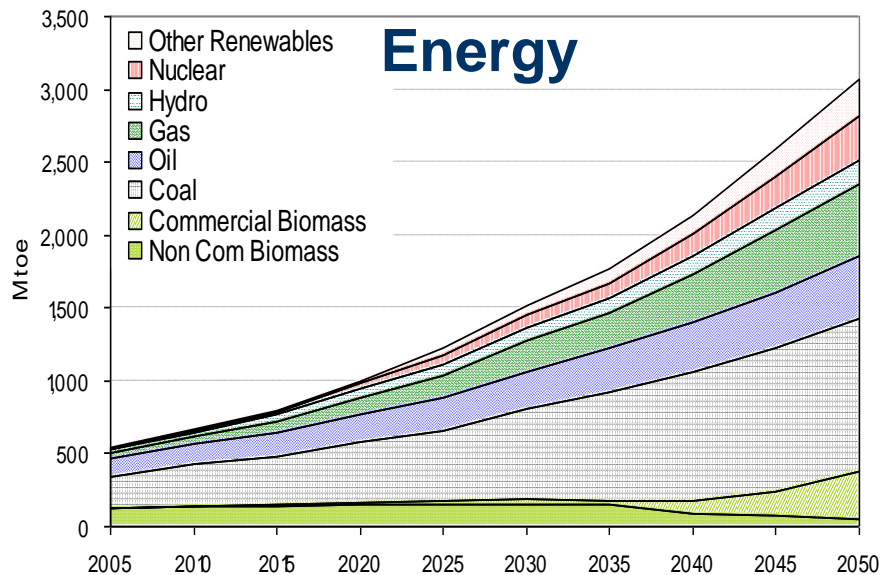
Annual Economic Growth: 7.2%

Annual Population Growth: 0.9%

Absolute Growth in 2050 over 2005

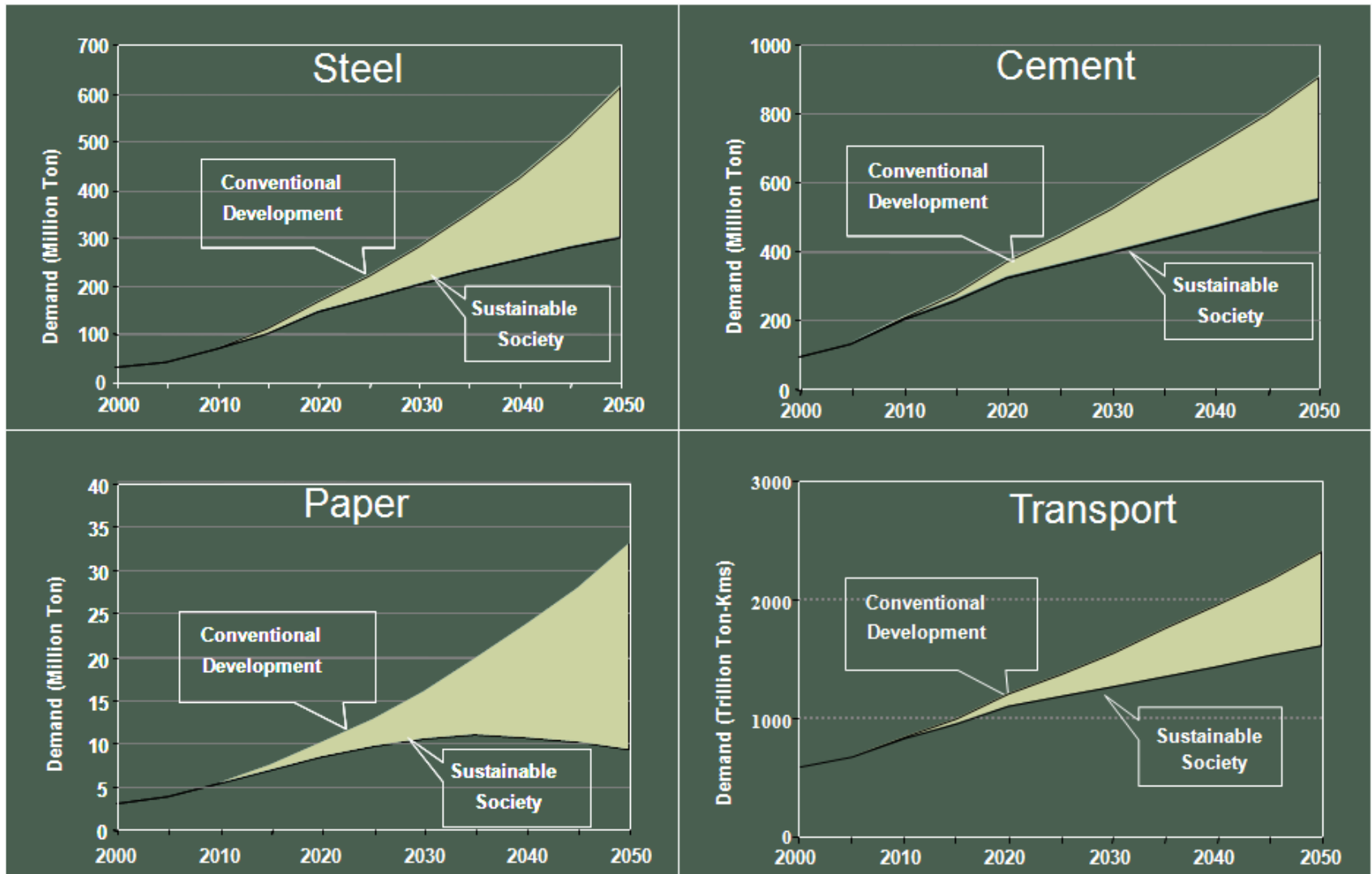
Economy 23 times

Population 1.56 times



