



# Gas and Energy Security in India

*Subash Dhar*

*Rajesh Nair*

NIES, Tsukuba  
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## Introduction: India Profile

<b>Indicators</b>	<b>1951</b>	<b>2001</b>
<b>Population (millions)</b>	361	1027
<b>Annual population growth rate</b>	1.25	1.95
<b>Per cent urban</b>	17	28
<b>Urban Population (million)</b>	62	285
<b>Literacy Rate</b>	34%	65%
<b>Income/Capita (US\$ 2000)</b>	\$55	\$687*
<b>Person Below Poverty Line</b>	43%	26%

\* \$2493 @ppp



## Introduction: Development and Climate

- Climate change issue is part of the larger challenge of sustainable development
- Climate policies more effective when consistently embedded within broader strategies designed to make national development paths more sustainable
- Development is the driving force for addressing climate change challenges



- Introduction
- **Recent Trends**
- Developing Country Transitions
- Transitions and Modeling
- Conclusion



# Recent Trends: Demographic and Economic

- India's population is projected to reach about 1.25 Billion by the year 2015 and 1.531 billion by 2050
- Higher real GDP growth rates in recent years (8-8.5%)
- Strong Balance of Payments position and FER
- About 60% of the population is in the working age group of 15-60 years. Expected to remain same through to 2050.
- Work force would contribute significantly to economic growth through savings, capital invest, triggering a virtuous cycle.



## Recent Trends: Technology

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Wide array of vintages across sectors

- Power Sector (2004):

Fuel	Share	Technology
Coal	58%	Sub and super critical, AFBC, PFBC, IGCC
Gas fired	11%	Simple/open cycle and combined cycle
Hydro	26%	Greater than 25 MW capacity
Nuclear	3%	Fission
Renewable	2%	Solar, wind, small hydro, biomass, geothermal

- Transportation and Industrial sector

- Mashelkar committee report
- Development of non-fossil fuels and alternative energy vehicles
- Liberalization of Indian economy has resulted in increasing industrial competitiveness (software industry contribution)



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## Socio Economic Transitions

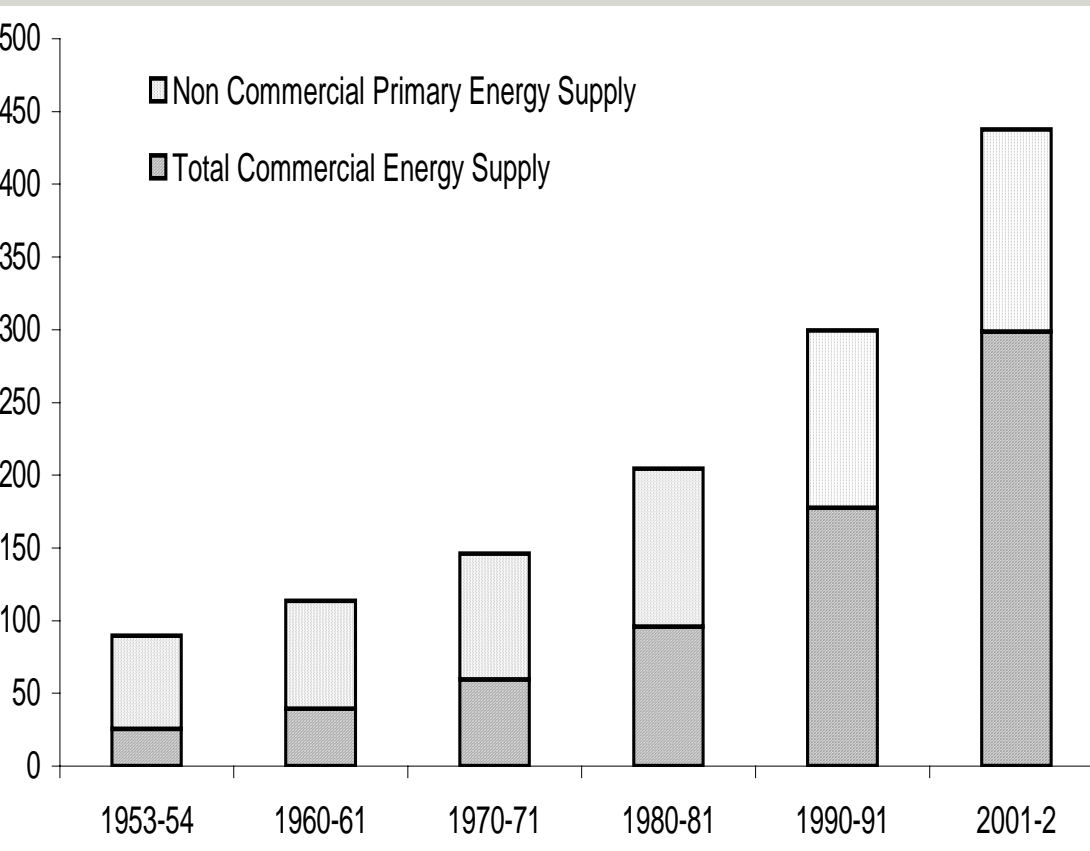
Geographical disparities in population growth and human welfare, and urban and international migration

- Divergence between the South and West and the North and East in economic welfare and demographics
- Population migration and strain of optimal resource use
- Liberalization, international migration of labour and GDP growth





## Transitions in Energy Resources



TPES in Mtoe

- The Total Primary Energy Supply (TPES) has grown at an annual rate of 3.4% during 1953-2001
- The share of commercial energy has increased from 28% in 1953-54 to 68% in 2001-02
- Non-commercial energy sources, having only one-third share of TPES, meet the energy requirements of over two-thirds of the Indian population



## Demand Side Transitions

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Acute power shortages have resulted in initiation of demand side management

