Chapter 5

Indian Power Sector

5.1 Introduction:

Electricity is an essential requirement for all facets of our life. It has been recognized as a basic human need. It is a critical infrastructure on which the socio-economic development of the country depends.

Supply of uninterrupted electricity at reasonable rate is essential for overall development of agriculture, commerce, services, industry and other sectors as well to exploit the tremendous potential of employment generation in these sectors. Availability of quality supply of electricity is very crucial to sustained growth of these segments. Today electricity is one of the key drivers for rapid economic growth, poverty alleviation and improved quality life. India has witnessed outstanding economic development in the last around twenty years.

The good and reliable infrastructure, including the abundant electricity supply has been one of the main reasons for acceleration of this development. Keeping in view the importance and contribution of electricity sector in the progress of other sectors; the Government of India has kept it on its priorities.

The power sector of India is quite promising and can fulfill the needs of all the sectors.
5.2 Meanings and Definitions:

a) Electricity Act 2003 means Act No36 of 2003 passed by Parliament of India
b) Generation means generation of electricity
c) Thermal Power means the electricity generated using coal, oil, gas and other fossil fuels.
d) Hydro Power means generation of electricity by harnessing the energy of falling water
e) Power Plants means the electricity generation plants
f) Transmission means the wheeling of electricity from generation house to the jurisdiction of distribution company
g) Distribution Company means the utility engaged in the business of distribution of power to the end users.

5.3 Beginning and Growth of Electricity in India:

In India, the first show of electrical light was demonstrated in Kolkata on 24th July 1879 by P.W. Fleury & Company. This was followed by another demonstration by Dey Sil& Company on 30 June, 1881 at Garden Reach Cotton Mills. Kilburn & Co, an agent of Indian Electric Company, secured license for lighting in Kolkata.

Indian Electric Company was registered in London. Later, this company was renamed as “The Calcutta Electric Supply Corporation Limited. In April 1899, the first thermal power plant of The Calcutta Electric Supply Corporation Limited was commissioned. [1]
After the successful demonstration and operations in Kolkata; electricity was introduced in Mumbai in 1882 at Crawford Market. In 1905 a power generating station was established for providing electricity to tramways by Bombay Electric Supply & Tramways Company [2]. In the year 1897; the first hydroelectric power plant was established in India. It was at Sidrapping for the Municipality of Darjeeling [3]. In Delhi, electricity was introduced in 1905 with the establishment of a 2 MW generating station in Old Delhi.

Indian Power sector is witnessing major changes. Growth of Power Sector in India since its Independence has been noteworthy. However, the demand for power has been outstripping the growth of availability. Substantial peak and energy shortages prevail in the country. This is due to inadequacies in generation, transmission & distribution as well as inefficient use of electricity.

Very high level of technical and commercial losses and lack of commercial approach in management of utilities has led to unsustainable financial operations. Cross-subsidies have risen to unsustainable levels. Inadequacies in distribution networks have been one of the major reasons for poor quality of supply. In the present time the demand of electricity varies during various seasons and even on a daily basis. It is not possible to store electricity. Therefore it is very challenging to continuously balance the grid operations.

India is targeting a gross domestic production (GDP) growth rate of 8-9% in the coming years. To enable this growth, the country’s economy needs the support of its power sector, which is witnessing heavy investments that will enable it to cater to India’s increasing power demand. The capacity addition target in the 12th Plan
(2012–2017) is expected to be 88.5 GW. Close to 100 GW of capacity addition is envisaged in the 13th Plan (2017–2022). [4]

The per capita consumption of power in India is far behind the developed countries. In 2009 it was 96 kilo watt hour in rural areas and 288 kilo watt hour in urban areas. However the world average of per capita consumption was 2600 kWh and it was 6200 kWh in the European Union [5]. The per capita total consumption of power in India is 778.71 kWh. The average per capita consumption of the world is 2782 kWh. In India the highest per capita consumption of electricity is in Dadra & Nagar Haveli at 11,863.64 kWh and Bihar is at bottom at 122.11 kWh according to the available record for the year 2009-10. The Government of India aims to make available 1000 kWh per capita consumption in the 11th plan [6]. The power sector of India is one of the most dynamic in the world in the utilization of renewable energy. Per Capita Consumption of Power in Major Countries is as given under:

**Chart 5.1**

*Per Capita Consumption of Electricity in Major Countries*
Table 5.1
Per Capita Consumption of Electricity in Major Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Per capita consumption of Electricity (Kwh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>17053</td>
</tr>
<tr>
<td>USA</td>
<td>13647</td>
</tr>
<tr>
<td>Australia</td>
<td>11174</td>
</tr>
<tr>
<td>Japan</td>
<td>8072</td>
</tr>
<tr>
<td>France</td>
<td>7703</td>
</tr>
<tr>
<td>Germany</td>
<td>7148</td>
</tr>
<tr>
<td>Korea</td>
<td>8853</td>
</tr>
<tr>
<td>UK</td>
<td>6067</td>
</tr>
<tr>
<td>Russia</td>
<td>6443</td>
</tr>
<tr>
<td>Italy</td>
<td>5656</td>
</tr>
<tr>
<td>South Africa</td>
<td>4770</td>
</tr>
<tr>
<td>Brazil</td>
<td>2232</td>
</tr>
<tr>
<td>China</td>
<td>2471</td>
</tr>
<tr>
<td>India</td>
<td>779</td>
</tr>
<tr>
<td>World</td>
<td>2782</td>
</tr>
</tbody>
</table>

In India, average T & D (Transmission & Distribution) losses; have been officially indicated as 23 percent of the electricity generated. However, as per sample studies carried out by independent agencies, these losses have been estimated to be as high as 50 percent in some states.
In a study carried out by SBI Capital Markets for DVB, in 2001 the T&D losses were estimated as 58%.

These losses are due to both technical and non-technical reasons and it is quite difficult to quantify the proportion. According to the estimates of Government of India the total transmission and distribution losses were around 27% during the year 2009-10 [8]. The government aims to reduce it to 17.1% by 2017 & to 14.1% by 2022 [9].

The illegal tapping of lines, faulty meters and low payment collection are few of the main causes of non-technical losses. Total aggregate technical and commercial losses vary from state to state. These losses vary from one area to the other even within the jurisdiction of a single distribution company.

During the year 2012-13, the availability of energy has increased by 6.2% and the peak demand has increased by 6.1%. Still there is shortage of electricity in the country and a large portion of our population does not have access to it.

The requirement, availability and shortage of electricity has been given as below [7]:

**Table 5.2**

*Electricity Demand and Supply in India*

<table>
<thead>
<tr>
<th></th>
<th><strong>Energy (MU)</strong></th>
<th><strong>Peak (MW)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement</td>
<td>998,114</td>
<td>135,453</td>
</tr>
<tr>
<td>Availability</td>
<td>911,209</td>
<td>123,294</td>
</tr>
<tr>
<td>Shortage</td>
<td>86,905</td>
<td>12,159</td>
</tr>
<tr>
<td>Percentage</td>
<td>8.7</td>
<td>9.0</td>
</tr>
</tbody>
</table>
5.4 Problems with Power Sector in India:

India's electricity sector faces many issues. Some are:

a) Government giveaways such as free electricity for farmers have resulted in poor financial health of the government owned distribution entities. Due to the financial problems these companies are finding it difficult to improve their network and pay the power purchase cost.

b) Shortage of fuel is one of the major concerns for the power sector of India. Around 57% of total installed capacity and around 80% of the power generated is from the coal based plants. Though there are abundant reserves of coal but there is shortage of coal for the power plants. The shortage of coal
is affecting the generation at the power plants owned by both private sector as well as the government owned [10].

c) There is improper infrastructure and insufficient pipeline connectivity which is a hurdle in exploitation to the full potential of the methane and shale gases available in the coal fields.

d) The exploration of natural gas at new offshore fields has not been to the full capacity. The power plants which were to get gas from these sources are lying idle due to non availability of natural gas.