LCS Transitions: 550 ppmv (3°C)

Dematerialization



Co-benefits of Energy Choices

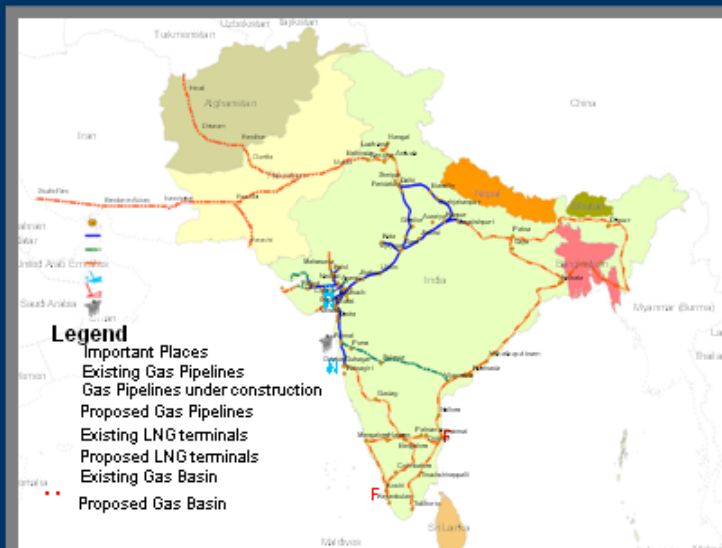
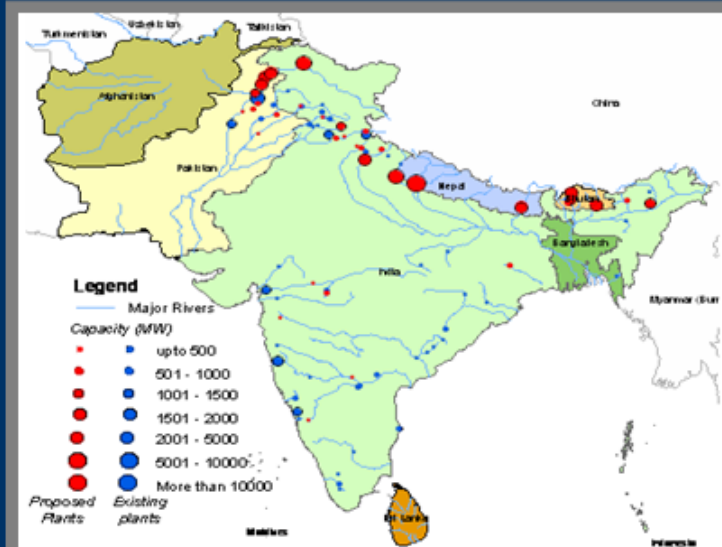
MDG 1: Eradicate extreme poverty and hunger, MDG 7: Environmental Sustainability

