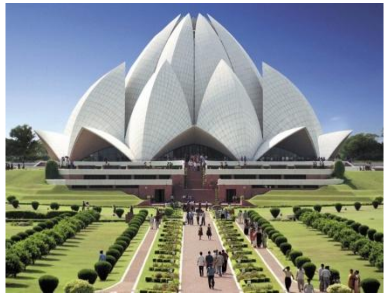
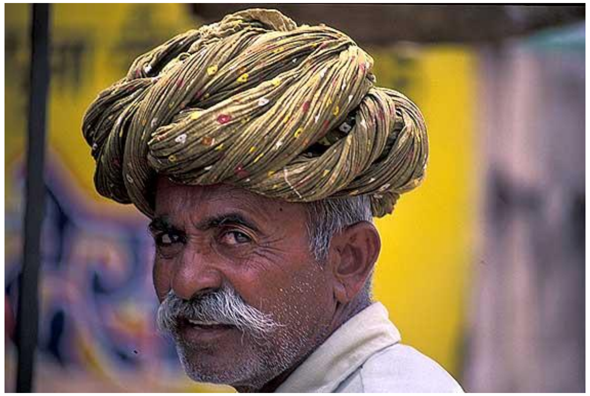
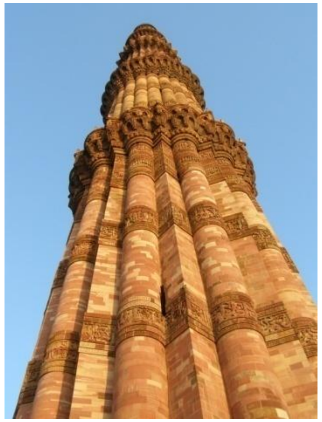






Terveisiä Intiasta!



Indian Energy Scenario:

