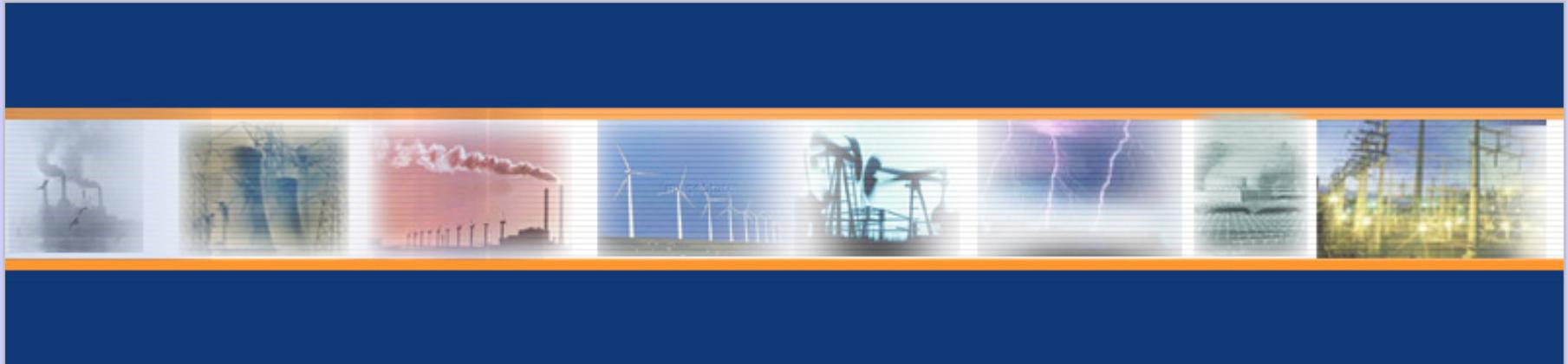


APEIS Project: India Report



Presented by
P R Shukla

Presented at The 11th International AIM Workshop, NIES, Tsukuba, Japan, February 19-20, 2005



1. Technology Database Development
 - [Energy Technology Transitions in India](#)
 - [New and Renewable Technology Database](#)
 - [Linking Innovations with MDG: Assessment of India's Bio-energy Program](#)

2. AIM/CGE Model Development
 - [Model Data Inputs](#)
 - [Energy and Environment Security in South-Asia](#)
 - [South-Asia Energy Cooperation Scenarios](#)
 - [Model Results](#)

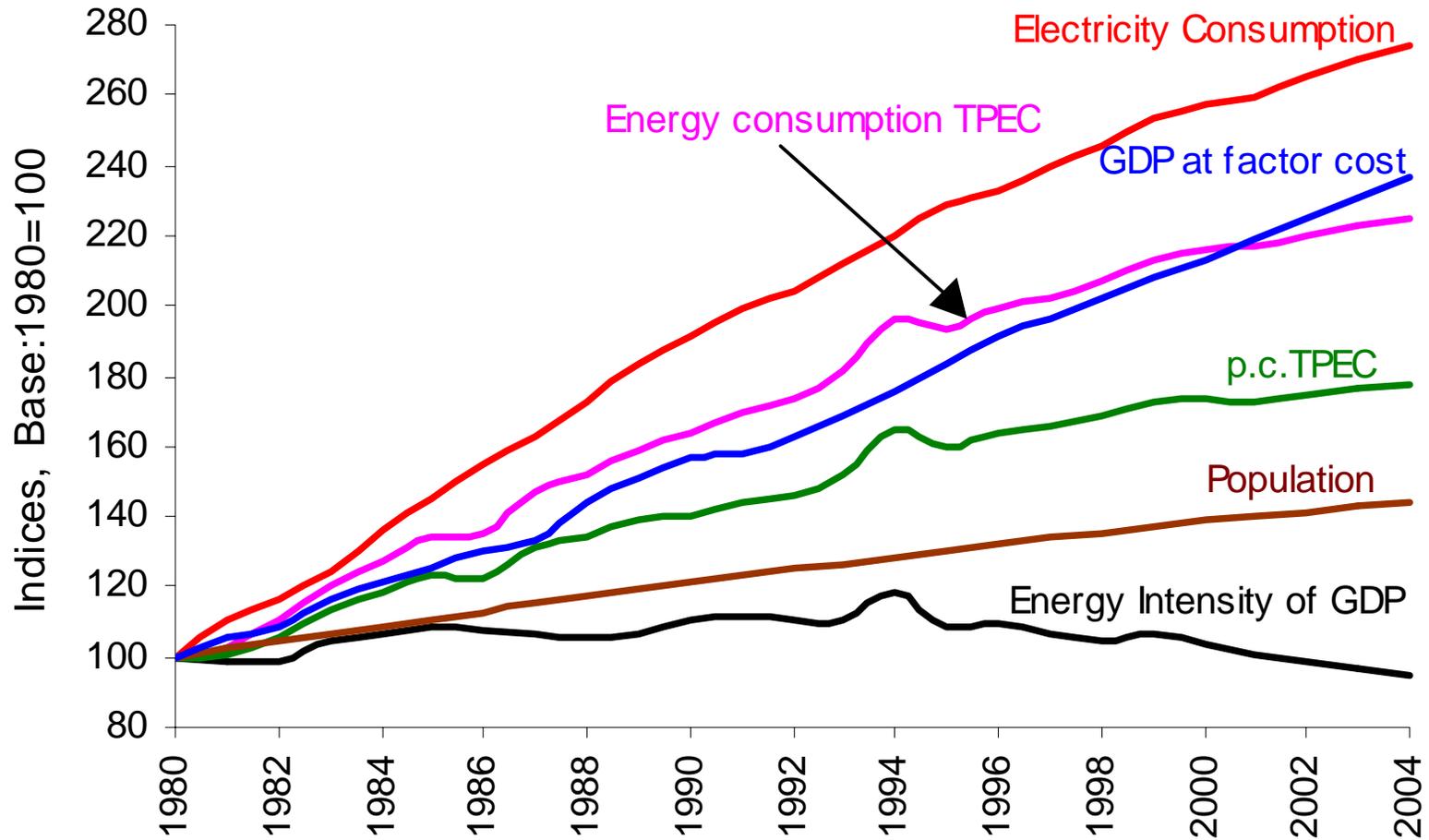
3. APEIS Project Interface with APN's CAPaBLE Project

