Indian Institute of Management, Ahmedabad

Economic Environment Modeling: Policy Insights for India

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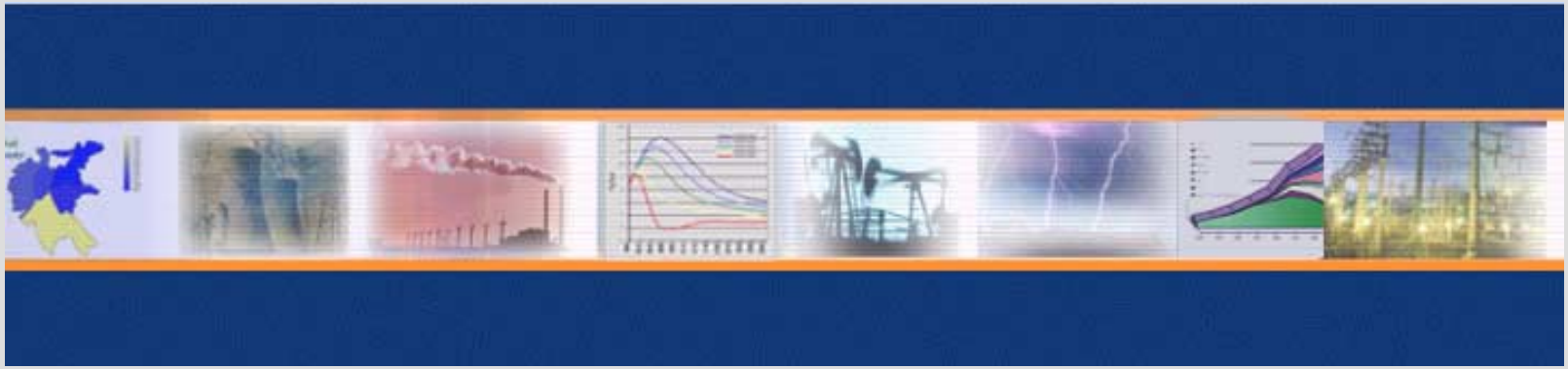


ECONOMIC AND ENVIRONMENTAL MODELING WORKSHOP
January 19-20, 2004, New Delhi

Few Key Questions for Emissions Policies

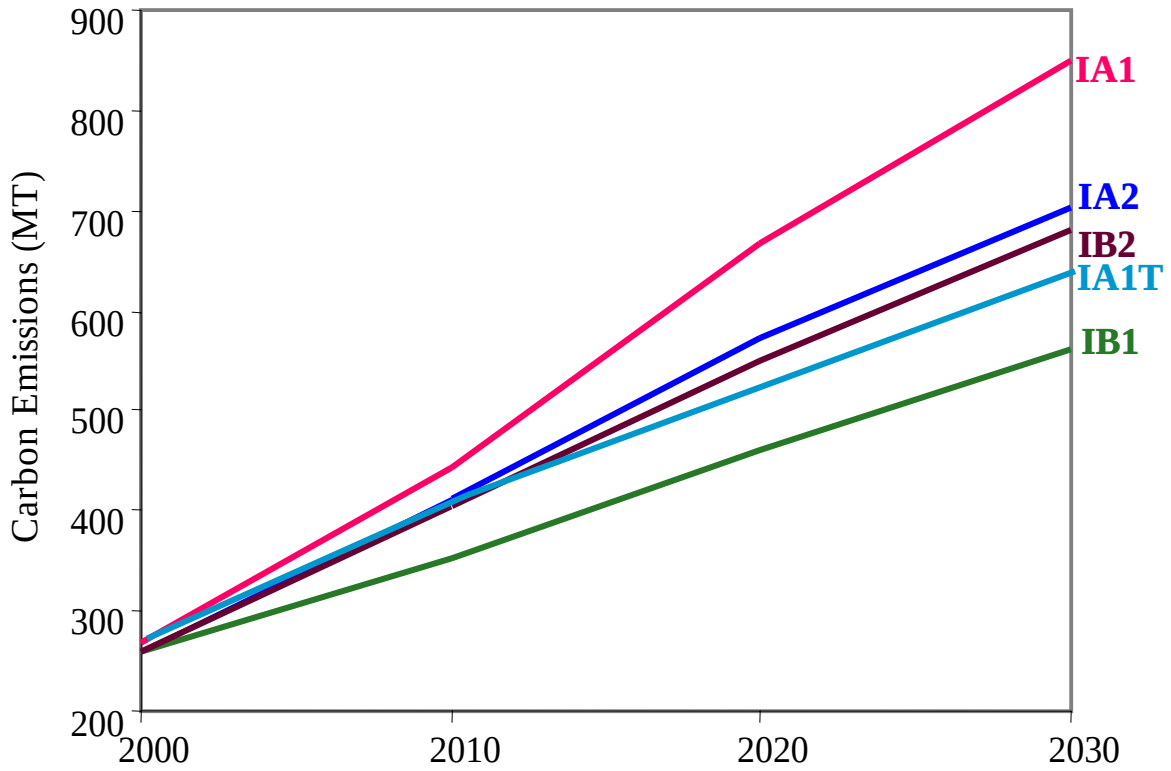
- What are the IPCC SRES equivalent alternate emissions pathways for India?
- What will be the future trends of emissions and intensities for India?
- How are local and GHG emissions control policies linked?
- What shall be the mitigation supply curve for India?
- How shall South-Asia regional cooperation affect energy and emissions?
- What shall be the implications of stabilization regime, e.g. 550 ppmv, on India's energy system during the century
- Should we promote supply-side push of clean technologies (e.g, solar PV) for GHG mitigation?