Distributed Generation – A Green Solution

to

Energy Deficiency

VTT: Espoo
04.06.2009

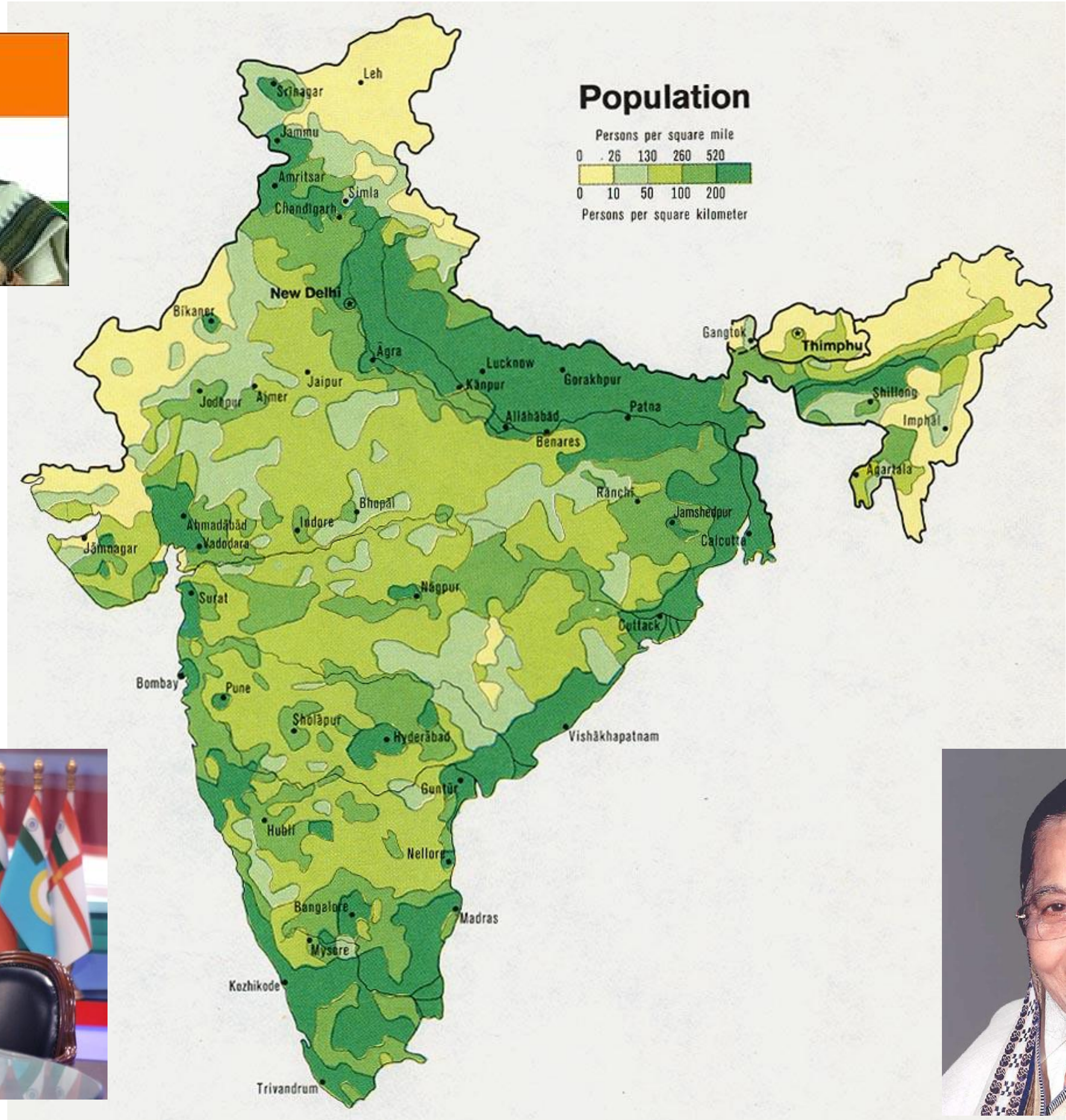
Arun Sahay

India Facts & Figures

‘ India lives in her villages’
~ Mahatma Gandhi

- 60% of our population lives in rural India.
- 80,000 villages still remain unelectrified.
- 35% of our population still remains illiterate.
- 127^{th} rank out of 162 nations in UN’s HDI
- Rural telecom, rural banking, irrigation pumps continue to falter due to lack of stable *power.*
- India imports about $3/4^{th}$ of our crude oil, and the country's oil bill accounts for 37% of total value of all imports. ($ 83 billion in 2007-08)

Power: Source-Requirement Mismatch



Candidate Generation Technologies

Region/ Countries	Generation Technology Options		
	Conventional Thermal	Cleaner and Efficient	Renewable
Yunnan – China	Conventional Coal	CFBC	Hydro, Geothermal, Solar PV, Wind
NREB – India	Conventional Coal	Combined Cycle, IGCC, PFBC, Nuclear	Hydro, Wind, Solar PV, BIGCC,
Indonesia	Conventional Coal, Oil and gas turbine	IGCC, PFBC, Combined Cycle	Geothermal, Hydro
Sri Lanka	Conventional Coal, Diesel generator, Oil based gas turbine	IGCC, PFBC, Oil based CC	Wind, Dendro-thermal, Hydro
Thailand	Conventional Coal and Oil-fired plants	Combined Cycle, IGCC, PFBC	BIGCC, wind, Solar PV
Vietnam	Conventional Coal, Oil based gas turbine	PFBC, Combined Cycle	Hydro

