CHAPTER 3

HISTORICAL PERSPECTIVE OF POWER SECTOR: A REVIEW

3.1 INTRODUCTION

This chapter attempts to provide a spectrum of Power Industry in the backdrop of India's macro economy. It attempts to review India's energy scenario, taking into account the type and sources of primary commercial energy being used in the economy, as the drivers of India's economic mobility. It identifies sectors and consumption pattern of alternate energy in all the sectors. A review has been made of the ongoing debate as to the causality of energy consumption and economic growth based on empirical analysis.

This chapter seeks to explain the following areas of the Indian Power Industry:

1. India's energy scenario.
2. India's Power Industry in a growing economy and its challenges.
3. Indian energy scenario – Conventional & Renewable.

3.2 ENERGY SCENARIO IN INDIA

Energy sector has been one of the strategic sectors of the Indian economy since independence. The sector has been receiving special significance in terms of policy and reforms only after the first oil crisis of 1973. India's energy production and consumption patterns have undergone substantial change over the last six decades. The policy initiatives taken and the fast technological adaptation have played a considerable role in enhancing the production of energy, whereas the economic growth of the economy which led to faster industrial growth is the factor behind the fast growth and changing pattern of energy consumption. The growth of the economy is directly related to the demand of the energy, more particularly the commercial usage of energy increases with economy moving ahead. This has led to the serious gap between the demand and supply of energy in India. Coal, petroleum and natural gas and power happen to be the important parts of energy sector.

India is the world's second most populous country in the world with a population of around 1.1 billion, and ranks fifth in the world in terms of primary energy consumption, accounting for about 3.5 per cent of the world's commercial energy demand. With a GDP growth rate of around 8% during the Tenth Five Year Plan of the Government (2002-2007), India is currently one of the fastest growing economies of the world.

With 2003-04 as the base, India's commercial energy supply would need to grow from 5.2% to 6.1% per annum while its total primary energy supply would need to grow at 4.3% to 5.1% annually. By 2031-32 power generation capacity must increase to nearly 8, 00,000 MW from the current capacity of around 1, 60,000 MW inclusive of all captive plants. Similarly requirement of coal, the dominant fuel in India's energy mix will need to expand to over 2 billion tonnes/annum based on domestic quality of coal. Meeting the energy challenge is of fundamental importance to India's economic growth imperatives and its efforts to raise its level of human development.

India should pursue all available fuel options and forms of energy, conventional and non- conventional to meet the energy challenges. Further, India must seek to expand its energy resource base and seek new and emerging energy sources. Finally, and most importantly, India must pursue technologies that maximize energy efficiency, demand side management and conservation. Coal shall remain India's most important energy source till 2031-32 and possibly beyond. Thus, India must seek clean coal combustion technologies and, given the growing demand for coal, also pursue new coal extraction technologies such as in-situ gasification to tap its vast coal reserves that are difficult to extract economically using conventional technologies.

The economic growth crucially depends on the long-term availability of energy from sources that are affordable, accessible and environmental friendly. The country, although rich in coal and abundantly endowed with renewable energy in the form of solar, wind, hydro and bio-energy has very small hydrocarbon reserves (0.4% of the world's reserve). India, like many other developing countries, is a net importer of energy, more than 25 percent of primary energy needs is being met through imports mainly in the form of crude oil and natural

gas. The rising oil import bill has been the focus of serious concerns due to the pressure it has placed on scarce foreign exchange resources and is also largely responsible for energy supply shortages. The sub-optimal consumption of commercial energy adversely affects the productive sectors, which in turn hampers economic growth.

The pattern of energy production, coal and oil account for 57 percent and 34 percent respectively with natural gas, hydro and nuclear contributing to the balance. In the power generation front, nearly 62 percent of power generation is from coal fired thermal power plants and 70 percent of the coal produced anually in India has been used for thermal generation.

The distribution of primary commercial energy resources in India is quite skewed. Nearly 70 percent of the total hydro potential is located in the Northern and North-eastern regions, whereas the Eastern region accounts for nearly 70 percent of the total coal reserves in the country. The Southern region, which has only 6 percent of the total coal reserves and 10 percent of the total hydro potential, has most of the lignite deposits occurring in the country.

The pre-reform period witnessed that the commercial energy sector was totally regulated by the government. The economic reform and liberalization, in the post 90s, has gradually welcomed private sector participation in the coal, oil, gas and electricity sectors in India. Energy prices in India have been under an administrated regime with subsidies provided to meet certain socio-economic needs of the public. This has led to distortion and inefficiency in the use of different sources of energy. The government has taken serious steps to deregulate the energy price from an Administered Price Mechanism (APM) regime. The prices of all grades of coal and petroleum products have already been deregulated. In the electricity sector, most of the State Electricity Boards (SEBs) have started taking reform measures for the development of the sector. In the case of power sector, reforms were introduced in the early 1990's and, through a process of learning; India has finally reached a stage where it has enacted the Energy Conservation Act in 2001 and the Electricity Act in 2003.The growth of the power sector over the period has been explained as below.

3.3 PRE INDEPENDENCE POWER SCENARIO

In the beginning, power development in India started with a number of small stations owned by private industries, local bodies or government establishments. Before independence power supply was mainly in the hands of private sector and restricted to urban areas only. A small beginning was made in 1897 when a small hydro electric station of 130 KW capacity was set up at Sidropong near Darjeeling. This technical marvel continues to generate power even after over a century. However, commercial production (steam power plant) and distribution started in 1889 in Calcutta (now Kolkata), some 17 years after New York and 11 years after London. Calcutta Electricity Supply Company (CESC) gave Calcutta its first electric power supply.

By 1900, the total installed capacity in the country reached 1.1 MW (1 MW thermal and 0.1 MW hydro). The hydroelectric project at Sivasamudram was commissioned in 1902 to harness the potential of the Cauvery River with an initial installation of 4 MW to provide electricity to the Kolar Gold Fields. The transmission line associated with this project was 150 km long.The capacity of this plant was gradually increased to 42 MW by the early 1930s. The Tata Power Company, a private utility, built its first large power station of 50 MW at Khopoli in 1914. Besides these, a large number of small diesels, thermal and hydro plants also came up in towns of princely states.

Before India's Independence, its electricity sector was decentralized. Electricity was generated and supplied locally by private entrepreneurs, enterprising municipalities, and provincial governments. TheTata hydroelectric project in Khandala supplied power to Bombay while the Mettur dam on the Cauvery supplied power to Madras Presidency. However, the emphasis was on supply to large urban concentrations, and there was little coordination or cooperation between different suppliers. The first legislation in this context was passed in 1877, providing for the protection of person and property, from injury and risks, attendant to the supply and use of electricity for lighting and other purposes. This Act was repealed and replaced by the Indian Electricity Act, 1903.

It was clearly recognized to be a somewhat tentative measure that would be amended with experience. The Indian Electricity Act, 1910 (hereafter, the 1910 Act) was passed by the Legislative Council on 18 March 1910 and came into force with effect from 1 January 1911.The new Indian Electricity Act, 1910, to amend the law pertaining to the supply and use of electrical energy, left the granting of all licenses in the hands of the local government, laying down some rules regarding safety. It was a comprehensive piece of legislation to regulate the generation, supply and use of electricity and dealt with licensing, regulation and safety, giving considerable authority to the provincial governments and is applicable to the whole of India except the state of Jammu and Kashmir. The 1910 Act deals with the grant of licenses to persons who wish to engage in the business of supply or transmission of energy and also for approval to non-licensees to undertake transmission, supply, and use of energy. This enabled several firms to obtain licensees for generation and distribution of power.

The 1910 Act has five parts. Part I deals with the preliminaries including definitions. Part II deals with the grant of licenses for supply of energy and matters related thereto including the performance and functioning of the licensees. Part II A deals with licensing of transmission. Part III deals with the supply, transmission, and use of energy by non-licensees. Part IV deals with general matters including those concerning the use of electricity by institutions such as railways and aerodromes, the constitution of advisory boards, etc.