Indian Emission Scenarios: Framework

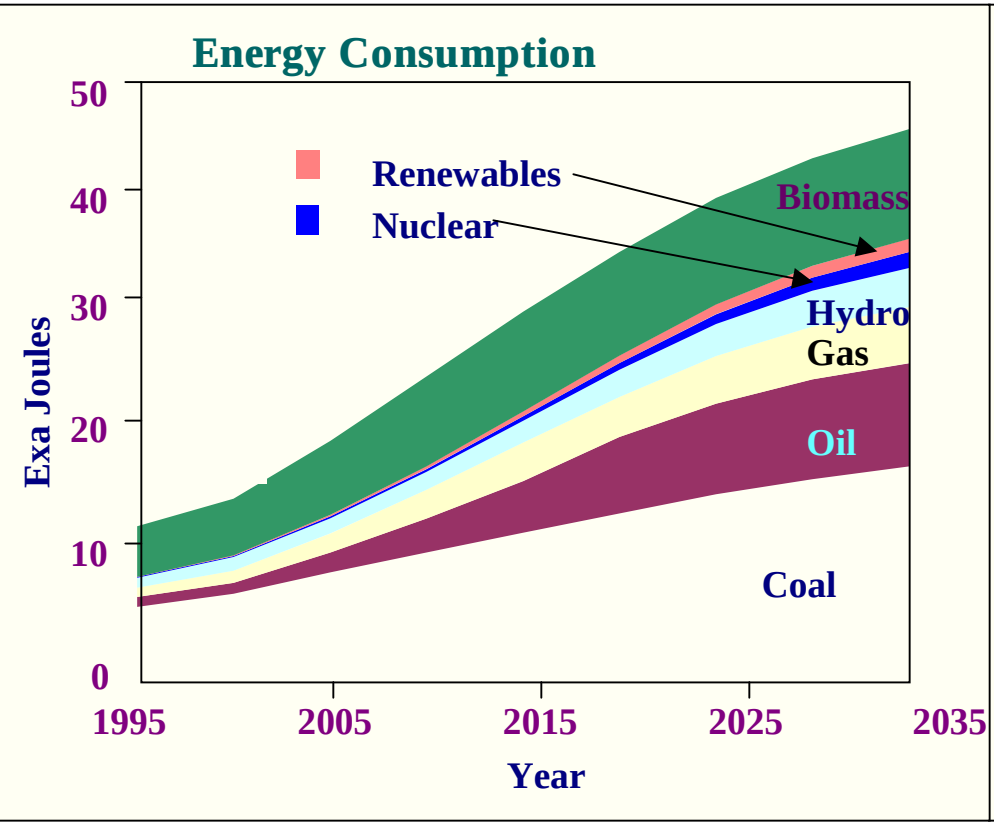
Market integration

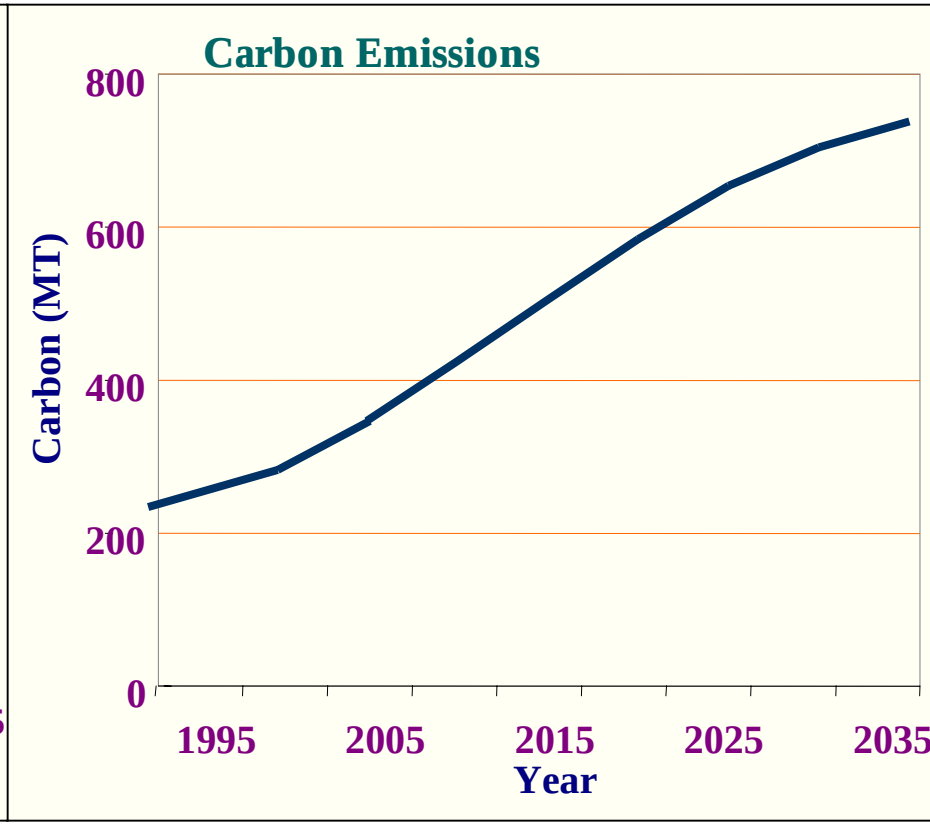
Governance	Integrated	Fragmented
Centralization	IA1 e.g. China	IA2 Pre-reform (Mixed Economy Model)
Decentralization	IB1 Sustainable Development	IB2 Self Reliance Model

Indian Emission Scenarios



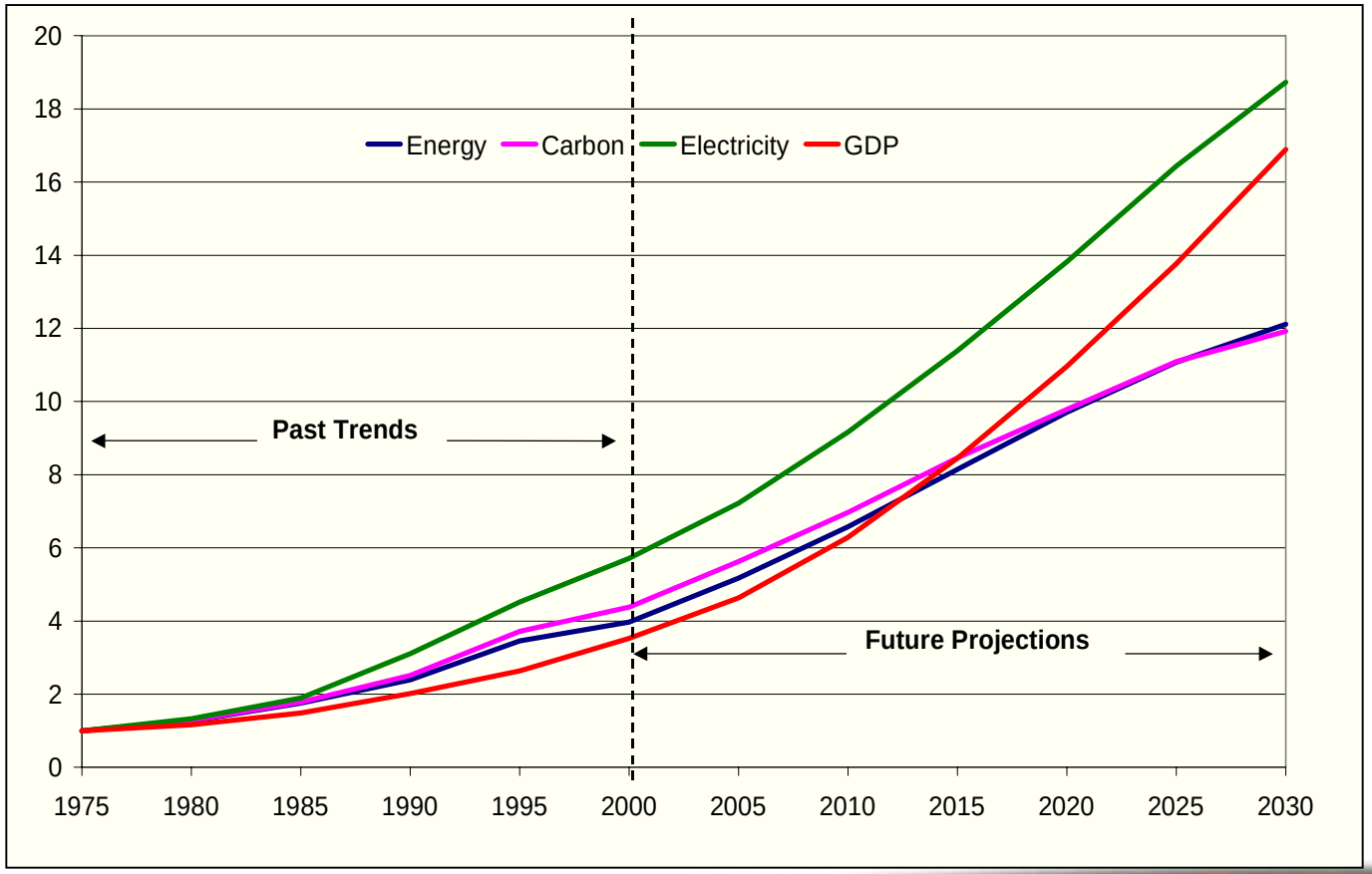
Energy and Carbon Emissions for India (IA2 Scenario):
AIM/MARKAL Model Analysis





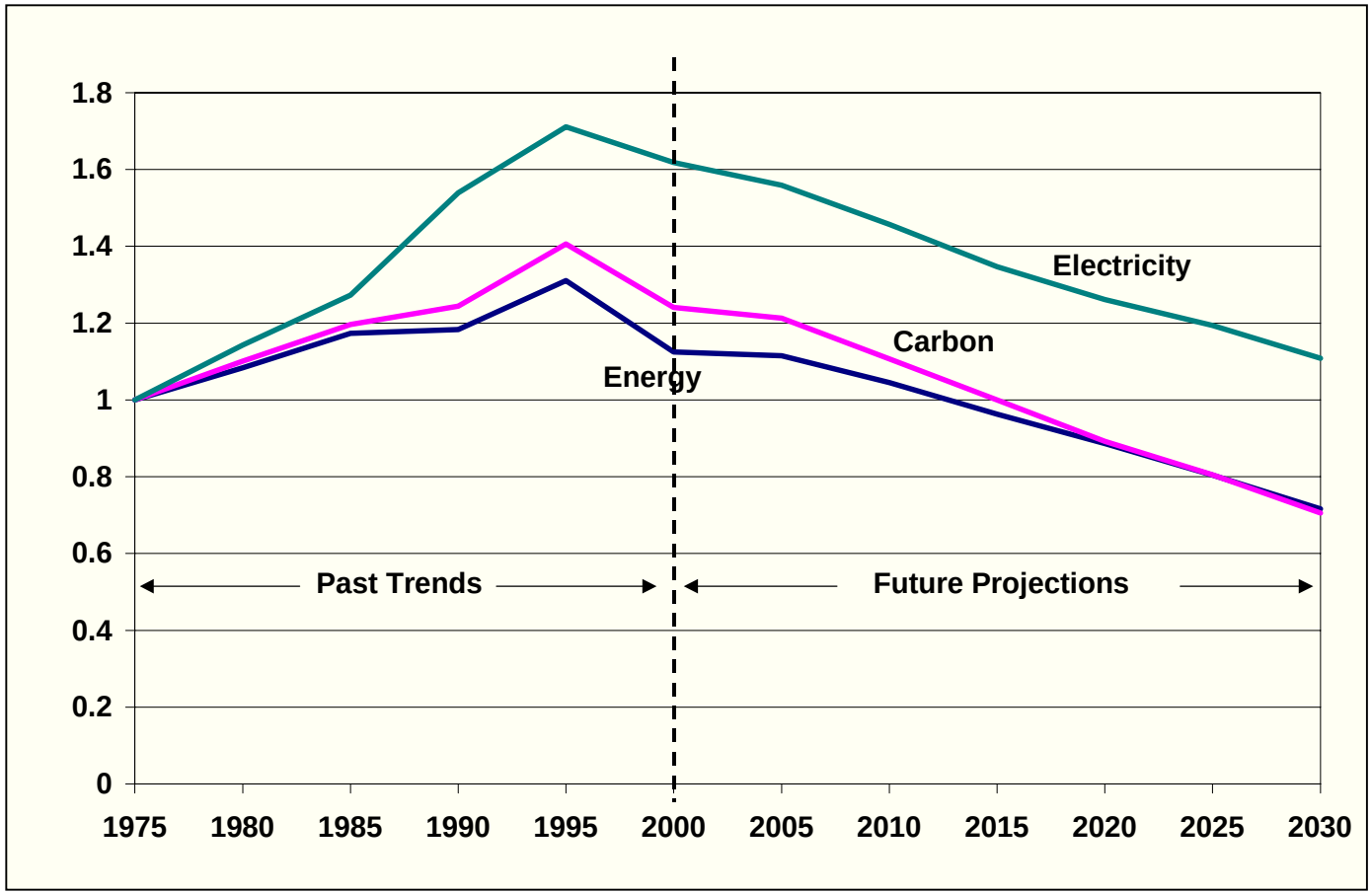
Energy, Carbon, Electricity and GDP

(History and Projections for Reference Scenario)

