

# ***Choosing between Low or High Carbon Intensive Development Patterns: What is the Rationale?***

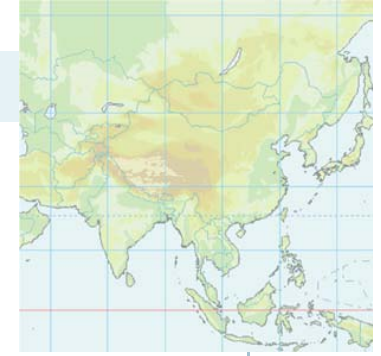
P.R. Shukla  
Indian Institute of Management  
Ahmedabad, India

Symposium on: *Transition towards low carbon societies in a changing world*

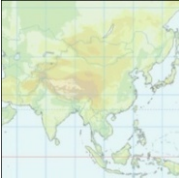
Organized by:

International Research Network for Low Carbon Societies (LCS-RNet)

November 29, 2011, Durban, South Africa

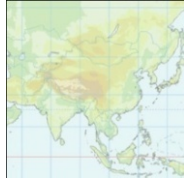


# Presentation Agenda



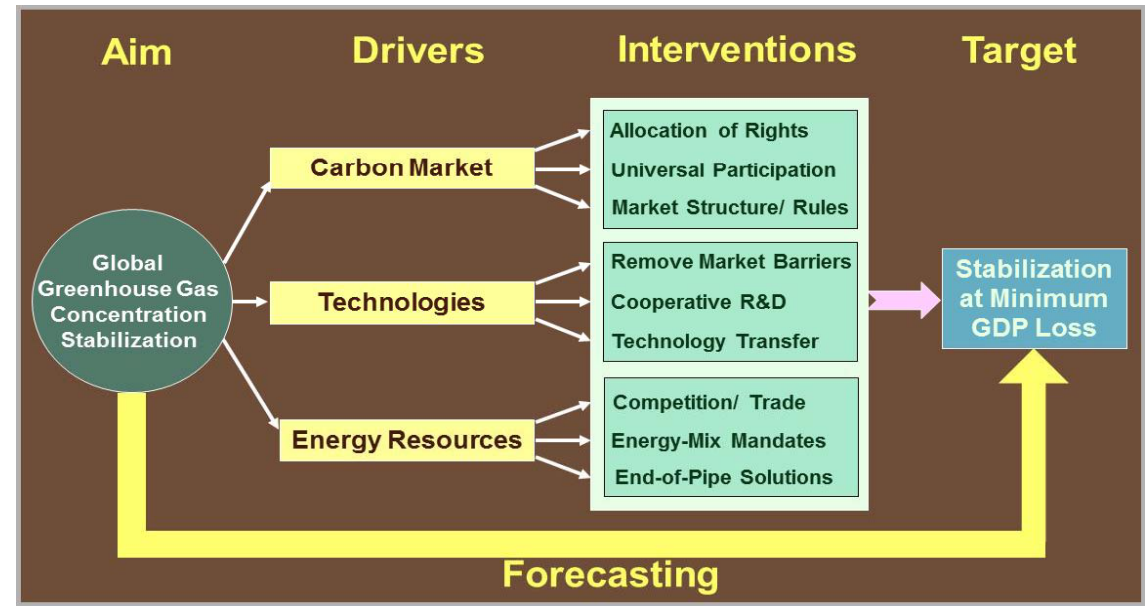
- **Low Carbon Society: The Framing**
  - Low Carbon Society Perspectives
  - Mapping Low Carbon Scenarios on a new Track
- **Aligning Development & Climate Actions**
  - Regional Cooperation and Coordination
  - Sector: E.g. Transport & Infrastructures
  - Cities: Mitigation & Climate Proofing
- **Conclusions**

# Low Carbon Society: Framing



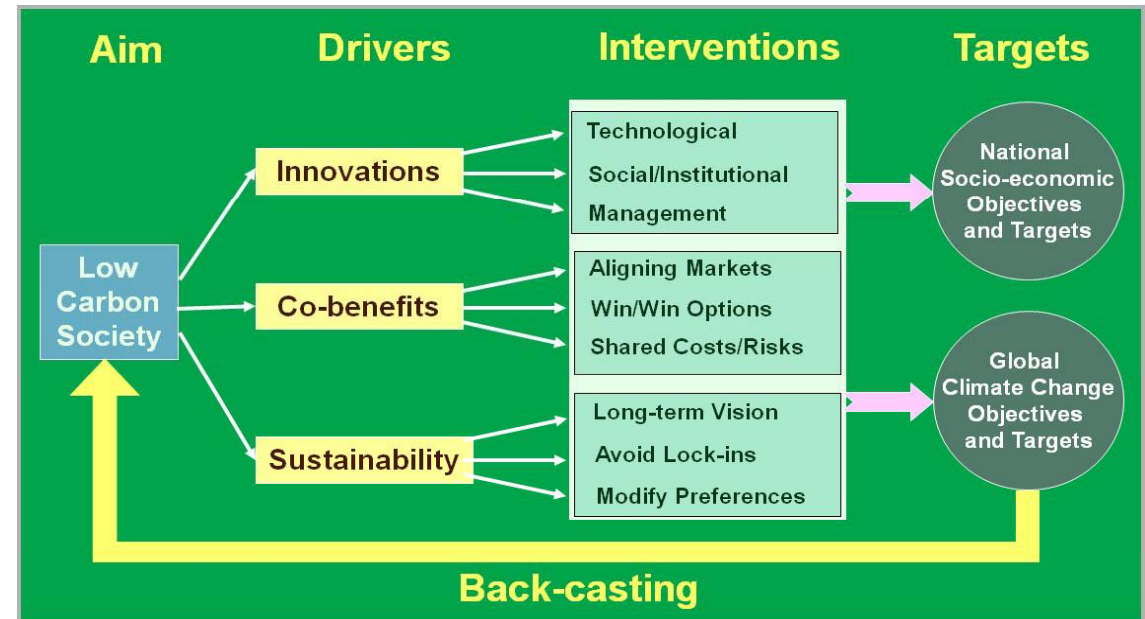
## Conventional: Climate Centric Paradigm Ideal World

- Universal Carbon Market
- Perfect Energy Market
- Flexible Supply / Inflexible Demand
- Rational Decision-makers
- 'Zero-Sum' Game (Competition and Conflicts)
- Externalities and Risk Framework

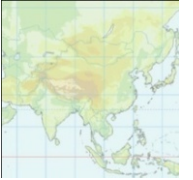


## Sustainability: Development & Climate Real World

- Fragmented Carbon Market
- Distorted Energy Markets
- Constrained Decision-makers
- Flexible Demand and Supply
- Multiple Dividends (Cooperation & Co-benefits)
- Innovations and Opportunity Framework