- Advances in lighting systems (issue of penetration)
  - CFL penetration in India is only 3% compared to 33% in Singapore and 40% in South Korea
  - Over 1 billion incandescent lamps are sold in India every year
- DSM in agricultural sector
  - 12 million electric pumps and about 6 million diesel pumps being used for irrigation in India consuming 60 billion KWh of electricity
  - Large potential for energy savings



# The Government Response: Development Plans

- Reducing the poverty ratio by five percentage points by 2007 and by 15 percentage points by 2012 (25% population below poverty line in 2002).
- Create 50 million employment opportunities by 2007 and 100 million by 2012
- Electrify 62,000 villages w/o power by 2007 through conventional grid expansion, the remaining 18,000 by 2012 through decentralized non-conventional sources like solar, wind, small hydro and biomass.
- Increasing the forest and tree cover to 25 per cent by 2007 and 33 per cent 2012 (23% in 2002).
- Cleaning of all major polluted rivers by 2007 and other notified stretches by 2012.



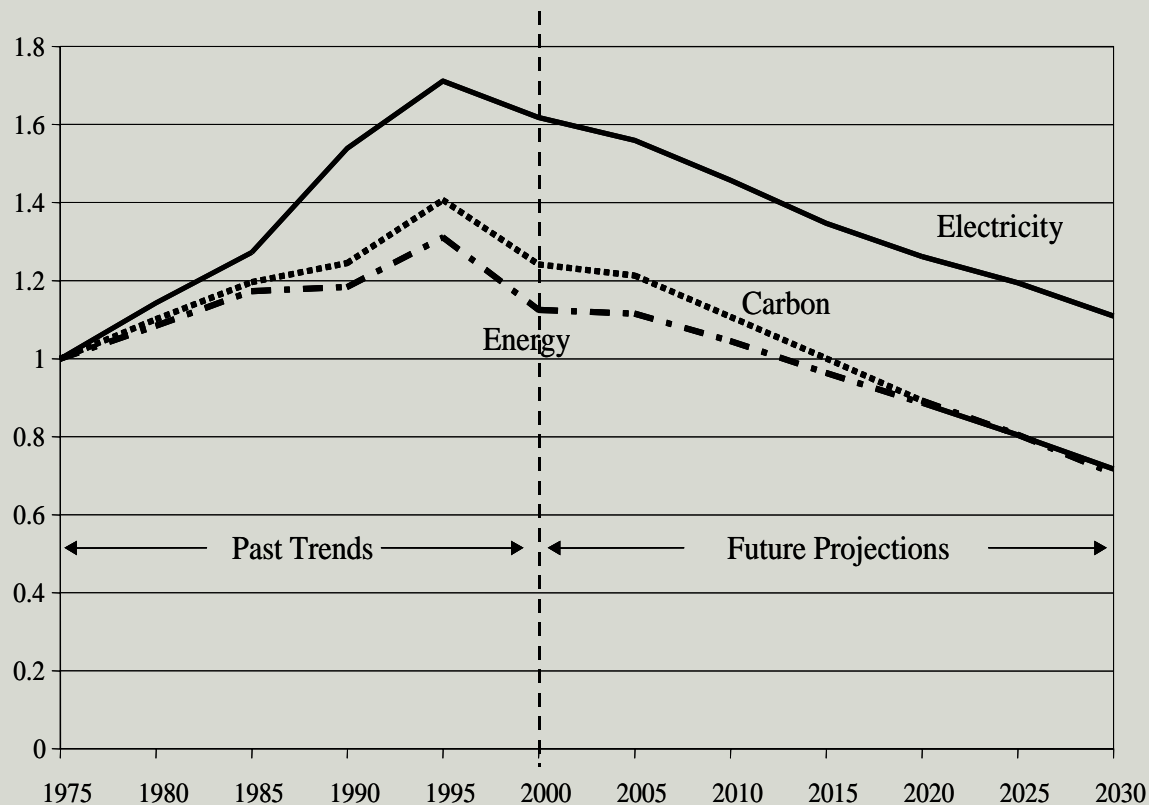
# Achieving Development Goals (Facilitators)

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- Most targets linked to energy availability
- Achieving the targets
  - Enhanced availability and access to physical infrastructure
  - Technology penetration: Integrating ICT would reduce transaction costs
    - Widespread penetration of e-governance may turn out to be the biggest transition
- Role of renewable energy in energy (access) transition



## Development Goals - Delivering Double Dividends



- Endogenous responses to “development goals” shape economic growth, endogenous technological change and consumption preferences that drive the energy and emissions trends
- Recent history and trends show that the economic reforms enlarge choices that are delivering double dividends as is evident from the declining trend of energy, electricity and carbon intensities of the Indian economy

*(based on modeling exercises reported in Garg et al. (2003), Nair et al. (2003) and Shukla et al. (2004))*



