



India



The super fast growth in the Indian economy is loyally being followed by a steep rise in the demand for energy, and electricity in particular. Current growth of electricity demand is around 8-9% every year. India's electricity consumption is at the sixth position globally with 606 units per capita consumption per annum. Soon it will become 1000 units per capita per annum by 2012. Such high demand stems from large population growth, rapid industrialisation and urbanisation and increasing per capita income. Thus there are increasing opportunities for private investors to woo power generation and distribution.

While electric power generation in India is largely done by government sector entities, and is controlled by various central public sector corporations, like the National Hydroelectric Power Corporation, National Thermal Power Corporation and various state level corporations (state electricity boards - SEBs), the transmission and distribution is by the State Electricity Boards (SEBs) or private companies. The current per capita power consumption of electricity comes to around 600 units (KWH) per year. The government has set up a 'Power for all by 2012' goal. As per data (May 2006) an additional power of 19,680 MW will be added within the tenure of the 10th Five Year Plan (2002-2007).

The electricity industry has been greatly influenced by the Electricity Act 2003, which unbundles the vertically integrated electricity



Photo: Bloomberg

supply utilities in each state of India into a transmission utility, and a number of generating and distribution utilities. Electricity Regulatory Commissions in each state set tariffs for electricity sales. The Act also enables open access on the transmission system, allowing any consumer (with a load of greater than 1 MW) to buy electricity from any generator. Significantly, it also requires each Regulatory Commission to specify the minimum percentage of electricity that each distribution utility must source from renewable energy sources.

Supply of power

Since independence in 1947 Indian Power Sector progress has been rapid. From mere 1713 MW of installed capacity in 1950 the capacity at the end of March 2007 rose to 124569 excluding capacity at the end of March 2007 rose to

PROFILE

Capital Area	New Delhi	Installed Capacity	112GW
Population	3.29 million km ²	Population Electrified	87%
GDP	1.095 billion	Main Voltages (kV)	400, 220, 132, 66
Currency	US\$4.294 trillion	Natural Resources	coal, bauxite, natural gas, petroleum, hydropower
	Indian Rupee		

Region	Peak demand (MW)	Availability	Energy requirement (GWh)	Availability
Northern	32,487	29,661	209,137	195,987
Western	35,143	29,117	233,486	205,653
Southern	27,441	25,642	176,037	169,501
Eastern	11,436	10,962	70,547	68,430
North Eastern	1,549	1,388	8,534	7,760
All India, aggregate peak	108,056	96,770	697,741	647,331

124569 excluding capacity of renewable energy. Total generation in April 2006-March 2007 was 659419 GWh in the utility sector.

The percentage of the population provided with electricity is: 475,117 of a total of 593732 villages; 80% of the villages have been electrified; 84% of the rural population have been electrified; 15,096,480 pump sets have been energised; per capita consumption is 619kWh.

Demand for power

Following the most obvious rule of direct proportionality between population, economic development and demand for power, the per capita consumption of electricity increased from 15KWh in 1950 to 619 in 2006-07. The distribution is demonstrated in the table above.

India relies on hydro power, fossil fuels like coal, lignite, natural gas; and nuclear power among its primary fuel resources. From an economically exploitable potential for an installed capacity of 148,700 MW of hydro power, India currently exploits 84,044 MW of power at 60 percent L.F. 94,000 MW of pumped storage hydro projects come from 56 identified sources. The balance of natural reserves are as follows:

- Coal Reserves - 204.7 Billion Tonnes
- Lignite Reserves - 27.5 Billion Tonnes
- Crude Oil - 732 Million Tonnes
- Natural Gas - 660 Billion Cubic Meter
- Uranium - 6700 Tonnes
- Thorium - 363000 Tonnes

As per the most probable plan of action, India hopes to add another 78,601 MW of power in its 11th Five-Year Plan (2007-2012) with 16,553 MW coming from hydro power, 58,668 MW of thermal and 3380 MW of nuclear power.

India imports power from Bhutan. From its total power generation of 406MW (336+70) from two of its projects, Bhutan exports the surplus 270 MW generated, to India.

Transmission and Distribution

Transmission and Distribution services were being generally handled by the State Electricity Boards of the respective states. Recently under the pressure of the Central government, transmission and distribution services have been un-bundled from other aspects such as generation, leading to the formation of the ESCOMS (Electricity Supply Companies) which



Photo: Bloomberg

handle the transmission and distribution of electricity. In some states private enterprises have been allowed to purchase power directly from the generating stations, as in Karnataka.

Several state governments in India provide electricity at subsidised rates or even free to some sections. This includes for use in agriculture and for consumption by backward classes. The subsidies are mainly as cross-subsidisation, with the other users such as industries and private consumers paying the deficit caused by the subsidised charges collected. Such measures have resulted in many of the state electricity boards becoming financially weak.

As per the presentation made by the Secretary (Power), Govt. of India, at the Asia Power Congress held on March 14, 2006 in Singapore, the investment requirements of the government are: USD 50 Billion for generation; and another USD 50 Billion for transmission, distribution and rural electrification. Total investment is projected at USD 100 Billion.

At present 40,000 MW generation capacity is already under execution with an investment of USD 43 billion committed. Public sector investments have been stepped up, but will need to be supplemented through private investments. 100% FDI in all segments of power sector has been allowed. The Law does not distinguish between domestic and international investors. The PFC has been designated as the nodal agency by the GoI for the development of seven Ultra Mega Power Projects, each with a capacity of 4,000 MW with the objective to develop large capacity power projects in India. These projects will have the advantage of economies of scale on account of large capacity at single location, reduction in emissions on account of super critical technology and lower tariff on account of the above and tariff based international competitive bidding adopted for selection of developers.