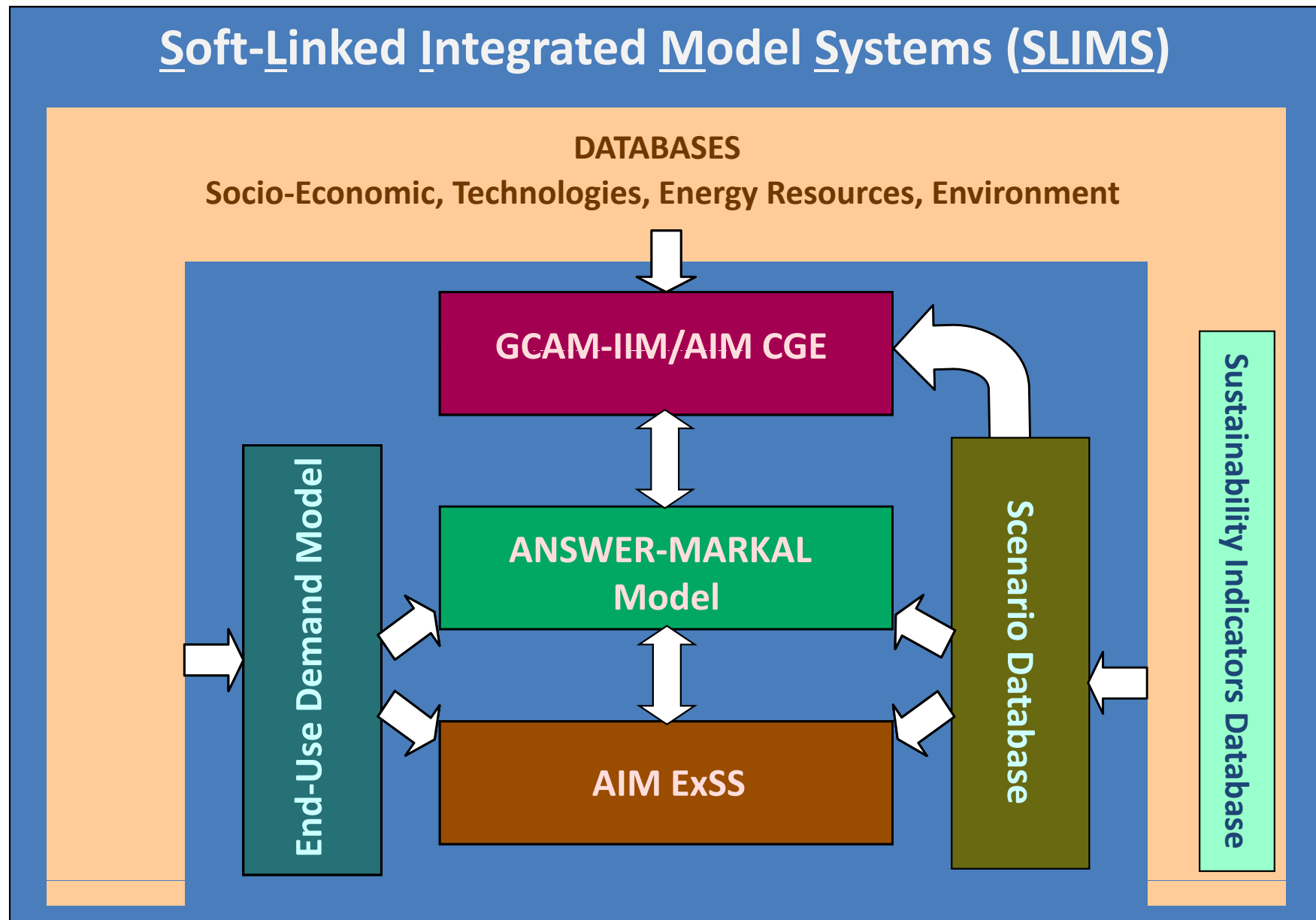
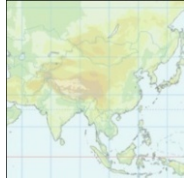


# Low Carbon Scenarios

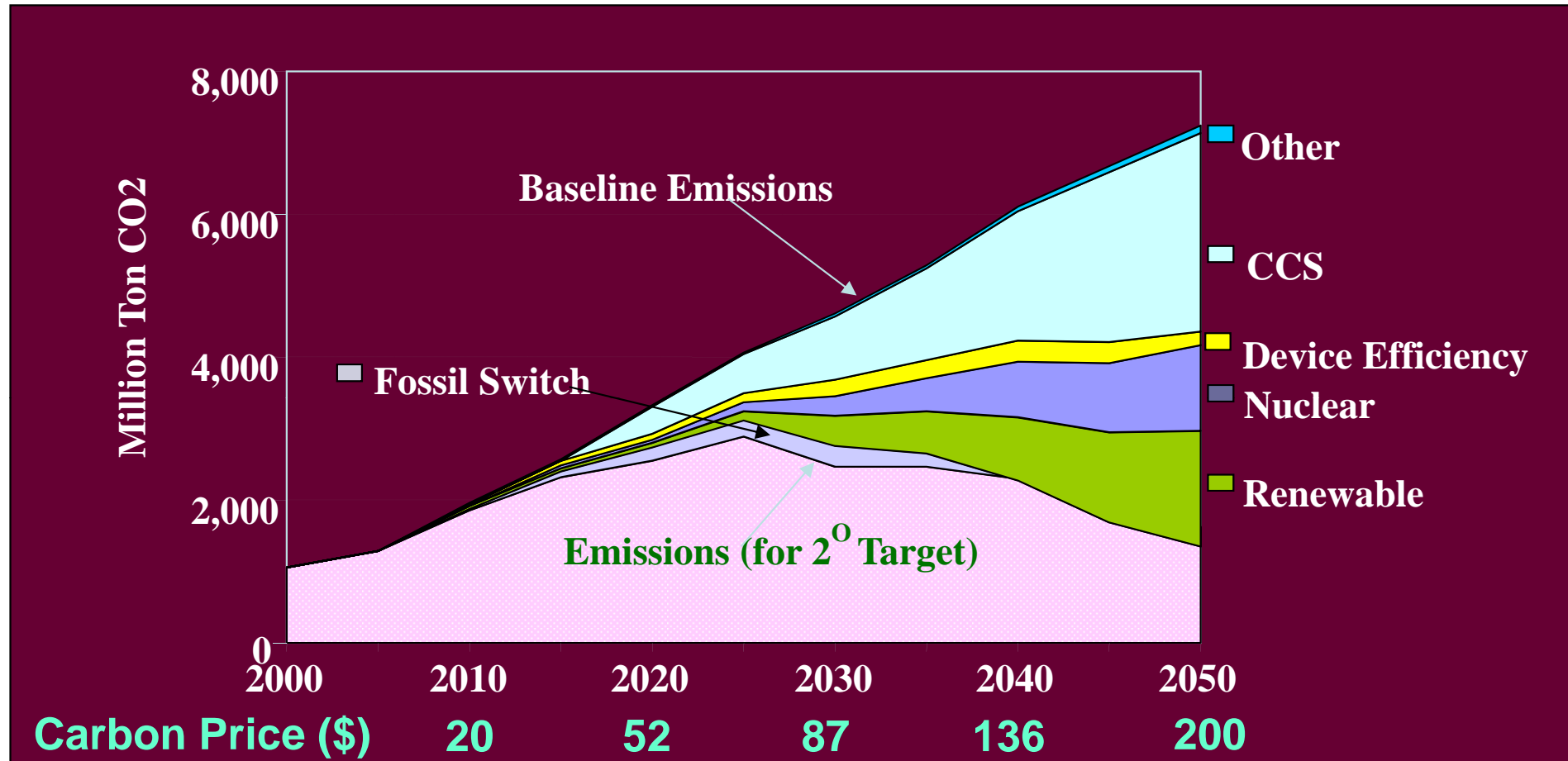
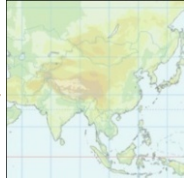


- **Mapping Transitions**
  - Demographic; Urban/Rural; Income; Behavior (e.g. consumption); Institutions
- **Economics: Paradigm Shift**
  - Cooperation & Co-benefits (e.g. energy security, AQ)
  - Finance (discount rates)
  - Market vs. Social Value of Carbon
- **Policies**
  - Technology: Infrastructures; Targeted R&D + industry
  - Coordinate policies to gain co-benefits
  - Climate Proofing (Carbon price + Adaptation)

