

CHAPTER-3

PROFILING POWER SECTOR IN INDIA

3.1. Power Sector in India: Past to Present

Growth of a nation depends on various inputs. Electricity is one of the most significant inputs for the growth of a nation. Electricity is the part of concurrent list in the constitution of India. Underlining the importance of electricity government of India has initiated for the enhancement of capacity in terms of power generation.

The first step to promote the development of this sector after independence was the enactment of the Electricity Supply Act, 1948. It established SEBs and consigned the accountability of energy efficacy advancement to the states of India. However, it was observed that there has been disparity in resource endowments between different regions. Consequently, power transportation from one state to another state began with the interference of the GOI to setup the central sector agencies for the development of power before eighties. Inequality in the progress of power sector among various states or regions mainly caused by unequal availability of power production resources, economic environment and poor infrastructure services was on the top priority to settle down. Power transfer and regional planning among states was started for the up-liftment of the power sector. For the purpose of coherent up-liftment of power sector, India was grouped into five regions. They are- 1) Eastern Region (E), 2) Western Region (W), 3) Southern Region (S), 4) Northern Region (N) and, 5) North-Eastern Region (NE). In each of the regions, central sector plants were setup to supply electricity to the states of the particular regions. In this way, the endeavor was made to build each region self-sufficient in power production (Rao, 2004; CEA, 2004; Varma, 1997). Big coal based power plants and big hydro based power plants were specially made under this system. These central sector power stations supplied electricity to the adjoining states in the regions as per their specified allocations. However, disparity in resource endowments between different regions had been observed. The eastern region had ample power all the year but other regional grids had shortages of varying degrees

(CEA, 2004; Mitra, 1997). Therefore, it was forecasted to link the regions to facilitate interregional power transmission via establishment of a national grid in a phased manner by the year 2012. Presently, contiguous regions have been interconnected and power is transferred between regions.

3.2. Power Generation from Hydro and Thermal Sources

Thermal power generation has increased over the time with much higher growth than the hydro power. This was because of relatively more capacity additions at the thermal power stations. It is shown in the Table 3.2.1 that the growth of thermal power, hydro power and nuclear power generation.

Years	Hydro	Nuclear	Thermal	Total
1991-92	72757.1 (25.35) [#]	5524.4 (1.92)	208747.2 (72.73)	287028.7
1992-93	69869.2 (23.18)	6726.3 (2.23)	224766.2 (74.58)	301361.7
1993-94	70462.7 (21.74)	5397.7 (1.67)	248189.2 (76.59)	324049.6
1994-95	82712 (23.6)	5648.2 (1.61)	262130.2 (74.79)	350490.4
1995-96	72759.2 (19.14)	7981.7 (2.1)	299316.3 (78.76)	380057.2
1996-97	68900.8 (17.4)	9071.1 (2.29)	317917.5 (80.3)	395889.4
1997-98	74581.7 (17.68)	10082.6 (2.39)	337083 (79.93)	421747.3
1998-99	82690 (18.44)	12015 (2.68)	353662 (78.88)	448367
1999-00	80637 (16.78)	13267 (2.76)	386776 (80.46)	480680
2000-01	74481 (14.91)	16928 (3.39)	408139 (81.7)	499548
2001-02	73579.9 (14.22)	19474.6 (3.76)	424385.8 (82.02)	517439.2
2002-03	64014 (12.02)	19390 (3.64)	449289.3 (84.34)	532693.3

Table 3.2.1. Annual Gross Generation of Power by Sources in India, 1991-92 to 2015-16 [in million units]

