India's Energy Challenge: Lessons from Japan

Japan – India Symposium

Tokyo, Japan

13th December 2012

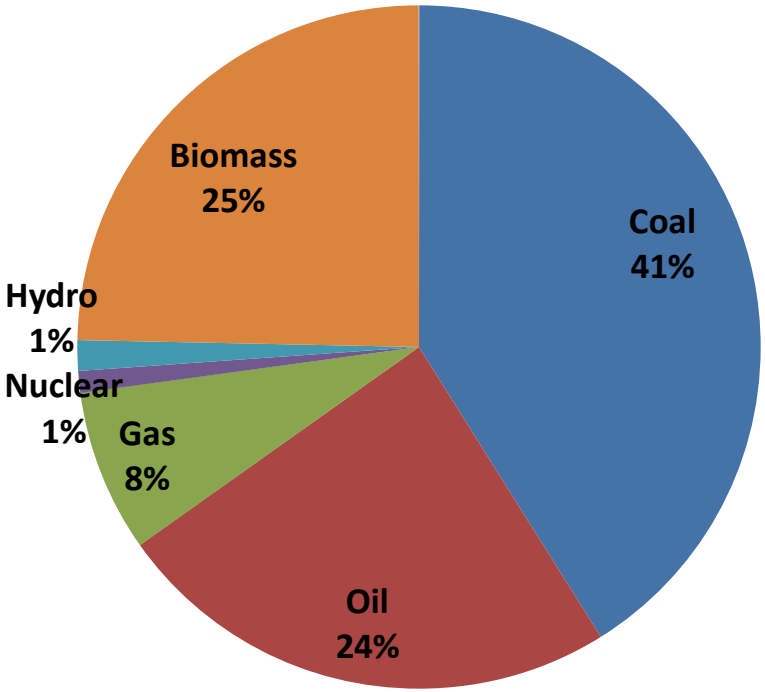
Key Messages

- **India and China will define future global energy challenges**
- **Japan & India: Roughly same aggregate energy consumption: India's quantity & Japan's quality**
  - Japan: Universal access to modern energy (equity), highly efficient (economically and ecologically)
  - India: Half the population without access to modern energy (inequitable); inefficient (economically & ecologically)
- **Regional cooperation & integration need to rely on or work in accordance with global rules and standards**
  - Japan's coping strategy (portfolio approach & efficiency): With almost 100 percent energy import dependence Japan is more energy secure than India which imports only 33 of its primary energy
    - Market mechanism for pricing, penalty for environmental degradation & carbon emission
    - Self reliance principles inapplicable in the energy sector

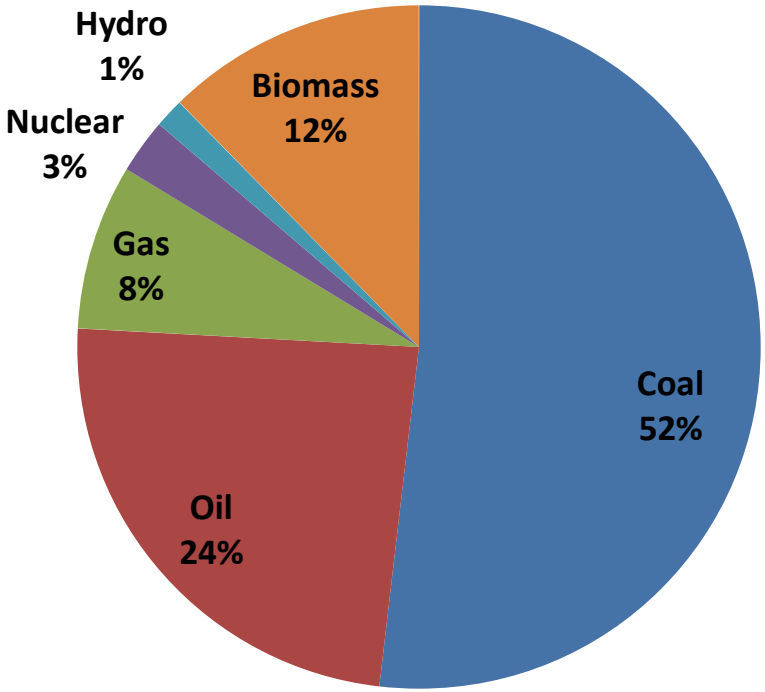
The appeal is not to our moral sentiments or animal spirits but to our own self-interest