By the year 1947, electricity generation and distribution of electricity mostly by the private companies grew from 1.1 MW to 1363 MW as shown in Table 3.1.

Table 3.1: Growth of Power Sector Generating Capacity in India before Independence (MW)

As on	Installed Capacity in MW						
	Utilities					Captive	Total
	Thermal	Hydro	Nuclear	Wind	Total		
1915	4	103	---	---	107	n.a.	n.a.
1918 (End of First World War)	27	103	---	---	130	n.a.	n.a.
1945 (End of Second World War)	627	442	---	---	1069	n.a.	n.a.
1947	854	508	---	---	1362	n.a.	n.a.

Source: Electricity India Vision 2027 by Virendra K. Sharma

3.4 INDIAN POWER SECTOR till 1990: A PRE-REFORM PROFILE

Although electric power generation in India on a commercial basis is almost a century old, substantial power development efforts began only after independence in 1947. The Government of India enacted the Electricity (Supply) Act, 1948, which came into force on 10 September 1948, was passed to facilitate the establishment of regional coordination in the development of electricity transcending the geographical limits of local bodies.

The 1948 Act aimed to ensure coordinated development of electricity in India on a regional basis. The government felt that this was a matter of increasing importance for post-war reconstruction and development. Further, it was also felt that the absence of a coordinated system, in which generation is concentrated in the most efficient units and bulk supply of energy centralized under the direction and control of one authority, was another reason that was impeding the healthy and economical growth of electrical development in the country. It was also apparent that if the benefits of electricity are to be extended to semi-urban and rural areas in the most efficient and economical manner consistent with the needs of an entire region, the area of development must transcend the geographical limits of a municipality, a cantonment board, or a notified area committee, as the case may be.

It was therefore necessary that the appropriate governments should be vested with the necessary legislative powers to link together under one control electrical development in contiguous areas by the establishment of what is generally known as the 'grid system'. It was under these circumstances that the 1948 Act was passed to facilitate the establishment of this system in newly licensed areas and to control the operations of existing licensees so as to secure fully coordinated development.

3.4.1 Growth of Power sector in Generation and Transmission

(a) Growth of Power Sector Generating Capacity during Five Year Plan in India

Commencing with a meagre installed capacity of 1300 MW during the year of national independence in 1947, the Indian power sector has made substantial

growth over decades. By the year 1990 the installed capacity grew to the tune of 75,000 MW and the total electricity sale was about 289,440 million units. The annual commercial loss of the SEBs during the year 1990-91 was about 40,210 million Indian rupees. The non-scientific tariff and poor techno-commercial management were identified to be the major reasons for this loss (Planning Commission, 2001b). The average unit cost of electricity production during 1990 was 108.59 paise whereas the average revenue realized through tariff was 81.80 paise only. Huge percentage of unused supply due to poor operating load factor of thermal stations (about 50%), non comprehensive energy accounting, high level of theft and pilferage of electricity, subsidy to agriculture sector, cross subsidy to domestic sector, etc., have been cited as the key factors of the defective functioning of the SEBs in India during this period (World Bank, 1998; Kannan and Pillai, 2000). Thus, there was a general approved consensus that maintaining this status quo will be detrimental to the economy of the nation and may shatter the sector itself.The growth of Power Sector generating capacity in India up to 1990 (MW) is shown in Table 3.2.

Table 3.2: Growth of Power Sector Generating Capacity in India up to 1990 (MW)

Installed Capacity	74,698MW
Hydro-thermal Ratio	21:71
Gross Annual Generation	289,440 million KWh
Energy Deficit	7.7%
Peak Power Deficit	18.8%
Per capita Consumption	271KWh
T&D loss	22.9%
Plant Load factor of thermal stations	53.9%
Annual Commercial Loss of Electricity	40,210 million rupees
Average Production Cost of SEBs	108.58ps/KWh
Average Tariff	81.80ps/KWh

Source: Ministry of Power, Govt. of India

Since independence, India has taken rapid strides in the development of the Power Sector both in terms of enhancing power generation and in making available power to widely distributed geographical boundaries. Still a large

number of people in our country have no access to electricity and a large number of villages are still out of reach of electrical power. Electricity being the prime mover of economic development, demand for electricity continues to grow relentlessly and new horizons have to be explored to fulfill it. The real growth in power sector started in 1950s with the introduction of separate allocation for power development in various Five Year Plans.

The first Five Year Plan was launched in 1951 and electrical power generation which was recognized as a major input for economic development of the country was given a high priority. The first two plans envisaged mainly development of hydro power and emphasis was laid on multi-purpose projects which provided irrigation, flood control and power generation. This period marked the advent of some of the major-hydro-electric projects in the country such as Hirakud in Orissa, Rihand in Uttar Pradesh, Bhakra complex in Punjab, Koyna in Maharashtra and Sharavati in Karnataka. The failure of monsoon for two or more consecutive years and need to utilize water of reservoirs during drought years essentially for irrigation brought out the need for planning for generation of power from thermal power sources. The third and subsequent five year plans not only provided generation of power from steam power stations but also on the rapid expansion in the installed capacity of power plants.

The intervention of Central Government in power generation and transmission started in 1948 when Damodar Valley Corporation (DVC) was formed to facilitate the economic and industrial growth of Damodar Valley comprising several districts of Bihar, Jharkhand and West Bengal. The DVC is a joint venture by the Government of India, West Bengal and Bihar. Likewise Bhakra Management Board (BMB) was constituted in 1966 for administration, maintenance and administration of Bhakra Nangal Hydro Project. Later on it renamed as Bhakra Beas Management Board (BBMB) to coordinate hydro projects on river Beas.

The need for development of electrical power at an ever increasing rate brought in several changes in the planning of power stations including unit sizes. A 30 MW steam turbine generator was considered very large at the

beginning of 1950's. The unit size increased to 60 MW and then to 120 MW in the 1960's. At the beginning of 1970's installation of 200 MW was planned in the power systems and the first 200 MW unit was commissioned at Obra in Uttar Pradesh in December, 1977.There were several 200 MW units which were planned in the later part of 70's and which came into operation during the Sixth Plan period. The first 500 MW unit in the country went into operation at the end of 1983 in the Tata Electric Company thermal power station at Trombay. The installed capacity in the country at the end of the Seventh Plan period (March 1990) reached to 63636 MW from 1713 MW in 1950. In about four decade since the planning started in the country, the installed capacity has gone up about thirty times.

For most of this period the country followed the practice of developing capacity through central planning during successive five year plans. Rarely however, did the actual capacity addition matched with the targets fixed. Due to inherent unviable functioning of the Electricity Boards during these years, the sector could not generate enough resources to found its investment requirements. The capacity addition by the year 1990 (at the end of 7th plan) is as follows (Table 3.3)

Table 3.3: Plan Wise Growth of Electricity Sector in India up to 1990 (MW)

As on	Hydro	Thermal	Nuclear	Total	Length of T&D lines (Ckt. Kms.)	Per capita Consumption $(KWh)
31.12.50	560	1153	0	1713	29271	18.23
31.03.56	1061	1825	0	2886	85427	30.9
31.03.61	1917	2736	0	4653	157887	45.9
31.03.66	4124	4903	0	9027	541704	73.9
31.03.69	5907	7050	0	12957	886301	97.9
31.03.74	6966	9058	640	16664	1518884	126.2
31.03.79	10833	15207	640	26680	214919	171.6
31.03.80	11384	16424	640	28448	2351609	172.4
31.03.85	14460	27030	1095	42585	3211956	228.7
31.03.90	18307	43764	1565	63636	4407501	329.2

Source: Central Electricity Authority, Govt. of India, July 2007.
$ As per U.N Methodology (Gross Electrical Energy Availability/Population)

There has been a constant endeavor to upgrade the coal-to-electricity conversion technology which initially used low capacity units in 50-60 MW range in the fifties to the present 660 MW range unit size and 800 MW in near future. There has been a corresponding improvement in the steam cycle parameters resulting in better plant heat rate and the increase in unit size bringing economies of scale. The new generation technologies, referred to as Clean Coal Technologies (CCT) are environmentally cleaner and in most cases result in higher efficiency.