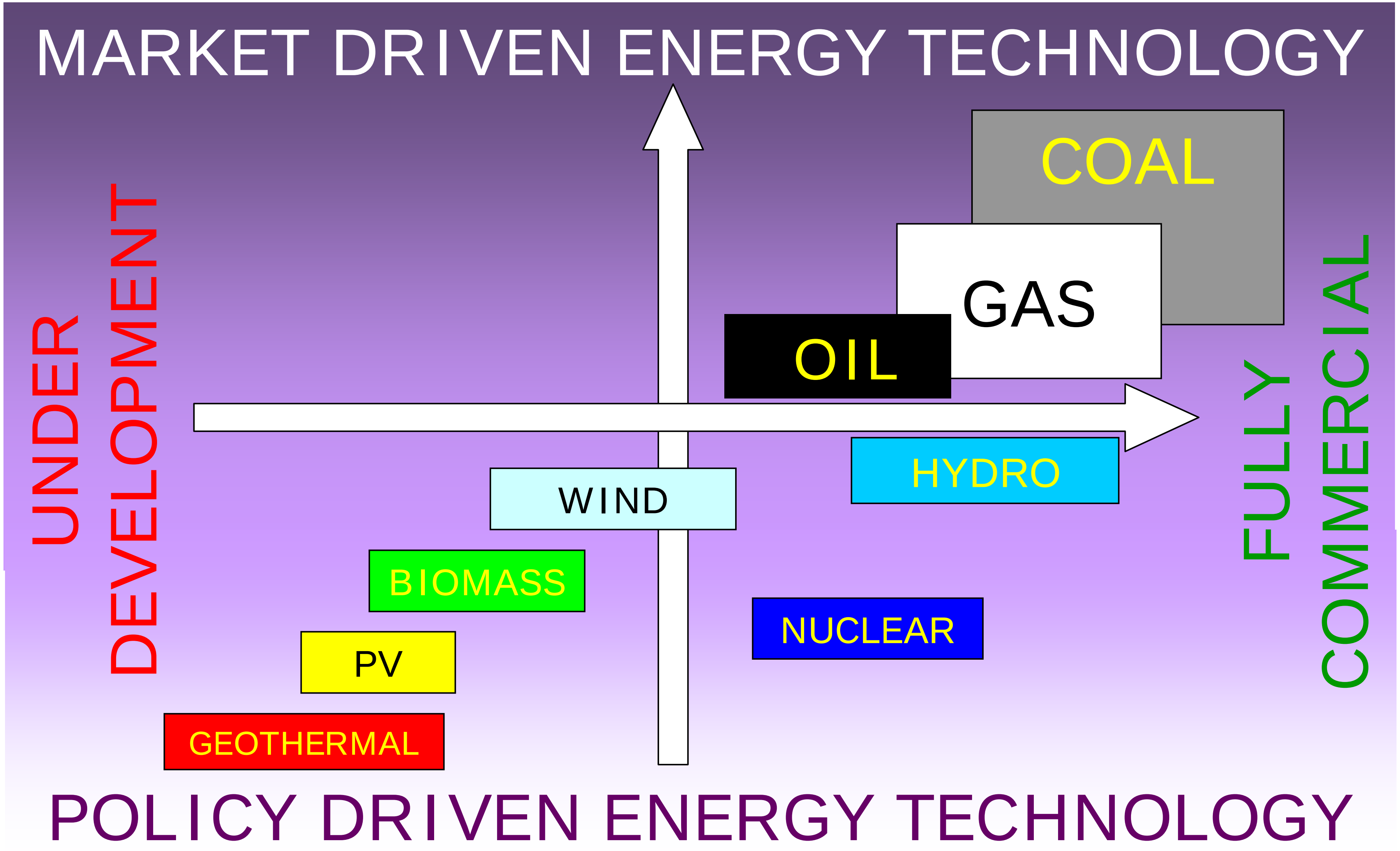
Note:

BIGCC = Biomass Gasification Combined Cycle, PFBC = Pressurized Fluidized Bed Combustion,

CFBC = Circulating Fluidized Bed Combustion, IGCC = Integrated Gasification Combined Cycle