Years	Hydro	Nuclear	Thermal	Total
2003-04	75242.5 (13.3)	17780 (3.15)	472079.2 (83.54)	565101.7
2004-05	84495.3 (14.38)	16845.3 (2.87)	486075.5 (82.75)	587416.1
2005-06	103057.3 (16.69)	17238.9 (2.79)	497214.3 (80.52)	617510.4
2006-07	116368.9 (17.56)	18606.8 (2.81)	527547.4 (79.63)	662523
2007-08	128702.1 (18.27)	16776.9 (2.38)	558990.1 (79.35)	704469
2008-09	118980.7 (16.44)	14712.6 (2.03)	590100.8 (81.53)	723793.6
2009-10	112038.2 (14.52)	18636.4 (2.42)	640876.5 (83.06)	771551.1
2010-11	119868.3 (14.78)	26266.4 (3.24)	665008.1 (81.98)	811142.8
2011-12	135794 (15.49)	32286.6 (3.68)	708805.9 (80.83)	876886.5
2012-13	118514.7 (12.99)	32866.1 (3.6)	760715.8 (83.41)	912056.7
2013-14	140445.4 (14.52)	34227.8 (3.54)	792477.1 (81.94)	967150.3
2014-15	129243.7 (11.57)	36101.5 (3.23)	877943.0 (78.60)	1116850
2015-16	121376.7 (10.4)	37413.6 (3.2)	943012.9 (80.76)	1167584

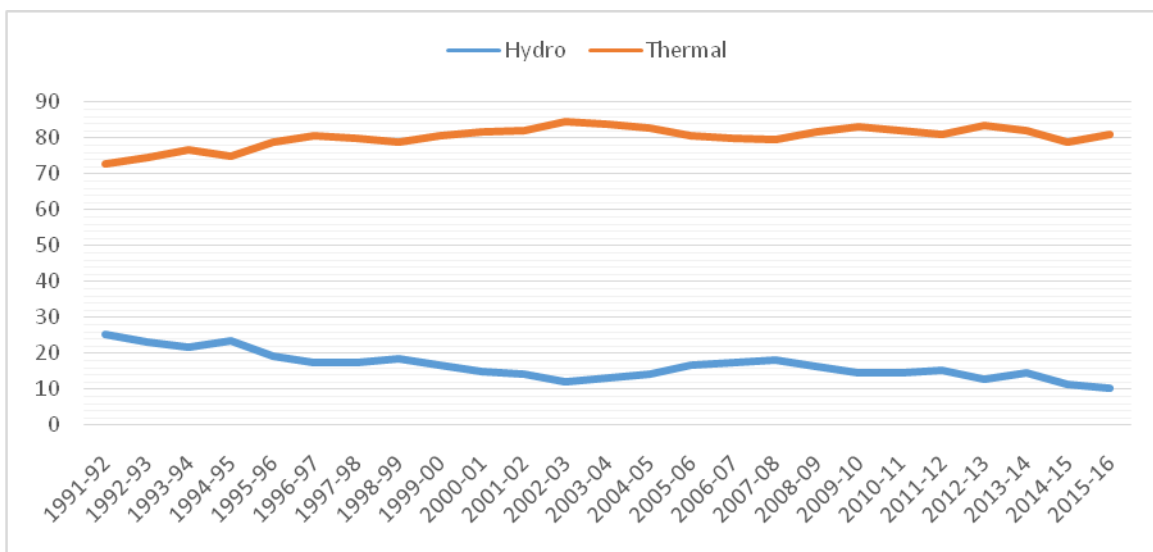
in parentheses, percentage share of the total of the individual year

Source: Ministry of Environment Statistics, GOI

In 1991-92, the growth rate of thermal power generation was 72.73 per cent which became 80.46 per cent in the year 1999-2000. In the terms of hydro power generation, there was a decline in growth rate during the same year. In the year 1991-92, the growth of hydro power generation was 25.35 per cent which became 16.78 per cent in the year 1999-2000. In aggregate power generation has increasing .The total power generation was 287028.7 MU in 1991-92 while in the year 1999-2000 it became 480680 MU.

The trend of power generation has increased in the year 2001-02. In the year 2001-02 the thermal power generation has achieved 82.02 per cent growth while the hydro power generation has achieved 14.22 per cent. After 2001-02 it was gradually increase and decrease but total power generation was increased that was 1167584 MU.