e) There has been adverse impact on the hydro electric generation plants due to the opposition of the general public and the controversies linked with environmental reasons. [11]

f) The power generation potential through the nuclear energy has not yet been fully utilized and the political classes are also opposing its expansion citing the examples of other countries such as the disaster in Japan.

g) High transmission, distribution and commercial losses which are more than 30%.

h) A very large portion of our population which is estimated to be around 600 million still does not have access to electricity. Even most of the electrified areas also do not get sufficient, reliable and uninterrupted power supply [12]

i) The green houses gas emission from the thermal power plants is very high which is 100 per cent more in comparison to the European Countries. It needs to be checked with better technology. [13]
5.5 Power for All Mission:

It was the target of the Union Ministry of power to provide electricity to all the households by the year 2012 and a road map was put in place for that. The objective for this mission was to provide sufficient, reliable and quality power at affordable cost to all the people so that it may lead to growth of GDP [14].

5.6 The Electricity Policy of India:

Electricity Act, 2003 supports and provides platform for the overall development of the power sector. It encourages competition to improve efficiency in services and delivery of quality power at affordable prices. The role of the regulatory bodies has also been given apex importance [15].

Drafted in consultation with the state governments and other stake holders in the electrical sector; the electricity policy of India aims at providing electricity to all the households in a period of five years. It is targeted to arrange sufficient power so that the demand can be met smoothly and efficiently. It emphasized upon increasing the per capita consumption and total financial and commercial turnaround of the power sector.

Though there must have been some constructive initiatives on certain points on the above targets but the details of the progress made is not available on record. As far as the target of availability and accessibility of power is concerned the condition is still dismal and a lot need to be done.
5.7 Generation of Power:

The sources of electricity generation in India can be divided into two segments.

a) Non-renewable sources

b) Renewable Sources

Majority of the power generated in India comes from the state governments owned power plants which is around 41 per cent of the total generation in India. Total installed capacity of generation plants is 211766.22 MW.

The share of private companies in the generation of electricity is also very prominent and it accounts to around 29%. The rest is generated by the central sector.

Total generation of power in India is as given in the tables and charts below:

Table 5.3
Total Installed Capacity

<table>
<thead>
<tr>
<th>Sector</th>
<th>MW</th>
<th>%age</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Sector</td>
<td>86,343.35</td>
<td>40.77</td>
</tr>
<tr>
<td>Central Sector</td>
<td>62,963.63</td>
<td>29.73</td>
</tr>
<tr>
<td>Private Sector</td>
<td>62,459.24</td>
<td>29.49</td>
</tr>
<tr>
<td>Total</td>
<td>2,11,766.22</td>
<td></td>
</tr>
</tbody>
</table>
**Chart 5.3**

*Sector Wise Contribution in Generation*

Total Installed Capacity (211766.22 MW)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Capacity in MW</th>
<th>%age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Sector</td>
<td>62459.24</td>
<td>29%</td>
</tr>
<tr>
<td>Central Sector</td>
<td>62963.63</td>
<td>30%</td>
</tr>
<tr>
<td>State Sector</td>
<td>86343.35</td>
<td>41%</td>
</tr>
</tbody>
</table>

**Table 5.4**

*Fuel wise Generation Capacity*

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Capacity in MW</th>
<th>%age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Thermal</td>
<td>141713.68</td>
<td>66.91</td>
</tr>
<tr>
<td>Coal</td>
<td>121,610.88</td>
<td>57.42</td>
</tr>
<tr>
<td>Gas</td>
<td>18,903.05</td>
<td>8.92</td>
</tr>
<tr>
<td>Oil</td>
<td>1,199.75</td>
<td>0.56</td>
</tr>
<tr>
<td>Hydro (Renewable)</td>
<td>39,416.40</td>
<td>18.61</td>
</tr>
<tr>
<td>Nuclear</td>
<td>4,780.00</td>
<td>2.25</td>
</tr>
<tr>
<td>Renewable Energy Sources</td>
<td>25,856.14</td>
<td>12.20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,11,766.22</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

In the Renewable Energy Sources small hydro project with 25MW or less and the power from biomass, power from urban and industrial waste and wind energy have been included [16].
5.7.1 Non Renewable Sources of Power Generation:

Non-renewable resources or finite resources are those do not renew themselves at a sufficient rate. These are limited resources. These have been the conventional sources of generation of electricity.