Source: Asian Regional Research Programme

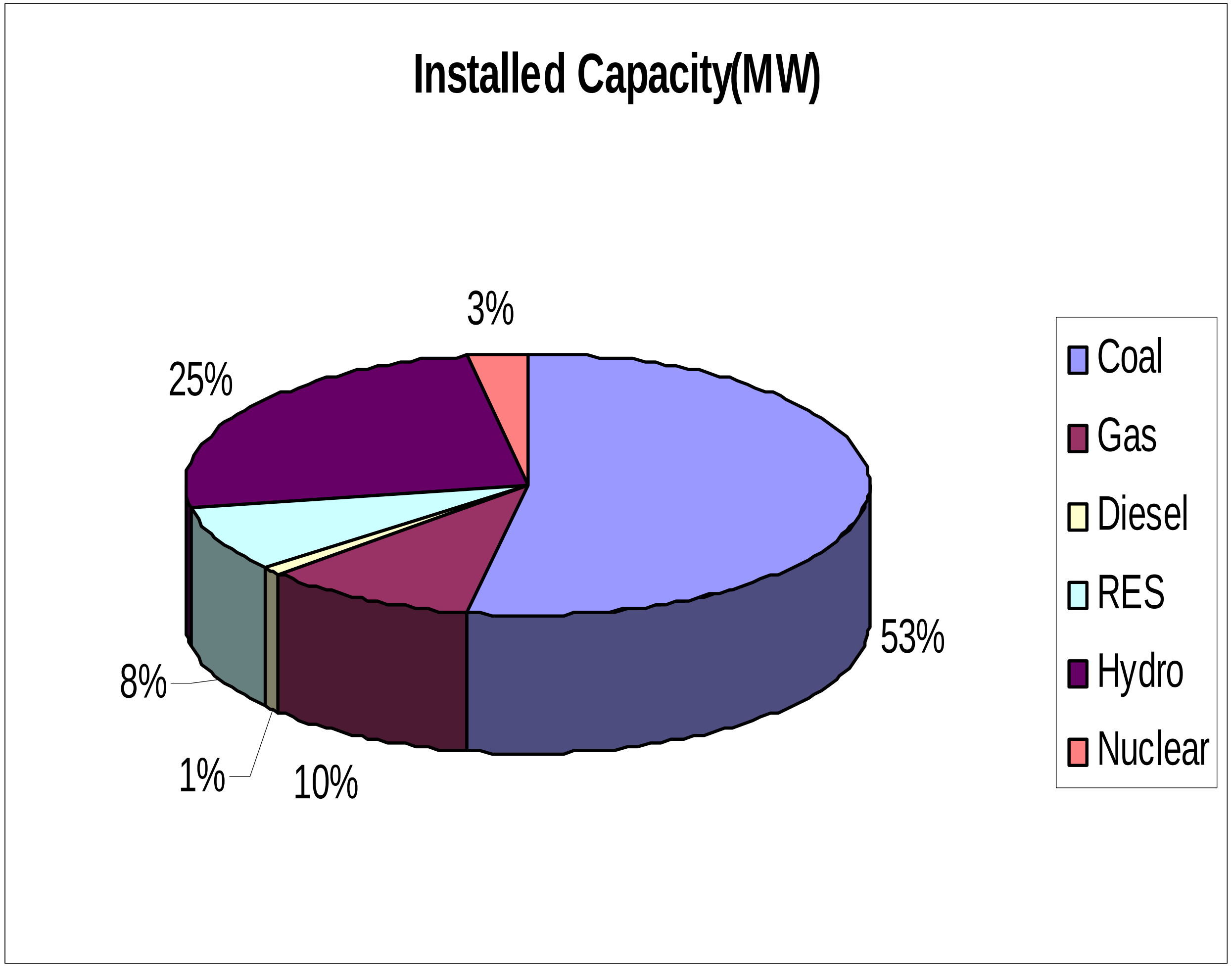
Indian Power Mix



World's Top CO_2 Emitters

	2005		2015		2030	
	Gt	Rank	Gt	Rank	Gt	Rank
USA	5.8	1	6.4	2	6.9	2