Figure 3.2.1. Power Generation from Hydro and Thermal Sources (in Million Units)



3.3. State wise Installed Capacity in India

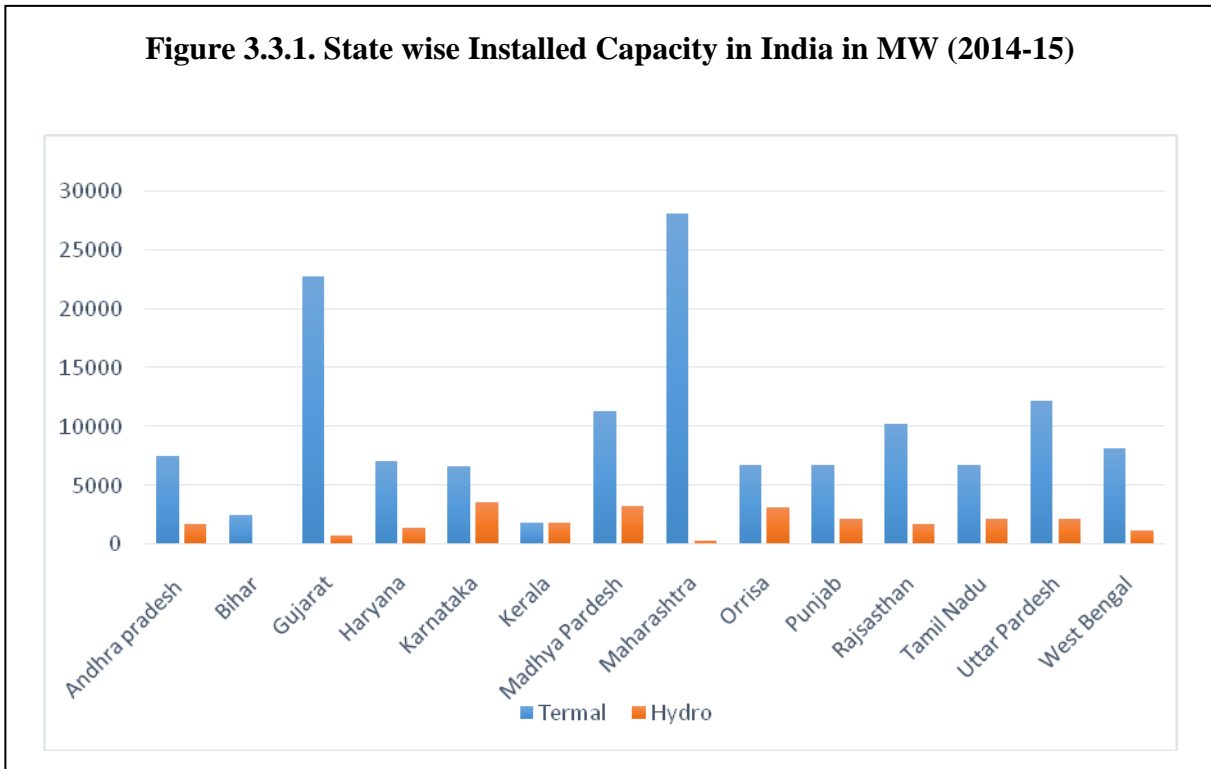
The power availability in India has increased significantly. In comparison to earlier years, the availability of power in the year after liberalization has increased significantly. The consumption of power has not only increased at central level but also it increased at state level. The state wise installed capacity of power has been shown in the Table 3.3.1 followed by Figure 3.3.1. It shows the installed capacity of thermal as well as hydro in different states of India.