Co-benefits of South-Asia Integrated Energy-Water Market

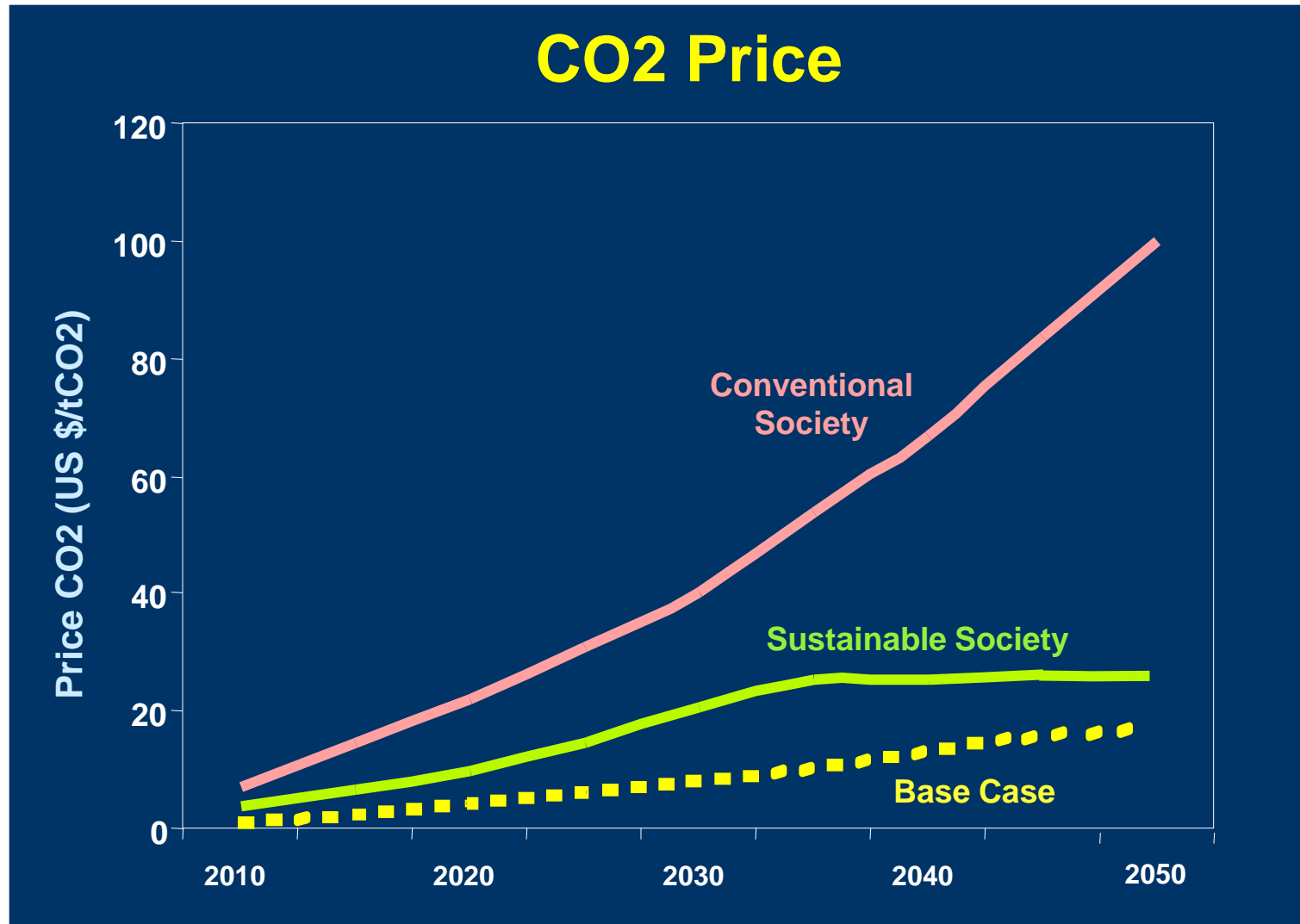
Benefit (Saving) Cumulative from 2010 to 2030		\$ Billion	% GDP
Energy	60 Exa Joule	321	0.87
CO ₂ Equiv.	5.1 Billion Ton	28	0.08
SO ₂	50 Million Ton	10	0.03
Total		359	0.98