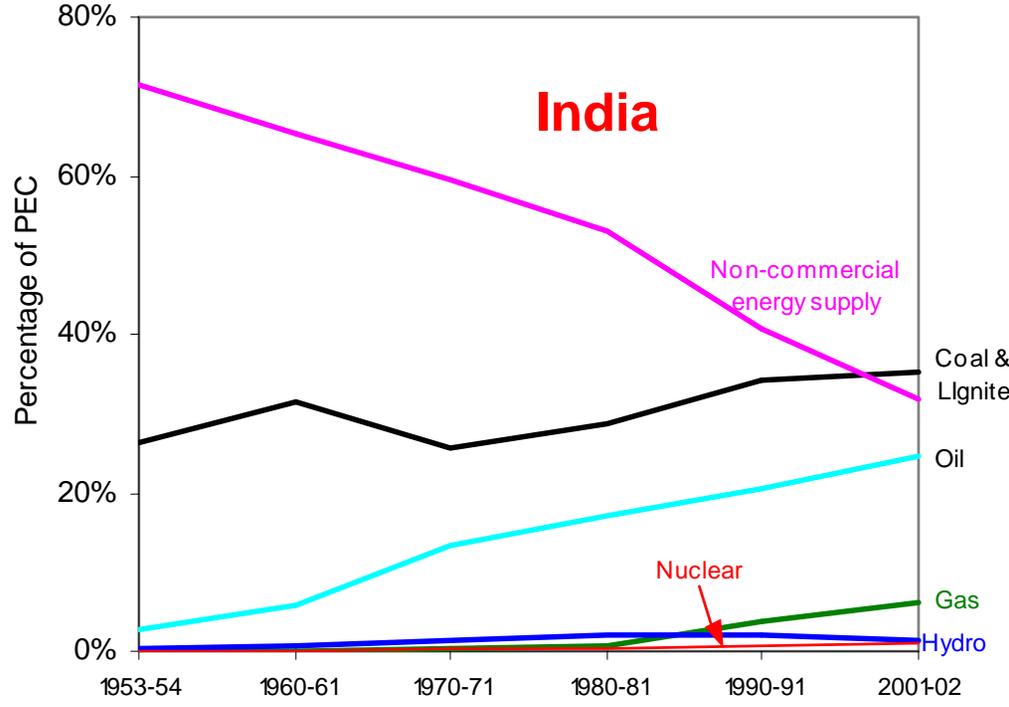
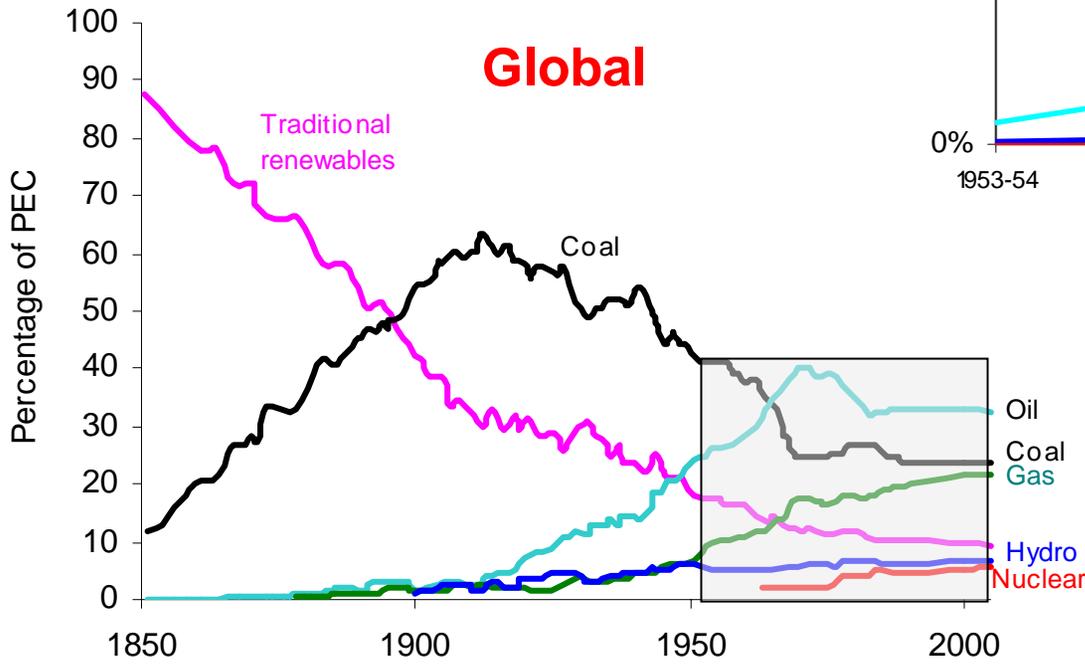


