CHAPTER-I

OVERVIEW OF ELECTRICITY SECTOR

I have divided this chapter into various sections in order to have better analysis and interpretation of financial data. These sections are as follows:

1.1	History of Electricity sector
1.2	Installed Capacity
1.3	Generation of Electricity
1.4	Captive Power
1.5	Demand
1.6	Growth of Electricity Consumption in India & Per-Capital consumption.
1.7	Rural Electrification
1.8	Renovation and Modernisation
1.9	Replacement of old Thermal Power Plants
1.10	Renewable energy in India (1) Wind, (2) Solar & (3) Biomass Power & Gasification and Bagasse Cogeneration)
1.11	Geothermal Energy
1.12	Tidal Power
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1.14	Electricity, Transmission and Distribution
1.15	Regulation and Administration
1.16	Trading
1.17	Government-owned Power Companies
1.18	Problems with India's Power Sector

CHAPTER-I

OVERVIEW OF ELECTRICITY SECTOR

I.1 History of Electricity sector

Electricity is one of the most vital infrastructure inputs for economic development in a country and it is the fulcrum on which rests the future pace of growth and development. The demand for electricity in India is enormous and is growing rapidly. The vast electricity market offers one of the highest growth opportunities for private developers

Table No.1.1

First Time in India

First Time	Year
Calcutta electric lighting licence --- Indian Electric Co	1897
Bombay Electric Supply & Tramways Company (BEST)	1882
Bombay Electric Supply & Tramways Company (BEST) set up a generating station	1905
Hydroelectric installation in India- at Sidrapong for the Darjeeling Municipality	1897
Electric street light in Asia was lit in Bangalore.(Now BANGLURU)	5/8/1905
Electric train in the country (Bombay's Victoria Terminus and Kurla)	3/2/1925
Fully solar powered Cochin airport with the inauguration of a dedicated solar plant.	18/8/2015
India began utilizing grid management on a regional basis	1960s
Interconnection of regional grids was established	October 1991
India has become net exporter of electricity	March, 2017

(Sources Wikipedia on Electricity sector in India page no1 & 2 . *Electricity sector in India-wikipedia*. Retrieved December 28, 2017.) (power, 2017)

Financial Management of Power sector.

As per the report of Economic Survey of India Power sector , GoI.2011-12. All Most all state Electricity Board was under the control of State Government. Revision of Tariff decided by State Government as per the Political position. Considering free

or very nominal/concessional rate to Agriculture Farmers by Government. Due to this revenue from sale of Power not equal to Cost to supply. Subvention Subsidy was available to SEB but payment of all types subsidy was not paid within time limit by State Government. Consequential net effect was to borrow more &more money froms Banks/FI for working Capital. Interest on working increased day by day to manage working Capital by SEB. SEB were entitled to get a rate of return of 3% on their net assets. The financial position of the SEB had started was Bad to worst. Free/ flat rate of power to Agriculture Farmers there for Rate for other Categories ware increase very high due to cross subsidy. In spite of adequate provision of Tariff and minimum rate on Assets has no impact financial performance of SEB. Due to theft and higher A T & C loss was adjusted towards Agriculture consumption of non metter consumers.

Source Economic Survey of India. Power Sector. Government of India. And Annual Reports of Ministry of Power (2001-02, to 2015-16) (India, 2011-12) (India P. C., 2011) (power, 2017)

I.2 Installed Capacity

As per the Executive Summary of Power sector. Government of India April 2017. At the time of 31st December 1947 Installed capacity was only 1362 MW. However at the end of 31st March 1990 only 63636 MW achieved by addition of 62274 MW during the period of 42 years. As Government of India started Reform of Power sector ,GoI unable to increase Installed Capacity of power Generation during the Post reform Period of 27 years achieved addition of 263213 MW .Due this Installed Capacity of Generation of Power at the end of 31st March 2017 on 326849 MW . The detail break up is as under.