Spill-over Benefits / Co-Benefits

- More Water for Food Production (MDG1)
- 16 GW additional Hydropower (MDG1&7)
- Flood control (MDG1&7)
- Lower energy prices would enhance competitiveness of regional industries (MDG1)

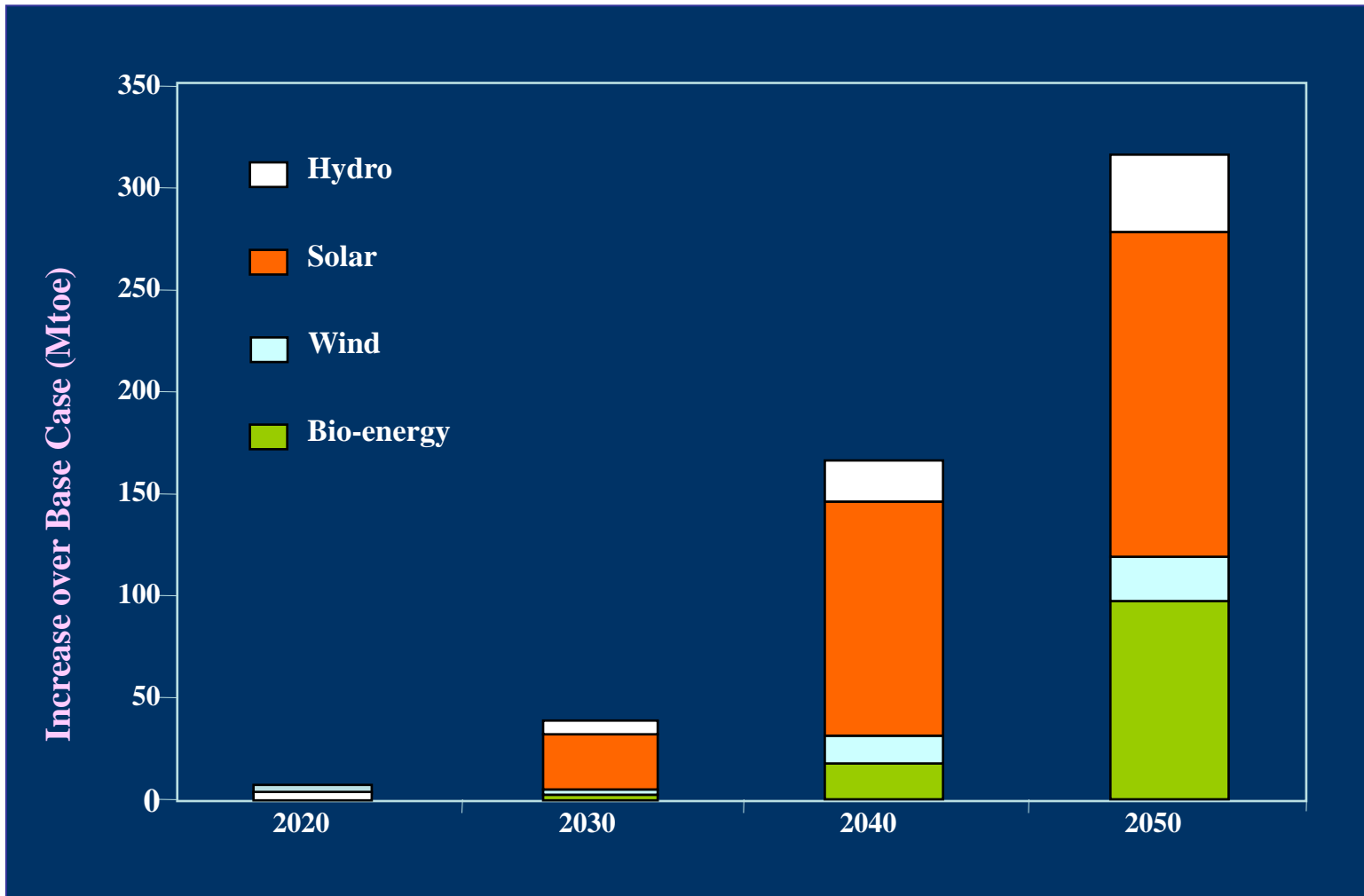


LCS with Lower Carbon Prices



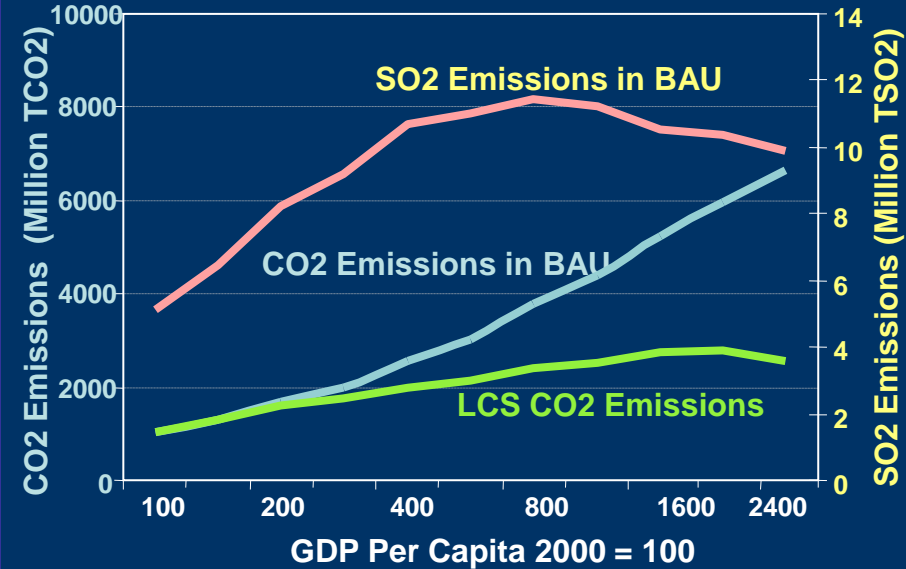
Additional Renewable Energy

(in Sustainability Scenario over Base Case)