The units installed during 1947-1950 were of small size ranging from 10 to 30 MW. Bokaro TPS of DVC became the first TPS to install units of 57.5 MW which were the largest unit size prevailing during 1951-60. During 1971-1980 was the era of large capacity addition through indigenously built equipments. The first indigenously built 100 MW unit was commissioned at Badarpur TPS in 1973. The first 110 MW unit was commissioned at Kothagudem in August, 1974 and first 200 MW unit (LMZ design) commissioned at Obra TPS, UPSEB in December, 1977.

The first indigenously built unit of 210 MW capacity was installed in Korba West TPS of MPEB in the year 1983. This was followed shortly by installation of first 500 MW unit at Trombay TPS of Tata Electric Co. in 1984.The 500 MW units were added in a big way during the period 1991-2000 and also fluidized bed combustion boilers were introduced for very low grade coal, washery rejects and fuels with high Sulphur.

But upto 1974 when India's installed generation capacity was 16,664 MW, the SEBs were almost solely responsible for power generation, transmission and distribution within their states. An assessment of the planned growth upto 1974 indicates that with the uneven distribution of primary energy resources such as coal and hydro power, power development with only states as spatial units, would result in large inter-state imbalances. The need for quicker and greater capacity addition to cope with the increasing demand of electricity led the Central Government to assume a leading role in large scale power generation as a matter of policy. In 1976, through an amendment of the Electricity Supply Act, the Government of India decided to play a leading role in large scale power

generation and set up Central Sector undertakings. Thus two Central Sector power generating agencies - NTPC, NHPC were established in 1975 and later joined by Nuclear Power Corporation, to generate and supply bulk power to SEBs. The capacity addition till1990 is as follows (Table 3.4).

Table 3.4: Plan Wise Growth of Electricity Sector in India (up to 10th Plan)

As on	Installed Capacity (MW)	Per capita Consumption $(KWh)
31.03.56	2886	30.9
31.03.61	4653	45.9
31.03.66	9027	73.9
31.03.69	12957	97.9
31.03.74	16664	126.2
31.03.79	26680	171.6
31.03.80	28448	172.4
31.03.85	42585	228.7
31.03.90	63636	329.2

Source: Central Electricity Authority, Govt. of India

In addition to these, central government also created special purpose generating companies as joint ventures with various states. These are:

- Tehri Hydro Power Corporation
- Nathpa - Jhakri Power Corporation now renamed as Sutlaj Jal Vidyut Nigam Limited.
- North - East Electric Power Corporation (NEEPCO)
- Neyveli Lignite Corporation and N.H.D.C

Rural Electrification Corporation Ltd., (REC) was incorporated in 1969 to finance rural electrification works. Power Finance Corporation (PFC) was incorporated in 1986 as prime development financial institution for funding the growth and development of power sector. In 1989, Power Grid Corporation of India Limited (PGCIL) was hired off from NTPC to be exclusively in charge of inter-state High Voltage transmission network.

(b) Hydro Thermal Mix

Ideally the generation of hydro-thermal mix for the country has been planned to be 40:60 taking into account availability of resources, reliability, and

demand pattern. Hydro-power is very attractive proposition for its cost (which becomes very low after payment of debt – power generation from Bhakra system costs only 8 paise per KWh).It also allows flexibility in operation to meet rising peak demand. Besides many of the storage projects for hydro power generation also meet the requirement of water for irrigation, drinking water and industrial purposes.

Capacity addition in hydro sector could not meet the expectations for many reasons such as environmental concerns, organized resistance to storage projects which enhanced risks during construction etc. As a result, the country's hydro thermal mix deteriorated to 21:71 by 31.12.1990.

(c) Efficiencies during Construction and Operation

Plant Load Factor (PLF) and availability are important measures of operation efficiency in thermal power stations which was 53.8% in 1990. Over the last few years there has not been any commendable achievement in improving the PLF and availability of thermal generation in the country.

Table 3.5: All India PLF of Thermal Power Stations (Coal and Lignite Based) by 1990

Year	PLF(%)
1985-86	52.4
1986-87	53.2
1987-88	56.5
1988-89	55
1989-90	56.5
1990-91	53.9

Source: Central Electricity Authority, Govt. of India, July 2007.

PLF will be actually much higher than the reported figure if one takes out many thermal stations of State Government (e.g. of Bihar, Assam) which are practically defunct but continue to be included in total capacity. Despite substantial capacity addition, the country faces shortage of power from moderate to acute levels varying from state to state.

(d) Captive Generation

As far as the Captive Power Generation in the country is concerned, there was a severe power shortage in Indian industry which led to setting up large captive facilities. This was imperative for continuous process industry (Steel, Cement, Aluminium, Ferro alloys etc.) as also the industry which is very sensitive to the quality of power (I.T. Sector) to have in-house power generation as the quality and quantity of power supplied by utilities was unreliable. The capacity addition upto 1990 (at the end of 7th plan) was as follows (Table 3.6).

Table 3.6: Growth of installed Generating Capacity of captive power plants in India-Mode wise (1MW & Above) up to 1990 (MW)

As on	Hydro	Steam	Diesel@	Gas	Sub-Total	Railways	Total
31.12.50	-	-	-	-	587.85	0.00	587.85
31.03.56	-	-	-	-	759.65	0.00	759.65
31.03.61	-	-	-	-	1001.37	0.00	1001.37
31.03.66	-	-	-	-	1082.36	0.00	1082.36
31.03.69	-	-	-	-	1277.47	0.00	1277.47
31.03.74	-	-	-	-	1732.70	0.00	1732.70
31.03.79	2.61	1949.23	559.17	44.27	2555.28	62.31	2617.59
31.03.80	2.61	2021.61	720.58	54.27	2799.07	60.44	2859.51
31.03.85	2.91	2803.18	2077.06	155.31	5038.46	81.80	5120.26
31.03.90	3.60	4822.85	2754.48	425.51	8006.44	109.29	8115.73

@ Includes Wind
-Breakup not Available
Source: Central Electricity Authority, Govt. of India, July 2007.

It may however be noted that captive generation is a sub optimal option in as much as it is costly and defeats the advantages of economies of scale. SEBs have so far been able to face the challenge posed by captive plants by levying various charges under different heads. Lack of sufficient investment in distribution over these years has rendered the network heavily overloaded.

3.4.2 Power Transmission

Transmission plays an important role in carrying power from generation to load centers. In a country like India where hydro potential is located mostly in

Himalayan region while coal is found in central India, the necessity of having a robust transmission network cannot be overstated. For the purpose of planning and construction of transmission networks, the country is organized in 5 regions viz. North, South, East, West and North East. Powergrid Corporation of India Ltd., a Central Government undertaking owns most of the high voltage inter-state transmission lines. With the emphasis on setting up of large power houses at pithead the need for inter-regional transfer of power became necessary.

The physical growth of the network was accompanied by substantial advancement in technology. From localized DC supply by CESC in the late nineteenth century and by BEST in the early twentieth century, a gradual shift occurred towards AC supply. Over the decades, the five-year period 1975-80 saw the maximum growth in T&D line length (about 55%). On the transformer capacity front, the period 1965-70 witnessed the highest growth, of over 142 %.

Rural electrification made great progress in the 1980s; more than 200,000 villages received electricity for the first time. By 1990 around 84 per cent of India's villages had access to electricity. Most of the villages without electricity were in Bihar, Orissa, Rajasthan, Uttar Pradesh, and West Bengal. Substantial progress has also been made in the electrification of villages and by 2007 nearly 80% villages have been electrified. The growth of T&D Lines upto 1990 is as follows (Table 3.7).