Table No. 1 2 Installed capacity of India

Table No. 1.3 Installed capacity of India Particulars	**INSTALLED CAPACITY (IN MW)**
Up to the end of March 1990	**063636**
Up to The end of March 2017	**263213**
Total at the 31/03/2017	**326849**

(Sources *Executive Summary of Power Sector.* Centaral Electricity of India. Delhi: Government of India. Retrieved from www.cea.nic.in/reports) (India M. o., April 2017)

During the period of 42 years i.e 1947 to March 1990. Total addition of 62274 MW i.e 1482.714 MW per year. As Government of India started Reform of Power sector ,GoI able to increase Installed Capacity of power Generation during the Post reform Period of 27 years achieved addition of 263213 MW. i.e 9748.629 MW. Per year.

The total installed utility power generation capacity as on 31st March 2017. with sector wise & type wise break up is as given below.

Table No. 1.3 Sector wise and Source wise Installed Capacity in India as on 31st March 2018 (in MW)

Sector	Central	State	Private	All India	%
Coal	54335.00	64685.50	73142.38	192162.88	58.80
Gas	7490.83	7257.95	10580.60	25329.38	7.75
Diesel	0.00	363.93	473.70	837.83	0.25
Nuclear	6780.00	0.00	0.00	6780.00	2.07
Hydro	11651.42	29683.00	3144.00	44478.42	13.61
Other Renewable *	0.00	1976.90	45393.12	57260.23	17.52
Total MW	80257.25	103967.28	142624.01	326848.53	100.00

**Small hydro 04379.86 Bio power /cogen. 8181.70 Solar Power 12288.83 ; Wind farm 32279.77 Bio –power waste to Energy 130.08 Total =57260.23*

(Sources *Electricity sector in India-wikipedia*. Retrieved December 28, 2017, Wikipedia on Electricity sector in India page no 3 of 20.) (power, 2017)

I.3 Generation of Electricity.

I.3.1 Power generation falls into four broad categories:-

1. Thermal power, which is often produced through thermal power plants using coal as a fuel.
2. Hydro power that is often produced by trapping river flows by construction of Dams and Hydro Power Stations.
3. Nuclear power.
4. Renewable sources of power such as Wind energy, Solar energy, Tidal power etc .

1.3.2 Electricity generation in India till 2017

Table No 1.4

Plan wise Growth of Generation of Electricity in India (in MUs)

Periods.	**Generation in MUs.**
April 1950 to March 1990	601091
April 1990 to March 2017	3742570
Total April 1950 to 31/03/2017	4343661

(Source: Planning **Commission Report and MoP.website.)**

This indicate that the Generation of country is increasing regularly on an average growth on year on year base from 6 % to 7 % . However after reform growth rate is higher.

I.3.4 Renewable sources of power such as Wind energy, Solar energy, Tidal power etc.

Renewable Energy is natural resources that are constantly being replenished, such as sunlight, wind , and water. Etc. Energy is generating for these natural resources is called Renewable Energy. Renewable energy sources are eco-friendly and no Pollution as like fossil fuels. Solar energy, wind energy, small hydro power, gasification and bagasse cogeneration waste to power, bio mass etc. are the various types of Renewable Energy.

I.4 Captive Power.

"Captive Power means the installed power generating for own purpose. Due to shortages of Finance , Government was not in position to installed required Power Generating Capacity, There for Captive power policy is introduced to remove short fall. Private party has installed Power plants for Captive purpose Iron & steel Chemicals & aluminium etc are participate at aggressive stage. As under.