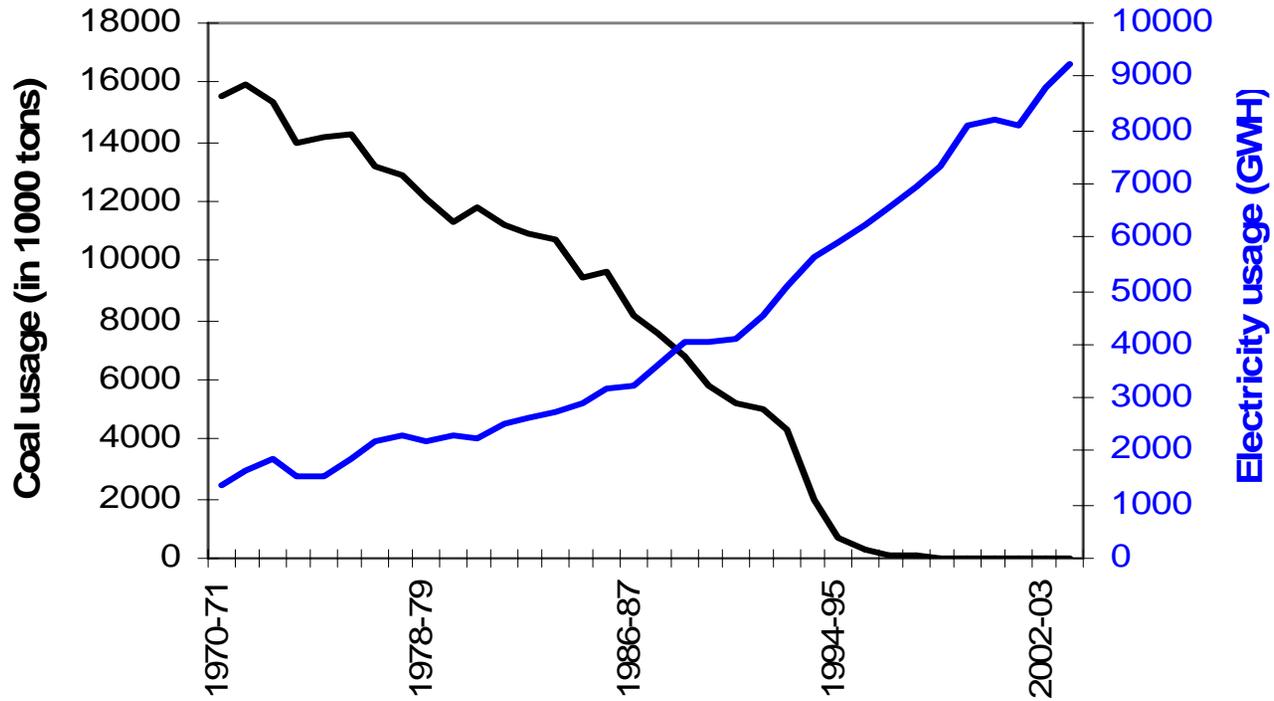
Technology Database Development

- Energy Technology Transitions in India
- New and Renewable Technology Database
- Linking Innovations with MDG: Assessment of India's Bio-energy Program