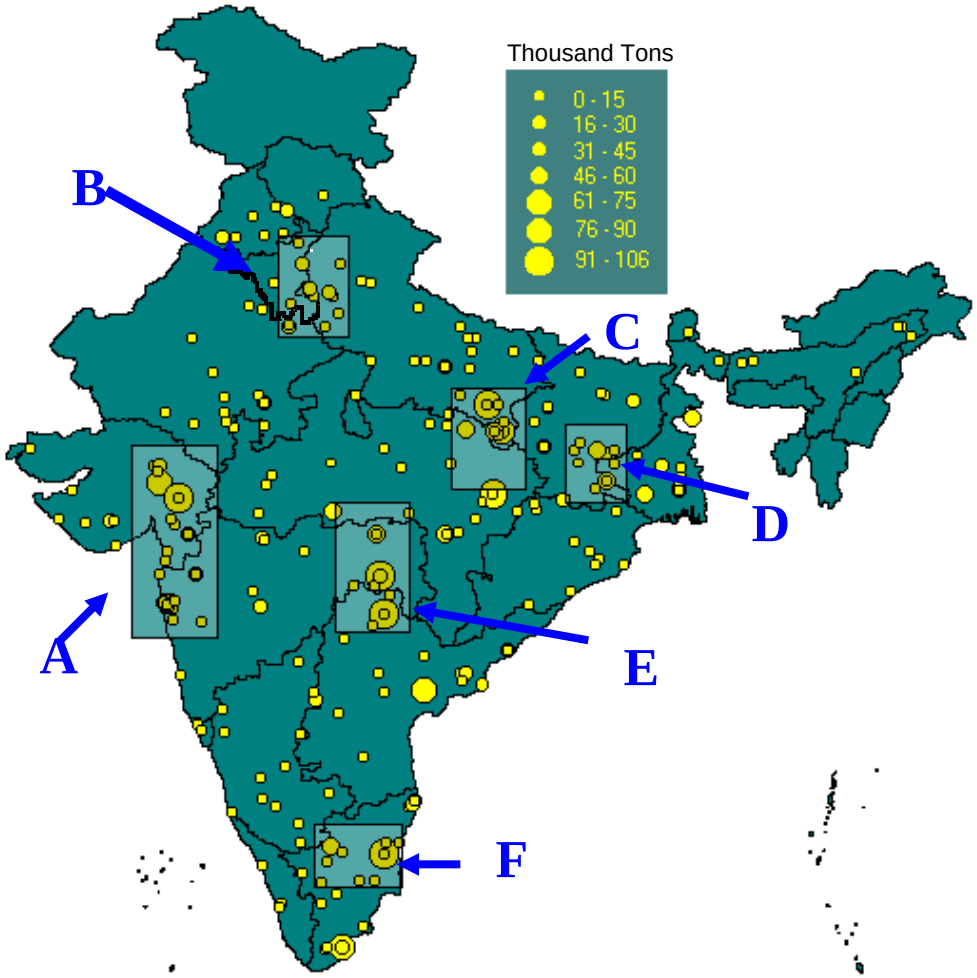


GDP intensities of Energy, Electricity and Carbon

(Reference Scenario)

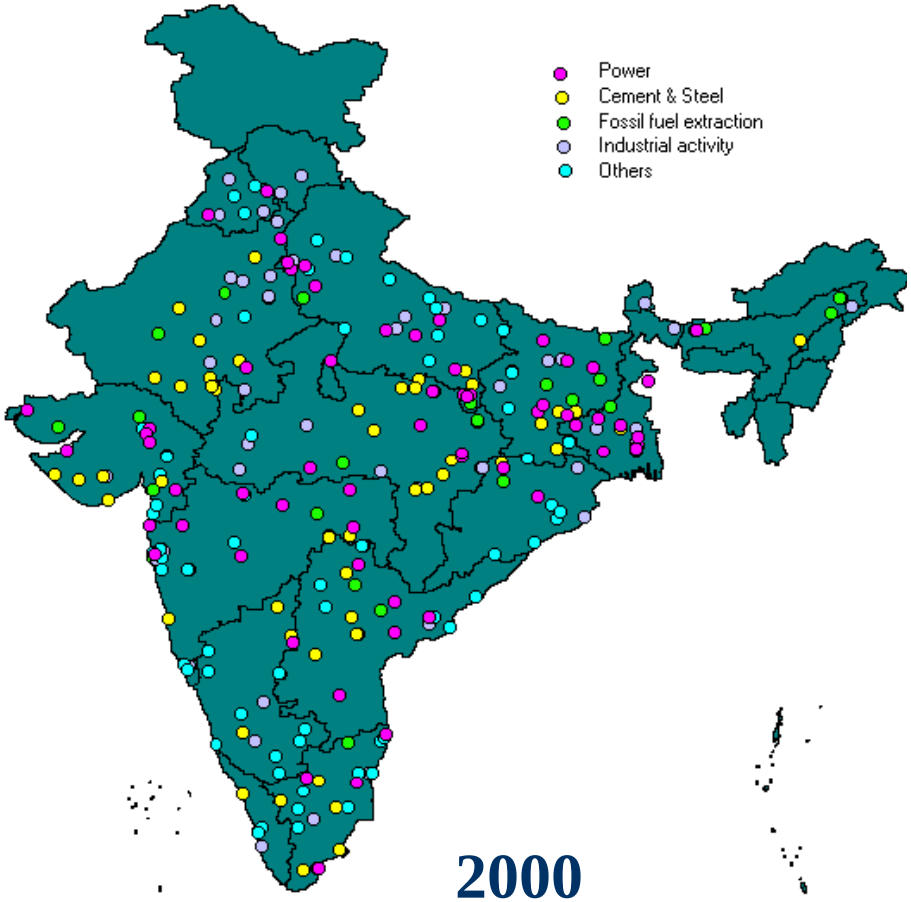


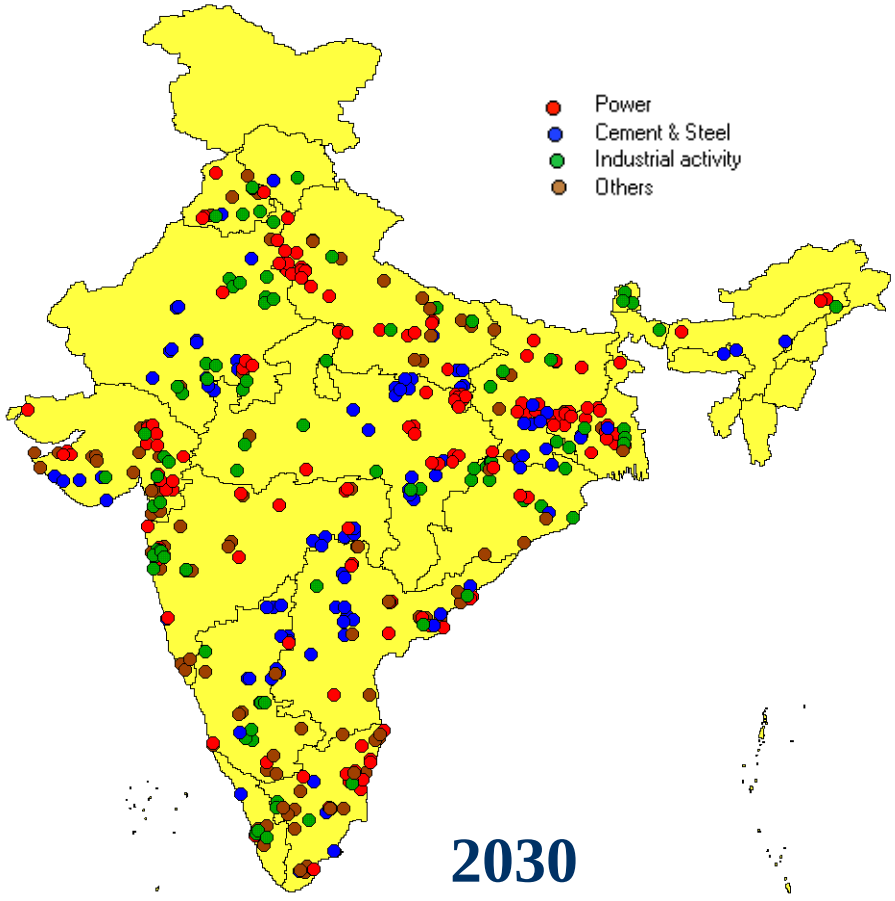
Large Point Sources of SO2 Emissions



Sectors	LPS covered
Power	94
Steel	11
Cement	85
Fertilizer	31
Paper	33
Sugar	28
Caustic Soda	19
Crude refinery	12
Petrochemical	14
HNO_3 manufacturing	5
H_2SO_4 manufacturing	63
Aluminum	3
Copper smelting	8
Lead smelting	5
Zinc smelting	3
Alcohol production	14
Coal mining	32
Natural gas production	9
N. gas transportation	12
Crude oil production	7
Municipal solid waste	14
Other industries	7
Total	**509**