Table 3.7: Plan Wise Growth of T&D Lines in India (up to 1990)

As on	Length of T&D lines (Ckt. Kms.)	Per capita Consumption $(KWh)
31.03.56	85427	30.9
31.03.61	157887	45.9
31.03.66	541704	73.9
31.03.69	886301	97.9
31.03.74	1518884	126.2
31.03.79	214919	171.6
31.03.80	2351609	172.4
31.03.85	3211956	228.7
31.03.90	4407501	329.2

Source: Central Electricity Authority, Govt. of India
$ As per U.N Methodology (Gross Electrical Energy Availability/Population)

3.4.3 Transmission System Development and Technology Trends

The Indian power sector has been continually governed by the technological developments in all the spheres of generation, transmission and use of electricity. Any action plan for growth of this basic infrastructure sector has to be integrated with the technological changes that are taking place globally.

At the time of Independence, power systems in the country were essentially isolated systems developed in and around urban and industrial areas. The highest transmission voltage at the time (1947) was 132 KV and the lines at this voltage were very few. Post- independence, India witnessed a spectacular growth in the transmission system, both in size and quality, in tandem with the growth of power generation capacity. The SEBs were responsible for the development of generation, transmission, distribution and utilization of electricity in their respective states. The objective of development was to have a coordinated process towards integrated system. Thus started the process of development of transmission and distribution system for extension of benefits of electricity to semi-urban and rural areas.

While the developments in the power generation field have been significant, particularly in terms of unit sizes, there have been equally significant developments in the areas of power transmission. The growth in transmission system is characterized by the physical growth in the network as well as introduction of higher transmission voltages and new technologies for bulk power transmission. Towards the later part of 1950's, 220 KV transmissions in conjunction with some of the power projects in the then composite states of Punjab and Bombay were planned. In the process 220 KV remained as the main transmission voltage throughout 1960's and it was at the beginning of 1970's that 400 kV was envisaged as the next higher transmission voltage in the country. The Obra- Sultanpur 400 KV line in Uttar Pradesh which was commissioned in 1977 was the first 400 KV line in the country. HVDC back-to-back link in 1989, 500KV, HVDC bi-pole line in 1990 and 765 KV transmission line from 2000 onwards came into existence.

3.4.4 Unbundling of Generation and Transmission in Central Sector

The development of power sector on the basis of "regional self sufficiency" resulted in lopsided growth with sub-optimal utilization of scarce national primary energy sources. The Indian Government thus decided to form a National Transmission Grid for integrated operation, optimal development and utilization of hydro and thermal resources as well as reliability of electricity supply. National Power Transmission Corporation was formed in 1989 which was subsequently renamed Power Grid Corporation of India.

The regional transmission systems were further strengthened in 1990s with the establishment of large hydro and super thermal power stations in the central sector in various regions along with extensive network of Extra High Voltage transmission (EHT) lines and High Voltage Direct Current (HVDC) links. In order to enable exchange of power between the contiguous regions, construction of a number of interstate and inter-regional transmission links was taken up. Over the years the regional grids have grown and at present all the contiguous regions have interconnections through AC and HVDC back-to- back systems with the ultimate objective of achieving a national grid.

The supply-demand gap of electricity in India is consistently widening over years and most of the States in India are facing heavy electricity shortage. Typical of most of the developing countries, the power 'crisis' in India also has been identified to have arisen out of serious inadequacies in the structure and performance of the power sector. Functional inefficiency of Government owned SEBs, non-rationality at all phases of trading of energy (including tariff setting, metering, billing and revenue collection), inability of the utilities to mobilize adequate resources for capacity expansion and modernization, etc., have been cited as the major reasons for the crisis (Baijal, 1999; Planning Commission, 2001a, b; Parikh and Radhakrishna, 2002). It was under these circumstances, Government of India, in the year 1991 decided to appropriately restructure the Indian power sector in a phased manner.

The prime objective of the comprehensive reform process was to transit the power sector into a technically efficient and commercially profitable energy

trading sector. The government felt that it is not possible to legislate for this purpose within the framework of the 1910 Act, which was conceived for a very different purpose. Thus, on the broad lines of the Electricity (Supply) Act, 1926 in force in the United Kingdom, an appropriate legislation (1948) Act which would enable provincial governments to set up suitable organizations to work out 'grid schemes' within the territorial limits of the province was enacted. It provided for the rationalization of the production and supply of electricity, and generally for taking measures conducive to the electrical development of the Provinces of India. It also enabled the creation of SEBs (State Electricity Boards) for promoting the coordinated development of generation, supply, and distribution in the provinces and other areas of the country. It aimed to link together less than one control, electrical development in contiguous areas by establishing "Grid-system" and constitution of semi-autonomous bodies (State Electricity Boards) to administer the grid-systems on quasi-commercial lines. With this, private companies were discouraged from setting up of power plants.

The SEBs came to be established in various states pursuant to a mandate contained in Section 5 of the 1948 Act. The CEA was established as a part-time body in 1951 but most of its functions were being discharged by Central Water & Power Commission (Power Wing), established in 1944, until 1974 when the CEA became a full time body consequent on the bifurcation of the Central Water & Power Commission. The CEA (Central Electricity Authority) was constituted to develop sound, adequate, and uniform national power policies to coordinate the activities of planning agencies in relation to the control and utilization of national power resources. Subsequent amendments introduced significant additions and changes.

Even though electricity was in the concurrent list of the Constitution, the Electricity Supply Act, 1948 provided for a more or less exclusive role for the States in the development of the electricity industry. The responsibility of the centre was confined to planning, coordination and regulation at the national level. However, nuclear power and power generation from lignite remained entirely under the control of the Central Government. Recognizing the

importance of electricity in development plans, many States created individual State Electricity Boards (SEBs). By the late 1950s, seventeen SEBs were created, nine states and Union Territories started undertaken undertaking electricity supply departmentally.

It was thought by policy makers that as the private players were small and did not have required resources for the massive expansion drive, the production of power was reserved for the public sector in the Industrial Policy Resolution of 1956. Since then, almost all new investment (barring those by existing 'Licensees') in power generation, transmission and distribution has been made in the public sector. Most of the private players were bought out by State Electricity Boards. All but a few private licensees like Tata Electric Co. (TEC), Calcutta Electric Supply Company (CESC), and Bombay Suburban Electricity Supply (BSES) now Reliance Energy and Ahmadabad Electric Supply Company (AEC) were taken over by the State Electricity Boards.

The Indian Electricity Rules, 1956 were issued in the exercise of the power under the 1910 Act (Section 37) providing for procedural aspects such as obtaining of licenses and for matters such as the general safety requirements, the general conditions relating to the supply and use of electricity and matters connected with the electric supply lines, overhead lines, electric traction, etc.

REBs (Regional Electricity Boards) comprising part-time members were constituted in 1964 to promote regional coordination and operation of power supply by a 1964 office order of the Government of India (inserted into the Act in 1991 by an amendment). These REBs had as members, the chairmen of the SEBs, while members of the SEBs ran the technical committees. The REBs administrative head was an officer on deputation from the CEA and was, therefore, also subservient to it. Private licensees did not find place in the REBs.The Salient features of selected regulations in India (upto 1991) as shown in Exhibit No. 3.1.