# Integrated Multi-Model Structure



# Mitigation Options: Climate-centric



## Climate-centric Approach: transition of conventional path with carbon price

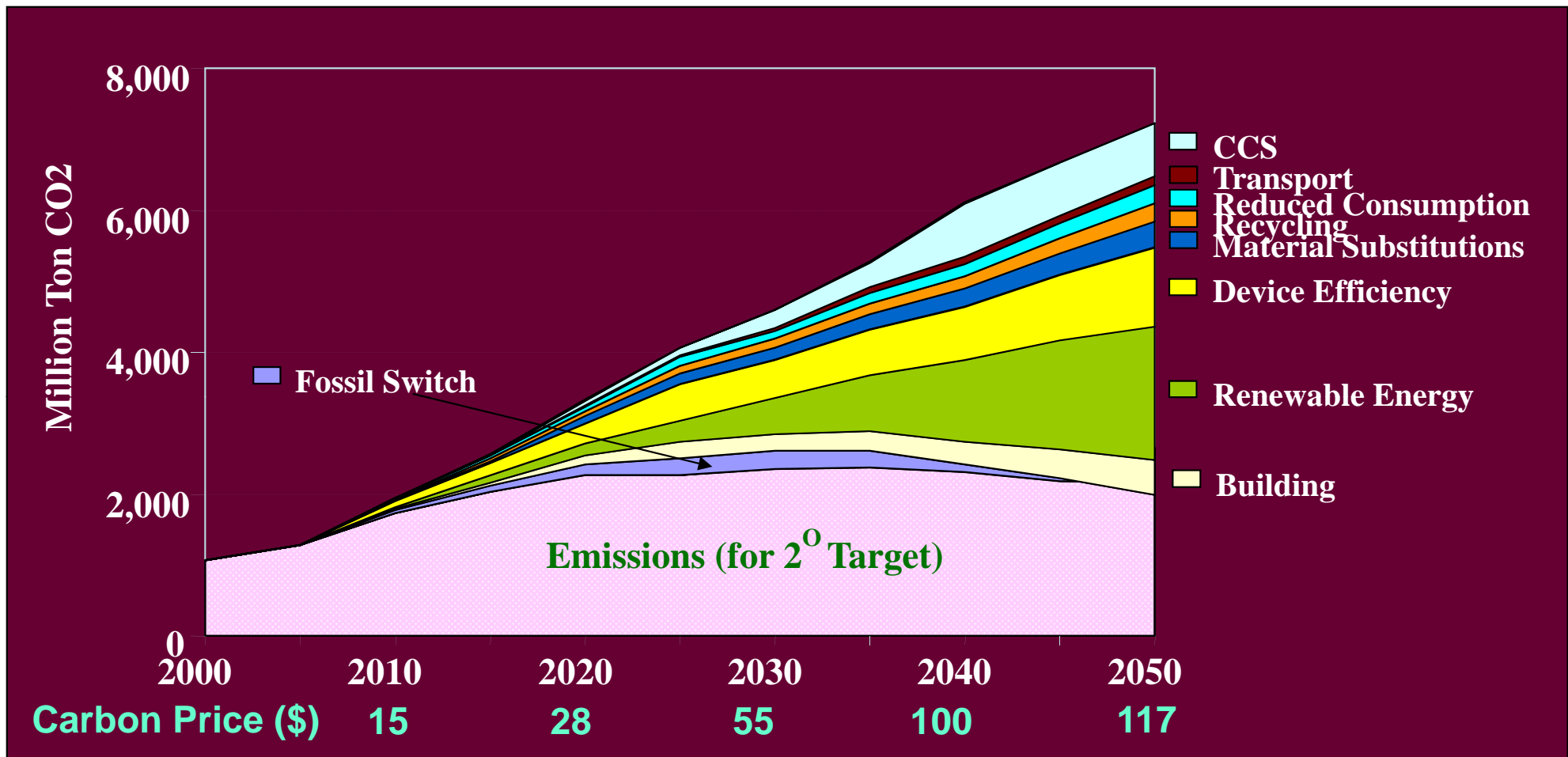
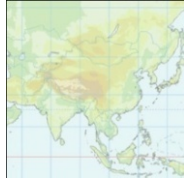
- High Carbon Price
- Climate Focused Technology Push
- Top-down/Supply-side actions

## Technology Co-operation Areas

- Energy Efficiency
- Wind/Solar/Biomass/Small Hydro
- Nuclear/CCS



# Mitigation Options: Sustainability

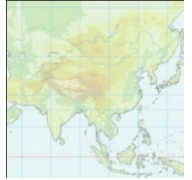


## Sustainability Approach: aligning climate and sustainable development actions

- Lower Carbon Price
- Bottom-up/Demand-side actions
- Behavioural change
- Diverse Technology portfolio

## Technology Co-operation Areas

- Transport Infrastructure Technologies
- 3R, Material Substitutes, Renewable Energy
- Process Technologies
- Urban Planning, Behavioral Changes



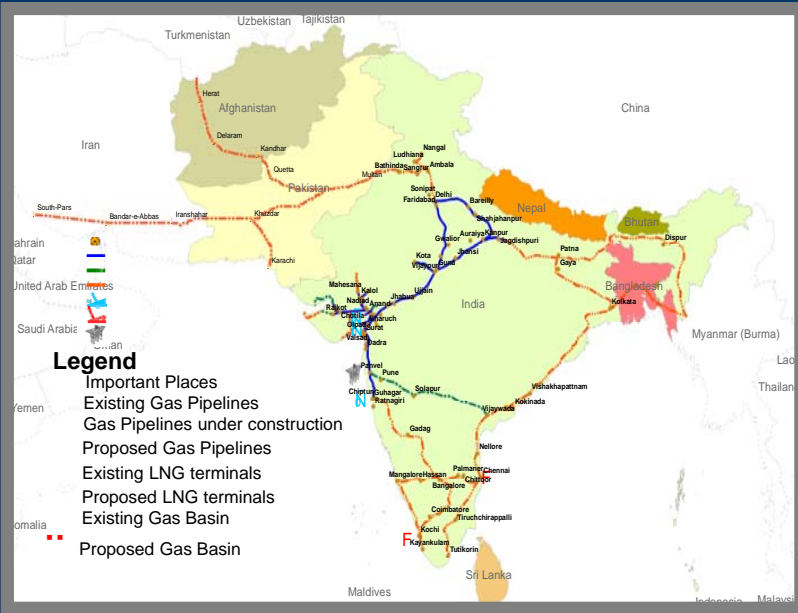
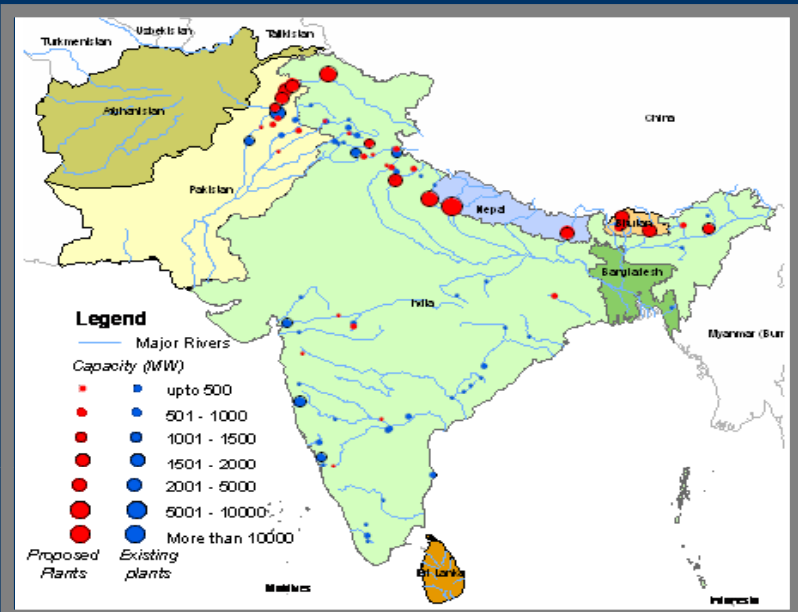
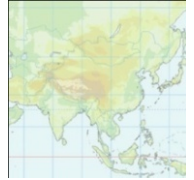
# **Pathways to 2°C Stabilization: Aligning Development & Climate Actions**

*(with illustrations from assessment for India)*

- **Regional Cooperation and Coordination**
- **Role of Sector Policies and Actions: E.g. Transport**
- **Role of Cities: Mitigation & Climate Proofing**



# Co-benefits of Energy Choices



## 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 <sub>2</sub> Equiv.	5.1 Billion Ton	28	0.08
SO <sub>2</sub>	50 Million Ton	10	0.03
<b>Total</b>		<b>359</b>	<b>0.98</b>