Table 3.3.1. State wise Installed Capacity in India (2014-15)

S.No.	States	Thermal (MW)	Hydro(MW)
1	Andhra Pradesh	7538.83	1721.99
2	Bihar	2516.24	129.43
3	Gujarat`	22816.36	772
4	Haryana	7087.82	1456.83
5	Karnataka	6642.88	3599.8
6	Kerala	1806.87	1881.5
7	Madhya Pardesh	11383.57	3223.66
8	Maharashtra	28145.2	331.84
9	Orrisa	6753.04	3145.13
10	Punjab	6733.8	2166.93
11	Rajsasthan	10225.75	1719.3
12	Tamil Nadu	6753.04	2182.2
13	Uttar Pardesh	12227.92	2168.3
14	West Bengal	8183.83	1248.3

Source: Ministry of Environment Statistics, GOI

Figure 3.3.1. State wise Installed Capacity in India in MW (2014-15)



The above Table 3.3.1 and Figure 3.3.1 shows installed capacity of thermal power and hydro power in Indian states. Maharashtra is one of the states which is at the top in installed capacity of thermal power. This state has 28145.2 MW installed capacity in the year 2014-15. After Maharashtra, Gujarat and Uttar Pradesh are at second and third position respectively in installed capacity of thermal power. It is due to the acceleration in industrialization.

India has initiated the installation of hydropower generation units. Although it has not achieved such level as compare to thermal power. There are some states in India which are doing well in hydropower. Among them Karnataka, Madhya Pradesh and Odisha are at first, second and third position respectively.

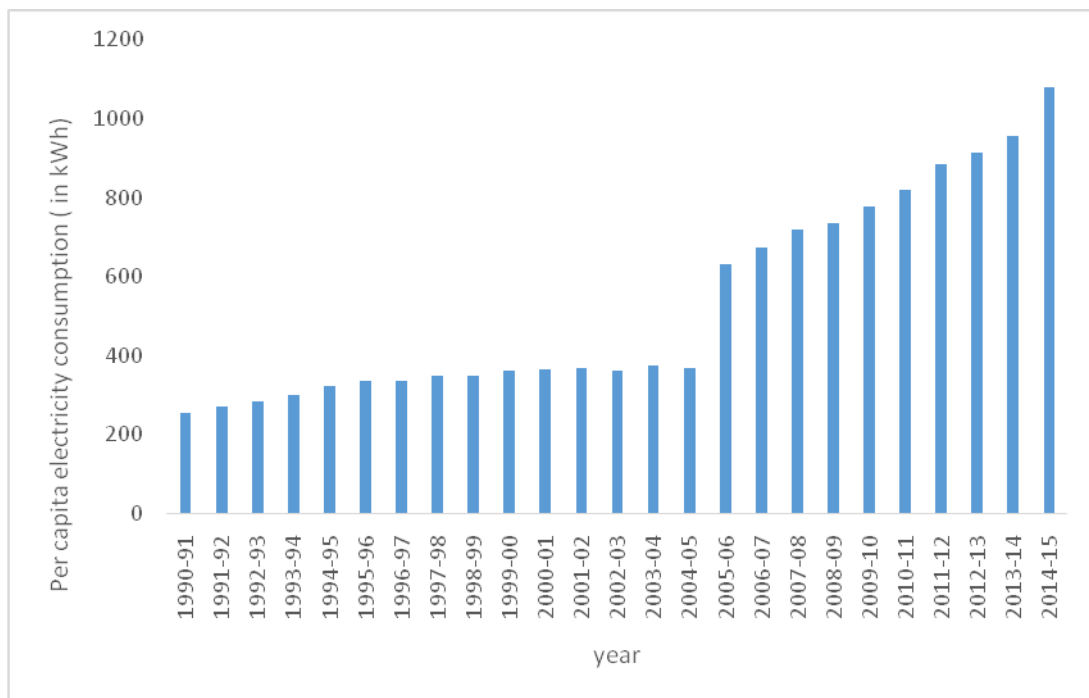
3.4. Per Capita Electricity Consumption in India

The availability of power has significantly increased in India in recent years. But per capita power consumption of has also increased. Per capita power consumption in India from the time of liberalization has been depicted in the Table 3.4.1 and Figure 3.4.1.