China	5.1	2	8.6	1	11.4	1
Russia	1.5	3	1.8	4	2.0	4
Japan	1.2	4	1.3	5	1.2	5
India	1.1	5	1.8	3	3.3	3

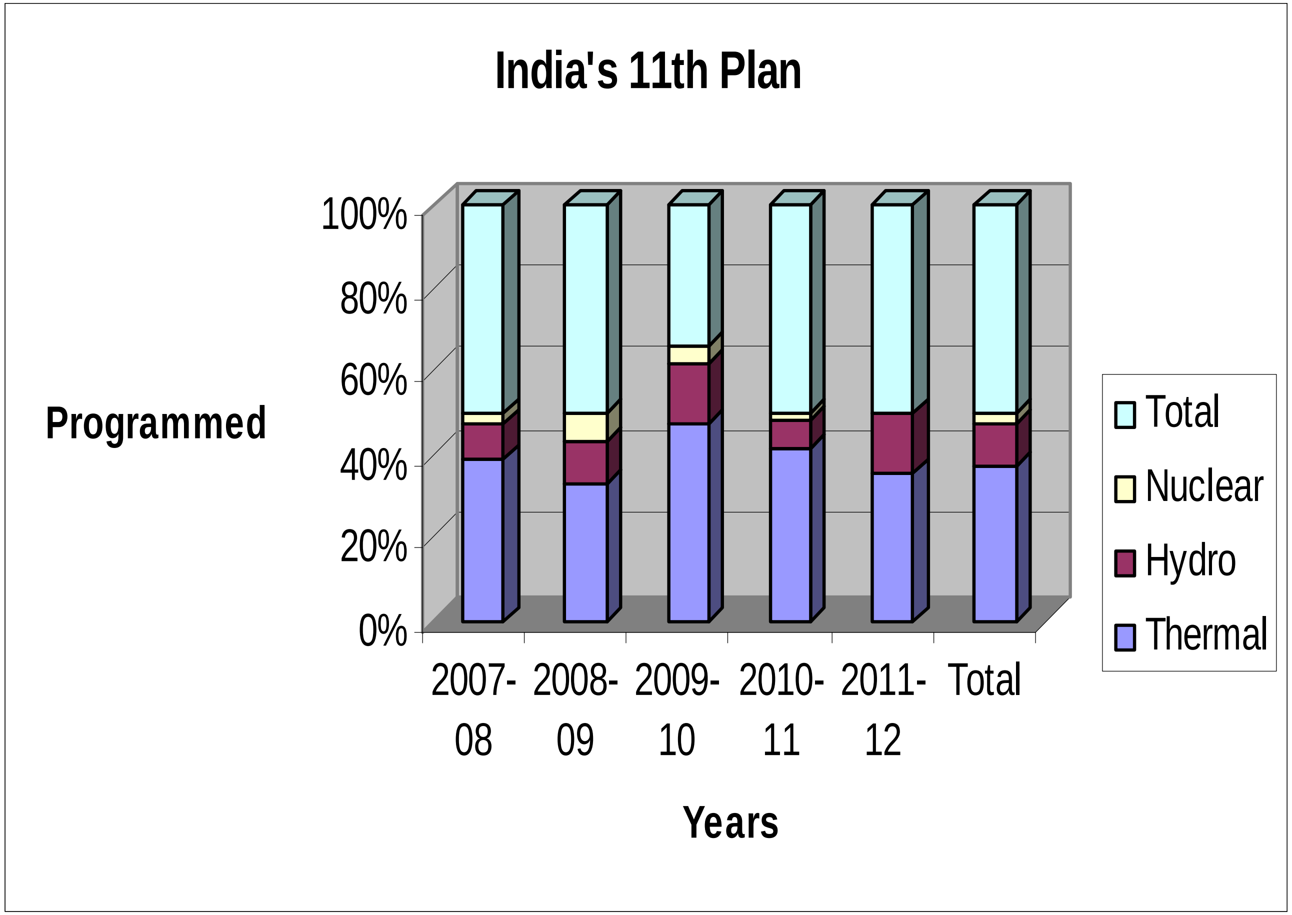
- Coal remains the biggest source of energy