Non-renewable resources can generally be divided into two main categories;

i. fossil fuels: (coal, petroleum, and natural gas),

ii. nuclear fuels: (uranium ore)
a) Thermal Power:

Thermal power plants contribute more than 65% of the total generation. The main fuels for generation of electricity in these plants are coal, natural gas, agricultural and domestic waste and petroleum products. The coal fired power plants consume more than 70% of the total coal production of the country [17].

It is expected that increasing demand of power will mainly be met from the thermal power plants.

The largest thermal power generation entity in India is NTPC which has an installed capacity of 41,184 MW and generates power from coal and gas. The total thermal generation in India is 1,41,713 MW out of this around 1,21,610MW is from the coal based power plants which is more than 57 per cent of the total generation. From the gas fired power stations in India 18,903.05 MW is generated which amount to 8.92 percent. The generation from the oil fired units is less than one percent and it is 1199.75 MW. [14]

b) Nuclear power:

The development of nuclear power plants began in 1964 and the first nuclear power station was established at Tarapur in Maharastra with the help of US based company General Electricals. Nuclear Power Corporation of India Limited was established in 1987. The total power generation capacity from the following nuclear power plants is 4780MW [18].
### Table 5.5

**Nuclear Power Plants Capacity in India**

<table>
<thead>
<tr>
<th>Name of Power Plant</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tarapur Atomic Power Station, Maharashtra</td>
<td>1400</td>
</tr>
<tr>
<td>Rajasthan Atomic Power Station, Rajasthan</td>
<td>1180</td>
</tr>
<tr>
<td>Madras Atomic Power Station, Tamilnadu</td>
<td>440</td>
</tr>
<tr>
<td>Kaiga Generating Station, Karnataka</td>
<td>880</td>
</tr>
<tr>
<td>Narora Atomic Power Station, UttarPradesh</td>
<td>440</td>
</tr>
<tr>
<td>Kakrapar Atomic Power Station Gujarat</td>
<td>440</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4780</strong></td>
</tr>
</tbody>
</table>

Shortage of nuclear fuel supply has adversely affected India’s nuclear power generation capacity. The contribution of nuclear power in the total generation of India is 2.25%.

Besides the above, a number of power plants are either under execution or in pipeline.
5.7.2 Renewable Sources of Power Generation:

The contemporary non-conventional sources of energy or renewable sources of energy like wind, tidal, solar are available without any cost. These sources are pollution-free and infinite. These sources have been used for many centuries for various purposes.

Though in the initial years the use of renewable sources was eminent but due to certain setbacks in their use the dependence on non-renewable sources increased. The renewable sources such as fossil fuels and nuclear sources can be easily
transported to anywhere and the plants can be setup. The over dependence on fossil fuels have polluted the atmosphere to the great extent. Also, the nuclear energy may also be very hazardous if it is not handled properly.

Keeping in view the limited availability of fossil fuels and the environmental hazards they are creating to the environment, it is imperative to all the nations to promote the use of renewable sources of energy.

Though in the initial years of establishment of power plants; generation from the renewable sources seems to be costly however with the development of technology these sources can be made more cost effective.

India has vast renewable energy resources but these resources could not have been utilized to the maximum potential. This sector is still underdeveloped.

The Union government has a separate ministry for non-conventional energy resources and the government has taken many proactive decisions but it is still far behind the other nations in the use of renewable energy. Presently following are the main renewable sources of electricity generation:

a) Water  
b) Tidal  
c) Solar  
d) Wind  
e) Bio-fuel  
f) Bio-gas  
g) Urban and Industrial Waste
a) Hydro Electrical Generation:

India has greatest potential for electricity generation from the hydro sources. The first hydro power plant in the Asia was also established by India way back in 1898 at Sidrapong at Darjeeling [2]. Besides, many power plants have been established to generate power from the water. However there is still huge scope for expansion.