Exhibit No. 3.1: Salient features of selected regulations in India (upto 1991)

Regulation	Salient Features
Central Acts and Rules Relating To Electricity	
The Indian Electricity Act, 1910	- Issue of licenses - Regulatory and safety aspects - Rules for non licensees - Guidelines for electrical works - Guidelines for determination of purchase price and charges
The Electricity Supply Act, 1948	- Formal establishment of SEB and Generating Companies - Power and Duties of the above entities with guidelines for works and trading procedure - Approval process for generating stations - Guidelines for licensee tariff - Procedures for Finance, Accounts and Audit
The Indian Electricity Rules, 1956	- Mainly technical guidelines and rules for works
The Central Electricity Authority Rules, 1977	- Defining the functions and duties of CEA
The Central Electricity Authority Regulations, 1979	- Lays down desired operational details for smooth functioning of CEA
The Electricity Wires, Cables, Appliances And Accessories (Quality Control) Order, 1993	- Quality control - Certification of manufacturers - Guidelines for storage, sale and distribution
Policy on Private Participation in Power Sector, 1991	- The main objective is to attract private investment - Up to 100% foreign equity participation permissible
The Electricity Laws (Amendment) Act, 1991	- Increased authority of the regional load dispatch centers (RLDC) - Grid Integration
The Electricity Laws (Amendment) Act, 1998	- Formal establishment of central and state transmission utilities as public companies - Independent standing for transmission
The Electricity Regulatory Commissions Act, 1998	- Establishment of CERC with provision for establishment of SERCs. - Guidelines for tariff and guidelines for supply and service
Fee for testing and Inspection, GOI Order, 1998	- Standardizing fees for testing and inspection by electrical inspectors
Other Acts and Rules Affecting the Electricity Sector	
The Atomic Energy Act, 1962	- Principal act for regulation of atomic energy - Fix rates and regulate supply of electricity from atomic stations
The Consumer Protection Act, 1986	- Protection of consumer's interests - Establishment of consumer councils and other authorities for settlement of disputes
The Electricity (Supply) Annual Accounts Rules, 1985	- Provision for establishment of a Bureau of Energy efficiency -Implementation guidelines

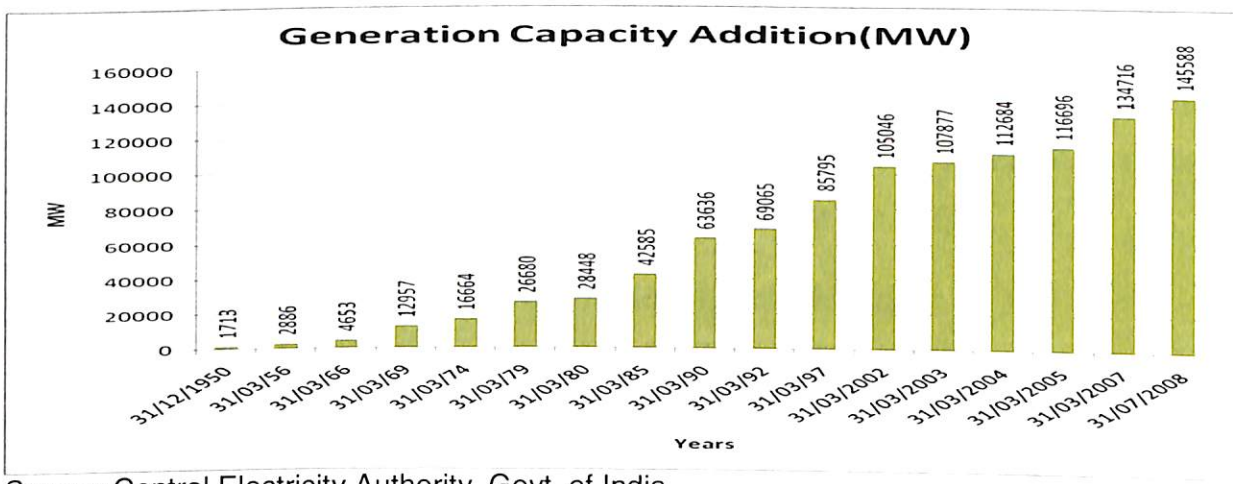
3.5 STATE OF INDIAN POWER SECTOR IN 1990'S AND BEYOND

a. Generation Capacity

The reforms in Power Sector were initiated in 1991 with opening of generation for private sector investment. Private participation in the Power Sector was seen as an effective remedy for the underlying problems. Through various amendments the government provided a legal framework for the entry of private sector in 1991. RLDCs (Regional Load Dispatch Centers) were also established at the same time to operate the power system in a region, ensure regional grid security, and integrate with power systems of other regions and areas. Tariffs in cases of interregional movements and transmission charges were to be determined by the central government on the advice of the CEA.

The installed capacity in the country at the end of the seventh Plan period (March 1990) reached to 63636 MW from 1713 MW in 1950. In about four decade since the planning started in the country, the installed capacity has gone up about thirty times. The Installed capacity in the country has increased from a mere 1,362 MW in 1947 to about 1, 45,588 MW at present (as on 31st July 2008).

Exhibit No. 3.2: Growth of Installed Generating Capacity in India



Source: Central Electricity Authority, Govt. of India

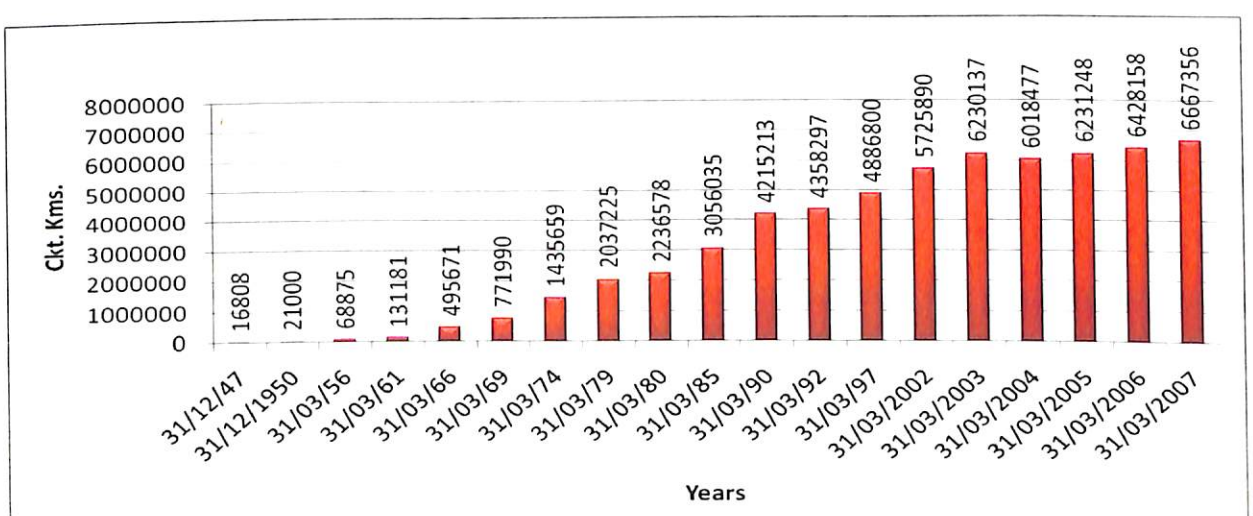
Lack of sufficient investment in distribution over these years has rendered the network heavily overloaded. For the 8th five-year plan, an ambitious target of addition of 36,000 MW was set up. The sector was opened for private investment; it was expected that approximately 14,000 MW will come from this sector. But the plan did not work out as was expected. During a mid-term

appraisal it was thought that a capacity addition of 26,000 MW will be possible. There were further slippages and therefore only 16,000 MW generating capacity could be added. The problems continued in the 9th five years plan and to cover up some of the backlog of the 8th plan, an ambitious target of 50,000 MW was fixed. The plan targets had to be revised and the 9th plan was reduced to 35,000 MW.For the Tenth Plan a capacity addition programme of approximately 41,000 MW has been targeted. The Central Electricity Authority has estimated the requirement for an additional capacity addition of 1, 00, 000 MW for attaining the objective of power for all by 2012.

b. Transmission Capacity

The draft National Plan prepared by CEA proposes enhancing inter-regional transfer of power capability of 37,200 MW by the year 2012. Power grid Corporation of India Ltd. has ambitious plan of developing National Grid by the year 2012, synchronizing all regional grids thereby facilitating transfer of power from any part of the country to any other part. To facilitate real time operation of the grid 5 Regional Load Dispatch Centres (RLDCs) have come up with state of the art technology. PowerGrid is also setting up a National Load Despatch Cetnre (NLDC) to facilitated co-ordinated scheduling and dispatch inter-connecting all the 5 regions. Besides PowerGrid Corporation State Government utilities own large network of transmission lines to facilitate transmission within the State. The power transmission & distribution network has also grown substantially as illustrated as Exhibit No. 3.3.