India: Primary Energy Demand: Dominated by Fossil fuels

2010: 691 mtoe



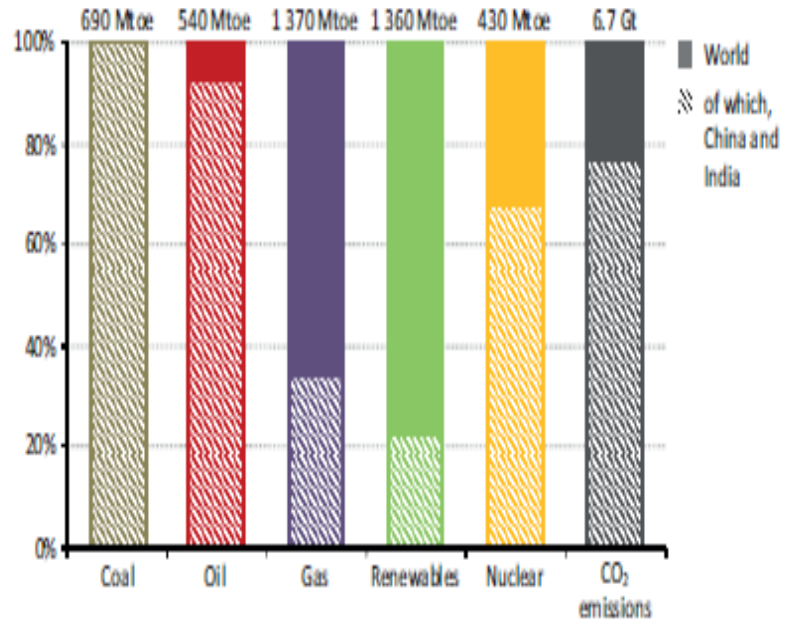
2035: 1680 mtoe



3 fold increase in energy demand; fossil fuel share increases from 73% to 84%

The ‘Chindia’ Energy Challenge

Chindia share in net increase in global primary energy demand

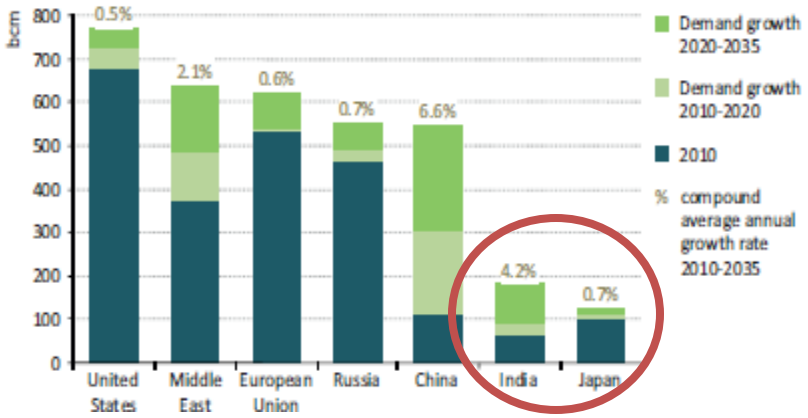


- But even by 2035 India’s energy demand will only be 57 % of China’s
  - Per capita energy consumption in India will hit 1 toe only in 2035

- **By 2020 India will**
  - Match China in population numbers & overtake China as the world’s fastest growing energy region
  - Overtake Japan/China/EU to become the largest coal importer
- By 2030-35 India will
  - Occupy coal space vacated by China (China’s coal imports expected to peak in 2015)
  - Overtake USA to become the 2nd largest energy consumer
  - Overtake oil & gas import bill of Japan initially and later USA
- By 2035 India & China will occupy oil space vacated by USA & EU
  - Together import 19.2 mbpd of oil
  - OECD imports will fall to 12.5 mbpd
  - China will off-set entire savings in EU
  - India will off-set savings realized by USA

