



# India – The New Energy Relationship

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Leena Srivastava

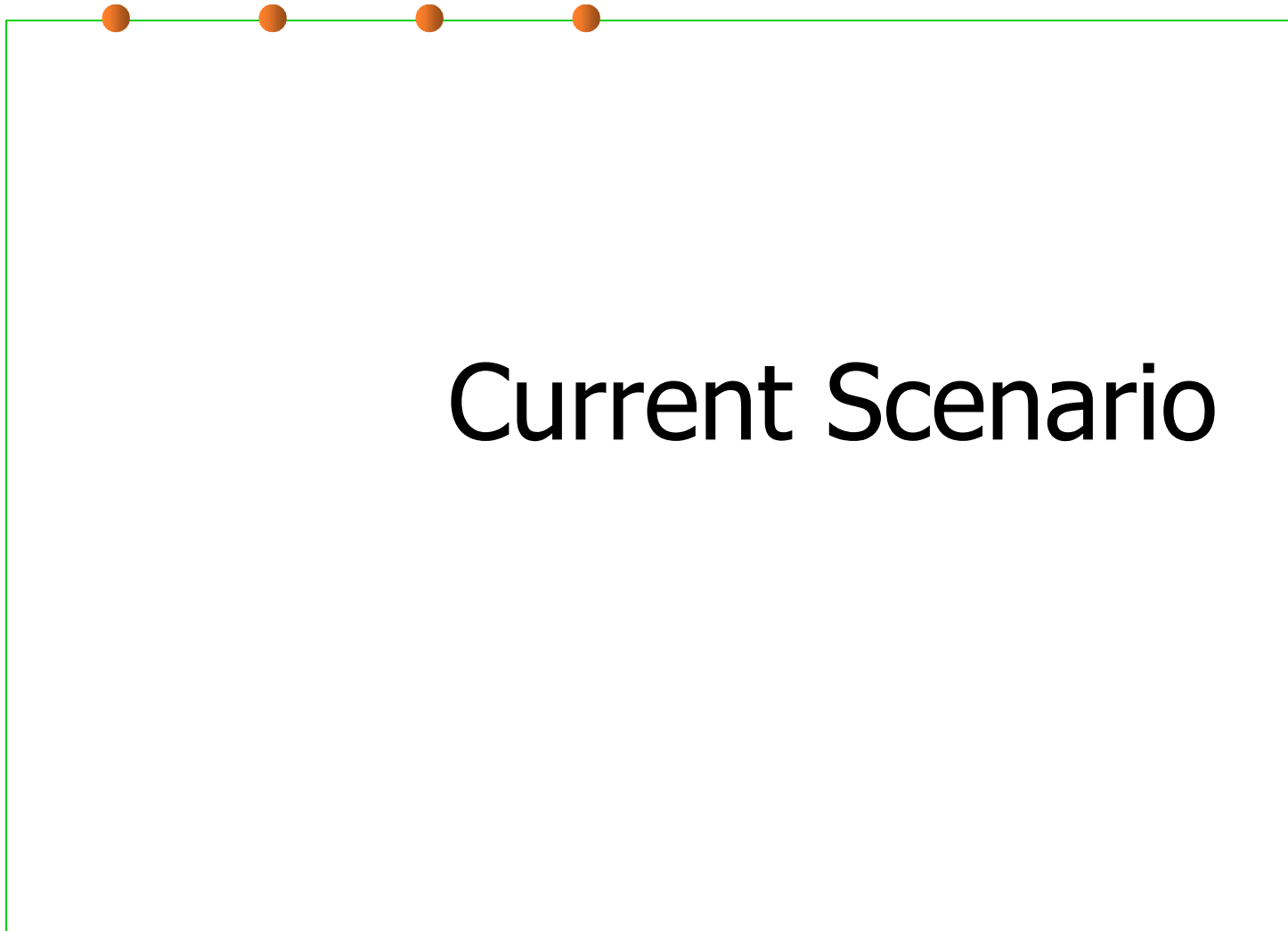
Sr. Vice President, TERI North America and  
Executive Director, TERI India



April 3, 2006



- Current Scenario
- Future prospects
- Options



# Current Scenario



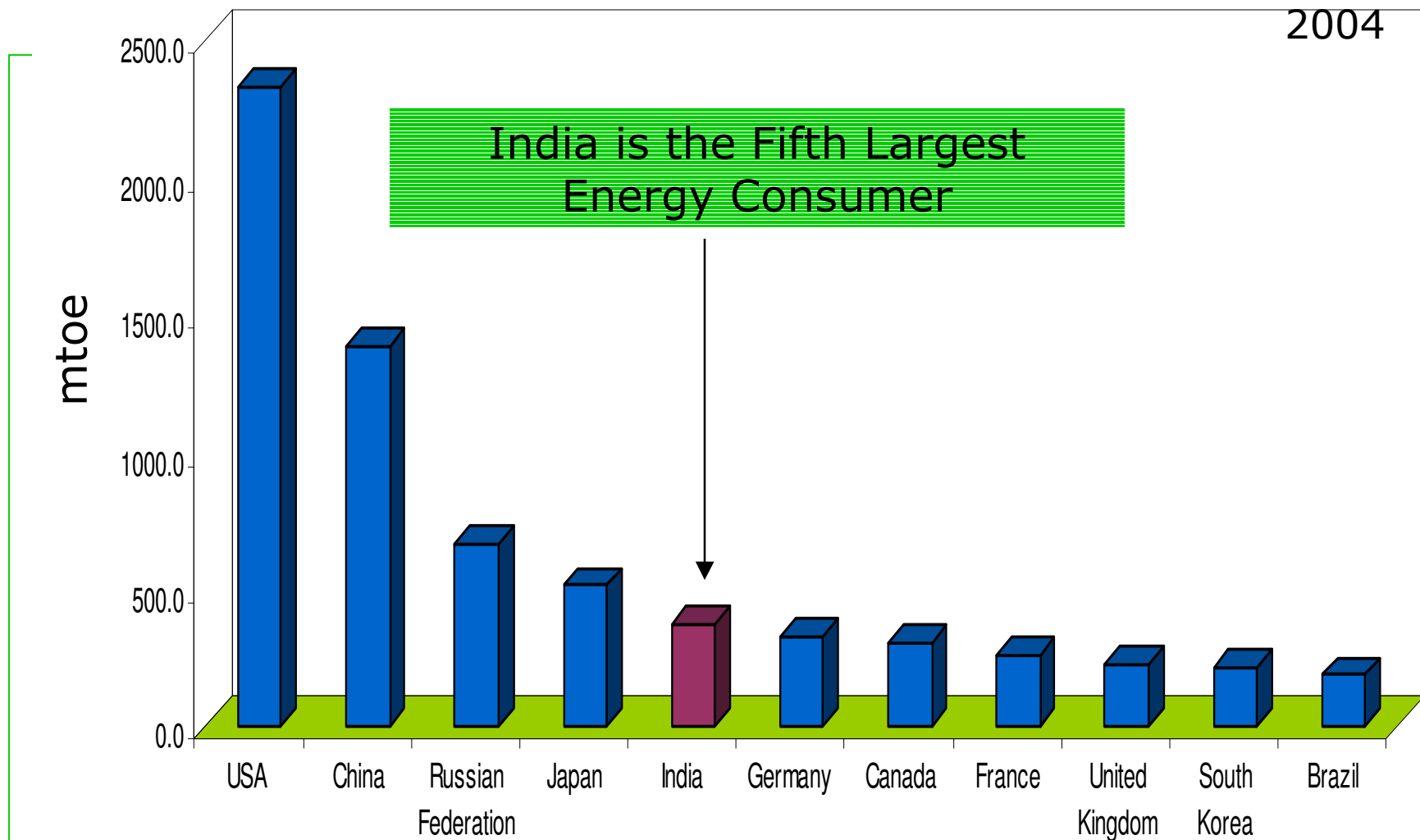
# India at a glance

- Population :
  - 1.07 billion in 2003-04
  - 17% of world population
- 72% lives in rural areas
- HDI: India ranks 127 out of 175 countries
  - 28.6% of population below national poverty line
  - 34.7% population living below \$1/day
- GDP ( US\$ billions): 600
- GDP per capita ( US \$ ) : 564
- Tenth Plan (2002-07) target for 8% economic growth