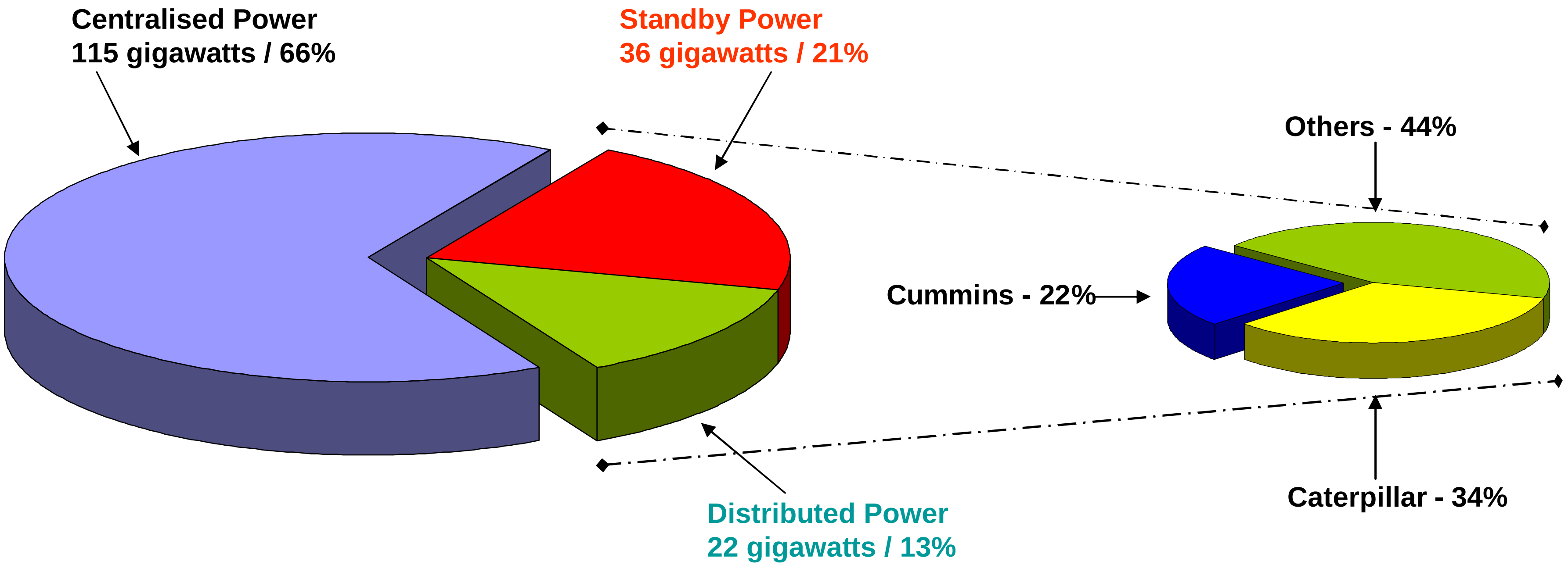
Energy Environment in India

- 53 % of the installed capacity (1,45,627 MW is on fossil fuels)
- 76% of the 11th plan capacity addition target (78,700 MW) is from coal
- High dependence on fossil fuels- coal, oil and gas - import dependent- concern for Energy security
- Fossil fuels Pollute and emit Green House Gases causing earth warming.(CO2, Methane etc)
- Wide spread shortages (10 to 15%); stunted industrial growth and poor quality of living
- Nuclear power to help in capacity addition.
- New and Renewable sources constitute a small portion of energy mix and needs to be promoted.

- Thermal generation will peak in 2009 -10 and thereafter….



Global Power Generation Market - $120 Billion



173 gigawatt energy market

Source: Financial Times Power Generation Industry Survey (2007)

INDIA"S NEW & RENEWABLE ENERGY
Cumulative achievements as on 31.03.2008

No.	Sources / Systems	Cumulative Achievements
1. Power From Renewables (Chart)		
A. Grid-interactive renewable power		
1.	Biomass Power (Agro residues)	605.80 MW
2.	Wind Power	8757.40 MW
3.	Small Hydro Power (up to 25 MW)	2180.84 MW
4.	Cogeneration-bagasse	800.83 MW
5.	Waste to Energy	55.75 MW
6.	Solar Power	2.12 MW
	Sub Total (in MW) (A)	12,402.74 MW
B. Distributed renewable power		
7	Biomass Power / Cogen.(non-bagasse)	95.00 MW
8.	Biomass Gasifier	99.79 MWeq
9.	Waste-to- Energy	26.70 MWeq
10.	Solar PV Power Plants and Street Lights	7.72 MWp
11.	Aero-Generators/Hybrid Systems	0.72 MW
	Sub Total (B)	229.93 MWeq
	Total (A + B)	12,632.67 MW
II.	Remote Village Electrification	3985 villages + 1142 hamlets

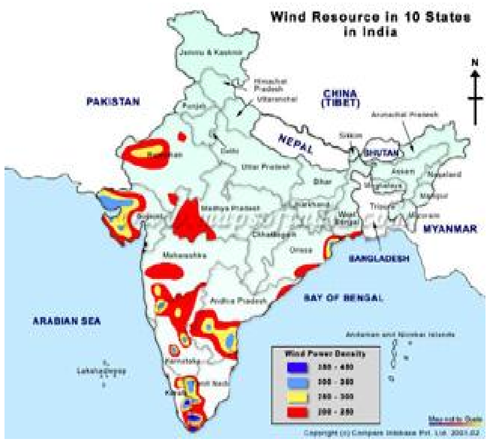
Source: BHEL

Indian Energy Scenario: A New Look

- In India, the importance of the role of renewable energy in the transition to a sustainable energy base was recognized as early as the 1970s.
- At the Government level, political commitment to renewable energy manifested itself in the establishment of the Department of Non-Conventional Energy Sources in 1982, which was subsequently upgraded in 1992 to a full-fledged Ministry of Non-Conventional Energy Sources (MNES – Now MNRES).
- It has been now re-christened as Ministry of New and Renewable Energy, since October 2006.
- Distributed Energy sources are both fossil fuel based as well as New and Renewable Energy based. The later has to make major contribution in Distributed Generation.

Types of Renewable Energy Sources

- Wind Power
  - K.E. of wind to electric energy through gear box and generator
  - 900Watt – 1.2 MW



- Solar Power
  - Direct conversion of sunlight into electricity
  - 50Watt - 1kW for standalone systems
  - 500Watt - 5kW for grid connected