## Spill-over & 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)



# Linking Global Best Practices with National Policies



## Sustainability Scenario

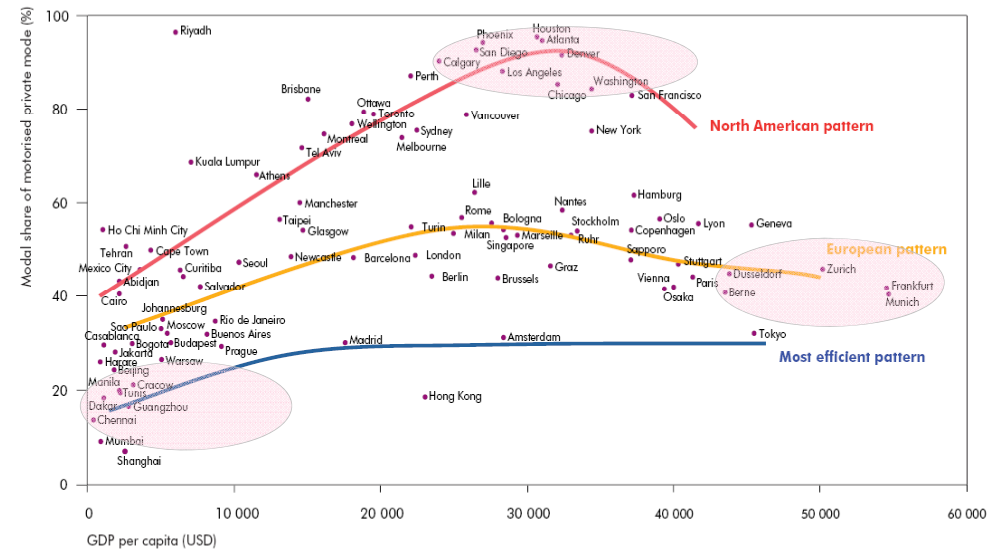
- **Avoid Lock-ins (Infrastructure)**

- Transport
- Energy

- **Co-benefits**

- Energy Security
- Air Quality
- Water Security
- Social Value of Carbon

Figure 15.11 Relationship between GDP per capita and motorised modal share

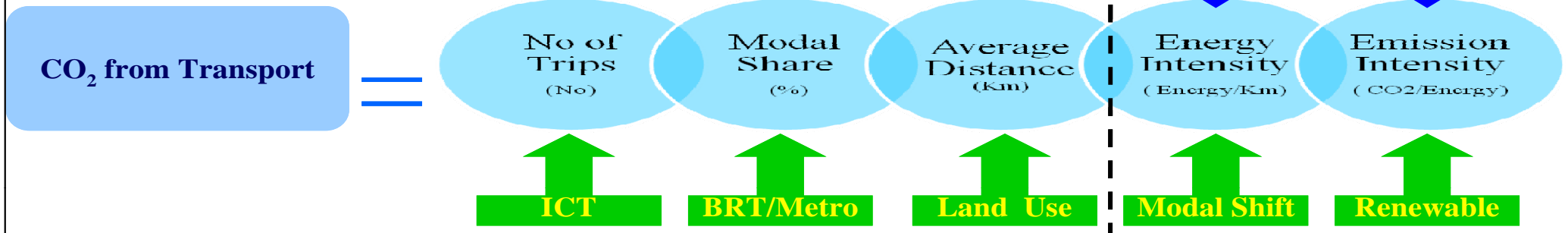


Source: UITP, 2006 (Courtesy of SYSTRA).

## Transport Transitions

### Demand Side

### Supply Side



2°C Stabilization with Sustainability

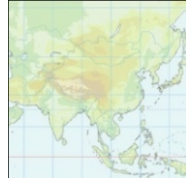


# Macro Indicators of Low Carbon Transport



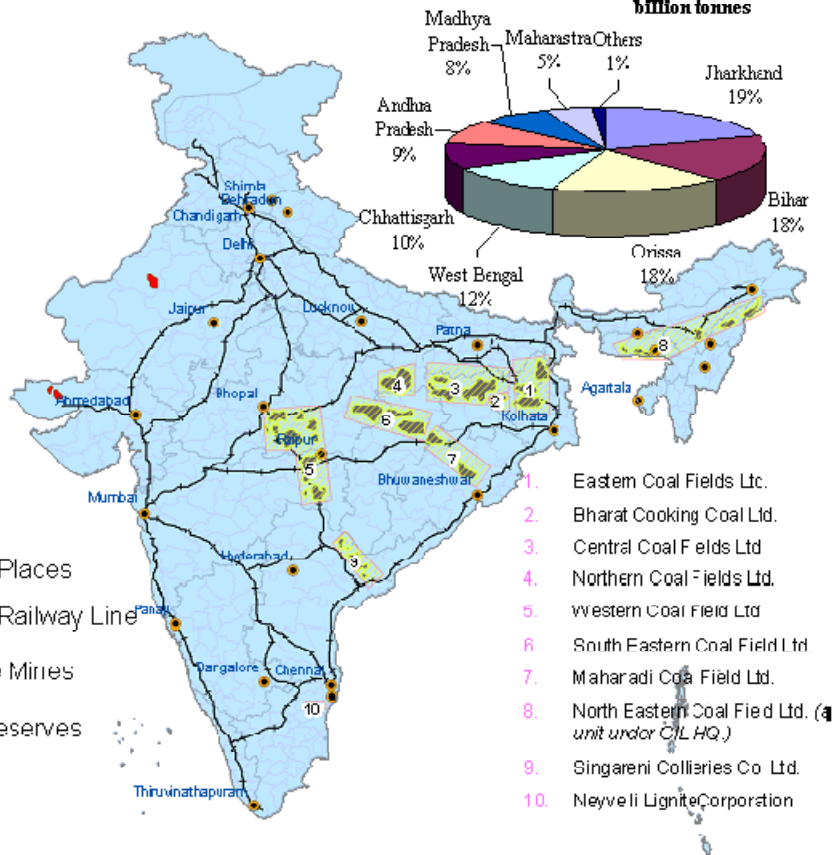
<b>Economic</b>	Carbon Intensity of Transport	Energy Security	Transport Infrastructure Investment	Total Cost of Transport
<b>Social</b>	Access to Transport	Transport Subsidies	Food Security	
<b>Environmental</b>	Air Pollution	Water: Pollution & Stress	Safety	
<b>Technical</b>	Vehicle (fleet) Energy & Emissions Efficiency	Carbon Content of Electricity	Transport Demand Substitution	Operational Efficiency of Transport Infrastructure
<b>Meta / Strategic</b>	Sustainable Urban Form and Structure	National Logistics Grid	Investment in Transport Sector Innovations	