Sources: Planning Commission , Human Development Report 2005

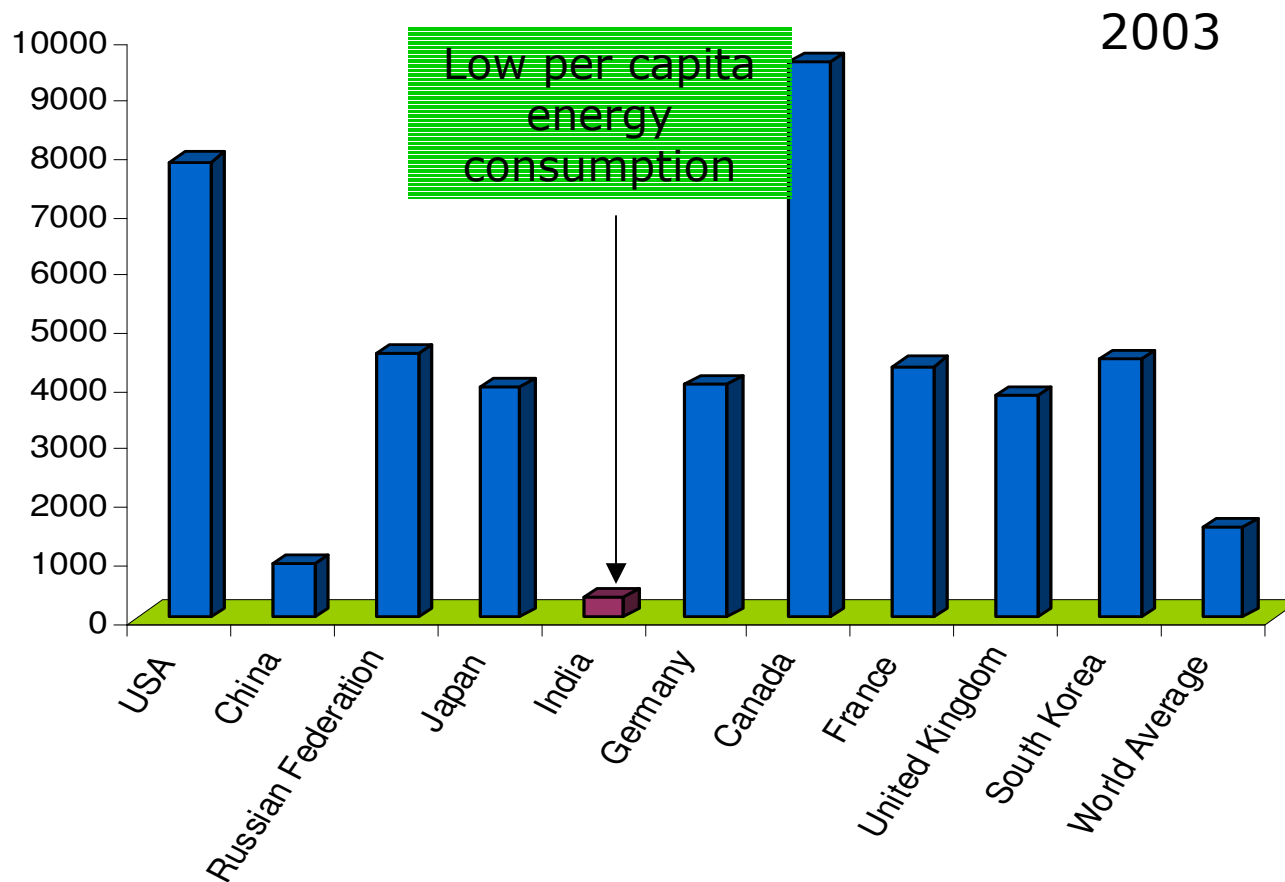


# Energy Demand



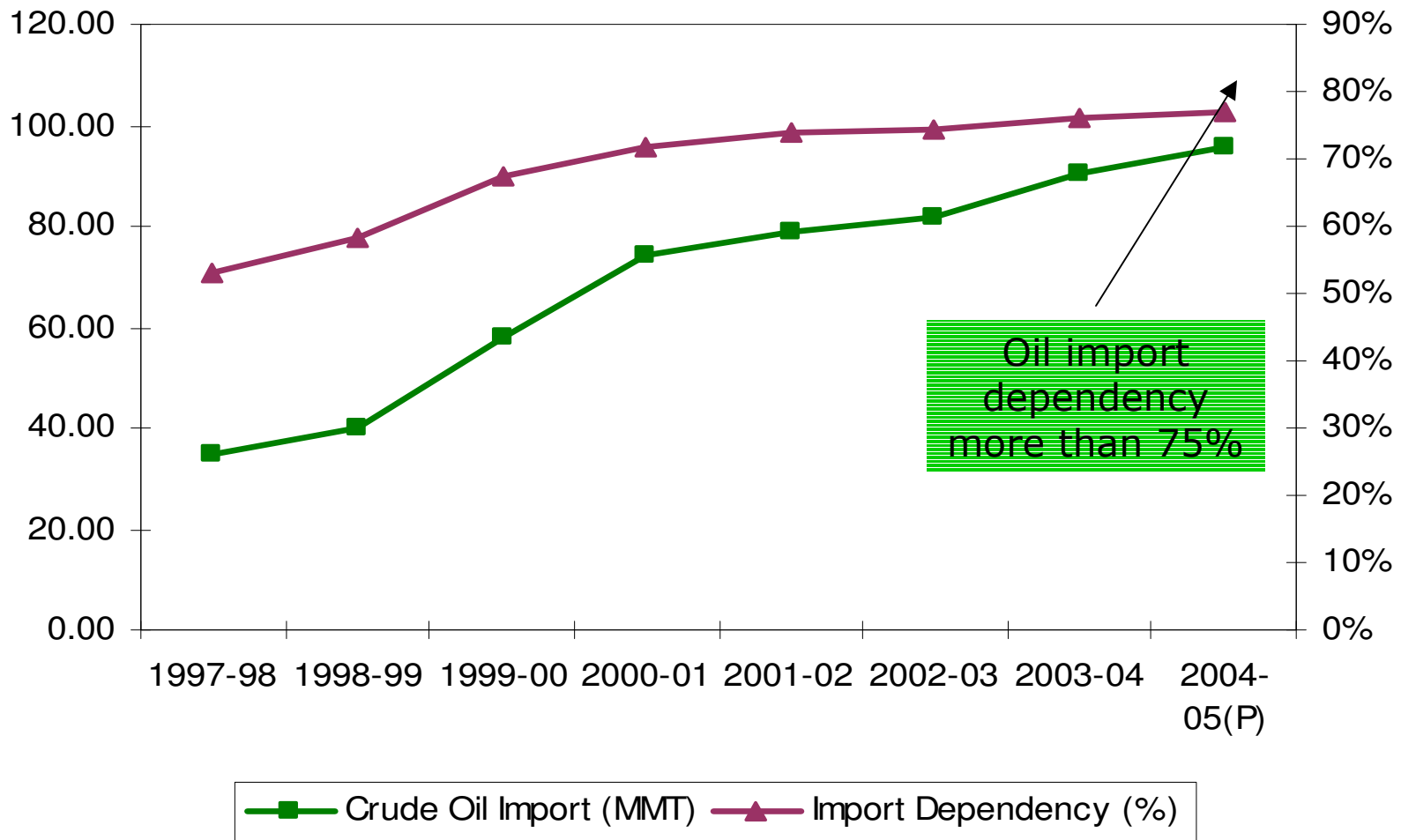
Source: BP Stats 2005

# Per Capita Energy Consumption (kgoe)



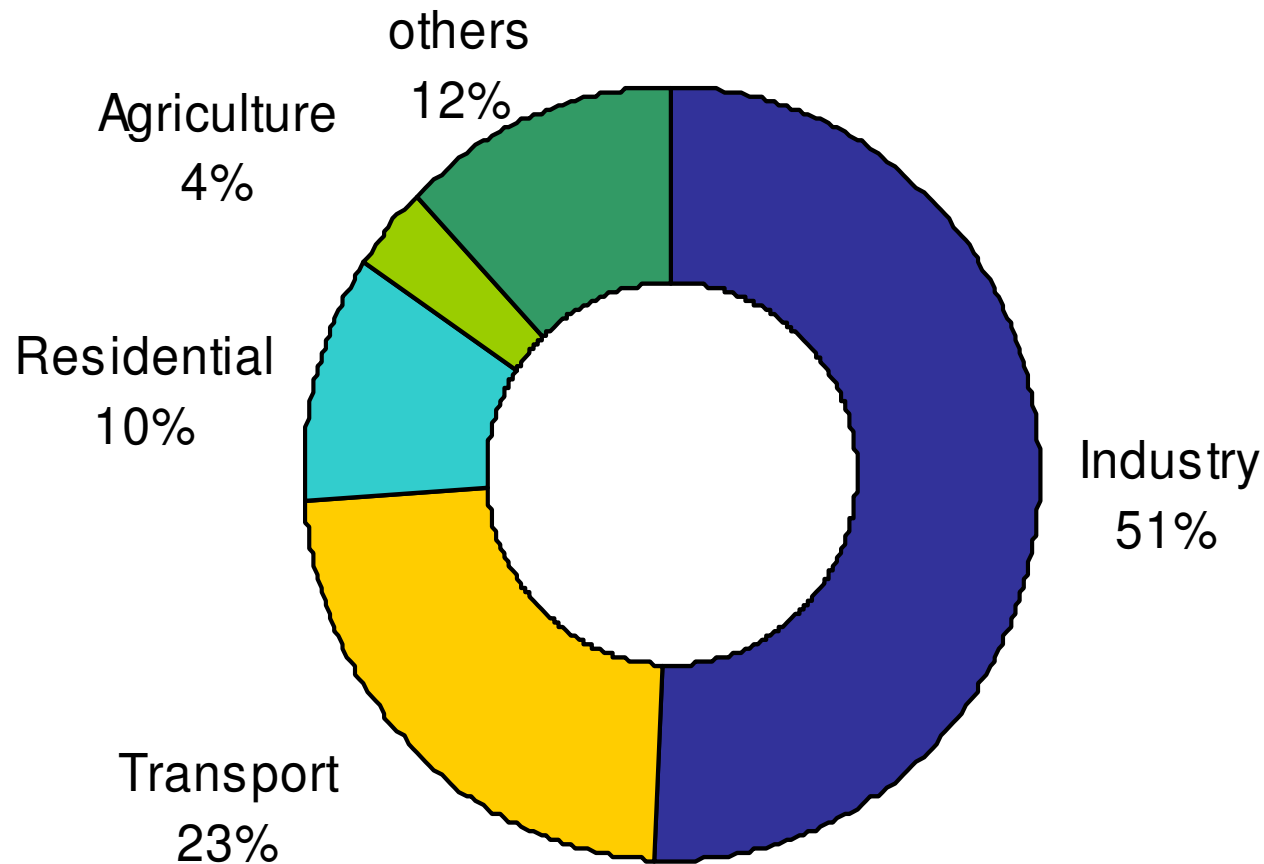
Sources: BP Stats 2005,  
HDR 2005

# Crude Oil Imports



Source: Ministry of Petroleum and Natural Gas 2005

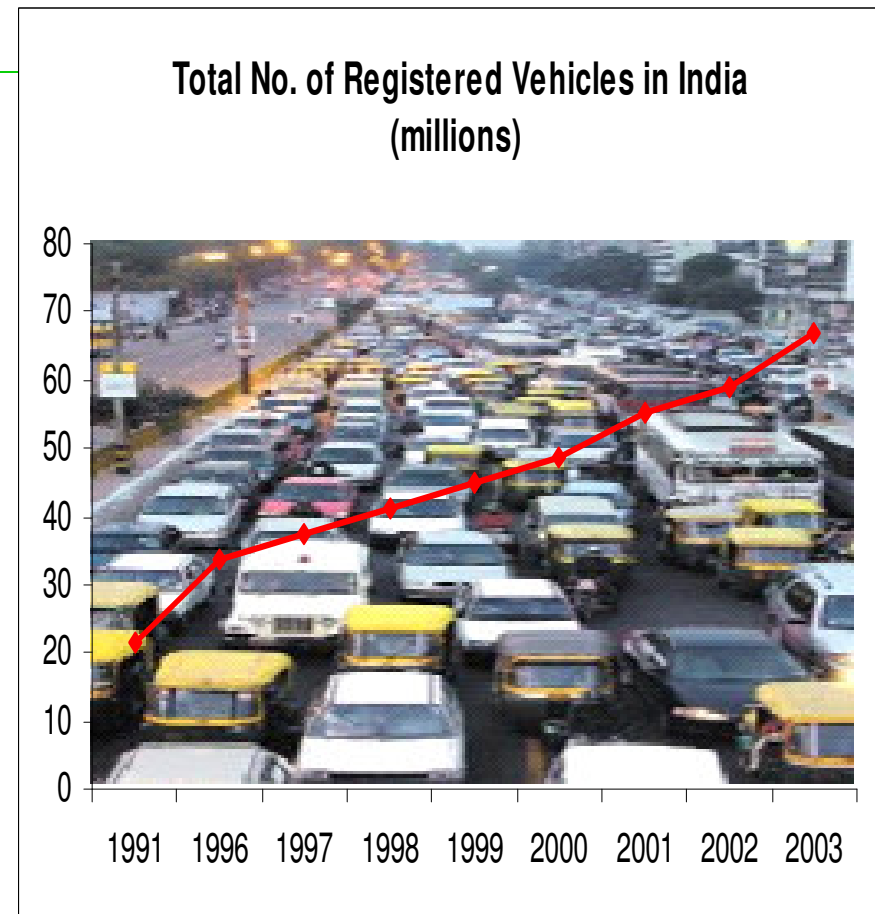
# Commercial Energy Consumption



Source: Compiled by TERI

# Growth in Transport Sector

- Transport is the fastest growing energy sub-sector
- Over 80% of passengers and 60% of freight are moved by road
- Increasing dependence on energy intensive personal modes of transport
- Diesel and petrol contribute to 98% of energy consumed in the transport sector