Table 3.4.1. Per Capita Power Consumption in India (kWh)			
Years	Per capita consumption (utilities +non utilities)	Years	Per capita consumption (utilities +non utilities)
1990-91	252.77	2003-04	373
1991-92	269.98	2004-05	367.72
1992-93	283.1	2005-06	631.4
1993-94	298.96	2006-07	671.9
1994-95	321.1	2007-08	717.1
1995-96	336.41	2008-09	733.5
1996-97	334.26	2009-10	778.6
1997-98	348.37	2010-11	818.8
1998-99	348.5	2011-12	883.63
1999-00	360.01	2012-13	914.41
2000-01	365.31	2013-14	956.77
2001-02	366.12	2014-15	1080.49
2002-03	360.97		
<i>Source: Planning Commission of India (Various reports)</i>			

In 1990-91, 252.77 kWh that increased to 367.72 kWh in 2004-05. Thus there was a significant growth of 45.48 per cent in per capita consumption. Figure 3.4.1 shows that how the trends of per capita electricity consumption has changed and recorded a new era of electricity consumption in India.

Figure 3.4.1. Per Capita Consumption Electricity in India



In the year 2005-06, the per capita electricity consumption was recorded as 631.4 kWh that increased to 1080.49 kWh in the year 2014-15. Therefore, during 2005-06 to 2014-15, the growth of per capita electricity consumption was 71.13 per cent that reveals a significant increase in per capita electricity consumption.

3.5. Electricity Demand and Supply Scenario in India

Despite the improved growth in per capita consumption of electricity, the nation has continued as power deficit nation. Due to rapid industrialization and mechanization activities in various sectors, the demand for power has increased. Consequently, the country is still facing power deficit scenario. In the recent times, the shortage of power in the states has increased rapidly. The demand supply scenario in India is given in the Table 3.5.1.

Table 3.5.1. Electricity Demand and Supply Scenario in India

Year	Energy				Peak Demand			
	Requirement (GWh)	Availability (GWh)	Deficit (GWh)	Deficit%	Demand (MW)	Peak met (MW)	Deficit (MW)	Deficit %
1990-91	267632	246560	21072	7.87	44005	37171	6834	15.53%
1991-92	2888974	266432	222542	7.8	48055	39027	9028	18.79%
1992-93	305266	279824	25442	8.35	52805	41984	10821	20.49%
1993-94	323252	299484	23758	7.35	54875	44830	10045	18.31%
1994-95	352260	327281	24979	7.09	57530	48066	9464	16.45%
1995-96	38960	354045	35676	9.15	60981	49836	11145	18.28%
1996-97	389721	365900	47590	11.51	63853	52376	11477	17.97%
1997-98	413490	390330	34175	8.05	65435	58042	7393	11.30%
1998-99	424505	420235	26349	5.9	67905	58445	9460	13.93%
1999-00	446584	450594	29836	6.21	72669	63691	8978	12.35%
2000-01	480430	467409	39807	7.85	74872	65628	9244	12.35%
2001-02	507216	483350	39187	7.5	78441	69189	9252	11.79%
2002-03	522537	497589	48085	8.81	81492	71547	9945	12.20%

Table 3.5.1. Electricity Demand and Supply Scenario in India

Year	Energy				Peak Demand			
	Requirement (GWh)	Availability (GWh)	Deficit (GWh)	Deficit%	Demand (MW)	Peak met (MW)	Deficit (MW)	Deficit %
2003-04	545674	519398	39866	7.13	84574	75066	9508	11.24%
2004-05	559264	548115	43258	7.31	87906	77652	10254	11.66%
2005-06	591373	578819	52938	8.38	93255	81792	11463	12.29%
2006-07	631757	624495	66092	9.57	100715	86818	13897	13.80%
2007-08	690587	666007	73336	9.92	108866	90793	18073	16.60%
2008-09	739343	691038	86001	11.07	109809	96785	13024	11.80%
2009-10	777039	746644	83950	10.11	119166	104009	15157	12.72%
2010-11	830594	788355	73236	8.5	122287	110256	12031	9.84%
2011-12	861591	857886	79313	8.46	130006	116191	13815	10.63%
2012-13	937199	911209	86905	8.71	135453	123294	12159	8.98%
2013-14	998114	959829	42428	4.23	135918	129815	6103	4.49%
2014-15	1002257	1030800	38143	3.6	148166	141160	7006	4.70%

Source: Central Electricity Authority, Monthly Reports (Various issues).