India & Japan: Quantity meets Quality

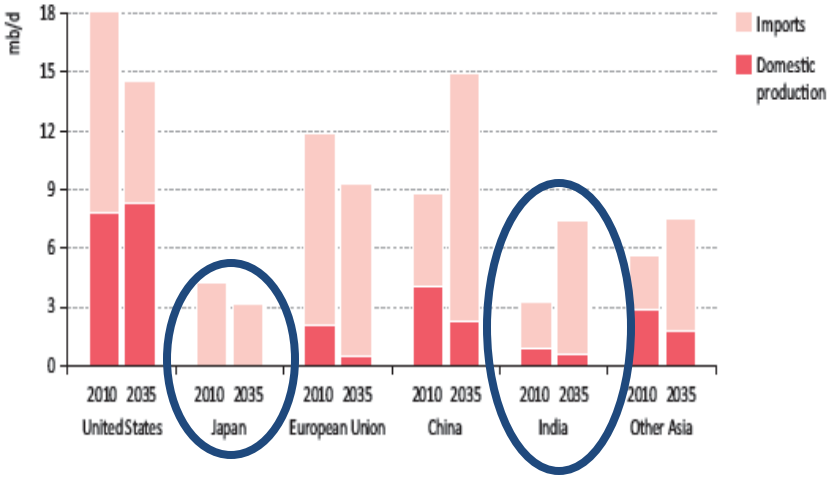
Natural Gas Demand Growth



- Natural gas demand & growth 2010-2035
  - Japan: CAGR 0.7 % 130 BCM
  - India: CAGR 4.2% 170 BCM

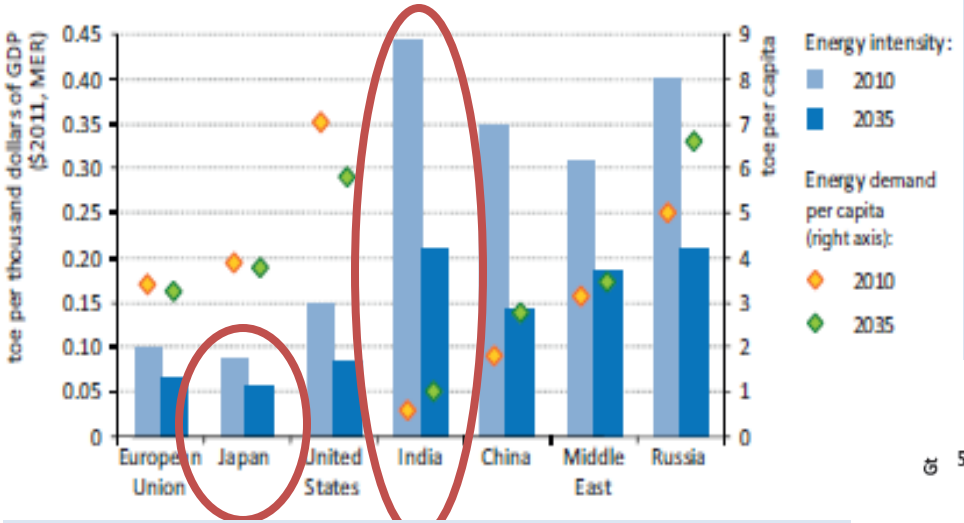
- Oil demand growth
  - Japan: Declines from 4.3 mbpd to 3.1 mbpd
  - India: Increases from 2.5 mbpd to 6.9 mbpd