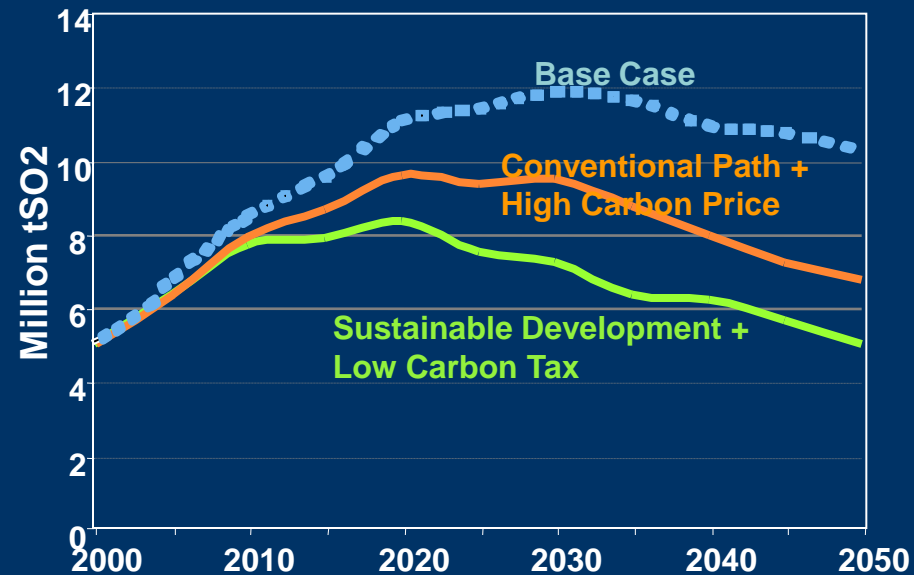


Air Quality Co-benefits

Emissions and Income

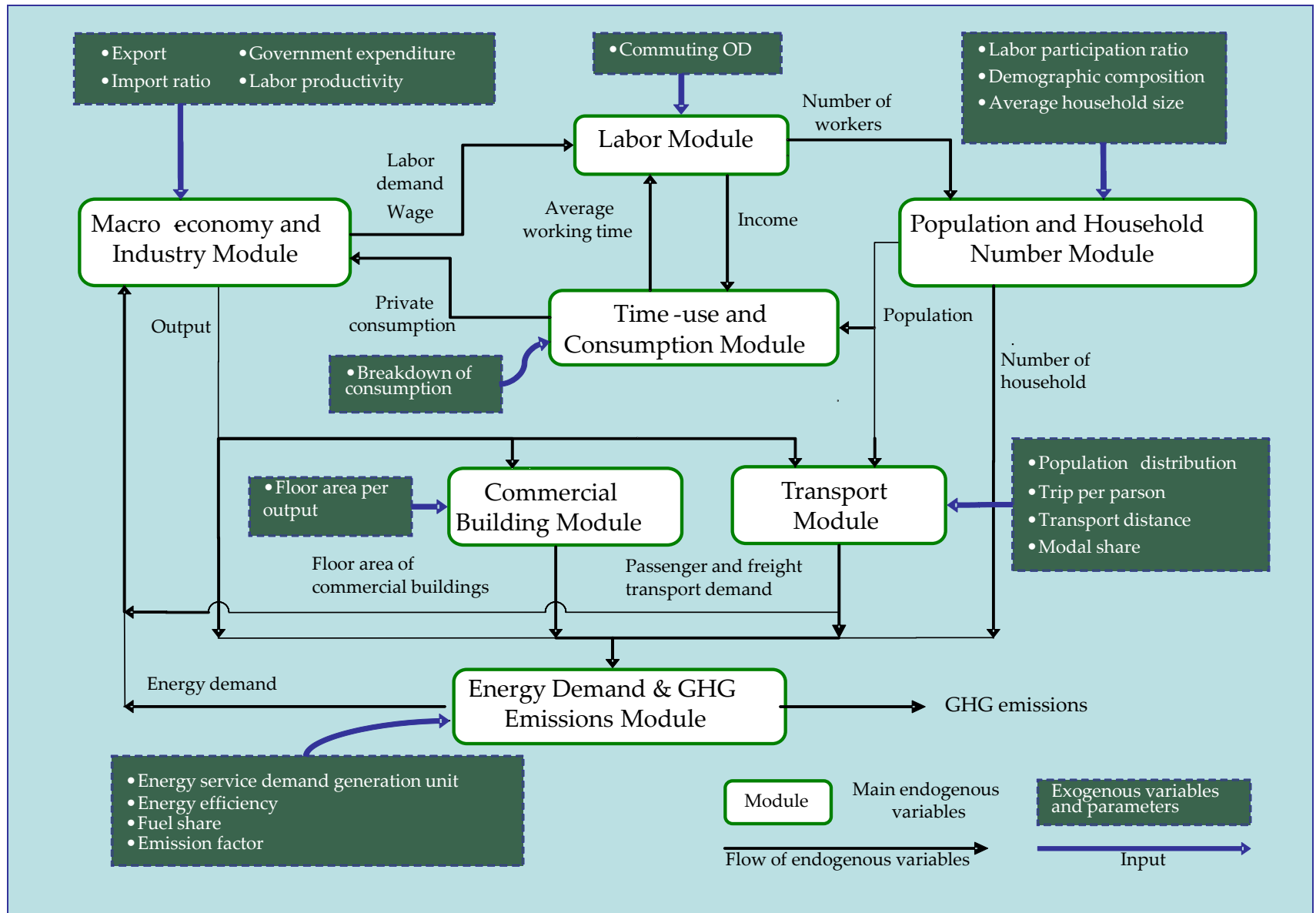