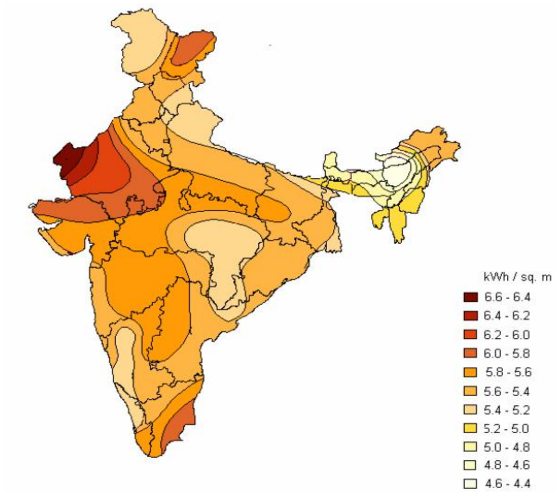


Figure 1 Solar radiation on India
Source: TERI

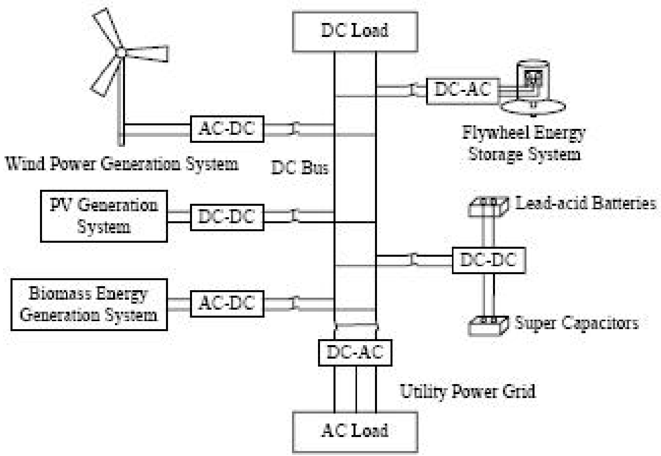
Renewable Sources contd…

- Biomass and Biofuels
  - Produced through direct combustion, anaerobic digestion, gasification, chemical or biochemical conversion.
  - 4 kW – 50 MW
  - Heat and power source. E.g. bagasse

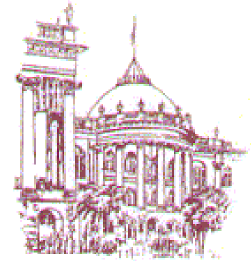
- Hydro
  - Falling water into electrical energy using turbine, generator, water flow controllers etc.
  - Small: 1 kW – 30,000 kW, Mini: 100 – 1000 kW

Renewable Sources contd…

- Hybrid
  - Goes on to build a distributed power generator using all other renewable sources.[3]



Distributed Energy (DE) in India



- Indian DE was born 110 years back!
  - 1899 CESC installed the 1st Power Plant of 1 MW for Calcutta (Kolkata) city
  - 1905 BEST installed 4.3 MW Power Plant for Bombay (Mumbai) for supply to city & its tramways
  - Soon followed other cities
    - **Surat**
    - **Ahmedabad**

- Post Independence, with rapid increase in demand
  - Larger capacity power plants took birth
    - **Lead to decline of DE in India**

CESC : Calcutta Electricity Supply Company
BEST : Bombay Electricity Supply & Tramways Company

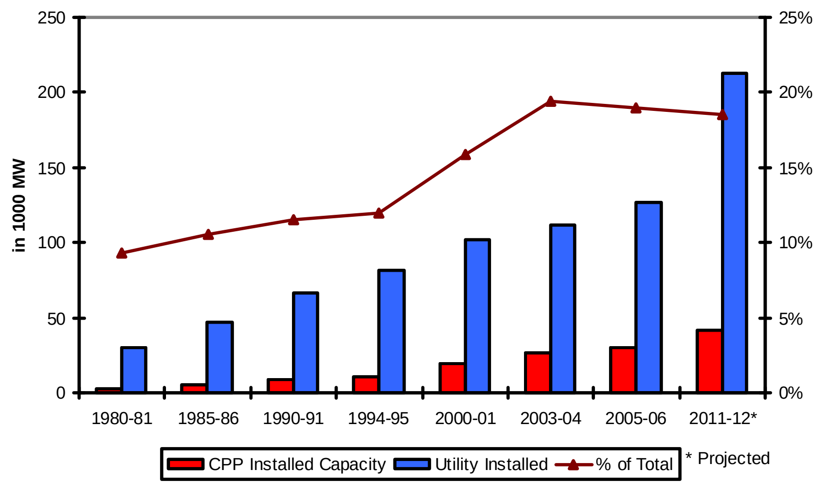
Pics courtesy CESC & BEST

DE in India

- Re-Emergence of DE
  - Captive Power Plants
    - Sugar Cogen
    - Refineries
    - Cement
    - Textile
  - Small hydro in the hilly regions
- Today, about 19% of India's installed capacity is in DE