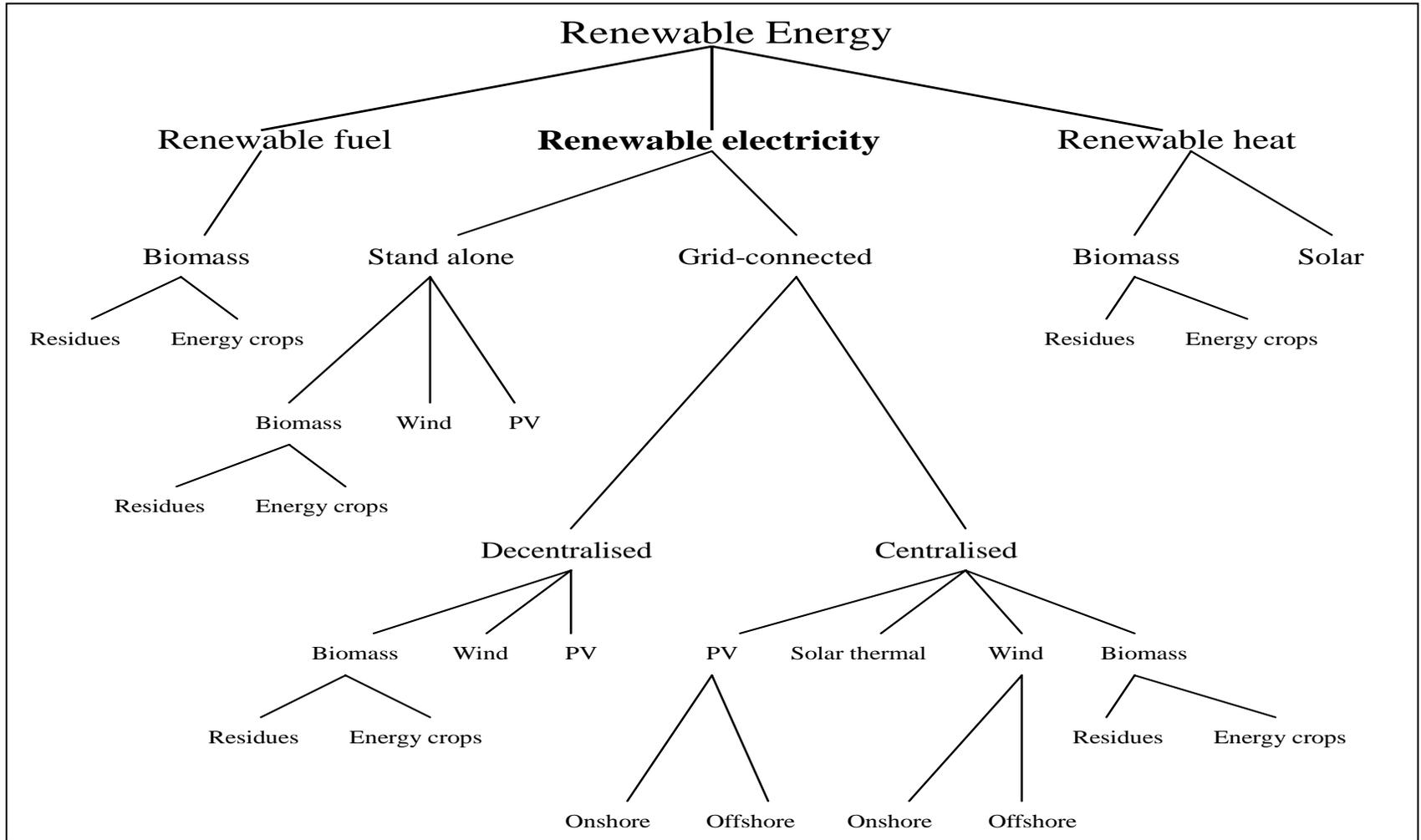


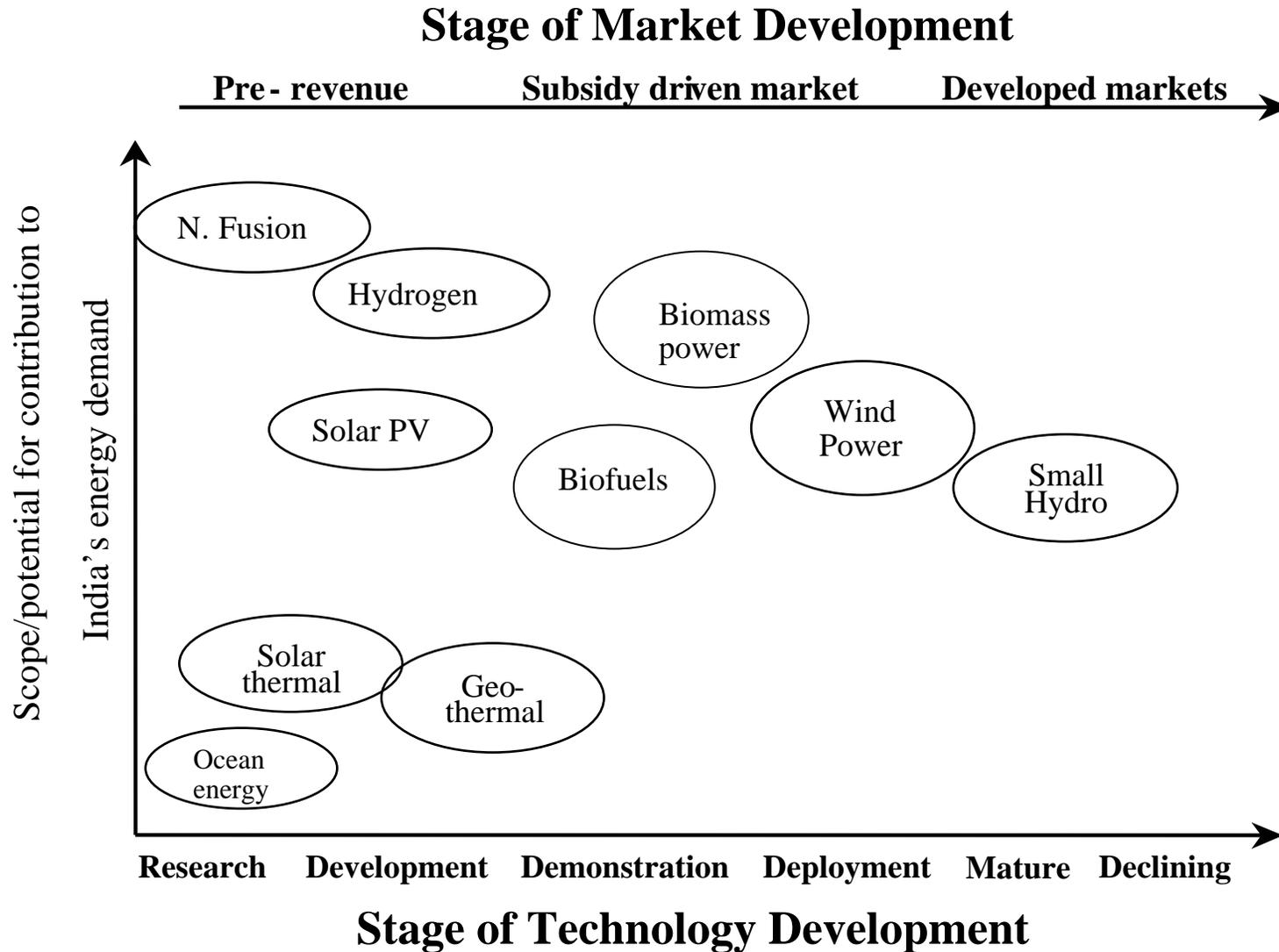






RET Classification



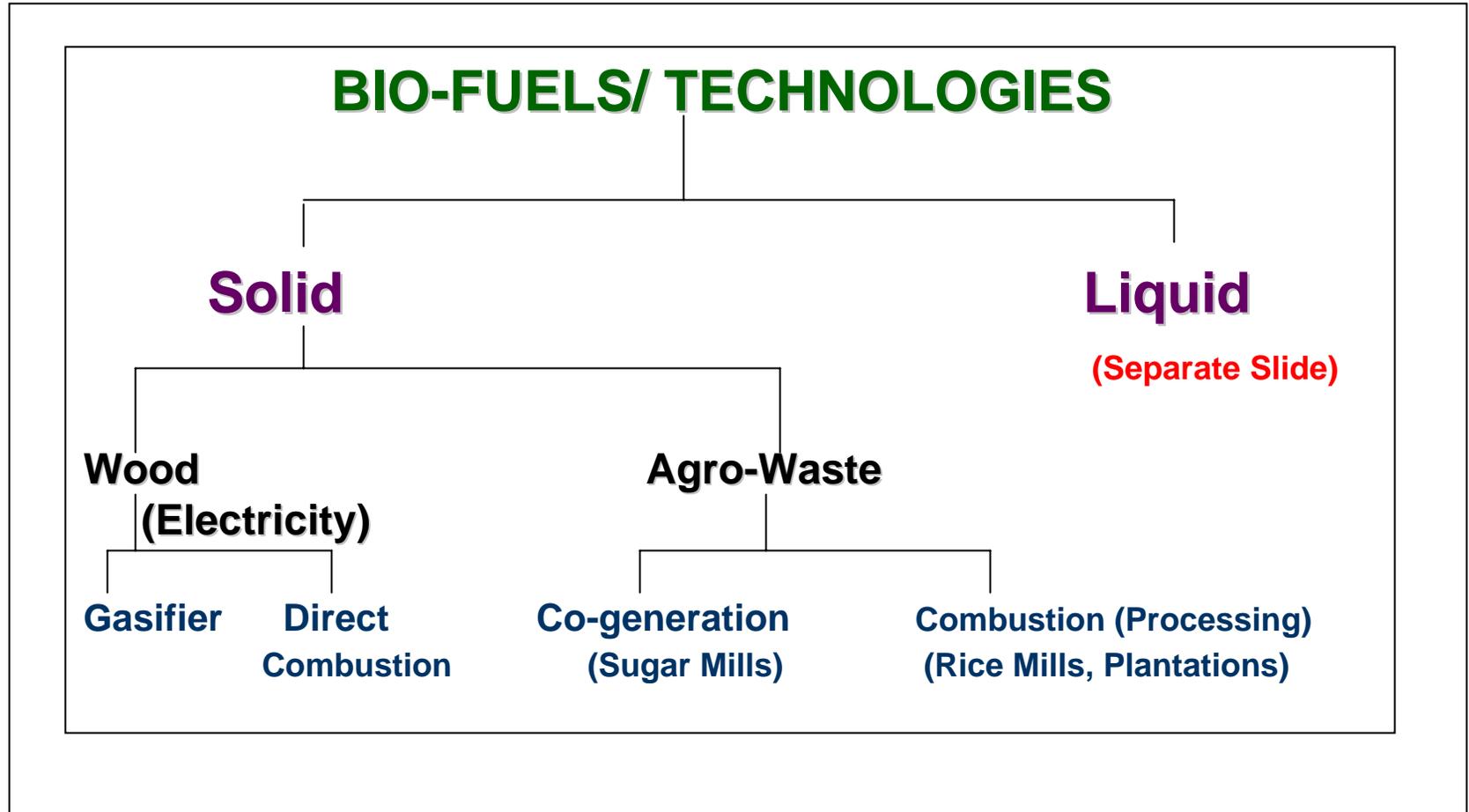


MDG, India's National Targets, Biomass and Climate Change

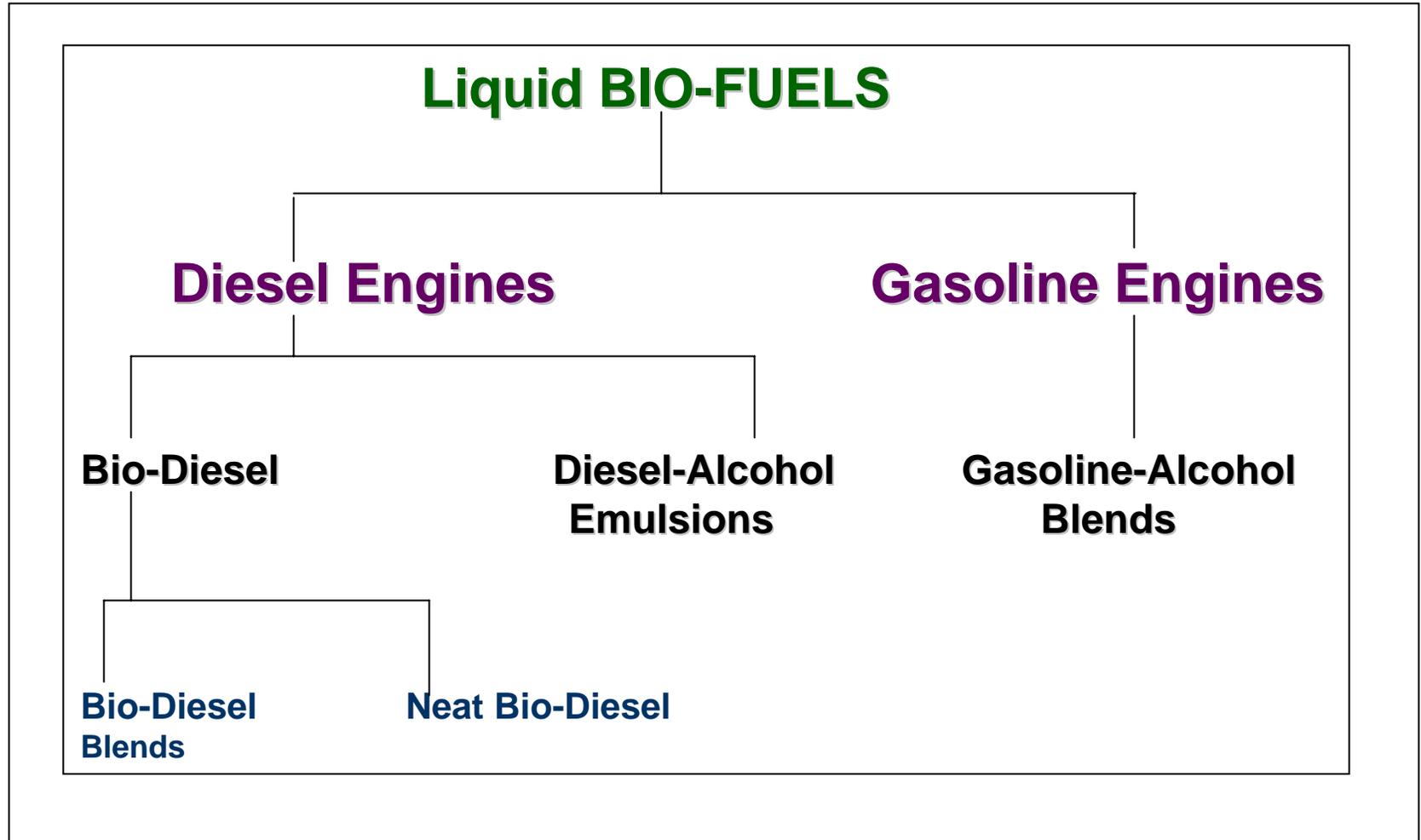
MDG and global targets	India's National plan targets	Interface with Climate Change
<p>Goal 1: Eradicate extreme poverty and hunger</p> <p>Targets: Halve, between 1990 and 2015, the proportion of people with income below \$1 a day and those who suffer from hunger</p>	<p>Double the per capita income by 2012</p> <p>Reduce poverty ratio by 15% by 2012</p> <p>Contain population growth to 16.2% between 2001-2011</p>	<p>Bio-energy can enhance rural income, substitute oil imports and enhance mitigative & adaptive capacity</p> <p>Lower population reduces pressure on land, water and energy consumption</p>
<p>Goal 7: Ensure environmental sustainability</p> <p>Targets: Integrate SD principles in country policies/ programs to reverse loss of environmental resources</p> <p>Target: Halve by 2015 the proportion of people without sustainable access to safe drinking water</p>	<p>Increase in forest cover to 25% by 2007 and 33% by 2012 (from 23% in 2001)</p> <p>Sustained access to potable drinking water to all villages by 2007</p> <p>Electrify 80,000 additional villages by 2012 via decentralized sources</p> <p>Cleaning of all major polluted rivers by 2007 and other notified stretches by 2012</p>	<p>Enhanced sink capacity; energy security due to substitution of fossil imports; reduced pressure on land, resources and ecosystems</p> <p>Better quality of life and adaptive capacity due to access to electricity, enhanced supply of clean water, health & education in rural areas</p>



Modern Biomass Fuels and Technologies



Modern Biomass Fuels and Technologies



■ Phase I (2003-07): Demonstration Projects

- *Plantation on 400,000 hectares of land*
- *Seed Collection*
- *Oil Extraction*
- *Transesterification*
- *Blending*
- *Marketing*

■ Phase II (2007-2012)

- *Self Sustaining Expansion of Biodiesel*
- *One hectare plantation likely to produce 3.75 MT of seed, yielding 1.2 MT of oil*