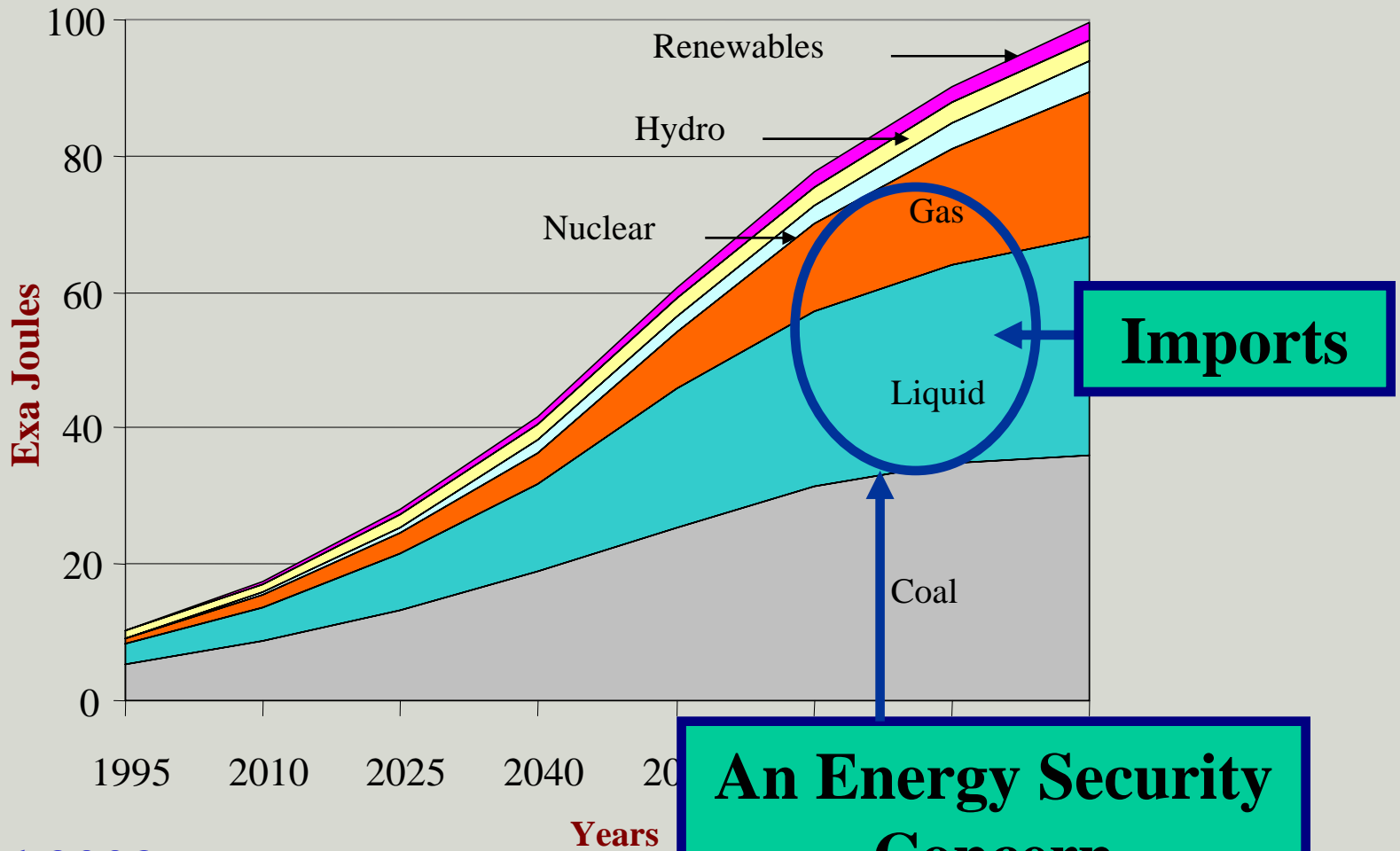
# Critical Priorities in the Indian Planning Process

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- Economic Security
- Energy Security
- Environmental Security
- Water Security
- Food, Shelter & Welfare Security



