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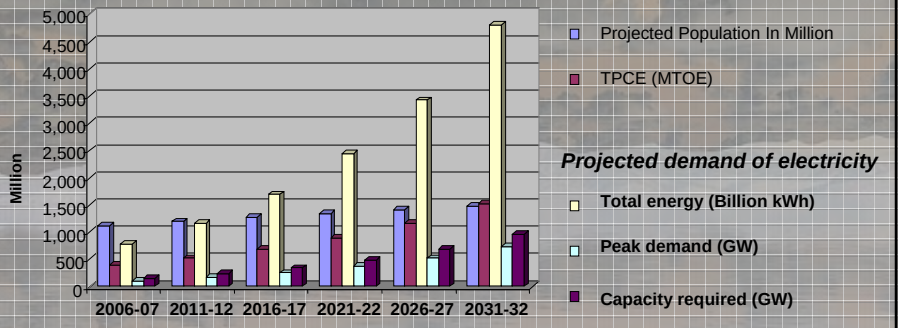
India's Projected Energy Demand



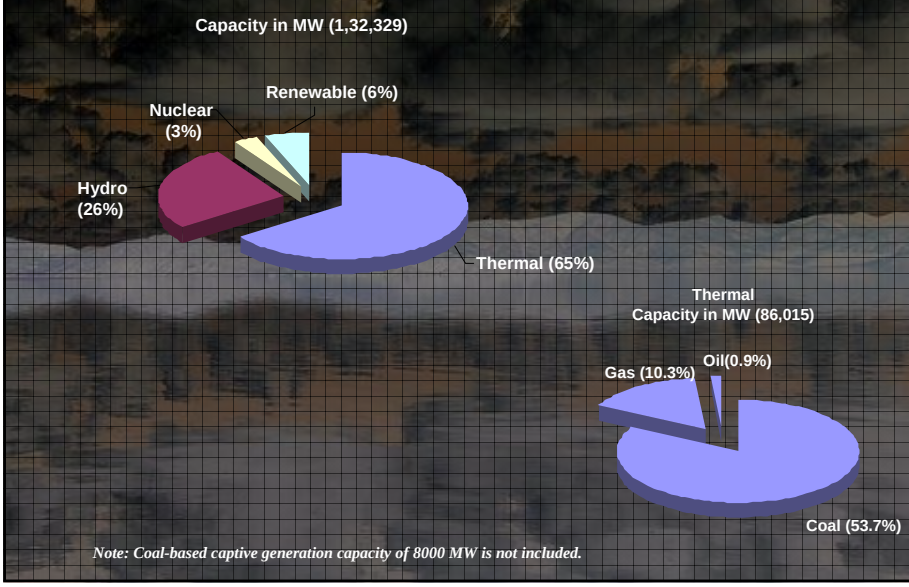
Source: Integrated Energy Policy Report of Planning Commission of India.

India's future 'Energy Vision'

"To reliably meet the demand for energy services of all sectors including the vulnerable households in all parts of the country with safe, clean & convenient energy at the least cost in technically efficient, economically viable and ecologically viable and sustainable ways considering different fuels and forms of energy, both conventional and non-conventional as well as new technologies and emerging energy sources."

Present Electricity Scenario

Installed electricity generation capacity (1st April 2007)

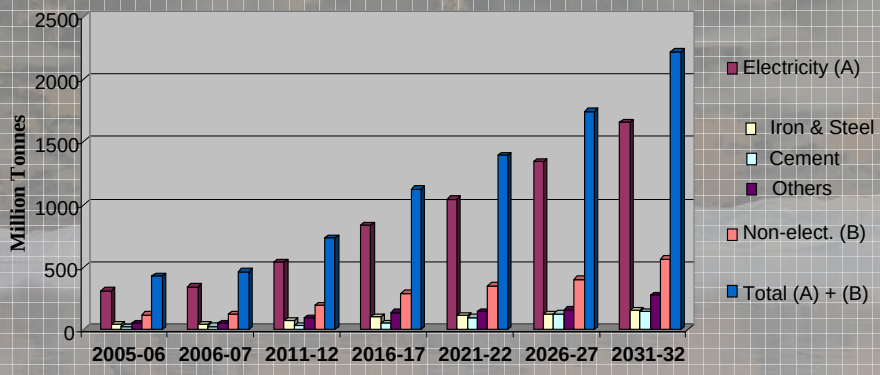


Note: Coal-based captive generation capacity of 8000 MW is not included.