Oil demand current & future



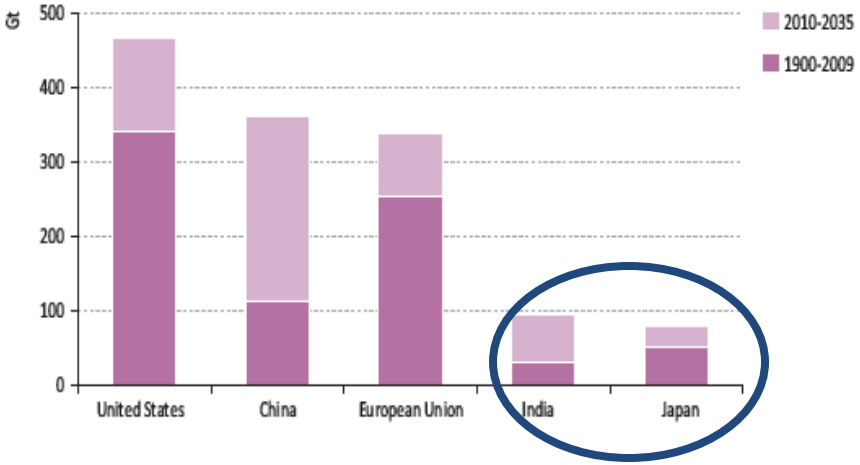
Quality Vs Quantity

Energy Consumption per unit GDP and per capita



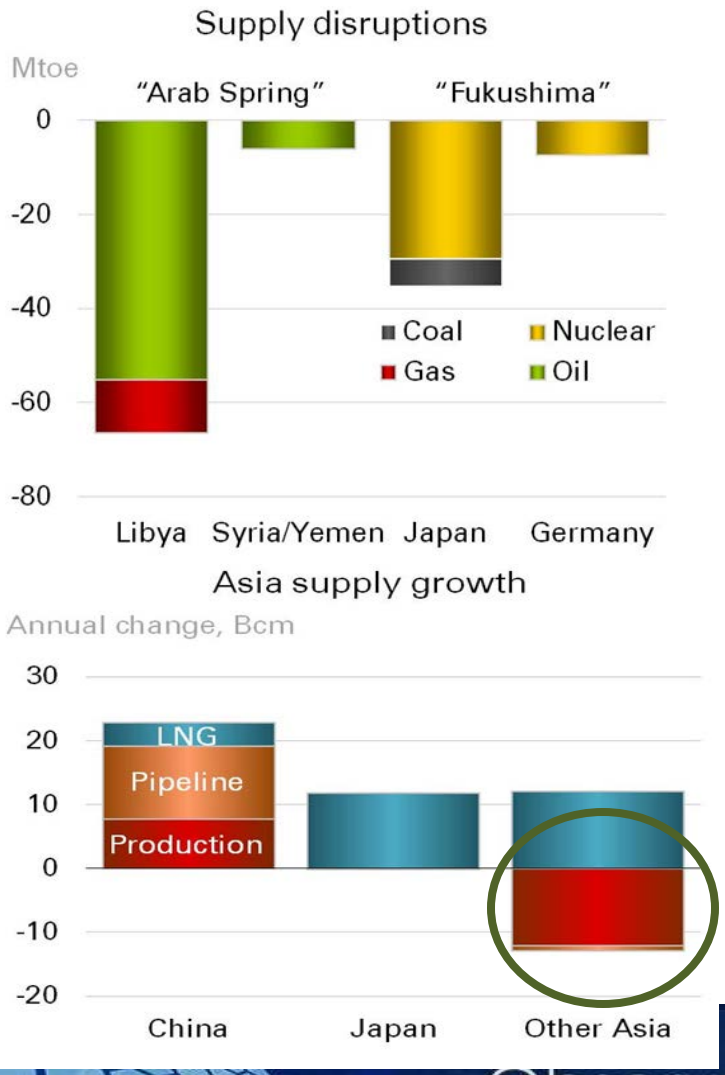
- Energy Consumption per 1000 USD GDP (2010-2035)
  - Japan: Fall from 0.08 toe to 0.06 toe
  - India: Fall from 0.44 toe to 0.22 toe
- Energy consumption per capita 2010-2035)
  - Japan: 4 toe to 3.8 toe
  - India: 0.6 toe to 1 toe

Cumulative carbon emissions



- Cumulative carbon emissions 1900-2035
  - Japan: 80 GT
  - India: 100 GT
- A USD 45,000 per capita country and an USD 1400 per capita country have roughly the same cumulative emissions
  - Quality - Japan: Technology & Efficiency
  - Quantity - India: Energy poverty, inequality & inefficiency