Exhibit No. 3.3: Growth of Transmission Lines in India



Source: Central Electricity Authority, Govt. of India

3.5.1 Physical Performance

Plant availability has remained more or less stable over the five-year period from 1996/97 to 2001/02 and started improving from 2002/03 onwards (Table 3.8).

Table 3.8: Plant Load Factor and Plant Availability Factor in various Years (all-India)

Year	Plant Availability Factor (%)	PLF (%)	T & D Losses (%)
1996/97	79.00	64.40	24.53
1997/98	79.40	64.70	24.79
1998/99	78.70	64.60	24.90
1999/2000	80.30	67.30	30.80
2000/01	80.50	69.00	29.90
2001/02	Not available	69.90	27.80
2002/03		72.2	32.54
2003/04		72.7	32.53
2004/05		74.8	31.23
2005-06		73.6	30.42
2006-07		76.8	28.61
2007-08		78.6	26.91

Source: Central Electricity Authority, Govt of India, July 2007.

The PLFs have improved, even in many state government-owned generation plants, though the improvement has been uneven across the country. However, in the decade since 1992, there has been significant improvement in PLF in every region, except the North-East where it declined.

The T&D losses were rising till the year 2000 (Table 3.9), almost negating the improving PLFs and generation efficiencies of thermal power plants. After 2000, the T&D losses started to decline, reflecting the measures taken in states like Andhra Pradesh, the incentives provided by Regulators and Central Government schemes, improvement in metering, etc.

Table 3.9: Plant Load Factor by Ownership and Region

	1992/ 93	1993/ 94	1994/ 95	1995/ 96	1996/ 97	1998/ 09	1998/ 99	1999/ 00	2000/ 01	2001/ 02
Ownership										
State	54.1	56.6	55.0	58.1	60.3	60.9	60.7	63.7	65.6	67.0
Central	62.7	69.8	69.2	71.0	71.1	70.4	71.1	73.8	74.3	74.3
Private	58.8	57.0	65.8	72.3	71.2	71.2	68.0	68.9	73.1	74.7
Region										
Northern	62.0	63.9	59.1	62.1	64.8	66.7	67.2	70.9	73.1	75.1
Western	59.7	63.4	63.8	68.1	70.2	70.3	70.7	72.3	73.4	74.2
Southern	62.6	68.3	69.1	74.7	75.8	77.0	75.4	79.6	82.0	82.3
Eastern	39.8	44.8	43.7	42.7	42.2	43.0	44.1	46.1	47.9	48.7
North-eastern	24.3	19.9	26.8	28.6	27.1	21.3	18.8	18.2	18.5	16.8
All India	57.1	61.0	60.0	63.0	64.4	64.7	64.6	67.3	69.0	69.9

Source: Central Electricity Authority, Govt of India

There has been significant improvement in PLFs in all segments of ownership, though SEBs still lags behind CPSUs and private generating stations .The performance of eastern regions is abysmal, perhaps reflecting on the quality of local governance.

From the period 2000 onwards, supercritical units of 660 MW were introduced and this marked the beginning of Supercritical Technology. Efforts were initiated for introduction of higher capacity supercritical units (800-1000 MW) and higher steam parameters (246 kg/cm^2 , 566 °C/593 °C) with a view to have quicker capacity addition & improved efficiency. Increased emphasis is being laid on standardization to achieve cost effectiveness. Initiatives are being taken towards increasing fly ash utilization and efforts are being made to encourage use of washed coal so as to improve plant performance as well as from environmental consideration.

3.6 STATE ELECTRICITY BOARDS

The State Electricity Boards (SEBs) owe their genesis to the Electricity (Supply) Act, 1948. After independence, the electricity sector was virtually nationalized. The need was felt for the State Government to step in to ensure supply of electricity to all nooks and corners of the country. Thus was created

the State Electricity Board as an arm of the State Government to discharge its social responsibilities.

Since their conceptualization and constitution, the SEBS have been playing the crucial role of building up the necessary generation as well as network facilities for smooth and coordinated supply of electricity to consumers of all categories. They facilitated extension of electricity into rural areas supporting electricity to rural households and energizing pumpsets, thereby helping rural economy and agriculture production.

Over a period of time, the SEBs grew into monolithic organizations with all powers of operation as well as regulations concentrated in them. The functioning of the SEBs also was affected as a result of their treatment as any other departments of the Government. State Governments had several powers which allowed them to intervene in the day to day functions of the Boards. State Governments had authority to approve budget, give clearance to borrowings, provisions of loans and subventions from the State Government to the Board, Government guarantee for loans to be taken by the Board etc. Although SEBs by the very nature of their activities were commercial organizations, they could hardly run the business on commercial lines as the political masters always chose to use the Board to sub-serve their political interests. Tariff reviews did not take place based on commercial considerations and needs but on the political expediencies. Coupled with this was the lack of motivational force in the Management of the Board that led to deterioration in the overall performance of the SEBs. The unwieldy structure of the organization also bred several inefficiencies.

3.7 REFORMS: INDIAN ELECTRICITY INDUSTRY

Electricity reforms in India formally started along with economic liberalization in 1991-92, though the impetus for private sector participation in the power sector predates this. Private participation in the power sector was seen as an effective remedy for the underlying problems. Through various amendments the government provided a legal framework for the entry of private sector in 1991. Subsequently a definite tariff structure was also put into place through a notification issued by the Govt of India..

As projects failed to take off as SEBs were required to achieve a minimum of three per cent rate of return (ROR) on their net fixed assets as most of the SEBs failed to stick on to the specification. In 1997-98, only 13 SEBs out of 16 (excluding Orissa) had positive ROR (with subsidy). Of these, only 3 SEBs, namely MSEB, HPSEB and BSEB had ROR of more than three per cent. Hence there was an urgent need of restructuring the tariff structure and create transparency in the provision of subsidies.

Despite many sweeteners to attract Independent Power Producers (IPPs), few private projects achieved financial closure, mainly because they involved near-bankrupt SEBs, among other discouraging features of the business environment, such as discrepant signals between the centre and the state, and lack of transparency. Budget outlays increased steadily till the Seventh Plan (1986-90), but thereafter, in the reform period, they declined.

The SEBs incurred heavy losses and failed to make the necessary payments to the CPSUs and the outstanding payments reached an all time high of Rs 400 billion (1.5% of GDP). Owing to their bulky design, these utilities were inevitably becoming cumbersome to manage.

The Ministry of Power, after wide ranging consultations with all the stakeholders namely State Governments, State Electricity Boards, utilities, experts, trade unions, private investors and political leaders, has evolved a new, comprehensive and detailed Action Plan for turning around the power sector. The Chief Ministers/Power Ministers' conference held in March 2001 recognized that the real challenge of Power Sector reform lies in distribution and resolved, inter alia, that commercial viability has to be achieved in distribution in 2-3 years through any or all of the following:

1. Creating Profit Centers with full accountability.
2. Handing over of local distribution to Panchayats/Local Bodies/ Franchisees/Users' Associations, wherever necessary.
3. Privatization of distribution.
4. An effective programme for identifying and eliminating power thefts in next two years.