Jatropha Plantation in India



Jatropha plant



Jatropha plantation on reclaimed desert using
sewage waste water in Middle East



Oil Extraction Plant



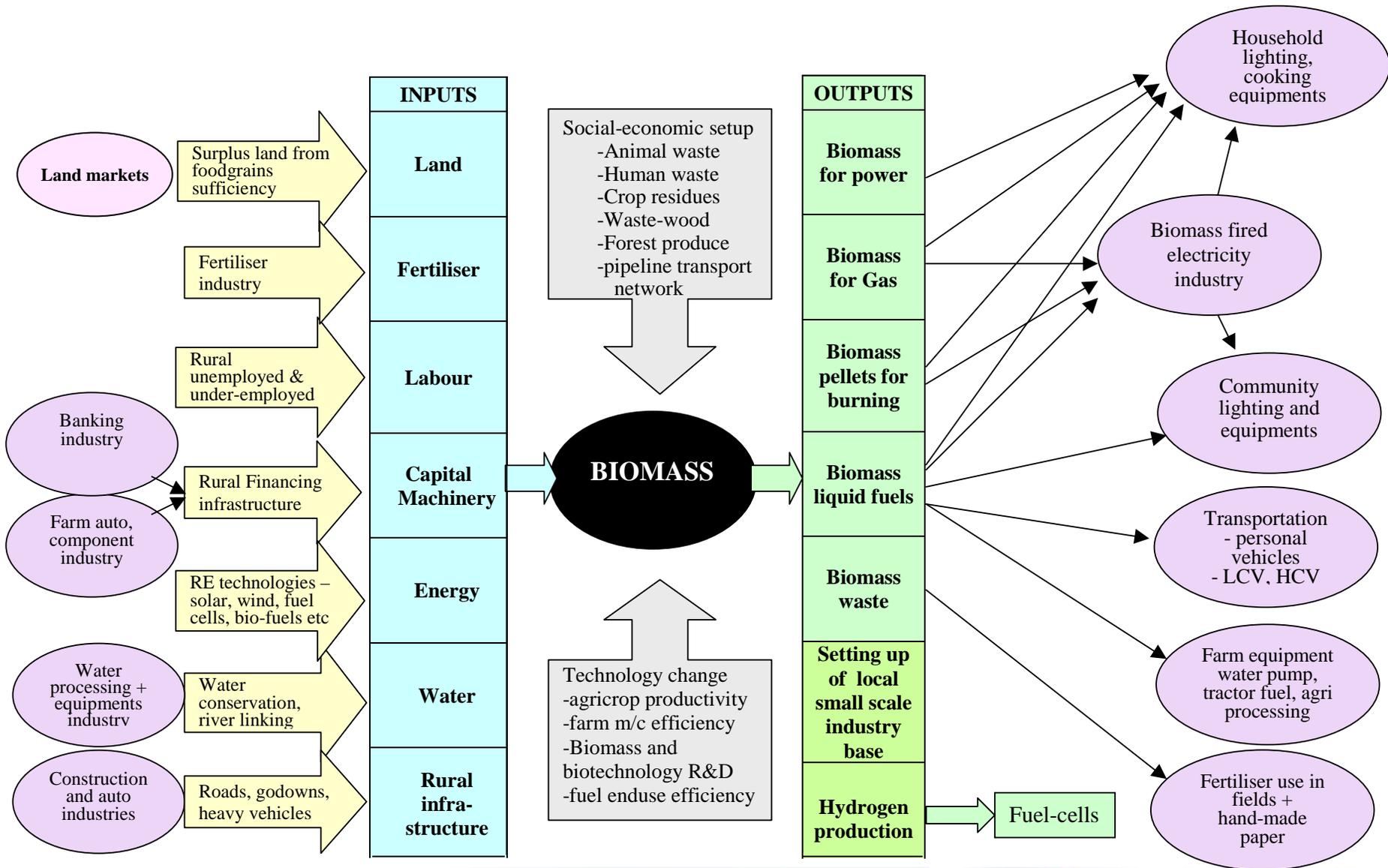
- Large scale employment potential exists for Jatropha plantation and seed collection and extraction.
- Seed yield of 4 Ton/Ha gives farmers Rs. 20000 income/ Ha/year from waste lands with support price of Rs. 5 per kg of seed.
- Energy security and environment benefits due to replacement of imported fossil oil