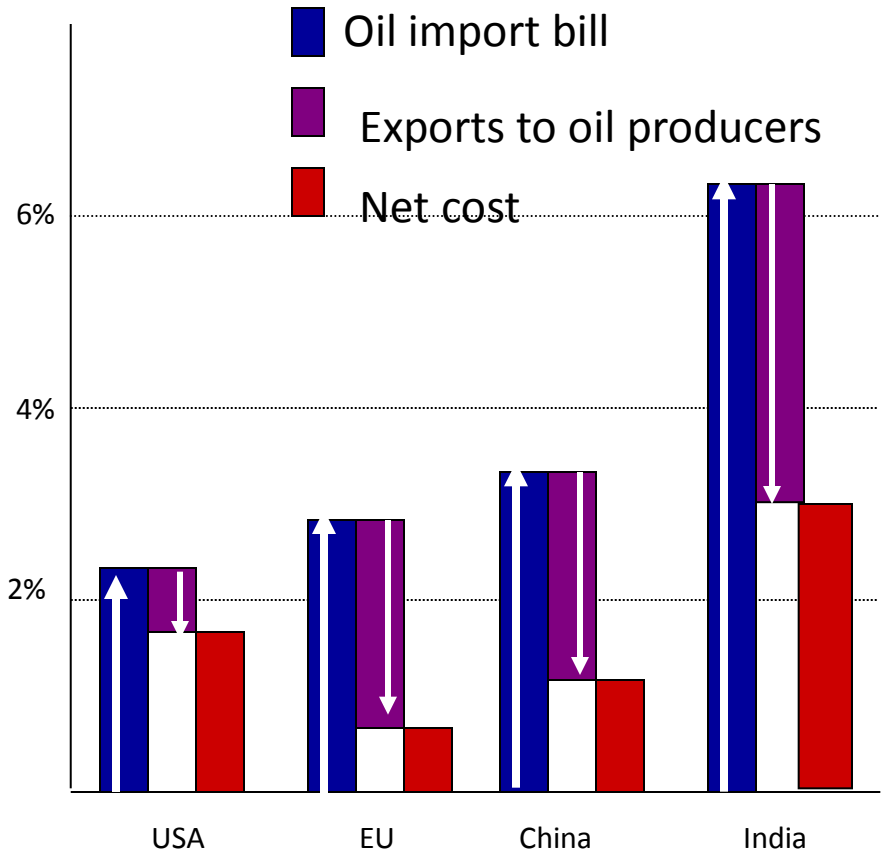
Energy Security: Japan's coping strategy



- **2011: Year of energy supply disruptions and high prices**
  - Political upheavals in hydrocarbon producing regions reduced hydrocarbon supply by 1.3 %
  - Natural disasters (tsunami) and its reverberations reduced world nuclear power by 7 %
  - Annual average price of oil was highest ever above USD 100/bbl
  - Floods in Australia reduced global coal availability
- **All fossil fuel disruptions were substituted by fossil fuels through the market mechanism**
  - Increase in OPEC oil production (Arabian peninsula and Iraq)
  - Increase in coal and gas based electricity in Japan
  - Increased coal supply from USA, Russia, Columbia and Indonesia
- **Gas supplies to Japan and China increased as they had open liquid markets**
  - Follow a portfolio approach to energy security