The total capacity of hydro power plants is around 39,426MW which constitute around 18% of the total installed capacity [16]. The majority of hydro power plants are owned by the Public Sector Undertakings such as BBMB, NHPC, NEEPCO, SJVNL and THDC etc.

b) Tidal Energy:

Due to the gravitational pull of moon and son; the sea water keeps rising and falling alternatively twice a day. These are called tides. These tides have great potential for generation of electricity which can go up to 9000MW. India has not yet exploit this resource at all. To properly tap this resource, a clear policy needs to be framed.

c) Solar Energy:

Sun is the universal source of energy. Most parts of India receive abundant sunlight throughout the year. If this inexhaustible source of energy is properly tapped to the maximum potential it can fulfill the entire needs of the electricity. At present the power generation cost from sun is costly which a deterrent factor is but this situation can be overcome with the advancement in technology.
The Government of India as well as various state governments have taken some proactive initiatives to promote the solar energy. These initiatives include making the use of solar equipments compulsory for certain purposes such as water heating etc in government buildings as well as certain other categories.

d) Wind Energy:
The generation of power from the wind started in India around two decade back. In the last few years the wind energy sector has grown significantly. Presently, the capacity to generate wind power is around 19051.5 MW which is 8.5% of the total installed capacity. Around 1.6% of total electricity is generated by wind in India.

<table>
<thead>
<tr>
<th>State</th>
<th>Capacity (in MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamil Nadu</td>
<td>7154</td>
</tr>
<tr>
<td>Gujarat</td>
<td>3,093</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>2976</td>
</tr>
<tr>
<td>Karnataka</td>
<td>2113</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>2355</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>386</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>435</td>
</tr>
<tr>
<td>Kerala</td>
<td>35.1</td>
</tr>
<tr>
<td>Orissa</td>
<td>2</td>
</tr>
<tr>
<td>West Bengal</td>
<td>1.1</td>
</tr>
</tbody>
</table>
e) Geo-Thermal Energy:

Geo-thermal energy is the heat generated from inside the earth. India is not very rich in this source. Geothermal energy is the natural heat of the earth and comes out in the form of hot springs etc. It is continually regenerated by the decay of radioactive elements that occur in all rocks. There are four major types of geothermal energy resources; Hydrothermal, Geo pressurized brines, hot dry rocks and Magma. In India, exploration and study of geothermal fields started in 1970. The GSI (Geological Survey of India) has identified 350 geothermal energy locations in the country. The most promising of these is in Puga valley of Ladakh. The estimated potential for geothermal energy in India is about 10000 MW. This resource has not yet been utilized.
f) **Energy from Biomass:**

Biomass which consists of all plant material and animal excreta are also the sources of energy. These sources have been in use for centuries by individuals and include woods, farm animal and human waste, biogases etc.

This source also has huge potential and is being explored for rural electrification. Besides, it can result in huge savings on the fossil fuel [28].

Now the emphasis is to connect the biomass generated electricity with the grid. With the advance technology this source can be utilized in a better way and to the full extent.

g) **Energy from Urban and Industrial Waste (Municipal Solid Waste):**

The purchasing power of the general public has improved and with the easy availability of consumer goods; the domestic waste is generated in huge quantity. The disposal of this waste is a very challenging task and various municipalities across the country are finding it difficult to properly dispose the waste.

According to the estimates of the Ministry of New and Renewable Energy, Government of India, approximately 55 million tons of MSW is generated annually in urban areas in India. The rate of increase in waste generation is 1.33%. [19].

The Municipal Solid Wastes (Management and Handling) Rules 2000 have been promulgated by the Ministry of Environment and Forests which stress upon adoption of sustainable and environmental friendly ways to process the municipal wastes. Various state governments have taken initiatives to utilize municipal wastes to
generate electricity and Master Plan has been developed for this purpose by MNRE [20].

It is estimated that in a span of ten years the potential can be increased by 50%. Though the cost of generation from municipal waste is higher than the generation cost from other sources; however it is still viable keeping in view that it serves dual purpose of waste disposal and energy generation.