Rural Employment

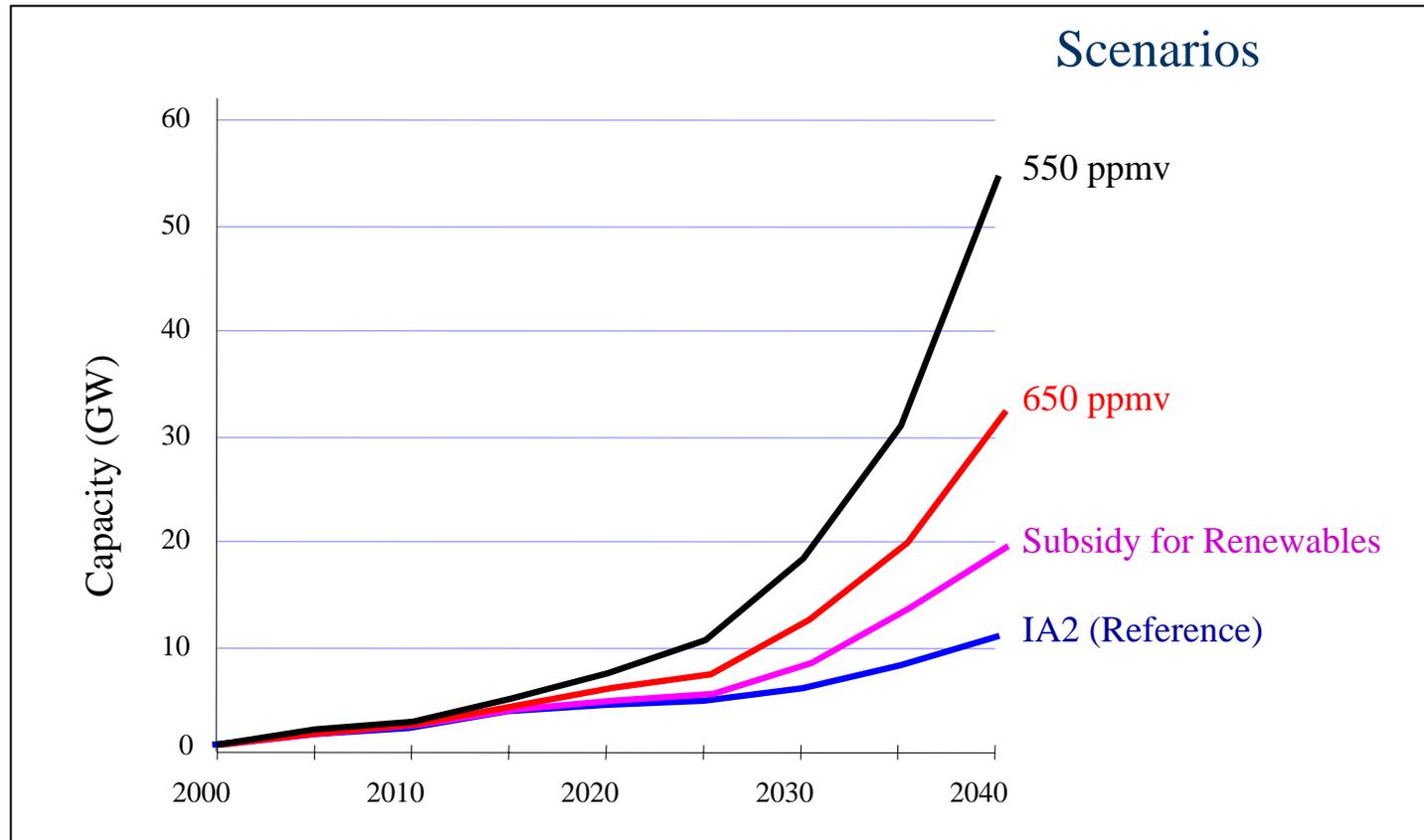


Trial Runs: 5-10% Bio-diesel by Indian Railways





Penetration of Biomass in Electricity Sector



AIM/CGE Model Development for India

- Model Data Inputs
- Energy and Environmental Security in South-Asia
- South-Asia Energy Cooperation Scenarios
- Model Results

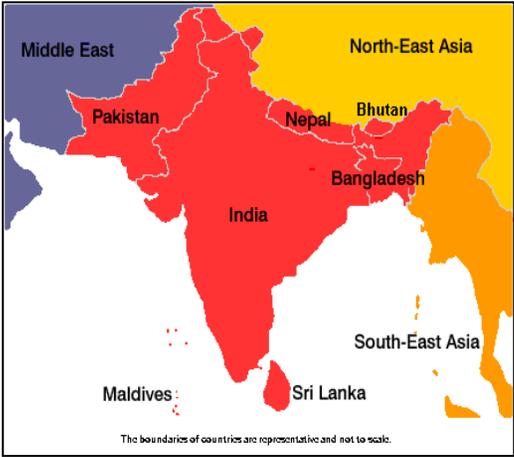


- **I/O Table India 1999 (Source , CSO)**
 - 115 X 115 Commodities
 - Disaggregated Oil & Gas into Oil & Gas
 - Aggregated to 35 X 35 Commodities
- **4 Energy Sectors / Commodities**
 - Coal / Petroleum / Gas / Electricity
- **Emission Coefficients**
 - Source: Garg & Shukla, 2002 and India's Initial NATCOM to UNFCCC (2004)



Energy and Environment Security in South Asia

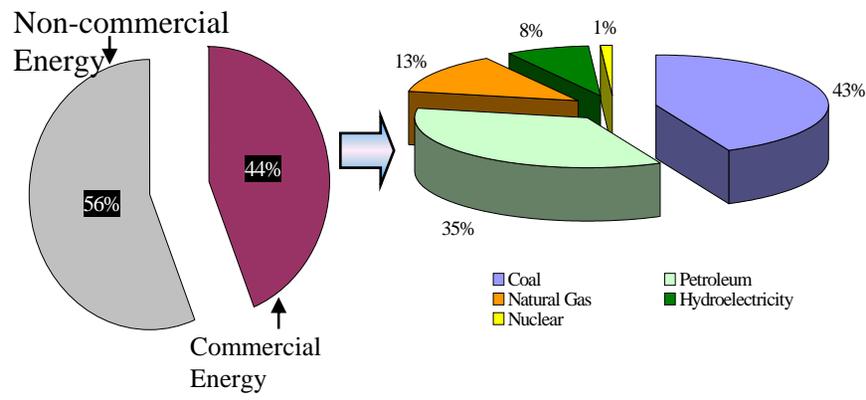
South-Asia Region



- Among the fastest growing regions
- Diverse geography, climate, energy resources, politico-economic systems
- High Fossil Dependence and Oil Imports
- Environment Security Concerns

Country	Dominant fuel in commercial energy consumption	Non commercial energy (as % of total energy consumption)
Bangladesh	Gas (65%)	47%
Bhutan	Imported oil & coal	95%
India	Coal (52%)	35%
Maldives	Imported oil	55%
Nepal	Oil (74%)	81%
Pakistan	Oil (55%)	33%
Sri Lanka	Oil (89%)	51%

Energy Mix in India



What are the implications of South Asian regional cooperation on carbon emissions?

Two Scenarios:

- Scenario I : With Strong Regional Energy Co-operation
- Scenario II: With Medium Regional Energy Co-operation

Regional Gas Markets



- Model Calibrated
- Initial Year (1998) Results validated with literature

Sector CO₂ Emissions Share (1998)

Sector	Share	CO ₂ (Million ton)
Electricity	38%	388
Manufacturing	42%	424
Other	7%	72
Transport	13%	135
	100%	1020