Source: BP, Brian Dodson at ORF-IEF conference

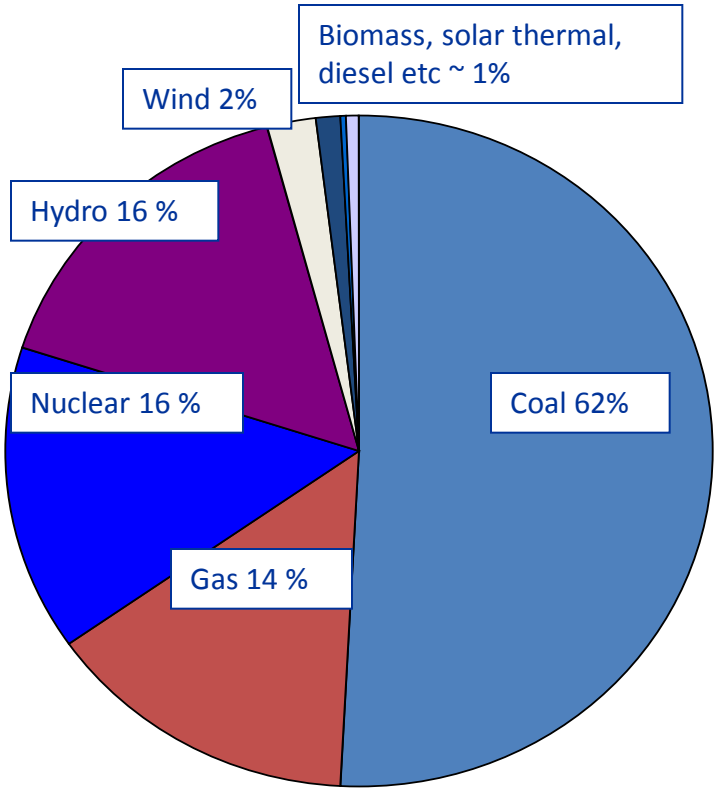
Oil Import Cost – Highest for India



- Relative risk of exposure to high oil prices increasing for India and decreasing for all OECD countries
  - All except USA are importing less oil and exporting more goods & services
  - USA is decreasing imports on account of domestic production
- Japan imports almost all its energy and spends less than 3 % of GDP on oil imports
- India imports 33 % of energy and spends more than 6% of GDP on imports (7.5 % last year)

Challenge: Reducing Carbon Emissions from Coal Combustion

Power Generation fuel shares by 2030 under aggressive nuclear capacity addition scenario



Domestic coal reserves: not as abundant as originally assumed?

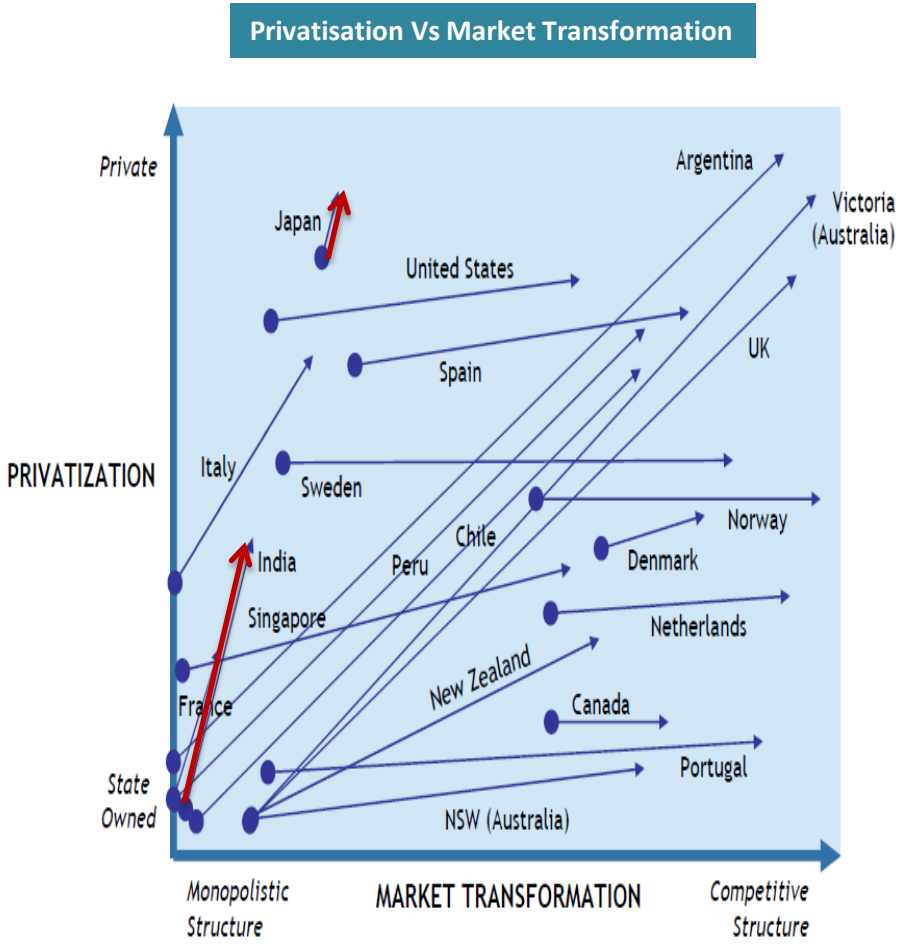
- Out of an inventory of 200 BT only 50 BT is thought to be economically extractible