# Infrastructures to Overcome Lock-ins

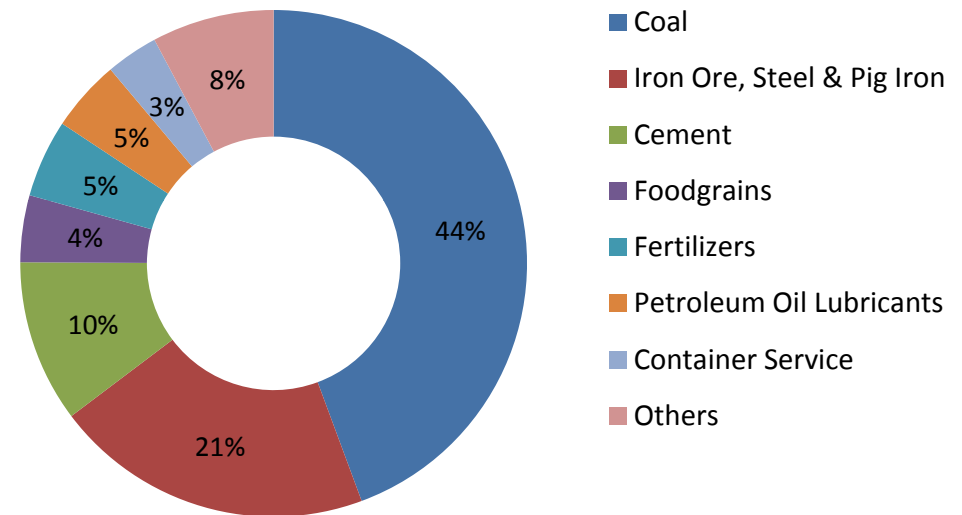


## Coal by Wire

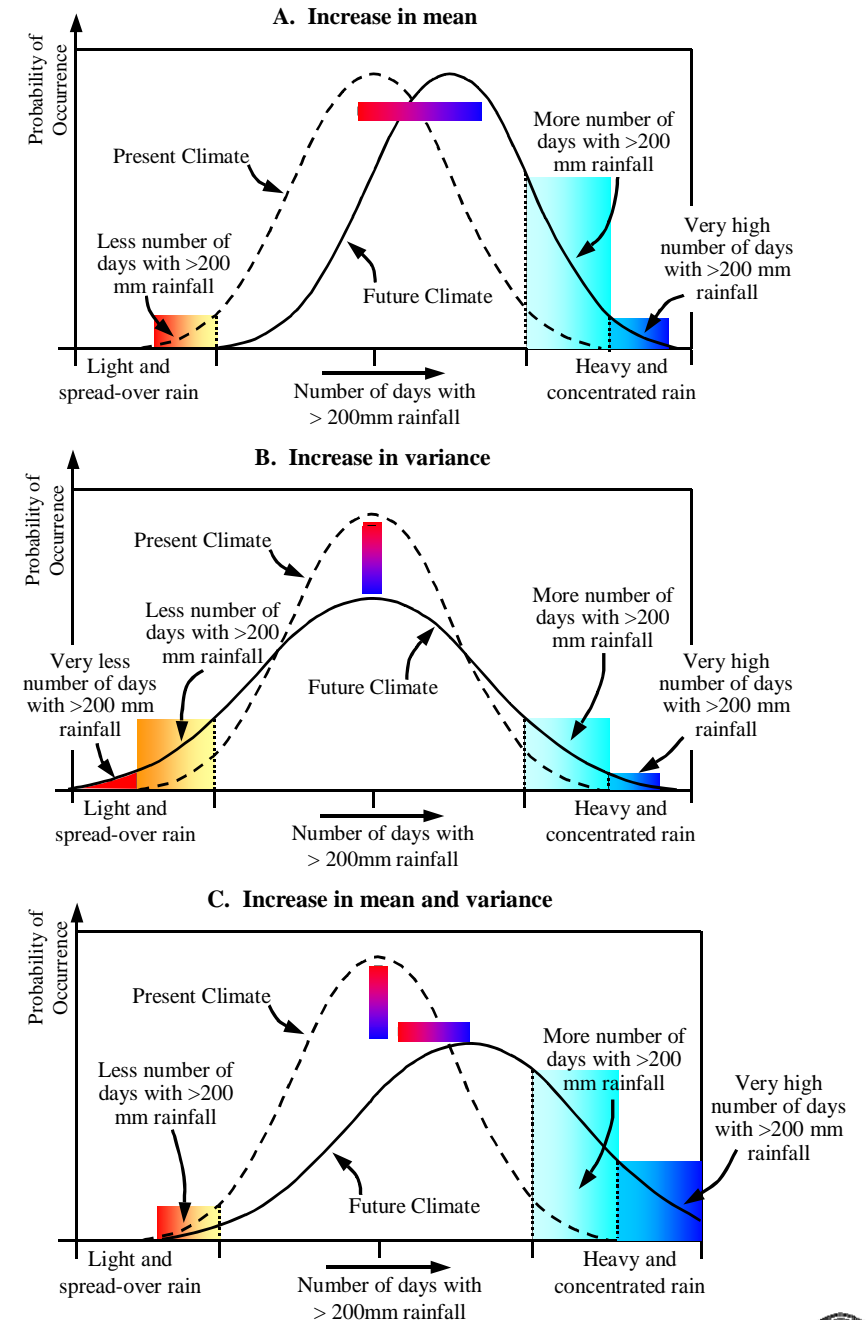
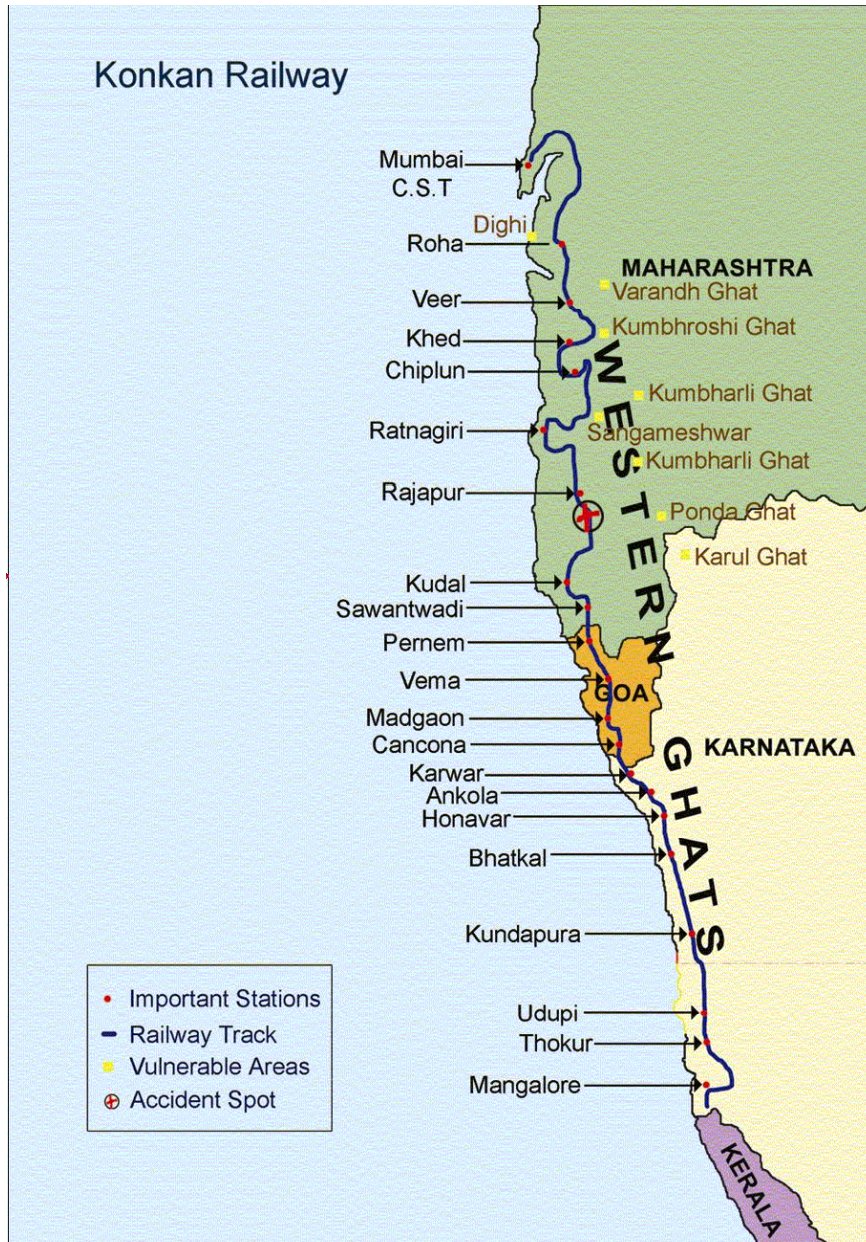
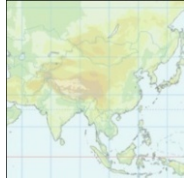
**State Wise Coal Reserves**  
Total Proven Reserves 66.9 billion tonnes



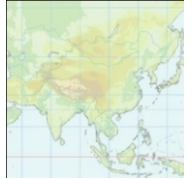
**Composition of Railway Freight Traffic (%): 2010**