COAL - the main stay of India's electricity supply

- Present electricity generation capacity: 1,35,000 mega watt.
- Projected to increase to 8,00,000 mega watts by year 2032.
- About 50 to 55 % of generation capacity will be coal based.
- Coal consumption is projected to increase 5 fold in 25 years.
- Indian coal deposits are of drift origin; ash content is high.
- Estimated resource as on January 01' 07 is 255 BT
- Out of this 98 BT is of proven category.

Projected industry-wise Coal Demand (Million tonnes)



1. Figures for 2011-12 and 2016-17 are of Working Group for 11th Five Year Plan estimate and for 2031-32 are of the Integrated Energy Policy Report.
2. Figures for intervening years have been extrapolated.
3. Calorific value of 4000 K cal/kg is taken as the basis of these estimates

Overall Quality of Coal Produced

Domestic coal production (in million tonnes)

	Coking	Non-coking	Grades (N.C)			Total
			A-B	C-D	E-F-G	
2005-06	31.39	375.61	26.32	92.67	256.62	407.00
2004-05	30.22	352.39	26.08	94.56	231.75	382.61
2003-04	29.40	331.85	25.97	93.48	212.40	361.25
2002-03	30.19	311.08	25.24	86.46	199.38	341.27
Increase in %	3.97	20.74	4.27	7.18	25.41	19.26

Clean Coal Initiative

Pre-combustion stage

1. Washing is undertaken for reducing ash
2. Coking coal is washed to lower ash content < 17.50%
3. Use of coal of ash content below 34% in some power plants mandated from 1st June 2002
4. Only one third of thermal coal is washed to < 34% ash

Combustion and post combustion stages

1. Centre for Power Efficiency & Environmental Protection established under NTPC to reduce CO_2 emissions and improve performance of coal-fired power plants.
2. Through R & D efforts iron & steel industry has reduced coal consumption per unit of output
3. Cement industry has also achieved similar results through in-house research and development work.

Several R&D and pilot projects undertaken have created awareness on CCT and resulted in better use of Indian coal with emphasis on emission reduction.

Clean Coal Technologies imperatives for India

- **Economic**: hydrocarbons and other fuel options are expensive but domestic coal provides a cheaper and better value option.
- **Energy Security**: to reduce over dependence on imports and domestic coal resources can be tapped.
- **Environment**: to mitigate global climate concerns (CO_2 emissions).

Thrust of the CCT programme

1. Cost effective coal washing, maximising recovery and environmental friendly disposal of rejects.
2. Full utilization of fly ash and bottom ash.
3. Reducing SO_x, NO_x & CO_2 emissions to meet international standards.
4. Maximising energy extraction from coal.
5. A 'Centre of Excellence' to implement CCT Programme through development, acquisition and adaptation of state of the art technologies to suit high ash content domestic coal is under consideration.

National Clean Coal Technology Centre

Establishment of a multi-institutional, multi-disciplinary autonomous and independent institution has been envisaged to identify & pursue:

1. Coal related R&D programmes
2. Major development and demonstration projects.
3. Cover entire coal chain - coal beneficiation, coal conversion, emissions monitoring and control.

And also:

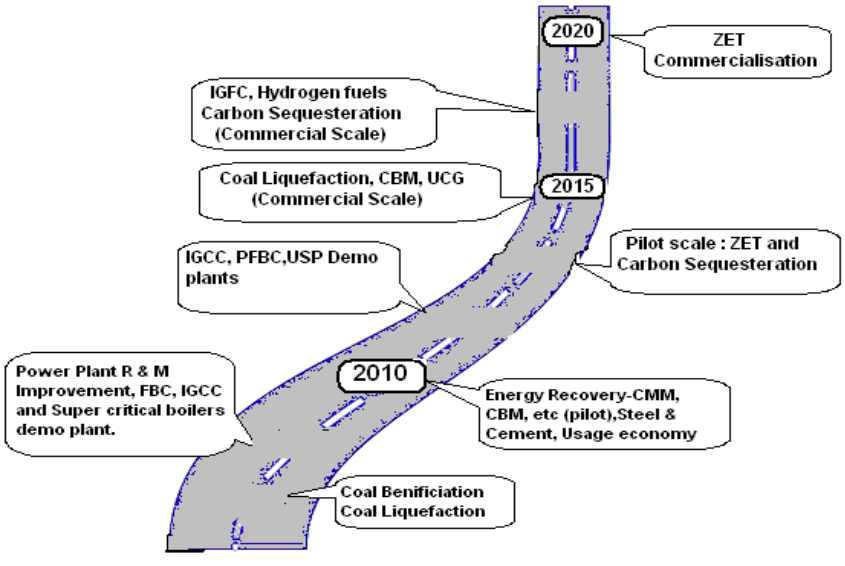
1. To ensure no programme gaps and minimize overlaps.
2. Validation and confirmation of results.
3. Leveraging investments, networking and collaboration.
4. Providing required alignment with US-India FutureGen project and other similar multi-country and multi-institutional projects.
5. Advise government on regulatory aspects.