Photograph courtesy : Arvind Mills Limited & Thermax Limited

Share of CPPs in Installed Capacity



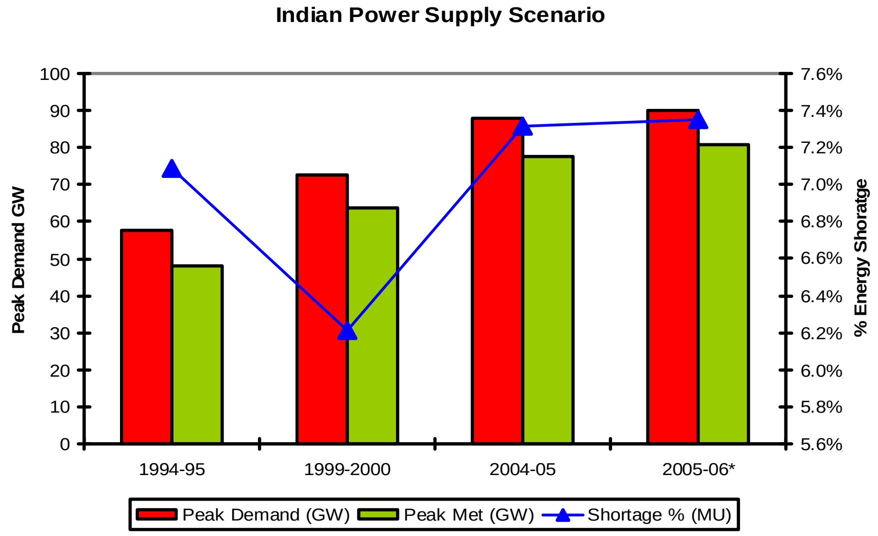
* Projected

DE Opportunities

- Drivers for DE in India
  - Increasing Demand-Supply Gap
    - Poor implementation of projects
    - Inadequate capacity addition
  - Poor availability & reliability
    - Most of small cities & towns get electricity only for 5-6 hrs/day!
    - Rural areas get electricity only for 3-4 hrs/day!
    - Industries have to live with
      - **Frequent interruptions**
      - **Frequencies between 48.5 – 51.5 Hz!**

Presently in India the Peak Demand shortage is 20% average and Energy Supply shortage is 17%!

	India	China
Population	1.13 Billion	1.33 Billion
GDP	$ 1000 Billion	$ 2450 Billion
Installed Capacity	172 GW	606 GW
Cap Addition/Yr	6 GW	70 GW



Source : Ministry of Power, India, India Census,CIA Factbook, Xinhua New agency, Chinese State Regulatory Commission

Distributed Power Opportunity

Year	Peak					
	Demand		Met		Shortage	
	(MW)	% Growth	(MW)	% Growth	(MW)	%
2002-03	81,492	3.9	71,547	3.4	9,945	12.2
2003-04	84,574	3.8	75,066	4.9	9,508	11.2
2004-05	87,906	3.9	77,652	3.4	10,254	11.7
2005-06	93,255	6.1	81,792	5.3	11,463	12.3
2006-07	1,00,715	8.0	87,105	6.5	13,610	13.5
11th Plan						
2007-08	1,08,866	8.0	90,793	4.2	18,073	16.6

Source; DE Management Study

Way Forward for DE in India

India urgently needs to look at DE proactively as one of the options for meeting its energy needs. Now is the time, or it will be too late.

- What needs to be done
  1. Need to influence policy makers about advantages of DE for India in its generation mix
     - Study India's long term generation & distribution needs
     - Design the generation mix based on Central & Distributed Generation
     - Lobby through International agencies
  2. Create 'Buy-in' for DE at
     - Central level
     - State level
     - Village Level

     through seminars, conferences & references for DE

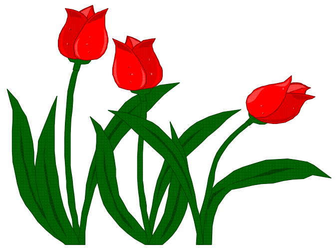
Indian DE Market Developments

- On-site Industrial Power Plants (Captive Power Plants)
  - Encouragement from the government to sale extra capacity
    - Grid / Transcos / Power Traders
    - Direct Users
  - Capacity augmentation to National Generation capacity
- Distributed Generation in Rural markets
  - Use of local resources
  - Hybrid systems of Solar / Biomass / Wind / Micro Hydro systems
  - Owned & operated by the village people
  - Quick to implement & start
  - No need of complicated and expensive distribution network

Conclusion

- DG technology has a huge *potential to help meet the energy requirements* in rural areas.
- It can *lessen demand and peak loads* on the grid, and *generate income* through the sale of excess power back to the grid in rural areas.
- DG *should be promoted in villages* by providing subsidies, sufficient equipments and skilled technicians.

Kiitoksia



Kysymyksiä?