Figure 3.5.1. Trend of Energy Deficit (%) in India

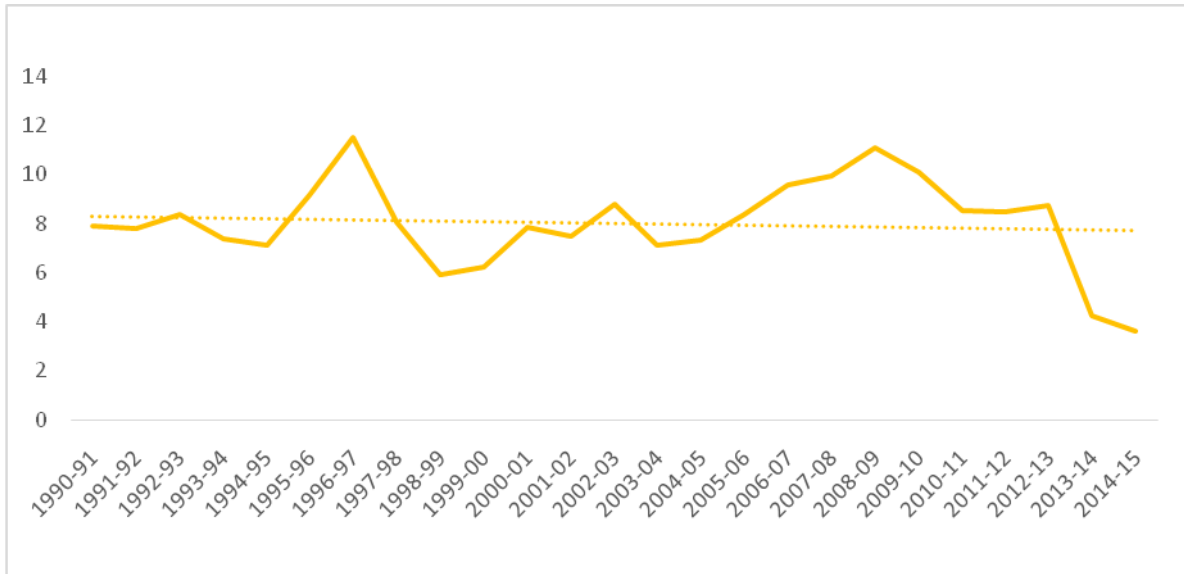
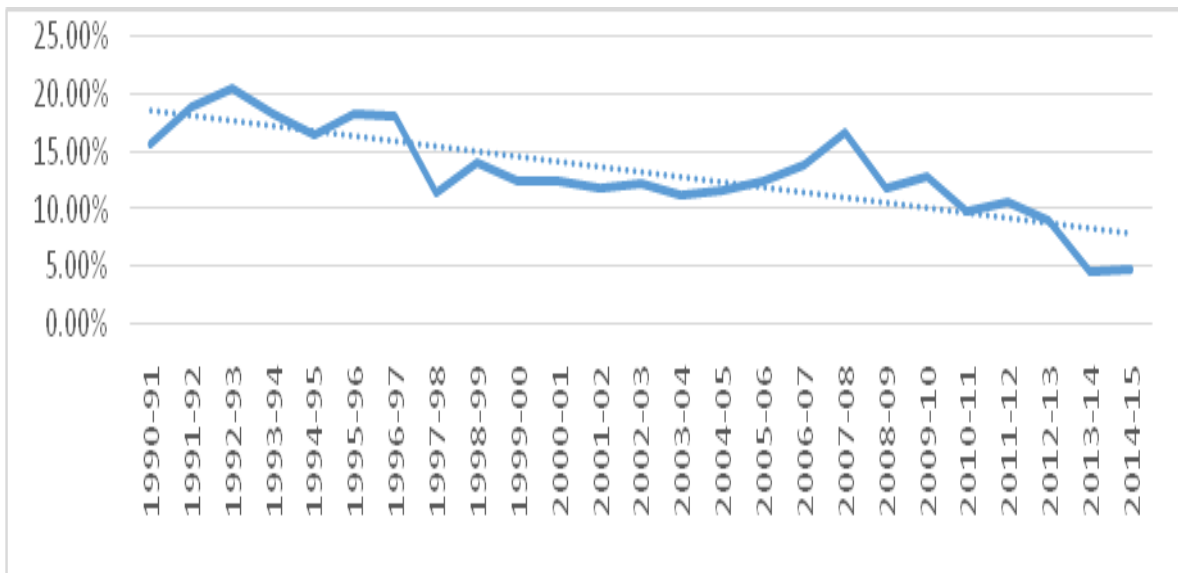