Co-benefits: SO2 Emissions



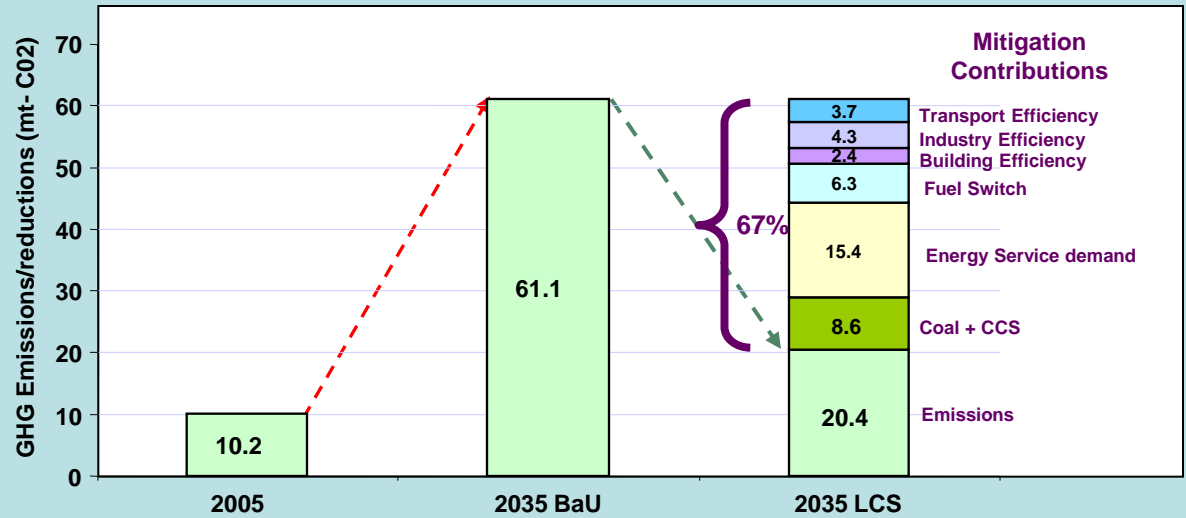
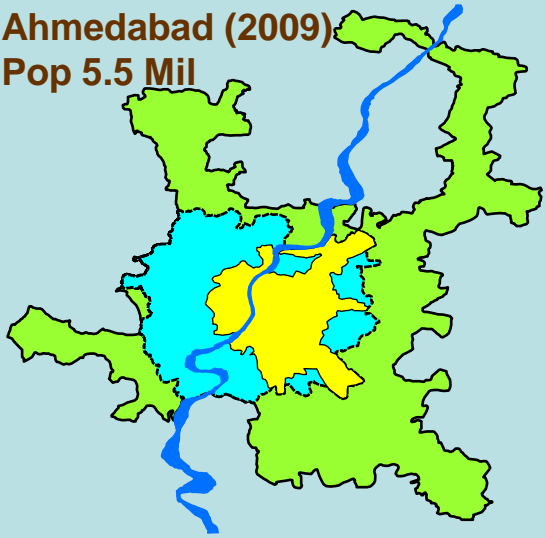
Low Carbon Cities