# Primary Energy Trend: India

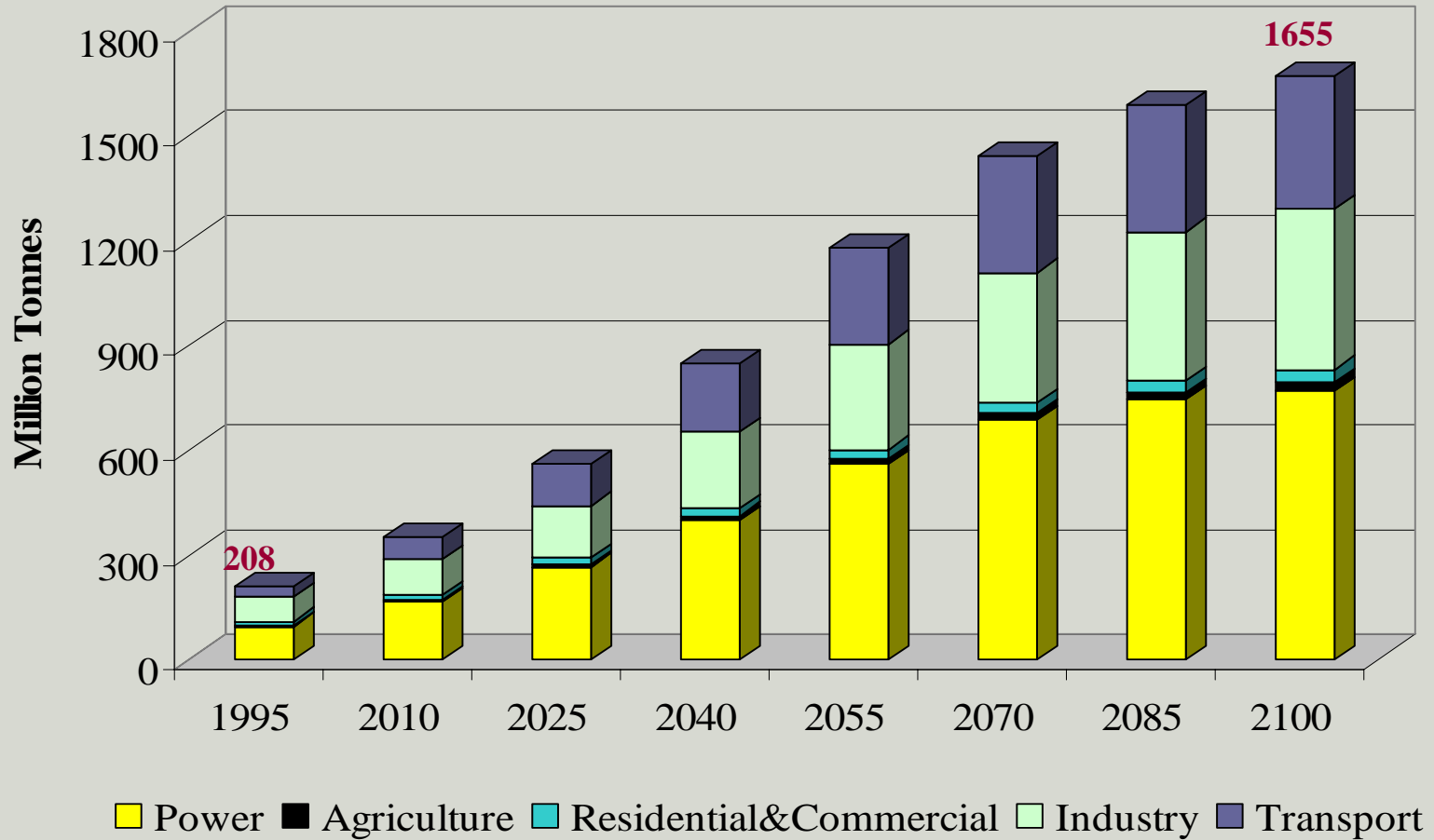


Nair et al 2003

**An Energy Security Concern**



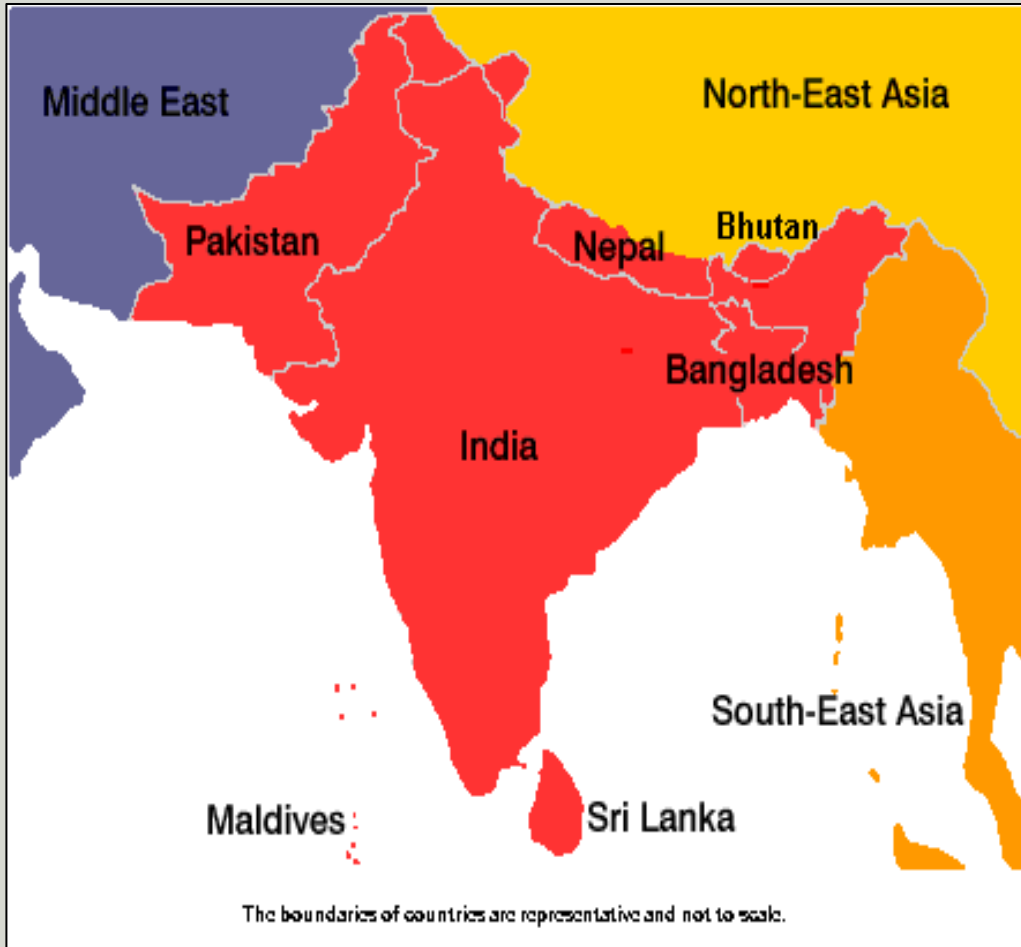
## Long-term Carbon Emission Trend







## The South Asian Region



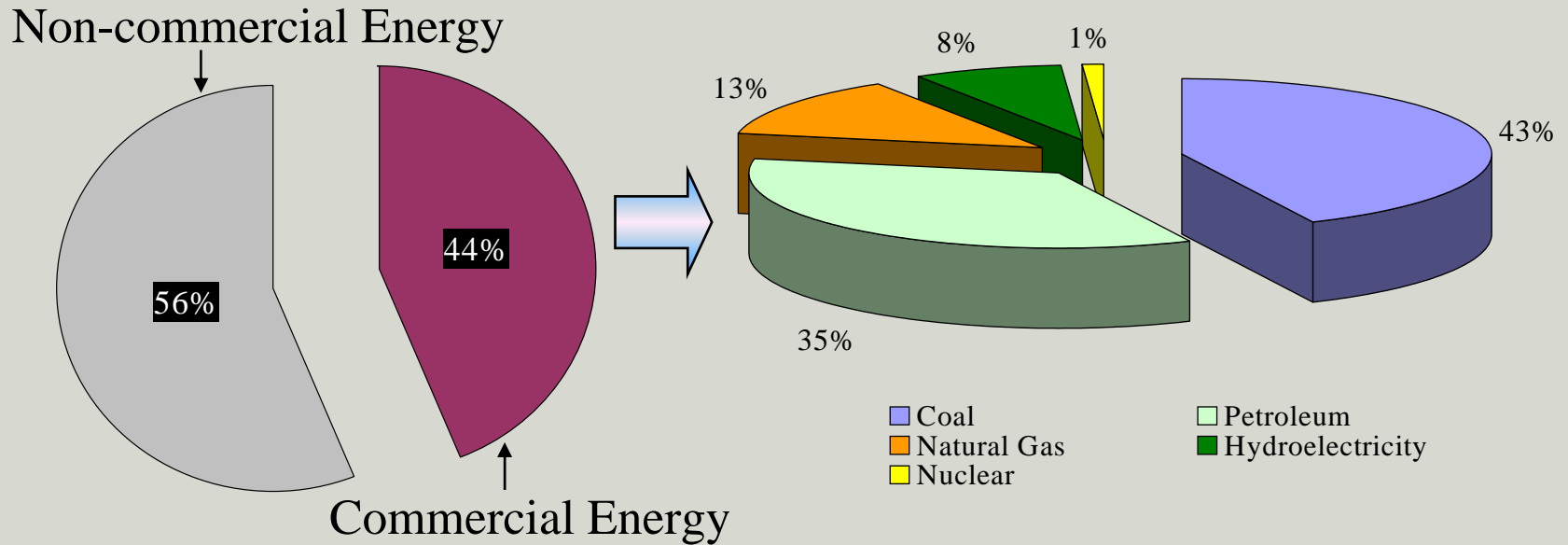
**The story of the Big Brother  
and six Siblings**



## The Context

Diversity in geography, climate, energy resources, political and economic structures

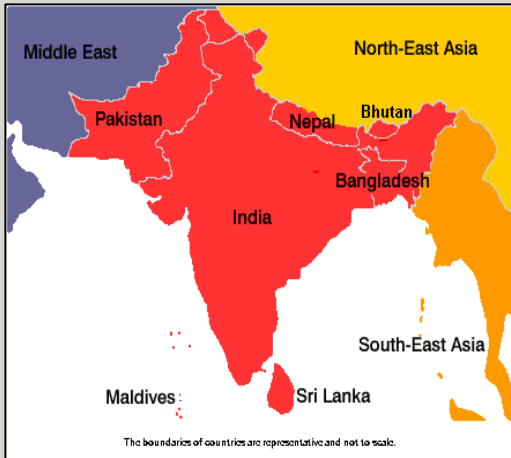
Energy mix:



Among the fastest growing regions and Energy and Environmental Security Concern