Source: MoRT&H Statistics 2005



# Energy Resources

- Coal meets 54% of India's total primary energy requirements
  - Domestic availability plays a key role
- Petroleum and natural gas ~ 40 %
- Hydro ~ 5% and Nuclear 1%
- Electricity energy requirements
  - 70 % met through thermal power plants
  - Increasing role of natural gas



# Significant Untapped Potential

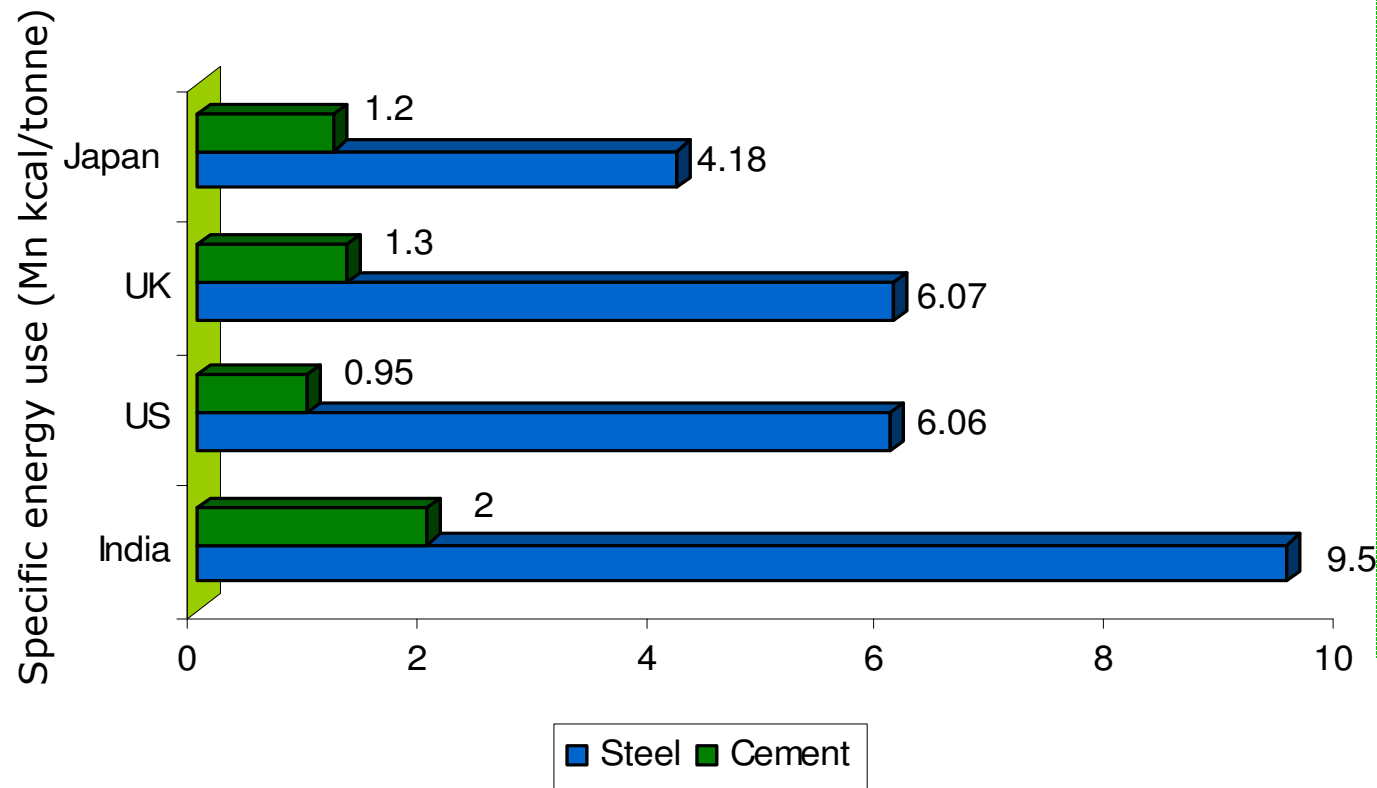
- R/P ratio for coal: > 200 years
- 80% of India's territory yet to be explored
- Wind 45,000 MW: exploited 1400 MW
- Large potential from other renewable sources such as solar, tidal, small-hydro and biomass energy
- Hydro - 125,000 MW; exploited ~ 24,000 MW
- Cogeneration potential ~ 15,000 MW
- Coal bed methane: potential 20,000 MW



# Power Sector

- Peak (12.3%) and energy (7.7%) shortages today
- High transmission and distribution losses: 30-40%
- Future capacity needs
  - ~ 1,00,000 MW to be added in 2002-2012 period
  - Another ~ 4,00,000 MW till 2050
- Supply side efficiency and Demand management
  - Assessed potential of 25,000 MW energy saving
  - One unit saved can avoid 2.5 to 3 times of fresh capacity addition