The 'Letters of Intent' (LoI) for two UMPPs were handed over on 28th December, 2006 to the successful bidders namely, M/s. Globelec Singapore Pte. Ltd (lead) & M/s. Lanco Infratech Ltd. for Sasan UMPP (M.P) and M/s. Tata Power Company Ltd. for Mundra UMPP (Gujarat).

Similar endeavor will be made by PFC for



Photo: Bloomberg

formation of a Shell company for Transmission and Hydro projects to be offered through competitive route as mandated by Government of India.

Energy policy of India

India is keen in decreasing its reliance on fossil fuels to meet its energy demand. The energy policy of India is characterised by tradeoffs between four major drivers:

- Rapidly growing economy, with a need for dependable and reliable supply of electricity, gas, and petroleum products;
- Increasing household incomes, with a need for affordable and adequate supply of electricity, and clean cooking fuels;
- Limited domestic reserves of fossil fuels, and the need to import a vast fraction of the gas, crude oil, and petroleum product



Photo: Bloomberg

- requirements, and recently the need to import coal as well;
- Indoor, urban and regional environmental impacts, necessitating the need for the adoption of cleaner fuels and cleaner technologies. These trade-offs are often difficult to achieve.

The supply of adequate, yet affordable electricity generated and used cleanly is a continuing challenge because expansion of supply and adoption of cleaner technologies, especially renewable energy, often means that this electricity is too expensive for many Indians, particularly in rural areas. In recent years, these challenges have led to a major set of continuing reforms and restructuring. Energy conservation has emerged as a major policy objective, and the Energy Conservation Act 2001, was passed by the Indian Parliament in September 2001. This Act requires large energy consumers to adhere to energy consumption norms; new buildings to follow the Energy Conservation Building Code; and appliances to meet energy performance standards and to display energy consumption labels. The Act also created the Bureau of Energy Efficiency to implement the provisions of the Act. In general, India's strategy is the encouragement of the development of renewable sources of energy by the use of incentives by the federal and state governments. Other examples of encouragement by incentive include the use of nuclear energy (India Nuclear Cooperation Promotion Act), promoting windfarms such as Muppandal, and solar energy (Ralegaon

Siddhi). A long-term energy policy perspective is provided by the Integrated Energy Policy Report 2006 which provides policy guidance on energy-sector growth.

Bio-diesel, wind and solar

The former President of India, Dr. Abdul Kalam, is one of the strong advocates of *Jatropha* cultivation for production of bio-diesel. The President said that out of the 60 million hectares (600,000 km²) of waste land that is available in India over 30 million hectares (300,000 km²) are suitable for *Jatropha* cultivation. Once this plant is grown the plant has a useful lifespan of several decades. During its life *Jatropha* requires very little water when compared to other cash crops. For plan for supplying incentives to encourage the use of *Jatropha* has been implemented.

India's theoretical solar potential is about 5000 TW·h per year (i.e. 600 GW), far more than its current total consumption. India heavily depends on foreign oil - a phenomenon likely to continue until non-fossil / renewable energy technology becomes economically viable in the country. Currently solar power is prohibitive due to high initial costs of deployment. However India's very long-term solar potential could be

State	Generating capacity (MW)
Tamil Nadu	3,457.5
Maharashtra	1,484.9
Karnataka	849.4
Rajasthan	469.9
Gujarat	667.1
Andhra Pradesh	121.8
Madhya Pradesh	57.8
Kerala	2
West Bengal	1.6
Others	1.6



Photo: Bloomberg

unparalleled in the world because, being a densely populated region in the sunny tropical belt, it has the ideal combination of both high solar insolation and a big potential consumer base density. A major factor influencing the regions energy intensity is the cost of energy consumed for temperature control. Since cooling load requirements are roughly in phase with the sun's intensity, cooling from intense solar radiation could make perfect energy-economic sense in the subcontinent, whenever the required technology becomes competitively cheaper. Considering, for example, the costs of energy required for temperature control - a factor squarely influencing the regions energy intensity - cooling from intense solar radiation could make perfect energy-economic sense in the subcontinent, more so, since cooling load requirements are roughly in phase with the sun's intensity. However a thriving market for solar technology can only spawn when the required technology becomes competitively cheaper, i.e. attaining cost parity with fossil of nuclear energy.

At the end of 2007 the installed capacity of wind power in India was 7,113.6 MW,

mainly spread across Tamil Nadu (3457.5 MW), Maharashtra (1484.9 MW), Karnataka (849.4 MW), Rajasthan (469.9 MW), Gujarat (667.1 MW), Andhra Pradesh (121.8 MW), Madhya Pradesh (57.8 MW), Kerala (2 MW), West Bengal (1.6 MW), Others (1.6 MW) Indian states.

The growth of power generating capacity in India is today driven largely by increasing energy needs. The short gestation periods for installing wind turbines, and the increasing reliability and performance of wind energy machines has made the sector a favored choice for capacity addition. The worldwide installed capacity of wind power reached 74,223 MW by the end of 2006. Germany (20,621 MW), Spain (11,615 MW), and the USA (11,603 MW) are ahead of India in fourth position. Tamil Nadu with its 3457.5 MW of generating capacity at the end of 2006 is located near the once impoverished village of Muppandal, supplying the villagers with electricity for work. The village had been selected as the showcase for India's \$2 billion clean energy program which provides foreign companies with tax breaks for establishing fields of wind turbines in the area.

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