Industry	Capacity in MW.as on 31st March 2009
were Iron & Steel	4161
Chemicals	3418
Aluminium	2317

(source *Executive Summary of Power Sector*. Centaral Electricity of India. Delhi: Government of India. Retrieved from www.cea.nic.in/reports) (India M. o., April 2017)

However growth of Captive Generation is increase vary fast tract. Details are as under. Growth of Captive Generation Capacity from 1980 to 2017 (MW) in the industries is 50289 MW as on 31 March 2017

Table No. 1. 5 Installed captive power generation capacity as on 31st March 2017

Source	Captive Plant Capacity in MW	Share
Coal	29888	59.43%
Hydro Electricity	54	0.11%
Natural Gas	6061	12.05%
Oil* includes Renewable Source	14285	28.41%
Total	50289	100.00%

(Sources ; *Executive Summary of Power Sector.* Centaral Electricity of India. Delhi: Government of India. Retrieved from www.cea.nic.in/reports Wikipedia of Electricity sector in India.**)** (India M. o., April 2017)

Table No.1. 6

Targets/Achievements for Capacity Addition in since First Five Year Plans (in MW)

Five year Plan.	Target	Achievement	Five year Plan.	Target	Achievement
I	1300	1100	VII	22245	21401
II	3500	2250	VIII	30538	16423
III	7040	4520	IX	40245	19015
IV	9264	4579	X	41110	21180
V	12499	10202	XI	78700	34462
VI	19666	14226	XII	88537	92423

(Source ; Planning Commission Report and Annual reports from MoP. & *Electricity sector in India-wikipedia*. Retrieved December 28, 2017,) **.** (power, 2017)

Government of India not achieved the targets set by Planning Commission of India, The main reason was inadequate technical resources and physical resources to achieve targets. However **in XII five year plan GoI had exceeds the targets .**

I.5 Demand.

Demand trends: The details of Power retirement and availability of power at all India level is as under. All India (Anticipated) Power Supply Position in FY 2016-17

Table No. 1.7 Power position in India

Power Position in India Over all

Region	Requirement in MUs	Availability in MUs	Surplu(+)/Defecit(-) in MUs	Surplu(+)/Defecit(-) in %
Western	379087	405370	26283	0.069
Northern	357459	351009	-6450	-1.8
Southern	310564	320944	10380	-3.3
Eastern	151336	135713	-15623	-10.3
North-Eastern	16197	14198	-1339	-8.3
Overall India	1216421	1227894	13251	1.1

(Source Electricity sector in India-wikipedia. Retrieved December 28, 2017,)

There is Surplus power During Non-peak period is 13251 MUs i.e 1.1 % over all India level even Though there is deficit in Northern, Eastern and North-Eastern region by 1.8 %,10.3% and 8.3% respectively. Even Though there is surplus in Western region by 0.069 %.

Table No. 1.8

Power position in India Peak Period.

Region	Requirement in MUs	Availability in MUs	Surplu(+)/Defecit(-) in MUs	Surplu(+)/Defecit(-) in %
Western	51436	56715	5279	10.3
Northern	55800	54900	-900	-1.6
Southern	40145	44604	4459	11.1
Eastern	21387	22440	1053	4.9
North-Eastern	2801	2695	-106	-3.8
Overall India	164377	169403	5026	2.6

(Source ; *Electricity sector in India-wikipedia*. Retrieved December 28, 2017 Planning Commission Report and Annual reports from MoP. website.) (power, 2017)

There is Surplus power During peak period is 5026 MUs i.e 2.6 % over all India level even Though there is deficit in Northern ,Eastern and North-Eastern region by 1.6 %, 4.9 % and 3.8 % respectively. Even Though there is surplus in Western region by 10.3 %, & Southern Region By 11.1 %.

I.6 Growth of Electricity in India & Per –Capita Consumption.