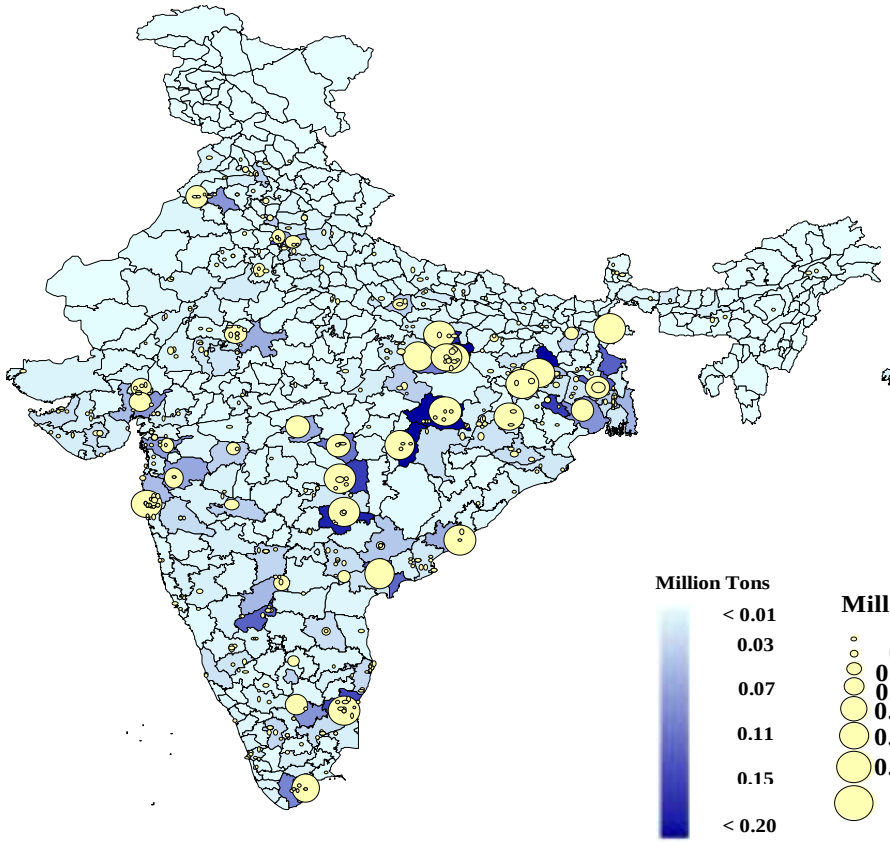
Locations of Large Point Sources



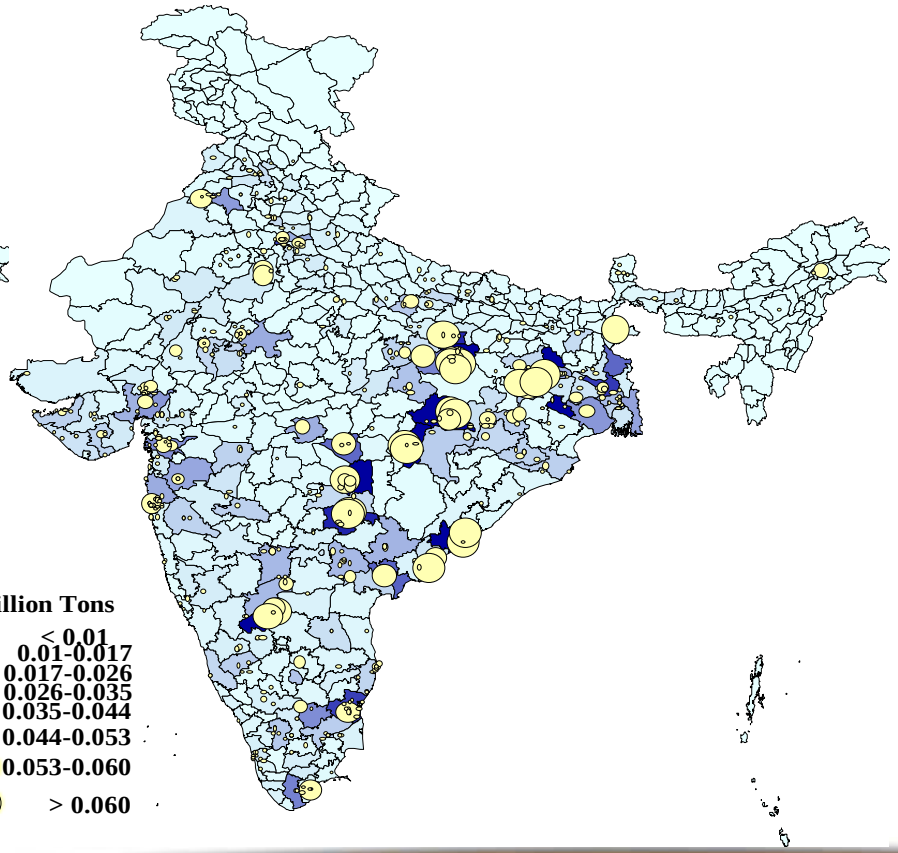


SO_2 Emission: AIM/Emission Model Analysis

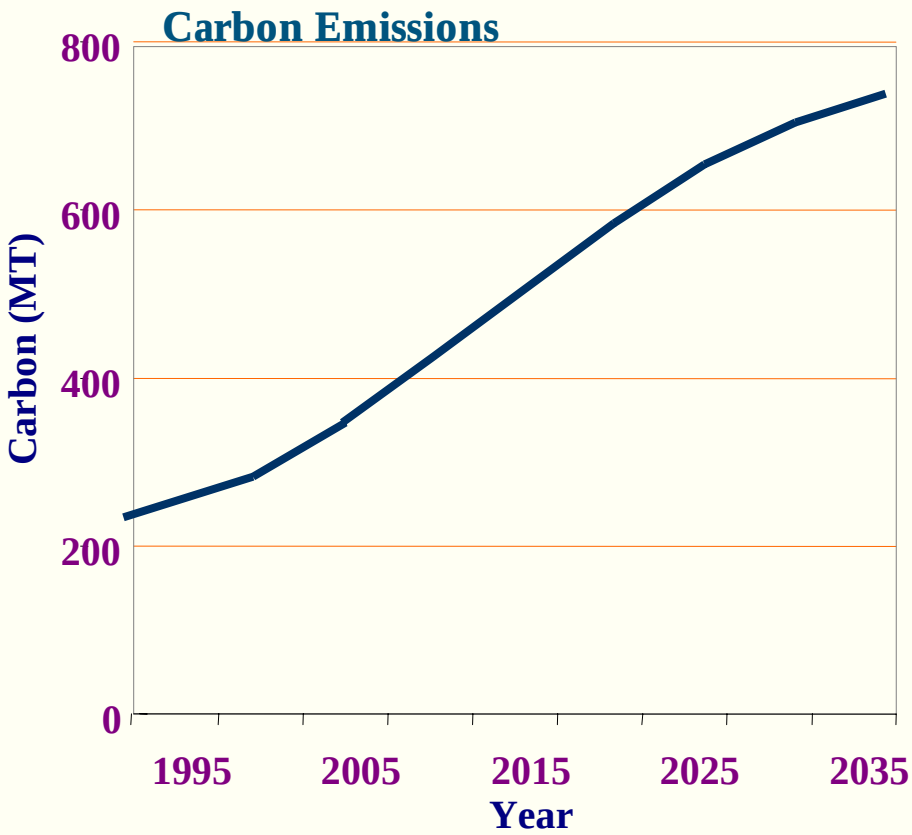
2000

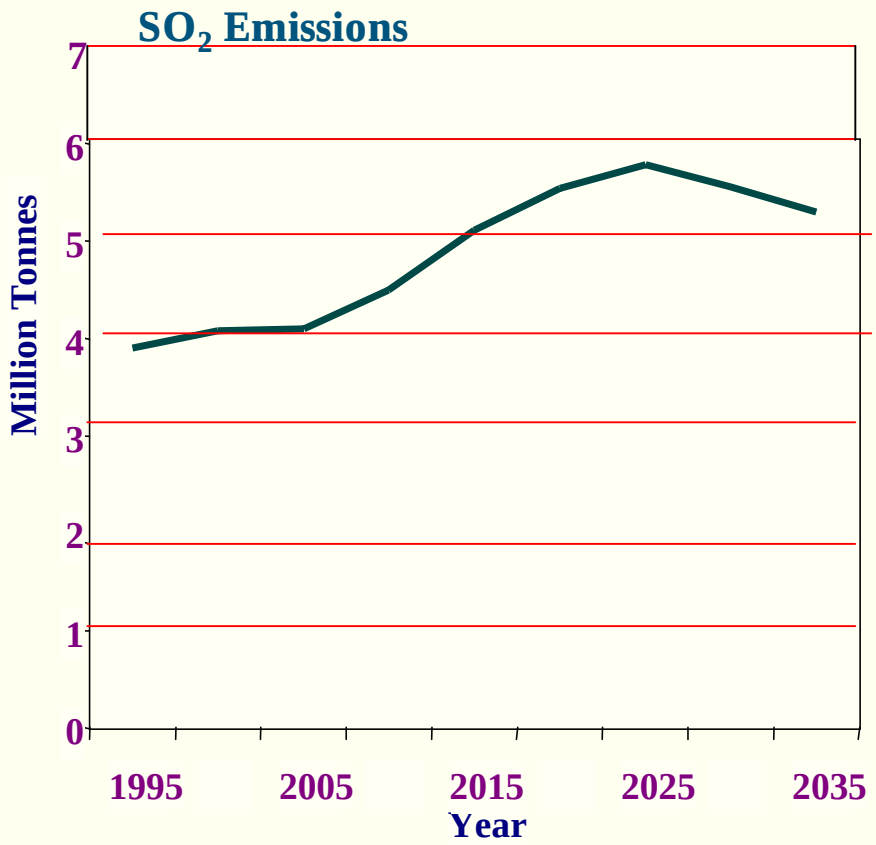