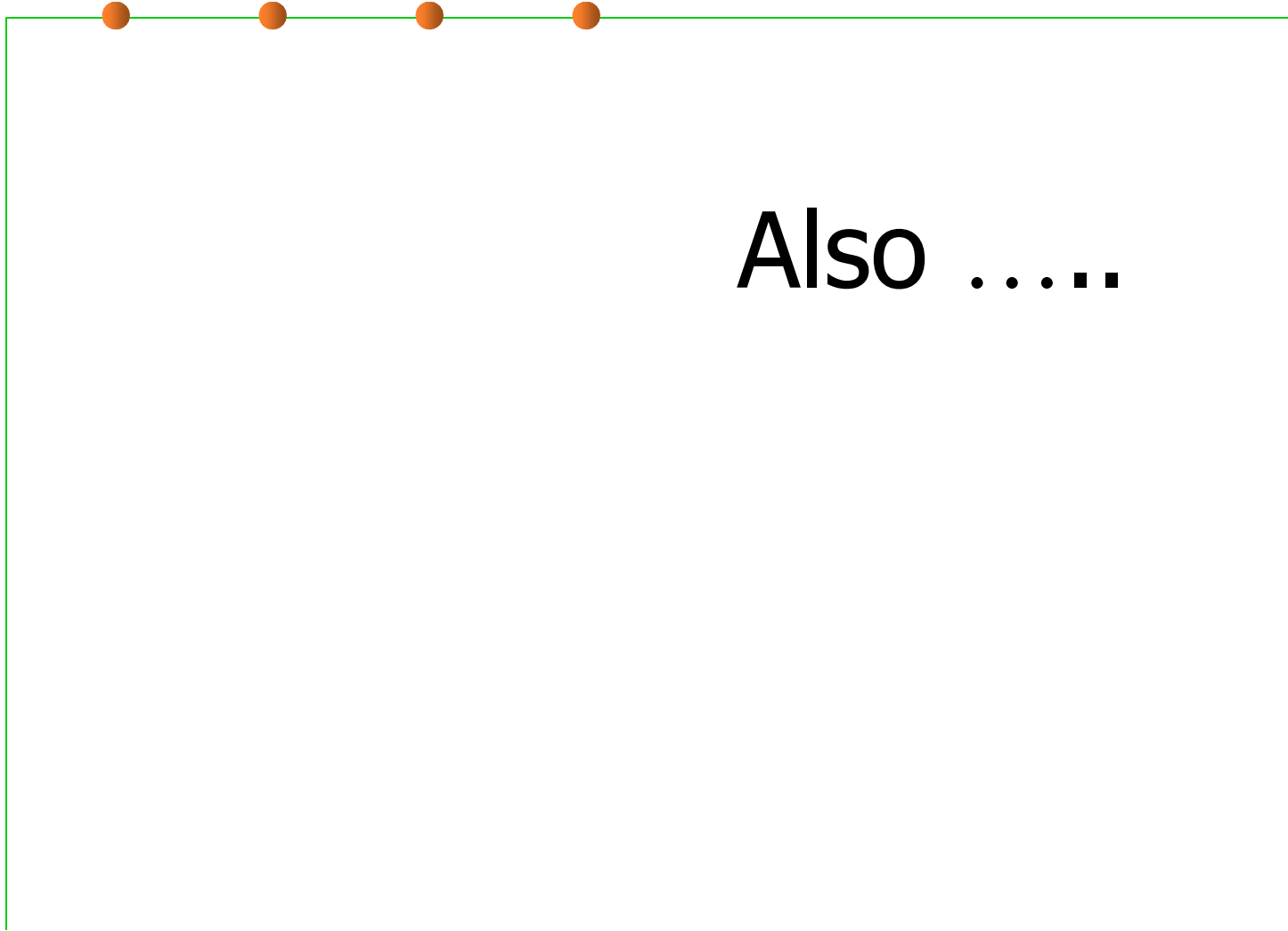
# Energy Intensity



India's energy intensity/GDP

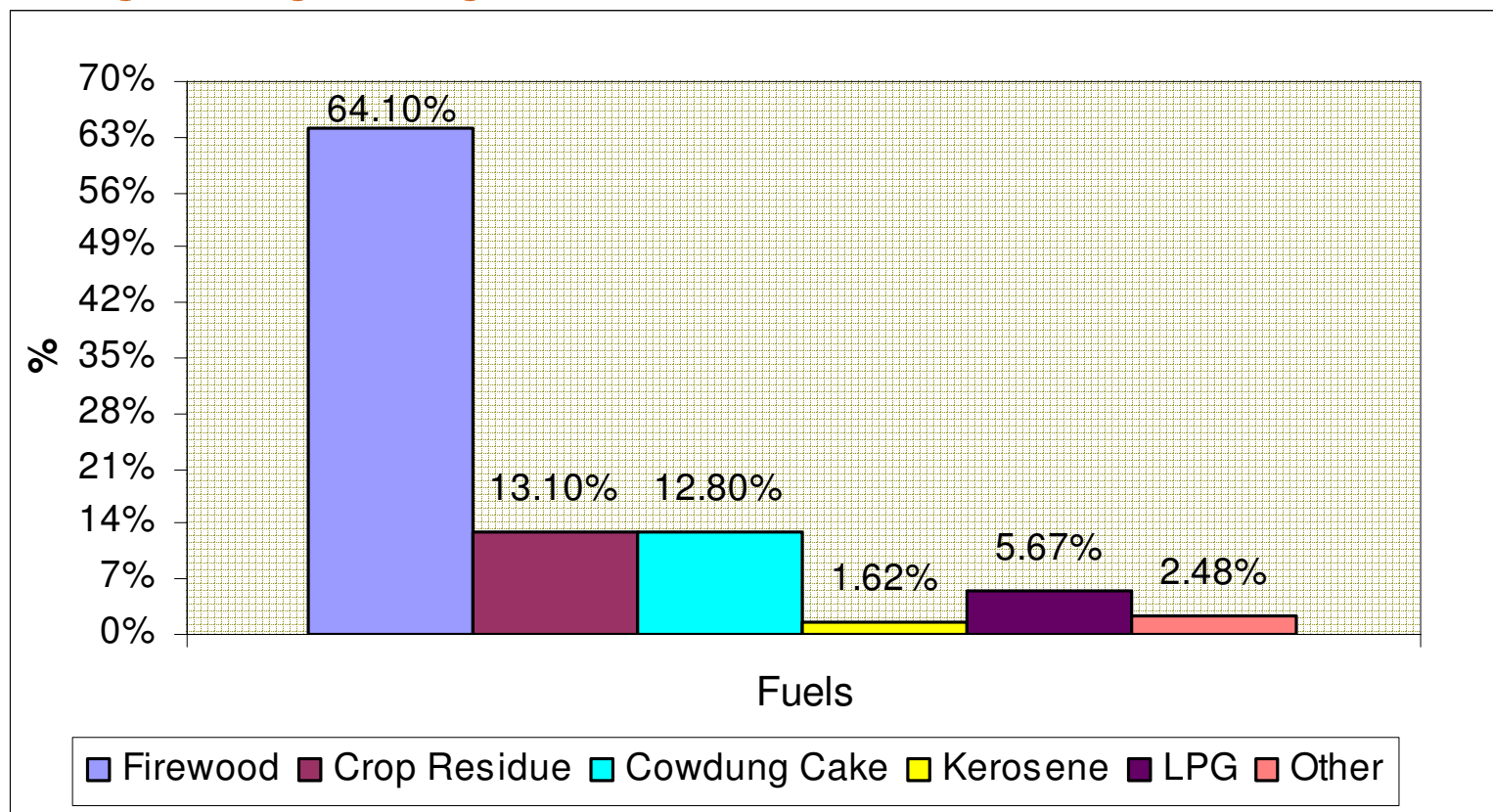
- 3.7 times of Japan
- 1.4 times of Asia
- 1.5 times of USA

Source: compiled by TERI

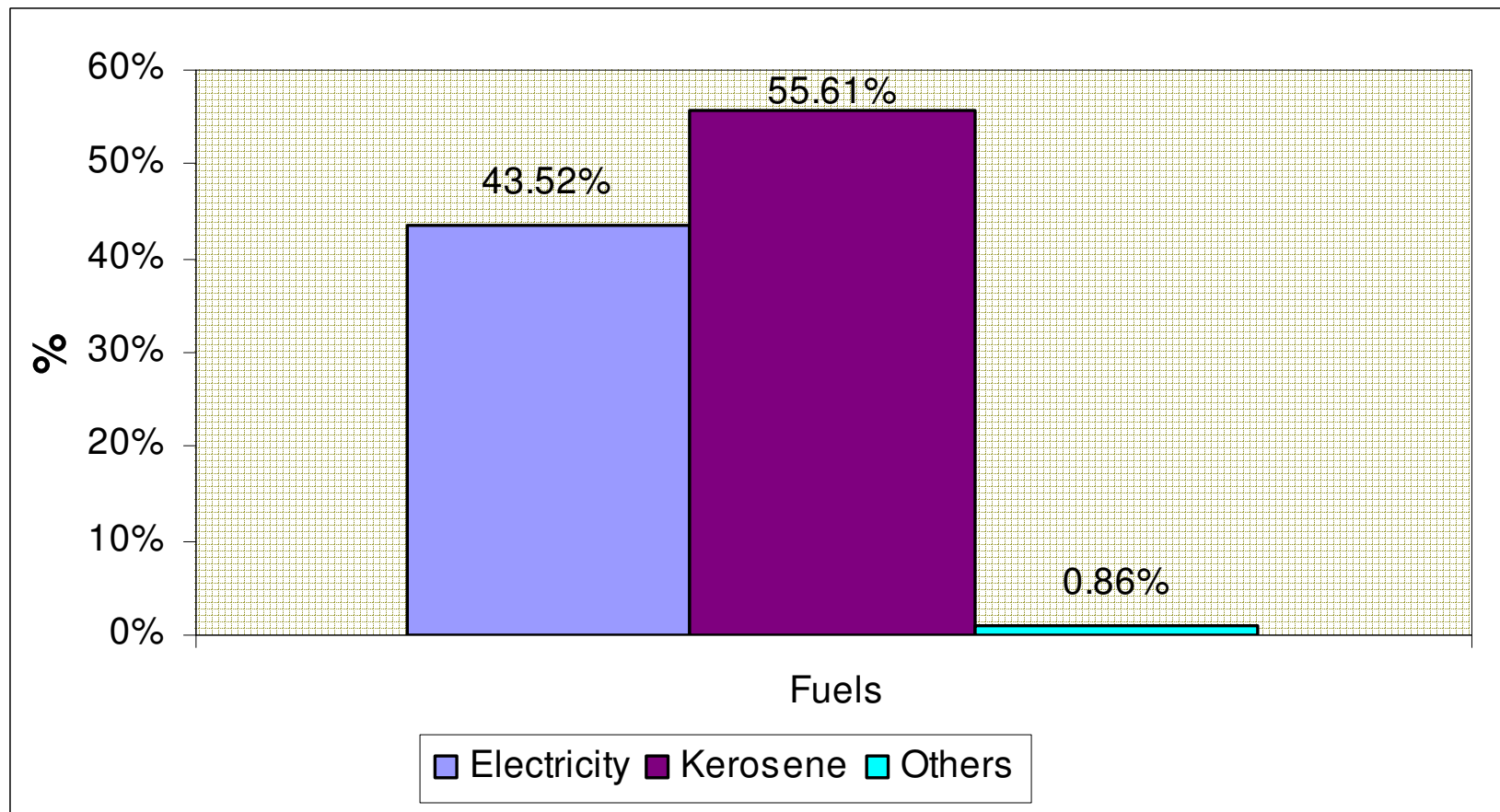


Also . . . .