Table No 1.9

Growth of Electricity Consumption in India

year ending on	Consumption (GWh)	Domestic	Commercial	Industrial	Traction	Agriculture	Misc.	Per Capita Consumption (in kWh)
31/12/1947	4182	10.11%	4.26%	70.78%	6.62%	2.99%	5.24%	16.3
31/12/1950	5610	9.36%	5.51%	72.32%	5.49%	2.89%	4.44%	18.2
31/03/1956	10150	9.20%	5.38%	74.03%	3.99%	3.11%	4.29%	30.9
31/03/1961	16804	8.88%	5.05%	74.67%	2.70%	4.96%	3.75%	45.9
31/03/1966	30455	7.73%	5.42%	74.19%	3.47%	6.21%	2.97%	73.9
31/03/1974	55557	8.36%	5.38%	68.02%	2.76%	11.36%	4.13%	126.2
31/03/1979	84005	9.02%	5.15%	64.81%	2.60%	14.32%	4.10%	171.6
31/03/1985	124569	12.45%	5.57%	59.02%	2.31%	16.83%	3.83%	228.7
31/03/1990	195098	15.16%	4.89%	51.45%	2.09%	22.58%	3.83%	329.2
31/03/1997	315294	17.53%	5.56%	44.17%	2.09%	26.65%	4.01%	464.6
31/03/2002	374670	21.27%	6.44%	42.57%	2.16%	21.80%	5.75%	559.2
31/03/2007	525672	21.12%	7.65%	45.89%	2.05%	18.84%	4.45%	671.9
31/03/2012	785194	22.00%	8.00%	45.00%	2.00%	18.00%	5.00%	883.6
31/03/2013	824301	22.29%	8.83%	44.40%	1.71%	17.89%	4.88%	914.4
31/03/2014	881562	22.95%	8.80%	43.17%	1.75%	18.19%	5.14%	957
31/03/2015	938823	23.53%	8.77%	42.10%	1.79%	18.45%	5.37%	1010
31/03/2016	1031642	22.97%	8.05%	44.20%	1.63%	18.17%	4.97%	1074.65

(Source ; *Growth of Electricity Sector in India from 1947-2017.* Delhi**:** Central Eletricity Authority of India. Retrieved from www.cea.nic.in/reports **&** Planning Commission Report and Annual reports from MoP. website**.)** (India C. E., 2017)

"Note: Per Capita Consumption=(Gross Electricity Generation + Net Import) / Mid Year Population Electricity generation."

India per capita electricity consumption was very low, however it is increasing after 2000 onwards. The highest increase in the per capita consumption during these 8 years has been in 2011-12 where it grew by almost 8%". Progress of the country is depends on the Per Capita electricity Consumption. There for I had compare this with other developing Countries as well as our BRICKS country. We are at lower lever but increasing trends. The detail information's are provided in followings tables. (power M. o., 2018)

Table No. 1.10

Per Capita Consumption of Electricity in India.

Year	2008-09	2009-10	2010-11	2011-12	2012-13	20134-14	2014-15	2015-16
Per Capita Consumption in KWH	734	779	819	884	914	957	1010	1075

(Source: *Growth of Electricity Sector in India from 1947-2017.* Delhi**:** Central Eletricity Authority of India. Retrieved from www.cea.nic.in/reports **&** Planning Commission Report and Annual reports from MoP. website**.)**(India G. o., Annual Report on the Working of power Sector State power Utilities & Energy Department., 2015-16) (power M. o., 2018)

Above table no. 1.10 indicate that the Per capita consumption of Electricity in India is increasing on year on year base.

Table No. 1.11

Per Capita Consumption of Electricity in India with BRICSs countries.(in Kwh)

BRICS Nations	South Africa	China	India	Russia	Brazil
2012	4410	3475	914	6602	2509
2013	4328	3766	957	6562	2583

(India P. C., 2011)

(Source: *Growth of Electricity Sector in India from 1947-2017.* Delhi**:** Central Eletricity Authority of India. Retrieved from www.cea.nic.in/reports**)**

Above table no. 1.11 **indicate** that the Per capita consumption of Electricity in India is on Fifth number in BRICS countries.

Table No. 1.12

Per Capita Consumption of Electricity in India. vis a vis some developed countries

Develop Countries	
Canada	**1552**
USA	**12987**
Australia	**10067**
Japan	**7836**
France	**7382**
UK	**5409**
World	**3026**
India	**957**

(Source: *Growth of Electricity Sector in India from 1947-2017.* Delhi**:** Central Eletricity Authority of India. Retrieved from www.cea.nic.in/reports Planning Commission Report and Annual reports from MoP. website.**)**

Above table no. 1.12 indicate that the Per capita consumption of Electricity in India is on Eighth number in Some developed counties ..