## Regional GDP (US\$)

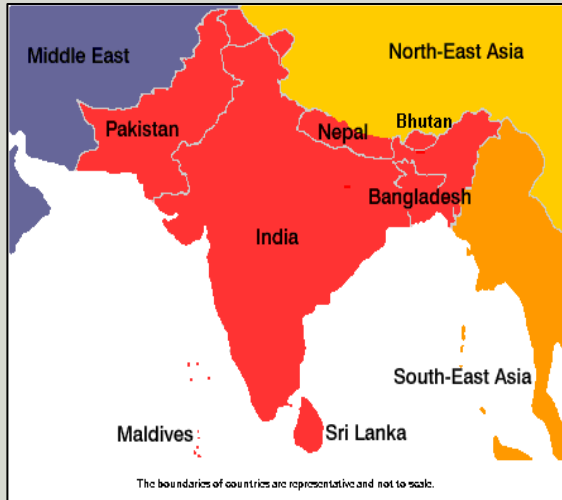


HDI Rank	Country	GDP (US\$ Billion)		GDP per capita	
		2002	2002 PPP	US \$ 2002	PPP US\$ 2002
127	India	510	2799	487	2670
138	Bangladesh	47	230	351	1700
96	Sri Lanka	16	67	873	3570
140	Nepal	5.5	33	230	1370
84	Maldives	0.6		2182	
136	Bhutan	0.5		695	

*Source: Human Development Report, 2004*



## Energy Resource Consumption (2002)



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



# Why South-Asia Energy-Electricity Market Integration?

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## Diversity of Energy Resources among countries