Extended Snapshot (ExSS) Model



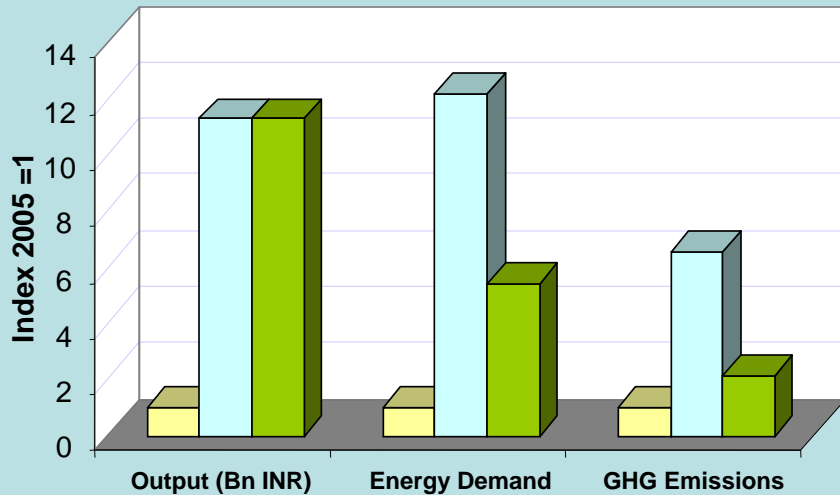
ExSS Model: Low Carbon Transition in Ahmedabad City

Ahmedabad (2009)
Pop 5.5 Mil



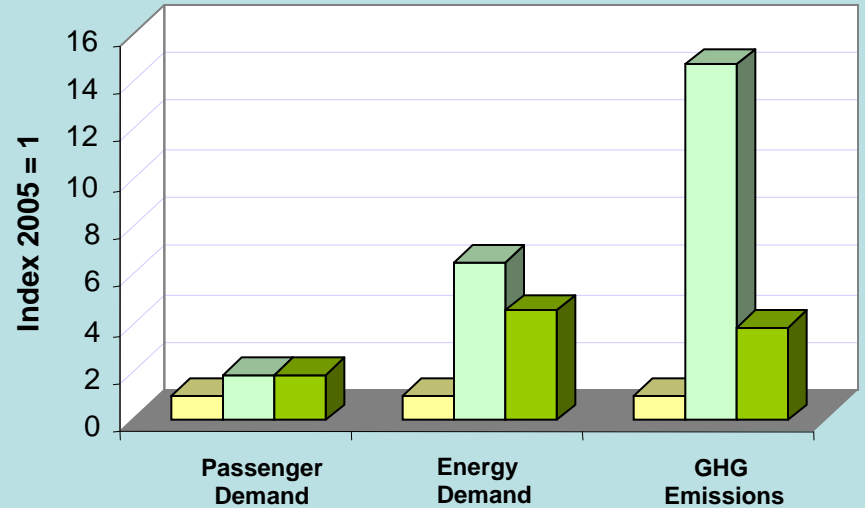
Industry Sector

2005 2035 BAU 2035 CM



Passenger Transport Sector

2005 2035 BAU 2035 LCS



Conclusions: LCS Research Focus

- **Articulate and Assess Alternate Pathways**
 - Development vision matters to LCS transition
- **Align development and climate actions**
 - Mainstreaming climate actions in development plans and processes
 - Avoid lock-ins into high emissions paths
 - Bottom-up actions coordinated with top-down vision and policies
- **‘Paradigm Shift towards ‘Co-benefits’ and ‘Co-operation’:**
 - Co-benefits reduces welfare losses
 - Deliver LCS at Low Carbon Price
- **Even in LCS, adaptation actions will be needed, but costs and risks shall be much lower**
- **LCS Research network is vital for capacity building for integrated assessment of climate change**



Thank you