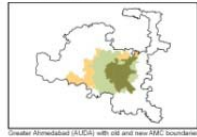
# Konkan Railway: Climate Proofing



# City Planning: Co-benefits

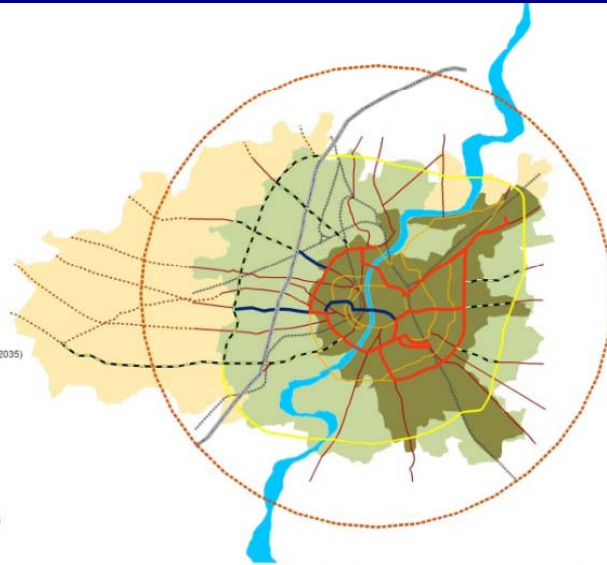


## Ahmedabad City: Pop. In 2010 - 5.5. Million



### Legend

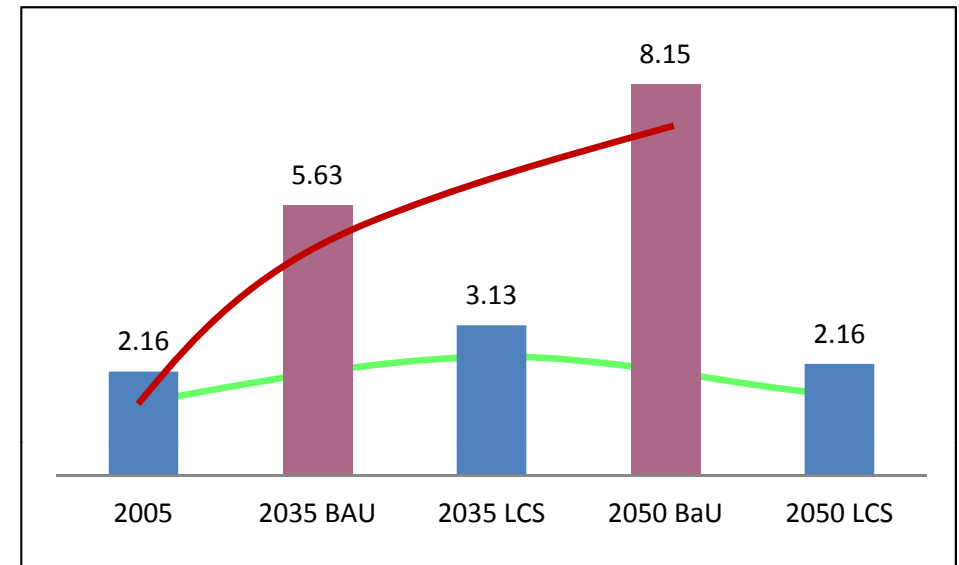
- Expected Ring Road
- Expected BRTS Routes (2035)
- Expected extended major radial roads (2035)
- S.G. Highway
- S.P. Ring Road
- Bus Rapid Transit System Phase-I
- Bus Rapid Transit System Phase-II
- City's other major ring roads
- City's major radial roads
- Railway line
- Sabarmati River
- Ahmedabad old boundary (before 2007)
- Ahmedabad city (after 2007)
- Ahmedabad city in 2035 (assumed)



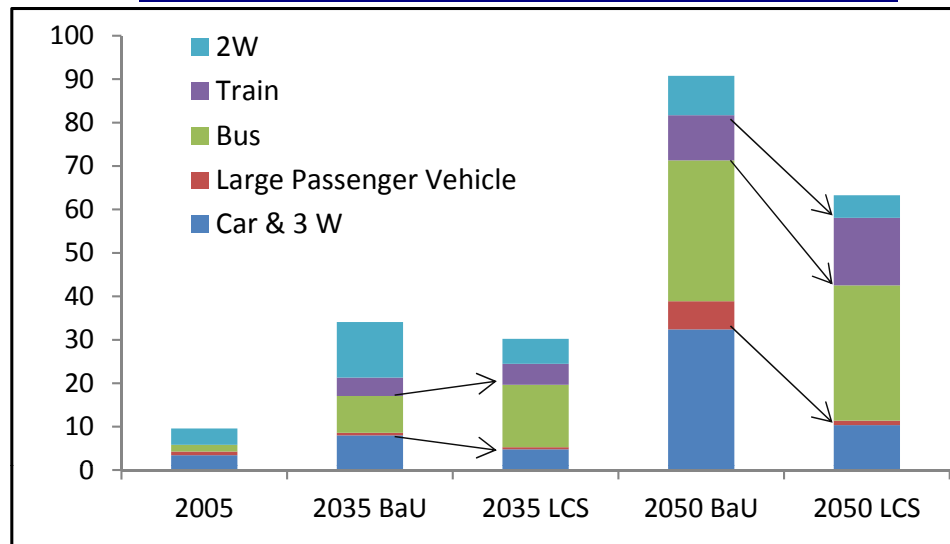
Note: Based on Ahmedabad Janmarg Map, AMC 2010

External boundaries not authenticated

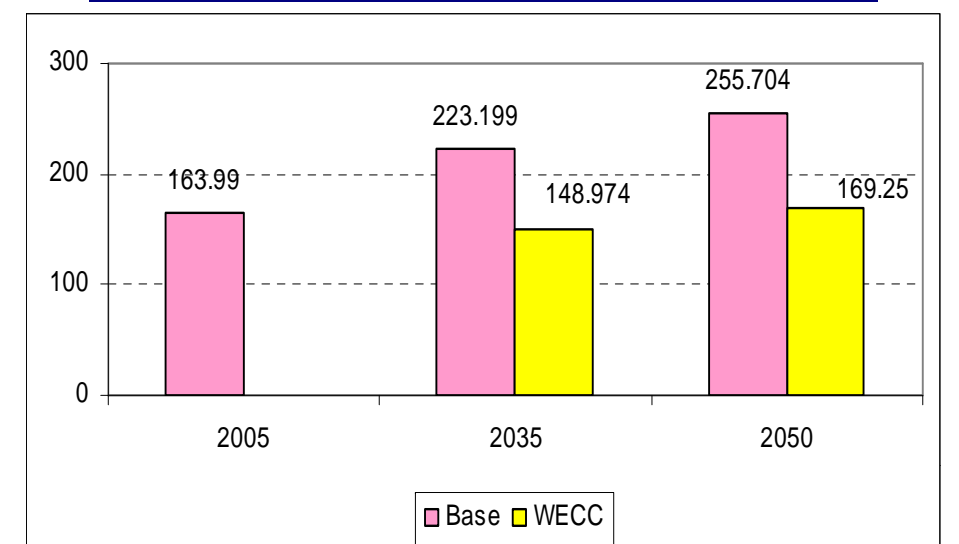
## Per Capita CO2 Emissions (Ton)