5.8 Transmission of Power:

Transmission of power is equally important part of the power system. Transmission network transmit the power from the generating stations to the distribution network.

The transmission system forms a vital link in the electricity supply chain. Transmission system provides ‘service’ of inter-connection between the generation companies and distribution companies. In the Indian context, the transmission system has been broadly categorized as Inter-State Transmission System and Intra-State Transmission system. The ISTS is the top layer of national grid below which lies the Intra-STS. Though the main transmission network is through 400 kV systems however, the highest voltage level of the transmission is 765 kV [16].

5.8.1 Interstate Transmission of Power:

The interstate transmission of power in India is mainly in the hands of central sector undertaking “Power Grid” which is one amongst the largest Power Transmission
utilities in the world. Power Grid is playing a vital role in the growth of Indian power sector by developing a robust Integrated National Grid and associating in the flagship programme of Govt. of India to provide Power for all. The length of transmission lines of Power Grid is about 1,01,334 ckm. The level of voltage is 765kV to downward up to 132kV. There are 168 sub-stations in the network of Power Grid and its transformation capacity is about 1,64,813 MVA [21].

The entire power sector of India can be divided for operational purposes into five regional grids [22].

a) Northern Grid

b) North-Eastern Grid

c) Eastern Grid

d) Western Grid

e) Southern Grid

Though the initial purpose for linking the regions was to transfer the surplus power but later on the focus was shifted from regional sufficiency to national sufficiency. With the interlinking of various regional grids; power can be transmitted from the generating plants to any corner of the country.

Presently, the inter-regional transmission capacity is around 37,250 MW [23].

On 25th February 2009 the National Load Despatch Centre (National Grid) was inaugurated. Now all the five regional grids (managed by concerned Regional Load Despatch Centres) and the National Grid (managed by National Load Despatch
Centre) have been converted into a separate organization namely Power System Operation Corporation.

The power operations within the region are coordinated by the Regional Load Despatch Centres while the National Load Despatch Centre coordinates interregional operations.

5.8.2 Intrastate Transmission of Power:

The transmission of power within a state is done by the transmission companies whom the licence have been given to operate. In obedience to the provisions of Electricity Act 2003 all the state owned electricity boards and other entities have been re-organised and separate entities have been carved out for transmission of power.

The Electricity Act, 2003 has brought profound changes in electricity supply industry of India leading to reorganisation of state electricity boards, unbundling of vertically integrated State Electricity Boards, implementation of Open Access in power transmission and liberalisation of generation sector.

As per Section 39 of the Electricity Act 2003 the state governments can notify a state transmission entity.

The transmission utilities are not allowed to do electricity trading business.

5.8.3 Transmission System in India:

The present capacity of the transmission network in India is as given under [16]:

75
### Table 5.7
**Transmission Lines (in circuit kilo meter)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Central Sector</th>
<th>State Sector</th>
<th>JV/Pvt.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>765 kV</td>
<td>7645</td>
<td>411</td>
<td>_</td>
<td>8056</td>
</tr>
<tr>
<td>400 kV</td>
<td>81519</td>
<td>35150</td>
<td>8370</td>
<td>125039</td>
</tr>
<tr>
<td>220 kV</td>
<td>10721</td>
<td>133415</td>
<td>830</td>
<td>144966</td>
</tr>
<tr>
<td>+-500kV</td>
<td>5948</td>
<td>1504</td>
<td>1980</td>
<td>9432</td>
</tr>
<tr>
<td>HVDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Chart 5.7
**Sector Wise Contribution in Transmission Lines**

Transmission Lines (in Circuit Kilo Meter)
### Table 5.8

**Sub Stations (Transformation capacity in MVA)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Central Sector</th>
<th>State Sector</th>
<th>Joint Venture/Private</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>765 kV</td>
<td>52500</td>
<td>1000</td>
<td>-</td>
<td>53500</td>
</tr>
<tr>
<td>400 kV</td>
<td>85165</td>
<td>82972</td>
<td>630</td>
<td>168767</td>
</tr>
<tr>
<td>220 kV</td>
<td>7716</td>
<td>234361</td>
<td>1567</td>
<td>243644</td>
</tr>
<tr>
<td>+/-500kV</td>
<td>9500</td>
<td>1500</td>
<td>2500</td>
<td>13500</td>
</tr>
<tr>
<td>HVDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Chart 5.8