Figure 3.5.2. Trend of Peak Demand Deficit in India



It is shown in the Table 3.5.1 that in 1990-91 deficit energy and peak demand deficit were reported as 7.87 % and 15.53% which increased to 11.51per cent and 17.97 per cent respectively in 1996-97. The widening demand-supply gap is due to low investment in the generation segment at the central levels. Another important reason for this was the rapidly increasing demand for electricity across various sectors. In the year 2014-15, the energy as well as peak shortages were reported at the levels 3.6 per cent and 4.70 per cent respectively. It may be noted that the central unit made the demand projections on the basis of power availability in the country. No estimates were made about the actual peak and energy demand. It was assumed whatsoever power is available would be consumed in various sectors. Therefore, given that the demand for electricity is increasing at a very high growth rate, there is an urgent need to boost the capacity addition programs. For this purpose, the government may also promote investment in the generation sector so that installed capacity is increased adequately.

3.6. Consumption of Energy by Various Consumer Categories

The electricity distribution company of India is selling energy to various consumers which are grouped into various categories such as domestic, commercial, agricultural, industrial transaction and other consumers. The sale of power to different consumer categories is given in the Table 3.6.1.

Table 3.6.1. Consumption of Energy by Various Consumer Categories (Million kWh)

Year	Domestic	Commercial	Agriculture	Industry	Transport & Railways	Others	Total
1990-91	31982	11181	44056	84209	4112	8552	190357
1991-92	35854	12032	50321	87288	4520	9394	207645
1992-93	39717	12653	58557	90170	5068	9738	220674
1993-94	43344	14144	63328	94503	5620	10259	238569
1994-95	47915	15973	70699	100126	5886	10428	259629
1995-96	51733	16996	79301	104693	6223	11652	277029
1996-97	55267	17519	85732	104165	6534	12642	280146
1997-98	60346	19367	84019	104926	6944	13924	296749
1998-99	64973	19799	91242	105080	7307	15380	309734
1999-00	70520	21161	97195	106728	8088	15410	312841
2000-01	75629	22545	90934	107622	8213	17862	316600
2001-02	79694	24139	84729	107296	8106	21551	322459
2002-03	83355	25437	81673	114959	8797	22564	339598
2003-04	89736	28201	84486	124573	9210	22128	360937

Table 3.6.1. Consumption of Energy by Various Consumer Categories (Million kWh)

Year	Domestic	Commercial	Agriculture	Industry	Transport & Railways	Others	Total
2004-05	95660	31381	87089	137589	9495	23454	386134
2005-06	100090	35965	88555	151557	9944	24039	411887
2006-07	111002	40220	90292	171293	10800	23411	455749
2007-08	120918	46685	99023	189424	11108	29660	501977
2008-09	131720	59189	104182	209474	11425	37577	553995
2009-10	146080	60600	109610	236752	12408	36595	612645
2010-11	272589	131967	169326	67289	14003	39218	694392
2011-12	352291	140960	171104	65381	14206	41252	785194
2012-13	365989	147462	183700	72794	14100	40256	824301
2013-14	384418	152744	199842	74247	15540	47418	874209
2014-15	418346	168913	217405	78391	16177	49095	948328
ACGR	-0.48	-0.40	-0.80	-0.96	-0.84	-0.77	-0.80

Source: Centre for Monitoring Indian Economy, Energy (March 2013)

As it is shown in the Table 3.6.1 the overall growth in sale was reported as (-) 0.80% during the period from 1990-91 to 2014-15. While the consumption of domestic and commercial categories have increased at a growth rate of (-) 0.48 per cent and (-) 0.40 per cent. Another important issue is the changes in the relative shares of consumption made by various consumer categories.