2030

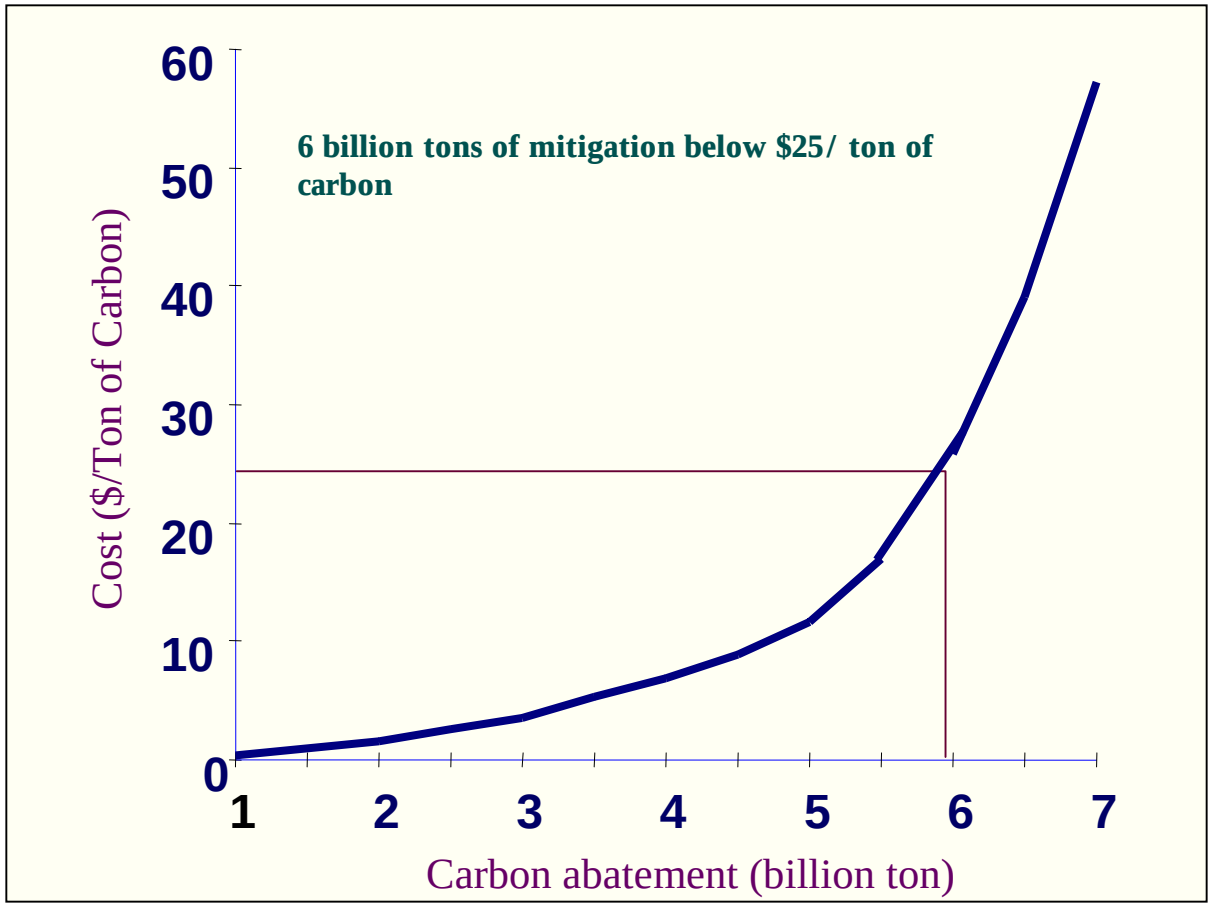


GHG versus Local Emissions in India





Carbon Mitigation Supply Curve: (2005-2035)



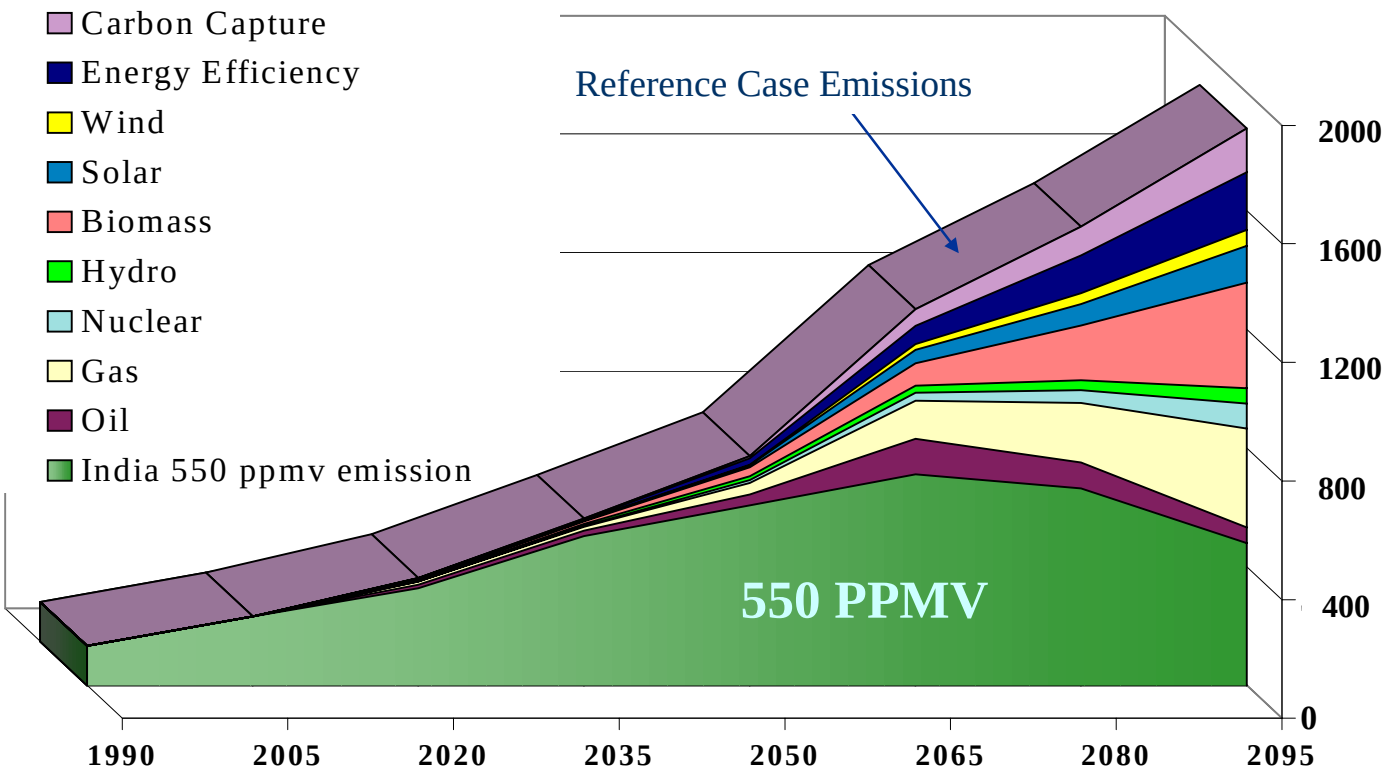
Carbon Mitigation

(under different Post-Kyoto Scenarios)