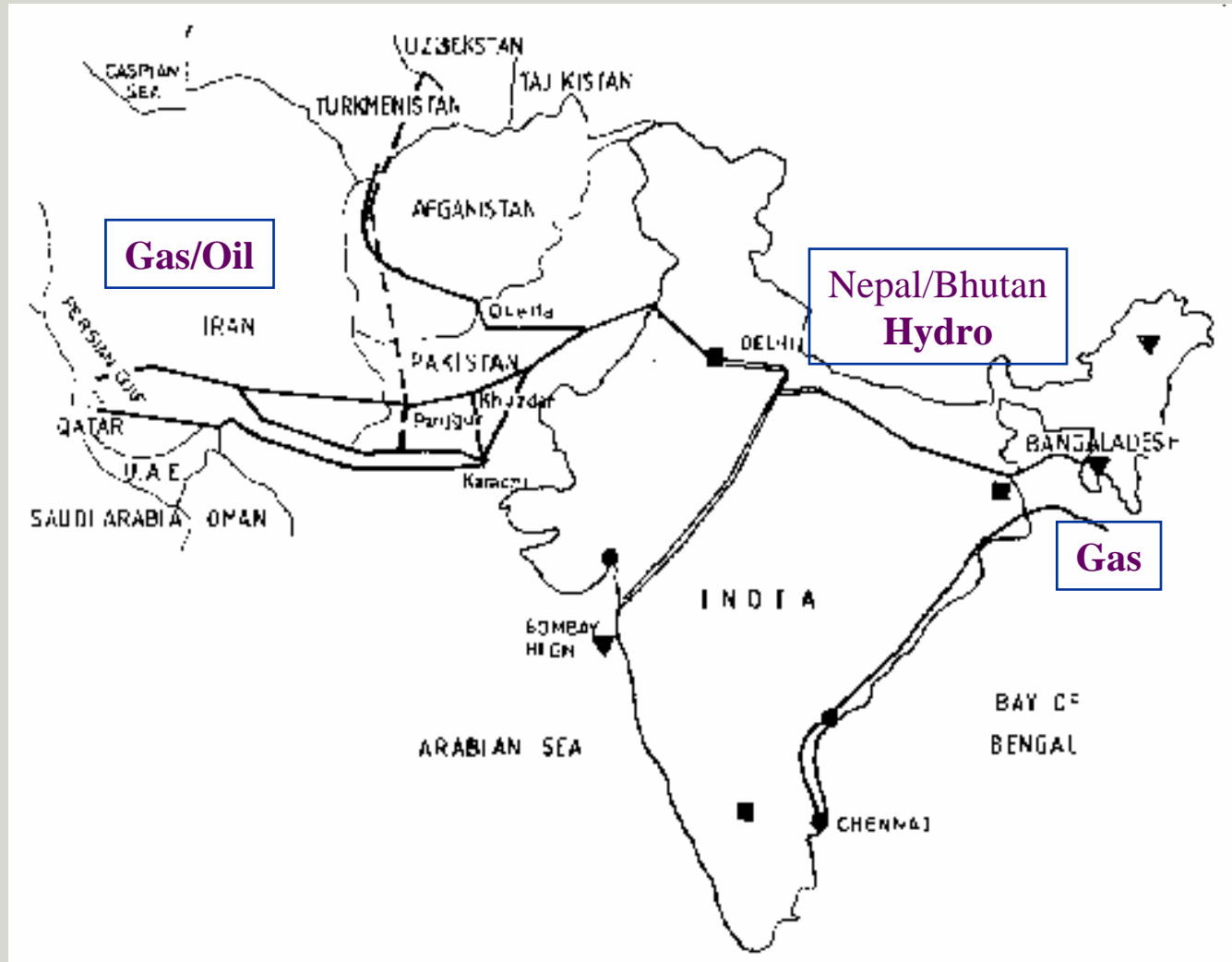
- India relies on poor quality domestic Coal
- Bangladesh has reserves of Natural Gas
- Nepal and Bhutan have Hydro power potential
- Sri Lanka needs to import fuel for power
- Pakistan has an important role as a transit state for Natural Gas

## Little Energy/ Electricity Trade in the Region



# Regional Energy-Electricity Markets

**Energy Markets**  
Gas  
Coal  
Electricity  
Hydro (Elec./Water)





# South-Asia Regional Energy Cooperation: Key Questions

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**What would be the benefits of integrating primary energy and electricity markets in the South Asian region?**

**What are the implications of such cooperation on regional carbon emissions?**

–The South Asian region includes Bangladesh, Bhutan, India, Maldives, Nepal, **Pakistan**, and Sri Lanka



## **Putting Into Perspective (Policy relevance)**

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**"We need to convert the relationship between Asian buyers and sellers into a community of partners, to have a common approach for the development of gas and investments"**

**"We need to move into the 21st century with the specific cooperation in the area of energy."**

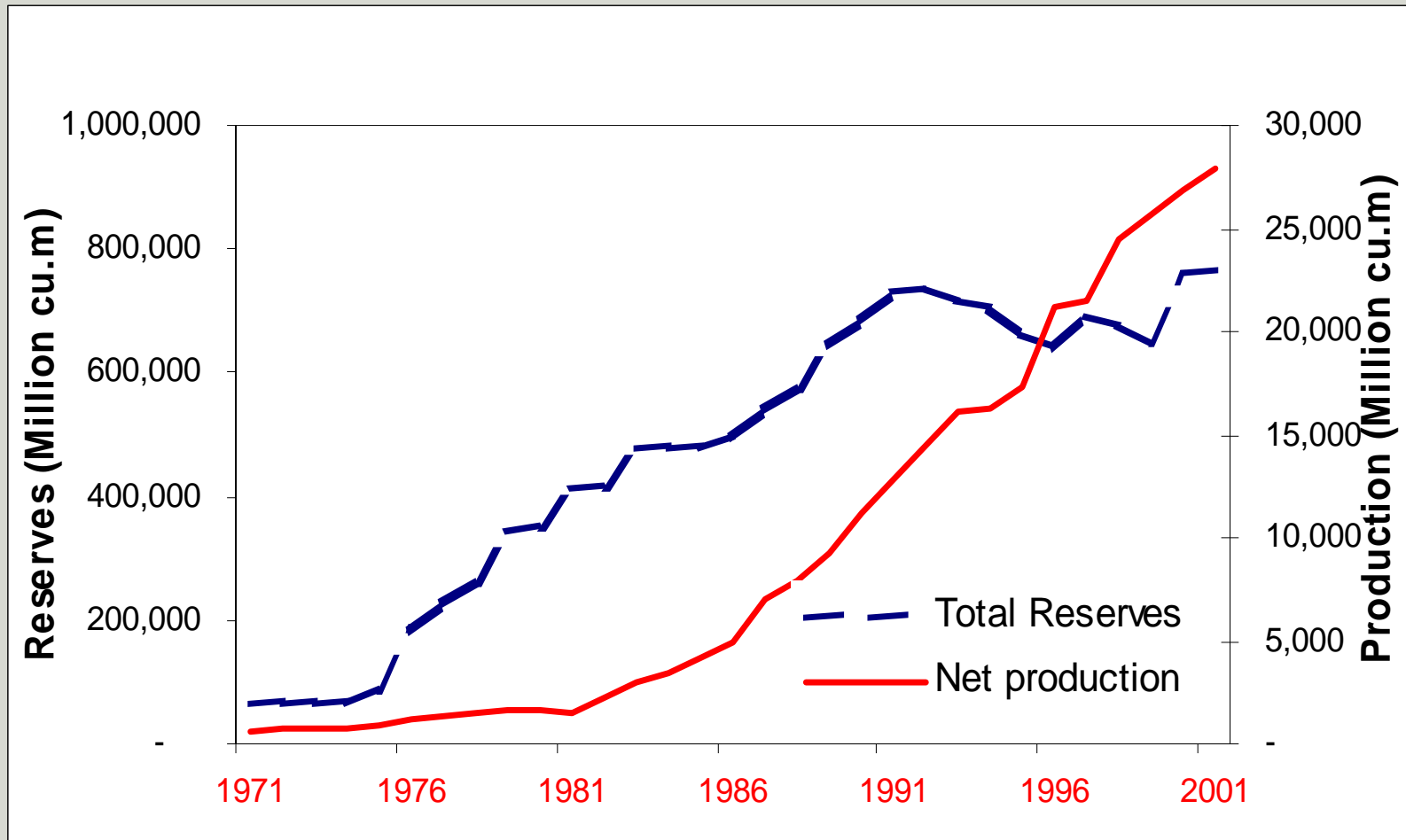
**Petroleum Minister Mani Shankar Aiyar**