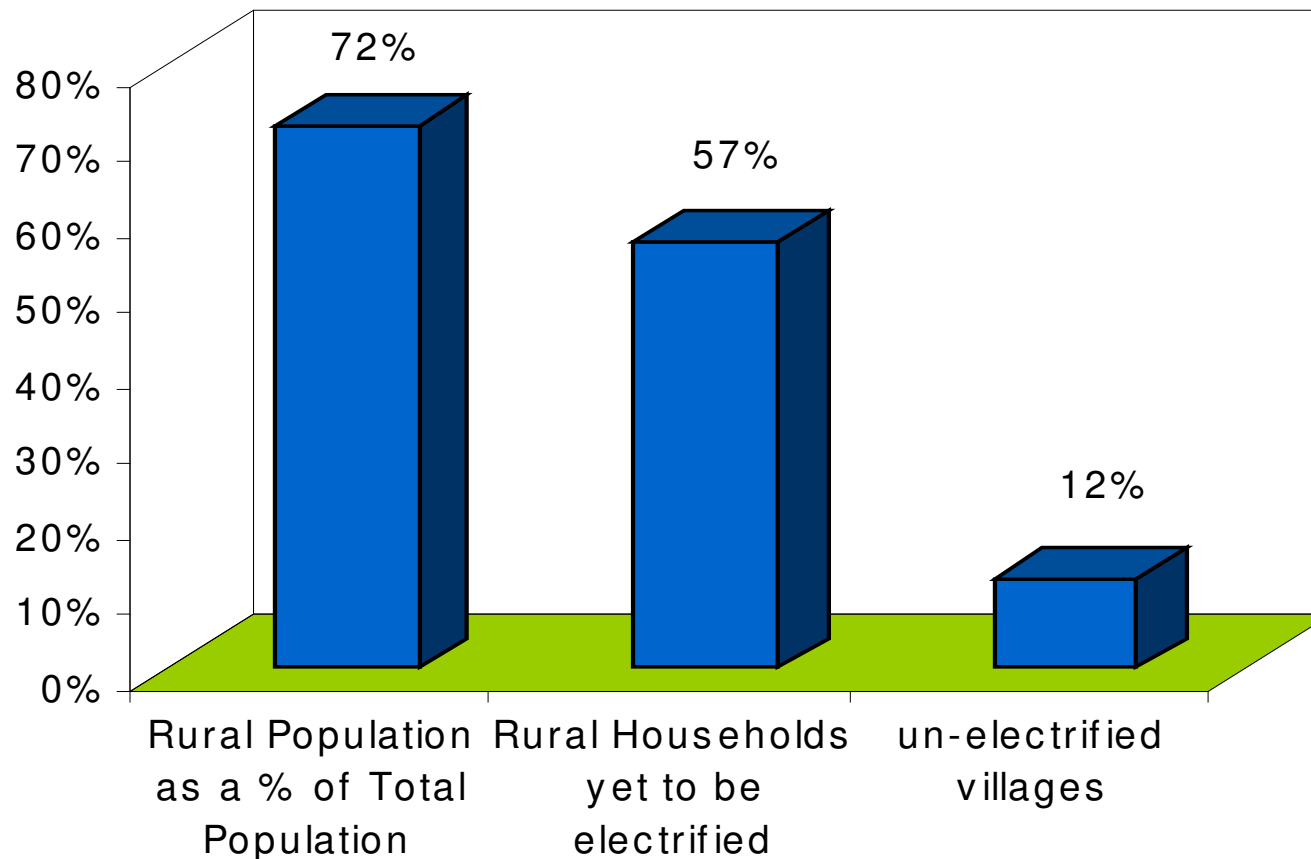
# Primary Fuels Used in Cooking - Rural



# Primary Fuels in Lighting - Rural



# Rural Electricity Access




Source: Ministry of Power 2005



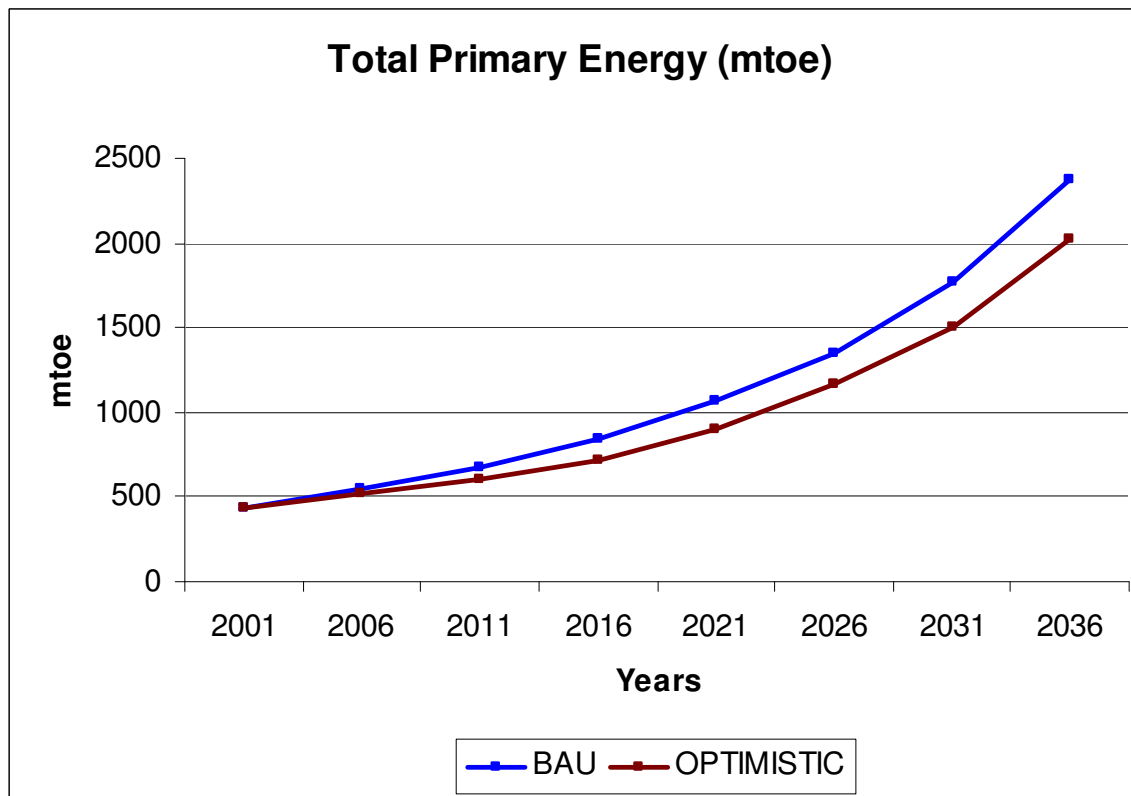
# Future Prospects



# India hopes for...

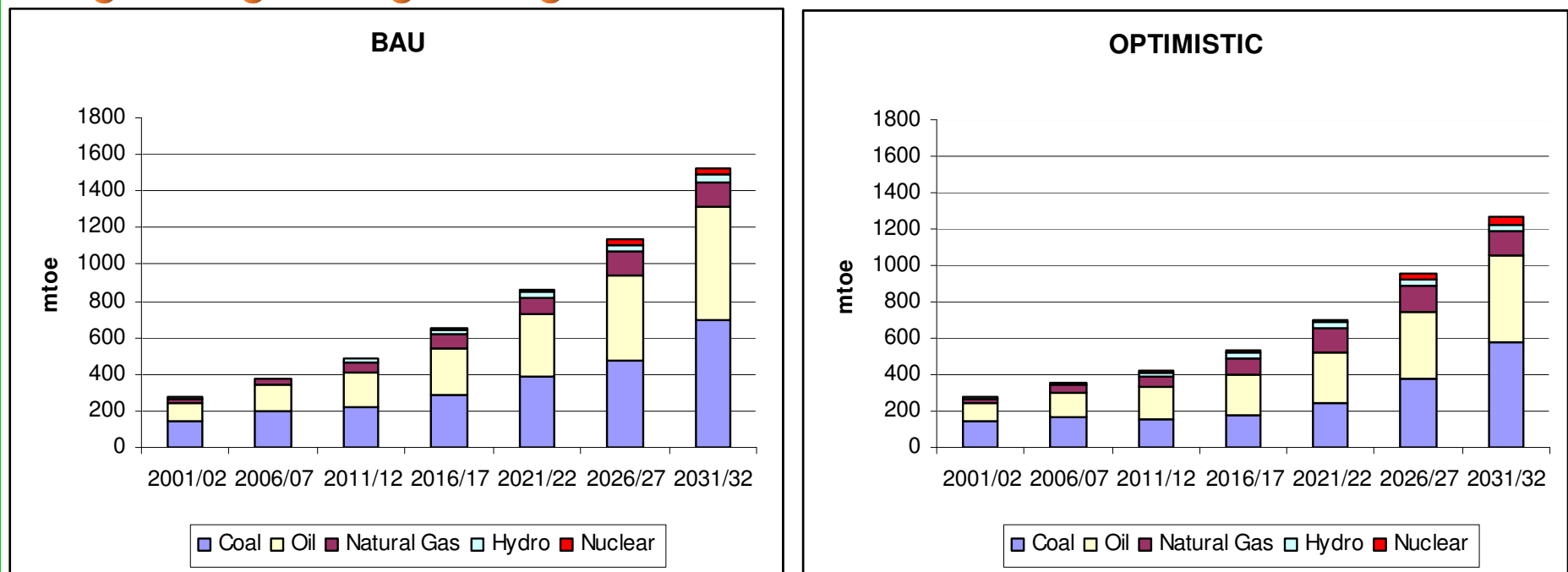
- 
- Economic growth rates of 8-10% per annum
  - Energy for all on demand in the next decade
  - “Developed” world status by 2020

# Total Primary Energy Requirement



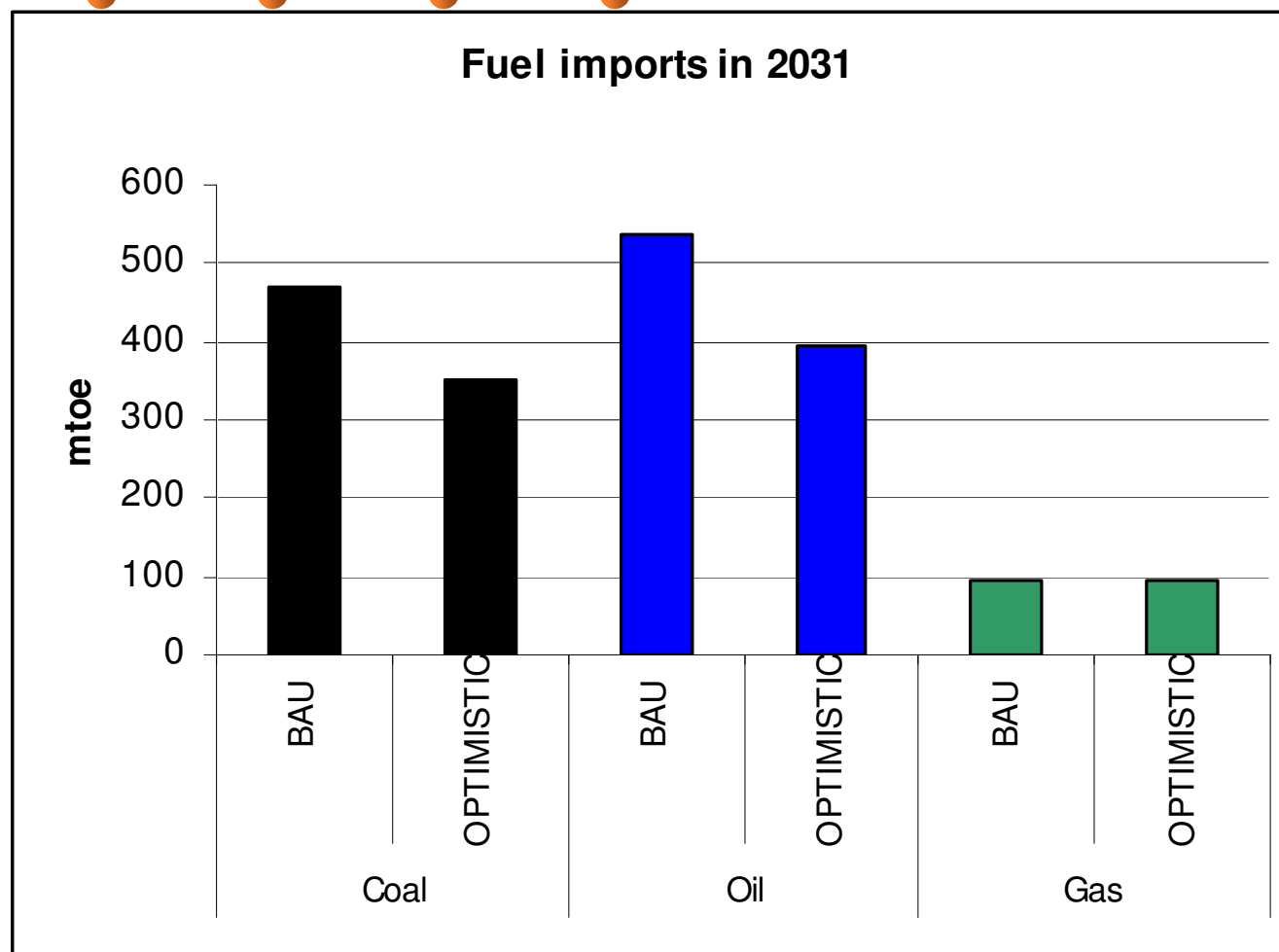
- Increase in primary energy
  - 4.0 times by 2031 (BAU)
  - 3.4 times (OPTIMISTIC)
- OPTIMISTIC scenario considers more aggressive technological pathway both for resource supplies and end-use technology penetration

# Total Commercial Energy Supply



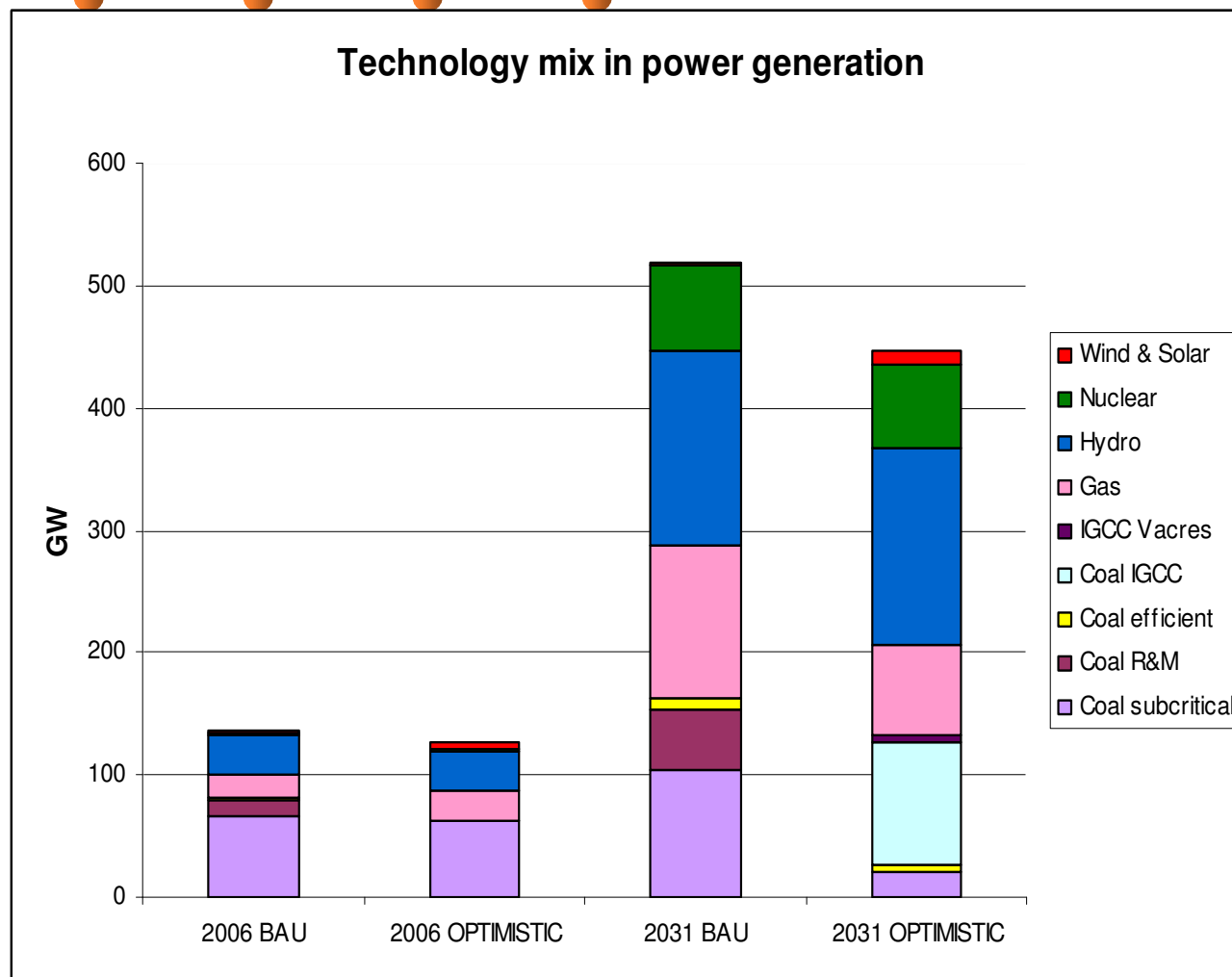
Commercial energy estimated to increase between 4.7 to 5.5 times from 2001 to 2031