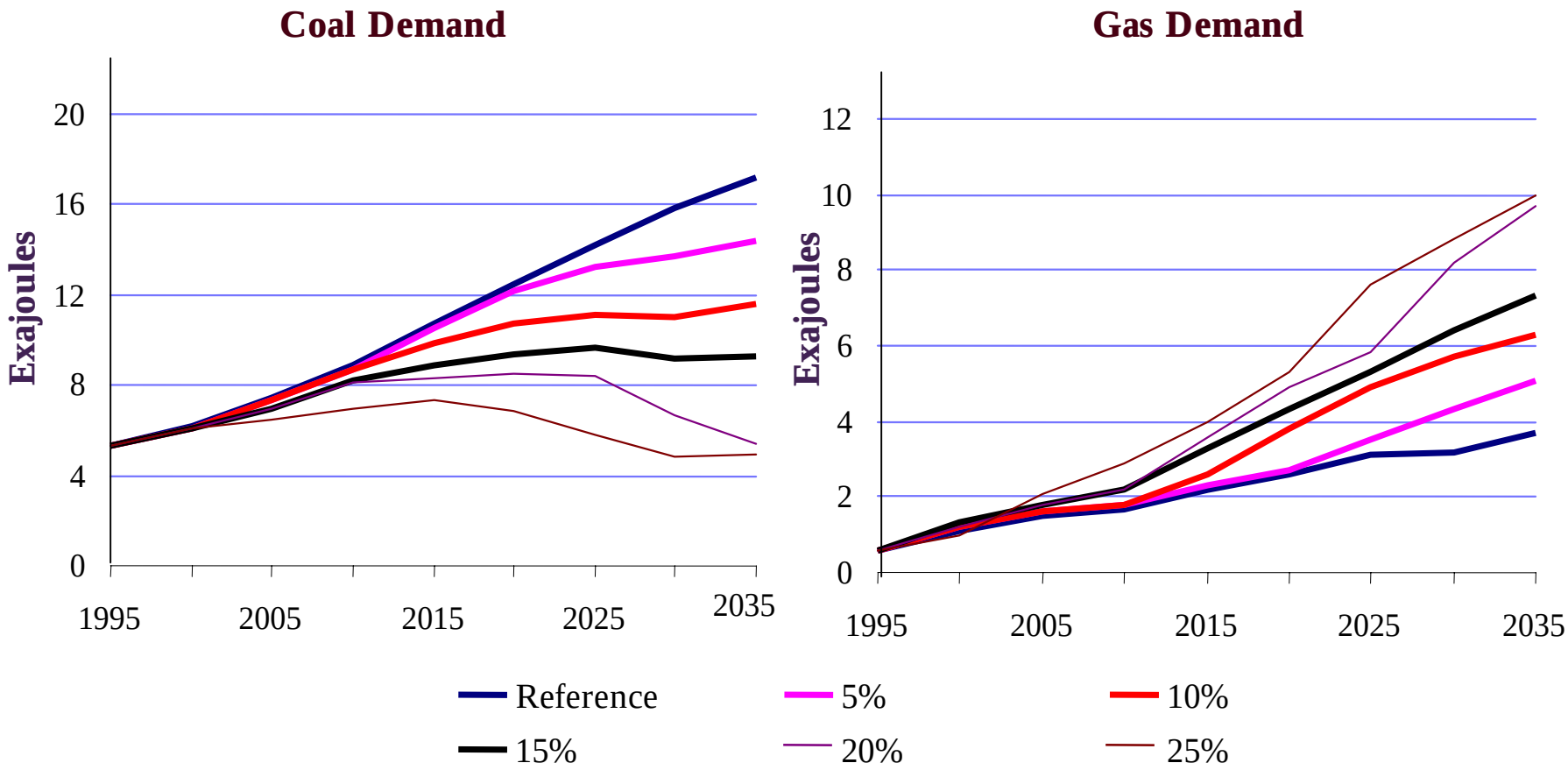
(in Million Ton)

Scenario	Kyoto Period 2000-2012	Medium Term 2000-2030	Long Term 2000-2100
750 ppmv	138 (3%)	743 (5%)	11334 (11%)
650 ppmv	301 (7%)	1555 (11%)	23666 (23%)
550 ppmv	449 (10%)	2503 (17%)	33284 (32%)

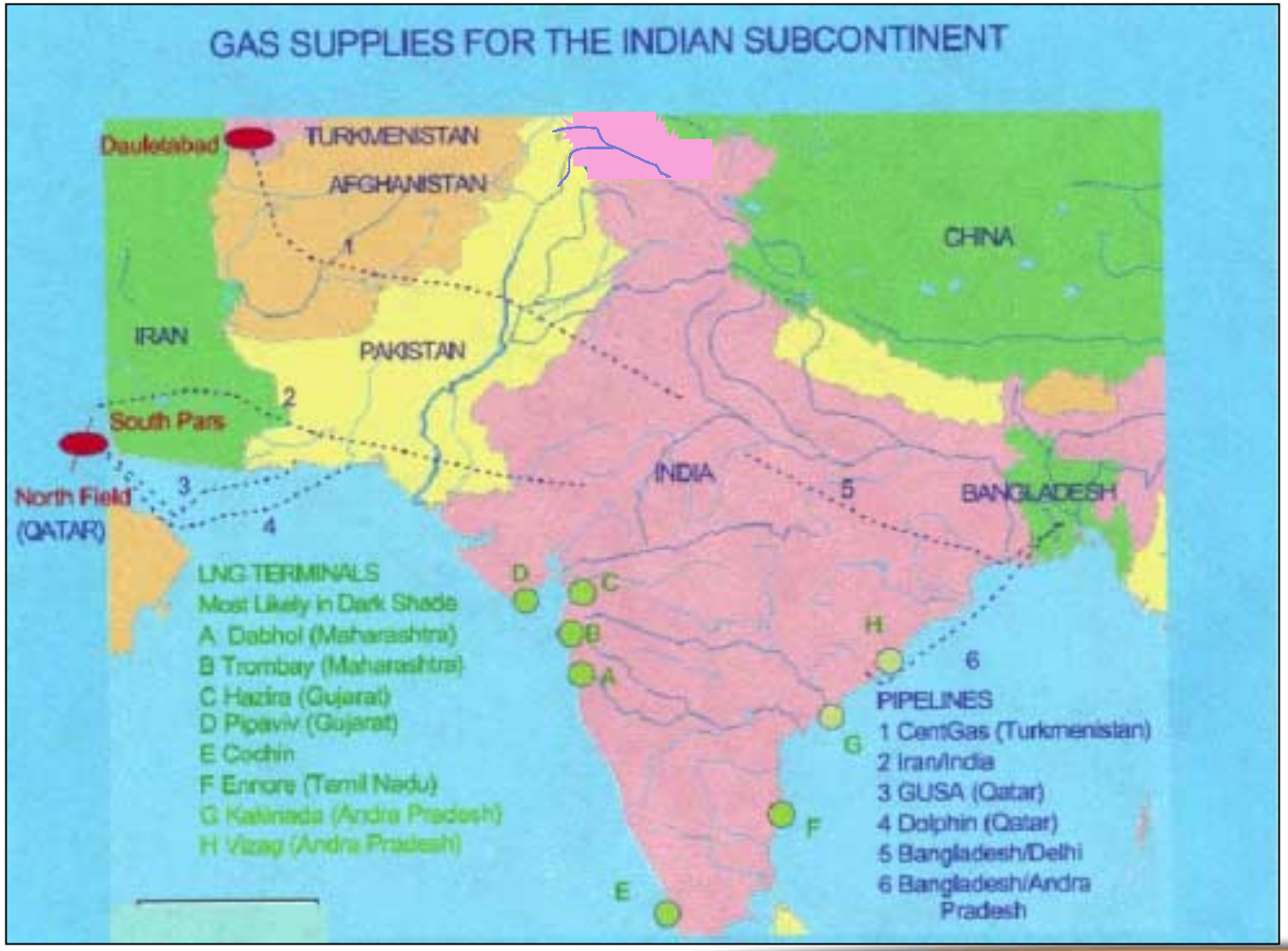
Technological Change in India to Stabilize CO_2 at 550 ppmv