**Sector Wise Transformation Capacity**

![Bar Chart](image-url)
5.8.4 Transmission System Development – Issues:

A reliable and strong transmission system with adequate wheeling capacity is equally essential to wheel power from the generating sources to the distribution centres. However there are certain issues related to the growth of the transmission sector. The right of way is a big concern and a serious consideration needs to be given to minimize it. The transmission lines go through forest areas and it is essential to guard the environment and wild life. There must be emphasis upon strengthening the national grid and minimize wheeling cost.

5.9 Distribution of Power:

The distribution of power is very important and crucial. It is directly linked with the end users and most of the problems in the power sector are related to the distribution sector. Losses of distribution companies had risen to about Rs. 60,000 crores in 2010-11 and this figure is likely to be significantly higher in 2012-13. The Thirteenth Finance Commission has projected the losses in the distribution sector to be over Rs.1, 16,000crore in 2014-15 [24].

In the absence of timely revision in consumer tariffs coupled with inadequate reduction in AT&C losses, the financial losses of distribution companies have been financed largely by loans from commercial banks. This has serious implications on the sustainability of the electricity sector as a whole, including future investments in capacity addition. The health of the distribution sector affects the whole sector. At
the end all the entities need finances which comes from the distribution companies. The distribution sector is plagued with high inefficiency, poor network, huge losses[10]. It is imperative to strengthen the network and for that huge investment is required. With the coming of Electricity Act 2003 the distribution sector has been given proper attention and the ailing electricity boards have been dismantled and separate entities have been formed for distribution. The government of India has also extended financial support to financially strengthen these entities through various schemes such as RGGVY and APDRP. The aim of these initiatives is to bring down the distribution losses to below 15%. In most of the states separate corporations have been formed. In Delhi and Orissa private parties have been roped in to professionally manage the distribution sectors.

The distribution sector is in need of intervention on priority and following steps are essential for further improvement and deliver the positive results.

a) Continued demand for power
b) Distribution Reforms
c) Supply codes and Performance Standards
d) Growing consumer awareness
e) Focus on IT
f) Move towards demand side management (DSM)
g) Environmental and social pressures
h) Tariff rationalization
i) Improving grid standards
5.10 Power Trading:

With an installed capacity of around 2,11,766 MW; India is the third largest generator of power in Asia. In 1947, when India gained independence it was 1362 MW. Though there has been an impressive progress on generation from, however, there is large scale shortage. Now all the generating entities want to sell their power at good price and who so ever gives the reasonable cost, they prefer to sign contract with. Besides, the demand of power varies from season to season as well as during different time of a day. Sometime, an entity has surplus power and wants to sell it to minimize financial implications. The surplus power is contracted through the power trading also.

PTC India Ltd is one of the leading power trading companies. There are several other power trading companies in India; many of them have been set up by the public sector such as NTPC Ltd has established NTPC Vidyut Vyapar Nigam Ltd.

The power trading entities are like middle man between the generating companies and the power purchasing companies.

5.11 Power Exchanges:

Presently IEX and PXI are the two power exchanges which are operational. Besides, the formation of NPEX has been approved by the regulatory bodies and its formation is in pipeline.
Power Exchanges provide a platform for electricity trading which is essential for the growth and sustainability of the sector. Both the power generator and power purchaser gets fair deal through these exchanges.

5.12 Regulatory Authorities:

Union Ministry of Power is the apex level body to regulate the power sector. It is the responsibility of this ministry to ensure overall development of electricity sector. The ministry takes policy decision in national perspective and monitor their implementation. In the Constitution of India, electricity has been placed in the list of concurrent subjects and both the centre as well as the state governments are empowered to take decisions on this. The state governments also have separate ministries or departments for power. There are following bodies for the regulation of electricity sector in India:

5.12.1 Appellate Tribunal for Electricity:

Consisting of a Chairman and three members; the Appellate Tribunal for Electricity has been created for deciding the appeals against the orders of CERC, SERC and JERC etc. The jurisdiction of APTEL is throughout India. Its office is in New Delhi [26].