# Energy Security



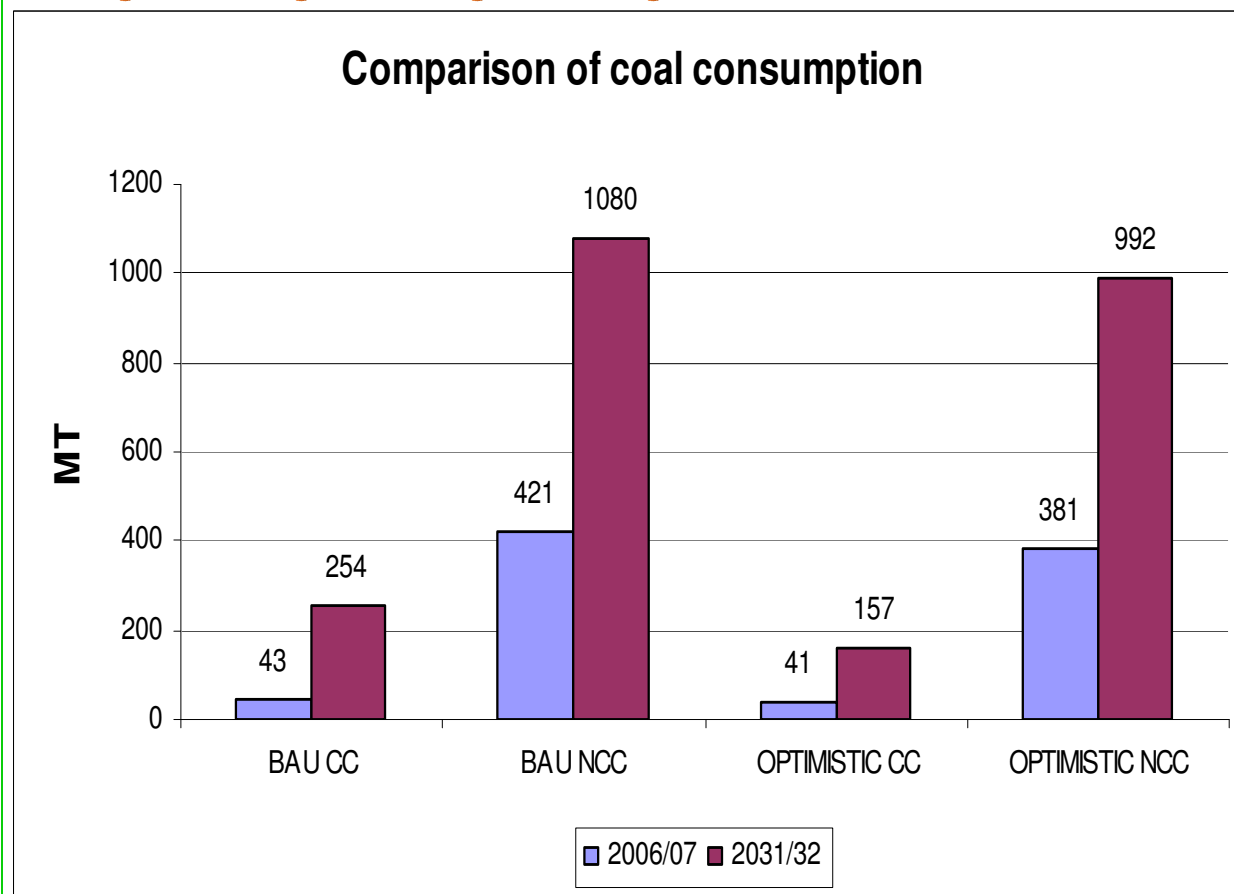
- Coal imports decrease in the OPTIMISTIC scenario due to clean coal technologies & efficiency improvements
- Oil & gas import dependency increases to 84% (BAU) & 80% (OPT) in 2031
- Coal import dependency increases to 67% (BAU) & 61% (OPT) in 2031

# Power Generation Technologies



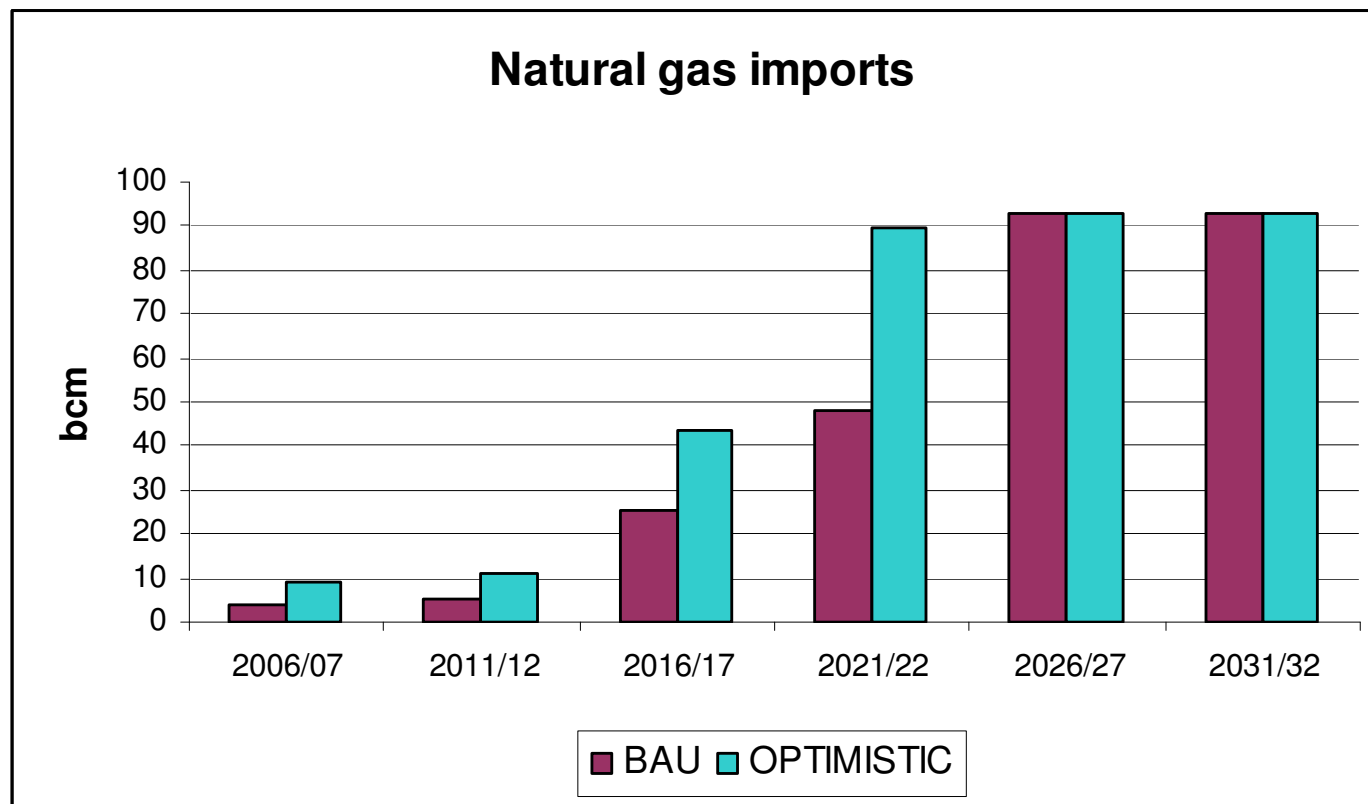
- IGCC is a clearly preferred option, but needs to be adapted & demonstrated for Indian coals
- Hydro is a preferred option → Govt. should pursue aggressive strategy to tap the potential as per Plans
- Nuclear power needs to be pursued from energy security angle