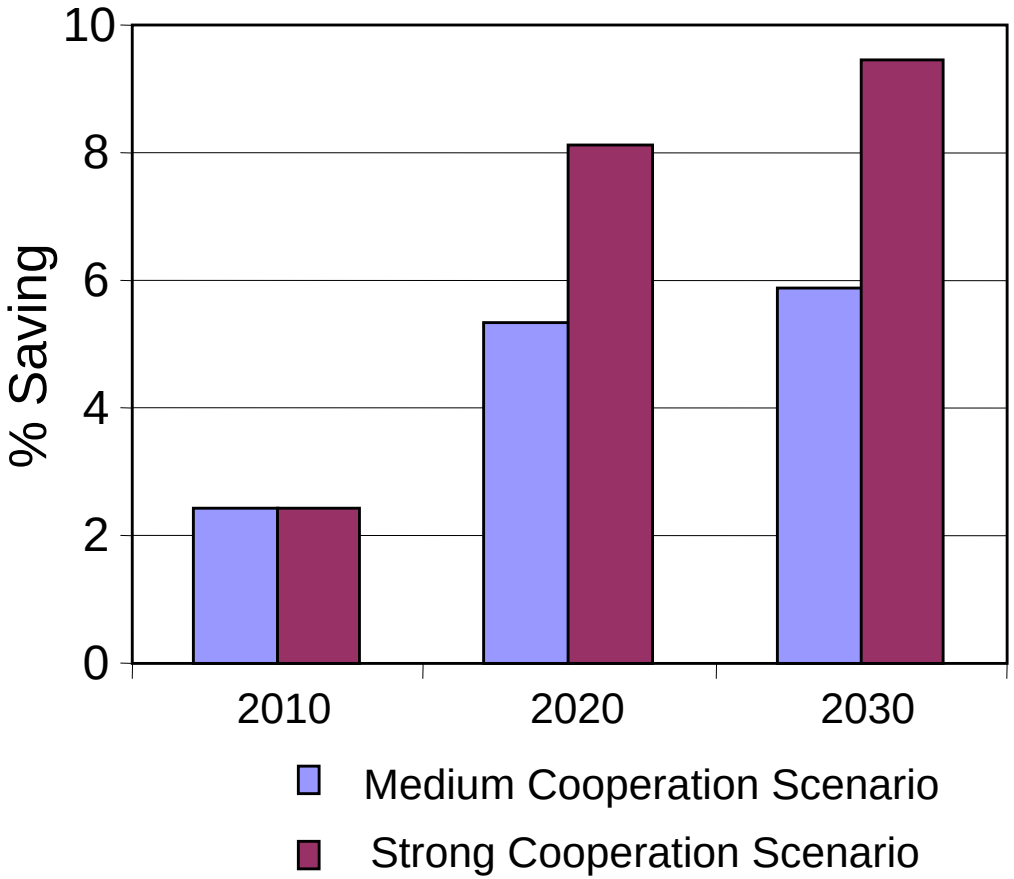
Implications of Mitigation: Coal and Gas in IA2 Scenario



Regional Energy Market Development

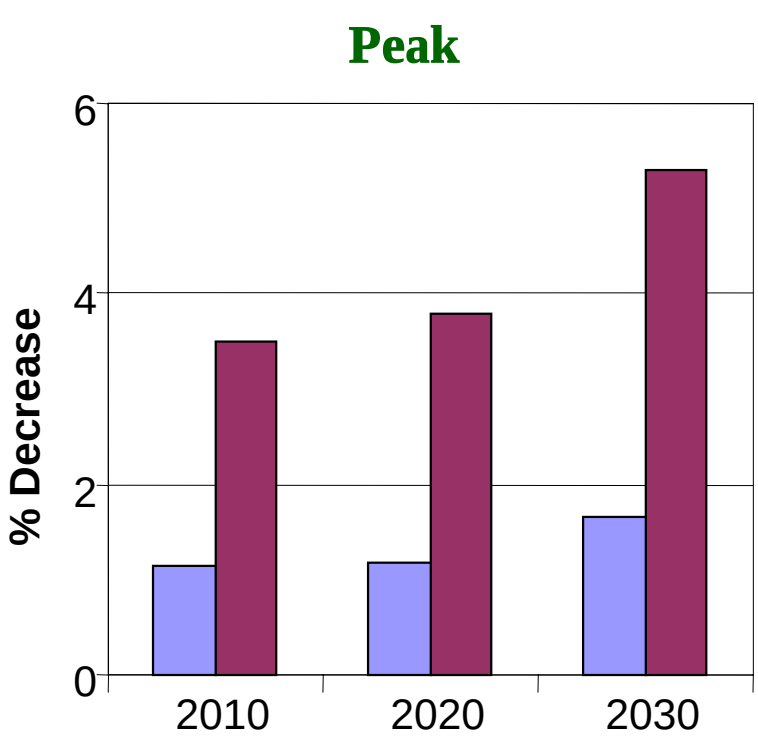


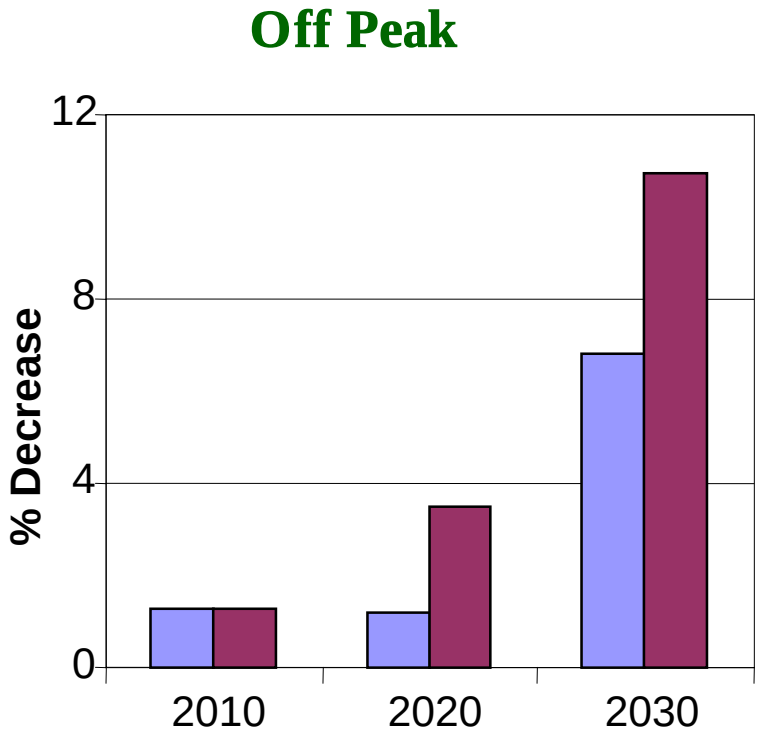
Total Primary Energy Supply Saving



- Cumulative Saving in Strong Cooperation: 60 EJ in 20 years (2010-2030)
- This is equivalent to $180 billion cumulative