- **Even if all coal reserves in India are used for power generation, Indian emissions are unlikely to exceed 4.5 GT or 3 tonnes per capita**
- **Increasing the efficiency of sub-critical Pulverised Coal power plants by 1 percent will decrease coal use by 3 percent**
  - **Reduction in annual coal consumption** by ~ 100 Million Tonnes
  - Will lead to a reduction in annual CO2 Emissions > 170 Million Tonnes (equal to the total emissions of Netherlands)
  - Japan has one of the most efficient coal based power generation fleets in the world

Japan's Contribution

- **Training activities aimed at transferring Clean Coal Technology (CCT) have continued since 2001**
  - 136 Indians have been trained in Japan until 2011
- **A successful model project was carried out by Japan's NEDO to reduce ash content in Indian coal on a commercial scale**
  - New technology is expected to be introduced on a larger scale in 2012

An undesired similarity?



- **Privatisation progressing faster than market transformation**
  - Fukushima? A lesson for India in a hurry to privatise and accelerate nuclear energy produciton?
  - Privatisation of profits and socialization of losses?
- **India's nuclear Targets**
  - **Before 1974 (first nuclear device tested)**: 43 GW by 2000 (33 GW from breeder reactors)
  - **After 1984**: 10 GW by 2000 (no breeder reactors)
  - **After 1998 (second nuclear device tested)** : 20 GW by 2020 (3.5 GW breeder reactors)
- **Long term projections:**
  - Pre-NSG waiver: 275 GW by 2050
  - Post NSG waiver: 455 GW by 2050 (35 % of 1300 GW total generation) out of which 95 % to come from breeder reactors
- **Questions**
  - Capacity developed in 60 years: 4.1 GW
  - Capacity expected in next 40 years: 455 GW
  - 100 fold increase in 40 years?

Ambitious even to the uninitiated ?

Impact of Economic Crisis - Creating clean energy or promoting industries (jobs) ?

- **Climate Change & RE Policy: Mother of all Trade Wars?**
  - **e.g. Crystalline Solar PV modules**: Glut in the market on account of overcapacity (50% in China) and slower demand from Europe (reduction in subsidies)
  - **USA**: Punitive duty of 250% on Chinese crystalline solar modules
  - **China**: Considering anti-dumping case against US dumping of poly-silicon
  - **Germany**: Hesitant on tariff barriers on Chinese modules as they are made on German machines!
- **What does all this mean for India's JNNSM? 20 GW solar by 2020**
  - Capital cost of solar PV fell by 30 % in 2011 on account of imported modules
    - Second round of Phase I bidding quoted prices pushd down to Rs 7.46/kwh!
  - Domestic content requirement circumvented
    - Shift towards less expensive thin film as domestic content requirement does not apply
    - US imports of thin film with low cost financing!

Bankability of solar projects questioned, Domestic PV manufacturing under strain

Millions yet to move from Carbohydrates to Hydrocarbons !

Carbohydrates carrying Carbon?

Carbohydrates carrying Hydrocarbons?

- **Over 300 million Indians do not have access to electricity 700 million use biomass as fuel for cooking**
- **Without enabling the shift from Carbohydrates to Hydrocarbons, generation of surplus energy (essential for material progress) cannot be facilitated**
  - Carbohydrate – Hydrocarbon = Net energy deficit (gender bias!)
- **Unaccounted energy derived from the poor (women) and the migrant labourer and their net negative energy consumption subsidizes energy consumption by the rich**
  - Reduces per capita energy consumption figures, reduces overall carbon emission figure
  - Underwrite India's sustainability!

These are India's 'green' poor and the main sustainability challenge – If they become rich (energy consumers) they will no longer be 'green' but if they remain poor they may become 'red' ?