It is compulsory that every bench of APTEL should have at least one judicial and one technical member.
5.12.2 Central Electricity Regulatory Commission:

CERC is a statutory body formed under the provision of Electricity Act, 2003. CERC looks into the interstate affairs such as the tariff of the central sector generating companies, interstate wheeling charges, and tariff of state generating companies selling power outside the state and so on. It issues licenses for interstate transmission and trading [25].

5.12.3 State Electricity Regulatory Commissions:

The role of state electricity regulatory commissions is limited to the electricity operations within a state. It determines the tariff for the generating companies, wheeling charges for the transmission companies and the retail tariff to be charged by the distribution companies from the end users. SERCs issue licenses for intrastate transmission and power trading. Besides, these commissions are to make policy for generation and promotion renewable energy. All the policy decisions by the companies engaged in the electricity sector within the state are to be vetted by the state regulatory commission. The companies engaged in the business of electricity file their revenue requirements before the concerned state regulatory commission giving full details of their power purchase costs, investments, operation costs and other expenses. The state regulatory commission scrutinizes these petitions and invites the public to give their response in view of the petitions filed. After giving the full hearing to the public as well as the petitioners, the state regulatory commission passes an order announcing the applicability of electricity rates applicable for various segments of consumers such as domestic, commercial, industrial, institutional and
agriculture etc [25]. The electricity rates vary from states to states. Even, in some states electricity tariff vary from one city to another.

5.12.4 Central Electricity Authority:

Central Electricity Authority (CEA) has been established under the provisions of erstwhile Electricity (Supply) Act, 1948 which has now been replaced by the Electricity Act, 2003. CEA assist central government on the matters related to the technical and economic aspects in the power sector. Besides concurring the setting up of new power plants, substations and lines; CEA also coordinate and supervise various programmes and perform statutory functions [25].

The authority has a chairman who is of the rank of the Secretary to the Government of India and six full time Members to look after various obligations.

5.13 Bureau of Energy Efficiency:

The gap between the demand and supply of power is very wide in India. Besides, many people do not judiciously use electricity. This reflects that on one side a large number of people do not have access to electricity while on the other hand many people are wasting it. Therefore, there is huge scope for saving the energy. It is estimated that around 23% energy goes waste and maximum of it is in industrial and agricultural sectors.

The Government of India enacted Energy Conservation Act 2001 to tap the vast potential of energy efficiency. Under the provisions of the Energy Conservation Act
the government of India has established Bureau of Energy Efficiency to promote energy efficiency through regulatory and promotional initiatives [27].

5.14 Conclusion:

Though India has made remarkable progress in the power sector during the last six decades but still there is huge shortage and a large portion of Indian population is without electricity. The shortage of electricity has adversely affected the overall economic growth of the country. The aggregate technical and commercial losses of the sector are very high that are deterrent for the growth of the sector. It is the need of the hour to minimize these losses for the health of the sector. The sector is plagued with distribution losses to the tune of Rs 60,000 crores.

The power sector has gone through the massive reforms. All the state electricity boards which were the sole utilities for generation, transmission and distribution of electricity have been restructured to bring in efficiency in the sector. Many schemes have been roped in to improve the financial health of the sector. The coal is still the major source of generation of power; it is the major reason for green-house gases emission also. There is huge potential for growth of renewable sources of power which are abundant in India. These sources can be more utilized with the advancement of technology so that the generation cost of electricity is minimized. The per capita consumption of electricity in India is 779kwh against the world consumption of 2782 kWh. Moreover, the divide between the urban and rural India is huge and there are around forty percent households in the country which do not have electricity supply. India has to go a very long way to attain the world standards. Besides, there is need to conserve electricity and the sources of generation of electricity.
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