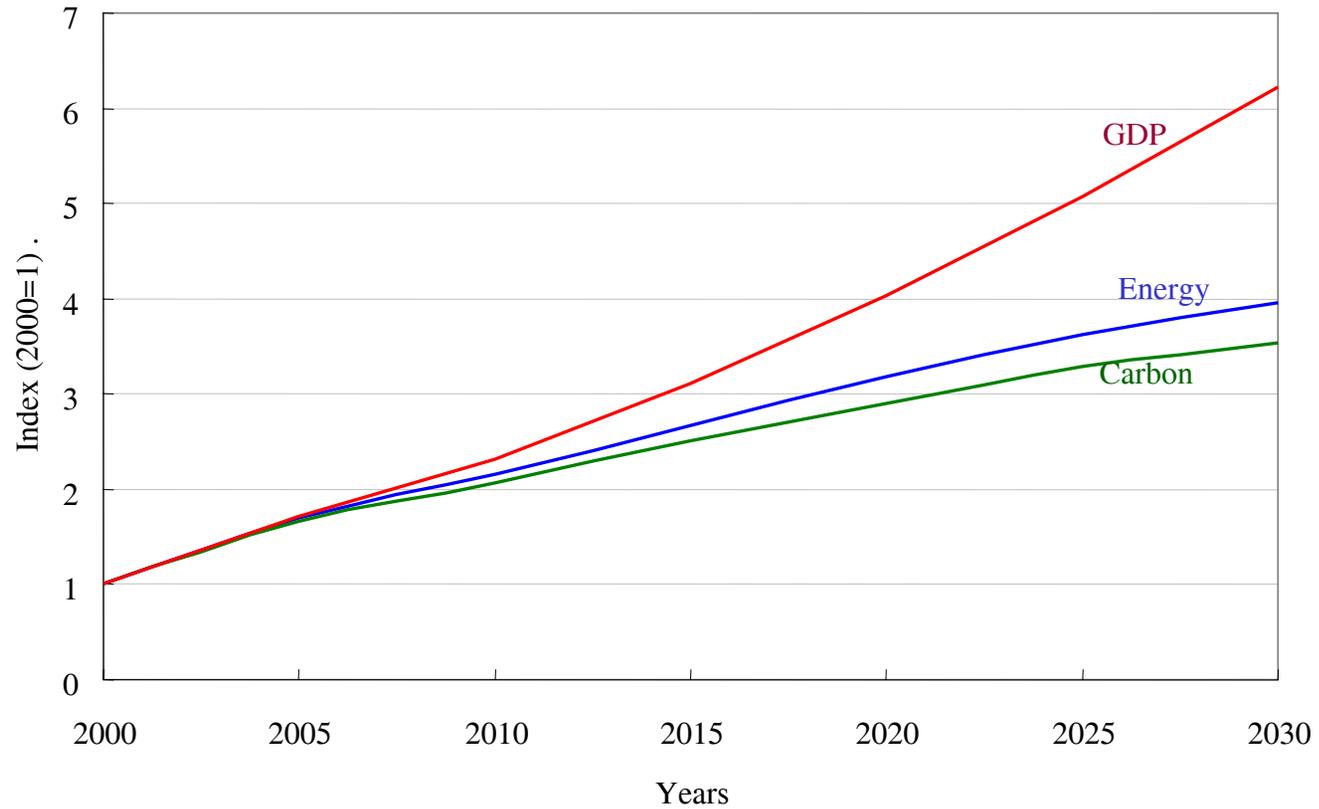


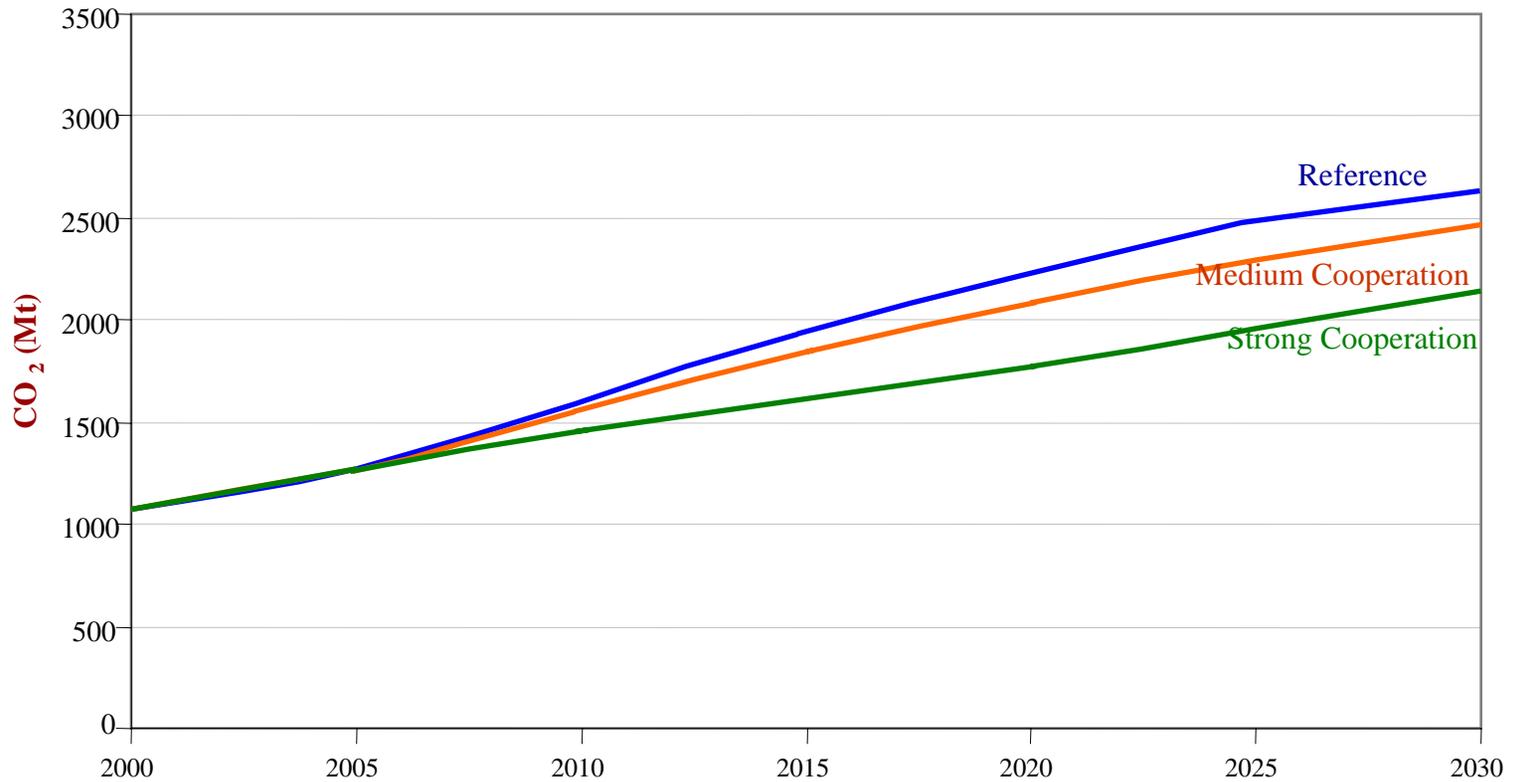
- **What does South Asian Regional Co-operation mean to gas supply?**
 - Pipelines from Myanmar / Bangladesh, Turkmenistan & Iran
 - Foreign Investments in LNG facilities
 - Long-term Gas Contracts

- **Assumptions**
 - Higher co-operation enhances gas supply (cross country pipelines)
 - Higher co-operation reduces gas prices

(Billion INR/ PJ)	1998	2005	2010	2015	2020	2025	2030	2035
Oil Prices	2.44	4	2	2.1	2.3	2.4	2.5	2.7
Gas Prices								
Reference Case		3.2	1.8	1.9	2.0	2.1	2.2	2.4
Strong Cooperation		3.2	1.6	1.7	1.8	1.9	2.0	2.2
Medium Cooperation		3.2	1.4	1.5	1.6	1.7	1.8	1.9







CAPaBLE Project

Integrated Assessment Model for Developing Countries and Analysis of Mitigation Options and Sustainable Development Opportunities

APEIS Session was held at the CAPaBLE Workshop at ERI, Beijing, September 6, 2005.