Clean Coal Technologies for the future

- CO_2 Sequestration
- Coal to liquid and Gas to liquid
- Emission control techniques
- Underground Coal Gasification
- Oxy fuel Combustion
- Coal Bed Methane, Coal Mine Methane
- IGCC
- Super Critical & Ultra Super Critical boilers

These technologies will ultimately lead to near 'zero emission' generation of electricity.

Clean Coal Technology Roadmap



Drivers for Clean Coal Technology initiative in India

1. Future energy demand-supply scenario is heavily COAL dependent.

2. India is the third highest coal consumer in the world and will maintain its position for 40 - 50 years.

3. Compared to hydrocarbon resources, coal is more abundant, sustainable and cheapest domestic fuel for power.

4. Increasing coal usage in power industry will increase CO_2 emissions.

5

Efficiency in utilization of coal is critical for conservation of resource, cost effectiveness and environmental acceptability.

Conventional technologies have limitations.

6

7

CCTs are required for improving efficiency and performance in the integrated Coal-Energy Chain.

8

Global climate change concerns need to be addressed and steps initiated well before the problem becomes unmanageable.

Enhanced Energy Recovery from COAL

Coal Bed Methane:

- 26 CBM blocks (total area 13,600 sq km) already allotted.
- CBM reserve in these blocks is estimated at 1374 BCM and the production potential is estimated to be 38 MMSCMD.
- A demo project under UNDP aegis is in advance stage of development.
- Commercial production of CBM expected to commence soon.

- Out of total inventory of 255 BT, 98 BT are of proven category.
- Only about 25% of the total proven coal reserve is extractable.
- Balance can't be mined due to geo-mining limitations.
- Energy content of such reserve can be harnessed by (UCG).
- Major environmental concerns are: ground water contamination, and subsidence when thick & shallow coal seams are gasified.
- In addition, 123 BT of tertiary coal reserve lies at depth in Gujarat. This can be only be exploited by UCG technology.
- UCG can be combined with CO_2 storage & capture.
- UCG offers global opportunities to leverage R & D, share lessons learnt and best practices so far established.

- **NE region coal deposits have low ash content and high sulphur.**
- **A pilot coal liquefaction plant has been set up and first phase of study has been successfully completed.**
- **Demo unit is under active consideration.**

India's response to Climate Change Concerns

Though there is no binding commitment on CO_2 emission reduction, India is working with international community on various R & D projects for development of new technologies:

- First Asian country to join the US Government Steering Committee for FutureGen Initiative.
- Carbon Sequestration Leadership Forum (CSLF)
- Methane to Market Partnership initiative.
- International Partnership for a Hydrogen Economy.
- India is a full partner in International Thermonuclear Experimental Reactor project.
- India has signed Charter of Asia Pacific Partnership for Clean Development and Climate along with US, China, Japan, Australia and South Korea.

Sufficient mitigation measures are enshrined in the energy policy framework and adequate emphasis is on development of clean sources of energy like hydro, nuclear and non-conventional sources.

India is bound by UN Framework Convention Treaty on Climate Change and Kyoto Protocol.

In per capita terms this works out to 3.5 tonnes of CO_2 compared to 2004 level of over 20 tonnes in the US and a global average of 4.5 tonnes in the same year.

These could rise to around 5 billion tonnes in 2031-32

Per capita CO_2 emission in India is among the lowest in the world.

Future energy demand-supply scenario is heavily dependent on coal.

Environmental sustainability is an important component of India's growth strategy.

Conclusions

Clean Coal Technologies are important in the entire coal-energy chain.

Coal consumption is set to increase five fold in 25 years.

Energy Coordination Committee under the Prime Minister is engaged in identification of actions required to be taken to fully meet country's energy needs, and its social, economic and environmental impact and global climate change concerns.

Though there is no binding commitment on CO_2 emission reduction, India is working with international community on various R & D projects.

National Energy Fund (NEF) with an initial allocation of about USD 225 million for R & D is underway.

R&D in energy sector is critical to augment energy resources and also to promote energy efficiency.

Carbon capture and storage and other challenging clean coal technologies are also being taken up on R & D basis.

First Asian country to join the US Government Steering Committee for FutureGen Initiative.

India is bound by UN Framework Convention Treaty on Climate Change and Kyoto Protocol.

BHEL & NTPC are working together on 125 MWe IGCC project at one of the existing gas-based power plant site.

A well considered CCT road map is under finalisation and steps initiated to establish an institutional infrastructure.

Thank you!