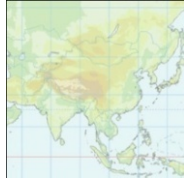
## Co-benefits: Transport Transitions



## Co-benefits: Water per capita (ML/million)

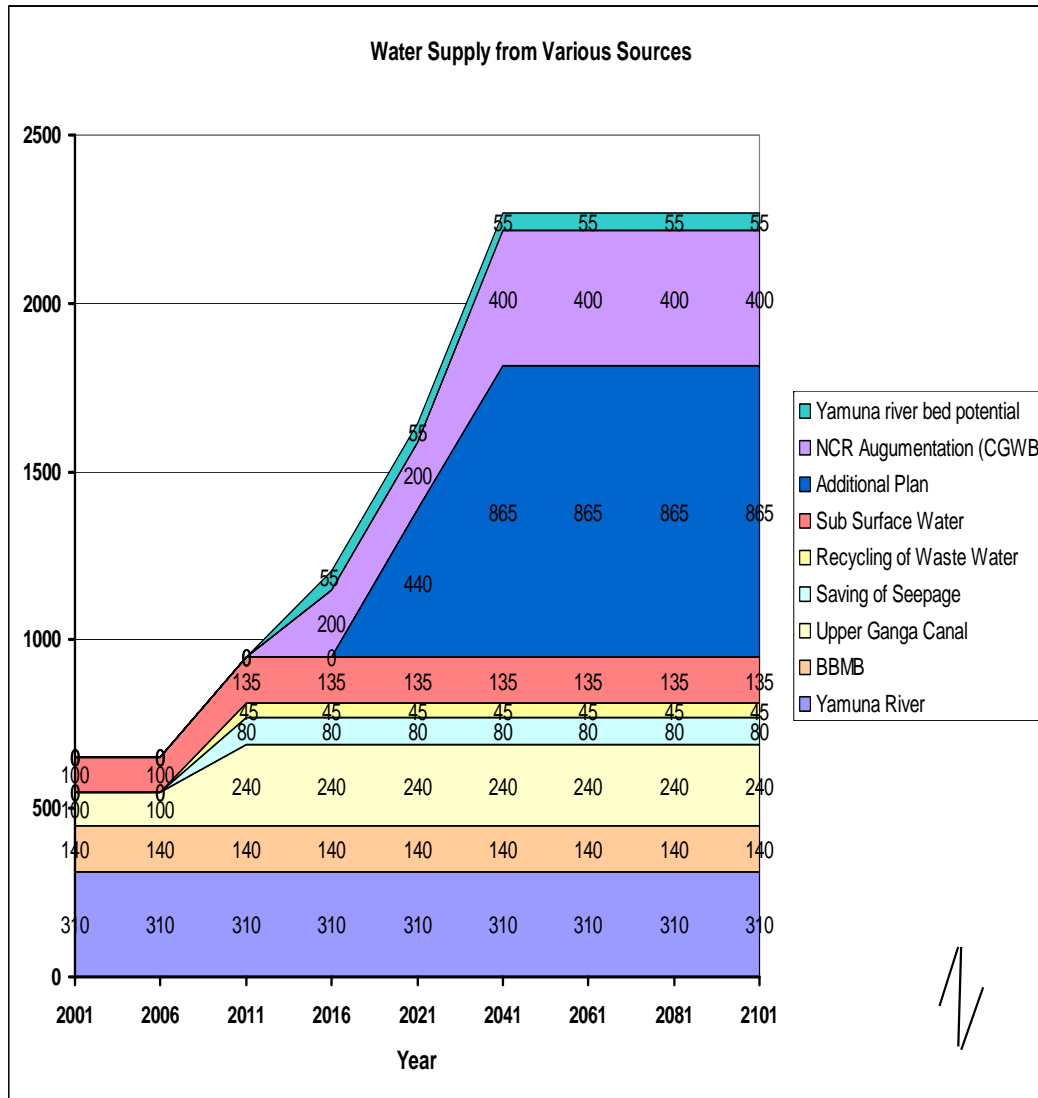


# Water Availability (DELHI)

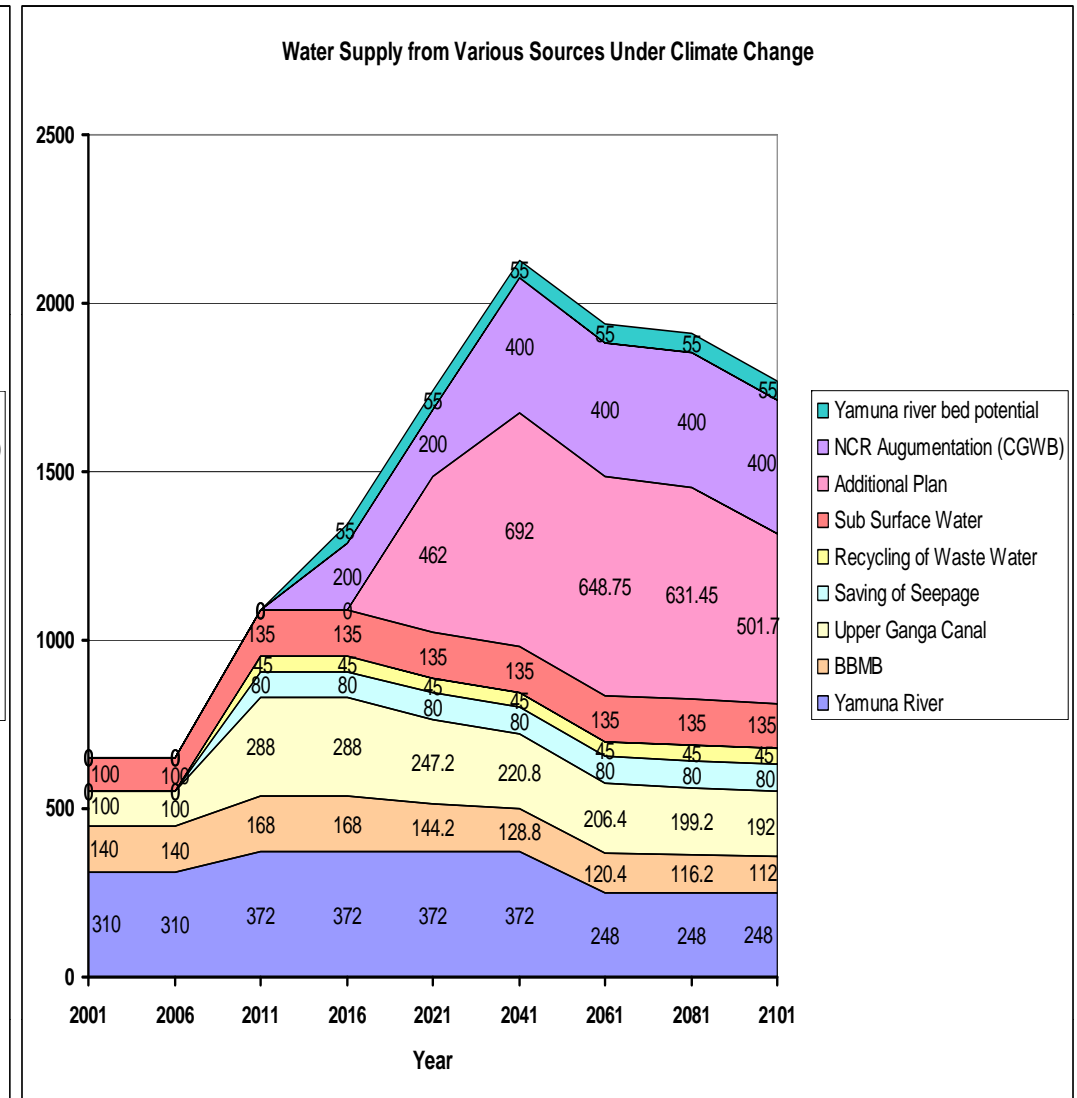


## Existing and Envisaged Sources of Water

### No Climate Change



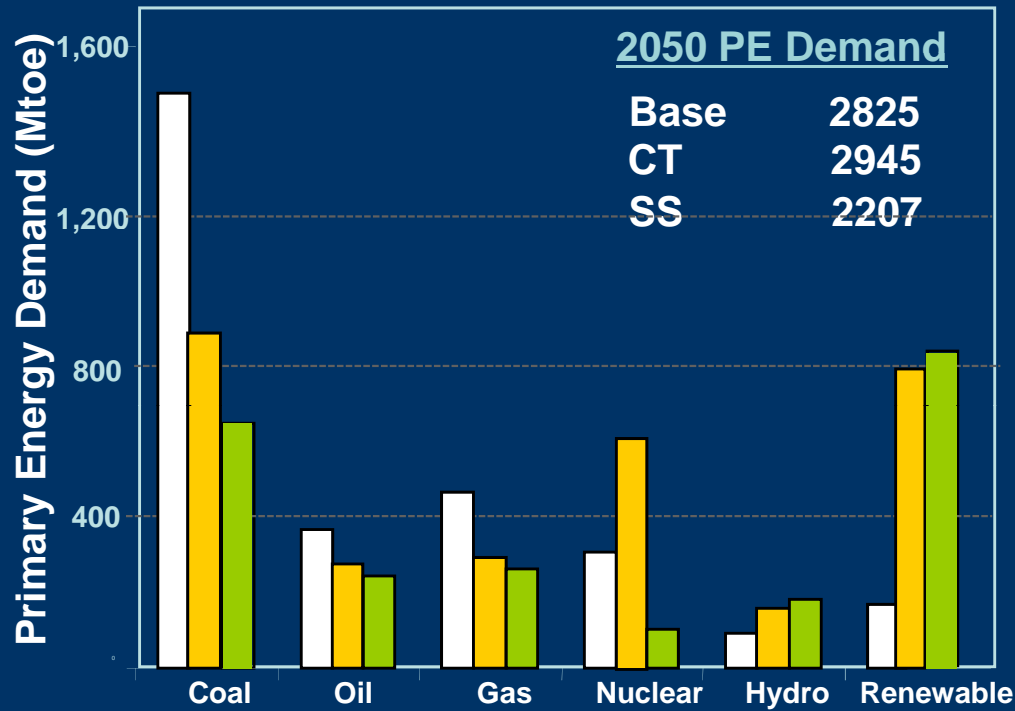
### Climate Change – SRES B2



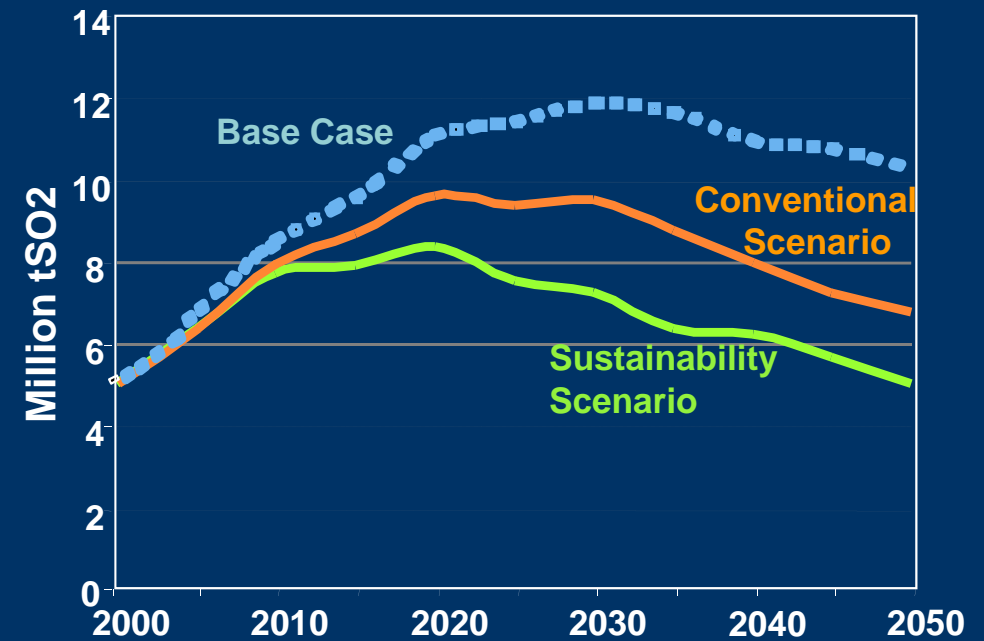
# Co-benefits: Energy Security & Air Quality



## Co benefits: Energy Security

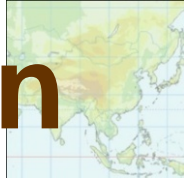


## Co-benefits: SO2 Emissions

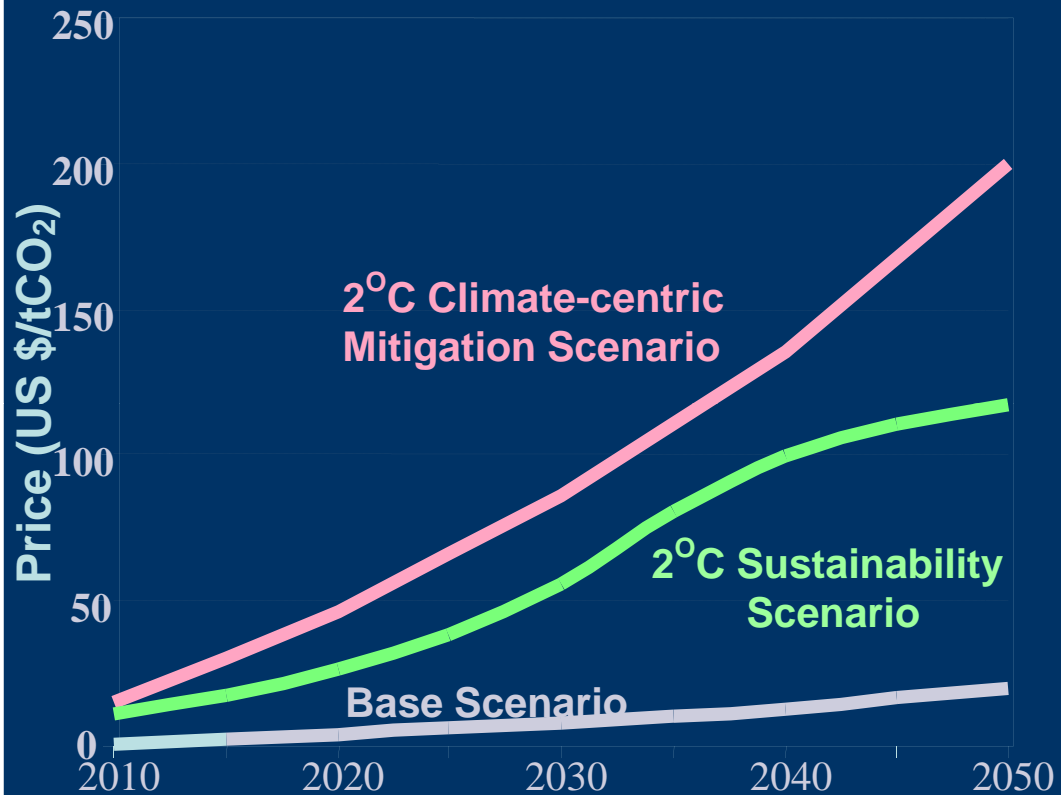