Table No. 1.13

Period	**PER CAPITA CONSUMPTION (KWH)**	**Increase Per Capita consumption over previous period**
Pre Reform. (1989-90 End of Seventh Five Year plan)	329.20	329.20
Post Reform Period (End of twelfth Five Year plan	1122.00	792.80

(Source: Researcher own calculation from Planning Commission Report and Annual reports from MoP. website.)

Per Capita Consumption of Electricity of India is increasing regularly on year on year base. During Post reform period Per Capita Consumption of Electricity of India is increasing at increasing rate regularly on year on year base.

I.7 Rural Electrification.

The Government has targeted to 100% village rectification .A scheme of Rural Electrification by GoI as well as all state is implementing for the same. "As of 30 November 2017 , 99.59 %of 597464 villages in India are electrified of those who did have access to electricity in rural India, the supply was intermittent and unreliable. "

(Source. Progress report of village electrification as on 31-05-2017 (www.cea.nic.in/2017/village -electification-11pdf.) (India C. e., 31-05-2017)

I.8 Renovation & Modernisation.

Renovation and Modernization of Thermal Power Plants

Renovation and Modernization (R&M) means a set activities to improved or maintain original efficiency of Plant and machinery. There are two types Renovation and Modernization (R&M) i.e

1. Complete Renovation and Modernization (Major R&M) and
2. Need base Renovation and Modernization . (Minor R&M)

Complete Renovation and Modernization is carried out when full main plant i.e Boiler, Turbine or Rotor etc. to improve to original capacity. Under this long time about one year is required and cost per MW about Rs.1.00 to Rs. 1.50 Crs while Need base Renovation and Modernization for particulars parts improvement required less time and cost depends how much works undertaking.

I.9 Replacement of old thermal power plants

Generally normal life is estimated 25 years of Thermal power Plants. Various Key parameters are also determine for ideal condition of working of plant. By utilisation of working of plants, Various Key Parameters are not maintain. Therefore those plants are not working as per permissible limit than require to Replacement of Old Thermal Power Plants.

Recently few old Gandhinagar unitNo 1 & 2 of 120 MW, Utran(Surat) 135MW,Ukai unit no 1 &2 of 120 MW,Sikka unit 1 &2 of 120 MW) were also decommissioned. However their residual life can be used effectively for grid reserve service by keeping them in working condition and connected to grid. (Agency, 2011) (An Expert Committee, 1980) (power M. o., 2018) (India P. C., 2011).

I.14 Electricity Transmission and Distribution.

Installed transmission (circuit km) and distribution capacity (MVA) as on 31st March 2017

Table No.1.14

Installed transmission (circuit km) and distribution capacity (MVA)

AC Transmission System as on 31/03/2017	**Target**	**Achieved**	**Achieved in % .**
765.KV voltage in CKM.	31240	32250	96.87
400.KV voltage in CKM.	157787	144819	108.95
220..KV voltage in CKM.	163268	170980	95.49
Total AC Transmission system voltage in CKM.	**352295**	**348049**	101.22
HVDC .voltage in CKM.	15556	16872	92.20
Total of AC + HVDC in CKM.	**367851**	**364921**	100.80
Inter-regional Transmission Capacity in MW.	**75050**	**65550**	114.49
AC Substations Transformation Capacity as on 31/03/2017	**Target**	**Achieved**	**Achieved in % .**
765. MVA.	167500	174000	96.26
400 MVA	240807	196027	122.84
220 MVA	312958	299774	104.40
Total AC Transmission system voltage in MVA	**721265**	**669801**	107.68
HVDC MVA .	19500	22500	86.67
Total of AC + HVDC MVA .	**740765**	**692301**	107.00

(Source: *Growth of Electricity Sector in India from 1947-2017.* Delhi**:** Central Eletricity Authority of India. Retrieved from www.cea.nic.in/reports Planning Commission Report and Annual reports from MoP. Website http.www.powermini.nic.in **)**

The above Table No.1.14 indicate that Installed transmission (circuit km) and distribution capacity (MVA) Government able to achieve the target to complet**e** AC

Transmission lines 400kv and others765 Kv more than 96 % and 220 kv 95% but over all 101 %.