# Coal Consumption (MT)



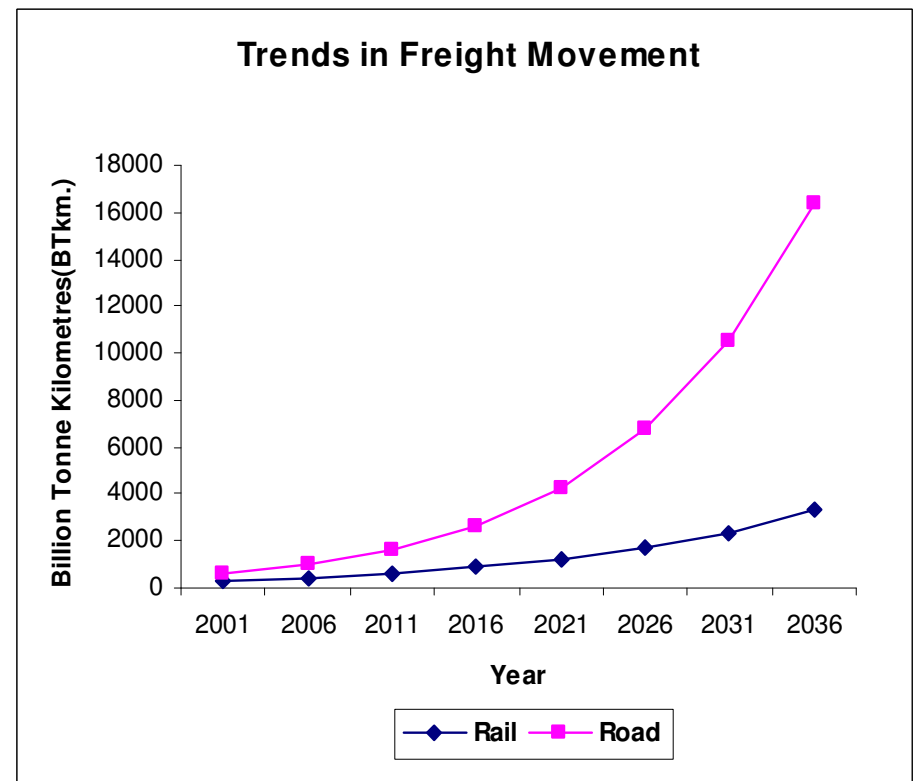
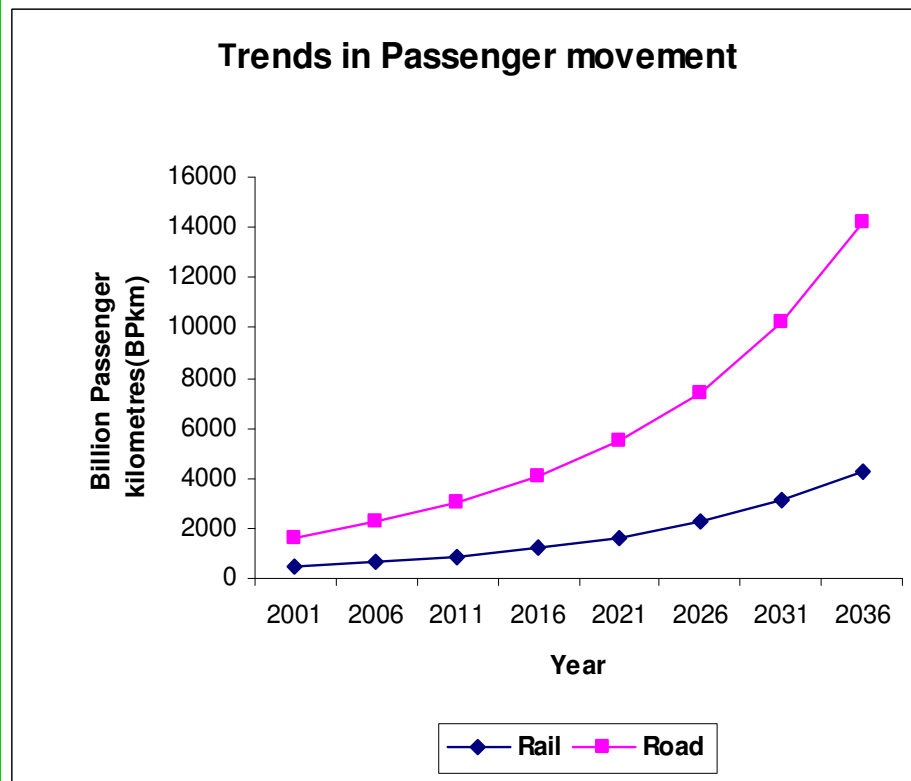
# Decrease in coal requirement (coking & non-coking) in the OPTIMISTIC scenario is due to energy efficiency improvements in power and industry

# Gas (bcm)



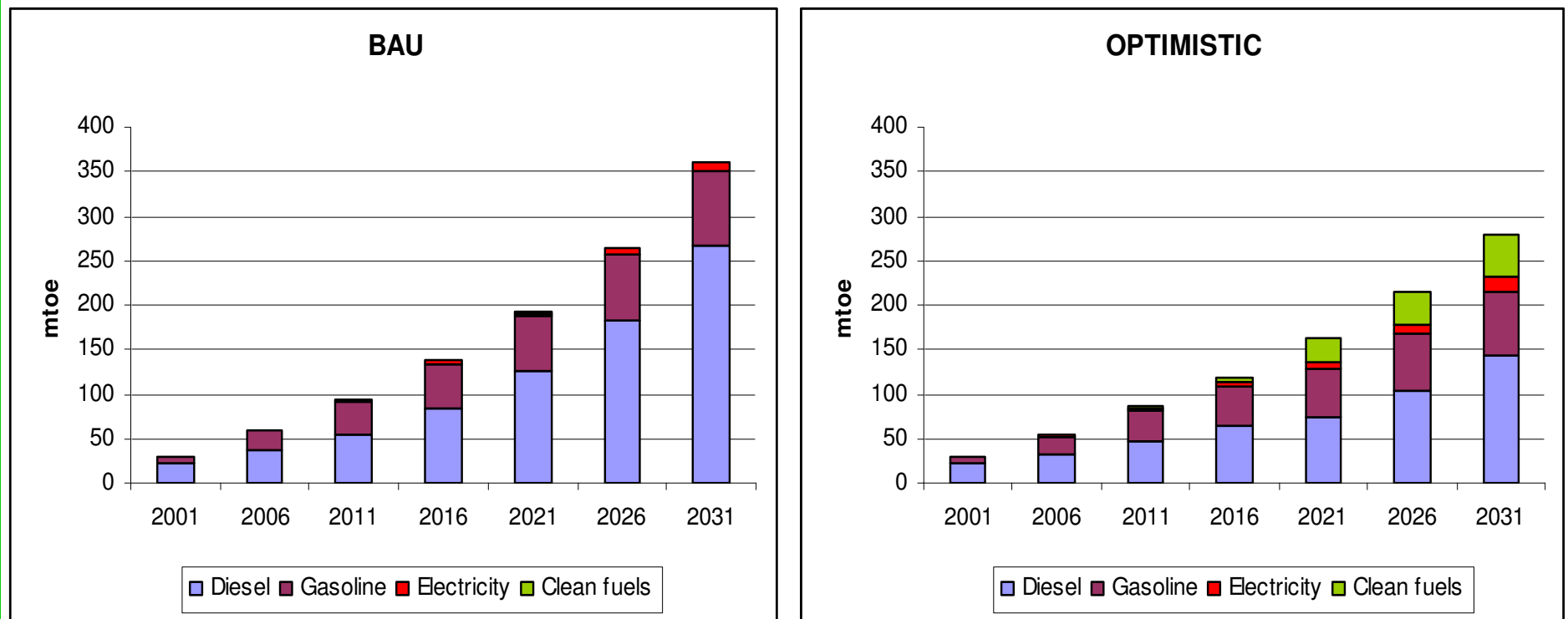
Total gas consumption restricted at 93 bcm after 2021; domestic gas – 46 bcm

# Growth & Energy in Transport Sector



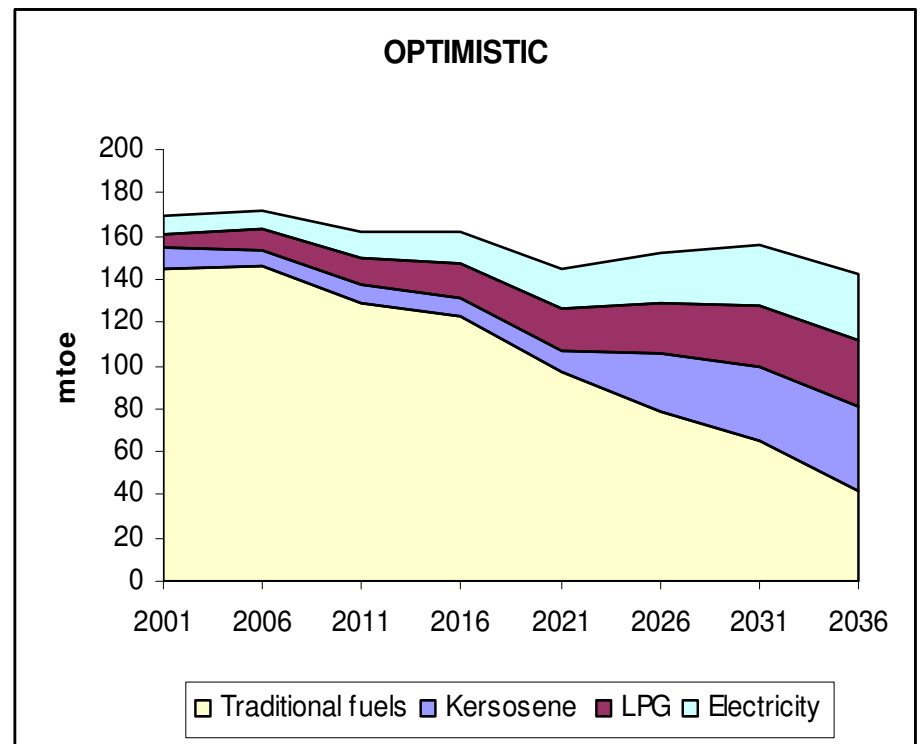
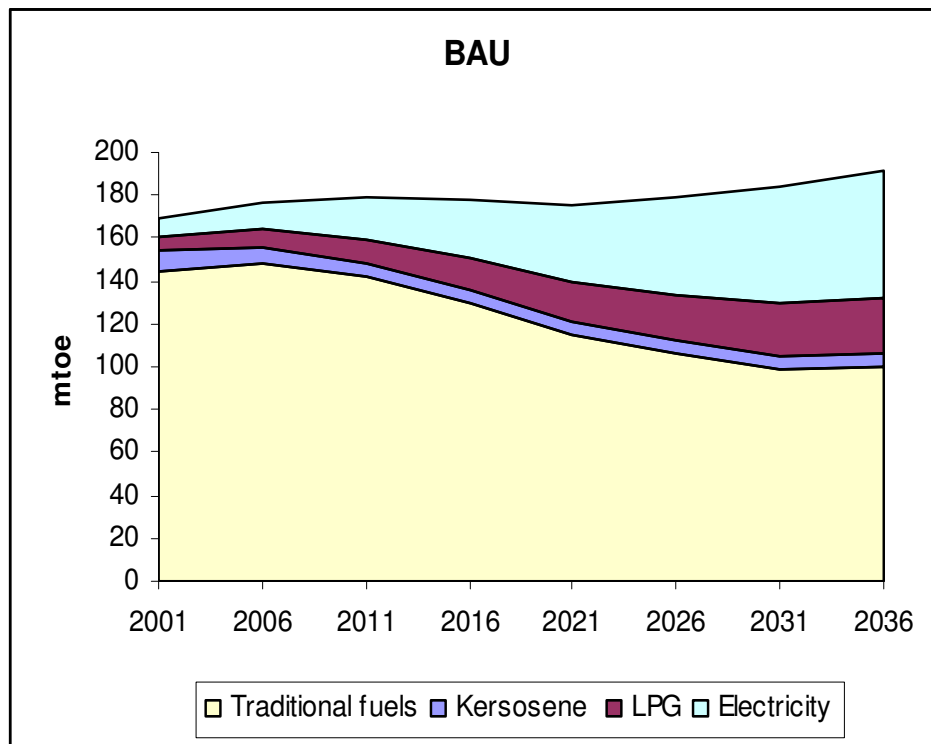
- Passenger movement demand increases 8.65 times; rail based 8.7 times, road based 8.6 times
- Freight movement demand increases 22 times; rail based 10 times, road based 29 times