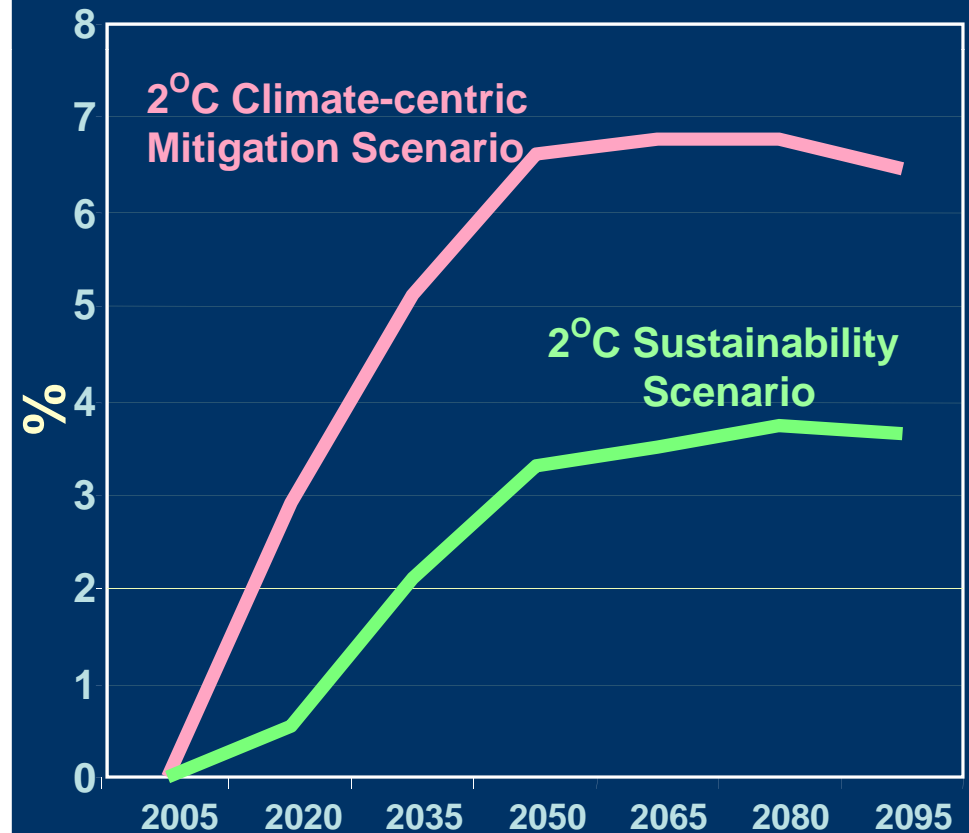
# Social vs. Market Value of Carbon



## Social Value of Carbon



## GDP Loss for India



# Conclusions: Choice of Development Path



- Conventional development path is untenable
- Alternate 'Development Paths' are feasible & advisable
- Sequencing may favor emerging countries to align development and climate actions
- Artificial separation of 'baseline' and 'climate change' actions is not helping
- Act early (in mitigation & adaptation) to avoid 'lock-ins'
- 'Social value of carbon' is lower than 'market value

*Thank you*