3.7. Relative Share in Total Consumption in Electricity

It is found that the relative shares of consumption among different categories have variations in the nation. Relative share of electricity consumption is the highest in industrial sector, then agriculture at second position then domestic, commercial and transaction and other comes at third, fourth and fifth position respectively. The evolution of consumption of electricity has been depicted in the Table 3.7.1.

Table 3.7.1. Relative Share in Total Consumption in Electricity					
Year	Domestic	Commercial	Agriculture	Industry	Transaction
1985	12.45%	5.57%	16.83%	59.02%	2.31%
1990	15.16%	4.89%	22.58%	51.45%	2.09%
1997	17.53%	5.56%	26.65%	44.17%	2.09%
2002	21.27%	6.44%	21.80%	42.57%	2.16%
2007	21.12%	7.65%	18.84%	45.89%	2.05%
2012	22.00%	8.00%	18.00%	45.00%	2.00%
2013	22.29%	8.83%	17.89%	44.40%	1.71%
2014	22.95%	8.80%	18.19%	43.17%	1.75%
2015	23.53%	8.77%	18.45%	42.10%	1.79%

Source: Centre for Monitoring Indian Economy, Energy (March 2013)

Table 3.7.1 shows that the relative shares of domestic as well as commercial consumer categories have recorded increasing pattern from year 1985 to 2015 more rapidly than that of other consumer categories. The relative share of domestic consumers has increased from 12.45 per cent in 1985 to 23.53 per cent in 2015. Similarly, the relative share of commercial consumers has increased from 5.57 per cent in 1985 to 8.77 per cent in 2015. For both of these categories, the increase in the relative shares is almost double of the level in 1985. The relative share of agriculture sector is showing more fluctuations in the relative shares. Moreover, the relative share of the industrial category has decreased from 59.02 per cent in 1985 to 42.10 per cent in 2015. The pattern of relative shares in total consumption of power across various consumer categories depends upon the overall structural changes in the economy. Another important reason is the poor metering of the power supply to agriculture sector. Most of the electricity supply to agriculture sector was un-metered. Therefore, the data on consumption and their relative shares were not very reliable.

3.8. Power Sector Reforms in India

Under the Electricity Supply Act 1910, the SEBs in India came to the existence as an integrated power utility. It continued discharging the production, transmission and distribution function until the reforms initiatives were taken in the states of India. The technical and financial performance of SEBs was not much satisfactory in the pre reform period. Moreover, the provision of free power supply, made available to farm sector, further deteriorated the financial health of power sector. Poor operational performance was one of the key internal causes responsible for the beginning of reforms in power sector. The other significant cause was to push up restructuring of power sector. In 1996, Orrisa State Electricity Board (OSEB) was split into distinguished companies for production, transmission and distribution. Moreover it also privatized the electricity distribution business in the state. Some state such as Haryana, Andhra Pradesh etc, started power sector restructuring process.

Most of the states only unbundled the SEBs but did not privatize the distribution business. In the same process the GOI started taking steps in order to imitate the power reforms process. It constituted an expert group to suggest a suitable road map of power sector reforms.

The installation of power generation units led to generation of electricity and also to increment of consumption of electricity. After the much endeavor of the installation of electricity generation unit India is founds there is deficit in the power supply. The demand of electricity is very high but the supply is not increasing such a speed. Still India is facing the power shortage and also it is increasing day by day. The share of electricity consumption in India shows the picture which indicates that the industrial sector has the largest share of the electricity consumption and then agriculture at second position then domestic, commercial and transaction and other comes at third, fourth and fifth position respectively.