# Energy Use in the Transport Sector

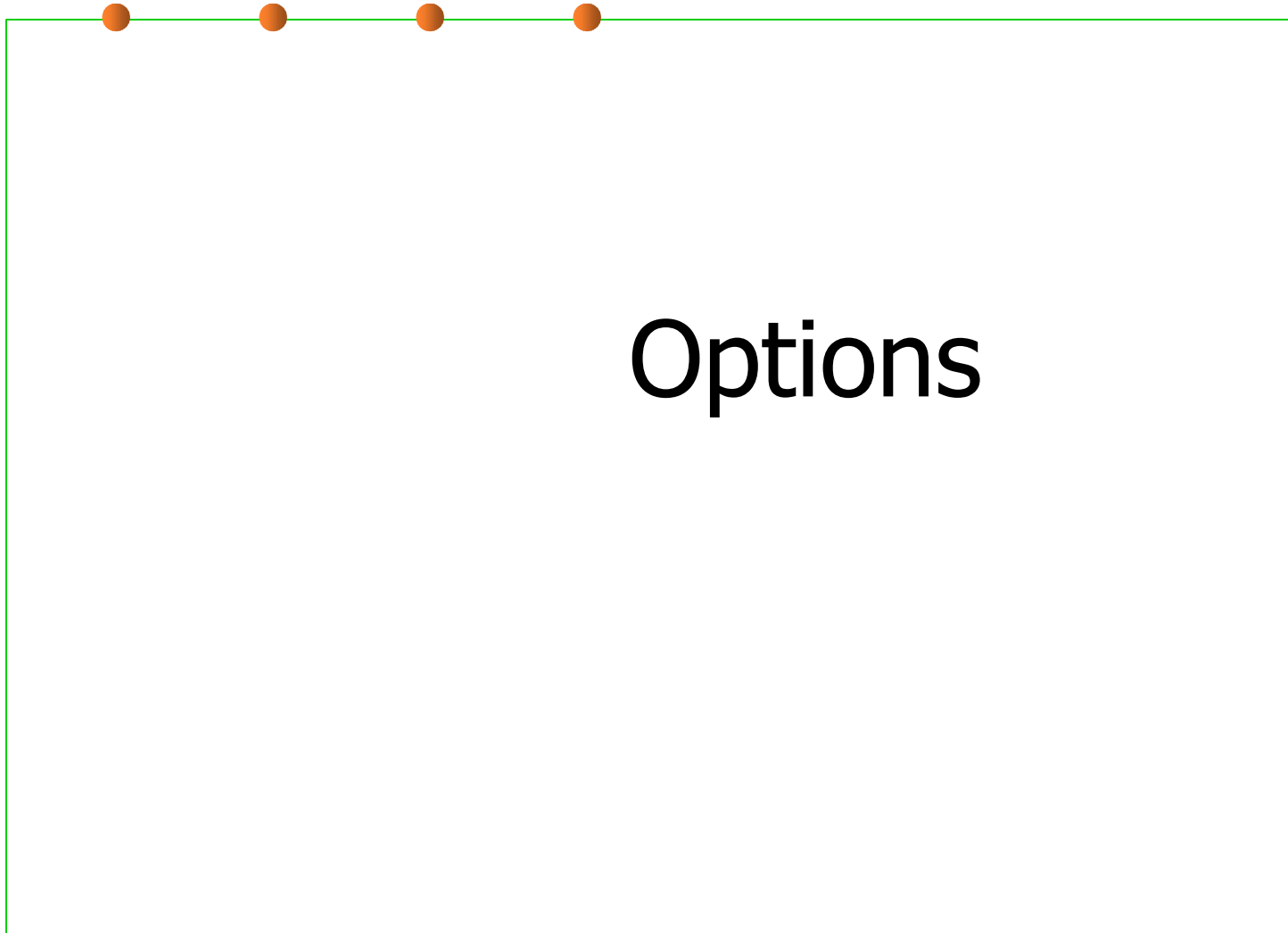


Total fuel requirement decreases from 360 mtoe to 280 mtoe in 2031 – savings equivalent to 3 times the current consumption

# Energy Use in Households




Electricity to all by 2011/12 in both cases and shifts from traditional to modern fuels based on affordability



# Options



# Enhance supply options

- 
- Optimise regional energy resources
    - Hydro power: Nepal and Bhutan
    - Natural Gas: Bangladesh
  - Natural gas imports
    - Iran
    - Turkemenistan
    - Myanmar
  - Equity oil and coal




# But...

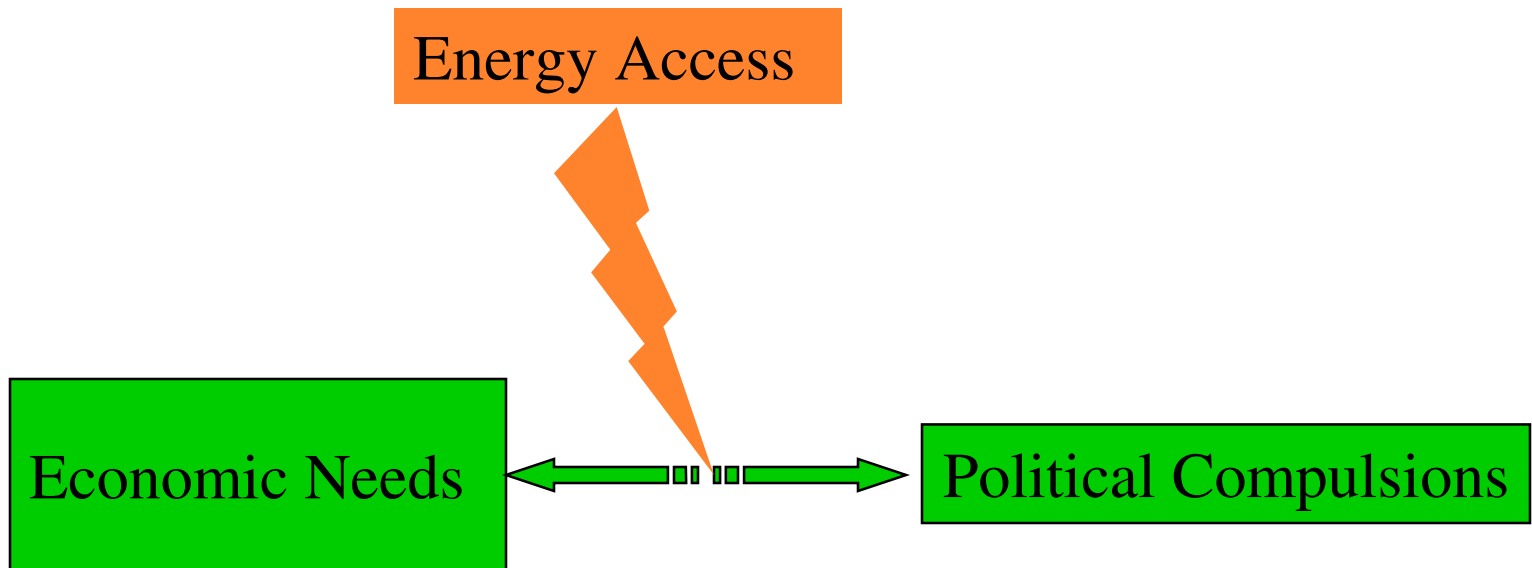
- Consumption of commercial energy is dismally low, ranging from 160 kgoe for Bangladesh to 494.03 kgoe for India.
- Access to electricity
  - Bangladesh – 30%
  - Bhutan – 11%
  - Nepal – 15 %
- Large rural populations a challenge
  - Affordability becoming a major concern



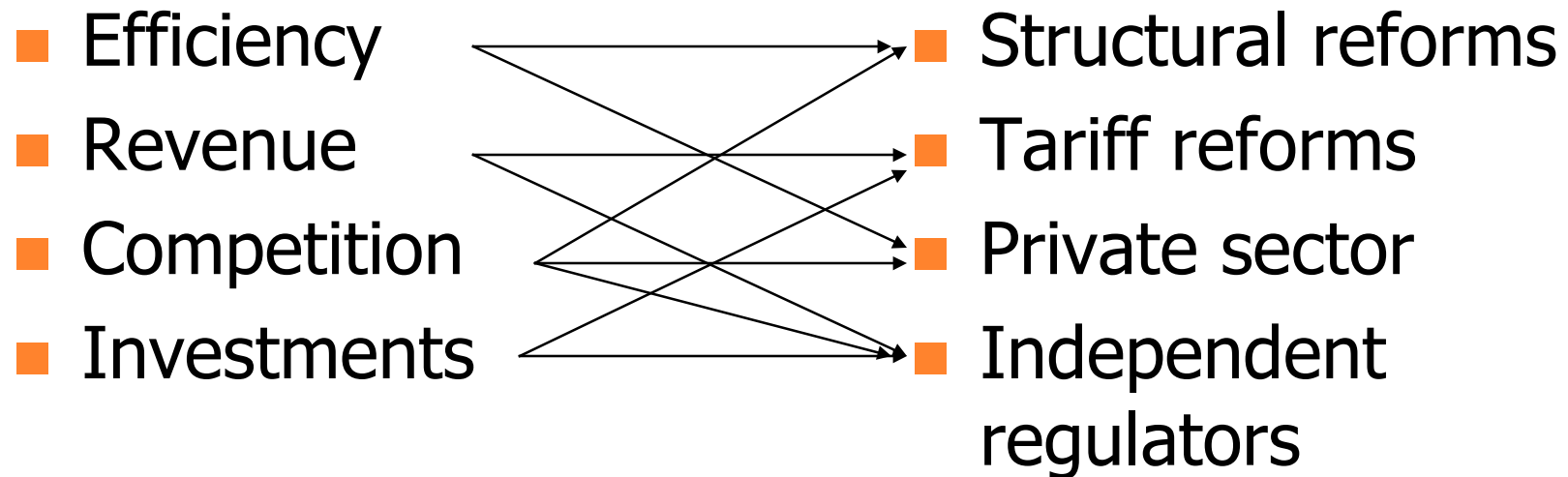
# Technological Options

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- Accelerate introduction of clean coal technologies especially in IGCC
  - Reduce high upfront costs of CFLs
  - Facilitate research in producer gas engines
  - Bio-fuels
  - Public transport

# Policy challenges




# Economic Needs






# Political Compulsions

- 
- ✓ Universal service
  - ✓ Affordability
  - X Price shocks




# The Developed World ...

- 
- Needs to recognize/respond to
    - India's growth challenge
    - Importance of civil nuclear cooperation
    - Investments for improving energy supply infrastructure
    - Technological needs for efficiency improvements



# And Finally ...



Extend the Public – private partnership  
model to the international level