Source:[hindustantimes.com](http://hindustantimes.com)





## Gas : Reserves Vs Production (India)



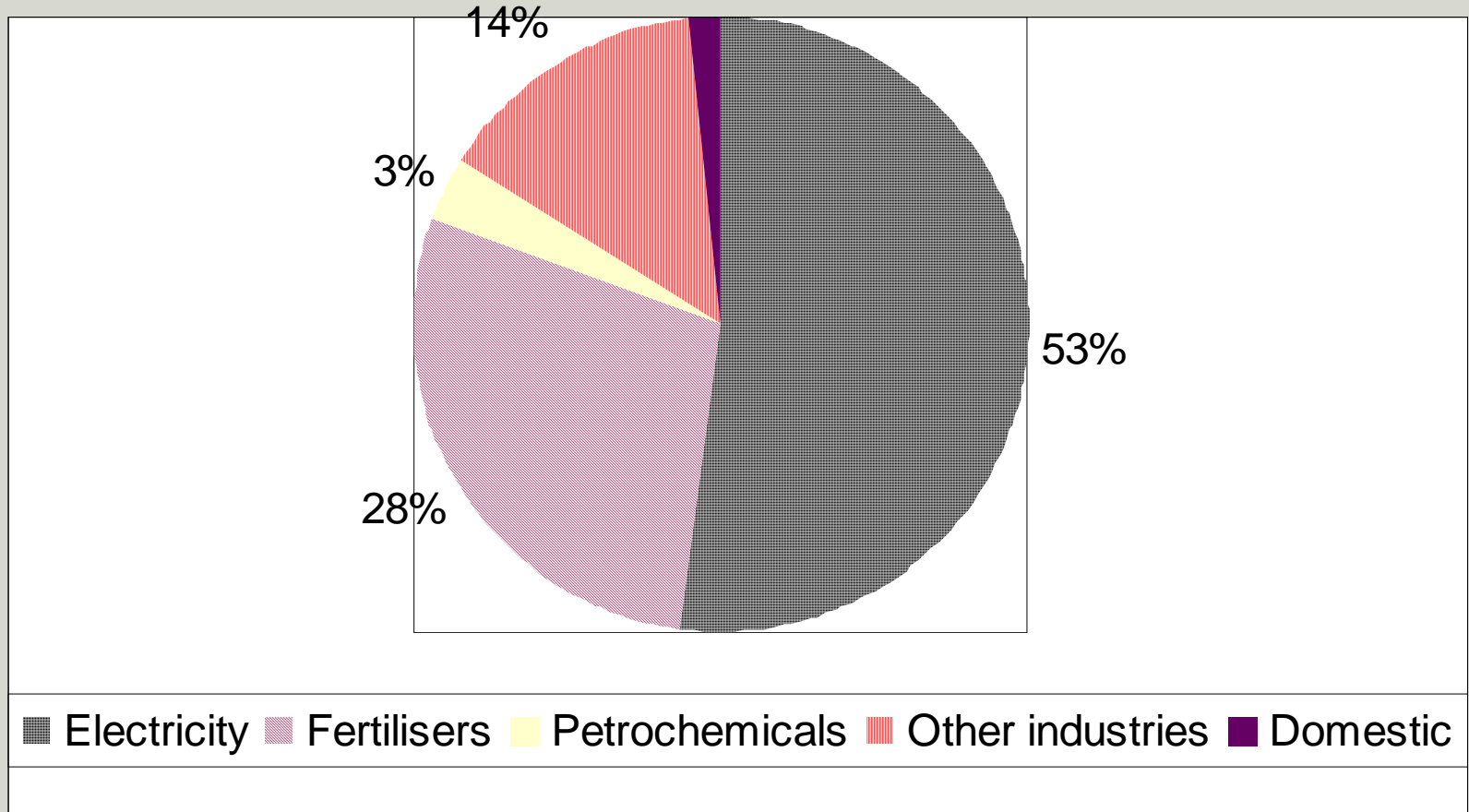


## World Gas Reserves Vs Production

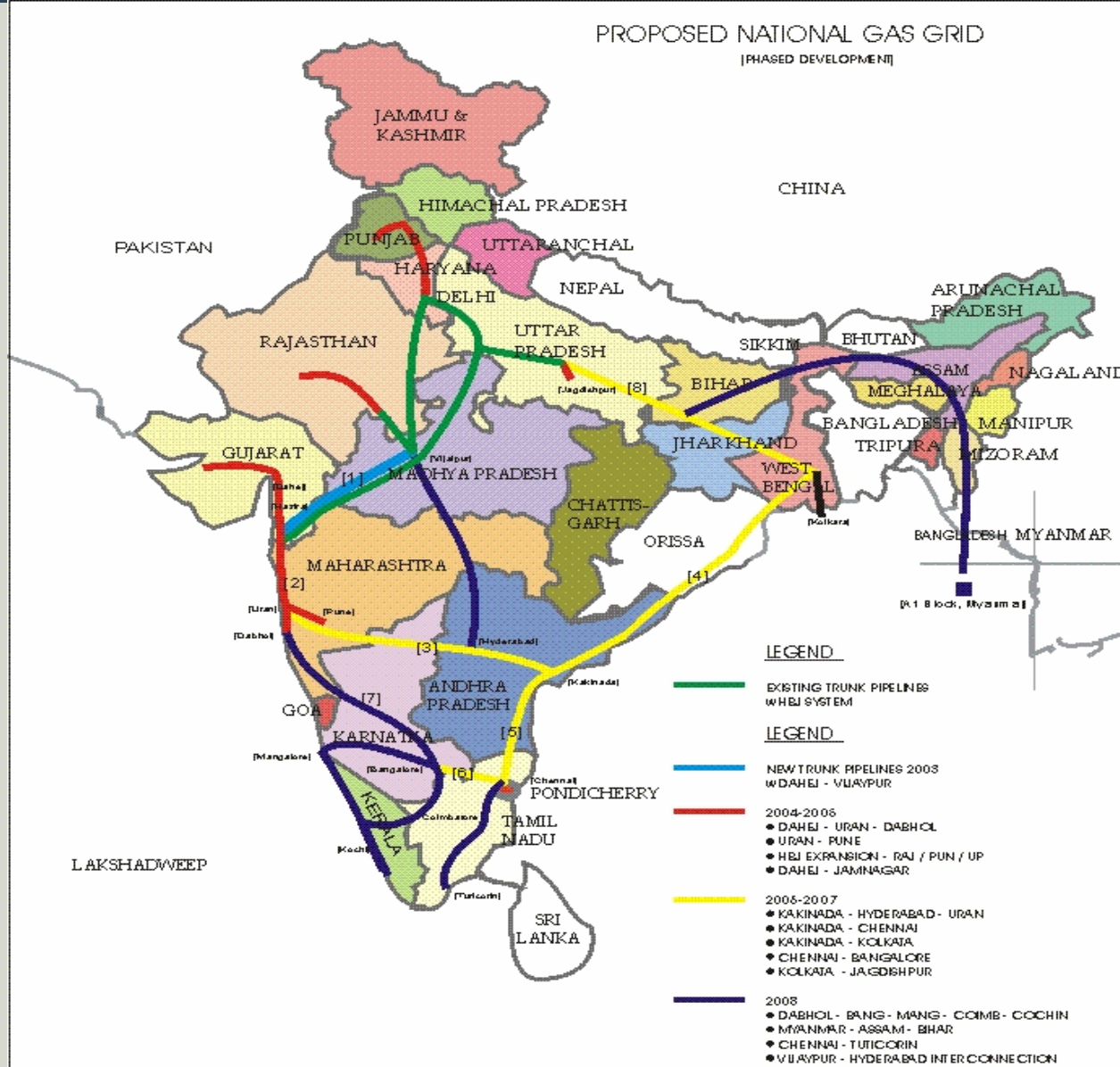
Natural Gas: Reserves	2003		R/P ratio	Natural Gas: Production **	2003
	Share of total	Cumulative Share			Share of total
Russian Federation	26.7%	26.7%	81.2	Russian Federation	22.1%
Iran	15.2%	41.9%	*	Iran	3.0%
Qatar	14.7%	56.6%	*	Qatar	1.2%
Saudi Arabia	3.8%	60.4%	*	Saudi Arabia	2.3%
United Arab Emirates	3.4%	63.8%	*	United Arab Emirates	1.7%
USA	3.0%	66.8%	9.5	USA	21.0%
Nigeria	2.8%	69.6%	*	Nigeria	0.7%
Algeria	2.6%	72.2%	54.6	Algeria	3.2%
Venezuela	2.4%	74.6%	*	Venezuela	1.1%
Iraq	1.8%	76.4%	*	Iraq	



# Gas Consumption Sector Wise for 2002 (India)



# Gas and Energy Security in India





## Question

What role will Gas Play in meeting India's Energy Needs?

- For the present exercise we will input to the Model Exogenously Prices for Gas & Oil for Next Ten Years(2000-2010)



## Model Data Inputs

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I/O Table India 1999 (Source , CSO)

- 115 X 115 Commodities
- Aggregated to 35 X 35 Commodities

Only 4 Energy Sectors / Commodities

- Coal / Petroleum / Gas / Electricity

Emission Coefficients taken same as Japan



## Model Results – Static Case

Model Successfully calibrated

CO2 Emissions for 1999

- 25% from Transport Sector
- 20% from Electricity Sector
- Doubtful Results as in 1995
  - 44% Emissions from Electricity
  - 18% Emissions from Transport
  - (Garg & Shukla , 2002, Pg. 41)
    - Could be due to assumption of Price = 1



## Scenarios to Analyse

- South Asian Regional Co-operation
  - Pipelines from Myanmar / Bangladesh & Iran
- International competitive markets (Japanese Expertise)
- Gas Cartels
- How would SA regional cooperation help in improving India's Energy Security?





## Environmental Problem

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- How would SA regional cooperation help in improving India's Environmental Security
- Impacts on GHG
- Impacts on Local Air Pollutants like SO<sub>2</sub> & NO<sub>x</sub>.



**Thank You**