I.15 Regulation & Administration.

Electricity is in Concurrent list of the Constitution of India. Ministry of Power is India central authority. So it is required to control by GoI only. Followings are the Primary duties of Government of India.

1 planning,
2 policy formulation,
3 processing of projects for investment decisions,
4 monitoring project implementation,
5 training and manpower development, and
6 the administration and enactment of legislation in regard to thermal, hydro power generation, transmission and distribution.

(India M. o., April 2017) (power M. o., 2018)

Reforms of Power sector in India

Due to shortages of Power in India, Government of India without adequate financial Budget it was not possible to installed more and more Power plants. In line with other Countries Private parties investment involvement requirement to coup up with requirement and industries growth and development. There for Reforms of Power sector in India introduce in India. Various laws are amendment .New ACT The Electricity Act 2003 is introduce by replacement of some old Act. Events are as under.

1 In 1991, the first phase of reforms focused on increasing investment in power Generation
2 Focus on creating rules to encourage Independent Power Producers (IPPs) with attractive guaranteed rates of return.
3 The 1991 reforms emanated from the Central Government, but the mind set of reform created the political space that allowed several States to begin structural reforms of their SEBs.
4 This second phase of reforms also included the establishment of Independent Electricity Regulatory Commissions (ERCs). Several States created ERCs from 1998 onwards under ERC Act adopted by the Central Government legislation

5 A third phase of reforms emerged at the end of the 1990s, as the Central Government attempted to coordinate a reform strategy for India as a whole. In addition to institutionalizing reform process that was underway in several States, this third phase of reform sought to improve the Distribution of electricity.

I.16 Trading

Bulk power purchasers can buy electricity on daily basis for short, medium and long term duration from reverse e-auction facility. The electricity prices transacted under reverse e-auction facility are far less than the prices agreed under bilateral agreements. Multi Commodity Exchange has sought permission to offer electricity future markets in India.

I.17 Government-owned power companies

Central government of India owned following companies for Generation of Power and Transmission of Power in India .

1. National Thermal Power Corporation,
2. Damodar Valley Corporation,
3. National Hydroelectric Power Corporation and
4. Nuclear Power Corporation of India.
5. Power Grid Corporation of India

I.18 Funding of power infrastructure

Central government of India establish the following Financial Institution to funding for Generation of Power , Transmission Distribution of Power in India .viz from (1) Rural Electrification Corporation Limited. And (2) Power Finance Corporation Limited. Now a days Banks and Other Financial Institution and Foreign Fund also available .

I.19 Problems with India's power sector

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

(A) Inadequate Fuel Supplies.

1. Coal, lignite, gas and oil are the basic fuel for Power Plants. Fuel is basically a natural product depend on various factors. In spite of available abundant reserves of coal, It is difficulties to mining coal to supply enough to coal to power plants.

2. Transport infrastructure has worsened these problems.
3. To increase coal production capacity, Coal India needs to mine new deposits.
4. Land acquisition for infrastructure in these coal-rich areas of India.
5. Coal India's coal pricing monopoly and implement coal trading in
6. Pipeline connectivity and infrastructure to natural gas potential. The giant new offshore natural gas field has delivered far less gas than requirement causing shortage of natural gas."

- (B) Rated **Plate** capacity of the Power plants owned are higher rated above the actual Capacity .IPPs are financing by over-invoice the plant cost. Due to This Plants are not contributing to the on line to maintain power system .
- (C) India's mountainous north and north east regions have been slowed down by ecological, environmental and rehabilitation controversies, coupled with public interest litigations There for Implementation of Hydroelectric power projects in. India"
- (D) New Power plants execution, availability of fuel quantities and qualities, Fuel resources available, environmental clearances, and training of skilled manpower are the Key implementation challenges
    - (Street, 2012) (power M. o., 2018) (power M. o., 2017)