Decrease In Electricity Costs

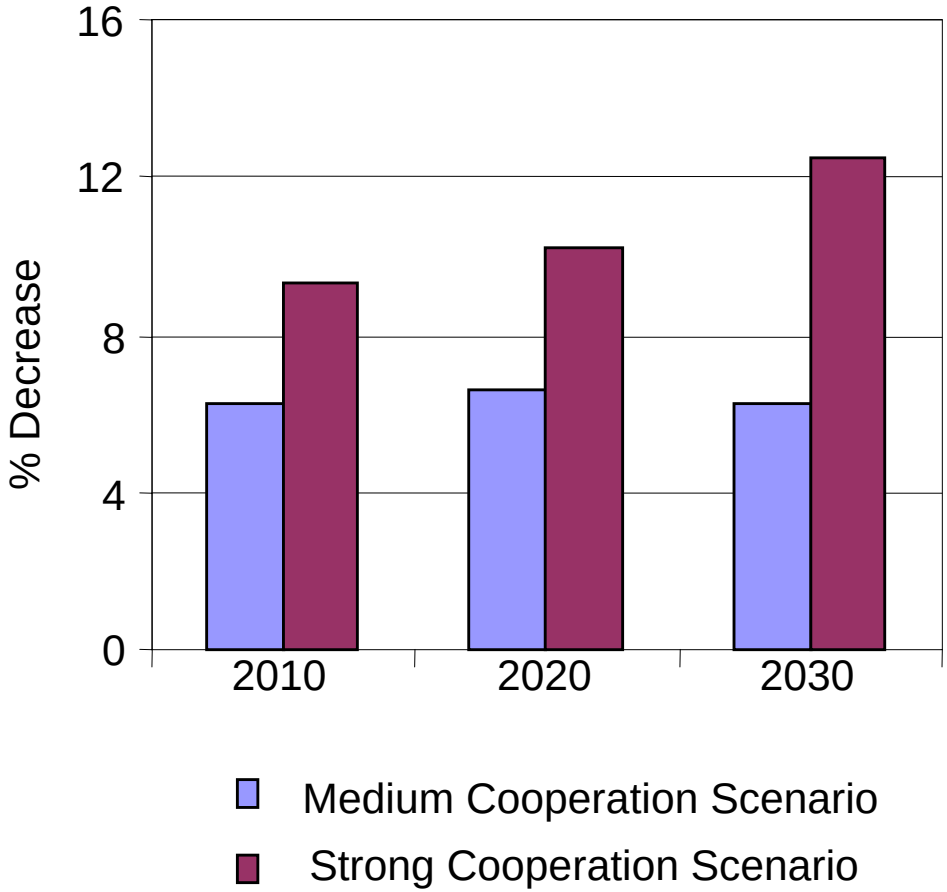




Medium Cooperation Scenario

Strong Cooperation Scenario

Reduction in Carbon Emissions



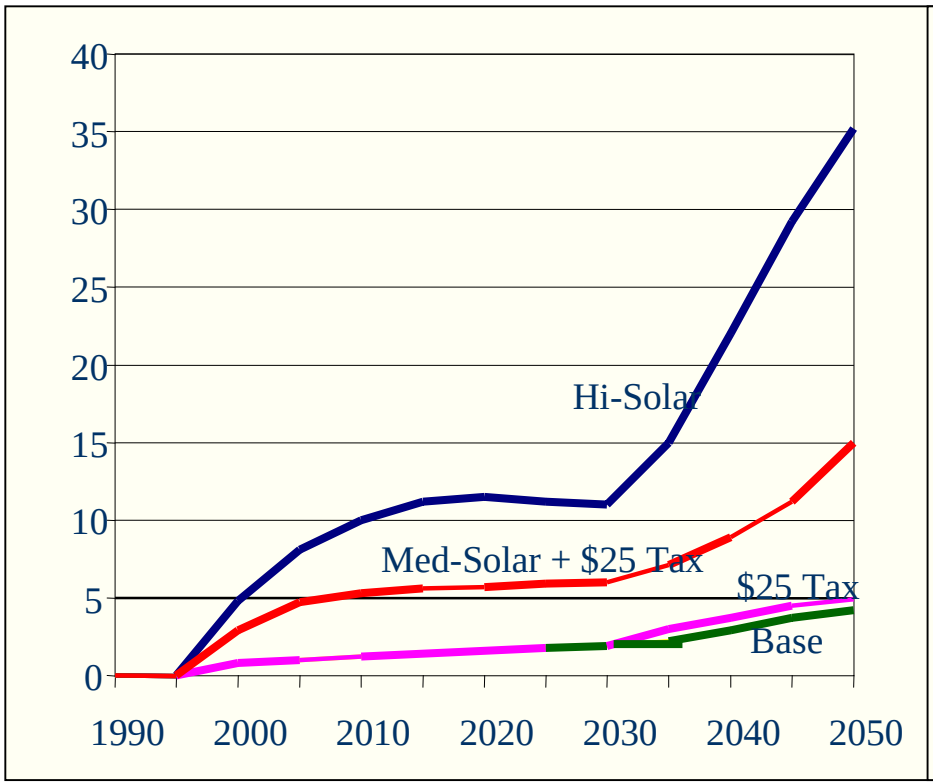
- Cumulative Savings in ACS: 1.4 Billion tonnes of Carbon.
- This is equivalent to $28 Billion saving

Benefits from South-Asia Energy Cooperation (2010-2030)

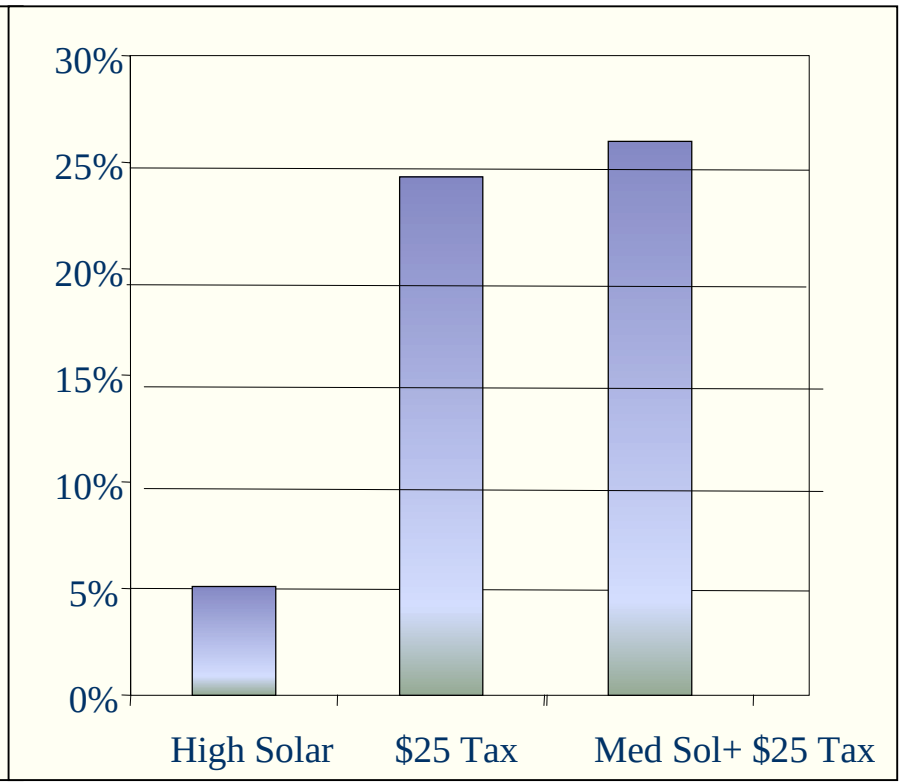
Benefit (Saving)		$ Billion	% of Region's GDP
Energy (Direct Benefits)			
Energy	60 Exa Joule	180	0.48
Investment in Energy Supply Technologies		72	0.19
Investment in Energy Demand Technologies		69	0.18
Environment (Indirect Benefits)			
Carbon	1.4 Billion Ton	28	0.08
Sulfur Dioxide (SO_2)	50 Million Ton	10	0.03
Total Direct and Indirect Benefits		359	0.98
Spillover Benefits			
Water	16 GW additional hydro capacity		
Flood Control	From additional dams		
Competitiveness	Reduced unit energy/electricity cost		

Penetration of Advanced Technology: *Competition Paradox*

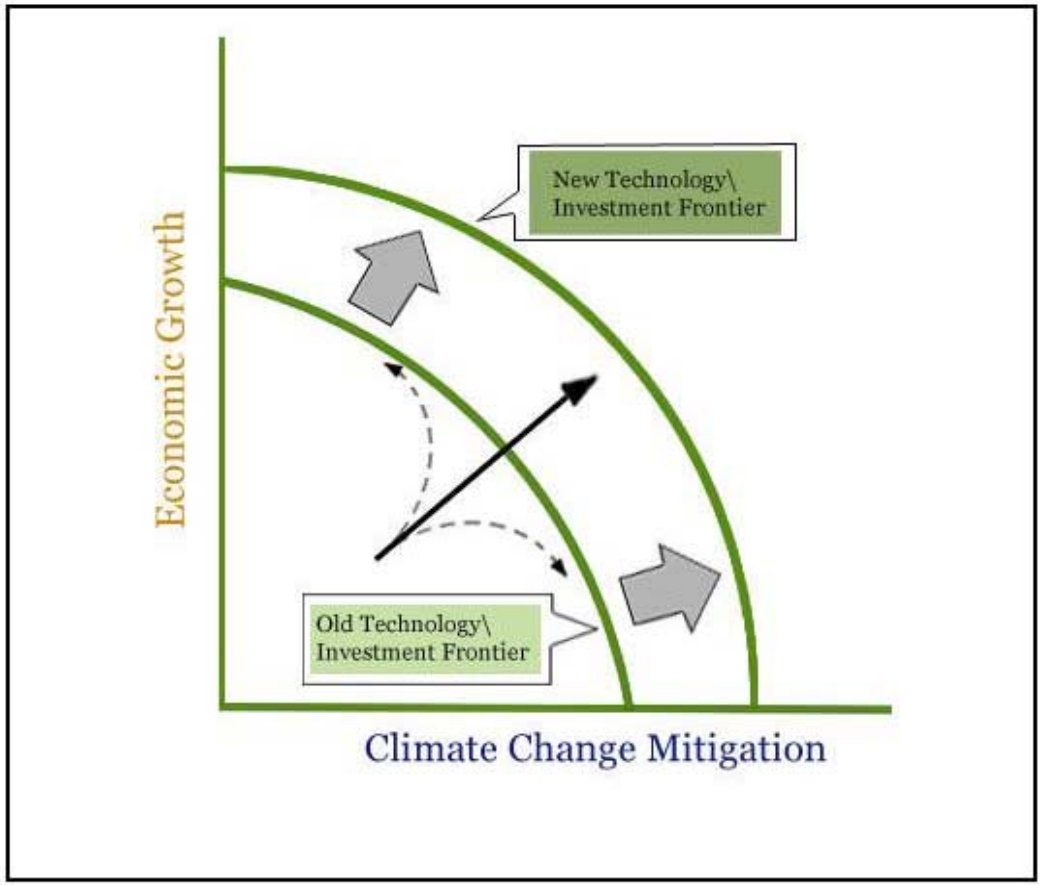
Solar PV Penetration



Carbon Mitigation



Conclusions

- Development pathway is a key driver of future emissions and mitigation costs
- Coal shall continue to remain significant source of future energy for India
- Local and global emissions mitigation policies are disjointed
- Emissions management for Large Point Sources like Power Plants offer co-benefit opportunities
- Strong mitigation regime, e.g. 550 ppmv, can alter the regional energy system significantly
- India has significant potential to be a competitive supplier of carbon credits (e.g. 6 billion ton at price $25/ton of Carbon by year 2035)
- Regional cooperation offers significant economic and environmental benefits (1% rise in regional GDP & 1.4 Billion Ton Carbon Mitigation between 2010-30)
- Supply-push of few clean technologies is inadequate for mitigation
- There is no “silver bullet” for mitigation; hence energy-technology stategy should have long-term perspective and follow portfolio approach

Development and Climate: Expanding the Frontier