The Government of India has been signing Memorandum of Understanding (MOU)/Agreements with States reflecting the joint commitment of the Centre and the States to undertake reforms in a time bound manner. These require the States to set up SERCs, undertake energy audit through full metering, reduce transmission and distribution losses and attain commercial viability. In reciprocation to the efforts of the States to achieve agreed milestones, the Central Government has committed assistance including allocation of additional power from unallocated share from Central Generating Stations, funds under specific programmes/schemes etc. The MOUs are now being fleshed out into Memorandum of Agreements (MOAs) with clearer and more specific milestones as the reform programme in the States is acquiring concrete shape.

The programmes like Accelerated Power Development and Reform Programme (APDRP) was designed to finance specific projects in identified distribution circles for a quick turn around and creation of centers of excellence. Under this scheme there was a provision for grants by the Ministry of Power to SEBs/Utilities for actual cash loss reduction.

The Ministry of Power has after consultations with all the stakeholders namely State Governments, State Electricity Boards, Utilities, experts, trade unions, private investors and political leaders prepared a draft of an All Party Declaration of a Common Minimum Programme on Power, which has been circulated and the renovation and modernization of the existing plants is being given priority with other measures for:

1. Reducing technical losses in distribution under the tightly focused APDRP programme;
2. Demand side management through energy efficiency and energy conservation; and
3. Improvement in capacities for inter-regional transfer of power through creation of the National Grid, the country is expected to achieve a satisfactory level in availability of power.

The budget for the year 2002-03 provides for introduction of a new interest subsidy scheme called the Accelerated Rural Electrification Programme with an outlay of Rs.164 crore. This would enable States to give the rural electrification programme greater momentum by accessing funds liberally from the REG and the Rural Infrastructure Development Fund (RIDF). Electrification of all villages by 2007 and provision of access to all households by 2012 has been accepted as a national goal.

3.8 DRIVERS OF POWER SECTOR REFORMS IN INDIA

Despite the subject of electricity being in the concurrent list, for most of the part it was the policies of State Governments which played a major role in shaping Indian power sector. Government of India played only a co-ordinating role through Central Electricity Authority until 1975 when it decided to play a role directly by incorporating NTPC, NHPC and undertaking large inter-state generation, transmission projects. At the State level the operations of State Electricity Boards were becoming unviable during 80s. Huge amount of power was being lost at the stage of highest value added i.e. distribution. Faced with problems of serious magnitude many States jumped into the bandwagon of power sector reforms during 1990s, as driven by following agencies/factors.

3.8.1 Government of India

Political Consensus Building

Government of India made several efforts from time to time to build consensus on power sector reforms. As early as in 1993, the Planning Commission had set up a NDC Committee on Power under the chairmanship of Shri Sharad Pawar, the then Chief Minister of Maharashtra. The Committee had recommended restoration of the autonomy of the state power utilities, distancing of State Government from the management of the State Electricity Boards, for agricultural consumers the State Governments should adopt the concept of All India Minimum Agricultural Tariff, constitution of independent professional Tariff Boards to be converted into statutory bodies in the long

run, imposition of stringent penalties in case of unauthorized use of electricity or theft, metering of all consumption etc.

The Prime Minister of India convened a conference of Chief Ministers in 1996 which adopted a Common Minimum National Action Plan for Power (CMNAPP) which called for (i) creation of Regulatory Commissions at Centre and States (ii) rationalization of retail tariff, under which no sector should pay less than 50% of the average cost of supply and the tariffs for agriculture should not be less than 50 paisa per unit and it should be increased to 50% of the average cost in not more than 3 years (iii) restructuring/corporatization of SEBs and make them function on commercial basis etc.

The Prime Minister of India held a conference of the Chief Ministers/Power Minister's on 3rd March, 2001, which took note of the challenges confronting the power sector. It was agreed that there is an urgent need to depoliticize power sector reforms and speed up their implementation. The resolution adopted at the conference provided inter alia as follows:-

- It is necessary to move away from the regime of providing free power. The past decisions of the Chief Ministers on a minimum agricultural tariff of 50 paise may be implemented immediately.
- Subsidies may be given only to the extent of State Governments' capacity to pay the subsidies explicitly through budget provisions.

Parliamentary Legislations

Central Government also tried to build consensus and bring about necessary legislative changes from time to time forcing the hands of State Governments. The notable changes included amendments to existing laws as also enactment of the Electricity Regulatory Commissions Act, 1998 and finally the Electricity Act, 2003. Building consensus was not easy and Government of India had to move step by step for example – Government of India wanted to make it mandatory for States to constitute State Electricity Regulatory Commissions. In the absence of enough support from States, it could only make an enabling provision in the Electricity Regulatory Commissions Act,

1998. Only in the Electricity Act, 2003, Government of India was able to mandate setting up of SERCs within six months.

Government of India however, realized that only legal provisions or resolutions of Chief Ministers Conferences were not enough. Resolutions adopted during such conferences were quickly forgotten by States where political expediency guided the decision making more than economic rationale. With a view to commercially incentivize States undertaking reforms, Government of India took following important steps:-

a. Loans from Power Finance Corporation (PFC) carried lesser interest rates for reforming States.
b. Allocation of power from Mega Power Project (whose tariff were lower on account of various fiscal concessions) to only those States which were implementing reforms.
c. Government of India entered into Memorandum of Understanding (MOU) and Memorandum of Agreement (MOA) with States whereby States committed to undertake concrete reform measures and in lieu Government of India promised assistance by way of Accelerated Power Development and Reform Program (APDRP). Among the notable features of APDRP was the incentive scheme under which a State was allowed untied grant matching with its actual reduction of losses. Many States have taken the benefit of this scheme .

Forcing the Hands of State

Saddled with huge receivables from State Electricity Boards, well performing CPSUs like NTPC, NHPC, PowerGrid etc. were being dragged into sickness. Forced by circumstances Government of India decided to have recourse to Central Plan allocation of States should they fail to pay the dues of Central Power Utilities. This way hard budget constraints were imposed on State Government.

Government of India also changed the criteria of allocation from central generating units moving away from Gadgil Formula which did not take into

account paying capacity of States. Now the Central Government is free to reduce allocation of State if it fails to pay the Central Utilities.

Burgeoning Subsidy Burden

States' tendency to use power sector as patronage was landing them in serious financial difficulties. Under Sec. 59 of the Electricity (Supply) Act, 1948 ,SEBs were to fix their tariff in such a manner so that they earn a minimum of 3% return on their net fixed assets. Since the State Government would not allow tariff to increase, SEBs window dressed their accounts in such a way that they met the legal requirement by showing the gap as subsidy receivables from State Government:

Table 3.10: Subsidy to Agriculture/Domestic consumers (Rs. in Crore)

Year	Subsidy to agriculture consumers	Subsidy to domestic consumers	Total subsidy
1996- 97	15585	4386	19971
2001-02	28123	12238	40361

Source: Planning Commission

As can be seen from the above (Table 3.10), total subsidy increased from Rs. 19971 Crores in 1996-97 to Rs. 40,361 Crores in 2001-02. Converted into subsidy per unit of sales, it has gone up from 75 paise per unit during 1996-97 to Rs. 1.26 per unit in 2001-02. Burden of these contingent liabilities was so huge that it started to hurt investment in other social sectors .

Multilateral Bodies

While the SEBs were suffering huge losses, there was emergence of Neo liberal policies in the west which shrank the scope of the State making unfettered markets and private sector the buzzwords of new globalized economy. These ideas were sharpened by International Financial Institutions such as World Bank into 'Washington Consensus'. In the developing countries public funding for electricity was drying up on account of inability of State to spare resources. World Bank changed its policy of lending in 1993 and the new policy regime required countries to encourage private investment, corporatize State agencies

and establish independent regulators as conditions of continuous funding. World Bank earlier used to fund generation projects. In the context of India, World Bank and ADB loans were attractive to State Governments as they were borrowed by Government of India at the first place and passed on to States as special central assistance. This meant that the World Bank loans were transferred as 70% loan and 30% grant to general category States and 90% grant and 10% loan to special category States. ADB and the World Bank have sanctioned following loans to States for reforming power sector:

World Bank assistance for reforming power sector

- Andhra Pradesh : US $ 210 Million
- Haryana : US $ 90 Million
- Orissa : US $ 350 Million
- U.P. : US $ 150 Million
- Rajasthan : US $ 180 Million

ADB (Asian Development Bank) assistance for reforming power sector

- Assam : US $ 250 Million
- Gujarat : US $ 350 Million
- Madhya Pradesh : US $ 350 Million

Most of these loans had a policy component and a project component. While policy component took care of settling some of the old dues, project component was for investment in transmission and distribution.These conditions included – enactment of reform laws, setting up of regulatory commissions, unbundling and in some cases privatization. Pressure was kept on by the multilateral funding bodies by strict monitoring of the loans and fulfillment of conditions precedent.

3.8.2 Multinational Power Majors

With the tapering off of electricity demand in the industrialized world large multinational power majors started looking for new opportunities overseas. For cash strapped developing countries liberalization of the electricity sector was essential for foreign investment. Restructuring of vertically integrated utilities became the litmus test for foreign investors. While there were differences in

approach of different countries restructuring was a common thread. By 1998, World Bank survey of 115 developing countries found that 44% had corporatized, 33% had passed a new electricity law, 29% had established a regulator, 40% had allowed entry of IPPs, 35% had restructured and 18% had allowed private distributors to take over distribution (Bacon 1999).

By 1997, investment in the electricity sectors of developing world peaked to $ 40 Billion a year. Latin America and East Asia attracted the most money. In India, private investment in generation started with a big bang when Enron promoted 2100 MW Dabhol project was commissioned in Maharashtra. AES Corporation took over majority shareholding in Orissa Power Generation Corporation and also took over distribution in Central Electricity Supply Company of Orissa (CESCO). Many other power majors like Powergen and National Grid of UK took keen interest in Indian market. Many other companies signed large IPP projects in India under MoU route. Only of late the relationship between restructuring and foreign investment has weakened in India for many reasons. Failure of Enron Worldwide put a question mark on the practices followed by multinational companies and their Dabhol project fell into serious trouble and closed since 2002.

The Indian industry faces a very high tariff regime so as to cross-subsidize other category of consumers. Industrial tariffs in India at Rs. 4-5 per KWh or US 7-10 cents are among the highest in the world. Even among other developing countries, industrial tariffs are lower than that in India – Argentina 7 cents, Bolivia 6 cents, Brazil and Thailand 6 cents and China 3-4 cents. Such high cost of power is rendering Indian industry uncompetitive vis-à-vis other countries. Faced with high cost of power coupled with poor quality and reliability, industry started relying on their own captive generation. State Electricity Boards are concerned over the impact of captive generation on their deteriorating finances. Liberal provision for captive generation in the Electricity Act, 2003 is putting market pressure on SEBs to improve their services.

3.8.3 Lack of Resources for Investment

Huge pilferage of revenue on account of high T&D losses incapacitated SEBs to fund their investment requirement. Many of the SEBs had no resources even to

carry out normal operation and maintenance activities. Private investors also found them to be so unviable that they were not sure of getting their payment for power that they would sell to SEBs. Private investors therefore started demanding layers of payment security instruments starting from LC to sovereign guarantees of State and counter guarantee from the Central Government. The only hope of getting finances was to initiate comprehensive reforms so as to build confidence among investors and financial institutions.

3.9 CONCLUSIONS

Until the 1940s, industry was confined to a few urban pockets where the total power generating capacity was about 1,350 MW. However after independence in 1947, a massive boost was given to the expansion of electricity through public investment. In 1948, the Electricity Supply Act brought all new generation, transmission, and distribution facilities within the State's purview. Each State subsequently established its own vertically integrated state electricity board (SEB). SEBs were the backbone of the electricity infrastructure, and by 1991 controlled 70 percent of electricity generation and almost all distribution.

India's Power sector was under government control until 1991 with all the major functions of generation, transmission and distribution to the consumers predominantly done by state-owned companies and boards. The government had a tight grip over the entire power business. The entire Power Sector was also owned, operated and regulated under the purview of government control.

The pace of capacity additions stagnated in the 1990s. Until the early 1990s, the power sector had received between 15% and 20% of the total central government budget. This share declined after economic reforms were introduced in 1991, in the expectation that part of the required investment would come from the private sector. But many of the projects proposed have not proceeded, in large part because of an inadequate legal and commercial framework, involving lack of law and contract enforcement and delays in obtaining regulatory approvals. In the last sixty years, growth and expansion of the network has brought in several complexities.

- The system is large and interconnected.
- All the states are connected and the regions are connected in the National grid.
- The financial viability of the present tariff structure is being questioned.
- Inefficient and huge number of manpower engaged by the SEBs.
- High AT&C / transmission and distribution losses.
- Low realization of revenue and
- Inefficient and unreliable supply

The Government has already taken the initiative in several areas to corporatize the Boards and privatize the Distribution areas. In a nutshell, the power sector is in a transition period.

The installed capacity in the country has increased from a mere 1,713 MW in Dec 1950 to 1, 43,311MW at the end on April, 2008 as shown in Table 3.11. India has achieved 80% of village electrification. The growth in demand has exceeded the supply and power shortages have been continually experienced. An investment of Rs. 9,00,000 crores, would be required to finance generation, transmission,sub-transmission,distribution and rural electrification projects to meet the objectives of power for all by 2011-12.

Table 3.11: The total installed capacity of Power Generation

1. Total installed capacity	**30.04.08**	
Sector	**MW(mega watt)**	**Percentage**
State Sector	74,829.36	52.5
Central Sector	48,470.99	34.0
Private Sector	20010.66	13.5
Fuel	**MW(mega watt)**	**Percentage**
Total Thermal	**92,156.84**	**64.6**
Coal	76,298.88	53.3
Gas	14,656.21	10.5
Oil	1,201.75	0.9
Hydro	35,908.76	24.7
Nuclear	4,120.00	2.9
Renewable	11125.41	7.7
Total	1,43,311.01	
2. Rural electrification		
No. of Villages (Census 1991)	593,732	
Villages Electrified	488,169	
Electrification %age	82.2%	
3. Overall electrification (REC Annual Report 2006-07)		
Household Electrified	62.18 million (43.5%)	
Households yet to be electrified	78.09 million (56.5%)	
Total No. of household	138.27 million (100%)	

Source: Central Electricity Authority Government of India

The Way Forward

In the past five years, strategic measures such as the Electricity Act 2003 and the Ultra Mega Power Projects (UMPPs) have been introduced, and a number of administrative steps, like tripartite agreements between the central government, central generators and the states and recapitalization of State Electricity Boards (SEBs) have been taken to unleash the potential of the power sector.

An evaluation of India's projected profile of capacity addition suggests that much needs to be done to alter the mix. In particular, India needs to shift its predominant focus from building base-load plants to a more balanced mix of base-load and peaking plants. This is imperative in order to ensure that the country can meet peak demand. Further, the current plans will significantly increase emissions, double India's energy imports, and increase input cost volatility.

To achieve this private sector investment should be encouraged through fixed return on investment. Return on investment need to be provided so as to attract adequate investment in preference to investment opportunities in other sectors based on clear evaluation of opportunities and risks.

Keeping account of the above issues, the working group on power sector for 11th plan recommends generation planning based on growth of energy generation of 9.5%.There is a need to emphasis on capacity addition programme, concerted efforts to continue in regard to:

- Development of captive power plants.
- Maximizing Generation from existing plants.
- Better O&M practices.
- Energy efficiency improvement through energy audit
- RM &U/partnership in Excellence programme.
- Development of Non-conventional energy sources.